Highlights from 17 years of SORCE/SOLSTICE Observations

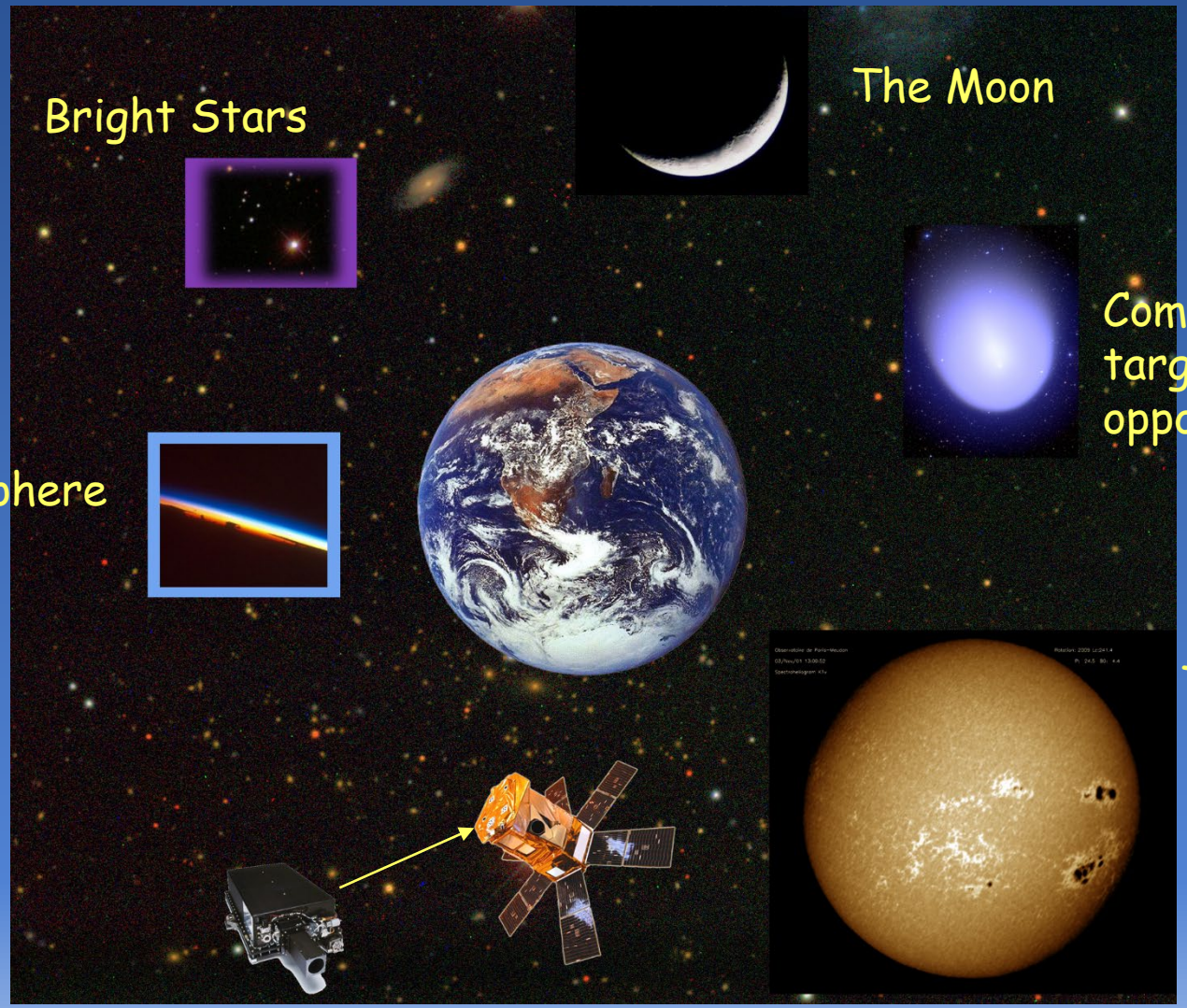
W MCCLINTOCK, M SNOW, T WOODS, J ELLIOTT, E LIEB, B VANIER, S BELAND

UNIVERSITY OF COLORADO BOULDER

LABORATORY FOR ATMOSPHERIC AND SPACE PHYSICS

