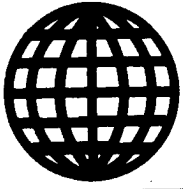


JPRS-CST-92-007  
16 APRIL 1992



**FOREIGN  
BROADCAST  
INFORMATION  
SERVICE**

# ***JPRS Report***

# **Science & Technology**

***China***

DTIC QUALITY INSPECTED 2

**DISTRIBUTION STATEMENT A**

**Approved for public release;  
Distribution Unlimited**

REPRODUCED BY  
U.S. DEPARTMENT OF COMMERCE  
NATIONAL TECHNICAL INFORMATION SERVICE  
SPRINGFIELD, VA. 22161

19980512 086

# Science & Technology China

JPRS-CST-92-007

## CONTENTS

16 April 1992

### SCIENCE & TECHNOLOGY POLICY

High-Tech To Be Industry's Top Goal [Chen Qide; CHINA DAILY, 2 Mar 92] .....	1
Priority Goes to Technology [Chen Weihua; CHINA DAILY, 9 Mar 92] .....	1
Broader Science Cooperation Urged [Zhou Jie; CHINA DAILY, 12 Mar 92] .....	2
Hefei State Synchrotron Radiation Laboratory Completed [Tien Wenxi, Guo Qinghua; LIAOWANG ZHOUKAN, 20 Jan 92] .....	3

### AEROSPACE

Italian, Chinese Aeronautics Joint Venture Established [AIR PRESS, 5 Feb 92] .....	5
Biomedical Experiments on Recoverable Satellites Detailed [Shen Liping, Wang Puxiu; ZHONGGUO HANGTIAN, Dec 91] .....	5
Aviation Industry Marching Forward [Lin Zongtang; GUOJI HANGKONG, Jan 92] .....	9
A Low-Altitude Breakthrough System Using Optimal Path Terrain Following [An Jinwen, Xiao Shunda; XIBEI GONGYE DAXUE XUEBAO, Dec 91] .....	10

### DEFENSE R&D

Experimental Fiber Optic Guided Torpedo System Described [Wang Yuqing, Xue Jingao, et al.; GUANGXIAN YU DIANLAN, No 4, Aug 91] .....	12
RC-180 Communications Jamming Equipment Certified [Huang Jiwei; ZHONGGUO DIANZI BAO, 7 Feb 92] .....	12
Navy's Science Think Tank Introduced [Zhang Zenan and Hu Hongbo; JIANCHUAN ZHISHI, 8 Aug 91] .....	13

### ADVANCED MATERIALS

High-Purity Indium Antimonide Monocrystal Domestically Developed [Li Qiongrui; ZHONGGUO DIANZI BAO, 28 Feb 92] .....	15
---	----

### BIOTECHNOLOGY

Cloning and Expression of Shiga-Toxin Gene From Shigella Dysenteriae Type I [Li Fengsheng, Huang Peitang, et al; WEISHENGWU XUEBAO, Dec 91] .....	16
A Clinical Study on Treatment of Epidemic Hemorrhagic Fever Complicated by Acute Renal Failure With Traditional Chinese Medicine Combined With Western Medicine [Liu Junbin, Chen Longbang, et al; JIEFANGJUN YIXUE ZAZHI, Feb 92] .....	16
Study of Natural Infection, Biting and Transovarial Transmission of Epidemic Hemorrhagic Fever Virus in Leptotrombidium (L.) Scutellare [Zhang Yun, Shi Jiang; ZHONGHUA LIUXINGBINGXUE ZAZHI, Feb 92] .....	16
Immunotoxins Prepared With Different Coupling Methods and Their Characteristics in Vitro and in Vivo [Ji Yanshan, He Yonghuai, et al; SHENGWUHUAXUE YU SHENGWUWULI JINZHAN, Dec 91] .....	16
Experimental Study on Gunshot Concussion of Peripheral Nerve [JIEFANGJUN YIXUE ZAZHI, Feb 92] .....	17

### COMPUTERS

Fifth-Generation Computing Breakthrough: Intelligent Computer Operating System Certified [JISUANJI SHIJIE, 4 Mar 92] .....	18
Domestically Developed PROLOG DBMS Knowledge Processing System Certified [Xin Zi; JISUANJI SHIJIE, 11 Mar 92] .....	18

English-Chinese, Japanese-Chinese Machine Translation Systems Certified [Hai Ping; JISUANJI SHIJIE, 5 Feb 92] .....	18
'Panda' VLSI CAD System Passes National-Level Appraisal [Chen Chunmei; JISUANJI SHIJIE, 29 Jan 92] .....	19
High-Speed Fiber Optic Transmission System for Linking IBM Mainframes Certified [Guo Ronghuan, Liu Changxi; JISUANJI SHIJIE, 29 Jan 92] .....	19
Domestically Made 40MB Winchester Disk Drive Put Into Production [Xiang Hanyuan; JISUANJI SHIJIE, 5 Feb 92] .....	19
Nation's First Overlay-Type Provincial-Level Public Packet Switching Data Communications Network Completed in Jiangsu [Liu Zhaofu; DIANXIN JISHU, Feb 92] .....	19
Development of DSP, Applications in Communications Engineering [Li Changli, Chen Xiqing; DIANZI XUEBAO, Jan 92] .....	20

### LASERS, SENSORS, OPTICS

New Application of Six-Port Technique for Measurement of Target RCS [Sun Jia; DIANZI KEXUE XUEKAN, No 6, Nov 91] .....	25
128 x 128-Pixel Platinum Silicide IR Focal Plane Array Detector Certified [Yu Ruming; ZHONGGUO DIANZI BAO, 31 Jan 92] .....	28
440,000-Pixel CCD Camera Developed [Sheng Tao; ZHONGGUO DIANZI BAO, 24 Feb 92] .....	28
Sino-U.S. Joint Venture To Produce, Develop Nonlinear Optical Crystals [Yang Zhaoliang, Li Cunfu; ZHONGGUO KEXUE BAO, 31 Jan 92] .....	28
DZR-III Centimeter-Class Satellite Laser Range Finder Developed [KEJI RIBAO, 21 Feb 92] .....	28
TEA CO <sub>2</sub> Laser Range Finder, Military Laser Alarm Certified [Li Lanyu; ZHONGGUO DIANZI BAO, 21 Feb 92] .....	29
Research on Characteristics of Er-Doped Superfluorescence Fiber Laser [Chen Yihong, Cheng Ruihua, et al.; KEXUE TONGBAO, 1-15 Feb 92] .....	29

### MICROELECTRONICS

GaAs MMICs, Other Devices Developed by Institute 55 Certified [Wang Lieqiang, Song Yuping; ZHONGGUO DIANZI BAO, 14 Feb 92] .....	31
26 Achievements of Institute 44 Pass Appraisal [Yu Ruming; ZHONGGUO DIANZI BAO, 21 Feb 92] ..	31
Qinghua Develops Room-Temperature Chip Thin-Film Deposition Equipment [Shu Guang; ZHONGGUO DIANZI BAO, 2 Mar 92] .....	31

### SUPERCONDUCTIVITY

Beijing Institute Develops Bi-Based Low-Temperature-Superconducting Tape [Ao Hong; KEJI RIBAO, 24 Feb 92] .....	33
Development of High-T <sub>c</sub> Superconducting Infrared Bolometers [Chen Juxin, Shi Baoan, et al.; HONGWAI YU HAOMIBO XUEBAO, No 6, Dec 91] .....	33

### TELECOMMUNICATIONS R&D

Anhui Vigorously Develops Provincial Fiber Optic Communications [Wei Baozhi; ZHONGGUO DIANZI BAO, 10 Feb 92] .....	36
Nation's First Manufacturing-Environment Multiuse Fiber Optic Cable Communications System Unveiled [Zhao Leqin; BEIJING KEJI BAO, 26 Feb 92] .....	36
Infrared Fiber Optic Communications Breakthrough Reported [Huang Xin; ZHONGGUO DIANZI BAO, 28 Feb 92] .....	36
Improved Definition TV Debuts in Xian [Xiao Ma; ZHONGGUO DIANZI BAO, 28 Feb 92] .....	36

### High-Tech To Be Industry's Top Goal

40101013A Beijing CHINA DAILY (SHANGHAI FOCUS) in English 2 Mar 92 p 1

[Article by Chen Qide, CD staff reporter: "Hi-Tech Is Industry's Top Goal"]

[Text] Shanghai will adopt a series of measures to push the development of hi-tech industry in four fields this year.

The fields are electronic information, aviation and spaceflight, marine oil development and modern biotechnology, which can be subdivided into digitally-controlled communications, computers, computer software, super-scale integrated circuits, trunk aircrafts, carrier rockets, applied satellite technology and genetic engineering.

According to the plan, the city's output value from hi-tech industries will reach 10.9 billion yuan (\$2 billion) by the end of 1995, of which electronic information will make up about 5.5 billion yuan (\$1 billion), aviation and spaceflight 750 million yuan (\$138 million), marine oil 320 million yuan (\$59 million) and modern biotechnology 600 million yuan (\$111 million).

Efforts will be made to update both techniques and equipment in hi-tech enterprises, to help narrow the gap with developed countries, local sources said.

To reach the goal, the city is working out preferential policies and regulations to stimulate local hi-tech industries.

The new regulations would allow hi-tech enterprises to set up limited-liability companies after approval so they can raise funds by issuing shares or bonds.

Those enterprises can be managed as joint ventures, practicing the distribution methods that overseas-funded businesses do.

A large sum of money from the local government will be available for use as risk funds. And development loans will also be available from local banks, sources said.

Industries dealing in integrated circuits, computers and computer software would be given priority—receiving up to 10 percent of their annual sales volume as development funds.

Three per cent of the city's total investment for infrastructure construction will be used to support establishment of key labs, pilot bases and experiment centres and to update equipment in scientific institutions.

Institutes and universities will be encouraged to give preferential treatment to hi-tech enterprises. "Details are being discussed," said sources.

But a number of scientific and technological workshops will be established in the city's Caohejing Hi-Tech Park to speed up the transfer of research findings into products, they said.

Meanwhile, the city is making preparations for the Science Park in the Pudong New Area, which will call for an investment of 500 million yuan (\$92 million). The hi-tech park, which will cover 8 square kilometres, is expected to take 20 years to complete.

First-phase development of 1.5 square kilometres should be completed by 1995, involving 80 domestic and foreign scientific and productive units having an annual hi-tech output value of 1.5 billion yuan (\$277 million).

### Priority Goes to Technology

40101013B Beijing CHINA DAILY (SHANGHAI FOCUS) in English 9 Mar 92 p 1

[Article by Chen Weihua, CD staff reporter]

[Text] Vice Mayor Gu Chuanxun said at a recent conference that further development of Shanghai's economy and industry during the 90's will primarily rely on technology advancement.

This progress in technology will be reflected in increased market competitiveness of local products, Gu commented at the citywide technology advancement conference attended by hundreds of local industrial experts and entrepreneurs.

Technology advancement shouldn't only be compared with domestic levels, but also with advanced international standards, according to the vice mayor, who is in charge of the city's industrial sector.

Gu called for expansion of channels for technology advancement, such as self-reliant research and development by enterprises, colleges and research institutes in the training of personnel and the development of new products—aided by favourable governmental policies.

Expanding channels also include the introduction of world advanced technology either by buying both hardware and software, or by cooperative production or running joint ventures.

The Municipal Economic Commission, after consulting with the city's finance and banking department, has announced eight measures encouraging technology advancement.

Some enterprises, which have a difficult task in developing new products, are expected to take over one percent of their total sales volume in technology development. According to previous rules, local State-run enterprises can only take one percent of the sales volume in technology development, according to Li Xiaohang, deputy director of Municipal Economic Commission.

Other encouraging measures include extending the term of tax exemption for some new products from the previous two-year tax exemption basis.

The Shanghai Branch of Industrial and Commercial Bank, a major source for technical renovation for local enterprises, will double its loans for technical renovation this year.

On the other hand, the finance bureau will put aside some funds to provide low-interest loans. Shanghai will also use part of its foreign currency reserve this year for technical renovation and technology introduction, according to Li, who previously worked with the Shanghai Public Security Bureau and Commission of Science, Technology and Industry for National Defense.

According to the measures, preferential policies will be given to colleges, research institutes and some high-tech projects.

Li also announced at the conference four key tasks for the city's technology advancement this year.

Emphasis will be placed on some fields expected to become the city's new pillar industries and products, Li said.

According to the planned target, output from 10 major fields and 50 pillar products will increase from the present 21.6 billion yuan (\$4 billion) to 60.6 billion yuan (\$11 billion) by 1995, with an annual growth of 15 percent.

Of this, output of automobiles, petro-chemicals, and household electric appliances will exceed 10 billion yuan (\$1.85 billion) by 1995.

The output of 19 new pillar products, including automobiles, power stations, optical fibre and cable, fax machines, computers, colour TV sets, refrigerators, air-conditioners, garments, plastic products, ethylene, ships, integrated circuits and digitally-controlled machine tools, is expected to hit 1 billion yuan (\$185 million) each by 1995.

Some 14 new products each are expected to have annual outputs exceeding 100 million yuan (\$18.5 million) by 1995. These include video machines, micro-wave stoves, electronic cameras, sensitization materials, diesel engines, textile machinery, medical instruments, mobile phones, copy machines, synthetic detergents, cosmetics, foods and interferon.

They are expected to become Shanghai's new pillar products along with thin steel sheets, thick steel plates and high-speed steel rods.

According to Li, the major tasks facing the city's technology advancement this year include emphasis on developing some high-tech projects in order to improve the potential for the city's industrial development.

Emphasis will be put on some 14 key research projects in the city and on turning scientific achievements into productivity.

Li also stressed preliminary preparation for the city's high-tech projects, including 2 million line process-controlled switchboard, computer software base, digitally controlled devices, hydraulic and pneumatic component base, video machine parts and a one million air-conditioner project.

He also called for rapid development of the city's new products, such as putting 1,000 new products into trial production and developing high-grade products this year.

The development of 10 common technologies faced by many parts of local industries, such as freon substitute, plastic technology and fuzz control, will also be accelerated.

### Broader Science Cooperation Urged

40101013C Beijing CHINA DAILY in English  
12 Mar 92 p 1

[Article by Zhou Jie, staff reporter]

[Text] China plans to import technology and recruit scientists from several independent states of the former Soviet Union this year.

According to a report delivered at the on-going work conference of the State Science and Technology Commission held in Beijing, China will be making arrangements for the recruitment with the Russian Federation and the independent republics of Ukraine, Byelorussia, Uzbekistan and Kazakhstan.

Governmental scientific and technological co-operation agreements between China and these states will be negotiated and signed sometime this year, "the sooner the better," according to the report presented by the Bureau of International Co-operation under the commission.

Meanwhile, according to the report, China will pay particular attention to scientific and technological co-operation with the Southeast Asian nations.

Chinese traditional scientific partners in the West remain important. The report calls for further governmental and non-governmental co-operation with the United States, Japan, Germany, France, Italy, Britain and the European Community.

China welcomed the hopes of Spain, Greece and Portugal to co-operate in scientific and technological areas and pledged to expand technology and talent exchanges with them.

The "quality of the co-operation" should be improved, said the report, referring to increased exchanges in the high technology area.

Officials in the commission said that they will take advantage of the coming United Nations' Environment and Development Congress in Brazil to actively negotiate and co-operate with foreign countries in solving environmental and developmental problems.

Officials reiterated that international scientific and technological exchange should involve more economic and trade activities, supporting an effort by the Chinese Government to sell its products in the world market.

"We encourage Chinese enterprises to set up joint-ventures, research institutions, and information service units in foreign countries," said the report.

International co-operation in science and technology started to boom when China opened to the outside world in the late 1970s.

### Hefei State Synchrotron Radiation Laboratory Completed

92FE0297A Beijing LIAOWANG ZHOUKAN  
[LIAOWANG WEEKLY] in Chinese No 3, 20 Jan 92  
pp 21-22

[Article by Tien Wenxi [3944 2429 0823] and Guo Qinghua [6753 1987 5478]]

[Text] On 23 December 1991 China's first synchrotron radiation facility—Hefei State Synchrotron Radiation Accelerator and Beam Experiment Station—passed the technical certification of the State Science Commission. Three days later, Hefei State Synchrotron Radiation Laboratory that houses this facility was officially certified and accepted by the State Planning Commission. Members of the state certification committee believe that the design and construction of the accelerator were successful and the major performance indicators have reached the international state-of-the-art of similar accelerators in the world. The finished beams and the design of the experiment station are also of world standard and can be used for a variety of experimental research. With this facility, China has entered the rank of leaders in synchrotron radiation technology and will play a major role in this high tech field.

Synchrotron radiation is a new type of artificial light source. It is an extremely strong electromagnetic radiation emitted in the tangent direction of circular orbits of high energy electrons traveling near the speed of light in a ring-shaped accelerator. It was first observed by a scientist named Pollack in 1947 and was gradually developed in the mid-1970's.

Synchrotron radiation has a number of very desirable characteristics, including high intensity, great brightness, continuous broad spectrum, good directivity and polarizability, pulsed temporal structure, and the spectrum may be computed accurately. These features have led to a wide range of applications and have attracted great attention in many countries. Capable countries compete in the construction of synchrotron radiation facility.

Today a dozen synchrotron radiation sources of various types are in operation in the world. Among the developing countries, China is the first one to have this type of high tech laboratory.

The synchrotron radiation facility in Hefei was developed by the China Science and Technology University. Construction began in 1984 and it took only 3 years to complete the 200 MeV electron linear accelerator. The electron storage ring was installed at the end of March in 1989. The system was tested and produced light at 01:08 on 26 April (Beijing time) in the same year. It took only 23 hours from the time the electron beam was first injected into the storage ring to obtaining storage beam and producing synchronous light.

