



NICER observations of comets:
charge exchange close and far

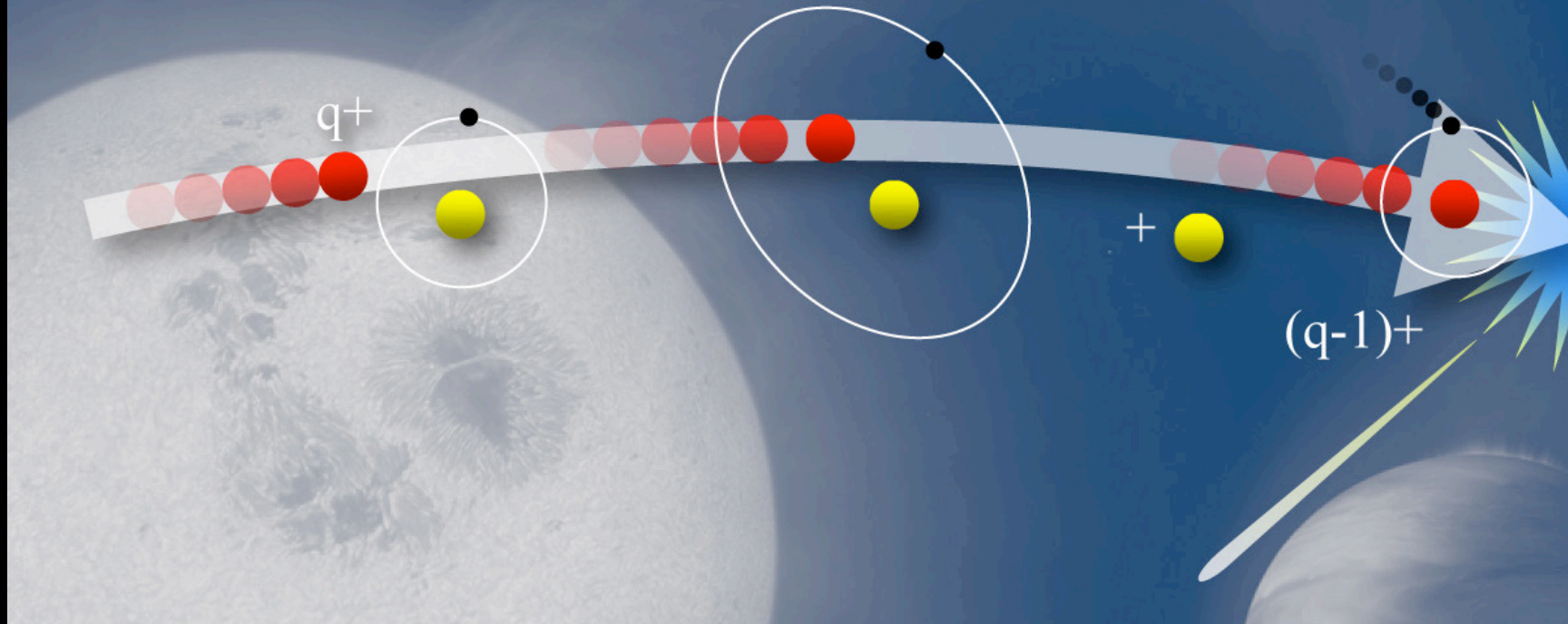
Dennis Bodewits, Thomas Deskins,
Damian Christian, Konrad Dennerl



NICER is very well suited to study comets and solar system objects

- Comets are extended sources: NICER has a large FOV
- Comets are moving across the sky
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Charge Exchange



Charge exchange reactions are quasi resonant and the resulting spectrum:

- Depends on velocity of the ion
- Depends on the electron donor (target gas)