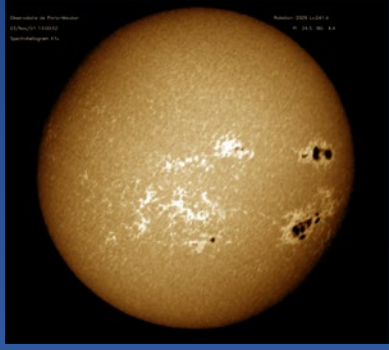
SNOW@LASP.COLORADO.EDU

Outline: SOLSTICE Observations

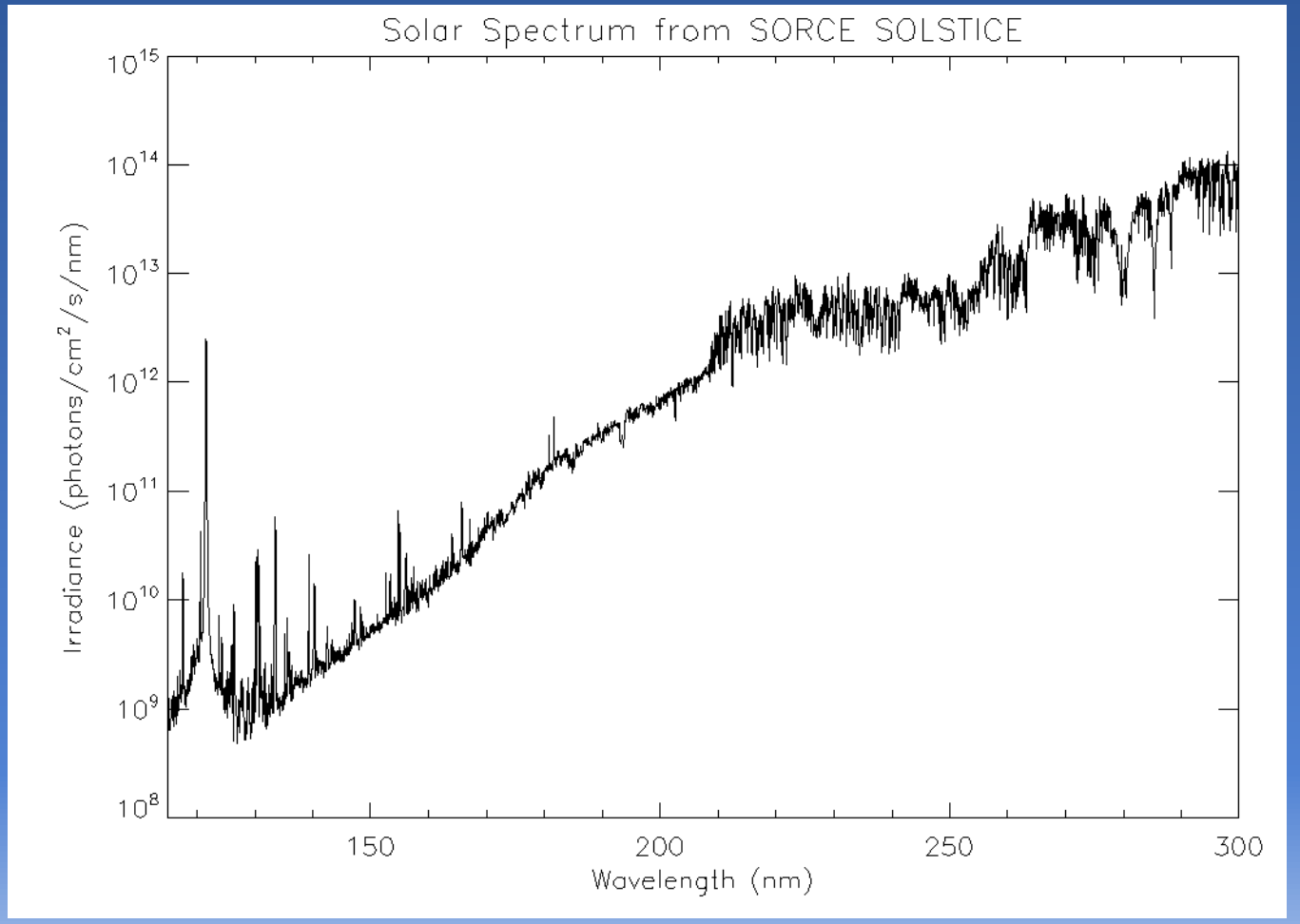


SOLar Stellar Irradiance Comparison Experiment

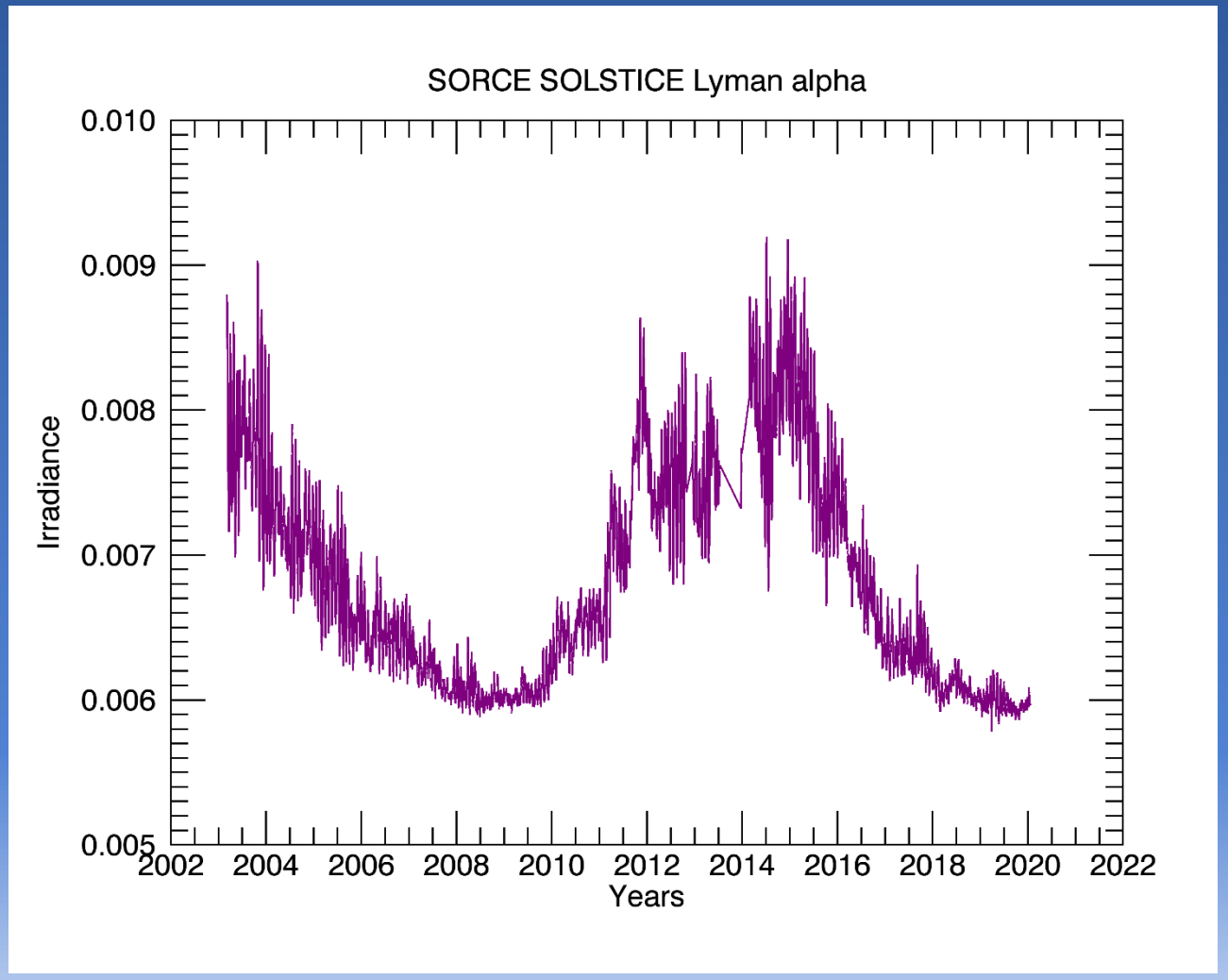
The Sun



- Monitoring SSI variability on long timescales
- Magnesium II index
- Lyman alpha
- Short timescale solar events
- Calibrate irradiance models
- Calibrate other solar measurements
- Reference spectra
- Solar diameter



