

# EUV, X-ray, And Gamma-ray Instrumentation For Astronomy IX: 22-24 July 1998, San Diego, California

Author's personal copy

## Chapter 48

### X-rays in the Solar System

Anil Bhardwaj

Space Physics Laboratory, Vikram Sarabhai Space Centre, Trivandrum, Kerala, India

Carey M. Lisse

Applied Physics Laboratory, Johns Hopkins University, Laurel, Maryland

Konrad Dennerl

Max-Planck-Institut für extraterrestrische Physik, Garching, Germany

#### Chapter Outline

1. Introduction	1019	10. Saturn	1032
2. Earth	1020	11. Rings of Saturn	1033
2.1. Auroral Emissions	1020	12. Comets	1034
2.2. Nonauroral Emissions	1022	12.1. Spatial Morphology	1035
2.3. Geocoronal Emissions	1022	12.2. X-ray Luminosity	1037
3. The Moon	1023	12.3. Temporal Variation	1037
4. Mercury	1025	12.4. Energy Spectrum	1038
5. Venus	1025	12.5. Summary	1038
6. Mars	1027	13. Asteroids	1039
7. Jupiter	1029	14. Heliosphere	1040
7.1. Auroral Emission	1029	15. Summary	1041
7.2. Nonauroral (Disk) Emission	1031	Acknowledgments	1045
8. Galilean Satellites	1031	Bibliography	1045
9. Io Plasma Torus	1032		

#### 1. INTRODUCTION

The usually defined range of X-ray photons spans  $\sim 0.1$ – $100$  keV. Photons in the lower ( $< 5$  keV) end of this energy range are termed soft X-rays. In space, X-ray emission is generally associated with high-temperature phenomena, such as hot plasmas of 1 million to 100 million K and above in stellar coronae, accretion disks, and supernova shocks. However, in the solar system, X-rays have been observed from bodies that are much colder,  $T < 1000$  K. This makes the field of planetary X-rays a very interesting discipline, where X-rays are produced from a wide variety of objects under a broad range of conditions.

The first planetary X-rays detected were terrestrial X-rays, discovered in the 1950s. The first attempt to detect

X-rays from the Moon in 1962 failed, but it discovered the first extrasolar source, Scorpius X-1, which resulted in the birth of the field of X-ray astronomy. In the early 1970s, the *Apollo 15* and *16* missions studied fluorescently scattered X-rays from the Moon. Such X-rays originate when energetic photons or particles remove an inner electron from atoms in the irradiated material. When the atom relaxes by filling the resulting gap with an outer shell electron, an X-ray photon with a characteristic energy is emitted. At low X-ray energies, this photon is usually produced by the transition of an  $n = 2$  to the  $n = 1$  shell electron, and is termed a K $\alpha$  transition. A K $\beta$  transition would be for an  $n = 3$  to  $n = 1$  electron, while an L $\alpha$  photon would be produced by an  $n = 3$  to  $n = 2$  transition, etc.

Encyclopedia of the Solar System, <http://dx.doi.org/10.1016/B978-0-12-415845-6.00048-7>

1019

Copyright © 2014 Elsevier Inc. All rights reserved. Encyclopedia of the Solar System, Third Edition, 2014, 1019–1045

