DXL: A SOUNDING ROCKET MISSION TO MEASURE SOLAR WIND CHARGE EXCHANGE

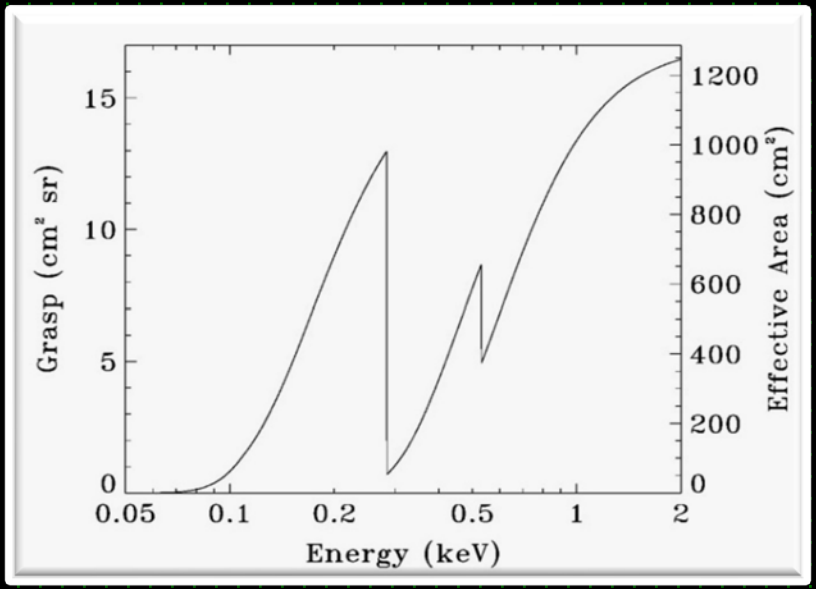
Meng Chiao, Michael R. Collier, Thomas Cravens, **Massimiliano Galeazzi,** Dimitra Koutroumpa, Kip Kuntz, Susan Lepri, Wenhao Liu, Dan McCammon, Rousseau Nutter, F. Scott Porter, Russell Roberts, Ina Robertson, Steve Snowden, Kayla Spencer, **Nicholas Thomas**, **Dhaka Sapkota**, **Youaraj Upreti**

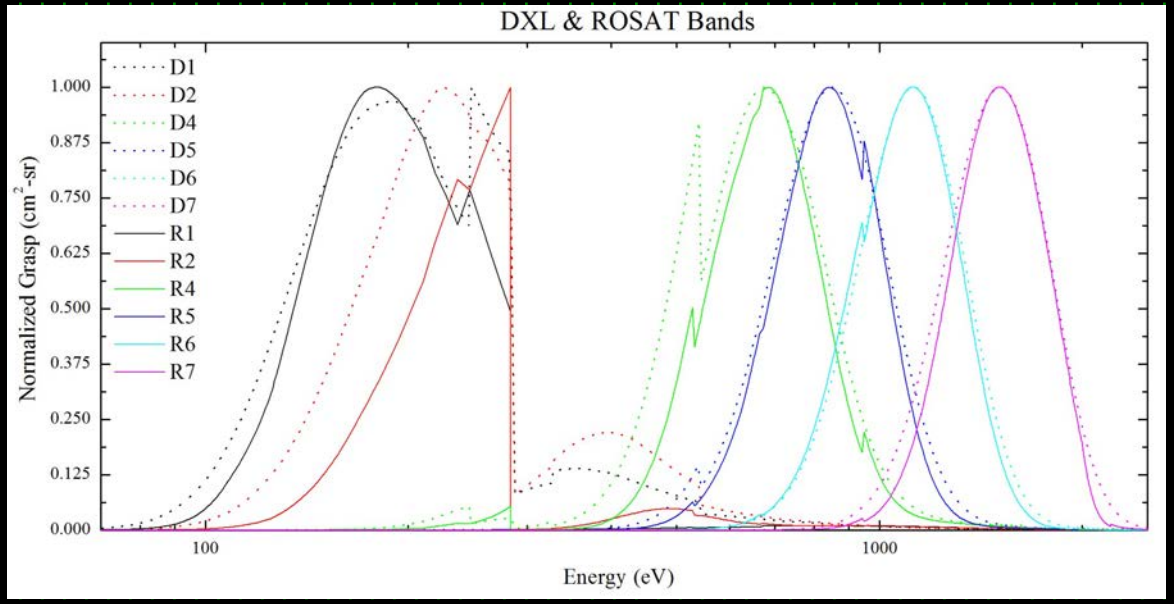
THE DXL INSTRUMENT

- Sounding rocket mission for the study of the Local Hot Bubble and SWCX
- 4 co-aligned X-ray proportional counters
- >1,000 cm^2 effective area, 7.5 deg FOV
- C, B, and Be filters
- High response from 40 eV to 10 keV
- 1-D images generated by rolling the payload
- Launched from WSMR, NM on 12/12/2012 and 12/6/2015, from PFFF, AK on 1/16/2018, and from WFF, VA on 1/9/2022
- First Demonstration in Space of Lobster-eye Optics

UNIVERSITY OF MIAMI

DXL RESPONSE





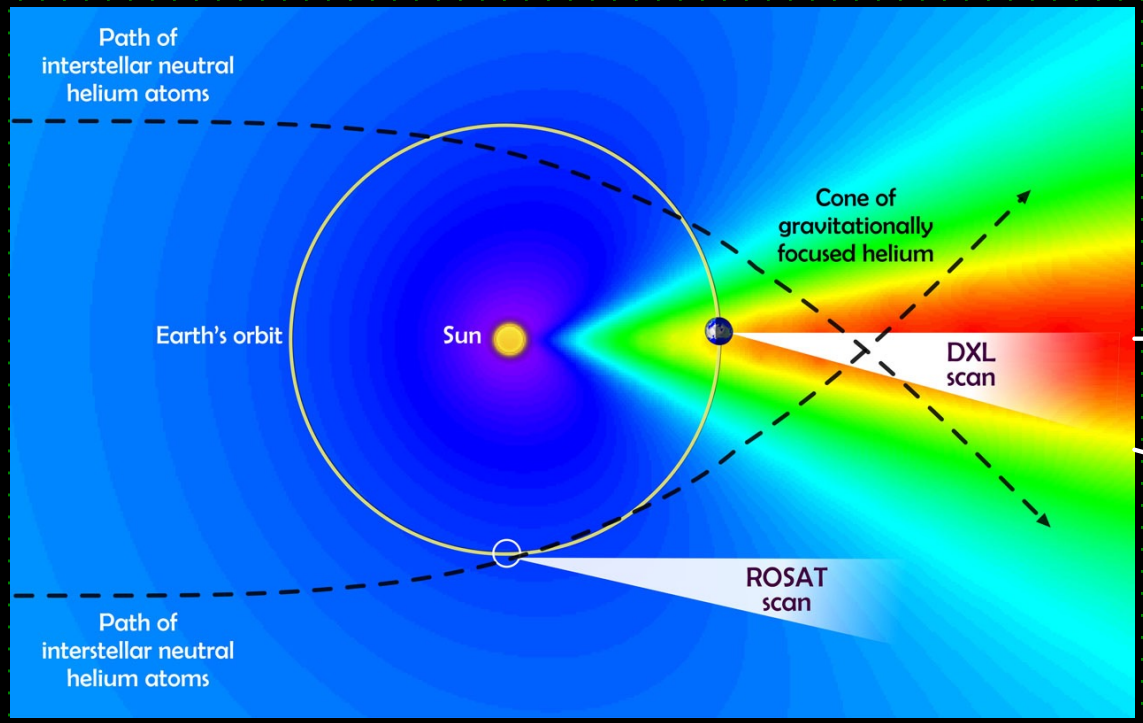
XMM-Newton has a grasp about 150 times smaller at ¾ keV requiring 40,000 s

