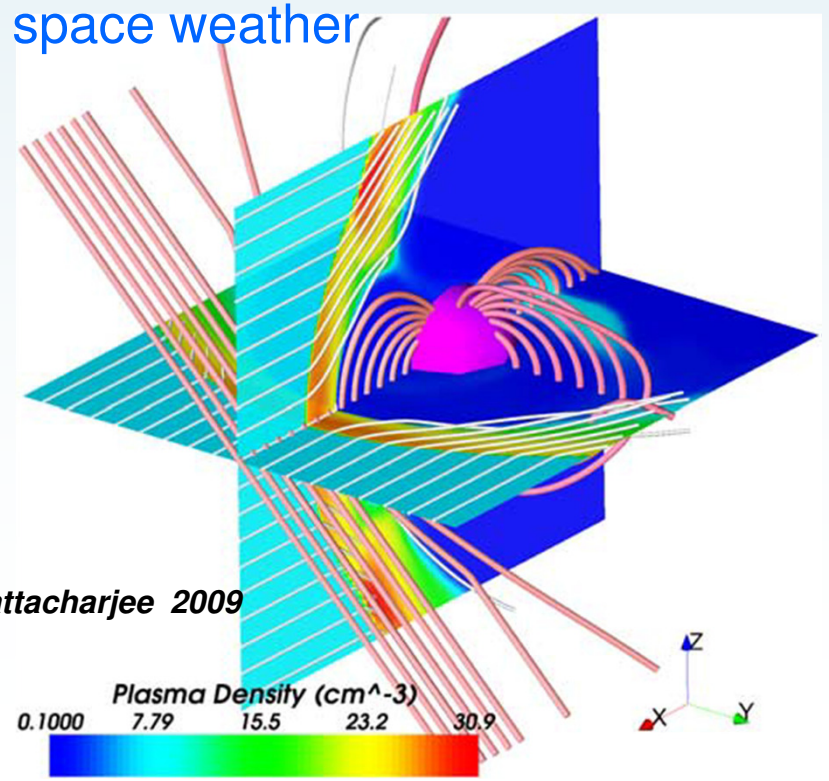
Summary remarks → open discussion

- Aim is **understanding the micro- and macro-scale processes** controlling the transport of mass, energy and momentum from the SW to the Earth's magnetosphere and ionosphere

- This will enable the development of **numerical simulations** which accurately reproduce (and help predict) space weather

- Global simulations require **global validation** measurements

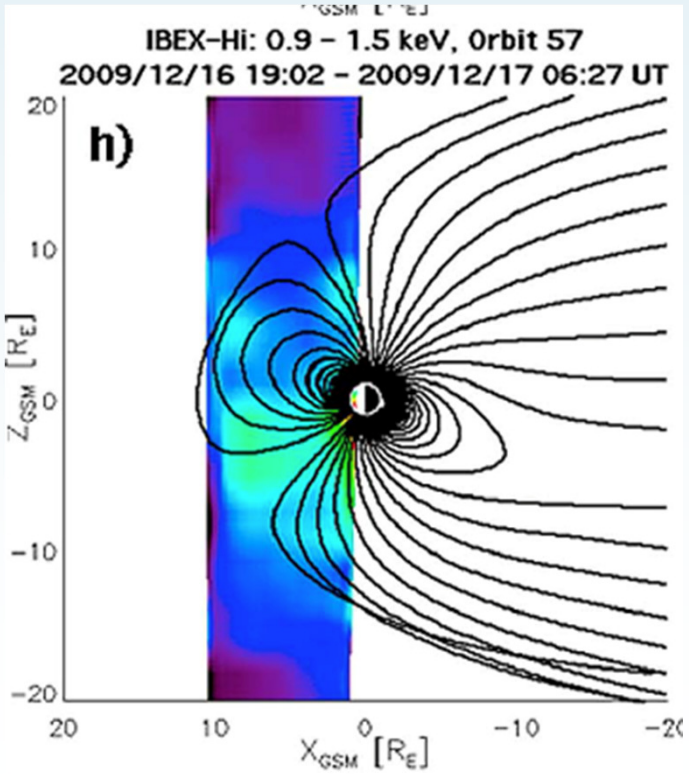
- Global measurements are needed to determine the extent/significance of proposed phenomena



