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## **X-ray Observations of the Sun: Solar Flares and their Impact on the Geophysical Space**

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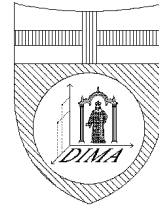
**13. SUPPLEMENTARY NOTES**

**14. ABSTRACT**  
The aim of the present project was to apply computational tools based on the theory and practice of inverse problems for inferring information on the dynamical processes occurring during solar flares. More precisely, we processed hard X-ray counts provided by the NASA satellite RHESSI (Reuven Ramaty High Energy Solar Spectroscopy Imager), on orbit since February 2002, in order to reconstruct images of the flaring electron distribution in the solar chromosphere at different energies, within an imagingspectroscopy framework. Specifically, the project focused on: • the formulation and validation of a regularization procedure which allowed the synthesis of electron maps at different electron energies from calibrated measurements, called visibilities, of specific spatial Fourier components of the source distribution; • the application of such a methodology to RHESSI data sets recorded during events of different magnitude and topography together with a rigorous statistical interpretation of the results.  
The main results of the project have been collected in the following papers: 1) Prato M, Piana M, Emslie A G, Hurford G J, Kontar E P and Massone A M 2009 A regularized visibilitybased approach to astronomical imaging spectroscopy SIAM J. Imaging. Sci. 2 910-930: in this paper we provide the mathematical foundation of a new approach to imaging spectroscopy, in which electron maps smoothed along the electron energy direction are reconstructed from the X-ray visibility observed by the Reuven Ramaty High Energy Solar Spectroscopy Imager (RHESSI). 2) Massone A M, Emslie A G, Hurford G J, Prato M, Kontar E P and Piana M 2009 Hard X-ray imaging of solar flares using interpolated visibilities Astrophys. J. 703 2004-2016: in this paper we describe a new imaging technique for the reconstruction of hard X-ray images from hard X-ray visibilities recorded by rotating modulation collimators. Further, we applied this imaging technique to real observations provided by RHESSI. 3) Prato M, Emslie A G, Kontar E P, Massone A M and Piana M 2009 The location of centroids in photon and electron maps of solar flares Astrophys. J. 706 917-922: using the regularized electron maps, in this paper we infer information about the energy transport processes occurring during solar flares. 4) Massone A M and Piana M The use of electron maps to constrain some physical properties of solar flares Sol. Phys. (in press): this paper describes a general framework within which the regularized electron maps can be utilized in order to select the most reliable model of energy transport for a given flaring event.  
In the framework of the project we also implemented two Interactive Data Language (IDL) software packages realizing the reconstruction of hard X-ray images and of regularized electron maps from RHESSI hard X-ray visibilities. Such packages are now at disposal of the solar physics community within the SolarSoftWare (SSW) tree. Finally, during the project we organized the 9th RHESSI workshop which took place in Genova, Italy, in Sep 2009.

**15. SUBJECT TERMS**  
EOARD, Space Weather, Solar Monitoring

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**Title of the project:** X-ray observations of the Sun: solar flares and their impact on the geophysical space

**Coordinator:** Michele Piana, Dipartimento di Matematica, Universita' di Genova

### **Scientific Report**

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