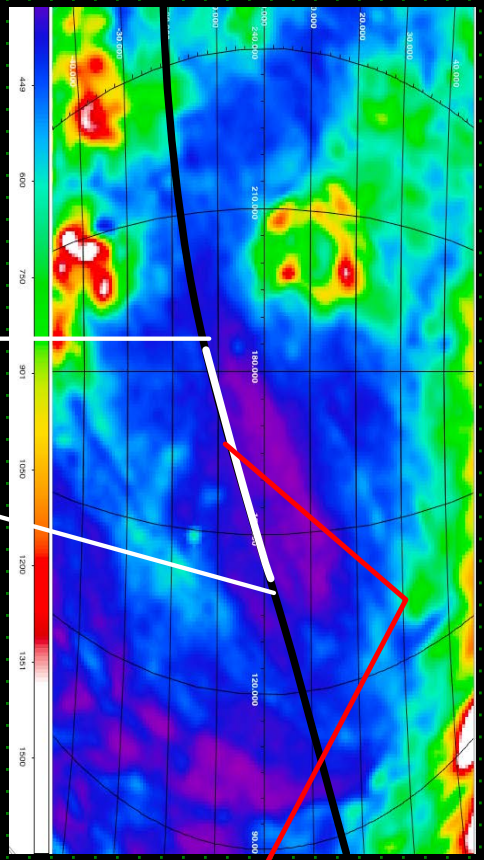
Suzaku about 2,000 times smaller, requiring 600,000 s of observing time

At lower energy the situation is much worse, in the ¼ keV band their effective area drops well below 100 cm^2, making any science there essentially impossible

UNIVERSITY
OF MIAMI

DXL STRATEGY (FLIGHTS #1 & 2)





- DXL should measure an excess emission due to SWCX from the He focusing cone

Slow scan region

UNIVERSITY OF MIAMI

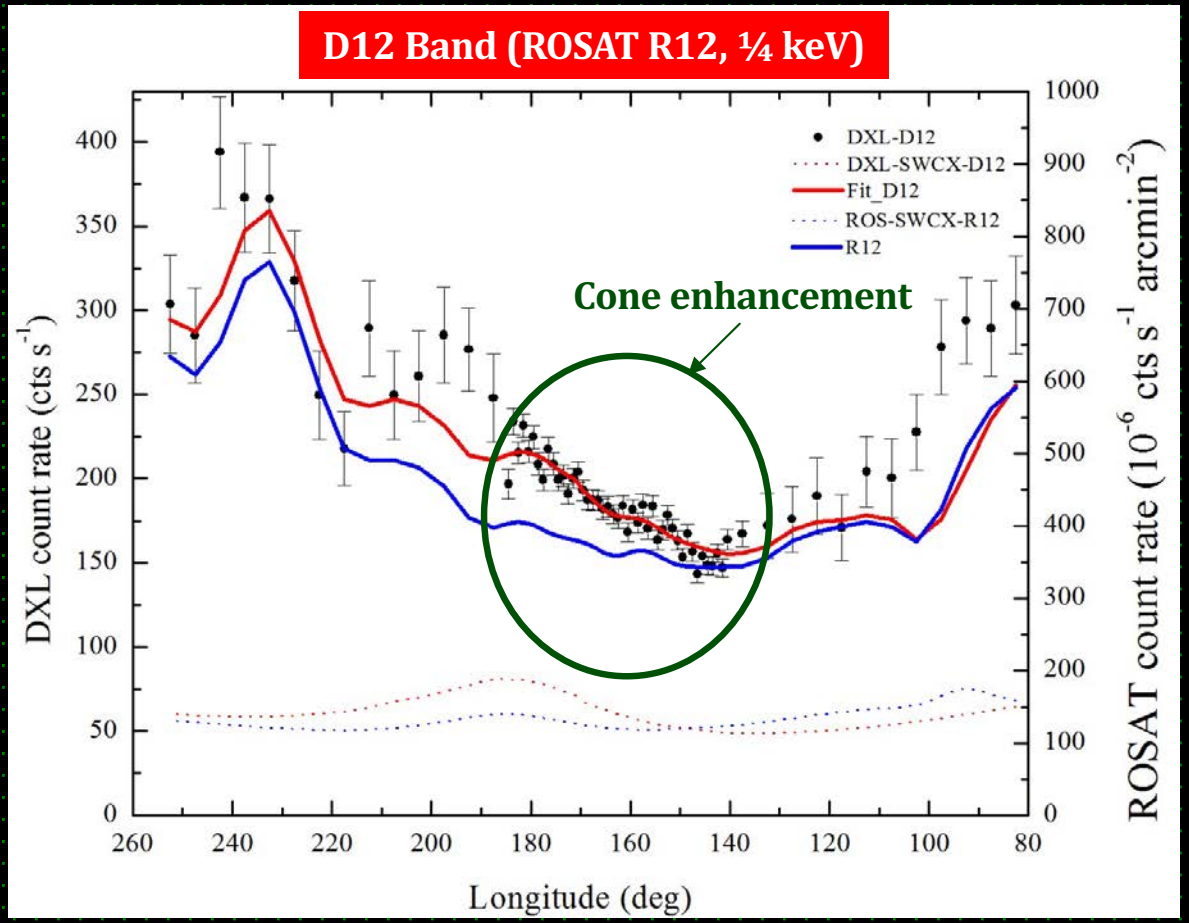
DXL RESULTS (FLIGHTS #1 & 2)

Galactic plane: 36%±5% (±5% systematic error)

Averaged over the whole sky: 27%±4% (±5% systematic error)

