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This memorandum report provides highlights of SSD activities in January 2007, and a summary of SSD accomplishments in CY 2006.

14. ABSTRACT

The Naval Research Laboratory (NRL) Space Science Division (SSD) conducts a broad-spectrum RDT&E program in solar-terrestrial physics, astrophysics, upper/middle atmospheric science, and astronomy. Instruments to be flown on satellites, sounding rockets and balloons, and ground-based facilities and mathematical models are conceived and developed. Division researchers apply these and other capabilities to the study of the atmospheres of the Sun and the Earth, including solar activity and its effects on the Earth's ionosphere, upper atmosphere and middle atmosphere, laboratory astrophysics, and the unique physics and properties of celestial sources. The program is important to orbital tracking, radio communications and navigation that affect the operation of ships and aircraft, utilization of the near-space and space environment of the Earth, and to the fundamental understanding of natural radiation and geophysical phenomena.

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Naval Research Laboratory Space Science Division Newsletter: 01/2007

Jill Dahlburg, George Doschek, James Kurfess, Judith Lean, David Siskind, Dennis Socker
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The Naval Research Laboratory (NRL) Space Science Division (SSD) conducts a broad-spectrum RDT&E program in solar-terrestrial physics, astrophysics, upper/middle atmospheric science, and astronomy. Instruments to be flown on satellites, sounding rockets and balloons, and ground-based facilities and mathematical models, are conceived and developed. Division researchers apply these and other capabilities to the study of the atmospheres of the Sun and the Earth, including solar activity and its effects on the Earth's ionosphere, upper atmosphere and middle atmosphere, laboratory astrophysics, and the unique physics and properties of celestial sources. The program is important to orbital tracking, radio communications and navigation that affect the operation of ships and aircraft, utilization of the near-space and space environment of the Earth, and to the fundamental understanding of natural radiation and geophysical phenomena. This first quarterly newsletter provides highlights of SSD activities in January 2007, and a summary of SSD accomplishments in 2006.

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Manuscript approved February 16, 2007.

1. NRL SSD 2006 in Review

January

The NRL Space Science Division Spatial Heterodyne Imager for Mesospheric Radicals (SHIMMER) integrator was delivered for inclusion in a Space Test Program (STP) satellite that is scheduled to launch on 22 FEB 2007. SHIMMER contains the 1st, and only, monolithic Spatial Heterodyne Spectroscopy (SHS) device. *(Code 7640)*

February

The joint Taiwan / US six-satellite Constellation Observing System for Meteorology Ionosphere and Climate (COSMIC) launched, carrying the collaborative NRL Space Science Division TIP, or Tiny Ionospheric Photometer. *(Code 7650, 7660, fmr 7607)*

May

Dr. Allan J. Tylka was twice recognized with honors. First, he was elected a Fellow of the American Physical Society (APS) in the Division of Astrophysics, with citation: "For innovative analyses of solar energetic particles that have clarified their origin, leadership in the field, and implementation of an engineering tool to assess their impact on satellite systems." Dr. Tylka was also selected by the American Geophysical Union (AGU) to receive the 2005 Editors' Citation for Excellence in Refereeing for the Journal of Geophysical Research-Space Physics. *(Code 7650)*

June

NRL delivered the Global Assimilation Ionospheric Model (GAIM) to the Air Force Weather Agency (AFWA). GAIM, which formally went operational at AFWA on 20 DEC 2006, has been under development since 1999 under the Multidisciplinary University Research Initiatives (MURI) program sponsored by the U.S. Department of Defense (DoD) and was managed by the NRL SSD. *(Code 7660, fmr 7607)*

August

The National Center for Environmental Prediction (NCEP) completed installation of the NRL Space Science Division ozone parameterization, CHEM2D-OPP, into their Global Forecast System for National Weather Service global forecasts. This followed a study by NCEP, which demonstrated that the NRL algorithm reduced ozone forecast errors by a factor of two over the previous approach. *(Code 7640)*

September

A multinational team of scientists, including members of NRL's Space Science Division, collaborated on the Solar B satellite, a three-year mission to study the outer atmosphere of the Sun, the corona, and how it interacts with the Sun's magnetic field. Through their

investigations, the scientists hope to learn the early warning signs of solar flares. Solar B, which successfully launched on September 22 from Japan, is the follow-on mission to Yohkoh, a cooperative Japan/US/UK mission that was launched in 1991 and observed energetic activity in the solar atmosphere continuously for more than nine years. Solar B is the second of NASA's Solar Terrestrial Probes to address fundamental questions about the physics of space plasmas and flow of mass and energy through the solar system. SOLAR-B, which was renamed HINODE upon launch, carries the NRL Space Science Division collaborative Extreme-ultraviolet Imaging Spectrometer (EIS), which achieved first light on 28 OCT 2006. EIS is observing emission lines produced by highly ionized elements in the solar corona and transition region of the Sun's atmosphere with the goal of understanding the physics of solar activity and coronal heating. *(Code 7670)*