Laboratory work on reactions is on going

Charge Exchange

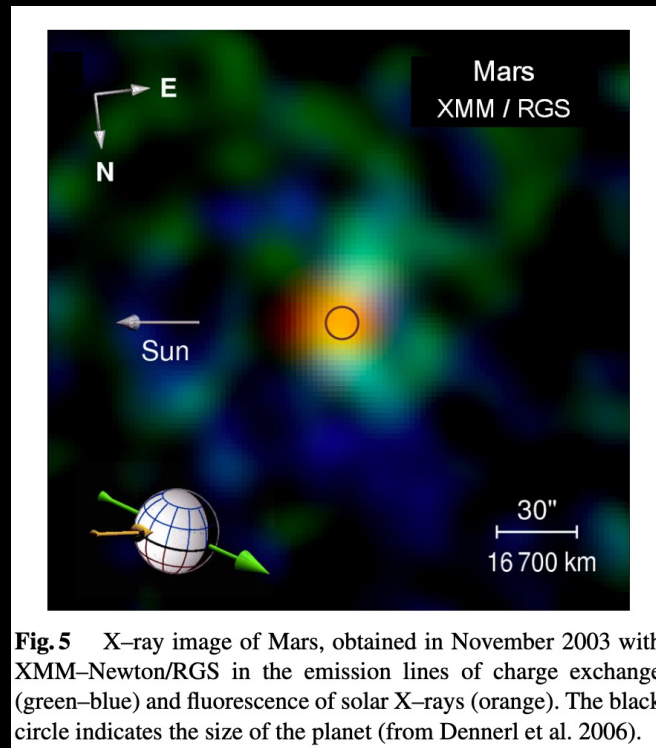
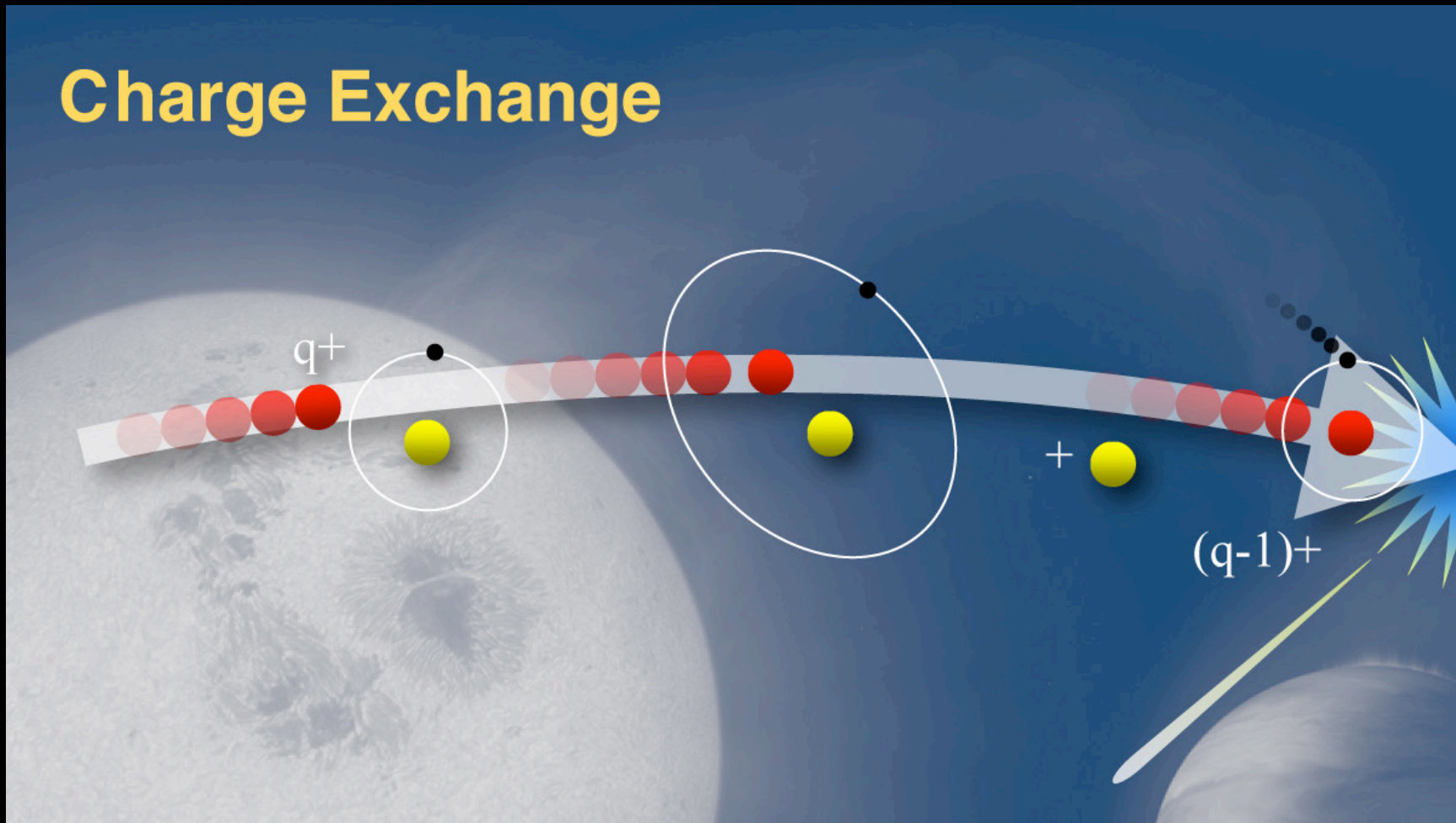


Fig. 5 X-ray image of Mars, obtained in November 2003 with XMM-Newton/RGS in the emission lines of charge exchange (green-blue) and fluorescence of solar X-rays (orange). The black circle indicates the size of the planet (from Dennerl et al. 2006).

Charge exchange reactions occur anywhere a hot plasma and a cold gas collide:

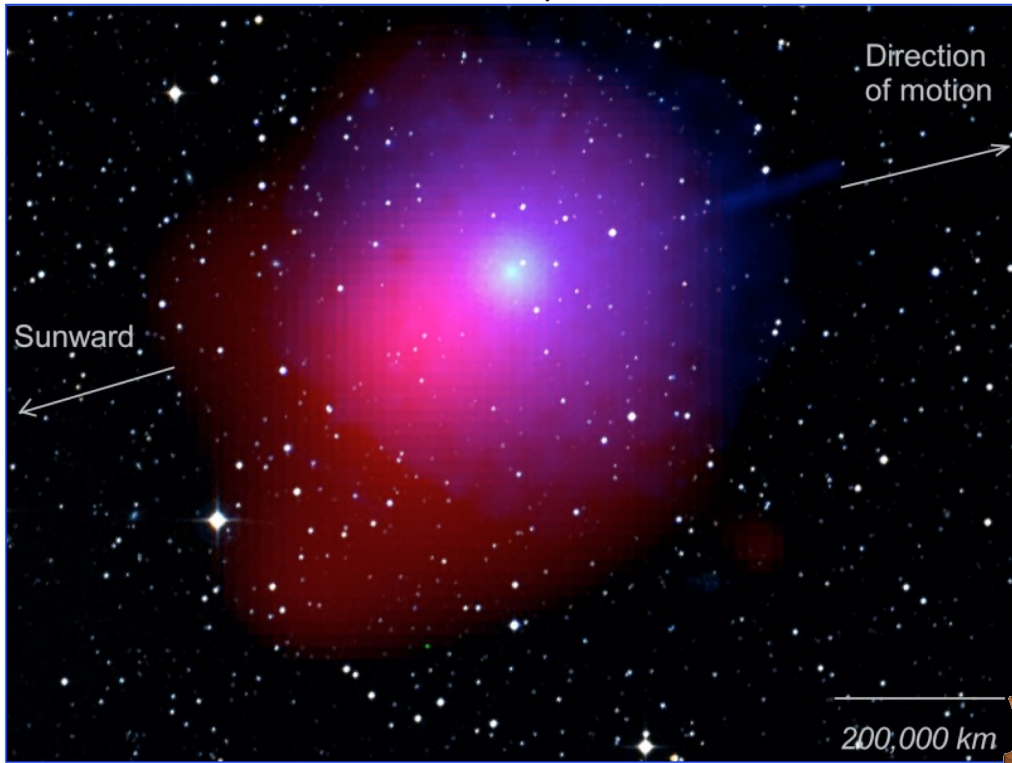
- Cometary atmospheres and planetary exospheres
- Supernova remnants and the interstellar medium
- Galactic halos
- Fusion reactors