Total investment in the Hefei State Synchrotron Radiation Laboratory is 62.4 million yuan and the area of the building is more than 20,000 square meters. According to the state certification committee, the engineering quality of the project was good and the radiation protection and release dosage were within the state standards.

The synchrotron radiation laboratory is a complex and demanding high tech project. A great majority of the technical staff of the Chinese Science and Technology University that worked on this project are middle-aged or younger. They bravely shouldered the heavy responsibility of this frontier high tech project.

In a national science and technology planning conference in September 1979, Bao Zhongmou [0545 1813 6180], then associate provost of the Chinese Science and Technology University, and a few other young scientists volunteered to build China's first synchrotron radiation light source. The Chinese Academy of Sciences supported their request and included the project in the national science and technology development plan. Since that time, these middle-aged and young technical people have devoted all their talents and intelligence to the development and construction of the synchrotron radiation light source.

Shortly before that time the Chinese Science and Technology University moved from Beijing to Hefei. The environment was poor for research and the budget was tight. There was a severe shortage of technical data and the staff participating in the development and construction lacked the experience of conducting a large scale research project. Faced with these difficulties, the young creators of the synchrotron radiation source were undaunted. They concentrated the state's investment on the main building and the design and development of the accelerator. To search for technical data, they went to every library and research institute of the universities in China and sought out well known scholars and experts. Even though they lacked the actual experience of engineering planning, they tried to attract talent and put their heads together. Very soon, they drafted a sensibly laid-out and practical design plan.

The laboratory was self-reliant from the design of engineering blueprints to the manufacture and testing of

major components. In the manufacturing of the deflecting magnet for the electron storage ring, Deputy Chief Engineer Zhang Wu [1728 2976] and two of his colleagues chose an unheard-of small factory—Liaoning Precision Instrument Plant—in order to cut costs. They lived in their factory and worked with the factory staff to carefully design and fabricate the parts. They adhered to quality control and succeeded in producing high precision large dipole magnets of first rate quality. The manufacturing cost was the lowest in the world.

The construction of the 200 MeV linear electron accelerator was a culmination of precision machining, microwave, electronics, computer, ultra high vacuum, accurate calibration measurement, and constant water temperature control. It is the bulk of the laboratory. With the

support of the various departments and laboratories of the Chinese Science and Technology University, the staff responsible for design and installation worked exceedingly hard, and completed the task with high quality in only 160 days.

From design, development, installation, to testing, the Hefei State Synchrotron Radiation Laboratory was independently completed by the technical staff of the Chinese Science and Technology University. Ninety-five percent of the equipment was made in China. In an international conference on synchrotron radiation held at the Chinese Science and Technology University in May 1989, foreign experts and scholars saw the Hefei synchrotron radiation accelerator in operation and regarded it as a miracle pulled off by the Chinese.

### Italian, Chinese Aeronautics Joint Venture Established

92MI0273 Rome AIR PRESS in Italian 5 Feb 92 p 223

[Text] Alenia of the IRI Finmeccanica [Institute for the Reconstruction of Industry-Mechanical Engineering Finance Corporation] group has founded the Italian-Chinese company Sapphire in Beijing along with the Chinese industrial Group RIDA and Dragon Base Investment Ltd. of Hong Kong. An Alenia press release dated 25 January reads as follows: "Sapphire, whose Chinese name is Lan Bao Shi, will operate primarily in the field of data processing and display systems."

Initially designed to supply maintenance services for air traffic control systems, this joint venture will transfer state-of-the-art air traffic control technology to China and will provide systems, carry out installation, and set up services as well as provide after sales assistance. "Sapphire also offers," the Alenia press release continues, "local businesses an opportunity to participate in the construction, assembly, and integration of Alenia components."

The release further states: "The founding of Sapphire opens up a new phase in Alenia's relations with China, where it is currently installing 13 air traffic control systems in the southeast of the country."

In addition to the three systems already in operation, a secondary radar for Shenzhen airport, located 30 kilometers from Hong Kong, and a conventional secondary radar for Tianjin airport, Beijing's second airport, will be completed by the end of 1992.

In 1989, Alenia was assigned a Civil Aviation of China contract for the supply and installation of 11 radar systems in Beijing, Shanghai, Changsha, Hefei, Fuzhou, Taiyuan, Enshi, Shenyang, Chongqing, Guangzhou, and Sanya. This network will enable China to have almost complete radar coverage of the eastern part of the country. Alenia will complete the installation of the primary and secondary radar systems and related control centers by the second half of 1992. Three systems, among them the secondary radar system at Beijing's Capital Airport, were installed a few months ago and are now fully operational."

### Radars for Chinese Air Traffic Control

"A second contract for a secondary radar for Shenzhen airport, signed a year ago, is currently being completed 30 kilometers from Hong Kong. The radar system, which is now installed, will be completed by the end of January 1992. Another contract, signed in November 1991, concerns the supply of a conventional secondary radar for Tianjin airport. The radar system will be installed in 1992.

These three contracts represent an important recognition for Alenia at a time when competition among the main international companies in the sector is intense. An interest in the Chinese market is demonstrated by the

1990-1995 air traffic control targeted project concerning the completion of a program to upgrade air traffic control infrastructures.

The program is considered to be of fundamental importance for the country's development, and has led the Civil Aviation authority to make two more calls for bids by the end of the year for the supply of new radar systems and air navigation equipment."

### Biomedical Experiments on Recoverable Satellites Detailed

92FE0265A Beijing ZHONGGUO HANGTIAN  
[AEROSPACE CHINA] in Chinese No 12, Dec 91  
pp 12-15

[Article by Shen Liping [3088 0500 1627] and Wang Puxiu [3769 2528 4423] of the Institute of Space Medico-Engineering: "China's Satellite Biological Compartment Experiments"]

[Text]

### Abstract

In October 1990, China successfully conducted the first biomedical experiments on higher animals in a recoverable research satellite. The experiments included a survival test of white mice in space and studies of the effect of space environment on the reproduction of fruit flies and the development of silkworm eggs and wheat seeds. The results of the experiments provided valuable information for future life-science research in space. [end abstract]

The recoverable satellite is an important segment of China's application satellites; it is also one of China's major aerospace achievements which has attracted worldwide attention. The extra payload capacity which exists on recoverable satellites can be used to conduct various scientific experiments on orbit; this capability provides an important means for conducting microgravity research and has attracted considerable attention both in this country and abroad.

In October 1990, the Institute of Space Medico-Engineering (ISME) conducted China's first experiment on higher animals in space using the biological compartment system on a recoverable satellite developed by ISME. On the same flight, two other experiments involving fruit flies and silkworm eggs were also successfully conducted. Thus, China became the third country in the world with the capability of performing independent animal experiments in space.

### Biological Space Experiment

Based on careful analysis of the available space, weight and power that can be provided by a recoverable satellite, ISME has established guidelines for defining the scope and types of biological experiments, and has actually conducted a number of experiments on animals and plants in space.



1. Experiment on white mice in low-earth orbit. The main objectives of this experiment are to study the effect of space environment, particularly the effect of weightlessness, on animal physiology, and to accumulate space medicine-related information. In addition, the experiment also provides data for evaluating the performance and reliability of the biological compartment system, and gathers useful information for developing animal life-support systems and for conducting future space experiments.

2. Study of the effect of space environment on the genetics of fruit flies. The purpose of this experiment is to explore the effect of space elements on the mutation of sex-linked recessive death-causing genes of fruit flies. The data can be used in assessing the safety of space flight and in studying preventive measures.

3. Study of the effect of space environment on the reproduction and development of fruit flies. The purpose of this experiment is to accumulate data for space life-science research.

4. Study of the effect of space environment on the development of silkworm eggs.

5. Study of the effect of space environment on wheat seeds.

In order to ensure the success of these experiments, a significant amount of ground work and basic research must be performed prior to and after the flight. These include the design of biomedical experiments, the selection, training, and the study of standard criteria of test animals, the study of space food for the test animals, the study of different methods of decontamination of the biological compartment and the test animals, the screening of biological test samples, and conducting ground experiments on the control group before, after and during the flight.

Clearly, this experiment is a multi-disciplinary research project; it requires the coordinated and unified efforts of experts in engineering, biology and medicine.

#### Biological Compartment System

The retrievable compartment of China's recoverable satellite is not sealed and is subject to substantial temperature fluctuations during flight; hence it does not provide the basic conditions for survival of living creatures. To ensure the success of the experiments, it is necessary to create an artificial environment suitable for the survival of the test animals. This requires the development of a special environmental-control/life-support system which we call the biological compartment system. This system is the main focus of engineering research for the satellite biological experiment.

In terms of engineering complexity and scale, the biological compartment system is a small-scale environmental-control/life-support system which can perform the following basic functions:

(1) Create and control an artificial environment suitable for animals to survive;

(2) Provide food and water to the test animals under weightlessness conditions;

(3) Monitor the operating conditions of the system and information about the test animals.

Clearly, it is a multi-faceted and multi-functional system which has a complicated interface relationship with the satellite, the space environment and the test animals. It is through these interfaces that exchanges of mass, energy and information take place; the basic characteristics of the interface also determine the design constraints and performance requirements of the biological life-support system. In general, the system design constraints are dictated by the following considerations: (1) test animal considerations, which include the species, quantity, energy metabolism, food and drink requirements, amount of waste discharge, habits, requirements on the atmospheric and mechanical environment, and endurance limits, and (2) satellite and space-flight considerations, which include storage space, weight limit, the type and capacity of power supply, duration of experiment, flight cycle, satellite environmental conditions, field service conditions at the launch and recovery sites, and satellite telemetry and control conditions.

The performance specifications of the system are determined by combining the overall flight test requirements and the design constraints mentioned above (see Table 1).

Table 1. Performance Specifications of the Biological Compartment System

Parameter	Performance specification
Flight cycle	8 day/night periods (design value is 11)
Total pressure in biological compartment	75.99-89.33 kPa
Oxygen partial pressure in biological compartment	14.96-46.66 kPa
CO <sub>2</sub> partial pressure in biological compartment	2 kPa
Temperature inside the compartment	14-28°C
Relative humidity inside the compartment	30%-80%

The biological compartment system can be divided into five major functional subsystems:

The compartment structure and temperature control subsystem: it is the key component of the biological life-support system which also controls the temperature inside the compartment.

The air supply and pressure regulation subsystem: it ensures that normal atmospheric pressure and oxygen partial pressure are maintained inside the compartment to provide survivable conditions for the test animals.

The air purification subsystem: it absorbs carbon dioxide and removes any toxic gases and part of the water vapor; it also maintains good ventilation conditions inside the compartment.

The animal servo subsystem: it includes the animal test cage, the waste collection unit, the food and water supply unit. It is designed to solve the waste management problem under weightlessness conditions and to provide food and water and proper living space for the test animals.

The telemetry and control and power supply subsystem: it performs the process control function and monitors the system operating conditions and information on the test animals; it also provides electricity for the system and performs the necessary power switching function.



Figure 4. Biological Compartment System

### Test Results

In order to validate the feasibility of the test plan, to evaluate the system performance and to assess the reliability of the experiment, a large number of ground tests were conducted before the flight test. These tests included performance tests at the component, subsystem and system

levels; reliability tests at the unit, component, subsystem and system levels; animal tests; and integrated operational tests of the entire system for 8-11 days. The results of pre-launch performance certification tests indicated that the biological compartment system was reliable, operationally stable and ready for flight test.

On 5 October 1990, China's first scientific research satellite carrying higher animals was launched from the Jiuquan Launch Center and successfully injected into orbit. On 13 October, after 8 days in orbit, the satellite was safely returned to earth according to plan. On the basis of the flight test data, examination of the disassembled compartment system after the flight, and analysis of the recovered animal and plant samples, the following results were obtained:

1. The biological compartment system functioned normally. During the entire flight, the pressure, temperature, humidity and carbon dioxide level inside the compartment all met design requirements. The flight test data obtained by the telemetry system and the Xian Satellite Launch Control Center provided real-time information on the operating conditions of the biological compartment system and the test animals.

2. The results of this flight test, in conjunction with results of control tests on the ground, provided large amounts of information on the effect of space environment—particularly the effect of microgravity—on the physiology of the test animals; this information is valuable to research on space biological medicine.

3. In the fruit-fly experiment, two groups of fruit flies were used: the first group was used to study the effect of space environment on the genetics of fruit flies; the second group was used to study the effect of space environment on the reproduction and development of fruit flies. Satisfactory test samples were obtained in both experiments.

4. In the silkworm-egg experiment, four different groups of silkworm eggs were used and the space radiation dosage was measured. The development period of the pre-processed embryo-development test group covered the entire orbit period; upon recovery, more than 700 eggs had hatched, the hatching period was 2 days shorter than that of the ground control group. The second-generation follow-up study is currently in progress.

Follow-up studies of the plant seed specimens are also in progress. These results indicate that this flight experiment has achieved all its objectives.

### Concluding Remarks

China's first flight experiment of higher animals in a low-earth orbit is a multi-disciplinary and multi-faceted research project involving medical science and engineering; it is also an integrated space-application activity which involves satellite design, launch operation, telemetry and control, and the recovery operation. A large amount of valuable test samples and test data have been collected, and first-hand experience and information have been accumulated. The results of this experiment will undoubtedly contribute to the success of future space life-science research.

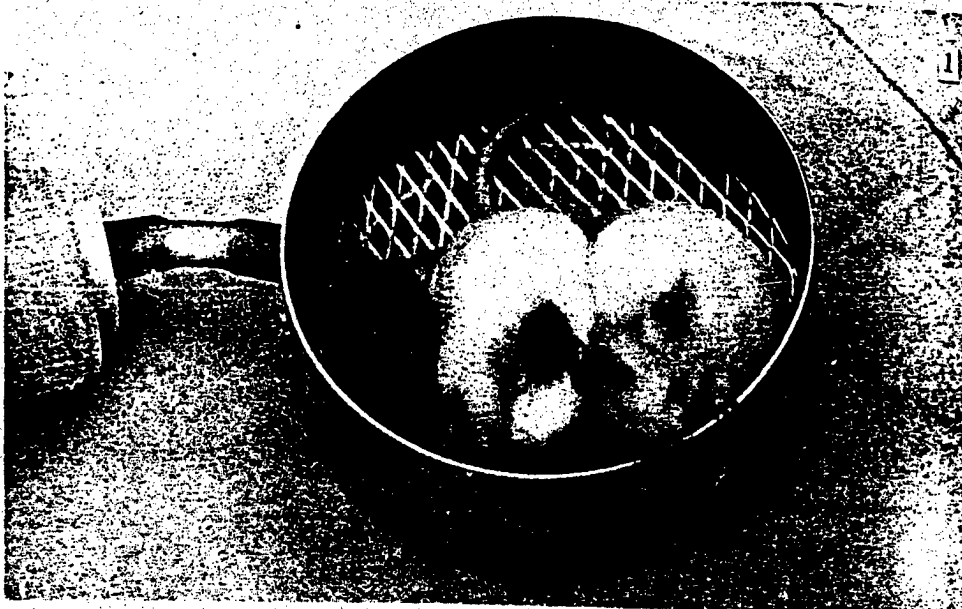


Photo 1 (inside front cover): Test Animals—White Mice

---

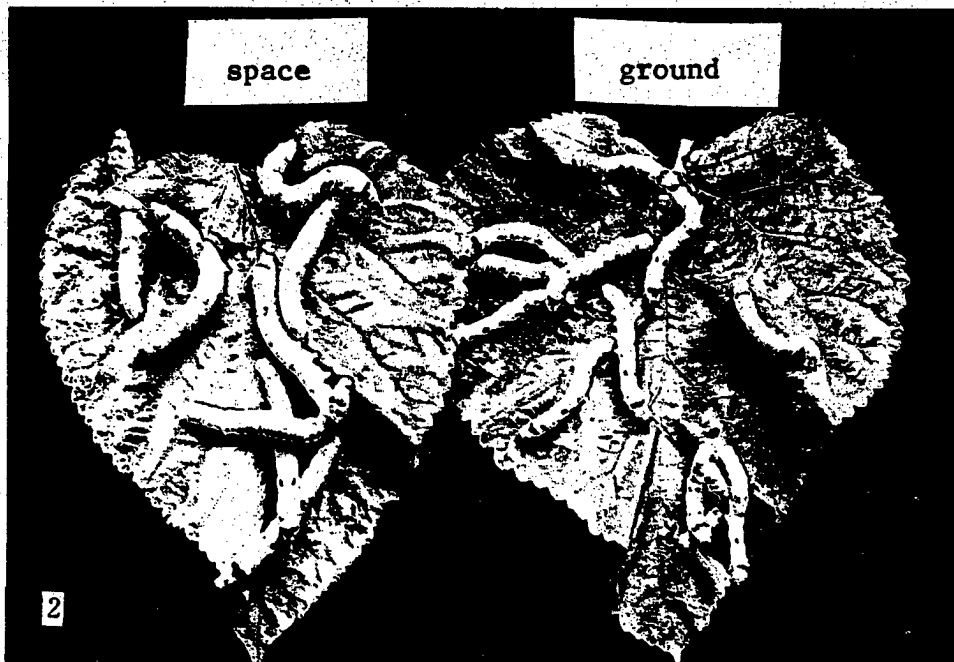


Photo 2 (inside front cover): Comparison of Silkworms Hatched in Space and on the Ground

---

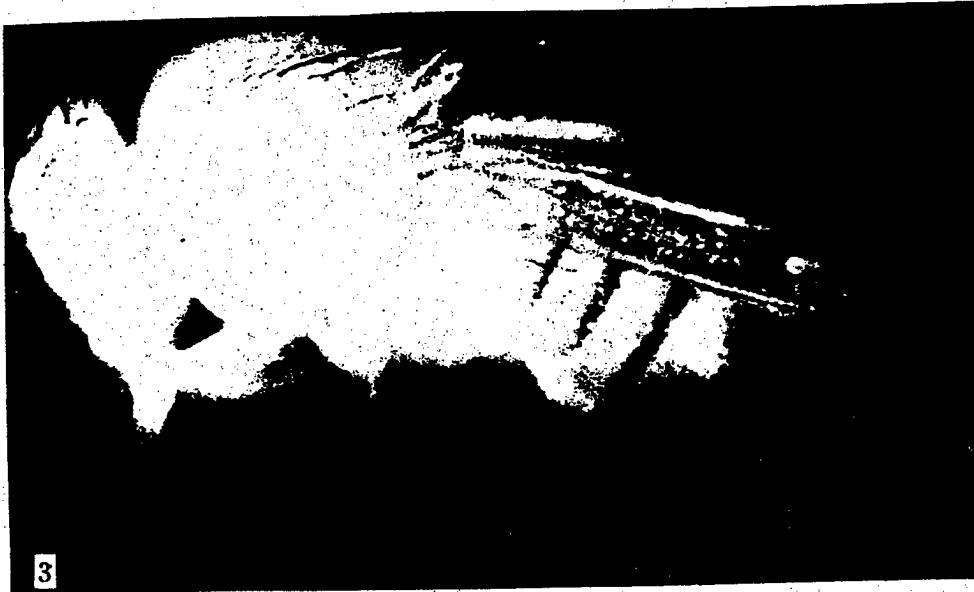


Photo 3 (inside front cover): Fruit Flies Used in Space Experiment

### Aviation Industry Marching Forward

40100025A Beijing GUOJI HANGKONG  
[INTERNATIONAL AVIATION] in English  
No 1, Jan 92 pp 10-11

[Article by Lin Zongtang, minister of MAS: "China's Aviation Industry Marching Forward"]

[Text] Since the Seventh 5-year Plan, China's aviation industry has been developing rapidly. It has gained great achievements in the construction of the national defence, national economy, international economic and technical exchange and cooperation, which has laid a sound foundation for the development in the next decade.