Dr. Spiro Antiochos received the Laboratory's annual E.O. Hulburt Award, NRL's highest civilian honor for scientific achievement. *(Code 7670)*

NRL's Large Angle Spectrometric Coronagraph (LASCO), which was launched onboard SOHO in DEC 1995, was credited with the 1000th discovery of the Kreutz group comets. *(Code 7660)*

The NRL Space Science Division delivered the Large Area Telescope (LAT) for the Gamma-ray Large Area Space Telescope (GLAST) satellite integration. GLAST is a program funded jointly by NASA and DOE, and includes many institutions in the US as well as other countries (Japan, France, Italy, Sweden). NRL was responsible for the development of the CsI calorimeter, and also undertook extensive environmental tests of the LAT in the NCST Environmental Test Facility. When launched in early FY08, GLAST will measure the most energetic processes in the universe - from γ-ray bursts, black holes, neutron stars, and solar flares - and has the potential to discover previously-unknown relics of the Big Bang. *(Code 7650)*

Two SSD-designed-and-built dust collectors were successfully flown and recovered as part of a Norwegian-Swedish-NRL rocket campaign to explore the upper mesosphere (90 km altitude). The objective of the NRL dust collectors was to return samples of nanometer sized dust are products of meteor ablation. The dust collectors have been returned to NRL and are being analyzed by Code 6300 with NASA funding. *(Code 7650)*

October

NRL's SECCHI (Sun-Earth Connection Coronal and Heliospheric Investigation) experiment was launched aboard NASA's STEREO observatories. SECCHI is a suite of remote sensing instruments which will observe Coronal Mass Ejections as they form at the Sun and then follow them as they travel through the coronal and interplanetary space. The SECCHI team includes researchers from NRL's Space Science Division and other national and international research groups. Researchers have already learned much about CMEs from instruments such as the Naval Research Laboratory's Large Angle Spectrometric Coronagraph (LASCO) experiment on the NASA/European Space Agency's Solar and Heliospheric Observatory (SOHO), but now scientists will use

NASA's new Solar Terrestrial Relations Observatory (STEREO) to obtain new and unprecedented views of the solar corona. STEREO, a two-year mission, will use two nearly identical observatories to provide 3-D measurements of the solar corona and CMEs as they propagate through the inner heliosphere. STEREO launched October 25, 2006, and achieved first light in early December 2006. *(Code 7660)*

November

The second of five Special Sensor Ultraviolet Limb Imager (SSULI) remote sensing instruments, developed by the SSD, was launched on November 4, 2006 on board the DMSP F-17 satellite. SSULI is the first operational instrument of its kind and provides a new technique for remote sensing of the ionosphere and thermosphere from space. SSULI's measurements will provide scientific data supporting military and civil systems and will assist in predicting atmospheric drag effects on satellites and reentry vehicles. *(Code 7660, fmr 7607)*

December

A pair of microsatellites, developed by NRL SSD and Code 8000 scientists and engineers for the Atmospheric Neutral Density Experiment Risk Reduction (ANDE-RR) mission, launched December 9 on NASA's Space Shuttle Discovery. The ANDE-RR microsatellites are being flown in preparation for the Atmospheric Neutral Density Experiment (ANDE). A second pair of microsatellites have been fabricated for the 2009 ANDE mission. ANDE is a low-cost mission to study the atmosphere of the Earth from low-Earth orbit by monitoring total atmospheric density at 400 kilometers. ANDE data will be used to improve methods for the precision orbit determination of space objects and to calibrate the radar fence, a space surveillance system belonging to the Air Force 20th Space Control Squadron, a principal resource for tracking low-Earth orbiting space satellites. *(Code 7660, fmr 7607)*

Dr. John Seely was elected a Fellow of the American Physical Society, with citation: “for fundamental contributions to the x-ray spectroscopy of hot laser-produced and solar plasmas, and for the determination of the atomic energy levels of highly-charged ions.” *(Code 7670)*

Dr. James Klimchuk was selected as an Honorary Fellow (aka Associate) of the Royal Astronomical Society. *(Code 7670)*