Local Hot Bubble the major contributor to ¼ keV emission

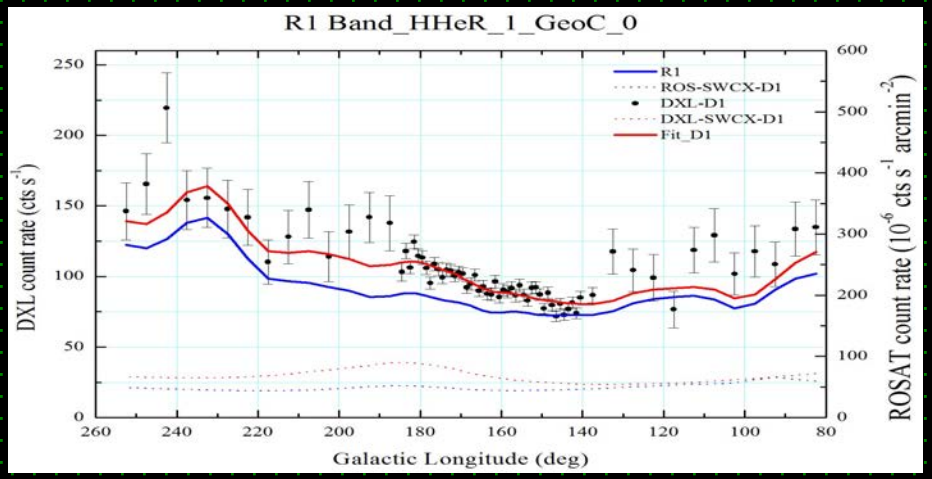
SWCX less than 40% in the ¼ keV band

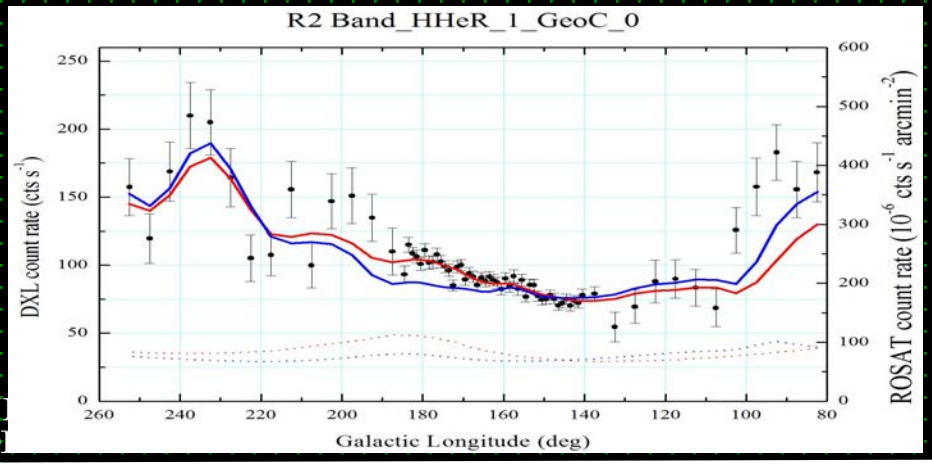


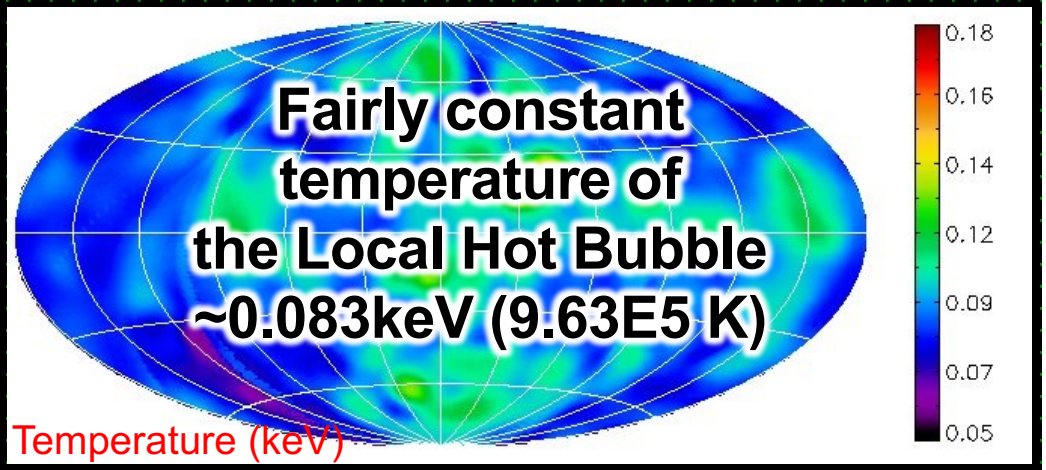
UNIVERSITY OF MIAMI

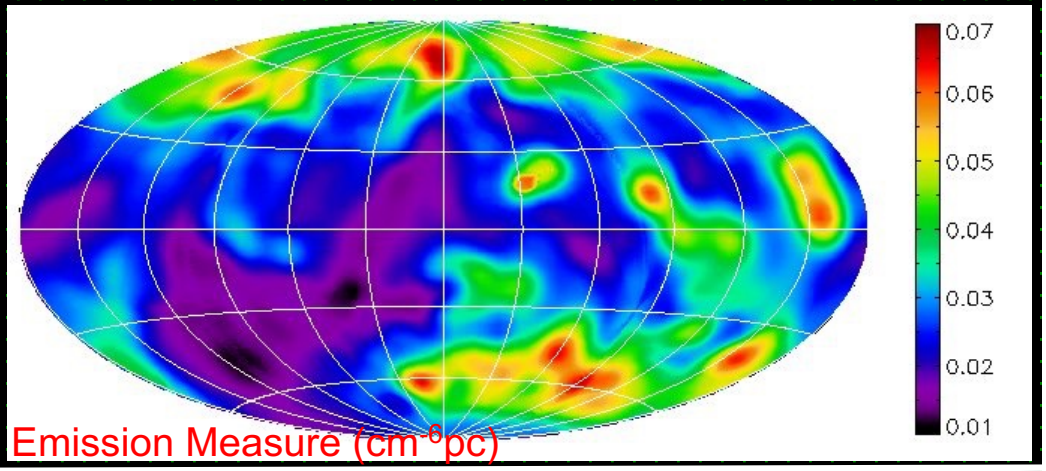
Galeazzi et al. 2014, Nature 512, 171