During the Seventh 5-year Plan, the aviation industry provided urgently-needed armament equipment for the modern construction of PLA with the background that the number of the armed forces was reduced by one million and the order of armament decreased by a quite large amount. Several types of newly-developed, modified or upgraded fighter, attacker, bomber, helicopter and trainer passed design qualification and certification, and were put into service. At present, all military-aircraft used by our Air Force and Navy are home-produced.

Since 1986, 19 types of civil aircraft have been developed, among which 14 have made maiden flight. Three types of aircraft have got domestic type certification. The number of Y-7 aircraft delivered has reached 71 and becomes the largest fleet of regional aircraft in domestic routes for CAAC. In 1990, Y-12 aircraft acquired CAA type certification of UK and 18 Y-12 have been exported. On Oct. 12, 1991, the 25th MD-82 airliner

jointly-produced by US and China was delivered and another formal contract has been signed to jointly-produce another 10 MD-80 series aircraft.

During the Seventh 5-Year Plan period, the aviation industry, making full play of its advantages in technique, facilities and human intelligence, developed over 4,000 civil products and set up over 100 production lines of civil products, forming 15 categories of products including textile machine, food packaging machinery, medical instruments, motorcycle, car and associated components, precision tooling and measuring instruments. A batch of enterprise groups and associations were formed according to their trade and specialty. In last five years, the production value of civil products in the aviation industry was increased by 25.8 percent annually, the percentage of which compared with the total value of industrial output in the aviation industry has risen from 61.2 percent in 1986 to 64.2 percent in 1990. The value of civil products during the Seventh 5-year Plan period was 3.76 times of that in the Sixth 5-year Plan.

At present, the aviation industry has established trade and cooperation relationship with over 60 nations and areas. Besides, the enterprises under MAS also have set up 45 export bases and enterprises with expanded authority. Subcontracted manufacturing of aviation parts and components from foreign major aircraft and aeroengine companies have been performed with the total value of foreign currency over 100 million US dollars. The total value of foreign currency through exportation of civil electro-mechanical products reached 510 million in last 5 years.

In the last 5 years, by means of international cooperation, K-8 trainer was successfully developed and WJ-5E aeroengine modified. The aviation industry has also set up long-term cooperation relationship with some foreign research institutions, companies and universities and has developed a large number of highly-qualified high-tech personnel through sending engineers and visiting scholars to study abroad.

During the Seventh 5-Year Plan period, the aviation industry made important breakthrough in advanced research. The aviation production technology also made outstanding progress. Research work on soft science gained important achievement. In the last 5 years, the aviation industry won 17 state's invention prizes, 73 state's science and technology progress prizes and 1,036 ministerial science and technology progress prizes. In the Seventh Five-year Plan period, the aviation industry invested special-purpose capital 1.78 billion through the state's loan and self-collection, which was mainly used for technical transformation in over 80 enterprises in MAS.

During the Eighth 5-Year Plan period and the coming 10 years, the major targets for the aviation industry are as follows:

1. Keep momentum in the aeronautical high-tech development. Pay great attention to the development of military aircraft to make it enter into a new stage. Make great breakthrough in the development of civil aircraft. In advanced research, concentrate resources to solve a number of key techniques and selectively keep track of the development of aeronautical science and technology in the world.
2. Continue carrying out vigorously the policy of strategic transfer from military production to civil production. In the field of civil aviation products, the main task will be developing China's trunk airliner and other aircraft be developed accordingly. For non-aviation products, emphasis should be put on the adjustment of products structure and develop as soon as possible a batch of mainstay products with the features of the aviation industry and being salable.
3. Speed up the strategic transfer from domestic market to international market and vigorously develop export-oriented economy. The exportation of civil aircraft such as Y-12, Y-8 and Y-7 should be performed with emphasis. At the same time, further expand subcontracted manufacturing of the aviation parts and components and speed up the pace of exportation of electro-mechanical products. Strive hard to develop a batch of new high-tech, highly value-added

export mainstay products and construct a group of new export bases and enterprises with expanded authority.

4. In prerequisite for assuring quality, further increase the economic benefits.

#### **A Low-Altitude Breakthrough System Using Optimal Path Terrain Following**

40100029A Xian XIBEI GONGYE DAXUE XUEBAO  
[JOURNAL OF NORTHWESTERN  
POLYTECHNICAL UNIVERSITY] in Chinese  
Vol 9, Extra issue, Dec 91 pp 1-9

[English abstract of article by An Jinwen and Xiao Shunda of the Department of Aeronautical Automatic Control, Northwestern Polytechnical University; MS received 11 Apr 91, project funded by NSFC]

[Text] A new design for a low-altitude breakthrough system using optimal flight path terrain following is discussed in detail. At present, terrain following systems used in aircraft are mostly based on the classical control theory. Its advantages are: the algorithm is simple and intuitive, real-time implementation is easy. But the error of terrain following is quite large and the service life of an engine will also be affected by such a system. The Funk algorithm for cubic-spline optimal terrain flight path is very complicated; the controller designed by Kelly and Simmons has the fault of large error when aircraft follows the optimal path. The very large amount of computation of the Funk-Kelly-Simmons scheme makes it difficult to implement real-time control.

Our contribution is to give a new scheme for automatic terrain following system. In this scheme, linear programming algorithm and output predictive control algorithm in modern control theory are applied. As a result the algorithm for automatic optical terrain following scheme is simplified and the accuracy of aircraft following optimal flight path is improved. Moreover a parallel data processing multi-processor system is designed [see Figure 11]. All these allow terrain following to take a step forward in real-time implementation, accuracy, and engineering application.

Simulation results indicate that the accuracy of path tracking of this system is quite high, the error of altitude being no more than 3 meters. They also indicate that the normal load factor falls within the range between 0 and 2.8 g. Such a performance fully satisfies the technical requirements for a low-altitude breakthrough system.

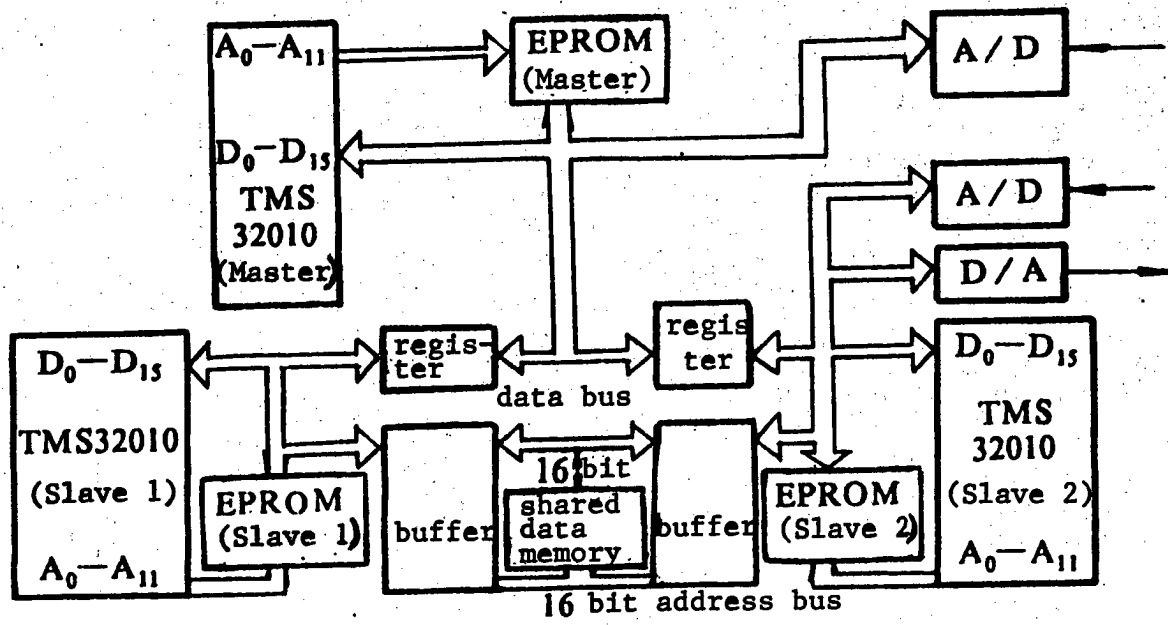


Figure 11. Schematic of Multiprocessor System Principle

### Experimental Fiber Optic Guided Torpedo System Described

92P60175A Shanghai GUANGXIAN YU DIANLAN  
in Chinese No 4, Aug 91 pp 23-26

[Article by Wang Yuqing [3769 5148 3237], Xue Jingao [5641 2516 4108], and Qin Juru [4440 5468 1172]:  
"Wired Light-Guide Torpedo Experimental System"]

dB), respectively. Linear FM pulse compression correlation of the signal was performed, and with an  $f_0$  of 30 kHz, a pulse width of 32 ms, an FM bandwidth ( $\Delta f$ ) of 2,048 Hz, and a T $\Delta f$  of about 64 were obtained.

Six other figures show the received signal pre-processing, the encoding design (sampling circuits, crystal oscillator, correlator, etc.), the optical transmitting terminal schematic, the optical receiver schematic, the decoder circuit schematic, and the sonar receiving array element layout.

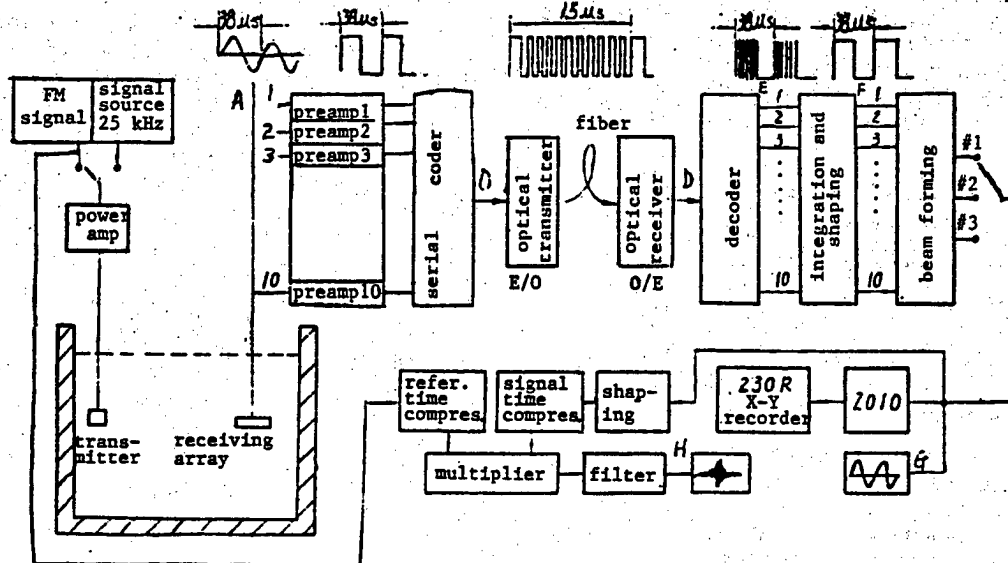


Figure 7. Schematic of Experimental System Showing Waveforms at Various Points

[Abstract] An experimental optical-fiber-guided torpedo system has been designed and tested at the small anechoic pool of Institute 726. In the experimental system, shown schematically in Figure 7, the acoustic signal received by the torpedo's self-guided transducer is processed, electro-optically (E/O) converted, transmitted across the 20-km-range analog optical fiber, optoelectrically (O/E) converted, and then accurately formed into three beams via appropriate signal processing steps. The optical transmitting terminal converts the serial data from the sonar receiving array into a 1.3- $\mu$ m-wavelength signal injected into the fiber with an optical power of -6 dBm. Total optical path attenuation is 25 dB. The hydrophone chosen for the experiment has a signal operating frequency ( $f_0$ ) of 25 kHz, the receiving array has 10 lines (with elements placed at  $-111.5^\circ$ ,  $-84.5^\circ$ ,  $-57.5^\circ$ ,  $-30.5^\circ$ ,  $-13.5^\circ$ ,  $+13.5^\circ$ ,  $+30.5^\circ$ ,  $+57.5^\circ$ ,  $+84.5^\circ$ , and  $+111.5^\circ$ , array element center spacing  $d = 27$  mm), and the operating clock is fixed at 8 MHz. Three different beams were tested: bearing  $0^\circ$  (#1), bearing  $15^\circ$  left (#2), and bearing  $30^\circ$  right (#3), with corresponding theoretical directionality angle  $\theta = 10$ , 11.5, and  $13^\circ$ , respectively. The beam directional plots observed during testing are shown in Figure 8. Measured values for  $\theta$  were about  $10^\circ$  (-3 dB), about  $11.1^\circ$  (-3 dB), and about  $11.5^\circ$  (-3

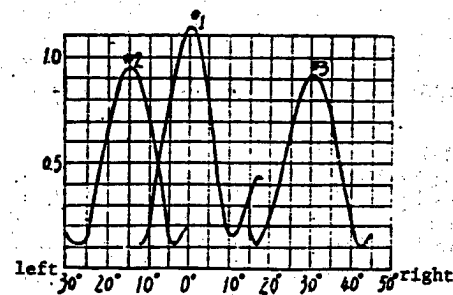


Figure 8. Measured Beam Directionality Plots

### RCT-180 Communications Jamming Equipment Certified

92P60175B Beijing ZHONGGUO DIANZI BAO  
[CHINA ELECTRONICS NEWS] in Chinese 7 Feb 92  
p 1

[Article by Huang Jiwei [7806 4949 0251]: "RCT-180 Communications Reconnaissance and Jamming Equipment Passes Appraisal"]

[Summary] The RCT-180 communications reconnaissance and jamming equipment developed by MMEI's Institute 54 recently passed the technical appraisal held in Shijiazhuang by the CHINATRON Corporation's Military Production Office. The RCT-180 communications jammer incorporates several advanced technologies such as a compression receiver, broadband solid-state high power synthesis, rapid frequency synthesis, and fast direction finding. With respect to frequency-hopped signals, it can perform monitoring, direction-finding, and tracking while jamming. It can do direction-finding of continuous-time signals as short as 2 milliseconds. The unit can also distinguish between three simultaneously operating non-orthogonal frequency-hopped networked stations, and can simultaneously jam three fixed-frequency transceivers. The unit's overall technical performance meets mid-to-late-eighties international standards.

### Navy's Science Think Tank Introduced

92FE0146B Beijing JIANCHUAN ZHISHI [NAVAL AND MERCHANT SHIPS] in Chinese No 8, 8 Aug 91 pp 4-5

[Article by Zhang Zenan [1728 3419 0589] and Hu Hongbo [5170 3163 3134]: "The Chinese Navy's Think Tank—A Visit to the Navy Military Science Institute"]

[Text] When various crises and armed conflicts occur in today's world, the navies of the militarily powerful countries are entering them with growing frequency. This indication shows that navies often can more quickly and comprehensively conduct actions to protect national interests than other branches of the military. For a modern navy, which has been given political, military, foreign relations, economic, and many other missions, its development strategy is becoming increasingly closely related to national interests. After the conclusion of the Gulf War, we were interested in China's navy and visited the Navy Military Science Institute, whose primary task is the formulation of naval development strategies.