2. ANDE Risk Reduction Micro-Satellites Deployed from Space Shuttle Discovery

NRL SSD Code 7660; January 9, 2007

A pair of micro-satellites developed by Naval Research Laboratory scientists and engineers for the 'Atmospheric Neutral Density Experiment – Risk Reduction' (ANDE-RR) mission were deployed from STS-116 NASA space shuttle Discovery on December 21, 2006 at approximately 18:22Z. The deployment accomplished the primary goal of the ANDE-RR mission, which was to test and verify the capabilities of the shuttle deployment mechanism of the full ANDE mission. Both micro-satellites MAA and FCal deployed, with the FCal spacecraft immediately releasing flawlessly from its cylinder; see Figs. 2.1 (payload deployment); and, 2.2 (FCal release; MAA emerged 33 minutes later). First radio contact with FCal occurred with a ground site in Sweden roughly one hour after deployment. Ground sites have now been in contact with both MAA and FCal spacecraft, and telemetry indicates that both are operating nominally. Plans are to proceed onward with the full ANDE mission, the objectives of which are to measure the neutral atmospheric density near 350 km altitude and to provide calibration targets for the space surveillance network.

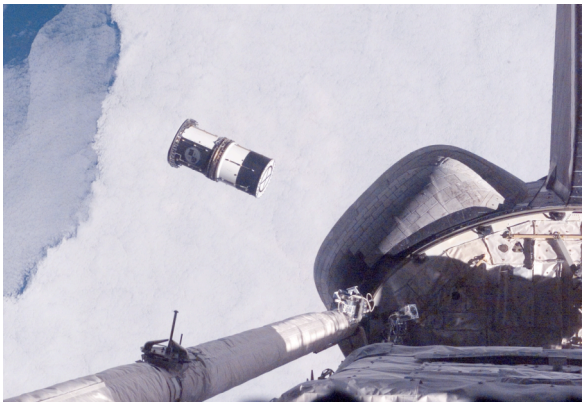


Figure 2.1. The ANDE-RR payload is deployed from the space shuttle Discovery on 21 DEC 2006 *(NASA)*.

Figure 2.2. After separation of the deployment mechanism, the micro-satellite FCal is free-flying *(NASA)*.

3. GAIM (Global Assimilation of Ionospheric Measurements) Model Operational
NRL SSD Code 7660; January 9, 2007

The Global Assimilation of Ionospheric Measurements (GAIM) model went operational at the Air Force Weather Agency (AFWA), located at Offut Air Force Base, on 20 December, 2006. GAIM has been under development since 1999 under the Multidisciplinary University Research Initiatives (MURI) program sponsored by the U.S. Department of Defense (DoD) and was managed by the Naval Research Laboratory's (NRL) Space Science Division. GAIM uses a physics-based model as the basis for assimilating a diverse set of near real-time measurements. It assimilates slant total electron content (TEC) observations from up to 400 Global Positioning System (GPS) ground receiver sites, in-situ electron density observations from Defense Meteorological Satellite Program (DMSP) satellites, and bottomside electron density profiles from ionosondes. The model provides specifications and forecasts on a spatial grid that can be global, regional, or local. The specifications/forecasts are in the form of 3-dimensional electron density distributions from 90 km to geosynchronous altitudes (35,000 km). NRL scientists have begun evaluating the use of new ultraviolet (UV) space sensor data with GAIM. The sources of UV data include a suite of operational UV sensors, the Special Sensor Ultraviolet Limb Imager (SSULI), which were developed by NRL's Space Science Division. NRL scientists expect to generate exciting science from investigating the addition of UV data sets with the GAIM model. The UV-capable version of GAIM is scheduled to go operational at AFWA in October 2007.