THE LOCAL HOT BUBBLE



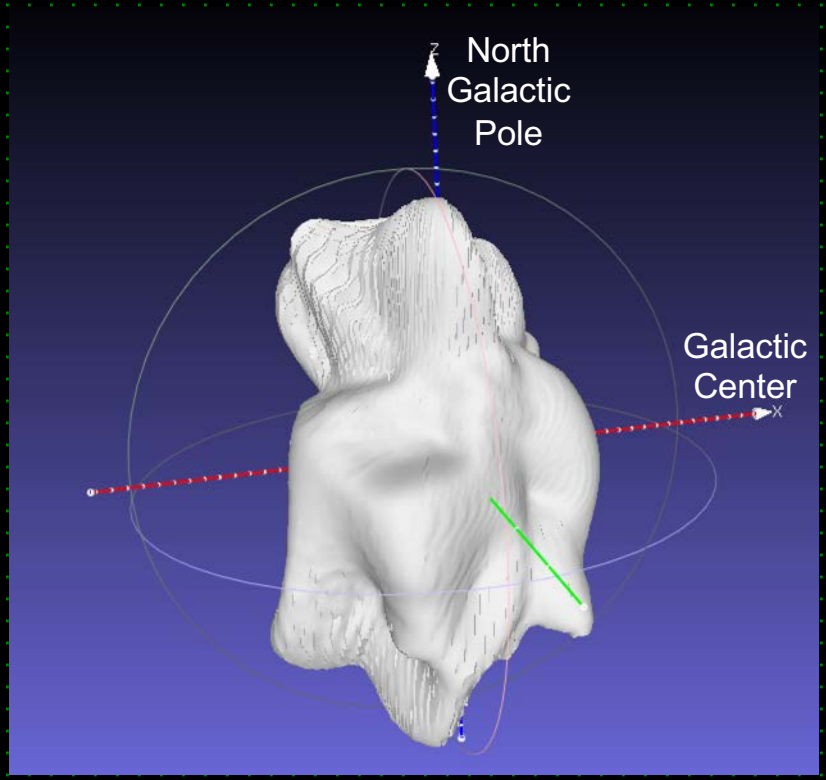




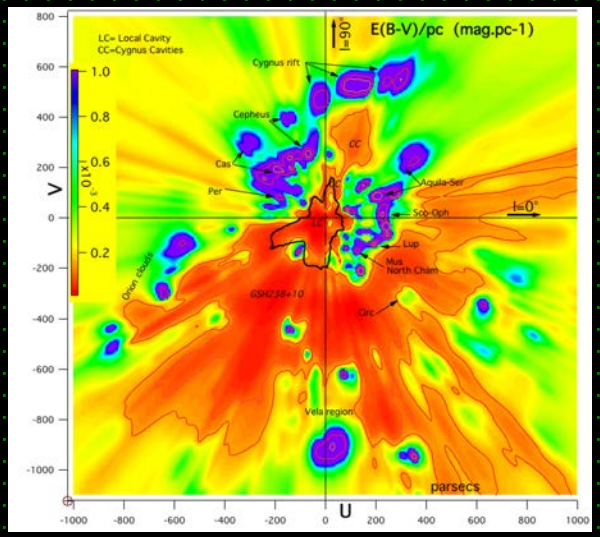


Liu et al., 2017, ApJ; 834,33 Uprety et al. 2016, ApJ829,83

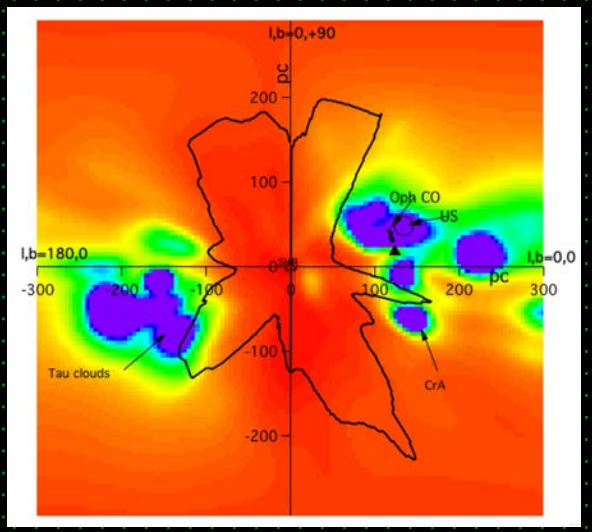
THE LOCAL HOT BUBBLE



Horizontal Plane



Vertical Plane (I=0,180)