#### I. A High-Level Beginning

In 1985, China announced a troop cutback of 1 million. While carrying out troop reductions and reorganization in all branches of our military, the Navy Military Science Institute, our military's first research organ focused on studying strategic science, was founded. To adapt to construction of a modernized navy, the Military Commission and senior naval officers provided considerable support in work to organize this research institute. The navy commander at that time, Liu Huaqing [0491 5478 3237], paid extremely close attention to the personnel assigned to the institute, personally made important choices of people, and directed the transfer of research personnel from all naval institutions of higher education and scientific research units. The research personnel were first recommended by their units and then wrote their own theses and submitted them to the evaluation committee for examination and revision; after which they underwent examinations for selective admission.

This gave the Navy Military Science Institute a relatively strong lineup from the day it was founded.

After the Navy Military Science Institute was founded, the experts and scholars turned their sights toward construction of China's navy during this century and into the next century. A major high-level theoretical topic for the navy, "The Navy in the Year 2000" was the starting topic. Using a scientific research attitude, they conscientiously solicited views from outside experts and scholars and cooperated with navy organs and the relevant military units in collecting information and data. On the basis of solid survey research they spent over 1 year in further research for a bluebook on standardizing naval development strategies, LIANGQIAN NIAN DE HAIJUN [The Navy in the Year 2000]. The topic was divided into a summary report, 13 special topic reports, and 15 appendices. The topic analyzed and predicted the international environment and domestic factors that will affect and restrict naval development over the next 15 years and analyzed development prospects for all areas of the navy. By means of rather high-level comprehensive research and with a prerequisite of giving full consideration to the various conditions that restrict navy development, they suggested objectives, optimum programs, and policymaking foundations for navy development during this century and policy proposals for selection. The predictions made in this topic were confirmed continuously via practice over the next several years. It provided a scientific theoretical foundation for readjustment of China's naval troop structure and raised naval development construction theory to a higher level.

On the basis of the first topic, the experts and scholars got busy again with a research topic dealing with China's naval development. In this topic, entitled "Balanced Development of the Chinese Navy in the Year 2000", the experts and scholars scientifically analyzed various issues China's navy faced regarding directions, suggested key points for troops, structures, and development for the Chinese navy before and after the year 2000, and thereby established the theory of balanced development for China's navy.

For the past several years, experts and scholars in the Navy Military Science Institute have concentrated on research on strategy and have provided reliable theoretical advice based on correct military theory and scientific methods for policymaking organs at all levels.

#### II. Research Based on Reality

While doing macro research on naval strategy, experts and scholars in the Navy Military Science Institute have used a common understanding of national interests to select research topics based on the various tasks facing the navy in protecting our national maritime interests. The Nansha [Spratly] Islands are a real issue that concerns China's national interests. With a powerful sense of responsibility, the experts and scholars undertook research on the topic "The Nansha Islands Situation and Our Countermeasures". Beginning in 1987, the Naval



Military Science invited leaders, experts, and scholars from the relevant departments and research organs of the state and held scholarly discussion meetings at various scales concerning the defense of our sovereignty over the Nansha Islands. These scholarly activities and research achievements further attracted enormous interest concerning the Nansha question on the part of all the people of China and provided the necessary data and countermeasures for selection for policymaking organs. The results of the research topic concerning the Nansha situation showed that the Navy Military Science Institute has made a contribution to the development of naval functions in the new era that cannot be underestimated.

The navy is a unique branch of the military that has high technological requirements and is knowledge-intensive. There are more than 2,000 types of regulation, ordinance, and legal documents in China's navy and as modernization levels of equipment become higher there must be abridgements, additions, and revisions to the content of several of them. The Navy Military Science Institute has assumed responsibility for this work and has now finished recompiling more than 700 types, which has provided effective guarantees for the construction of standardization in the navy.

To improve the military quality of officers of all ranks in the navy, the Navy Military Science Institute has integrated with the characteristics of China's navy and written seven theoretical monographs on naval campaign science, naval troop tactical science, naval command science, and so on.

### III. To Move Toward the World

To enable China's navy to move toward the world as quickly as possible, the Navy Military Science Institute has been extremely concerned with borrowing from the successful experiences of navies in foreign countries. Over the past several years, with the assistance and guidance of the relevant higher level departments, they invited 19 experts and scholars in 15 groups from foreign countries for lectures and discussions, conducted survey research 11 times for 24 naval vessels from 10 foreign countries that visited, and sent seven people on eight occasions to foreign countries to participate in international scholarly exchanges.

Naval attaches from France, England, and the United States assigned to China were invited to the Navy Military Science Institute to lecture, as were the Navy War Department Strategic Research Group from the United States and other current naval officers as well as England's former national defense chief of staff and

former NATO Military Commission chairman admiral of the fleet (Xi'er Nuodun), France's former armed services chief of staff admiral (Lagesite), and other retired high-ranking military officers. Others included Stanford University Asian Issues Research Center director professor Liu Yisi [0491 2496 2448], England's Submarine Museum director (Kangpudun Huo'er) and other internationally renowned scholars as well as weapons systems experts like Bai Ruobo [4101 5387 0590], director of the Beijing office of England's (Mak-eni) Corporation and others. The lectures concerned topics like world strategic deployments, the situation around China's periphery, submarine warfare, aircraft carriers, the use of ship-carried helicopters, and other campaign and tactical questions. These scholarly exchanges strengthened our understanding of naval construction and warfare training in foreign countries and we obtained a great deal of information that can serve as a reference for guiding China's naval construction.

With the increasingly significant role of the navy in modern warfare, the experts and scholars in the Navy Military Science Institute have been conducting timely and intensive research on laws of modern warfare and the effectiveness of the navy in warfare. It should be mentioned that as soon as the Gulf War ended, they immediately convened a symposium on the navy in the Gulf War. The content of the discussions covered 10 topics including the basic situation and primary characteristics of the Gulf War, strategic command in the Gulf War and the military strategy for China's military during the new era in view of the environment around China's periphery, China's naval and land-based troop construction in view of the role of naval and land-based troops in the Gulf War, the characteristics of high-tech weapons and equipment utilization in the Gulf War, proposals for China's naval equipment construction, and others. On the basis of thorough analysis of these issues, many constructive views were provided concerning the development of China's navy.

With the implementation of China's Eighth 5-Year Plan, the Navy Military Science Institute has also shifted its sights toward the three main directions of the international and peripheral environments, naval construction, and basic science. They have established several ten research topics at three levels for the state, the military, and the navy. After our visit, we felt that the Navy Military Science Institute will play an increasingly important role in the development of China's navy.

[Photo caption]: Central Advisory Commission members Huang Hua [7806 5478] and Huang Zhen [7806 6966], Navy commander Zhang Lianzhong [1728 6647 1813], and Political Commission (former) Li Yaowen [2621 5069 2429] at the symposium.

**High-Purity Indium Antimonide Monocrystal  
Domestically Developed**

92P60179A Beijing ZHONGGUO DIANZI BAO  
[CHINA ELECTRONICS NEWS] in Chinese  
28 Feb 92 p 3

[Article by Li Qiongrui [2621 8825 3843]: "New Break-through in Domestic Manufacture of Infrared Material: <211> Surface-Grown InSb Monocrystal Developed; Breaks Through Blockade, Strengthens Domestic Power"]

[Summary] An infrared (IR) material sorely needed in sophisticated optoelectronic countermeasures technology of the kind demonstrated in the Persian Gulf

War—where IR-guided smart weapons proved remarkably effective—has been independently developed by MMEI Research Institute 11. The new material—high-uniformity, high-purity <211> surface-grown indium antimonide (InSb) monocrystal—passed the CHINATRON Corporation-organized expert technical appraisal held on 21 February, at which its overall performance was judged to meet mid-to-late-eighties international standards. The new material fully meets national defense needs, and its domestic development represents a smashing of the economic blockade imposed by foreign nations on export of this material to China. Participating in the appraisal were representatives of NDSTIC, the Air Force, the Ministry of Aerospace Industry, and CAS.

### Cloning and Expression of Shiga-Toxin Gene From *Shigella Dysenteriae* Type I

40091011B Beijing WEISHENGWU XUEBAO [ACTA MICROBIOLOGICA SINICA] in Chinese Vol 31 No 6, Dec 91 pp 420-425

[English abstract of article by Li Fengsheng [2621 0023 3932], Huang Peitang [7806 1014 1016], et al., (Institute of Biotechnology, Academy of Military Medical Sciences, Beijing]

[Text] The chromosomal DNA of *S. dysenteriae* type I W30864 was isolated and digested by EcoRI. The 3-7 kb DNA fragments were recovered and ligated with vector pUC-19. After transformation, the recombinants were screened by SLT (shigella dysenteriae-like toxin) gene probe. The positive clones were obtained. The cloned EcoRI fragment containing both ST-A and ST-B subunit gene was about 4.5 kb. The cloned ST strain was also detected by Hela-S3 cell for cytotoxicity, and detected by rabbit ileal loop test for enterotoxicity. Besides, the cloned strain showed the neurotoxic activity when experimented with mouse. The production of shiga toxin in the cloned strain was 16 times of that of its parent strain *S. dysenteriae* W30864. The production differences between ST producing stains and SLT producing strain was also tested in our experiment.

### A Clinical Study on Treatment of Epidemic Hemorrhagic Fever Complicated by Acute Renal Failure With Traditional Chinese Medicine Combined With Western Medicine

40091011C Beijing JIEFANGJUN YIXUE ZAZHI [MEDICAL JOURNAL OF CHINESE PEOPLE'S LIBERATION ARMY] in Chinese Vol 17 No 1, Feb 92 pp 3-5

[English abstract of article by Liu Junbin [0491 0193 1755], Chen Longbang [7115 7893 5721], et al., Department of Infectious Diseases, Xijing Hospital, Fourth Military Medical University, Xi-an]

[Text] A new remedy for treatment of epidemic hemorrhagic fever (EHF) complicated by acute renal failure (ARF) has been tried in the present study. Eighty-seven cases were given "MAODAN-HUANG" a preparation concocted with Chinese medicinal herbs, together with drugs prescribed according to Western medicine, and 86 cases only with the latter as controls. The results showed that the cure rate in the studied group (72.4%) was higher than that in the control group, while the mortality rate in the studied group (12.7%) was significantly lower than that in the control group (25.6%). The periods of both oliguria and elevated blood urea nitrogen in the studied group (3.9 plus over minus 2.9 days and 15.6 plus over minus 10.5 days, respectively) were shorter than those in control group (5.0 plus over minus 3.5 days and 21.5 plus over minus 11.5 days, respectively). It was also found that the rate of gastro-intestinal hemorrhage in studied group (12.6%) was significantly lower than that in control group (20.1%). It is

suggested that the new therapy had a good curative efficiency for EHF complicated by ARF.

### Study of Natural Infection, Biting and Transovarial Transmission of Epidemic Hemorrhagic Fever Virus in *Leptotrombidium* (L.) *Scutellare*

40091011D Beijing ZHONGHUA LIUXINGBINGXUE ZAZHI [CHINESE JOURNAL OF EPIDEMIOLOGY] in Chinese Vol 13 No 1, Feb 92 pp 16-18

[English abstract of article by Zhang Yun [1728 0061], Shi Jiang [0670 3068] Institute of Military Medicine, Nanjing Command, PLA]

[Text] In order to clarify the significance of *Leptotrombidium* (L.) *scutellare* in transmitting EHF, from Oct. to Nov. 1988, lungs of rodents captured in endemic areas of EHF in Shangxi Province were taken for detecting EHF antigen by IFAT. Twenty-six out of 459 lungs were positive (5.7%). Six strains of EHFV were isolated from L. (L.) *scutellare* collected from the rodents. In Oct. 1989, 28 *Apodemus* captured from areas without reported cases of EHF were placed on grassland in endemic areas, free L.(L.) *scutellare* were lured in all mice and 3 strains of EHFV were isolated.

The above results demonstrate that L.(L.) *scutellare* can naturally be infected by EHFV and can be transmitted via bites. It is also suggested that this species of mites could transmit the disease transovarially. These results further indicate that L. (L.) *scutellare* can serve as a transmitting vector of EHF.

### Immunotoxins Prepared With Different Coupling Methods and Their Characteristics in Vitro and in Vivo

40091011A Beijing SHENGWUHUAXUE YU SHENGWUWULI JINZHAN [PROGRESS IN BIOCHEMISTRY AND BIOPHYSICS] in Chinese Vol 18 No 6, Dec 91 pp 443-447

[English abstract of article by Ji Yanshan [3078 6056 1472], He Yonghuai [6320 3057 2037], et al., (Institute of Basic Medical Sciences, Academy of Military Medical Sciences, Beijing 100850)]

[Text] A monoclonal antibody (H<sub>65</sub>) was coupled to ricin using three different cross-agents respectively. Immunotoxins (ITs) with greater cytotoxic potency were obtained through a proper scheme. The ITs reduced the <sup>3</sup>H-leucine incorporation of Molt-4 cells by 50 % at a concentration (IC<sub>50</sub>) of 2.7 X 10<sup>-12</sup>mol/L.

ITs prepared with disulfide bond is 5-10 fold more cytotoxic in vitro than those prepared with thioether bond. The speed of metabolism of the latter in vivo is two times slower than that of the former. Because these two kinds of ITs have different degradation products, their metabolism pathways in vivo may be different also.

**Experimental Study on Gunshot Concussion of  
Peripheral Nerve**

40091011E Beijing JIEFANGJUN YIXUE ZAZHI  
[MEDICAL JOURNAL OF CHINESE PEOPLE'S  
LIBERATION ARMY in Chinese Vol 17 No 1, Feb 92  
pp 31-33

[English abstract of article by Chen Ge [7115 7245],  
Hu Weiyi [5170 1218 1138], Department of Neuro-  
surgery, Chengdu General Hospital of Chengdu Com-  
mand, Chengdu and Liu Yinqiu [0491 5593 4428],  
Institute of Surgery, Third Military Medical Univer-  
sity, Chongqing]

[Text] Concussion injuries of peripheral nerves are frequently encountered in gunshot wounds of extremities. With the aid of high speed X-ray imaging technique, the sciatic nerve of dogs were visualized continuously during the formation of the temporary cavitation when a high-velocity of bullet was shot into the thigh. It was concluded that the concussional injury of the nerve was the result of a combination of stretching, compression, and concussion. There was a exponential correlation among cavity volume, absorption of energy and nerve displacement. The pathological changes include extensive microvascular injury and partial breakage of nerve fibres. Extensiveness and lack of uniformity in pathological changes may have some clinical implications.

**Fifth-Generation Computing Breakthrough:  
Intelligent Computer Operating System Certified**  
*92P60180E Beijing JISUANJI SHIJIE [CHINA  
COMPUTERWORLD] in Chinese No 9, 4 Mar 92 p 1*

[Unattributed article: "Domestic Fifth-Generation Computer Research Breakthrough: '863' Intelligent Computer Operating System Passes Appraisal"]

[Summary] The KZ<sub>2</sub> intelligent computer operating system developed by Nanjing University's Computer Sciences Department as an "863" Plan key project passed the achievement evaluation held recently by the State S&T Commission in Nanjing. This achievement represents a major breakthrough in the nation's research on fifth-generation computers.

Nanjing University researchers began designing their intelligent operating system, a key part of fifth-generation computing now being actively explored by developed nations such as the United States, Great Britain, and Japan, in January 1990. Within a half year—i.e., in July 1990—they had begun programming individual steps, and in September 1991 they initiated joint debugging and trial operation. The results from the trials indicate that the system has fully met the design targets in terms of "intelligentization" (the system has a knowledge-processing-based man-machine interface and task dispatcher), naturalization (the system can accept a human's natural language input), distributedness (use of a distributed system for maximizing resources and raising processing speed), parallelization (the system has a parallel processing organization), and integration (in terms of integrating existing software with newly developed software into a unified system).

Via an on-line international search of U.S. and British data bases, the appraisal experts determined that 34 technical papers have recently been published worldwide on this subject; of these 34 papers, Nanjing University researchers have published three. The experts unanimously agreed that the KZ<sub>2</sub> intelligent computer operating system is at the international state-of-the-art, and will be a major boost to China's fifth-generation computer research and to the nation's competitiveness in this area.

**Domestically Developed PROLOG DBMS  
Knowledge Processing System Certified**

*92P60180F Beijing JISUANJI SHIJIE [CHINA  
COMPUTERWORLD] in Chinese No 10, 11 Mar 92 p 1*

[Article by Xin Zi [2946 1311]: "China Develops High-Efficiency Tool for Structurally Large Knowledge Bases"]

[Summary] In a 6-year effort, 40-year-old post-doctoral researcher Li Lei [2621 4320] has succeeded in developing a PROLOG data base management system (DBMS) knowledge processing system—a world-class achievement formally certified by the State Education

Commission on 19 January in Guangzhou. The PROLOG-language DBMS knowledge processing system is a key tool for logical inference design in the structurally large knowledge bases of fifth-generation computers, a subject of great interest and competitiveness among the United States, the EC, and Japan. In 1985, while studying for his Ph.D. at Lyon University I under noted scholar J. Kouloumdjian, Dr. Li participated in the EC ESPRIT program's study of knowledge-based system design, with the goal being a new system integrating data bases and logical program design technology. One of his accomplishments was a semi-compiled technique for a PROLOG DBMS. In 1988, he returned to China and under various post-doctoral grants continued his studies in advanced computing—especially on the topic of integrating difference optimization methods, semi-interpreting techniques, and special-purpose parallel communications interface technology.

In the computer room of the Computer Department at Zhong Shan (Sun Yat-Sen) University's Lingnan Institute, Dr. Li gave this writer a demonstration of his PROLOG DBMS knowledge processing system, which runs on a Sun workstation under the UNIX operating system environment. It is implemented specifically in Quintus PROLOG, with the Ingres relational data base. According to Dr. Li, the system uses a dynamic connection technique, with a DBMS question-answering technique based on grouping of DB predicates—a completely automatic intelligent question-answering compound technique. Essentially, a step-by-step result is obtained by assembling relevant data at each step and eliminating superfluous data at each step; this technique is built into the control strategy of the system. After the demonstration, Dr. Li indicated that he hopes his system will be commercialized as quickly as possible, and put on the international market.