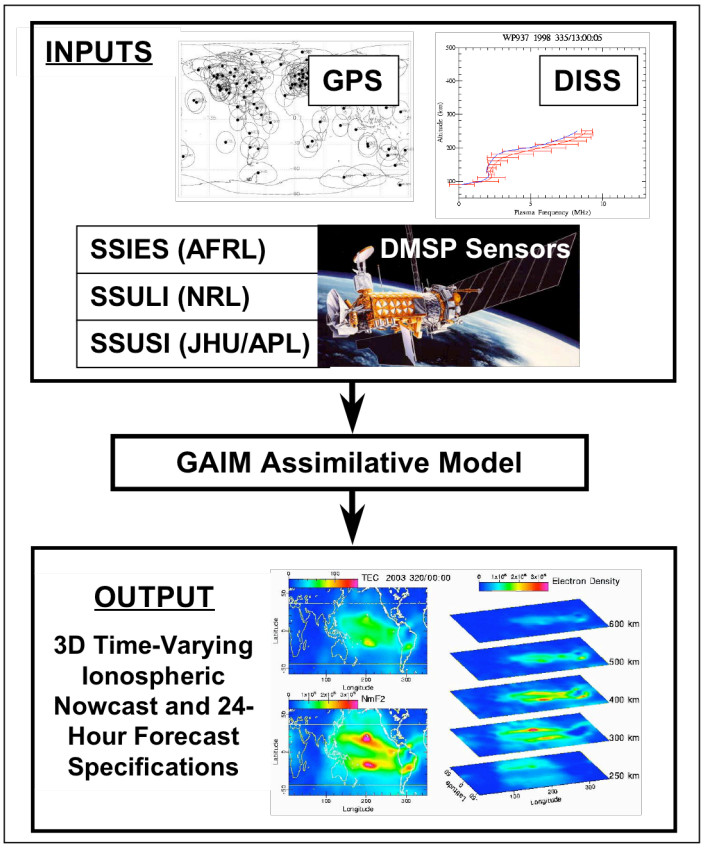


Figure 3.1. GAIM Assimilative Model.

4. EIS (Extreme-ultraviolet Imaging Spectrometer) First High Temperature Solar Flare Images

NRL SSD Code 7670; January 18, 2007

The first images of hot gas in a solar flare from the NRL Space Science Division collaborative Extreme-ultraviolet Imaging Spectrometer (EIS) have now been obtained; see Fig. 4.1 for a post-flare coronal loop at the solar limb after a reconnection event. Comparison of the Ca XVII observed emission of this loop (Fig. 4.1 bottom right image) with that of simultaneous Fe XI emission (leftmost image in Fig. 4.1 center row) establishes the presence of a bright knot of 6 million degree Kelvin plasma at the loop top. Why these isolated hot plasma features distinctly appear - and then remain confined at the top of the loop instead of spreading along the loop structure - has remained a mystery since the time such features were first observed with Yohkoh. Thermally high-resolution images of solar flares with EIS will help to unravel this unsolved problem. EIS is carried onboard the HINODE satellite, a three-year mission to study the outer atmosphere of the Sun, the corona, and how it interacts with the Sun's magnetic field. HINODE, successfully launched on September 22 from Japan, is the follow-on mission to Yohkoh, a spacecraft that also contained a cooperative Japan/US (with NRL)/UK experiment. Yohkoh was launched in 1991 and observed energetic activity in the solar atmosphere continuously for more than nine years.