More than one solar cycle of observations from SORCE



UV Variability 220-240 nm Controversy

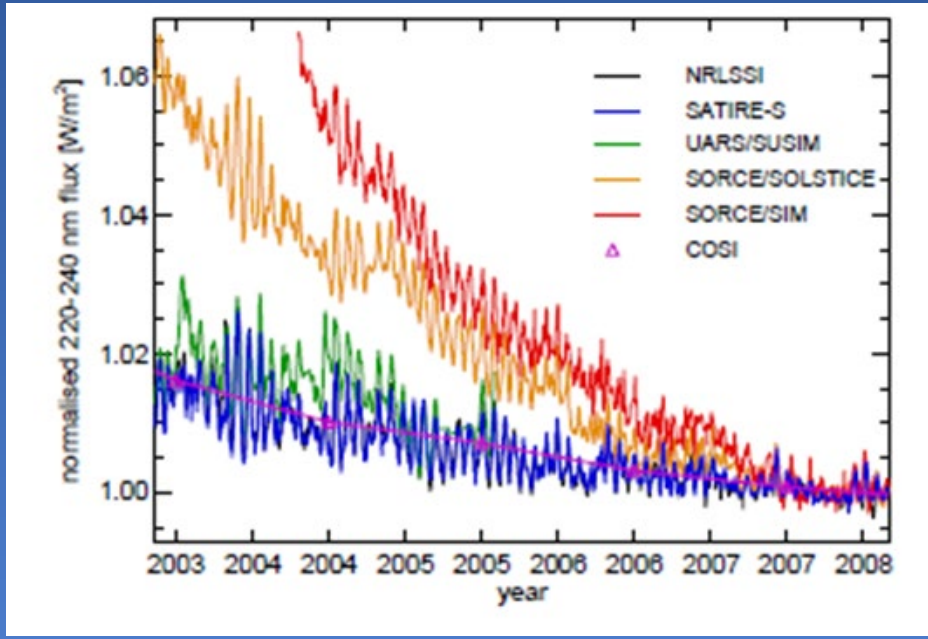
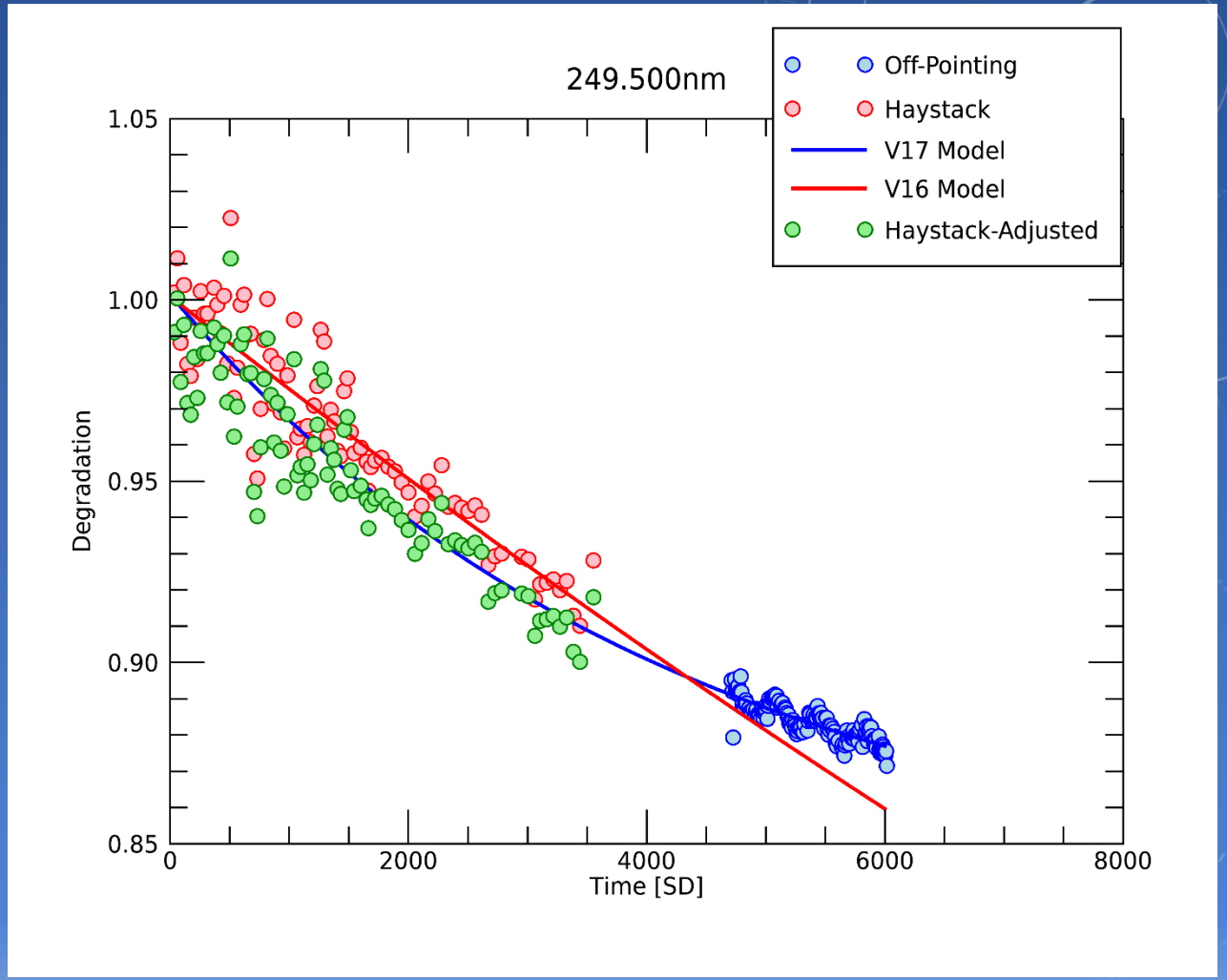
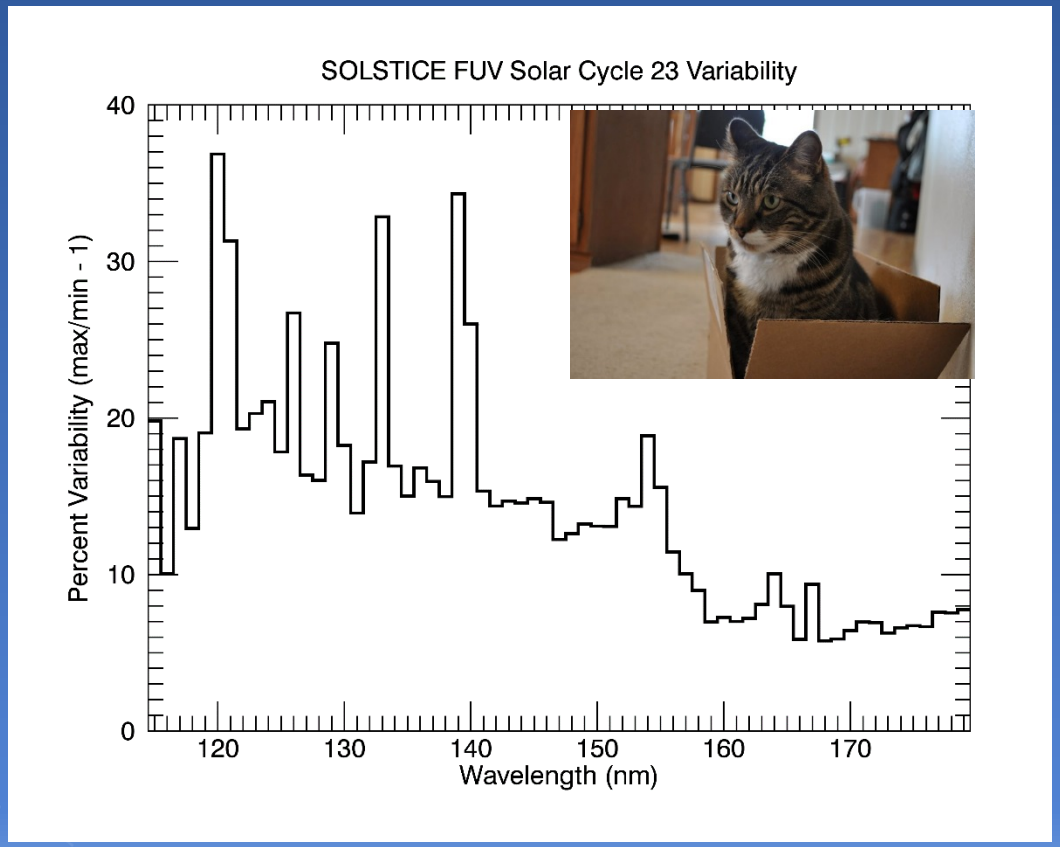