**English-Chinese, Japanese-Chinese Machine  
Translation Systems Certified**

*92P60180D Beijing JISUANJI SHIJIE [CHINA  
COMPUTERWORLD] in Chinese No 6, 5 Feb 92 p 1*

[Article by Hai Ping [3189 5493]: "Satisfying Results in Machine Translation Research: Gaoli English-Chinese, Japanese-Chinese Machine Translation Systems Pass Appraisal in Beijing"]

[Summary] The English-Chinese and Japanese-Chinese machine translation systems developed by the Beijing Gaoli [7559 4539] Computer Software Company recently passed the technical appraisal given in Beijing by a panel of experts. The JFY-IV/V English-Chinese system was originally a rational-grammar-based system developed by the Chinese Academy of Social Sciences' Institute of Linguistics; this older system was then further jointly developed by Gaoli and the Institute of Linguistics into an experience-based system which uses words to build sentences. It contains a 40,000-term expert dictionary, is fully user-friendly and updatable, is

written in a specialized machine-translation and natural-language-processing language called JFY, and has a machine grammar of 700 rules and a background knowledge base of 150 knowledge inference rules. In a test conducted with the aid of the "machine translated text quality assessment software" developed by Beijing University's Computational Linguistics Institute, the finished text produced with the JFY-IV/V system had a translation accuracy of 80 percent and a comprehensive score of 76.

The Gaoli Japanese-Chinese machine translation system, jointly developed by Gaoli and by Heilongjiang University's Machine Translation Laboratory, has a 30,000-term (including over 1,000 phrases) Japanese-Chinese/Chinese-Japanese electronics dictionary and over 500 linguistic rules. The system's translation accuracy as measured by the test group was 70-75 percent; in an Olivetti M300/10 microcomputer, the system took 8 minutes 47 seconds to translate 110 sentences of original Japanese text. The Olivetti Company had previously reached an agreement with Gaoli for sales rights to the two systems in the Asian-Pacific region.

#### 'Panda' VLSI CAD System Passes National-Level Appraisal

92P60180A Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 5, 29 Jan 92 p 1

[Article by Chen Chunmei [7115 2504 2734]: "Major Breakthrough in Very-Large-Scale Integrated Circuit CAD Technology"]

[Summary] The "Panda" VLSI CAD system, developed in a 4-year effort by a team of 16 units (totaling 120 engineers) led by the Beijing Integrated Circuit Design Center, passed the MMEI-organized national-level appraisal held on 21 January. The Panda computer-aided design system, oriented toward full-custom VLSI circuits of up to 100,000 transistors, runs under the XENIX operating system or the X windows system, is written in 1.8 million lines of C-language code, and was developed with an Ethernet network and 32-bit workstations. It is designed to run on a variety of workstations, including the Sun3 series, the Sun SPARC Station 1+, the HP 9000/300 series, and the Huasheng (HUASUN) 4065.

#### High-Speed Fiber Optic Transmission System for Linking IBM Mainframes Certified

92P60180B Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 5, 29 Jan 92 p 2

[Article by Guo Ronghuan [6753 2837 3562] and Liu Changxi [0491 7022 3886]: "High-Speed Fiber Optic Transmission System for Linking IBM Mainframes Debuts"]

[Summary] A "high-speed fiber optic transmission system" for linking IBM mainframe computers passed technical appraisal on 10 January in Beijing. The new

system, independently developed by the Hua Zi [5478 6327] Company, is the nation's first 7,000-meter-range high-speed fiber optic secure duplex data transmission system for linking IBM mainframes, easily surpassing the under-1,500-meter limit of the old short-range transmission systems. Tested in over 2 years of trial operation, the new system has proven stable, reliable, high in performance, and easy to use.

#### Domestically Made 40MB Winchester Disk Drive Put Into Production

92P60180C Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 6, 5 Feb 92 p 1

[Article by Xiang Hanyuan [0686 3352 3293]: "Domestically Made 40MB Winchester Disk Drive Enters Production in Hunan"]

[Summary] The JN-4050 3.5-inch 40MB Winchester disk drive, jointly developed by Plant 4507 and by Huazhong (Central China) University of Science and Technology as a key State Seventh 5-Year Plan priority project passed the production design finalization organized by MMEI at the end of the past year. This new disk drive, which has an average track-access time of 18 milliseconds, is an ideal external storage device for 286 and 386 microcomputers and for word processors. It was technically certified by MMEI in February 1991, after which Plant 4507 made certain improvements to its production technique and undertook trial small-batch production and testing. It fully meets domestic needs for 3.5-inch Winchester disk drives and can fully replace imported drives.

#### Nation's First Overlay-Type Provincial-Level Public Packet Switching Data Communications Network Completed in Jiangsu

92P60165A Beijing DIANXIN JISHU [TELECOMMUNICATIONS TECHNOLOGY] in Chinese No 2, Feb 92 p 48

[Untitled news brief by Liu Zhaofu [0491 3564 1381]]

[Summary] The first domestic overlay-type provincial-level public packet switching data communications network was completed in December 1991 in Jiangsu Province, and put into trial operation. The new Jiangsu network, which can handle a variety of information types including telephone, telex, and electronic mail, consists of a node unit, the network control center (located in Nanjing), and 12 concentrators. The star-coupled network links 11 cities under the jurisdiction of the provincial government, and can be interconnected to the national packet switching network now being built and to international packet switching nets. The new network is expected to be used by a variety of customers, including the press, banking and financial firms, ticket sales firms, weather forecasting units, rail and aerial transport businesses, and libraries and archives.

### Development of DSP, Applications in Communications Engineering

92P60153A Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA] in Chinese Vol 20 No 1, Jan 92 pp 67-73

[Article by Li Changli [2621 2490 4539] and Chen Xiqing [7115 1585 3237] of the Chinese Academy of Sciences (CAS) Institute of Acoustics, Beijing 100080: "Development of DSP, Its Applications in Communications Engineering"; MS received Jun 91, revised Sep 91]

[Excerpts]

#### Abstract

The features and functions of digital signal processing (DSP) chips and their development support—especially the TMS320-based series of development/high-speed processing boards and software designed by the CAS Institute of Acoustics—are introduced. Some examples of the use of DSP in communications engineering are also offered. [Passage omitted]

#### II. DSP Software and Hardware Development Technology

[Passage omitted] The CAS Institute of Acoustics was one of the first domestic research units to get involved with DSP technology. After comparing various models of DSP chips, the institute finally chose to build a product series based on the Texas [Instruments] TMS320 chip family. The institute has already put out several DSP development/high-speed processing systems, the latest of which is an advanced floating-point

signal processor (FPP) TMS320C30-A-based development/high-speed processing board with corresponding software. These tools have been used a number of times to develop scientific-research and industrial products with features such as abundant software/hardware design, integrated debugging, program solidification, and off-line operations.

The institute-designed development/high-speed processing systems have a modularized structure, with the hardware consisting of a variety of cards all designed to be inserted into the expansions slots of IBM PCs and their compatibles. Software according to function is divided into several software packages. The user according to his individual needs can combine the hardware and software into a functionally complete system, such as the one shown schematically in Figure 1.

These systems have the following kinds of functions:

#### (1) TMS320-Series Hardware and Software Development

Adding a TMS320 development/high-speed processing board with the appropriate software packages to an IBM PC or compatible permits the user to edit, assemble, link, do non-real-time and real-time simulation, and a variety of other tasks with his own independently designed programs. When developing hardware (the TMS320C25 and TMS320C30 permit the user to directly write programs in C), the user needs to use a

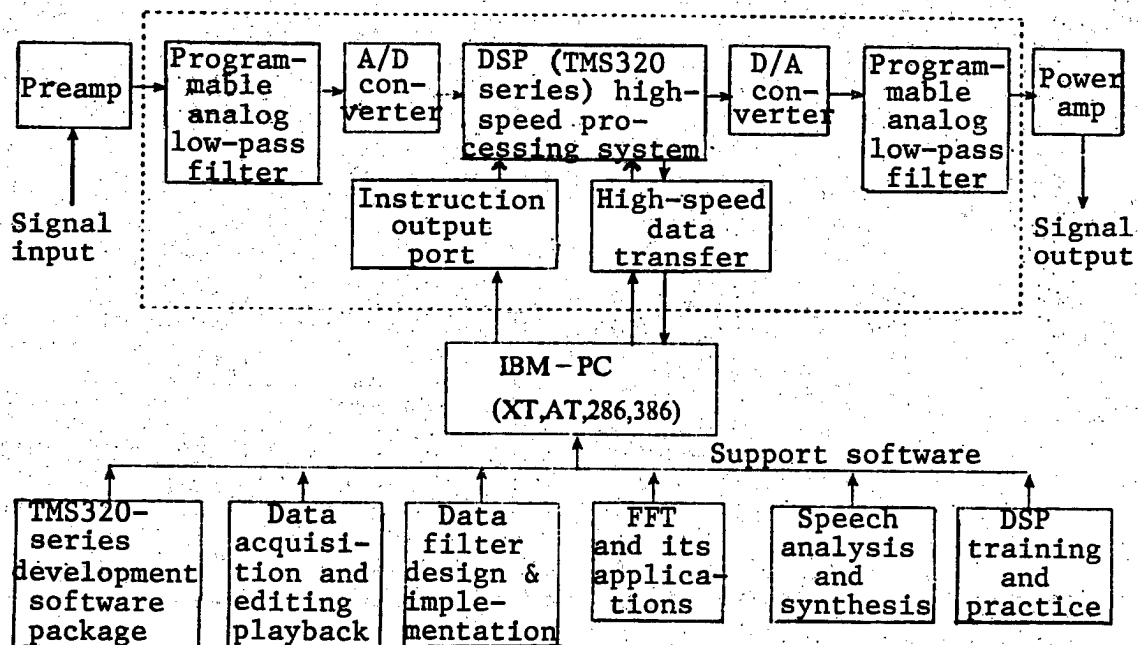


Figure 1. Structure of Master/Slave System Consisting of IBM PC and DSP Development/High-Speed Processing Board

short flat flexible cable to connect his system to the development board; with a double-line oscilloscope or logic analyzer, the user can employ his own debugging routines to inspect user system faults. The TMS320C25 and TMS320C30 master clock speeds are relatively high, and require the use of specially designed user system boards.

**(2) Sonic-Frequency or Ultrasonic-Frequency Data Acquisition**

All of the TMS320-based development/high-speed processing boards come with a 1-way or 2-way 12-bit A/D, D/A or 1-way 14-bit A/D, D/A converter, and therefore do not require special analog-digital converter boards; one can directly use them for data acquisition and playback. There are two modes of data acquisition: in the first, an interrupt subroutine is employed to permit real-time acquisition and processing; in the second, data files to be stored on the PC's hard disk or floppy disk are created.

**(3) PC Operating Speed Increase**

As is well known, in engineering areas such as digital communications and signal processing, there are a number of common operations such as convolution, filtering, the fast Fourier transform (FFT), the Hilbert transform, and matrix inversion—operations for which a

PC is too slow or not qualified. In our system, the PC and high-speed processing board can form a master-slave system, and the dual-port register permits machine-to-machine high-speed data transfer. This combination of the PC's flexibility with the DSP board's high-speed processing power increases system operating speed and data throughput potential.

**(4) Real-Time Simulation of Digital Communications Terminal Design and Algorithms**

Many types of communications terminal equipment, such as voice codecs [i.e., coders/decoders], modems, and encryption/decryption devices, can be designed with our system, with its abundant resources and hardware support; adding peripherals such as a telephone handset or a FAX machine permits real-time simulation of new designs. If resources and operating speed are insufficient, one can select a higher-grade development/high-speed processing board such as the TMS320C25-E model or the TMS320C30-A model. After software optimization is completed and the performance indicators satisfy the requirements, one can develop new formal prototypes which will shorten lead times and reduce costs.

DSP development/high-speed processing boards now manufactured by the Institute of Acoustics are indicated in Table 2. (Please note that each board comes with the appropriate development software package and applications software package.)

**Table 2. DSP Development/High-Speed Processing Boards Developed by CAS Institute of Acoustics**

Model	Processor	On-chip memory	External memory	Operating speed (one multiply-and-add operation)	A/D D/A word length and speed*
TMS32010B	TMS32010	144 x 16	prog. RAM4K x 16 expan. RAM32K x 16	400 ns	1-way A/D, 12-bit, 40 kHz 1-way D/A, 12-bit, 400 kHz
TMS32010C	TMS32010	144 x 16	prog. RAM4K x 16 expan. RAM32K x 16	400 ns	1-way A/D, 12-bit, 40 kHz or 125 kHz, input has 2.4.8.16 analog branch switch 1-way D/A, 12-bit, 400 kHz
TMS320C25A	TMS320C25	544 x 16	prog. RAM16K x 16 data RAM32K x 16	100 ns	1-way A/D, 12-bit, 40 kHz or 125 kHz 1-way D/A, 12-bit, 400 kHz
TMS320C25D	TMS320C25	544 x 16	prog. RAM16K x 16 data RAM32K x 16 expandable prog. EPROM16K x 16 prog. RAM16K x 16 data RAM32K x 16	100 ns	2-way A/D, 12-bit, 40 kHz or 125 kHz 1-way D/A, 12-bit, 400 kHz
TMS320C25E	TMS320C25	544 x 16	prog. RAM64K x 16 data RAM64K x 16 dual-port RAM2K x 16	100 ns	1-way A/D, D/A, 14-bit, 19.2 kHz, with programmable I/O analog filter
TMS320C30A	TMS320C30	2K x 32 instruction buffer memory 64 x 32	RAM128K x 32 dual-port RAM4K x 16 expandable dynamic RAM 4M x 32	60 ns (floating-point)	1-way A/D, D/A, 14-bit, 19.2 kHz, with programmable I/O analog filter. Can be expanded to 2-way A/D, 16-bit, 200 kHz, and 2-way D/A, 16-bit, 200 kHz, with 2-way programmable I/O analog filter, each way A/D has 2.4.8.16 analog branch switch

\*Note: A/D, D/A sampling rates are all programmable; table shows maximum sampling rate.



**III. Examples of DSP Applied to Communications Engineering**

**1. Applications in Voice Codec Technology**

Voice codec technology such as 32 kbps adaptive differential pulse code modulation (ADPCM CCITTG721), 16 kbps sub-band coding, 9.6 kbps multiple-pulse-excitation linear predictive coding (MPLPC), 4.8 kbps code excitation linear predictive coding (CELPC), and 2.4 kbps linear predictive coding (LPC), is commonly used in the transmission and storage of voice signals. The TMS320C25 (or TMS320C30) model's operating speed and internal resources are fully capable of satisfying any needs in this area. Figure 2 shows a voice codec system consisting of the TMS320C25 DSP

chip, a TLC32044CAIC and external programs and data registers. The TLC32044C, an audio-frequency circuit interface chip, includes a 14-bit A/D and D/A programmable I/O analog filter, gain control, and other components.

In a number of vocoder designs, 9.6 kbps MPLPC is a quite effective technique. We have used a TMS32020 chip to construct a real-time system of this type; the principle and algorithms are detailed in reference 12, while all the program module execution times are given in Table 3. If one uses a TMS320C25, then the execution times are only half those shown in the table. Experimental results show that the synthetic speech quality is quite satisfying.