Comets are accessible charge exchange laboratories

Astronomy Picture of the Day

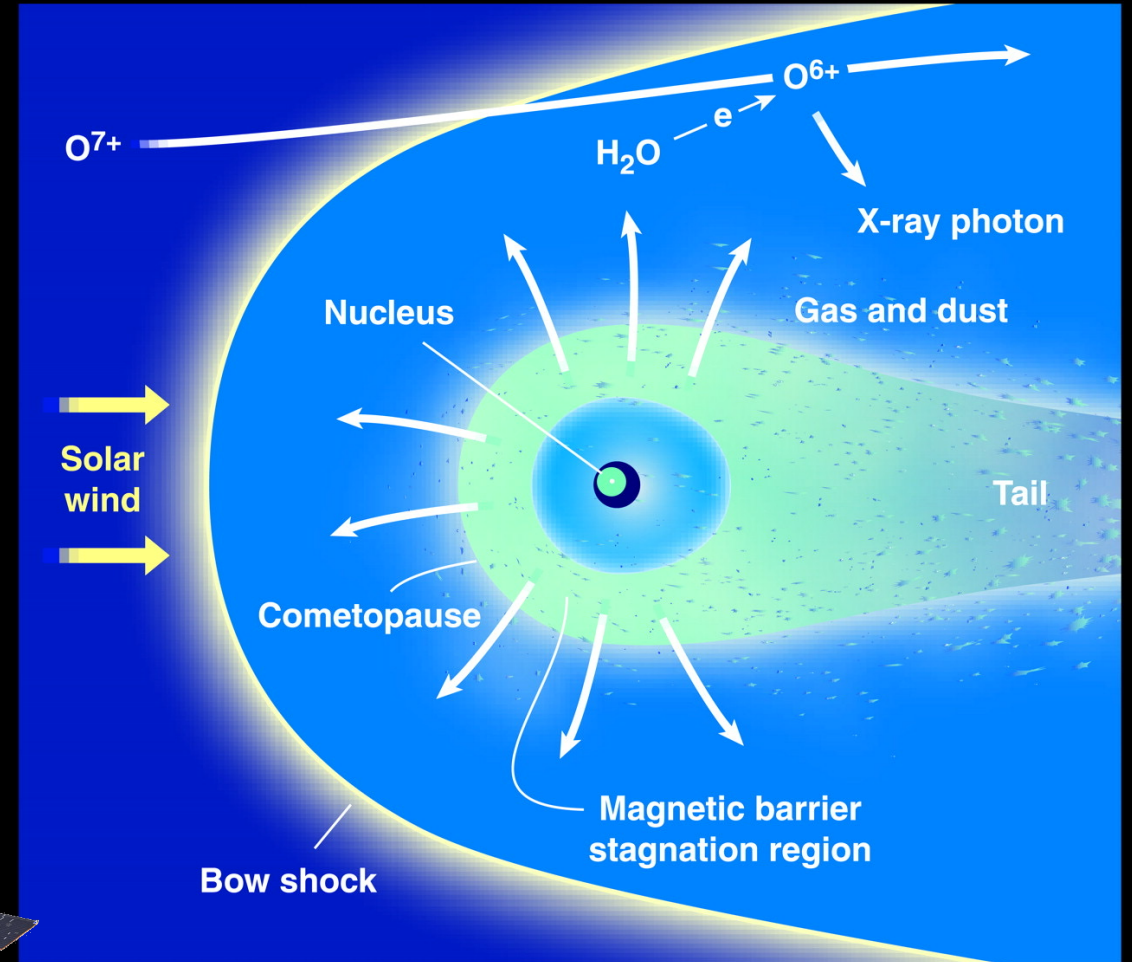
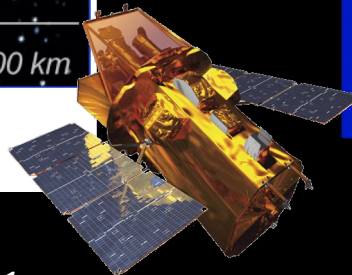
[Discover the cosmos!](#) Each day a different image or photograph of our fascinating universe is featured, along with a brief explanation written by a professional astronomer.