Dorelli & Bhattacharjee 2009

Summary remarks (2)

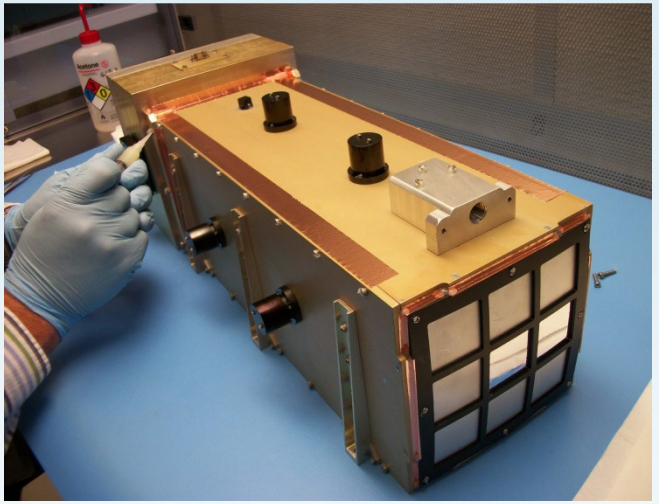
- Short of implementing constellation-type missions, **global imaging** can provide the necessary data
- Closest we have gone so far is the **IBEX ENA imaging** of the bow shock, magnetopause and cusps
- However, integration time is very long (10-20 hrs) and resolution limited (4-6 R_E), while boundary dynamics occurs much faster (minutes) and on smaller scales (1 R_E)
- Hence the need for a **new regime of global imaging** based on the SWCX of high charge state SW ions with exospheric neutrals
- And a **prototype** has actually been flown!