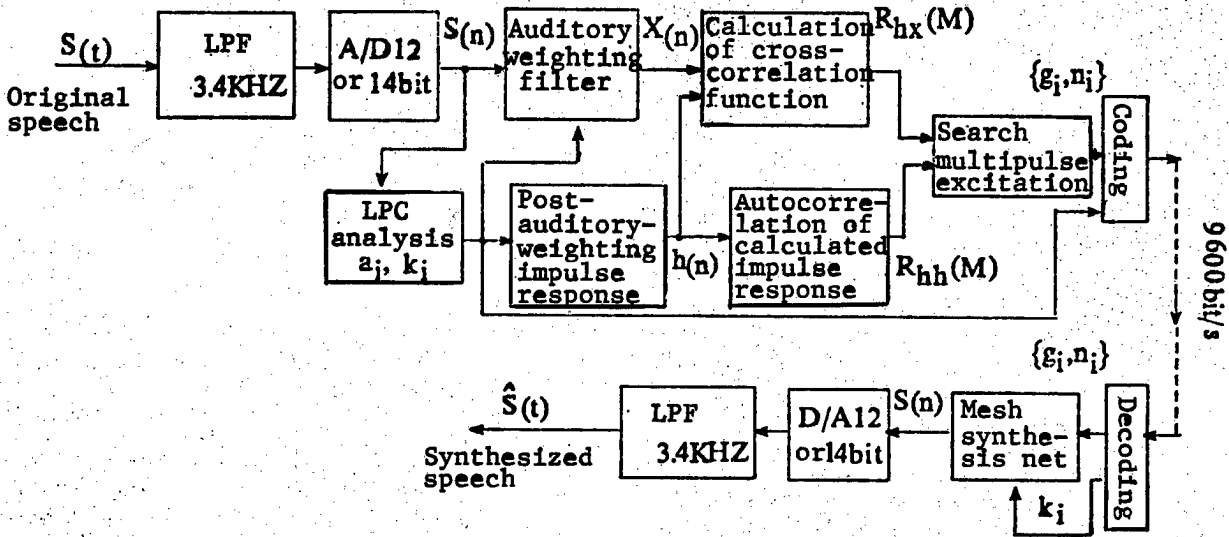


Figure 2 (a). Schematic of MPLPC Speech Coding/Decoding Principle (LPF = low-pass filter)

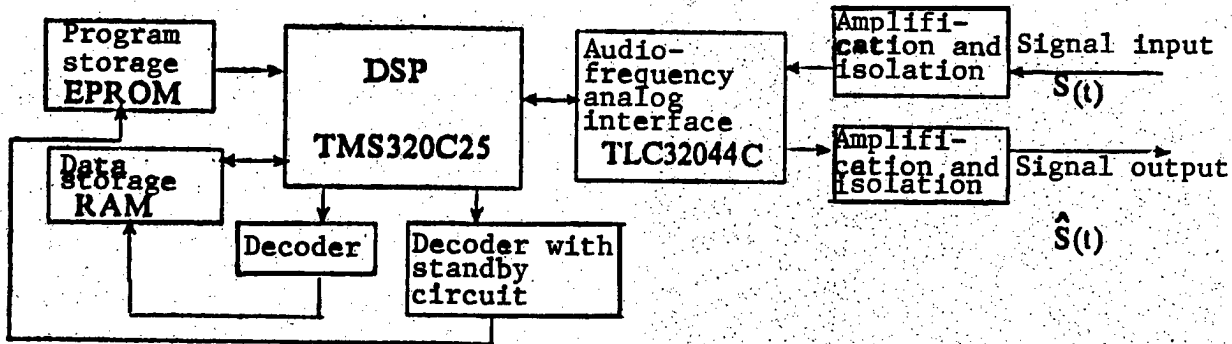


Figure 2 (b). DSP System Implemented With Voice Codec

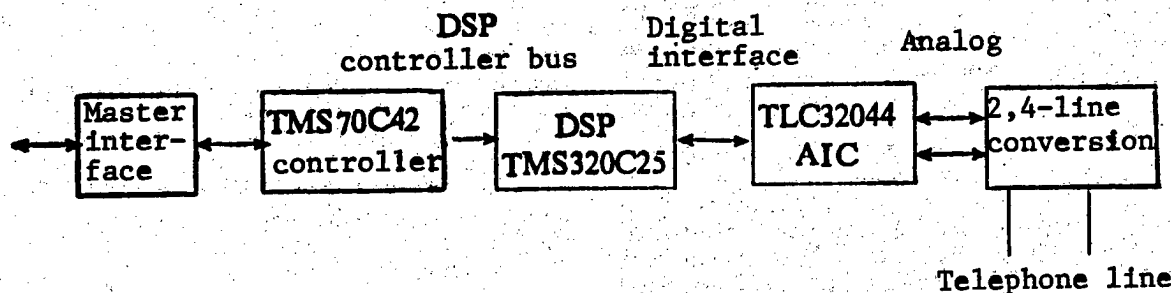


Figure 3. Modem Built Around a DSP Chip (AIC = audio-frequency circuit interface chip)

Table 3. Required Time for Each Frame To Execute MPLPC Operation

LPC analysis	1.5 ms
Calculate $h(n)$ , $R_{hh}(M)$ , $R_{hx}(M)$	3.3 ms
Determine multipulse-excitation amplitude and position	8.3 ms
I/O and synthesis	4.6 ms
Coding and decoding	2.0 ms
Total	19.7 ms

## 2. Applications in Modems

In modems, DSP is used for modulation/demodulation, adaptive equalization, echo canceling, and similar tasks. The TMS320C25 has a very large amount of storage space and abundant internal resources, and can therefore support a number of standard algorithms, such as Bell103, Bell212A, V.22, V.29, V.32, and V.33, as well as several specialized algorithms. The modem shown in Figure 3 consists of a controller, DSP chip, and audio-frequency analog interface, among other components.

In the classical modem, synchronization and timing are achieved via phase detectors, loop filters, voltage controlled oscillators, and similar components, all of which form a phase-locked loop (PLL) circuit. In the DSP chip (a TMS320C25 or TMS320C30), there are clock circuits programmable with a high degree of precision; the TLC32044C audio-frequency interface circuit also has a 14-bit A/D and D/A converter that has a speed fine-tunable via a program. Therefore, in the modems designed around the aforementioned DSP chips and other components, all operations including timing and synchronization can be completely implemented via software. A 2,400 bps modem can be built around one TMS32010 chip with the appropriate support circuitry. A 2,400-9,600 bps model can be built around one TMS320C25 chip with corresponding support devices.<sup>11</sup>

Use of DSP techniques to implement high-speed data transfer via short-wave radio channels (HF modem) is one of the hottest topics in digital communications now being studied. Because short-wave radio channels are

susceptible to time dispersion, frequency dispersion, additive Gaussian noise, and other factors, there are many obstacles to be overcome in the design and implementation of an HF modem. Two methods, detailed below, are currently receiving the most attention.

### (1) Frequency Domain Technique

This method, also called multitone concurrency, calls for the simultaneous emission of many long narrow-band orthogonal tones, with each tone having a time duration equal to several times the length of the channel pulse response. Since the multitone concurrency technique permits accurate gating of the received waveform, intermark interference is suppressed. The multitone concurrency technique has produced excellent results in overcoming problems such as multipath effects and frequency expansion. In terms of implementation, there are a variety of different schemes, all employing DSP chips. In the Harris (U.S.) Company's RF-3466 multitone parallel modem, which includes two TMS32010 DSP chips (one for FFTs and one for Hilbert transforms), data transfer is effected with the help of an Intel 80186 microprocessor to provide control and supervision. In China, there are a number of organizations working on this technology, and the majority employ this same method; some systems use two TMS32010 chips, while others use two TMS32020 chips.<sup>9</sup> Since multiprocessor-based systems are structurally complex, notoriously difficult to program, lacking in universality, and suffer from other drawbacks, we have chosen to concentrate on systems built around a single TMS320C25 (or TMS320C50) chip and a TLC32044C; with these devices we can implement a high-performance compact parallel HF modem.

### (2) Time Domain Technique

In this method, time domain equalization is applied to suppress intermark interference and frequency crossfire. Since the first theoretical elaboration in the early seventies by M. M. Goutmann and G. D. Forney in which HF channels were shown to be feasible for single-tone serial high-speed data transmission, many researchers have explored techniques to implement this method; for example, in 1974 Godard creatively applied Kalman

filter theory to short-wave channel adaptive equalization and thus shone new light onto the task of implementing high-speed data transmission over short-wave channels. At present, a number of experimental systems, prototypes, and even a few commercialized products have been developed abroad; their performance is better than that of the multipath concurrency system.<sup>10</sup>

The serial HF modem has not yet been commercialized here in China, although a number of types are now in the development process. The U.S. GTE Company's 2,400-baud serial prototype uses a Kalman equalization algorithm. [passage omitted]

The TMS320C30's operating power and flexibility are higher than those of the special-purpose processor used in the GTE serial HF modem. The TMS320C30's resources include an FPP, on-chip DMA controller, two-way timing circuit, and a two-way serial transmit-and-receive interface. Therefore, a system built around one or two TMS320C30 chips and a TLC32044C with the appropriate external circuitry can be used in real time to implement the modulation and demodulation functions, Kalman adaptive equalization, and error-correcting code functions of an HF modem. Research on these areas is now being conducted at the CAS Institute of Acoustics.

[Passage omitted]

#### References

1. Texas Instruments, "First-Generation TMS320 User's Guide."
2. Texas Instruments, "Second-Generation TMS320 User's Guide."
3. Texas Instruments, "Third-Generation TMS320 User's Guide."
4. Analog Devices, "DSP Products Databook," 1989.
5. AT&T, "WE DSP16 Digital Signal Processor."
6. AT&T, "WE DSP32C Digital Signal Processor."
7. Motorola, "DSP56000/DSP56001 Digital Signal Processor User's Manual."
8. Texas Instruments, "Digital Signal Processing Applications With the TMS320 Family."
9. Li Changli, Mo Fuyuan, et al., "TMS32020/TMS320C25 Multifunctional High-Speed Processing System," Proceedings of the Third National Conference on Signal Processing, 1988, p 962, Xian.
10. Wu Jiaming, "A Study of High-Speed Serial HF Modem Design, Channel Experimentation, and Implementation," Master's Thesis, CAS Institute of Acoustics, May 1989.
11. Ji Xiaodong, "Special-Purpose Modem Research and TMS320 Implementation," Master's Thesis, Beijing Institute of Posts and Telecommunications, September 1989.
12. Cui Chenglin, "Research on Implementation of 9600 bps Multiple-Pulse-Excitation Linear Predictive Voice Coding," Master's Thesis, CAS Institute of Acoustics.
13. Huang Huaixin, "Use of a TMS32010 To Implement an HF Modem," Proceedings of the Third National Conference on Signal Processing, November 1988, pp 895-898.

### New Application of Six-Port Technique for Measurement of Target RCS

92FE0346A Beijing DIANZI KEXUE XUEKAN  
[JOURNAL OF ELECTRONICS] in Chinese  
Vol 13 No 6, Nov 91 pp 640-643

[Article by Sun Jia [1327 4471] of the University of Electronic Science and Technology, Chengdu: "New Application of Six-Port Technique for Measurement of Target Radar Cross Section"; MS received 7 Apr 90, revised 13 Sep 90]

#### [Text] Abstract

In this article, a new method of measuring target radar cross section (RCS) using the six-port technique in a conventional laboratory is presented, and a new error correction model is given. The experimental results of RCS measurement using a six-port reflectometer are also presented.

#### 1. Introduction

The measurement of target radar cross section (RCS) is an important problem in the application of electromagnetic theory and electromagnetic engineering. To achieve accurate RCS measurement, unwanted signals in the measured data must be eliminated. The traditional method of eliminating unwanted signals is to measure target RCS in a microwave anechoic chamber where background electric disturbances are strictly controlled. However, because of the high cost of constructing a microwave anechoic chamber, it is impractical for every research organization to have access to an anechoic chamber for RCS studies. Therefore, development of a technique for eliminating background electric disturbances without using an anechoic chamber is of both theoretical and practical importance in conducting frequency-scan studies of RCS. In this article, the application of the newly developed six-port technique for measuring target RCS without using an anechoic chamber is discussed. The six-port technique has proven to be a powerful method in microwave network analysis, and has been widely used in microwave measurement and microwave engineering. In this article, the feasibility of using a six-port technique for RCS measurement is demonstrated by theoretical analysis; the construction of a measurement system using the six-port reflectometer is

also discussed. By using computer software and the vector analysis capability of the six-port technique, it is possible to eliminate the effect of background electric disturbances in making measurements outside the anechoic chamber. In addition, a new error correction model is proposed from which correction formulas for RCS measurement using the six-port measurement system can be derived.

#### 2. New Method of RCS Measurement Using the Six-Port Technique

The RCS of a target can be derived from the radar equation:

$$\sigma = \frac{(4\pi)^3 R_1^2 R_2^2 P_r L_p}{G_t G_r P_0 \lambda^2} \quad (1)$$

where  $P_0$  is the output power of the transmitting antenna,  $P_r$  is the received power of the target return,  $G_t$  and  $G_r$  are respectively the transmitting and receiving antenna gain in the target direction,  $R_1$  and  $R_2$  are respectively the distances between the target and the transmitting and receiving antennas, and  $L_p$  is the polarization mismatch coefficient. From equation (1) it is easy to derive various methods of measuring RCS. Examples of these methods include the standing-wave-ratio method, the spatial separation method, the continuous-wave method, the frequency-modulation method, the Doppler shift method and the frequency-scan network analyzer method. The system circuit diagram for RCS measurement using the six-port technique is shown in Figure 1. Instead of using the traditional vector network analyzer as the receiver, this system uses a high-performance, low-cost single six-port reflectometer. This design makes it possible to achieve high measurement accuracy and good measurement function with a simple and inexpensive system. The allocation of signals of the two channels is accomplished using a highly directional 10-dB directional coupler. The frequency-scan signal generator is the HP8350B unit built by the Hewlett-Packard Company. All the waveguide elements in the system are commercial products made in this country. The frequency-scan six-port reflectometer is described in detail in Reference 1; the control system is the Great Wall 0520CH microcomputer.

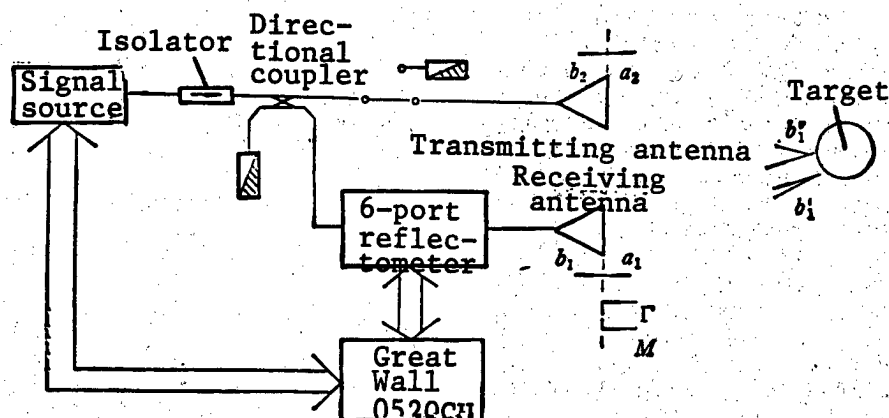


Figure 1. Circuit Diagram of the Six-Port Reflectometer RCS Measurement System

In Figure 1,  $a_2$  is the output voltage wave of the transmitting antenna;  $a_1$  is the output voltage wave of the receiving antenna;  $b_1$  is the input voltage wave of the receiving antenna;  $b_1'$  is the scattered voltage wave of  $a_1$  from the target to the receiving antenna; and  $b_1''$  is the scattered voltage wave of  $a_2$  from the target to the receiving antenna. The main function of the six-port reflectometer is to measure the composite reflection coefficient.<sup>2</sup> Thus,

$$\Gamma = (b_1/a_1)|_{a_2=0} = b_1'/a_1 \quad (2)$$

$$M = b_1/a_1 = (b_1' + b_1'')/a_1 \quad (3)$$

where  $\Gamma$  is the reflection coefficient measured by the six-port reflectometer for a passive transmitting antenna;  $M$  is the measured reflection coefficient for an active transmitting antenna. As an approximation, the reflection of  $a_2$  by the receiving antenna and the higher-order reflections between the target and the antenna and between the background and the antenna can all be neglected.

From equation (1), we obtain:

$$\sigma = k |b_1''/a_2|^2 = k |b_1'/a_1|^2 \quad (4)$$

where  $k = (4\pi)^3 R^4 L_p / (G_r G_t \lambda^2)$ . Since the receiving antenna and the transmitting antenna are in proximity to each other, one can make the approximation  $b_1'' \approx b_1'$ .

From equation (2) and equation (3), we have:

$$\begin{aligned} |M - \Gamma| &= |b_1''/a_1| = |a_2/a_1| |b_1'/a_2| \\ &= |a_2/a_1| \sqrt{\sigma/k} \end{aligned} \quad (5)$$

Because the microwave hardware of the measurement system is fixed, the power distribution between the transmitting branch and the receiving branch for a specific frequency is a constant, i.e.,

$$|a_2/a_1| = \sqrt{c}$$

Then, the target RCS can be expressed as

$$\sigma = (k/c) |M - \Gamma|^2 \quad (6)$$

Equation (6) shows that the target scattering cross section is a function of the active reflection  $M$  and the passive reflection coefficient  $\Gamma$ . Therefore, as long as the constant  $k/c$  of the measurement system can be calibrated, it is possible to determine the target cross section by measuring the active and passive reflection coefficients  $M$  and  $\Gamma$ .

To perform frequency-scan measurement of target RCS outside an anechoic chamber, one must address the problem of background cancellation. In order to fully utilize the vector analysis capability of the six-port reflectometer and the processing function of the computer software, it is necessary first to calibrate the scattering cross section of the environment (which includes the power leakage between the transmitting antenna and the receiving antenna, the indoor background scattering, and scattering of the supporting structure). To accomplish this, a new error correction model for target RCS measurement using the six-port technique is proposed. Its signal flow diagram is shown in Figure 2, where  $E_x$  is the isolation error component,  $E_t$  is the reference-target tracking error component, and  $E_{s1}$  and  $E_{s2}$  are the mismatch error components between the antenna feeds.  $E_x$  is used to correct the indoor background disturbances and the signal cross-talk between the antennas.  $E_t$  is specified according to the characteristics of the reference target. For simplicity,  $E_{s1}$  and  $E_{s2}$

are assumed to be zero. Based on the correction model described above, the author has developed a system calibration and measurement software package for target RCS analysis. The basic procedure is as follows:

(1) Calibrate the frequency-scan six-port reflectometer system using the method of Reference 1;

(2) In a conventional laboratory environment, remove the target (but keep the support structure) and measure the active and passive reflection coefficients  $M_x$  and  $\Gamma_x$  to determine the isolation error component  $E_x$ ;

(3) Measure the active and passive reflection coefficients  $M_0$  and  $\Gamma_0$  of a standard target with known RCS  $\sigma_0$  (such as a metal sphere or metal plate) to determine the target tracking error component  $E_t$ ;

$$k/c = \sigma_0 / (M_0 - \Gamma_0) - (M_x - \Gamma_x)^2 \quad (7)$$

(4) Measure the active and passive reflection coefficients  $M$  and  $\Gamma$  of the test target and solve for RCS with the following equation:

$$\sigma = (k/c) (M - \Gamma) - (M_x - \Gamma_x)^2 \quad (8)$$

### 3. Experimental Results

An experiment has been conducted using an RCS measurement system based on the frequency-scan six-port reflectometer shown in Figure 1. The test range is chosen

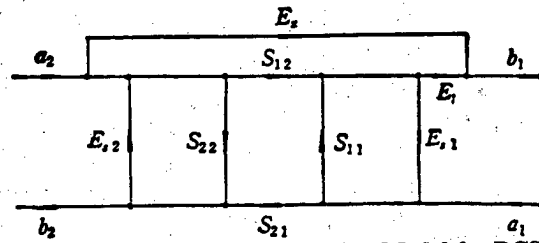


Figure 2. A New Error Correction Model for RCS Measurement

to be  $R = 3.8$  m, which is determined by the minimum test range of the antenna and the constraint imposed by the total laboratory area. The target is suspended with a nylon cord. The standard target used for calibration is a square metal plate. Because of bandwidth limitation of the horn antenna, the experiment is conducted in the range 9-10 GHz. The test objects consist of two metal plates ( $15 \times 15 \text{ cm}^2$  and  $20 \times 20 \text{ cm}^2$  in size). The test results are shown in Table 1, where the measured data are compared with theoretical calculations; the maximum deviation between the two is shown to be  $\Delta\sigma = 0.5$  dBsm. Since the background scattering cross section is already quite large (similar to  $-20$  dBsm), these test results have demonstrated the feasibility of measuring the target RCS using the six-port technique outside an anechoic chamber. The results have also demonstrated the validity of the error correction model proposed in this paper and the effectiveness of this measurement system in eliminating background electrical disturbances.