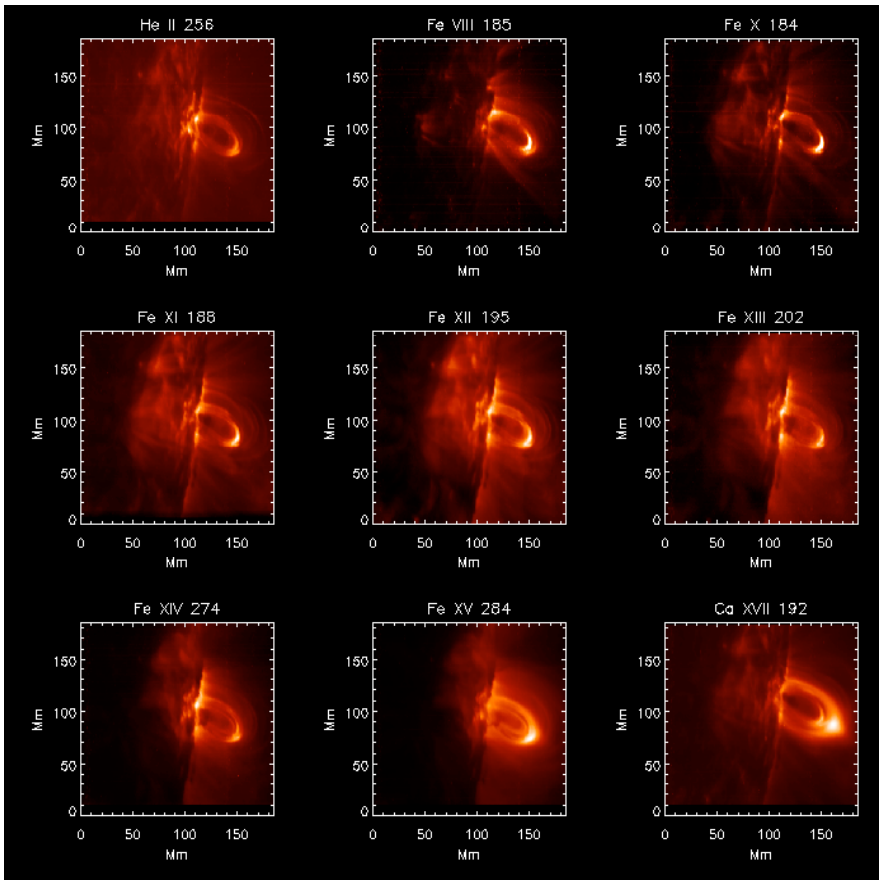
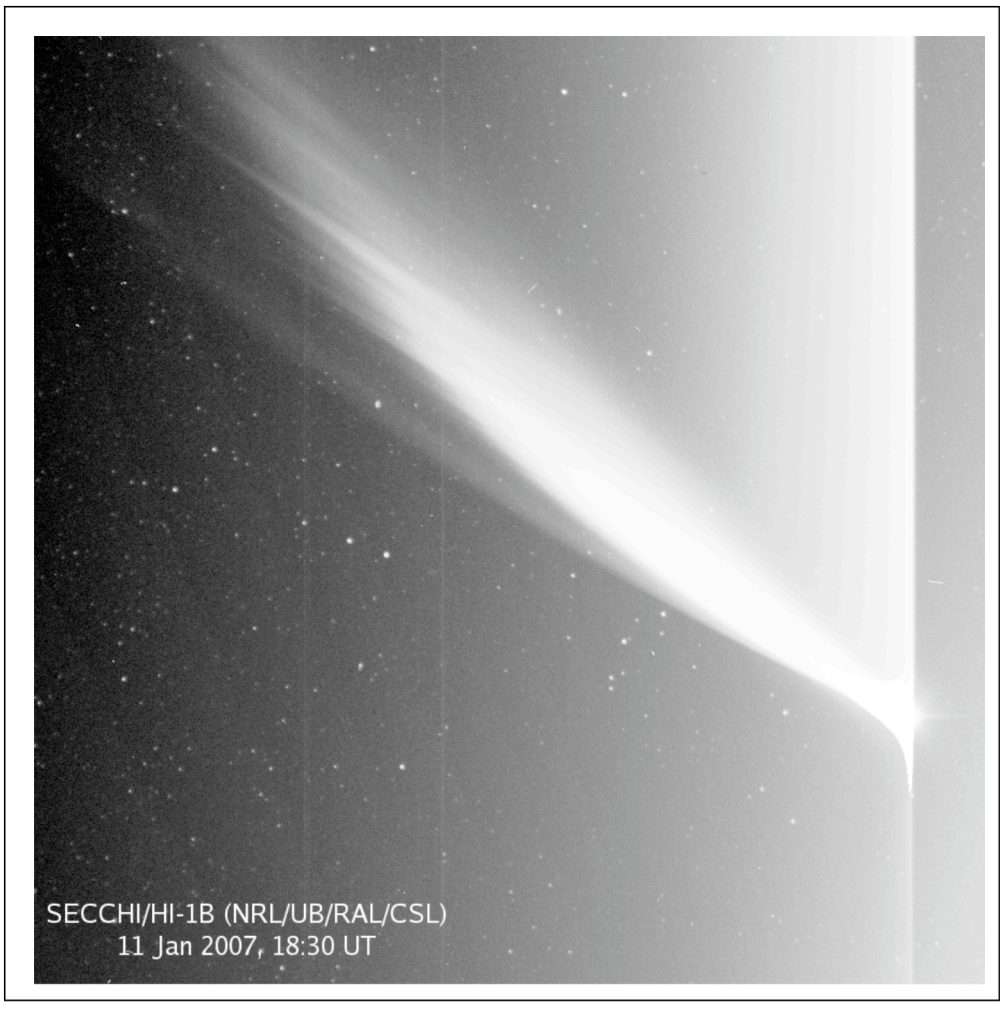


Figure 4.1. A post-flare coronal loop at the solar limb after a reconnection event.

5. SECCHI HI-1B First Light
NRL SSD Code 7660; January 18, 2007

This image from the SECCHI/HI-1B instrument on the NASA STEREO-B (Behind) spacecraft was taken on January 11, 2007 just after the door covering the instrument was opened for the first time after the STEREO launch on October 26, 2006. The image is dominated by a spectacular view of comet C/2006 P1 (McNaught) The full field of view of the HI instrument is centered at about 14 degrees from sun center and is 20 degrees wide. The comet tail is nearly 20 degrees in length and shows multiple rays. The comet is saturating the image even at the shortest exposure time of 1 sec. The images are full resolution 2048 x 2048, which corresponds to 35.1 arc-sec/pixel. The SECCHI/HI instrument was built for the NASA STEREO mission by a consortium consisting of NRL, the University of Birmingham (UK), Rutherford Appleton Laboratory (UK) and Centre Spatiale de Liege (Belgium). With the successful opening of the HI-B door, SECCHI is now 10 for 10! All ten telescopes are operating well and taking data. The purpose of SECCHI is to study the 3-D evolution of coronal mass ejections, the most energetic eruptions on the sun and the primary cause of major geomagnetic storms, from their origin to their eventual impact at Earth.