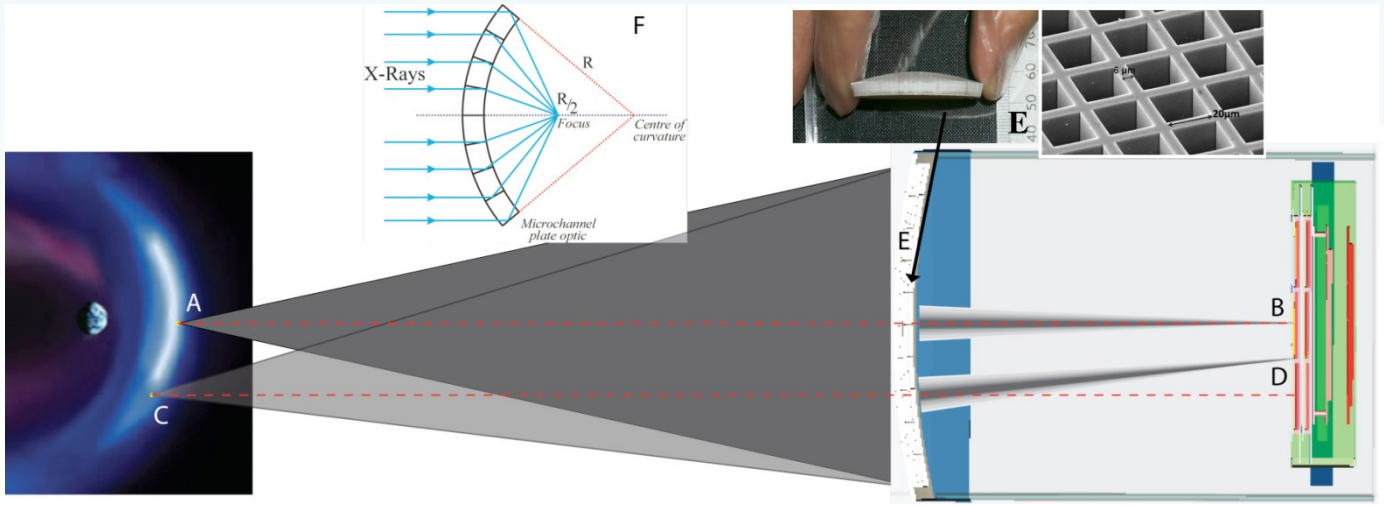


Petrinec et al. 2011

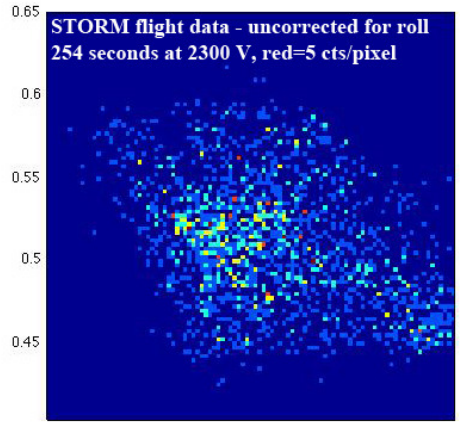
Prototyping

- A **wide FOV soft X-ray telescope** operated successfully on the Dec. 2012 DXL (*Diffuse X-ray emission from the Local galaxy*) rocket flight using Lobster-eye micropore optics developed by the Univ. of Leicester & Photonis + an MCP detector with a wedge and strip anode





Collier et al. 2013



- See Thomas et al. SPIE, submitted, 2013

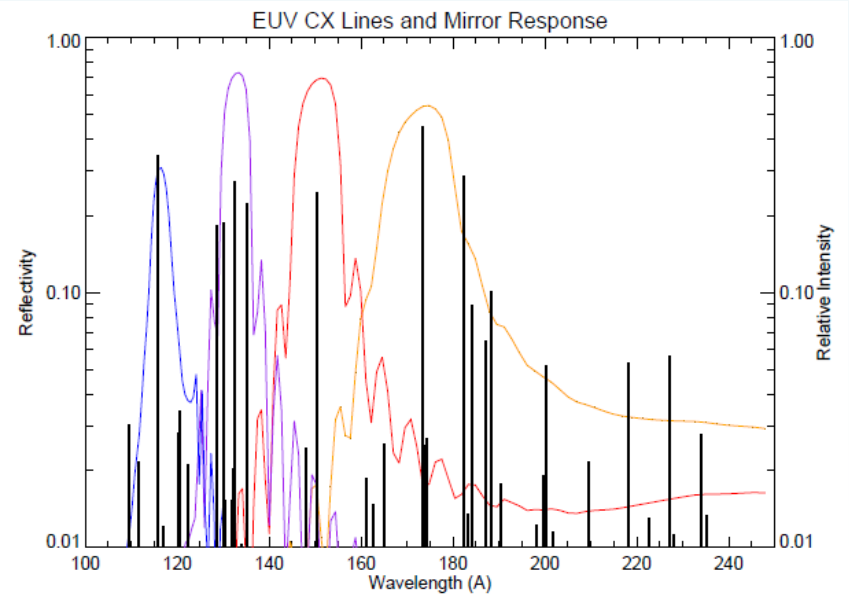
Current studies

- Recently proposed implementations such as AXIOM suffer from complex **PSFs** and limited **effective areas**, hence low sensitivity, resolution, and measurement cadence

- CX produces emission lines from FUV to EUV to soft X-rays

- S. Sembay, J. Carter and A. Read (2013) turned their attention to EUV: **normal incidence mirrors with multilayers** for energy band selection, greater effective area and spatial resolution

- Baseline: 1.4 m diameter mirror, FOV 7°, 20 cm radius detector (CCD, MCP, intensified CCD), optical blocking filter