2009 February 21



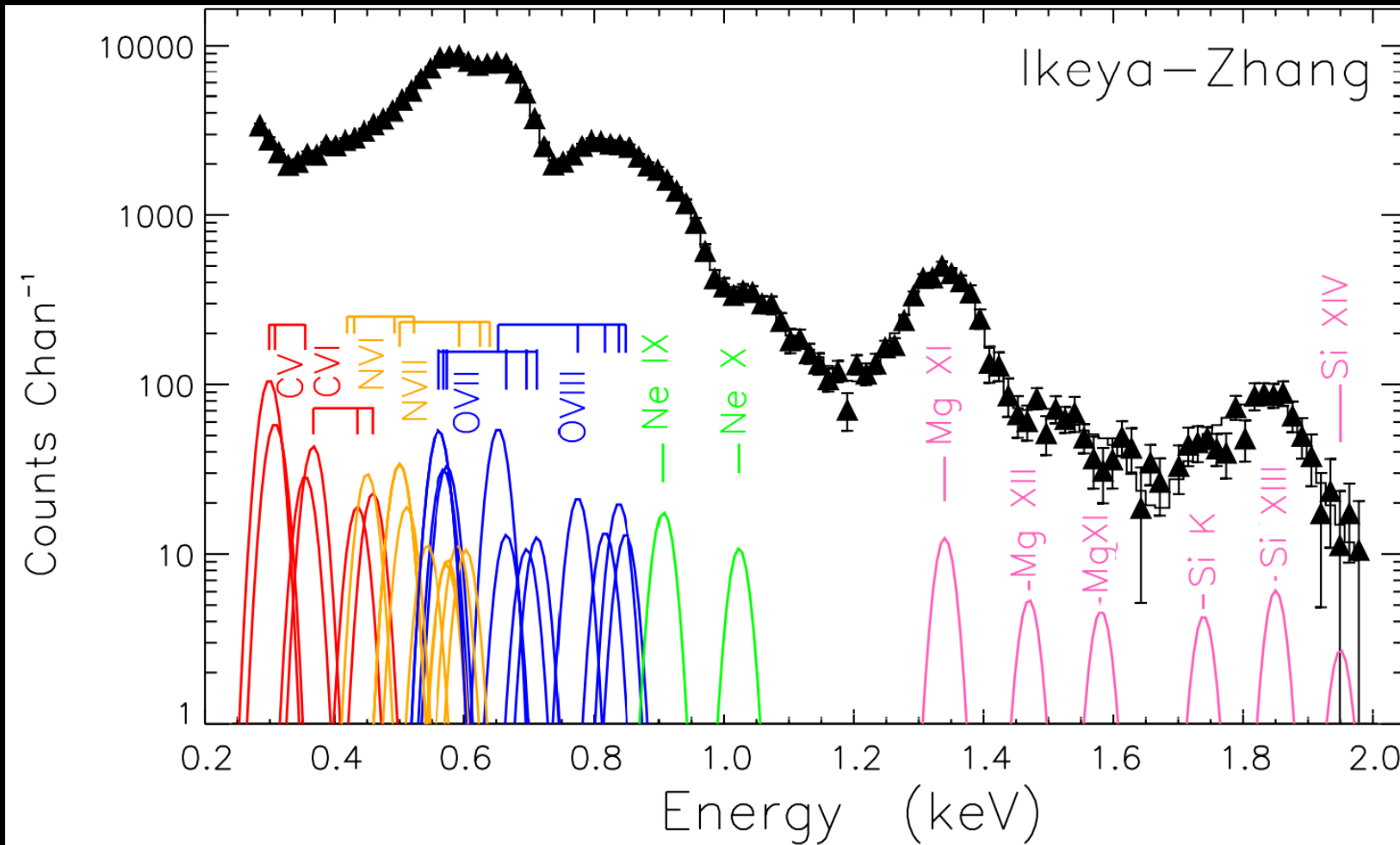
The Swift View of Comet Lulin

Credit: [NASA](#), [Swift](#), [Univ. Leicester](#), [DSS](#) (STScI/AURUA),
Dennis Bodewits (NASA/GSFC), [et al.](#)



Cravens 2002

Solar wind charge exchange spectra



Cometography.com/M. Jäger

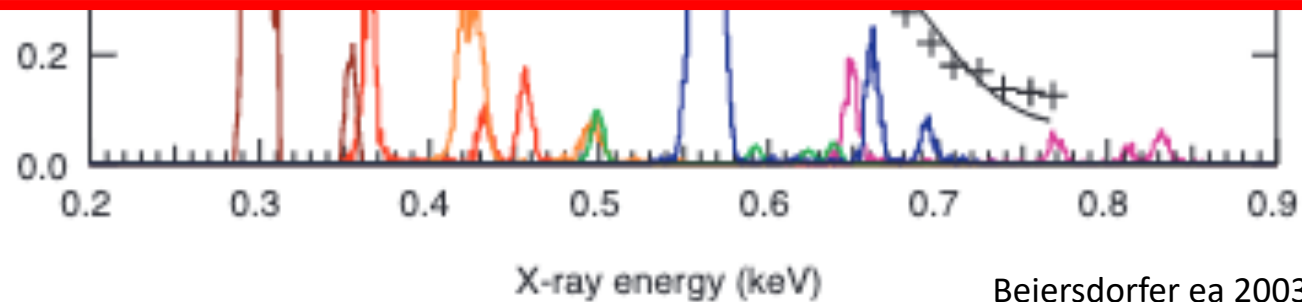
This is exactly the background spectrum you all try to model and remove

Solar wind charge exchange spectra

The Astronomy and Astrophysics Reviews manuscript No.
(will be inserted by the editor)