6. NRL SEAP Summer Student Receives Intel Science Talent Search Semifinalist Award

NRL SSD Code 7670; January 18, 2007

A 2006 Science and Engineering Apprentice Program (SEAP) summer student, Caroline Bogdan, received an award of $100 for her summer project at NRL in August 2006. This week she was informed that she has also been chosen to receive an Intel Science Talent Search Semifinalist award of $1000 plus matching funding for her school, Thomas Jefferson High School, for this same project. Ms. Bogdan's winning work describes the dynamics of solar coronal streamers. Under the mentorship of NRL SSD scientist, Dr. Neil Sheeley, she measured height and time coordinates of coronal events observed with NRL's LASCO (Large Angle Spectrometric Coronagraph), and fit those measurements with smooth curves. She then differentiated the curves to obtain the speeds and accelerations of solar events, and studied the results for different kinds of coronal motions. Her observations established that the speeds and accelerations of streamer detachments were similar to those of the solar wind, suggesting that the streamers and the wind have a common origin, whereas the dynamic properties of coronal mass ejections (CME's) were more explosive in nature. Ms. Bogdan is also recipient of an early acceptance to the Massachusetts Institute of Technology.

7. NASA STEREO Mission Spacecraft Commissioning Complete
NRL SSD Code 7660; 26 January 2007

The NASA STEREO mission, launched October 25, 2006, successfully completed spacecraft level commissioning on January 23, 2007. Each of the two STEREO spacecraft is currently being placed into an appropriate solar orbit to obtain three-dimensional (or stereo) imagery. One satellite is placed in orbit ahead of the Earth (STEREO-A) and one behind (STEREO-B). Instrument level commissioning began on January 24, 2007 and will be completed on February 23, 2007. All 10 instrument channels in the NRL led Sun Earth Connection Coronal and Heliospheric Investigation (SECCHI) are operating properly and have already successfully completed many of the required instrument level commissioning tasks. Each SECCHI suite contains two Coronagraphs (COR1 and COR2); one Extreme Ultraviolet Imager (EUVI); and two Heliospheric Imagers (HI1 and HI2). The COR1, COR2, and EUVI are bundled together on one optical bench that is referred to as the Sun Centered Imaging Package (SCIP). The two HI imagers are bundled together separately from the SCIP. The reason for the five different instruments in each SECCHI suite is the need to cover all fields of view from the sun's surface (EUVI) through the corona (COR1 and COR2) and the interplanetary medium between the corona and Earth (HI1 and HI2). Each of the two NASA STEREO spacecraft contains one SECCHI suite as a primary payload. The three other instruments, separate from SECCHI, on each STEREO spacecraft are: PLASTIC (University of New Hampshire); IMPACT (University of California); and SWAVES (Paris Observatory).

Figure 7.1. Artists conceptual drawing of the two NASA STEREO spacecraft in orbit around the Sun [http://www.nasa.gov/mission_pages/stereo/mission/index.html; NASA].

8. Three NRL Space Science Division Branch Heads Participate in NRL/ USNA Science and Technology Education Partnership Conference, 22-24 JAN 2007
NRL SSD Code 7600; January 26, 2007

Three NRL Space Science Division (SSD) Branch Heads presented research overviews at this week's Science and Technology Education Partnership Conference at the USNA: Dr. David Siskind (Code 7640); Dr. Dennis Socker (Code 7660); and, Dr. George Doschek (Code 7670). Dr. Siskind presented 'The Middle Atmosphere, the Ignored Layer of the Terrestrial Atmosphere,' a summary of the basic physical, chemical and dynamical processes that govern the structure of the middle atmosphere. Dr. Socker presented 'Science and Engineering Trade Experience on Solar Space Missions,' an overview of the trades among science, engineering and cost for space instruments, with case study examples taken from the many solar space instruments flown by the NRL Solar Physics Branch, Code 7660, on NASA missions from 1971 to the present. Dr. Doschek presented 'The Atmosphere of the Sun,' in which he discussed new findings about the Sun's atmosphere obtained from instruments flown on a number of spacecraft missions, including: the Yohkoh and Hinode satellites flown by the Japanese space agency JAXA with instrumentation from NRL, NASA, the United Kingdom, and Japan; the TRACE and STEREO missions flown by NASA with NRL instrumentation, SECCHI, on STEREO; and, the European SOHO spacecraft with instrumentation provided by both NASA (including NRL hardware) and the European space agency (ESA). This conference represents a partnership between the United States Naval Academy and the Naval Research Laboratory to promote a better understanding of science and technology in support of Navy and Marine Corps operations. From the time of this initial call from the NRL Director of Research for NRL candidate speakers, positive response from the SSD was considerable. Dr. Siskind summarized the event as: "I only have good things to say about this program. The hospitality was gracious and the experience was fascinating. I would recommend this to any NRLer. It was truly a pleasure to visit USNA."