Data From Lallement et al. 2014

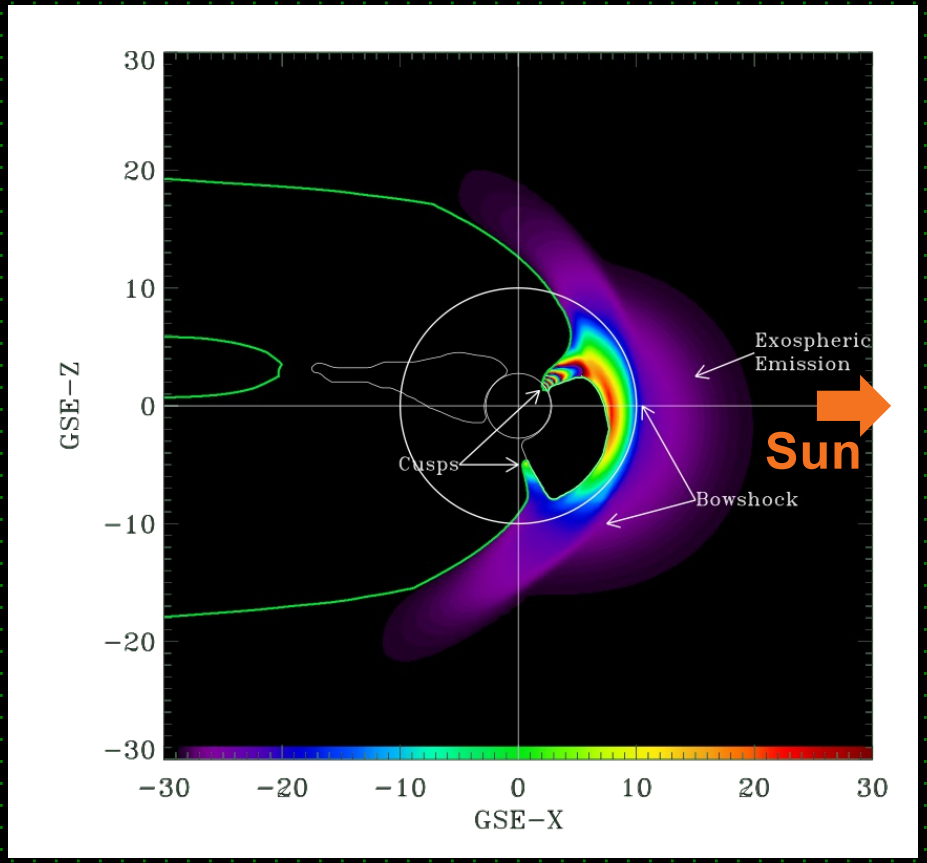
3D model of LHB

UNIVERSITY
OF MIAMI

Liu et al., 2017, ApJ; 834,33 Uprety et al. 2016, ApJ829,83

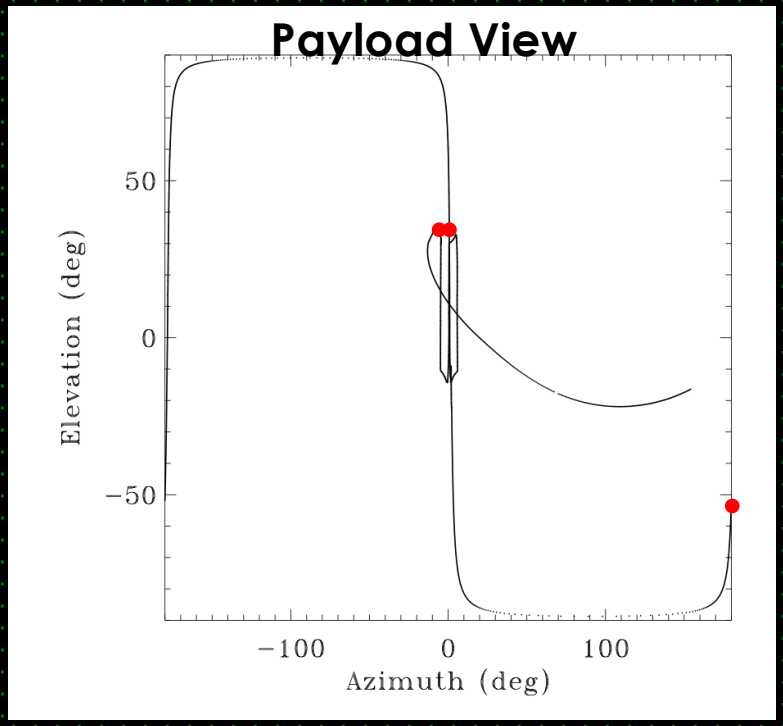
FLIGHTS # 3 & 4 SCIENCE GOAL

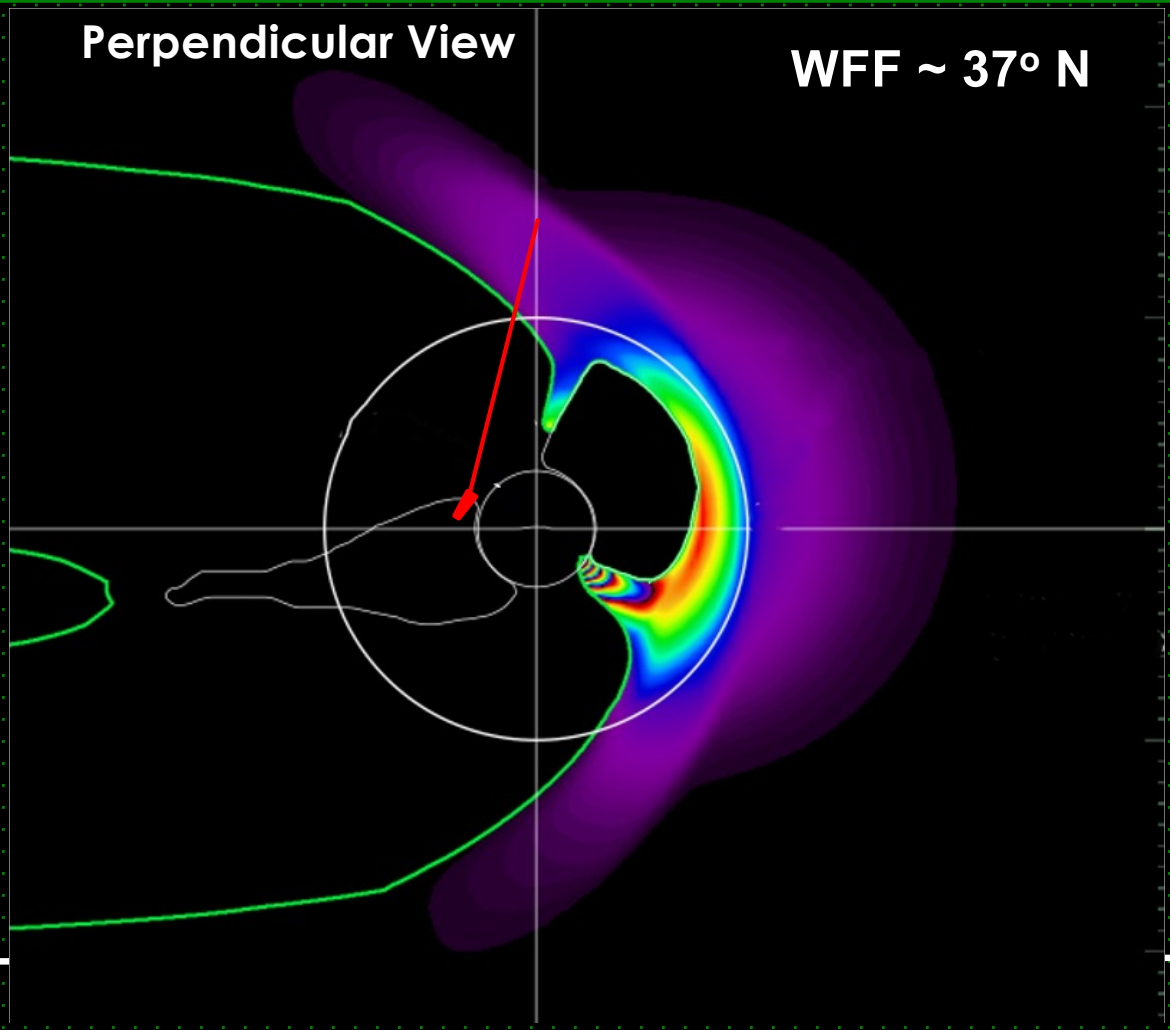
Measuring the compound cross section with H using the spatial signature of the Cusp



