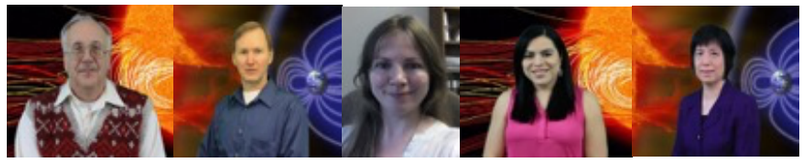
New Techniques for Imaging Earth's Magnetosphere



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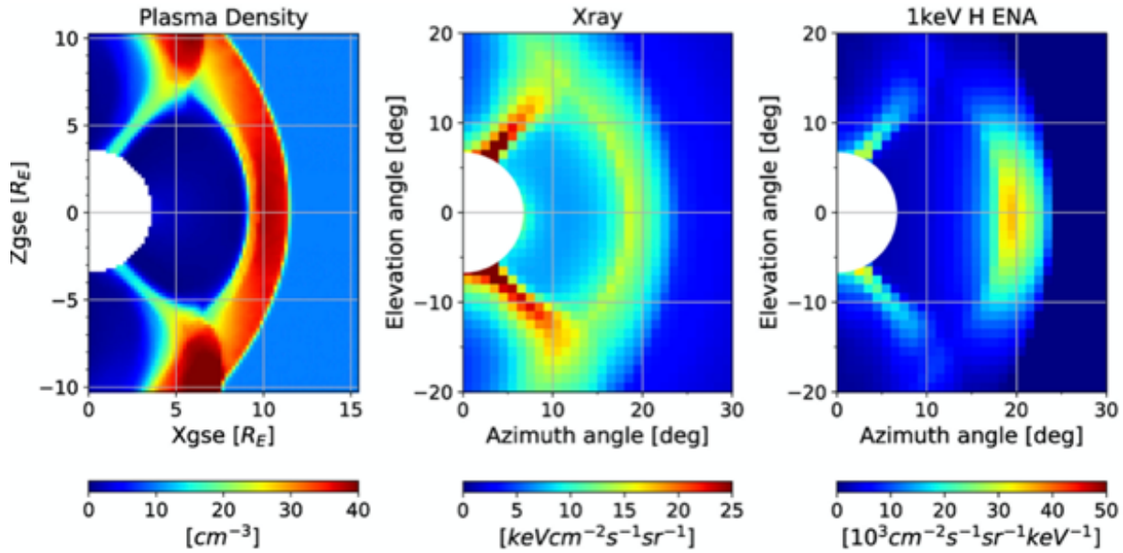
The Hubble Space Telescope (HST) and Solar Dynamics Observatory (SDO) provide amazing images that not only help scientists understand our universe but serve as a gateway for the people of all ages to experience and explore nature's wonders. HST shows us planets in our solar system and objects in the farthest regions of the visible universe. SDO provides near-real times images of our Sun in wavelengths visible to us but mostly ones we can't see with our eyes and actually ones that we can only see from space, outside of our thick atmosphere. What SDO tells us is that the Sun is always spewing out light, material, and magnetic fields that interacts with everything in the solar system from planets we can see with HST to the one we live on, Earth.

When this happens at Earth, the material and magnetic fields from the Sun clash with Earth's magnetic field created a complicated tear-drop shaped structure around our planet with its tail pointing away from the Sun. This "magnetosphere" is huge, at some parts reaching out past the Moon. We fly spacecraft through it to study the details of this structure, which not only impacts the space environment around our planet but also affect parts of our atmosphere. The magnetosphere doesn't give off light we can "see" but this dynamic structure does radiate in X-rays and energetic atoms called ENAs. Capturing those X-rays and ENAs would allow us the make an image of the magnetosphere giving us a real picture of the global structure.

The LEXI and SMILE missions will provide soft X-ray images of the Earth's magnetosphere after their anticipated launch in 2023 and 2024, respectively. Other future missions will do the same using ENAs. This paper introduces two innovative imaging techniques that use soft X-rays and ENAs to visualize the Earth's sunward side of the magnetosphere. The paper simulates the images missions using these techniques would see. **This research will help scientists understand how the space environment affects Earth's atmosphere.**



The first image shows a model density of Earth's magnetosphere. The next two images show simulated "pictures" of the magnetosphere in Xrays and energetic neutral atoms (ENAs), respectively.

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