9. NRL Tiered Systems Study Presented at AFCEA WEST, 31 JAN – 2 FEB 2007
NRL SSD Code 7600; January 31, 2007

The 17 JAN 2007 NRL Tiered Systems Study Memorandum, 'Developing a Viable Approach for Effective Tiered Systems' (Final Report of the 2006 DoD Office of Force Transformation NRL Tiered Systems Study) was presented 31 JAN - 2 FEB at the NRL Exhibit Booth at AFCEA WEST 2007 in San Diego. The 2006 NRL-wide Study, chaired by SSD Acting Division Superintendent Jill Dahlburg, investigated the tremendous learning opportunities that presently exist to understand how to realize net-centric operations, and the resulting Study Report provides findings and recommendations to enable achievement of effective tiered systems-of-systems in the near-term. The ability to share information to and from the tactical edge will allow Operators to work in more dispersed environments while taking decisive, collective actions. To realize this vision, there are significant S&T issues that must be resolved. Possibilities of net-behavior must be better understood in order to shape future DoD net-centric systems technologies and operation concepts, to define with stability the defense industry after next, and - centrally - to develop the future tactics, techniques, and procedures that will enable net-centric advantages to be effected at the tactical, operational, and ultimately strategic levels. Near-term success will be realized by proceeding with scenario-driven, experimentally-based tiered systems development and demonstration activities that are co-evolved in small development cells staffed with cohesive teams of Service Lab technologists and Operational/ Tactical war fighters who are chartered to work collaboratively for four to five consecutive years. Topical focus for each cell should be provided by a net-centric overarching theme. Within 18-48 months each cell should provide: (1) experimental distributed tiered systems capabilities (hardware and software) for war fighter experimentation and evaluation; and, (2) elucidation of methodologies for tiered systems developments for wide prototyping.

10. Secretary Bodman briefed about LAT instrument on the Gamma-ray Large Area Space Telescope (GLAST)
NRL SSD Code 7650; February 1, 2007

During his February 1 2007 visit to NRL, the Honorable Samuel W. Bodman, Secretary of the Department of Energy, was briefed on several Space Science Division projects, among them NRL's contribution to the NASA/DOE GLAST mission that will be launched early in FY08; see Fig. 10.1. NRL has a long history of development of gamma-ray detectors for space missions, including NASA's Solar Maximum Mission (SMM) that was on orbit for most of the 1980's and NASA's Compton Gamma Ray Observatory (CGRO) that was on orbit for most of the 1990's. The next major gamma ray mission, scheduled for launch in about one year, is NASA's Gamma-ray Large Area Space Telescope (GLAST) Mission that will undertake observations of 20 MeV – 300 GeV gamma rays from astronomical sources (neutron stars, black holes, active galactic nuclei, solar flares, etc.) and observations of gamma ray bursts above 25 keV. NRL is one of the major contributors to the principal instrument on GLAST, the Large Area Telescope (LAT). LAT is the product of a successful collaboration among DOE, NASA, and a large international team and is managed by the Stanford Linear Accelerator Center. LAT consists of a silicon tracker, a cesium iodide calorimeter, and a charged particle anticoincidence detector that combine to provide the direction and energy of the incoming gamma rays. NRL designed and built the 1500 kg calorimeter and also completed the environmental tests of the LAT. GLAST (shown in Fig. xx) will have about 30 times better sensitivity than the high-energy telescope on CGRO, and is expected to discover about 10,000 high-energy gamma ray sources, compared to about 270 discovered by the EGRET instrument on CGRO. Following Dr. James Kurfess (SSD Code 7650) briefing to Secretary Bodman about GLAST, Dr. Dennis Socker (SSD Code 7660) briefed the Secretary about NASA STEREO/ SECCHI.

Figure 10.1. The GLAST spacecraft in preparation for performance and environmental tests at the General Dynamics facility in Gilbert, AZ.

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BIOGRAPHIES

Jill Dahlburg, Code 7600 [Jill.Dahlburg@NRL.NAVY.MIL], the Senior Scientist for Science Applications reporting to the Director of Research at NRL, is detailed as Superintendent (Acting) of the NRL Space Science Division from May 2006. Her technical collaborations include scientists in both the national and international physics and engineering communities. She serves on a number of review, editorial and advisory boards, among them as: Chair, Department of Energy Office of Science federal panel, the Advanced Scientific Computing Advisory Committee; Member, Fusion Energy Sciences Advisory Committee; Member, LLNL Defense & Nuclear Technologies Director's Review Committee; 2005 Chair, American Physical Society (APS) Division of Plasma Physics; and, 2002 Chair, APS Maxwell Prize Committee. Dr. Dahlburg, a Fellow of the APS, holds a BA in liberal arts from St. John's College in Annapolis and a PhD in plasma physics from the College of William & Mary in Virginia.