UNIVERSITY
OF MIAMI

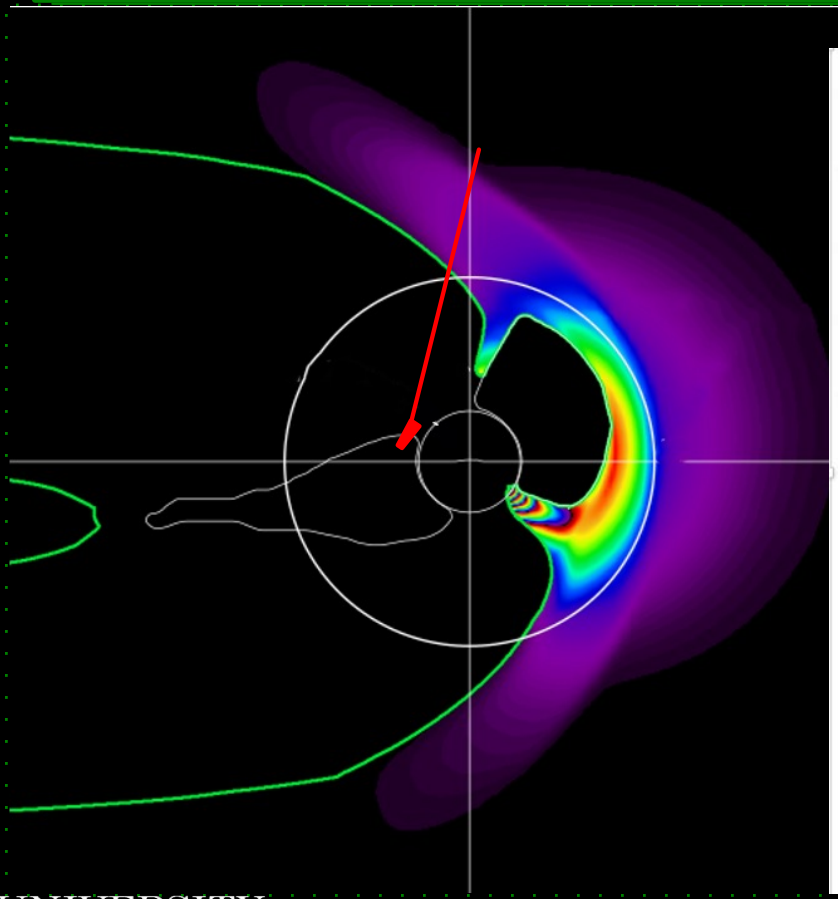
FLIGHTS # 3 & 4 STRATEGY

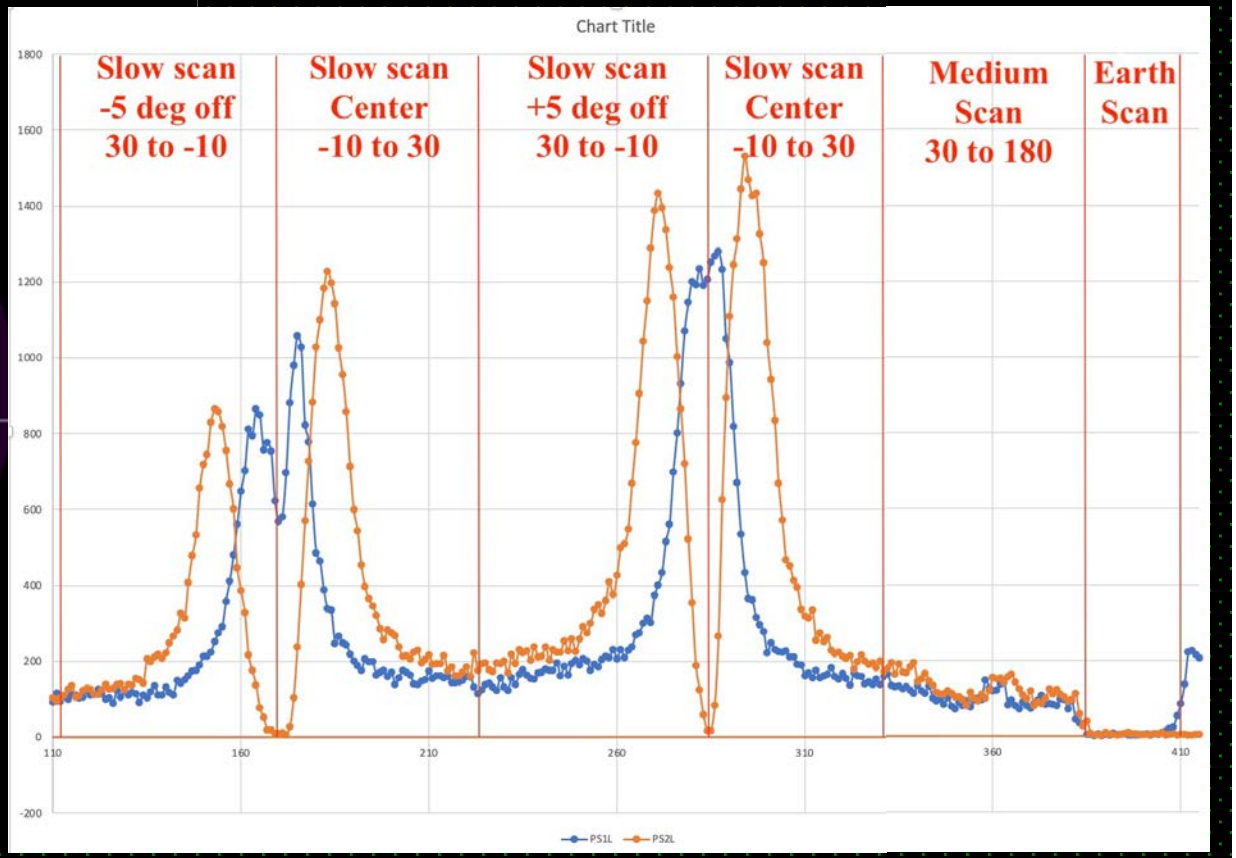




UNIVERSITY
OF MIAMI

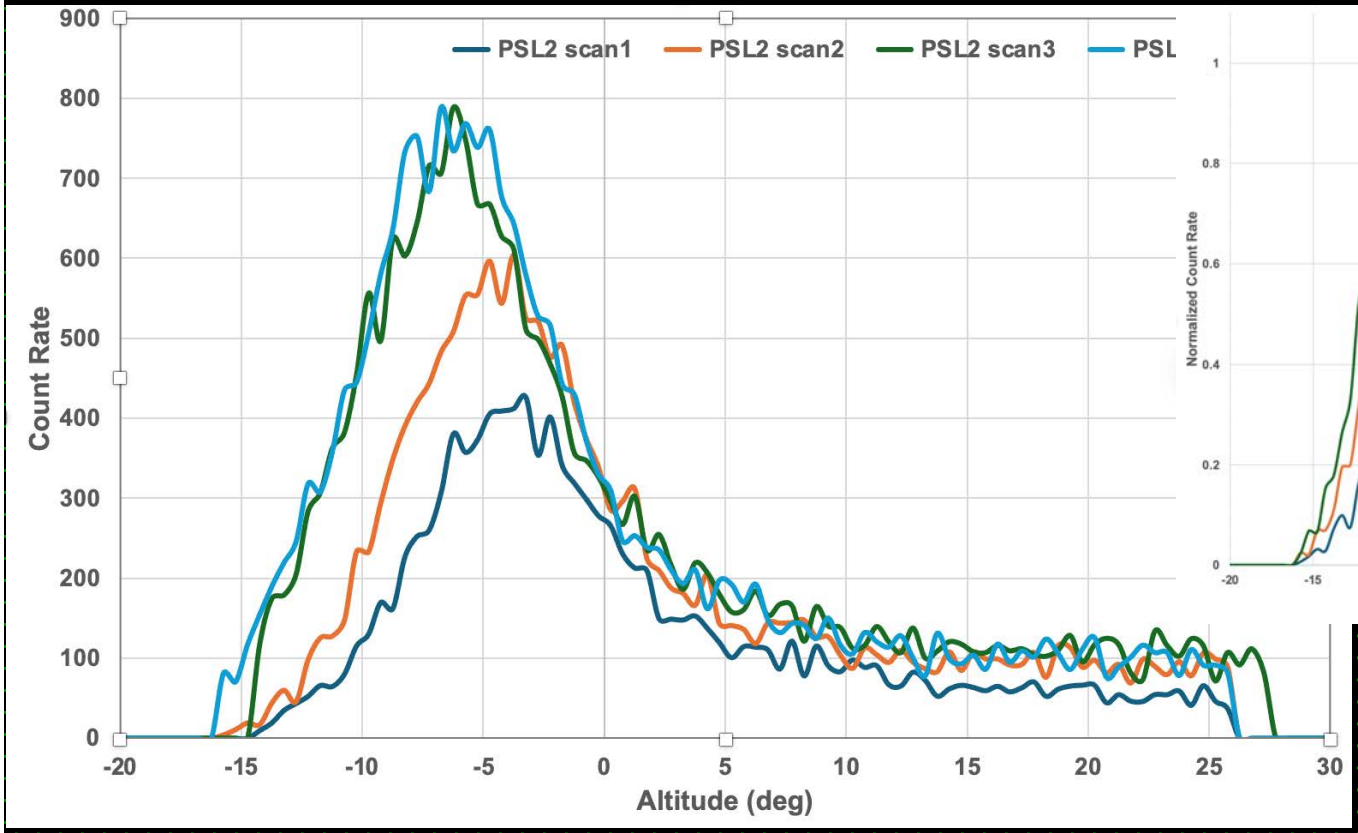
DXL FLIGHT #4 RESULTS

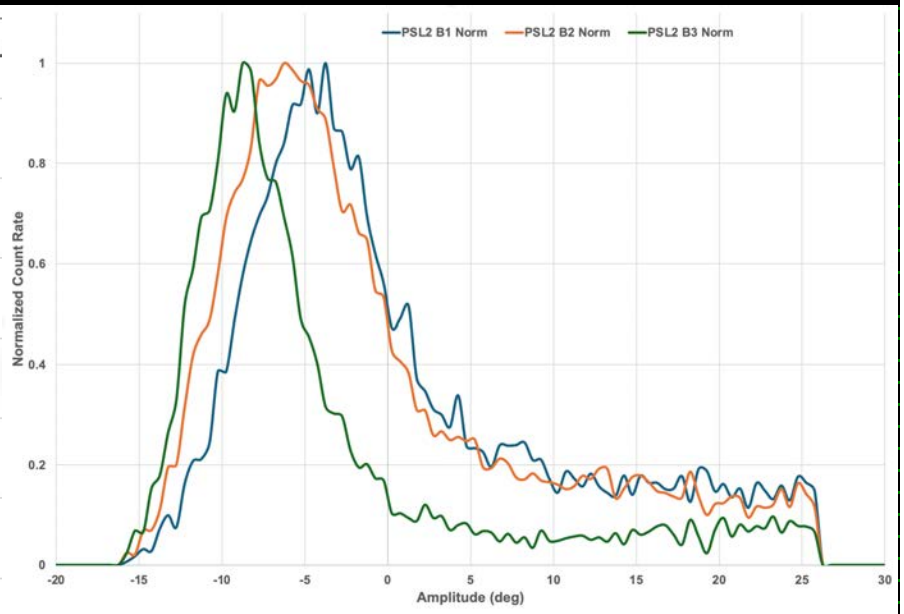




UNIVERSITY OF MIAMI

DXL FLIGHT #4 RESULTS



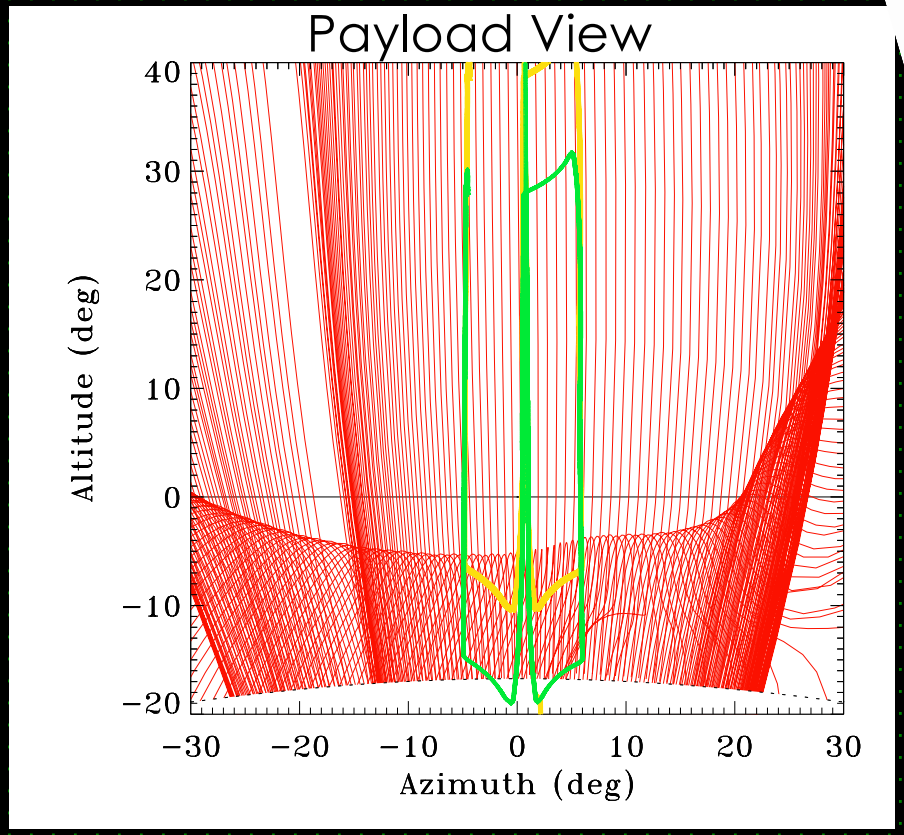


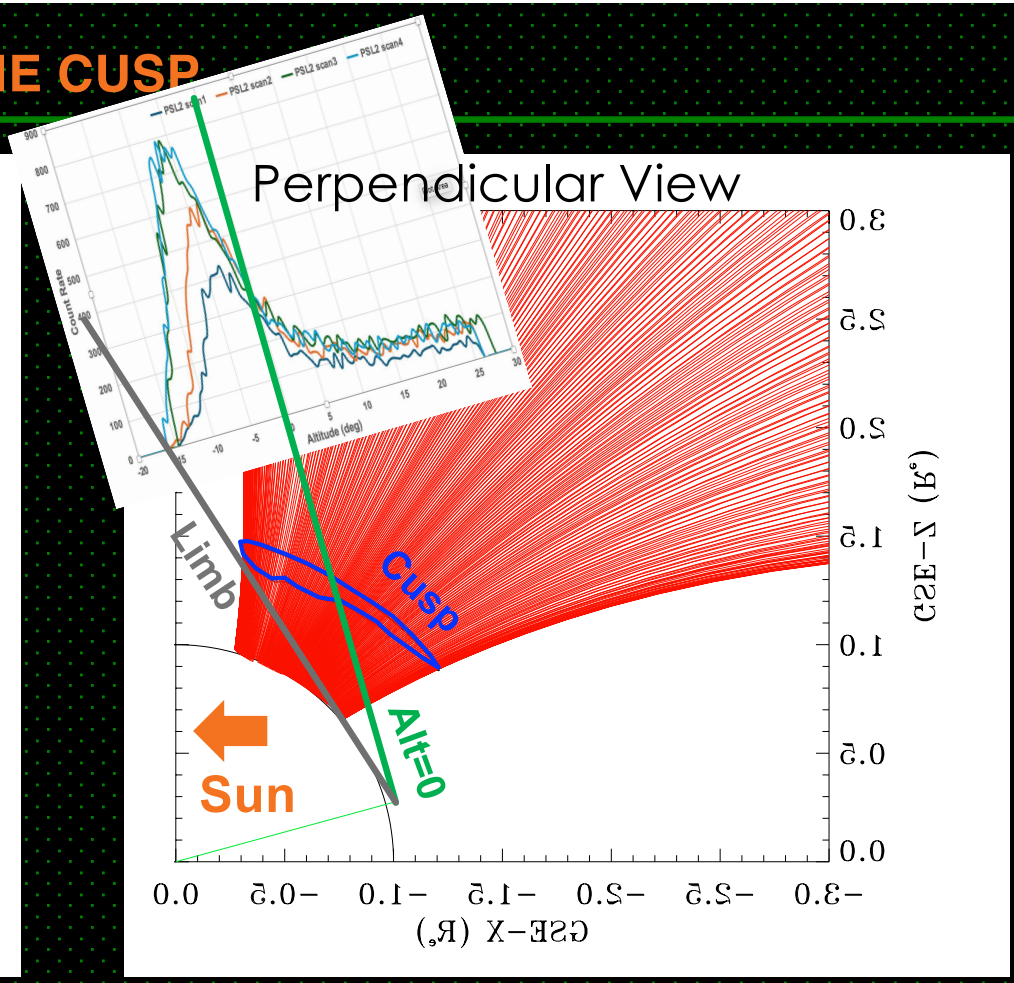
Count rate vs. Altitude for scan #2 for three energy bands

Count rate vs. Altitude for 4 scans in the lowest energy band

UNIVERSITY OF MIAMI