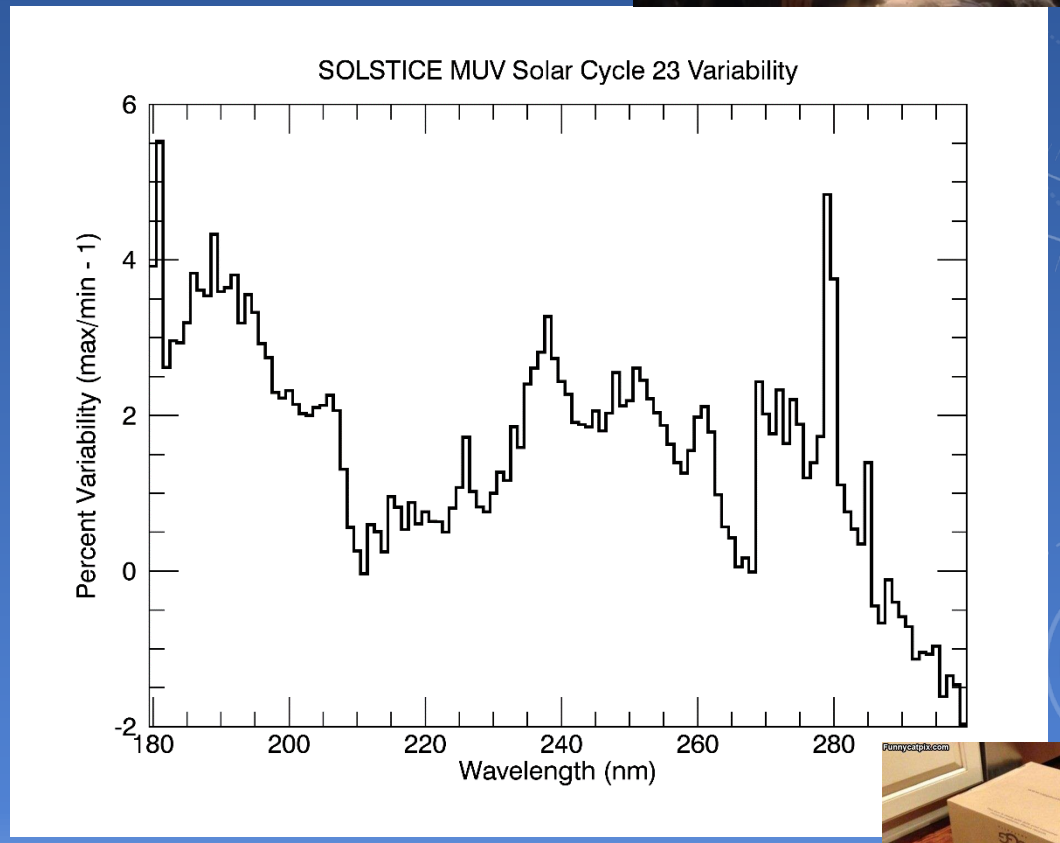
Figure 8 from Ermolli et al. (2013)



