MODELING OF THE EUV AND X-RAY EMISSION SPECTRA INDUCED BY THE SOLAR WINDS IONS IN THE HELIOSPHERE

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Annual Report

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Progress Report 1

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Modeling of EUV and X-ray Emission Spectra Induced by Solar Wind Ions in the Heliosphere

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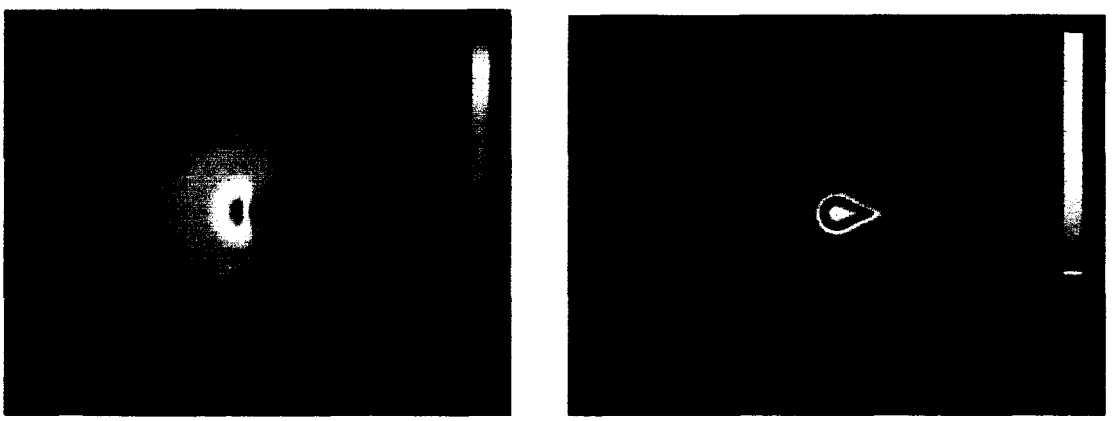
We have carried out investigation of the EUV and X-ray emission spectra induced in interaction between the Solar Wind (SW) and interstellar neutral gas. The spectra of most important SW ions have been computed for the charge-exchange mechanism of X-ray emission using new accurate spectroscopic data from recent laboratory measurements and theoretical calculations. Total spectra have been constructed as a sum of spectra induced in the charge-exchange collisions by individual O^{q+}, C^{q+}, N^{q+}, Ne $^{q+}$, Mg^{q+} and Fe^{q+} ions. Calculations have been performed for X-ray emission from the heliospheric hydrogen and helium gas. X-ray maps of the heliosphere have been computed. In figure, the power density of X-ray sources in the heliospheric ecliptic plane is shown for the H gas (left figure) and for the He gas (right figure). Distances from the Sun (0,0) are given in AU. The helium cone is clear seen in the X-ray map of the charge-exchange emission induced by the solar wind.



X-ray emission spectra detected by the Chandra X-ray telescope from the "dark" side of Moon has been identified as a X-ray background emission induced by the solar wind from the geocorona. Spectra and intensities of this charge-exchange X-rays have been compared with the heliospheric component of the X-ray background. Observations and modeling of the SW spectra induced from the geocorona indicate a strong presence of emission lines of highly charged oxygen ions. Anisotropy in distribution of heliospheric X-rays has been predicted and

calculated for the regions of the fast and slow solar winds.

The results of investigations are published in the articles:

- R. Pepino, V. Kharchenko, A. Dalgarno, and R. Lallement, *Spectra of the X-Ray Emission Induced in the Interaction between the Solar Wind and the Heliospheric Gas*, ApJ, **617**, 1347 (2004).
- V. Kharchenko, *Atomic Processes in the Solar Wind: EUV and X-ray Emission Induced by Charge-Transfer Collisions*, AIP Conferences Proceedings, **719**, 416 (2004).
- B.J. Wargelin, M. Markevitch, V. Kharchenko et al., *Chandra observations of the "dark" Moon and geocoronal solar wind charge transfer*, ApJ, **607**, 596 (2004).
- J. D. Gillaspy et al., *Visible, EUV, and X-ray spectroscopy at NIST EBIT facility*, AIP Conferences Proceedings, **730**, 245 (2004)
- V. Kharchenko, R.Pepino, A. Dalgarno, and R. Lallement, *Spectra of X-ray Emission from the Heliospheric Gas*, EOS Trans. AGU, **85**, FXX (2004).

and reported in invited talks on Conferences:

- 2004 - Harvard-Smithsonian Center for Astrophysics Workshop, Cambridge, *The Charge-Exchange Mechanism of X-ray Emission*
- 2004 - AAS 204th Meeting, Denver, *Heliospheric and Cometary X-rays Induced by the Solar Wind*
- 2004 - 3^{rd} International IGPP Conference, California, *Atomic Processes in the Solar Wind*
- 2004 - 14^{th} APS Conferences on Atomic Processes in Plasmas, Santa Fe, *X-ray emission from comets, planets and heliospheric gas*

We continue our investigations according to the Management Plan: Calculations of X-ray spectra at different compositions of the solar wind; analysis of heliospheric EUV and X-rays observed with the Chandra, XMM-Newton, ROSAT, and EUVE telescopes. I would like to ask NASA administration to release the next year's award funds in the previously agreed-to amount of **$94,974.**

Sincerely,
Vasili Kharchenko