THE CUSP





UNIVERSITY OF MIAMI

The red lines are the field lines defining the exterior surface of the cusp.

THE LOBSTER-EYE X-RAY TELESCOPE (LXT)

Micropore Optics coupled to large area CCD detectors

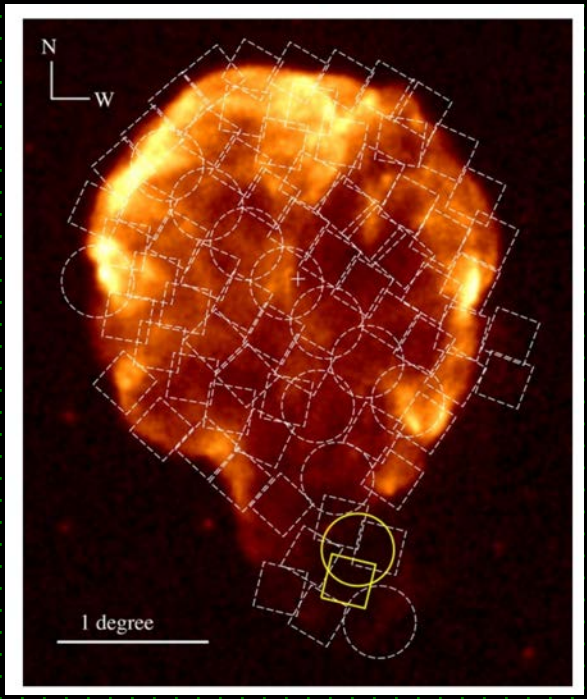
- **Broad energy range 0.1-10 keV**
- **Large FoV** (7.5°×7.5° per telescope)
- **Good energy resolution (~100 eV FWHM)**
- **Moderate Angular Resolution (~ 8 arcmin FWHM)**
- **Moderate effective area (tens of cm^2)**
- **Compact design with low MOI for rapid repointing (50 cm focal length)**