George Doschek, Code 7670 [George.Doschek@NRL.NAVY.MIL] a Supervisory Research Physicist in the SSD, received his PhD in physics from the University of Pittsburgh in 1968. He has been Branch Head of the Solar-Terrestrial Relationships Branch in the Space Science Division since 1979. Between 1970 and 1979 he was a Research Astrophysicist at NRL, and between 1968 and 1970 he was an E.O. Hulburt Fellow at NRL. His primary research interest is in the physics of the solar atmosphere, particularly understanding this physics through the application of high resolution UV-X-ray spectroscopy. He has a general interest in the application of spectroscopy to astronomy and laboratory plasmas such as laser-produced plasmas, an area he has also worked in. He is a member of the AAS, the OSA (Fellow), the AGU, and the IAU. He has served on many space science committees and is a past Chairperson of the AAS Solar Physics Division. He is the EIS/Hinode PI to NASA.

James Kurfess, Code 7650 [Jim.Kurfess@NRL.NAVY.MIL], a Supervisory Astrophysicist in the SSD, is Head of the High Energy Space Environment Branch. He currently serves as the Focus Area Coordinator for the ONR-funded Space Research and Space Technology programs at NRL, and as Manager of programs In the High Energy Astrophysics Task Area. He has served as Principal Investigator on projects supported by NASA, DTRA, and DHS, including the Oriented Scintillation Spectrometer Expeirment on NASA's Compton Gamma Ray Observatory from 1991-2000. He has served on numerous external scientific advisory panels, is a Fellow of the American Physical Society (APS) and served as Chair and Secretary-Treasurer of the Astrophysics Division of the APS. Dr. Kurfess received his BS, MS and PhD degrees from Case Institute of Technology (now part of Case Wetern Reserve University).

Judith Lean, Code 7605 [Judith.Lean@NRL.NAVY.MIL], is Senior Scientist for Sun-Earth System Research in the SSD. She has served on a variety of NASA, NSF, NOAA and NRC advisory committees, including as Chair of the NRC Working Group on Solar Influences on Global Change. A member of the AGU, IAGA, AAS/SPD and AMS, she was elected a member of US National Academy of Sciences in 2003, and Fellow of the American Geophysical Union in 2002. She is the recipient of a number of NASA

research grants, in collaboration with other SSD and US scientists, and is currently a Co Investigator on SORCE, TIMED/SEE, SDO/EVE and GLORY/TIM space missions. A US citizen since 1992, she has a Ph.D. in Atmospheric Physics, 1982, from the University of Adelaide, Australia and B.Sc. (Hons) from the Australian National University (1975).

David Siskind, Code 7640 [David.Siskind@NRL.NAVY.MIL], a Supervisory Research Physicist in the SSD, has been the Branch Head of the Upper Atmospheric Physics Branch since 2002. He received his PhD in atmospheric, planetary and astrophysical sciences from the University of Colorado in 1988. Before coming to NRL in 1992, he was a post-doctoral fellow at the University of Michigan from 1988-1990 and a research scientist at NASA/Langley Research Center from 1990-1992. His research has focused on understanding the photochemistry and transport of trace constituents in the stratosphere, mesosphere, and thermosphere, solar/terrestrial coupling, and the analysis of remote sensing data obtained from satellites, sounding rockets, and ground based observatories. He is a Co-Investigator on the TIMED/SABER instrument team and on the Aeronomy of Ice in the Mesosphere (AIM) Small Explorer. He is a member of the AGU, served 4 years as Associate Editor of the JGR-Space Physics, was the lead editor on the AGU Monograph "Atmospheric Science Across the Stratopause", served on the Sun-Earth Connection 2000 Roadmap team, and was a contributor to Chapter 6 of the WMO 1999 Ozone Assessment Report.

Dennis Socker, Code 7660 [Dennis.Socker@NRL.NAVY.MIL], a Supervisory Astrophysicist in the SSD, is head of the Solar Physics Branch. He holds a BA in Astronomy from San Diego State University and a PhD in Astronomy from Indiana University. Dr. Socker is a member of the American Physical Society, the American Astronomical Society, and the American Geophysical Union. He joined the Solar Physics Branch in 1979 and has made substantial contributions to the Branch's High Resolution Telescope and Spectrograph sounding rocket program, Spacelab 2 mission, Solar and Heliospheric Observatory Large Angle Spectrometric Coronagraph, and the Solar Terrestrial Observatory Sun-Earth Connection Coronal and Heliospheric Investigation.