



# Probing Solar Coronal Heating with EUNIS

(Extreme Ultraviolet Normal Incidence Spectrograph sounding rocket investigation)

J. W. Brosius (671/CUA), A. N. Daw (671), D. M. Rabin (670) and the EUNIS Team

70-year-old question:

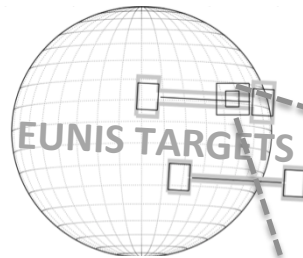
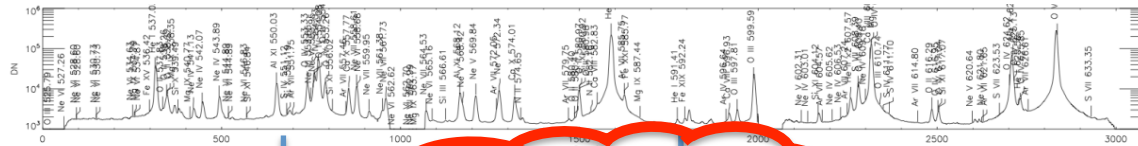
Why is the Sun's tenuous corona so much hotter than its visible surface?

EUNIS has:

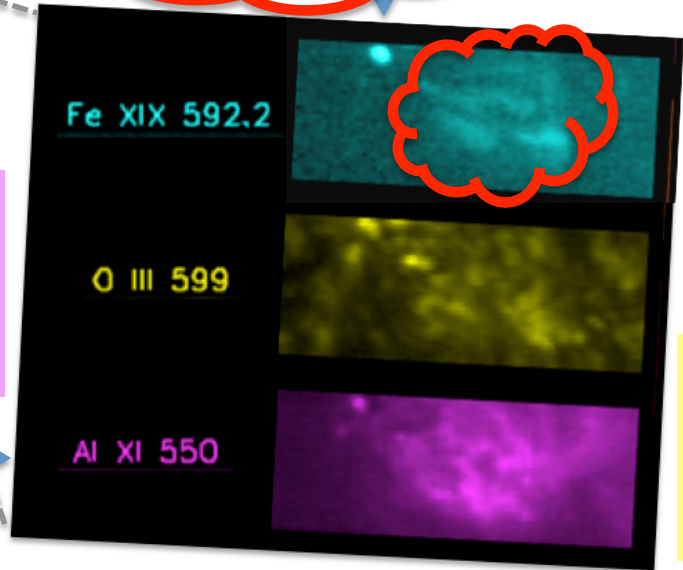
- Wide dynamic range
- High sensitivity
- High spectral resolution

To provide:

- Excellent temperature fidelity (emission lines formed at different temperatures are well separated in spectra)
- Images (shown at right)



**Superhot Corona:  
10 Mega-Kelvin**



**Normal  
Corona:  
1 Mega-Kelvin**

**Lower  
Atmo-  
sphere:  
0.1 MK**

The widespread, faint line emission from the 10,000,000 degree plasma predicted by the **nanoflare model of coronal heating** is finally observed: EUNIS found the **"smoking gun"**

- Brosius, J. W., Daw, A. N. & Rabin, D. M., *Astrophysical Journal*, 790, 112 (2014)
- The EUNIS team was awarded the R. H. Goddard Science Exceptional Achievement Award for 2014

# Talking Points

Nanoflares, i.e., a multitude of frequent, highly localized, tiny flare events have been proposed as one of the leading models to explain the hot corona. Before EUNIS, the proof of this concept has been elusive.

- The diagram at the top shows a super high-precision solar spectrum, i.e., the decomposition of solar emissions across different wavelengths.
- The images show a 50,000 km by 50,000 km section of the solar atmosphere, taken at the indicated wavelengths.
- The 3<sup>rd</sup> successful flight of EUNIS occurred on April 23, 2014.
- Major improvements such as cooled detectors allowed EUNIS to detect the faint, superhot emission predicted by nanoflare models of coronal heating. Jim Klimchuk (671) is the leading proponent of nanoflare theory.
- EUNIS can isolate the superhot plasma because it resolves individual spectral lines, unlike filter-based instruments such as AIA on SDO.
- The superhot plasma is not only detected, it is widespread, as predicted by nanoflare theory.
- EUNIS is funded under H-TIDeS for a 4<sup>th</sup> flight that will probe the superhot plasma even more directly.