Solar Wind Charge Exchange: An Astrophysical Nuisance

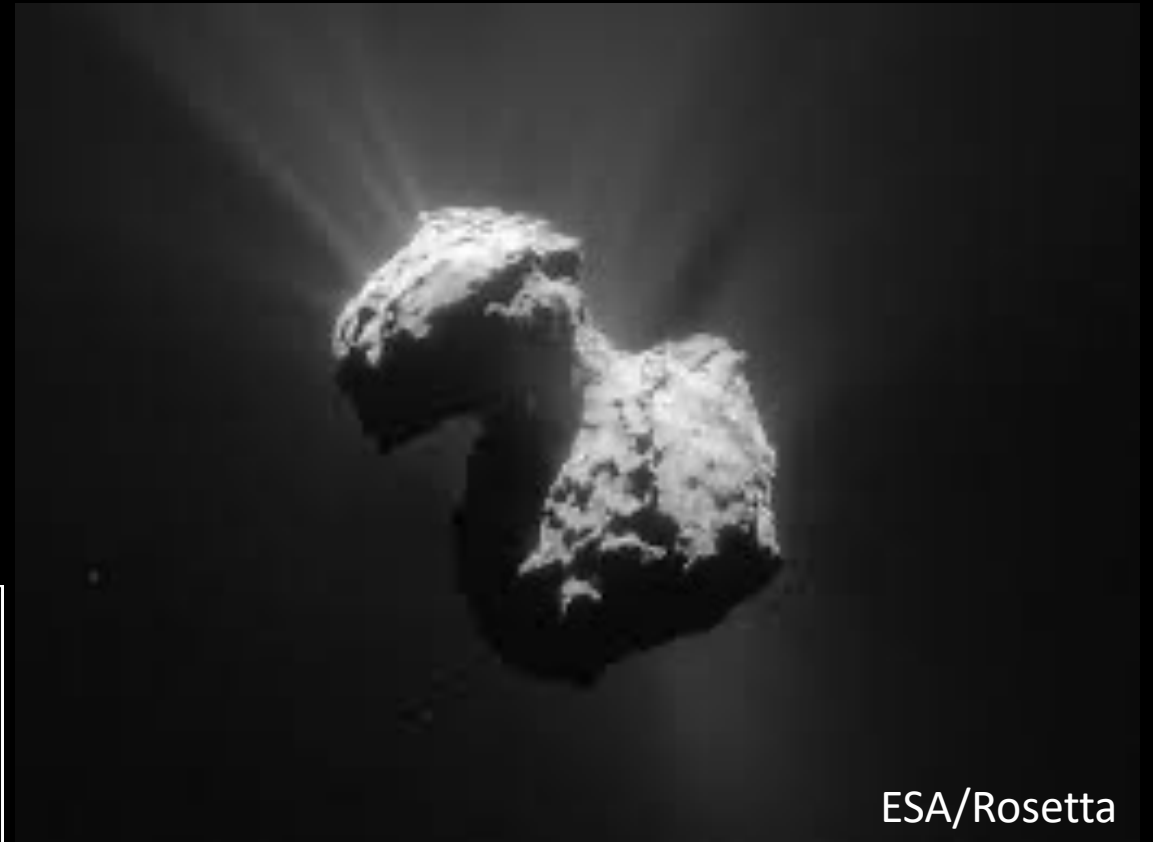
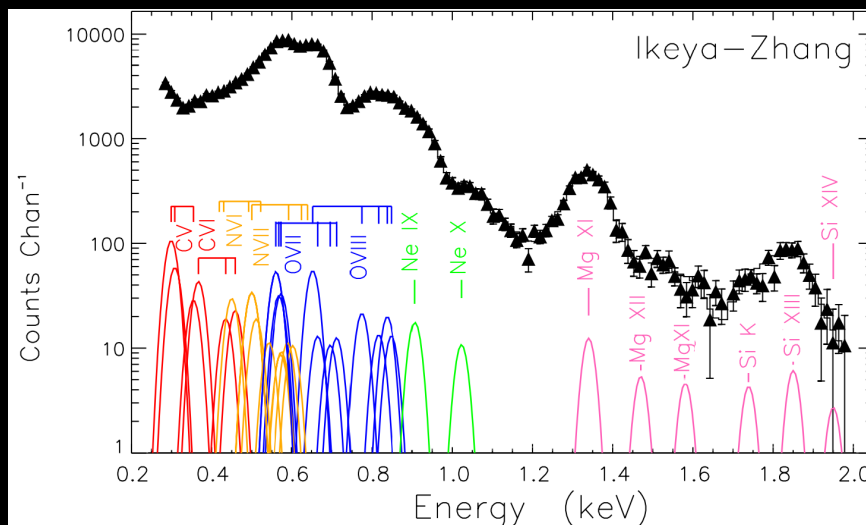
K. D. Kuntz