Table 1. Measured Results of Target RCS Using the Six-Port Reflectometer

Frequency (GHz)	Metal plate I (dBsm)			Metal plate II (dBsm)		
	Calculated value	Measured value	Deviation	Calculated value	Measured value	Deviation
9.0	7.58	7.55	.03	12.58	12.82	-.24
9.2	7.77	7.48	.29	12.77	13.18	-.41
9.4	7.96	7.94	.02	12.96	12.48	.48
9.6	8.14	7.85	.29	13.24	13.04	.10
9.8	8.32	8.01	.31	13.32	13.74	-.42
10.0	8.50	8.38	.12	13.50	13.25	.25

The primary causes for introducing errors in the test results are: (1) the background scattering cross section  $\sigma_b$  is too large; (2) the output power of the frequency-scan signal source fluctuates with time; (3) the laboratory is too narrow, which limits the test range  $R$ ; and (4) the test results are affected by the propagation of measurement errors of the six-port reflectometer.

### 4. Conclusion

The application of six-port technique for frequency-scan measurement of target RCS is a new method which can

be used in a conventional laboratory environment. This new method has many advantages such as high measurement accuracy, high processing speed, high degree of automation, and ease of operation.

### References

1. Sun Jia, "Theory of Six-Port Technique and Its Application in Stealth and Counter-Stealth Technology," Doctoral Thesis, University of Electronic Science and Technology, September 1989.
2. S. H. Li, R. G. Bosisio, IEEE TRANS. ON MTT, MTT-30 (1982), pp 1085-1090.

**128 x 128-Pixel Platinum Silicide IR Focal Plane Array Detector Certified**

92P60181A Beijing ZHONGGUO DIANZI BAO  
[CHINA ELECTRONICS NEWS] in Chinese  
31 Jan 92 p 3

[Article by Yu Ruming [0151 3067 2494]: "High-Pixel-Count Platinum Silicide Infrared Focal Plane Research Victory Reported"]

[Summary] A 16,384-pixel (128 x 128) platinum silicide (PtSi) infrared (IR) focal-plane-array (FPA) detector chip developed by MMEI's Research Institute 44 passed the technical appraisal assigned by the State S&T Commission and organized by the CHINATRON Corporation on 20 January. Technical experts from the State S&T Commission, CAS, NDSTIC, Ministry of Aerospace Industry, and other organizations appraised the device—the largest-scale PtSi Schottky barrier IR FPA yet made domestically—as meeting 1980's advanced international standards in terms of sensitivity, resolution, spectral response range, and transfer efficiency. This kind of detector, which operates at room temperature, has been developed by only a few advanced nations, who have guarded the technology through rigid export restrictions. Institute 44 researchers used domestically made equipment in developing this detector—as well as the previous-generation 64 x 64-element version—and have taken the initial steps toward commercialization of the product. They have also made some gratifying breakthroughs in development of 256 x 256-pixel IR FPA detectors. These devices have applications in national defense, IR night vision, satellite-borne remote sensing, security, resources exploration, transportation monitoring, medical diagnosis, and industrial measurement.

**440,000-Pixel CCD Camera Developed**

92P60181E Beijing ZHONGGUO DIANZI BAO  
[CHINA ELECTRONICS NEWS] in Chinese  
24 Feb 92 p 1

[Article by Sheng Tao [4141 3447]: "Major Advance in Charge-Coupled Image Pickup Device Development: MMEI Institute 44's 440,000-Pixel CCD Camera Puts Out Clear Images"]

[Summary] On 15 January, this reporter learned from officials of MMEI's Institute 44, located in Sichuan's Yongchuan County, that the institute has developed the nation's highest-pixel-count charge-coupled-device (CCD) camera: a 440,000-pixel CCD camera that has put out clear images in the laboratory. This advance, a

major step forward in CCD camera development, represents mid-to-late-eighties internationally leading technology, with applications in telemetry and remote sensing, reconnaissance, missile guidance, facsimile transmission, and industrial monitoring. The institute researchers painstakingly worked out the design and development on a domestically made 3-micron-technology CCD fabrication line that does not include one piece of imported equipment.

**Sino-U.S. Joint Venture To Produce, Develop Nonlinear Optical Crystals**

92P60181B Beijing ZHONGGUO KEXUE BAO  
[CHINESE SCIENCE NEWS] in Chinese  
31 Jan 92 p 1

[Article by Yang Zhaoliang [2799 6856 5328] and Li Cunfu [2621 1317 1381]: "China Puts Up Technology, U.S. Puts Up Funds: Kefeng Laser Company Established in Fujian Province"]

[Summary] Fuzhou (ZHONGGUO KEXUE BAO wire report)—A Sino-U.S. joint venture to produce and develop nonlinear optical crystals—Fuzhou Kefeng [4430 7685] Lasers Ltd.—was formally established on 18 January in Fuzhou. In the new joint venture, the CAS Fujian Institute of Material Structure's Crystal Technology Development Company is a technology shareholder; while the U.S. (Hong Kong) firm Fenghuang ("Phoenix") Laser Systems Ltd. and the Hong Kong firm Hua Min [5478 7044] (Group) Ltd. are each investing U.S.\$5 million to provide capital. State Councillor & State S&T Commissioner Song Jian, CAS President Zhou Guangming, and U.S. Commerce Secretary Robert A. Mosbacher sent their congratulations on the founding of the joint venture. With Chinese expertise in nonlinear optical crystals as the backbone, Kefeng Lasers Ltd. will engage in the development, production, and international marketing of a variety of nonlinear optical crystals, including the BBO and LBO types.

**DZR-III Centimeter-Class Satellite Laser Range Finder Developed**

92P60181C Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 21 Feb 92 p 2

[Untitled photoreport, photo by Pan Shengli]

[Summary] The State Seismological Bureau's Seismological Research Institute and the CAS Survey and Geophysics Institute have jointly developed the DZR-III centimeter-class artificial satellite laser range finding system, a state-of-the-art system installed in China's "Wuhan Artificial Satellite Laser Range Finding Observation Station."



The photograph shows Research Fellow Xia Zhizhong (at left) and two assistants examining the DZR-III.

**TEA CO<sub>2</sub> Laser Range Finder, Military Laser Alarm Certified**

92P60181D Beijing ZHONGGUO DIANZI BAO  
[CHINA ELECTRONICS NEWS] in Chinese  
21 Feb 92 p 3

[Article by Li Lanyu [2621 5695 1342]: "Two Institute 27 Achievements Pass Appraisal"]

[Summary] Two high-tech achievements of MMEI's Research Institute 27—a TEA [transversely excited atmospheric] CO<sub>2</sub> laser range finder and a military laser alarm—recently passed expert appraisal. The experts unanimously agreed that the former has an atmosphere-optimized wavelength, strong penetrating power, and high accuracy, and that its overall technical indicators match those of mid-eighties international instruments. The military laser alarm, which is highly resistant to electromagnetic interference, has an alarm range exceeding 20 kilometers, and in terms of monitoring

radius, false alarm rate, and reliability has reached the leading position domestically.

**Research on Characteristics of Er-Doped Superfluorescence Fiber Laser**

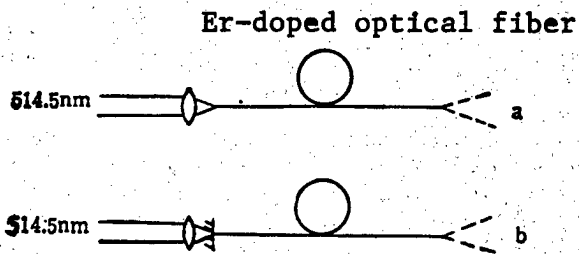
92P60161A Beijing KEXUE TONGBAO in Chinese  
Vol 37 No 3, 1-15 Feb 92 pp 275-277

[Article by Chen Yihong [7115 0001 4540], Cheng Ruihua [4453 3843 5478], Shen Hongwei [3088 4767 5898], and Gan Fuxi [1626 4395 3588] of the CAS Shanghai Institute of Optics and Fine Mechanics (SIOFM), Shanghai 201800: "Study of Characteristics of Erbium-Doped Silica Fiber Superfluorescence"; MS received 12 Mar 91, revised 12 Jun 91]

[Summary] The superfluorescent optical fiber, which operates on the principle of amplified spontaneous emission, has proven interesting because of its applications in fiber optic sensors, especially the fiber optic gyro and several signal-processing fiber optic systems.<sup>3,4,5</sup> The authors have studied the characteristics (generation and spectral change processes) of a superfluorescence fiber laser (SFL) consisting of a domestically made Er-doped



fiber and a 514.5-nm-wavelength Ar-ion pump laser in both single-pass and double-pass configurations (see Figure 1). Experimentally obtained values of maximum output power for the single-pass and double-pass SFL configurations were 0.28 mW (for a pump absorption power  $W_p = 290$  mW) and 3.2 mW (for  $W_p = 240$  mW), respectively—values which exceed those reported in references 6 and 7 for a similar arrangement.



**Figure 1. SFL Configurations. a: Single pass, b: Double-pass**

#### References

1. Digonnet, M. J. F., Liu, K., *J. LIGHTWAVE TECHNOL.*, 7 (1989), 1009-1015.
2. Duling, I. N., Burns, W. K., et al., *OPT. LETT.*, 15 (1990), 33-35.
3. Bergh, R. A., et al., *OPT. LETT.*, 7 (1982), 563-566.
4. Fesler, K. A., Kalman, R. F., et al., *PROC. SPIE*, 1171 (1990), 346-352.
5. Maslehi, B., et al., *PROC. IEEE*, 72 (1984), 909-914.
6. Wysocki, P. F., et al., *PROC. SPIE*, 1171 (1990), 261-270.
7. Desurvire, E., Simpson, J. R., *J. LIGHTWAVE TECHNOL.*, 7 (1989), 835-845.
8. Desurvire, E., et al., *TECHNICAL DIGEST OFC'91*, San Diego, USA, 1991, 176-180.
9. Auge, J. C., Fevrier, H. A., et al., *PROC. SPIE*, 1171 (1990), 130-136.
10. Zyskind, J. L., Simpson, J. R., et al., *PROC. SPIE*, 1171 (1990), 137-145.

**GaAs MMICs, Other Devices Developed by Institute 55 Certified**

92P60182A Beijing ZHONGGUO DIANZI BAO  
[CHINA ELECTRONICS NEWS] in Chinese  
14 Feb 92 p 3

[Article by Wang Lieqiang [3769 3525 1730] and Song Yuping [1345 3768 1627]: "Institute 55's Scientific Research Level Advances Into New Realms"]

[Summary] Fifty-six scientific research achievements of MMEI's Institute 55 in the area of microwave semiconductors—including 20 judged to meet mid-to-late-eighties international standards—recently passed formal technical appraisal. In the area of power devices, the major advances include development of a GaAs power field-effect oscillator in a microstrip fully encapsulated housing containing five 2-mm-gate-width FET single cells; at a 3 GHz frequency, this device has an oscillating output power of 2.5-3.34 W and represents the first domestic implementation of a GaAs power device with an oscillating output power of over 2 W. Also, on a 3-inch Si fabrication line, the institute has developed the first domestic L-band pulsed power transistor, which has a yield of over 50 percent and an output power of over 55 W for a matched group of 10 single cells.

In the area of microwave device reliability, six product varieties—including a Si mixer, step device [step recovery diode], PIN device, GaAs mixer, low-noise FET, and a power FET—all passed a six-level inspection. Three microwave diodes, tested for a long period of time, not only performed well but also had an actually measured failure rate that exceeded level six. A 6 GHz low-noise TiPtAu Schottky barrier GaAs FET has demonstrated a burnout resistance superior to that of the Japanese-made NE67383 device. An analysis of data from life tests shows that its failure rate is lower than  $10^{-9}$ /hour.

In the area of GaAs monolithic microwave integrated circuits (MMICs), notable advances include development of an X-band power amp MMIC with an output power of 770 mW at 7 GHz and a 1 dB bandwidth of 600 MHz. Also, a MMIC VCO [voltage-controlled oscillator] has shown a power of 15 dBm in the 7.3-10.7 GHz frequency range and 13 dBm in the 11.3-13 GHz range.

Finally, notable advances in the area of millimeter-wave devices include the first domestic development of a 3-mm CW avalanche diode with an output power of 80-120 mW in the 75-100 GHz range and a peak output power of 170 mW right at 78 GHz; a 3-mm pulsed avalanche diode with a 75-97 GHz output pulsed power of 4-5 W, a pulse width of 40-80 ns, a repetition rate of 10-50 kHz, and a maximum output power of 6.2 W at 87.8 GHz; and an 8-mm dielectric frequency-stabilized microstrip Gunn oscillator with an output power of 170 mW and a frequency stabilization of 9.7 ppm/degree—performance indicators equivalent to those of the comparable product introduced in 1990 by the U.S. firm MA/COM.

**26 Achievements of Institute 44 Pass Appraisal**

92P60182B Beijing ZHONGGUO DIANZI BAO  
[CHINA ELECTRONICS NEWS] in Chinese  
21 Feb 92 p 3

[Article by Yu Ruming [0151 3067 2494]: "26 Achievements of Institute 44 Pass Appraisal"]

[Summary] Twenty-six optoelectronics-related achievements of MMEI's Research Institute 44 have passed formal appraisal. The experts from the State S&T Commission, NDSTIC, CAS, Ministry of Aerospace Industry, MMEI, and the CHINATRON Corporation noted that the development of these 26 devices has boosted the nation's optoelectronics technology to a new level.

Of the 26 achievements, the majority involve military/civilian dual-use products, such as a 3-5-micron 512-bit IR detector used in outer-space detection, night-vision IR imaging, and medical treatment and health; a 2 x 455-bit single-phase high-speed CCD delay line used in radar, communications, IR imaging, sonar, and electronic countermeasures; a secure, jam-resistant, low-power-consumption radar signal-transmission analog optical terminal, the first domestic radar terminal to achieve high-quality transmission and long-range (30 times that of the usual video cable transmission) radar echo reception; and several long-range/high-capacity optical-communications-oriented and special-purpose optical transmitters and optical detectors, such as a 0.8-micron-wavelength GaAs laser diode and a high-power pulsed GaAs laser diode as well as two other kinds of GaAs laser diodes, two 1.3-micron edge-emitting LEDs, and six photodiodes. A 384 x 491-bit, 600 x 500-bit, and one other large-surface-array CCD and camera demonstrated high resolution, a large dynamic range, high sensitivity, compactness, and high image clarity, and can be used in space remote sensing, astronomy, and communications, as a number of other fields. The appearance of these devices contributes not only to the military engineering modernization effort and to the development of new-generation strategic and tactical weapons, but also to the advancement of the civilian economy.

**Qinghua Develops Room-Temperature Chip Thin-Film Deposition Equipment**

92P60182C Beijing ZHONGGUO DIANZI BAO  
[CHINA ELECTRONICS NEWS] in Chinese  
2 Mar 92 p 3

[Article by Shu Guang [2562 0342]: "Qinghua Develops Chip Room-Temperature Thin-Film Deposition Equipment; Smashes Embargo, Fills Domestic Void"]

[Summary] On 24 February this year, in a laboratory of the Beijing State Optoelectronics Technology Center (SOTC), a panel of some 10 experts summoned by the State Education Commission appraised the microwave electron cyclotron resonance (ECR) plasma chemical

vapor deposition (CVD) equipment developed by Qinghua University's Department of Electronic Engineering. According to a Qinghua University research fellow who spoke for the department, the new microwave ECR plasma CVD equipment is designed for deposition of a variety of thin films such as silicon nitride, silicon oxide, and diamond-like films and for operation at room temperature.

The SOTC director commented that, since this equipment was export-restricted by foreign nations, the task of domestically developing it was undertaken in 1988 by three Qinghua University scientists and was eventually

included among the State "863" Plan priority research projects. After over 2 years of effort, they finally developed this mid-to-late-eighties-level high-tech product, thus breaking the foreign embargo. It is understood that this piece of equipment has now reached a utilitarian stage, after 6 months of trial operation and testing of high-quality batches of thin films. The appraisal experts concluded that the equipment's principal performance indicators meet the design requirements, and that its development will provide an important boost to the nation's R&D in the materials science, microelectronics, and optoelectronics areas.