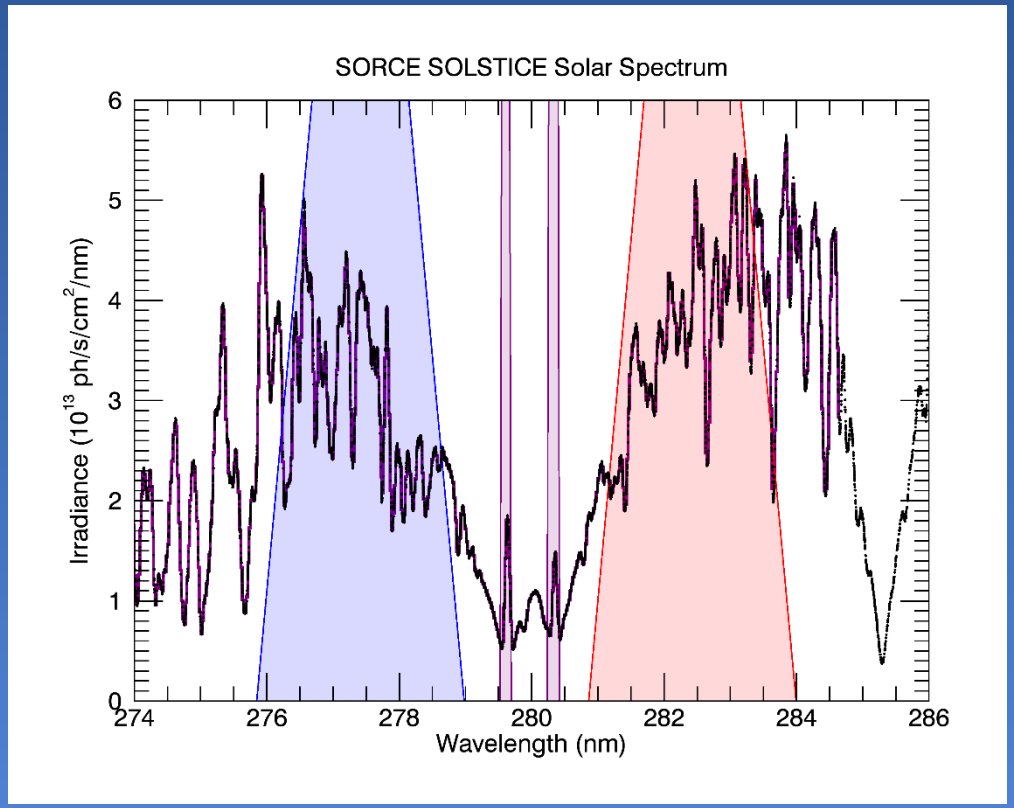
See Josh Eliott's poster for more info!