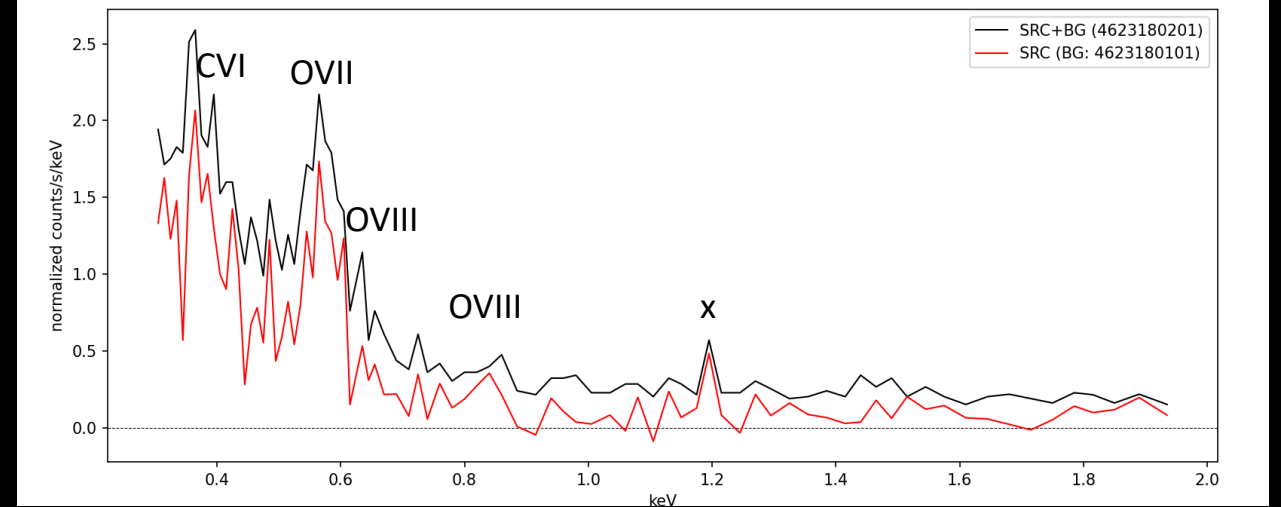
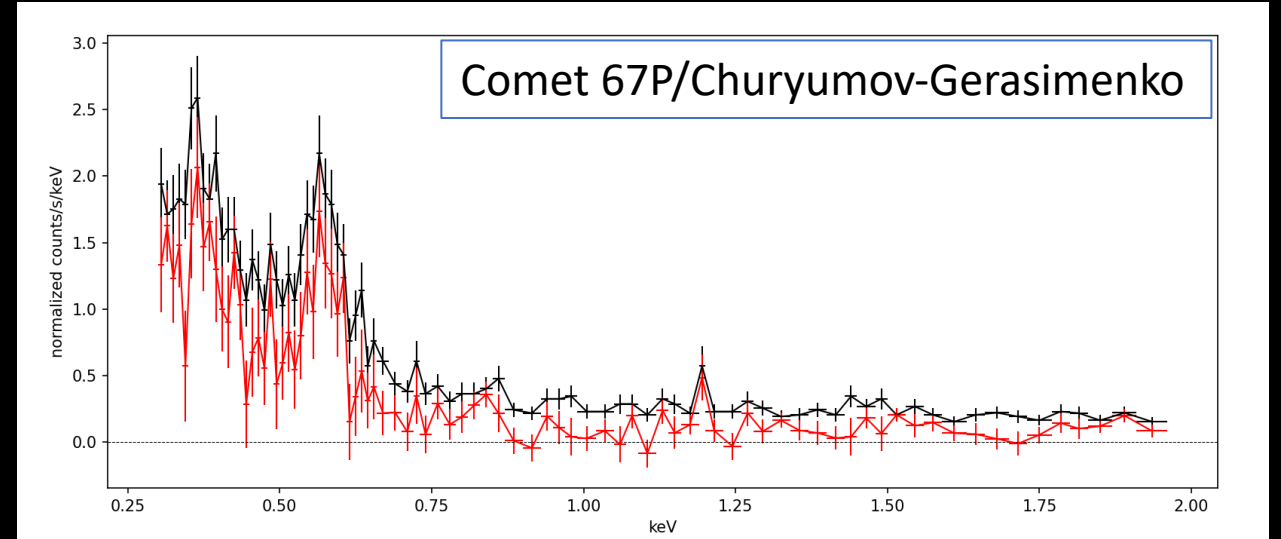
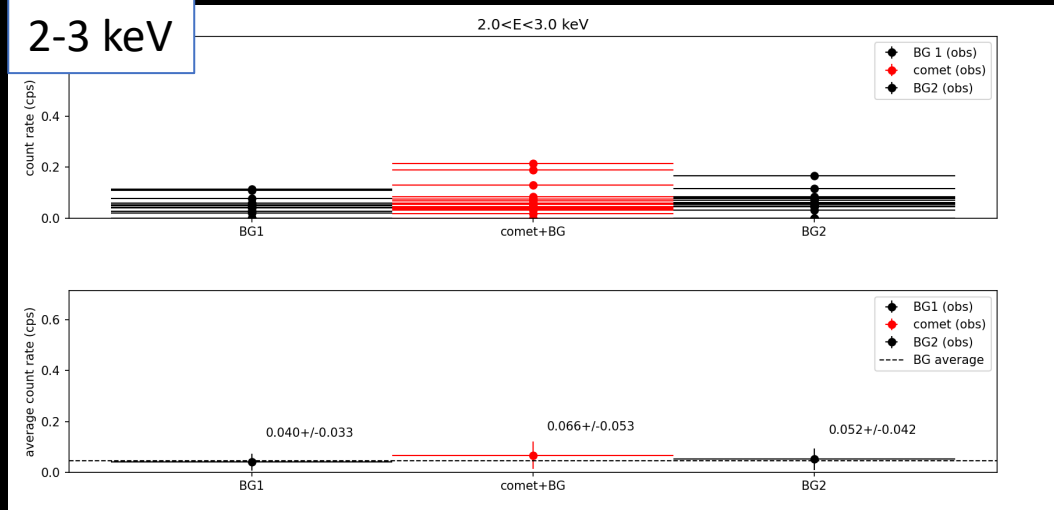
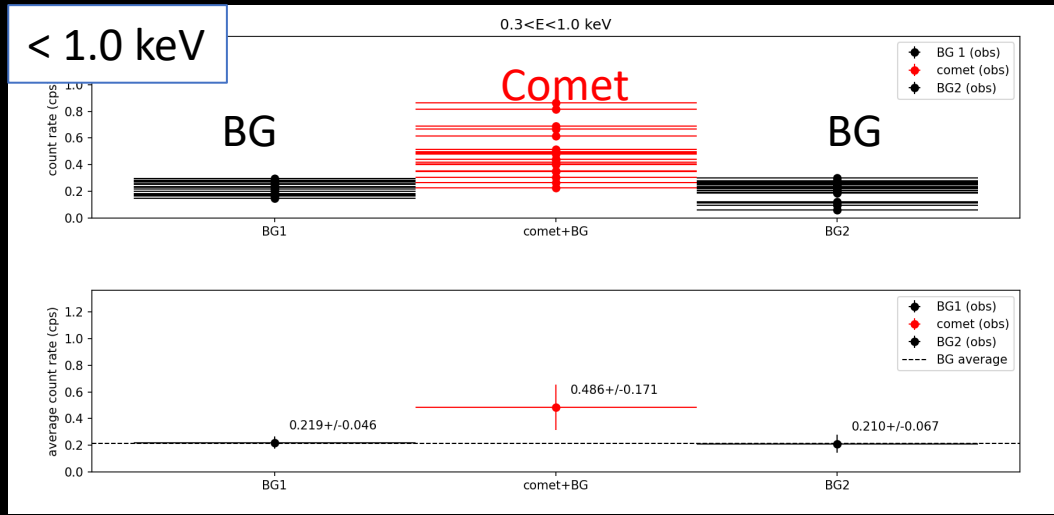
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Example science case 1: Rosetta's 67P

- Mission ended in 2015
- Comet had close approach in 2021 (0.45 AU)
- Dust and gas conditions are very well known
- Proximity to Earth allows us to use solar wind measurements at L1
- Compare Rosetta plasma suite results with global interaction
- Are there any emission features between 1-2 keV?