Applications:

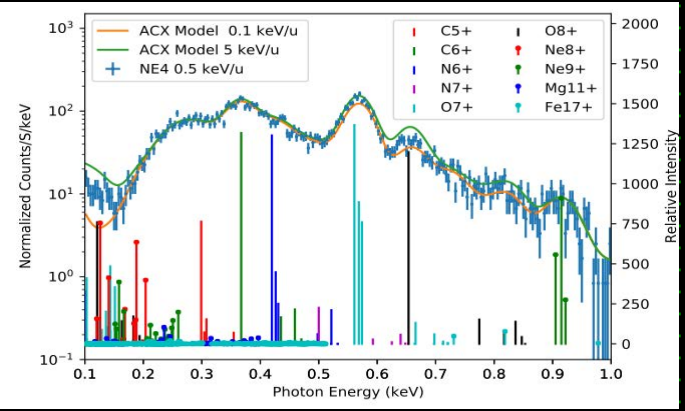
- **Multi-messenger science**
- **Transient searches**
- **Low brightness diffuse objects**

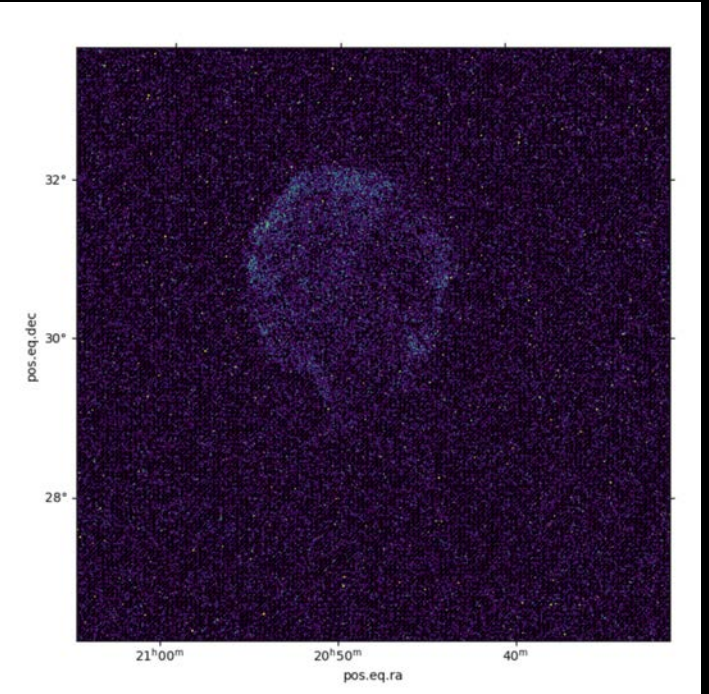
UNIVERSITY OF MIAMI

THE CYGNUS LOOP WITH LXT



Cygnus Loop
(NASA Mission 36.402)





Thanks to LXT very large field of view it is possible to observe the whole loop with a single pointing, thus removing cross-calibration issues and minimizing the effect of time varying background

UNIVERSITY
OF MIAMI

UNIVERSITY
OF MIAMI