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14. ABSTRACT

This report results from a contract tasking Swedish Institute of Space Physics (IRF) as follows: The contractor will investigate the use of high power large aperture radar for the categorization of meteorites. Tristatic measurements using the European Incoherent Scatter (EISCAT) radar network will be collected and analyzed. The goal of this research is to determine the optimum radar modes, operating frequencies, and radiated power for detecting and tracking meteors.

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High Power Large Aperture Radar Methods for Meteor observations

EOARD Contract Number F61775-01-WE084
September 24, 2001 September 24, 2002

Final report
October 18, 2002

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Swedish Institute of Space Physics

I am very grateful for the contract I got from EOARD for the period September 2001 to September 2002. During this time I got a lot of work finished that had not been done while I was preparing for the Meteoroids 2001 conference. In addition new things were started. During the period January 1st to July 31st, I used the support to be able to work full time with research. In my Lecturer position at the University of Umeå, I have full time teaching in principle, but have had already since 1996 (until 2005 for the moment) half working time paid from the Swedish Institute of Space Physics for research.

During the fall 2001 papers (1), (2) and (5) in the publication list were finished. During spring-summer 2002 the papers (3) and (4) were submitted, published and presented as posters at the annual Swedish radio science conference RVK-02 (Radio Vetenskap och Kommunikation) in Stockholm and at XXVIIth URSI General Assembly, Maastricht, the Netherlands. Paper (6) will be finished within a few weeks. The draft attached was the latest version printed since my total computer crash on October 6th. It contains the most essentials, but we will make the paper more consequent before submitting it to Annales Geophysicae. Paper (7) in the present paper version also contains the essential scientific items, but must be filled with some more text and read by my co-authors. As discussed in this paper the hyperthermal charge transfer cross sections seem to have a very important effect on the observability of the head echoes on the high power large aperture radars. High velocities (above 30 km/s) are required, and this seems to be the observed case at the radars that can observe vector velocities. If true, this has an effect that must be taken into account as interpreting all kinds of results and applications these radars are used for. I hope to be able to submit the paper to Geophysical Research Letters during this year.

We have had two 24 hour meteor/dust campaigns on EISCAT this year at the vernal and autumnal equinoxes. A raw analysis to get the rates has been done on the spring data. We observed 33 tristatic meteors, for which we can get the vector velocities as we continue the analysis (earlier we had 10 cases on 40 hours from November 1997 and 1998 campaigns). The fall campaign went technically well, but no analysis has been done so far. The high time and space resolution coded data is complicated, and it must be merged together from the three stations to get the true vector velocities. This is time consuming, especially as the method is new due to the recent upgrade of the EISCAT signal processing facilities, and there does not exist analysis programs yet. The increase of the rates is probably due to the upgrade. The tristatic velocity results will be important to further confirm the ideas of paper (7).

The future plans are to run two more campaigns at summer and winter solstices next year. I have got at least one PhD student position from the Graduate School of Space Engineering. I have two very good candidates, who can start on January 1st 2003, for the position(s). I have also applied for a post doc for the project from the Swedish Research Council, the decision will be taken in early November. So I am hopeful that we can get the data fully analysed in the near future.

Publications

(1) Pellinen-Wannberg, Asta, The High Power Large Aperture Method for Meteor Observations, Meteoroids 2001 proceedings, ESA SP-495, 2001.
(2) Brändström, Urban, Björn Gustavsson, Åke Steen, and Asta Pellinen-Wannberg, ALIS (Auroral Large Imaging System) used for optical observations of the meteor impact process, Meteoroids 2001 proceedings, ESA SP-495, 2001.
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(4) Pellinen-Wannberg, A., G. Wannberg, A. Westman, I. Häggström, J. D. Mathews, D. Janches, and D. D. Meisel, Global Interplanetary Dust Distribution Measurements with the EISCAT and Arecibo HPLA Radars, RVK-02 (RadioVetenskap och Kommunikation) proceedings, 97-100, 2002.
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(6) Westman, A., G. Wannberg, and A. Pellinen-Wannberg, Meteor head echo height distributions and the meteor impact mechanism observed with the EISCAT HPLA UHF and VHF radars, in manuscript, to be submitted to Annales Geophysicae, 2002.
(7) Pellinen-Wannberg, A., E. Murad, G. Wannberg, and A. Westman, The hyperthermal ionization effect on the HPLA radar head echo observability, in manuscript, to be submitted to Geophys. Res. Letters, 2002.