Observing strategy: shadow observations

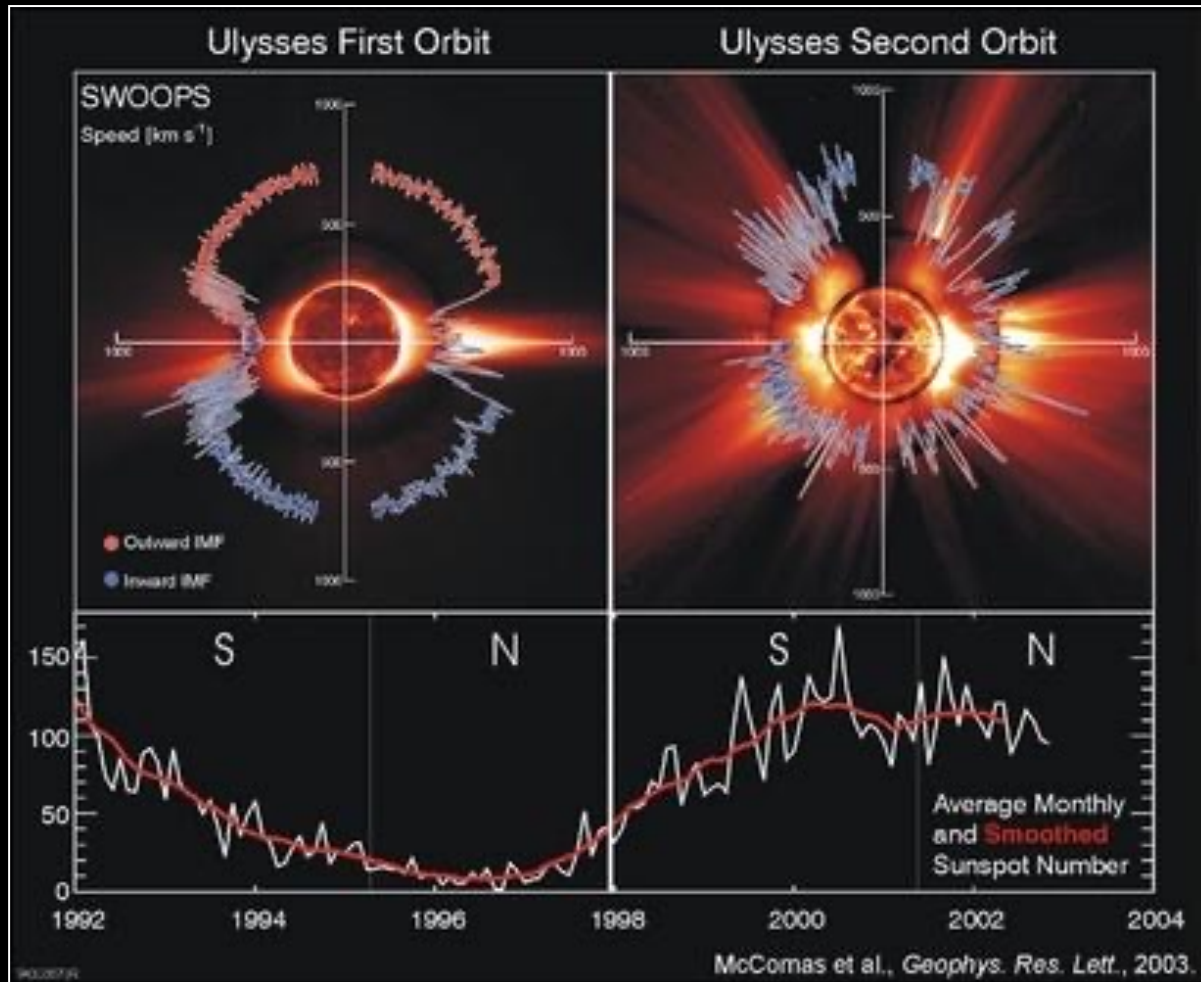


T-48h

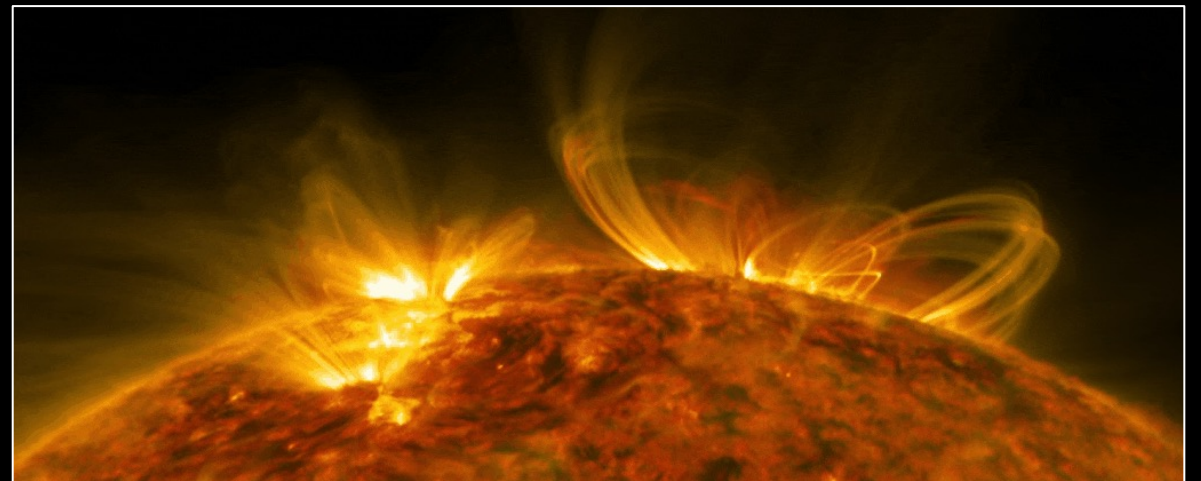
T+48h

Deskins ea (in prep)