**Beijing Institute Develops Bi-Based Low-Temperature-Superconducting Tape**

92P60183A Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 24 Feb 92 p 1

[Article by Ao Hong [2407 1347]: "New Advance in Superconductivity Research at Beijing General Institute of Nonferrous Metals"]

[Summary] A Beijing General Institute of Nonferrous Metals research group led by Senior Engineer Zhou Yiru [0719 6318 5423] recently developed a Bi-based 2223 superconducting tape which exhibits the following performance as measured by tests jointly conducted at the State Superconductivity Center and the CAS Institute of Physics: at liquid-helium temperature (4.2K), the material's zero-magnetic-field current density is  $1.2 \times 10^5$  A/cm<sup>2</sup> without loss of superconductivity; with a magnetic field perpendicular to the current and parallel to the tape plane, the current density remains at  $1.2 \times 10^5$  A/cm<sup>2</sup> without loss of superconductivity for a 1-tesla field and drops to  $6.3 \times 10^4$  A/cm<sup>2</sup> for a 7-tesla field. For a 5-tesla magnetic field perpendicular to the current and perpendicular to the tape plane, the current density is  $4.1 \times 10^4$  A/cm<sup>2</sup>. This is the highest measured value attained domestically to date, and is at an internationally advanced level. The excellent performance of this low-temperature superconducting Bi-based tape improves the prospects for applications of high-temperature superconductors in a variety of areas.

**Development of High-T<sub>c</sub> Superconducting Infrared Bolometers**

92P61066A Shanghai HONGWAI YU HAOMIBO XUEBAO [JOURNAL OF INFRARED AND MILLIMETER WAVES] in Chinese Vol 10 No 6, Dec 91 pp 459-464

[Article by Chen Juxin [7115 5282 2450], Shi Baoan [4258 0202 1344] et al. of the CAS Shanghai Institute of Technical Physics, Shanghai 200083, Cao Xiaoneng [2580 2400 5174], Yang Caibing [2799 1752 3521] et al. of the CAS Institute of Electronics, Beijing 100080, and

Zhang Yingzi [1728 7751 1311], Zhao Yuying [6392 3768 5391], and Li Lin [2621 2651] of the CAS Institute of Physics, Beijing 100080: "Development of High-Temperature Superconducting Infrared Detectors"; MS received 3 Jul 91, revised 16 Aug 91]

[Abstract] High-T<sub>c</sub> superconducting IR bolometers have been developed by dc magnetron sputtering of 200-300-nm-thick YBa<sub>2</sub>Cu<sub>3</sub>O<sub>7-x</sub> thin films on SrTiO<sub>3</sub> and LaAlO<sub>3</sub> substrates. Zero-resistance temperature T<sub>c0</sub> is 90K and critical current density J<sub>0</sub> exceeds  $1 \times 10^5$  A/cm<sup>2</sup>. The performances of the bolometers are measured with a standard blackbody at 500K and with a modulation frequency of 10 Hz. The NEP [noise equivalent power] (500, 10, 1) of the SrTiO<sub>3</sub>-based bolometer is  $1.6 \times 10^{-10}$  W/Hz<sup>1/2</sup> and its D\* [detectivity] (500, 10, 1) is  $8.2 \times 10^{-8}$  cm-Hz<sup>1/2</sup>/W. The NEP (500, 10, 1) of the LaAlO<sub>3</sub>-based bolometer is  $10^{-11}$  W/Hz<sup>1/2</sup>. The frequency dependence of the detectivity and responsivity and the noise spectrum are measured and analyzed.

Figure 1 [not reproduced] is a graph of the resistivity of the YBaCuO thin film vs temperature. Figures 2-4 are reproduced below. Figures 5-7 [not reproduced] show the high-T<sub>c</sub> superconducting IR bolometer's noise spectrum, responsivity spectrum, and detectivity spectrum, respectively.

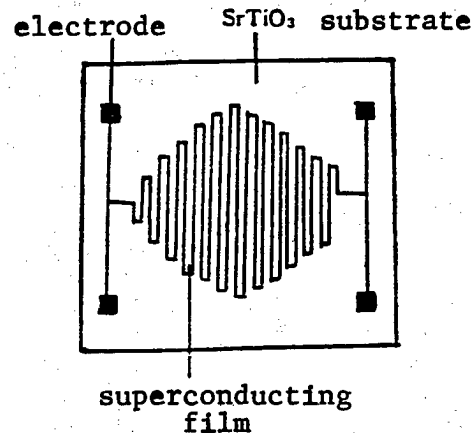


Figure 2. Schematic Diagram of the Sensitive Element of the High T<sub>c</sub> Superconducting Bolometer

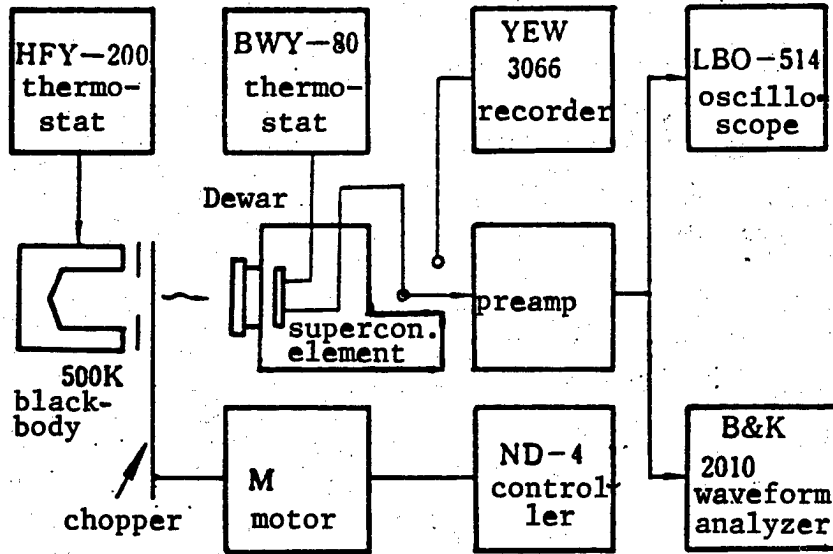


Figure 3. Measuring System for Performances of High  $T_c$  Superconducting IR Bolometers

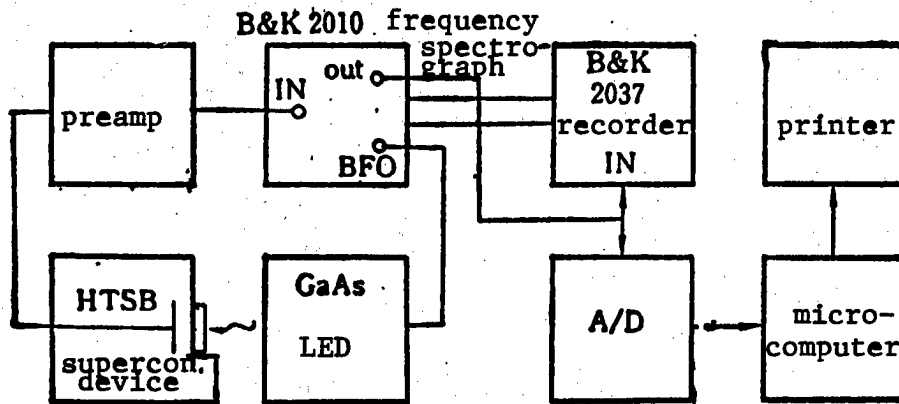


Figure 4. Schematic Diagram of the Measuring System for Frequency Spectrum of High  $T_c$  Superconducting IR Bolometers

Table 1 is reproduced below. Table 2 [not reproduced] shows the dependence of various performance indicators of the #7 bolometer on frequency.

Table 1. Main Performance Parameters of High  $T_c$  Superconducting Infrared Bolometers

Device No.	Substrate thickness (mm)	Material	Transition temp. (K)	Modulation freq. (Hz)	Signal $V_s$ ( $\mu$ V)	Noise $V_n$ ( $\mu$ V)	SNR $V_s/V_n$	Responsivity $R_V$ (V/W)	NEP (W/Hz <sup>1/2</sup> )	Detectivity $D^*$ (cm-Hz <sup>1/2</sup> /W)
#5	SrTiO <sub>3</sub> 0.5	YBCO	85	10	24	0.036	640	104	$2.5 \times 10^{-10}$	$5.2 \times 10^8$
#6	SrTiO <sub>3</sub> 0.28	YBCO	87	10	17.5	0.022	796	105	$2.1 \times 10^{-10}$	$6.4 \times 10^8$
#7	SrTiO <sub>3</sub> 0.5	YBCO	86.5	10.8	35.7	0.0357	1000	134	$1.6 \times 10^{-10}$	$8.2 \times 10^8$
#4	LaAlO <sub>3</sub> 0.5	YBCO	90	10	20	0.031	640	108	$1.7 \times 10^{-10}$	$5.6 \times 10^8$

References

1. Nishino and Kawamichi, OPTRONICS (in Japanese), 1987; (II): 106-110.
2. Carr, G. L., et al., APPL. PHYS. LETT., 1990; 57 (25): 2725.
3. Richards, P. L., et al., APPL. PHYS. LETT., 1989; 54 (3): 283-285.
4. Brasunas, J. C., et al., J. APPL. PHYS., 1989; 66 (9): 4551-4554.
5. Dwir, B., et al., SUPERCOND. SCI. TECHNOL., 1989; 2 (6): 314-316.
6. Li Xizhi et al., INT'L J. IR & MM WAVES, 1989; 10 (3): 445-456.
7. Zeng Guangli et al., HONGWAI JISHU [INFRARED TECHNOLOGY], 1991; 13 (1): 1-5.

### Anhui Vigorously Develops Provincial Fiber Optic Communications

92P60184A Beijing ZHONGGUO DIANZI BAO [CHINA ELECTRONICS NEWS] in Chinese  
10 Feb 92 p 2

[Article by Wei Baozhi [7614 0202 5347]: "Anhui Vigorously Develops Fiber-Optic Cable Communications in Province"]

[Summary] In order to promote P&T development and increase city-to-county long-distance telephone capacity, the Anhui Province P&T Management Bureau recently put up investment funds for construction of two city-county fiber optic cables, groundbreaking for which has already taken place. The first project, a Ma'anshan City-Dangtu County fiber optic cable, construction for which began on 16 November 1991, will permit simultaneous transmission of 90 long-distance and metropolitan voice circuits. The second project, a 13-million-yuan 207-km-long Fuyang-Mengcheng-Bo Xian fiber optic cable unveiled on 5 December, uses late-eighties fiber optic technology and can simultaneously transmit 1920 telephone circuits or other traffic. It is understood that upon the completion of these two new cables, the province P&T authorities will again connect Mengcheng, Huaiyuan, and Bengbu with a fiber optic cable and will use a 140 Mb/s [DS4 standard] digital system to connect it with the Tianjin-Nanjing State Level-One Trunkline Priority Project fiber optic cable and with the already-completed Wuhan-Wuhu-Nanjing cable, thus permitting Anhui provincial customers to be connected via cable with the national backbone network.

### Nation's First Manufacturing-Environment Multiuse Fiber Optic Cable Communications System Unveiled

92P60184B Beijing BEIJING KEJI BAO [BEIJING SCIENCE AND TECHNOLOGY NEWS] in Chinese  
26 Feb 92 p 1

[Article by Zhao Leqin [6392 2867 3830]: "First Domestic Manufacturing-Environment Multiuse Fiber Optic Cable Communications System Unveiled"]

[Summary] The nation's first multiuse fiber optic cable communications system designed for a manufacturing environment was recently unveiled by Beijing Aerospace University's Manufacturing Engineering Department. This new system, independently developed over a 2-year period, consists of five subsystems, including the subsystem for duplex transmission of color TV imagery and sound, and the digital fiber optic multiplexed transmission subsystem. The bit error rate of the intelligent fiber optic remote-control system, fiber optic distributed digital control system, and passive RS-232C-interface optical terminal is less than  $10^{-6}$ . Via this multiuse fiber optic cable communications system, designers of the Yun 7-200B aircraft propeller were able to connect their CAD/CAM system (developed by the Beijing Institute of

Aeronautical Manufacturing Technology) with a machining center located 1 kilometer away, and thus to increase efficiency in the machining of a number of difficult parts.

### Infrared Fiber Optic Communications Breakthrough Reported

92P60184C Beijing ZHONGGUO DIANZI BAO [CHINA ELECTRONICS NEWS] in Chinese  
28 Feb 92 p 3

[Article by Huang Xin [7806 6580]: "Infrared Optical Communications Captures Ultra-Long-Band Territory"]

[Summary] A major NSFC-funded project assigned to the CAS Shanghai Institute of Optics and Fine Mechanics, Shanghai Institute of Technical Physics, Shanghai Institute of Metallurgy, and Shanghai Jiaotong University has culminated in a series of important results in basic physics research on ultra-long-wavelength (2-5  $\mu\text{m}$ ) IR fiber optic communications. These results recently passed the acceptance check given in Shanghai by a group of national experts. The field of ultra-long-wave IR fiber optic communications is a cutting edge field combining research in materials science, optics, optoelectronics, and physics. The project has resulted in development of a number of new devices, including two high-detectivity, high-response-speed IR detectors that have been incorporated in an IR fiber optic transmission experimental system and in several IR detector systems; development of an oxide glass optical fiber, a key element in ultra-low-loss IR fiber optic communications systems; and construction of a complete experimental ultra-long-wave IR optical communications system. Project researchers have published 106 papers on this topic in domestic and foreign journals and at academic conferences, at which some results have been judged to be at the leading edge of experimentation internationally.

### Improved Definition TV Debuts in Xian

92P60184D Beijing ZHONGGUO DIANZI BAO [CHINA ELECTRONICS NEWS] in Chinese  
28 Feb 92 p 1

[Article by Xiao Ma [5618 7456]: "Intermediate-Resolution IDTV Debuts in Xian"]

[Summary] One need take an ordinary color TV set, insert a device costing only 70 or 80 yuan, and the image quality noticeably improves in terms of clarity and naturalness. This device is the key part of the color TV intermediate-resolution IDTV [improved definition television] system recently developed by Xidian University (Xian University of Electronic Science and Technology) Associate Professor Tang Weijuan [0781 5633 1227]. It is understood that this digital-IC-based IDTV system is best suited for large-screen color TV receiver sets; e.g., it works better on a 53-cm set than on a 46-cm set. In addition, the new invention has applications in medical diagnosis, military television, and other video areas.

NTIS  
ATTN PROCESS 103  
5285 FORT ROYAL RD  
SPRINGFIELD VA

2

22161

This is a U.S. Government publication. Its contents in no way represent the policies, views, or attitudes of the U.S. Government. Users of this publication may cite FBIS or JPRS provided they do so in a manner clearly identifying them as the secondary source.

Foreign Broadcast Information Service (FBIS) and Joint Publications Research Service (JPRS) publications contain political, military, economic, environmental, and sociological news, commentary, and other information, as well as scientific and technical data and reports. All information has been obtained from foreign radio and television broadcasts, news agency transmissions, newspapers, books, and periodicals. Items generally are processed from the first or best available sources. It should not be inferred that they have been disseminated only in the medium, in the language, or to the area indicated. Items from foreign language sources are translated; those from English-language sources are transcribed. Except for excluding certain diacritics, FBIS renders personal names and place-names in accordance with the romanization systems approved for U.S. Government publications by the U.S. Board of Geographic Names.

Headlines, editorial reports, and material enclosed in brackets [ ] are supplied by FBIS/JPRS. Processing indicators such as [Text] or [Excerpts] in the first line of each item indicate how the information was processed from the original. Unfamiliar names rendered phonetically are enclosed in parentheses. Words or names preceded by a question mark and enclosed in parentheses were not clear from the original source but have been supplied as appropriate to the context. Other unattributed parenthetical notes within the body of an item originate with the source. Times within items are as given by the source. Passages in boldface or italics are as published.

#### SUBSCRIPTION/PROCUREMENT INFORMATION

The FBIS DAILY REPORT contains current news and information and is published Monday through Friday in eight volumes: China, East Europe, Central Eurasia, East Asia, Near East & South Asia, Sub-Saharan Africa, Latin America, and West Europe. Supplements to the DAILY REPORTs may also be available periodically and will be distributed to regular DAILY REPORT subscribers. JPRS publications, which include approximately 50 regional, worldwide, and topical reports, generally contain less time-sensitive information and are published periodically.

Current DAILY REPORTs and JPRS publications are listed in *Government Reports Announcements* issued semimonthly by the National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, Virginia 22161 and the *Monthly Catalog of U.S. Government Publications* issued by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

The public may subscribe to either hardcover or microfiche versions of the DAILY REPORTs and JPRS publications through NTIS at the above address or by calling (703) 487-4630. Subscription rates will be

provided by NTIS upon request. Subscriptions are available outside the United States from NTIS or appointed foreign dealers. New subscribers should expect a 30-day delay in receipt of the first issue.

U.S. Government offices may obtain subscriptions to the DAILY REPORTs or JPRS publications (hardcover or microfiche) at no charge through their sponsoring organizations. For additional information or assistance, call FBIS, (202) 338-6735, or write to P.O. Box 2604, Washington, D.C. 20013. Department of Defense consumers are required to submit requests through appropriate command validation channels to DIA, RTS-2C, Washington, D.C. 20301. (Telephone: (202) 373-3771, Autovon: 243-3771.)

Back issues or single copies of the DAILY REPORTs and JPRS publications are not available. Both the DAILY REPORTs and the JPRS publications are on file for public reference at the Library of Congress and at many Federal Depository Libraries. Reference copies may also be seen at many public and university libraries throughout the United States.