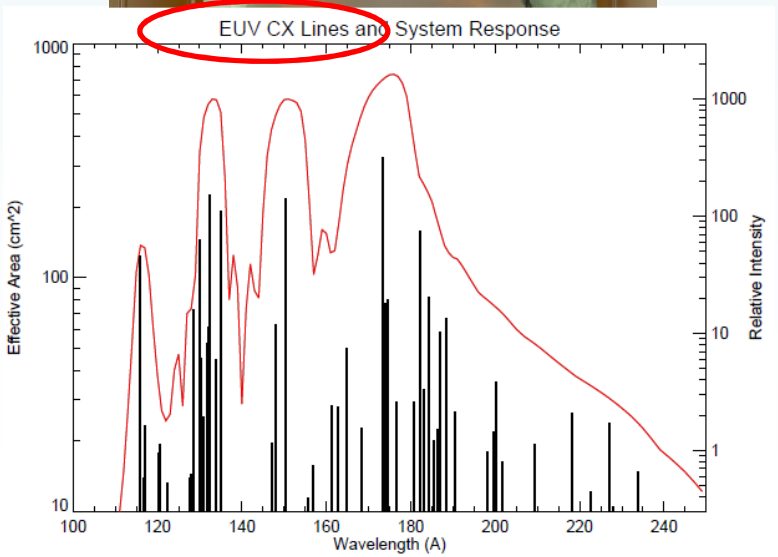


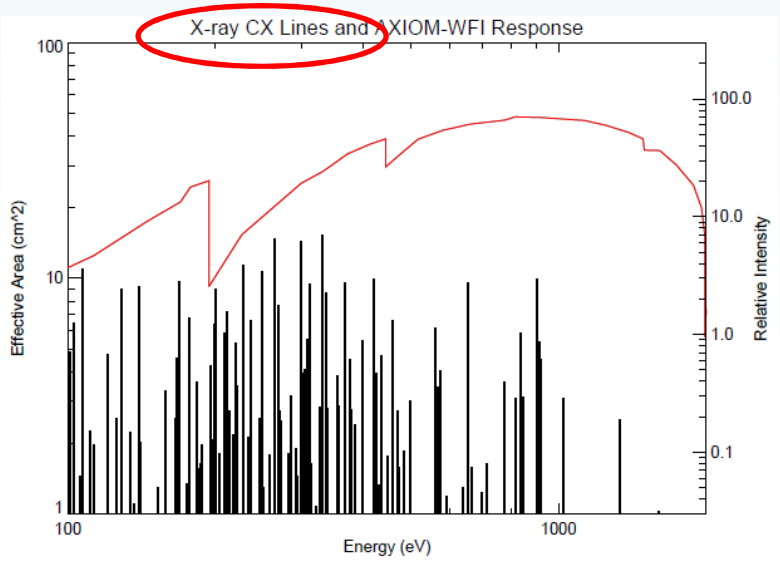
EUV and soft X-rays?

Magnetospheric structures detectable by the AXIOM WFI would be detected by the EUV imager (best case example) in ~ **150x less time**

Pauer et al. 2010

Possible solution: combine EUV imager with small Lobster-type optics X-ray imaging spectrometer, providing high quality spectra integrated over larger spatial scales and longer time intervals





Looking to the future …

- **Forthcoming ESA M4 opportunity**
- Worth considering **all that can be fitted** in a M-size cost envelope:
  - Combination of fast EUV and slow soft X-ray telescopes
  - Ideally add a small spacecraft for simultaneous in situ plasma measurements
- Imaging the **plasmasphere** and outer **magnetospheric boundaries in EUV** could attract community support
- Success requires **a range** of imaging targets and techniques
- Purpose of this session is to **highlight** the new technique of high energy global imaging and begin **exploring possible complementary activities** in view of a realistic response to the M4 mission opportunity