Case 2: Comet X-rays vary on different time scales



- Solar flares: 10s of minutes
- Comet rotation/outbursts: hours-days
- CIRs: hours-day
- CMEs: days
- Solar rotation: 27 days
- Solar cycle: 11 years

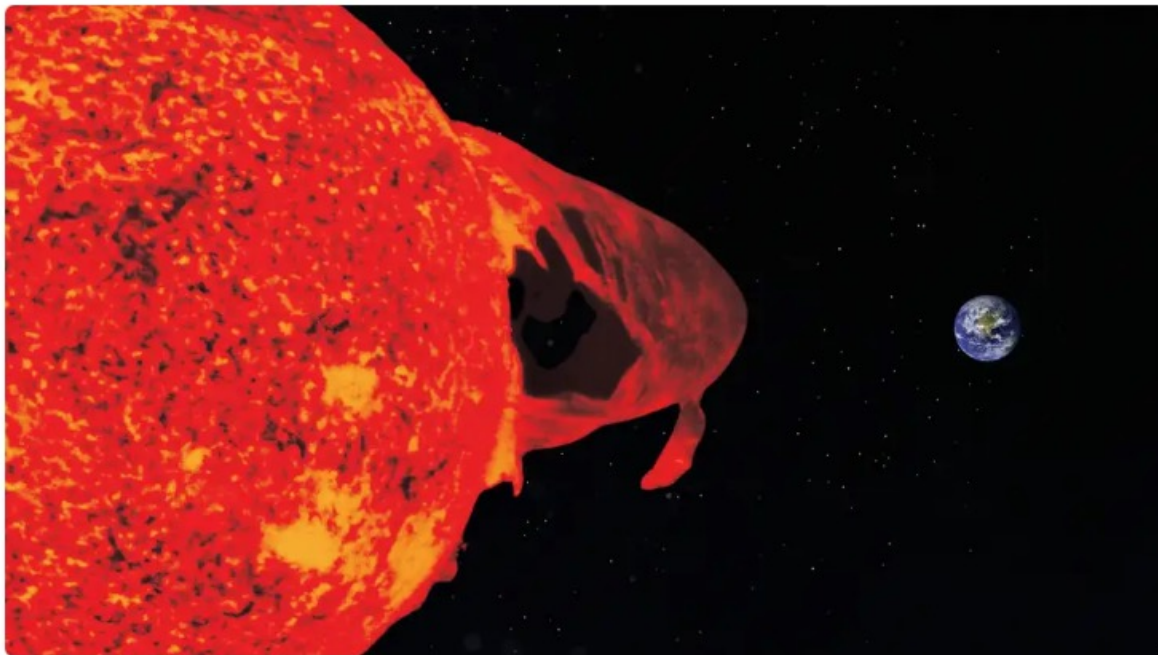


Example science case 2: rough space weather

SPACE SCIENCE

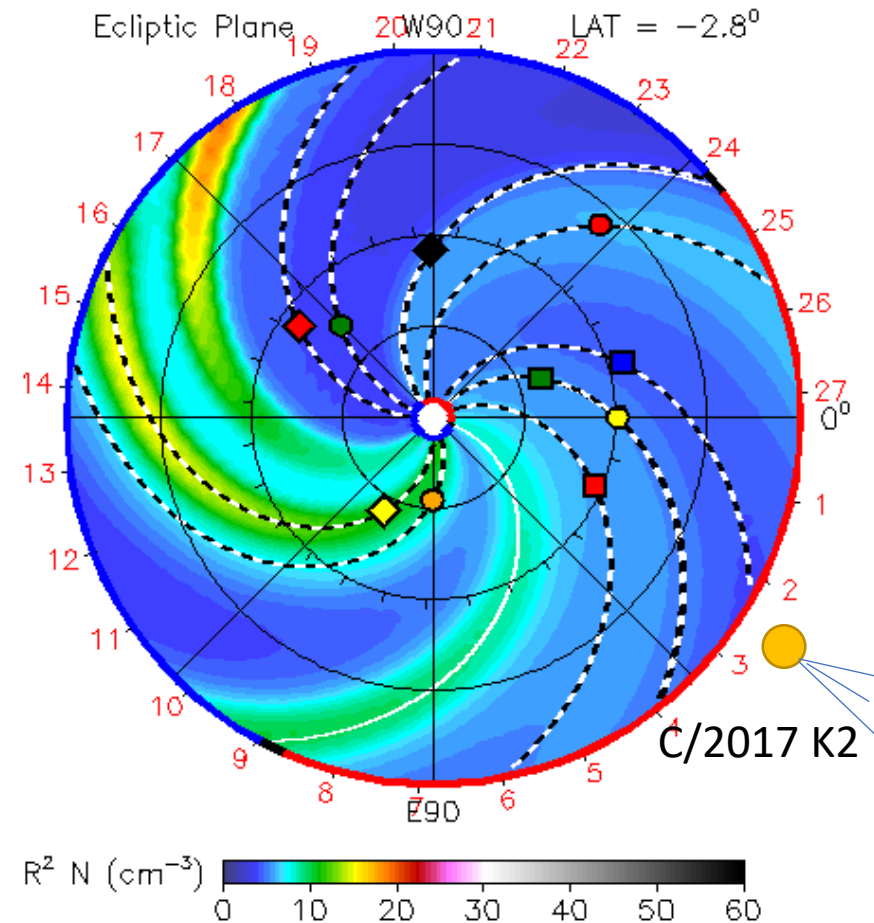
'Cannibal Coronal Mass Ejections' to Trigger Geomagnetic Storms on August 18; Power Grid Fluctuations, Auroras Expected

By TWC India Edit Team · 16 August, 2022 · TWC India



2022-08-13T00:00

Earth Mars Mercury Venus
Stereo_A Stereo_B



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Thank you!



dennis@auburn.edu