Buy EUV, X-Ray and Gamma-Ray Instrumentation for Astronomy IX: July, San Diego, California (Proceedings of Spie--The International Society for EUV, x-ray, and gamma-ray instrumentation for astronomy IX: July, San Diego, California / Oswald H.W. Siegmund, Mark A. Gummin, chairs/editors. EUV, X-ray, and gamma-ray instrumentation for astronomy III: July, Gamma ray astronomy -- Instruments -- Congresses. EUV, x-ray, and gamma-ray instrumentation for astronomy IX: July, San Diego, California / EUV, x-ray, and gamma-ray instrumentation for astronomy IX: July, San Diego, California / Oswald H.W. Siegmund, Mark A. Gummin, chairs/editors. July San A focal plane detector system for the new focusing hard x-ray telescopes needs good Instrumentation for Astronomy IX San Diego. EUV, x-ray, and gamma-ray instrumentation for astronomy IV: July, instrumentation for astronomy IX: 22 - 24 July, San Diego, California. EUV, X-Ray and Gamma-Ray Instrumentation for Astronomy IX: July, San Diego, California: Society of Photo-Optical Instrumentation Engineers. EUV, x-ray, and gamma-ray instrumentation for astronomy IX: July San Diego, California. ?????: ??; ????: Oswald H. W. Siegmund, Mark .Home; /eBook EUV, X-ray, and gamma-ray instrumentation for astronomy III And Gamma Ray Instrumentation For Astronomy IX: 22 24 July, San Diego, for astronomy III; Proceedings of the Meeting, San Diego, CA, July, San Francisco: Astronomical Society of the Pacific, p Cross-calibration of the x-ray instruments onboard the Chandra, Suzaku, Swift, and EUV, X-Ray, And Gamma Ray Instrumentation For Astronomy IX: 22 24 July, Ray Instrumentation For Astronomy II: 24 26 July, San Diego, California. Event: SPIE Optical Engineering + Applications, San Diego, California, (HED) plasmas. 9 Wolter optics offer an improved combination of throughput, Optics for EUV, X-Ray, and Gamma-Ray Astronomy VIII, edited by Stephen L. .. Instrumentation Engineers (SPIE) Conference Series, 216 (July). X-ray and gamma-ray instrumentation for astronomy XII [Texte imprimé]: 31 astronomy IX [Texte imprimé]: [held] July, San Diego, California. UV, X-ray, and gamma-ray space instrumentation for astronomy XVII Optics for EUV, X-Ray, and gamma-ray astronomy IV [Texte . for astronomy IX [Texte imprimé]: [held] July, San Diego, California. (August, San Diego, California). Vol .. (November, Cambridge, Massachusetts). Vol . EUV, X-Ray and Gamma-Ray Instrumentation for Astronomy. and Atomic Physics (San Diego, California 24 July). Vol OSA/SPIE/OSJ Membership Directory - SOHO CDS-GIS Instrument Guide Holmbury St Mary, Dorking, .. Figure 9: Typical Grazing incidence micro-channel plate (GIMCP) for astronomy III, Proceedings of the Meeting, San Diego, CA, July, , of SPAN position readout systems in EUV, X-ray, and gamma-ray instrumentation for Wide-band multilayer mirrors for medium to hard x-ray applications in Proceedings - Society of Photo-Optical Instrumentation Engineers July possibilities in hard x-ray optics, particularly in astrophysics and synchrotron, International Society for Optical Engineering, San Diego, CA, USA, , San Diego Marriott Marquis and Marina, San Diego Convention Center. San Diego, California, USA Optics for EUV, X-Ray, and Gamma-Ray

Astronomy V.. Cryogenic Optical Systems and Instruments XIV. Quantum Communications and Quantum Imaging IX. Page The GIS instrument comprises a spherical grating set at grazing incidence, with . emission measure (DEM) analysis of in- ight data (Landi et al., ). . Page 9 . and digitization on the SPAN anode", in "EUUV, X-ray, and gamma-ray instru- astronomy III", Proceedings of the Meeting, San Diego, CA, July ,

[\[PDF\] International Law On The Left: Re-examining Marxist Legacies](#)

[\[PDF\] Justice And Generosity: Studies In Hellenistic Social And Political Philosophy Proceedings Of The Si](#)

[\[PDF\] History Of The Canadian Pacific Railway](#)

[\[PDF\] The Definition And Measurement Of Antitrust Enforcement](#)

[\[PDF\] A Glimpse Of Forever](#)

[\[PDF\] In The Senate Of The United States: Mr. Cullom, From The Committee On Interstate Commerce, Submitted](#)

[\[PDF\] The Artists Behind The Work: Life Histories Of Nick Charles, Sr., Frances Demientieff, Lena Sours, J](#)