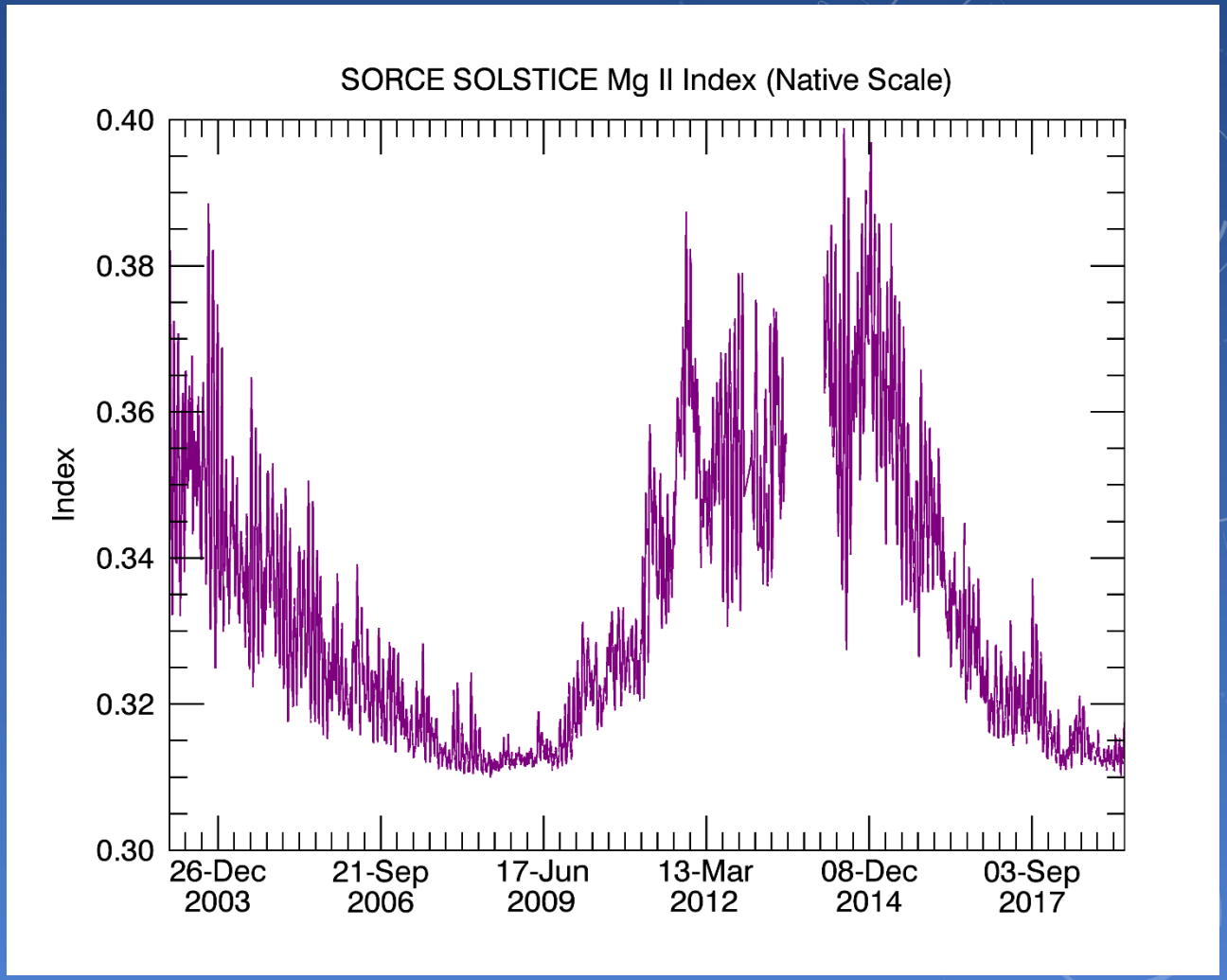
Variability as a function of wavelength





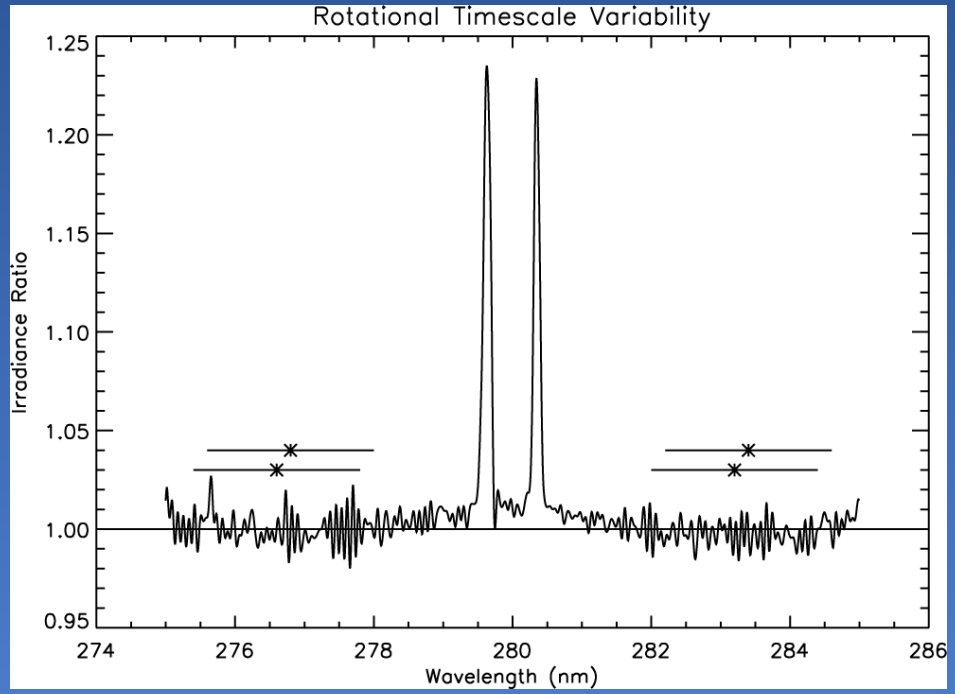
Magnesium II Index

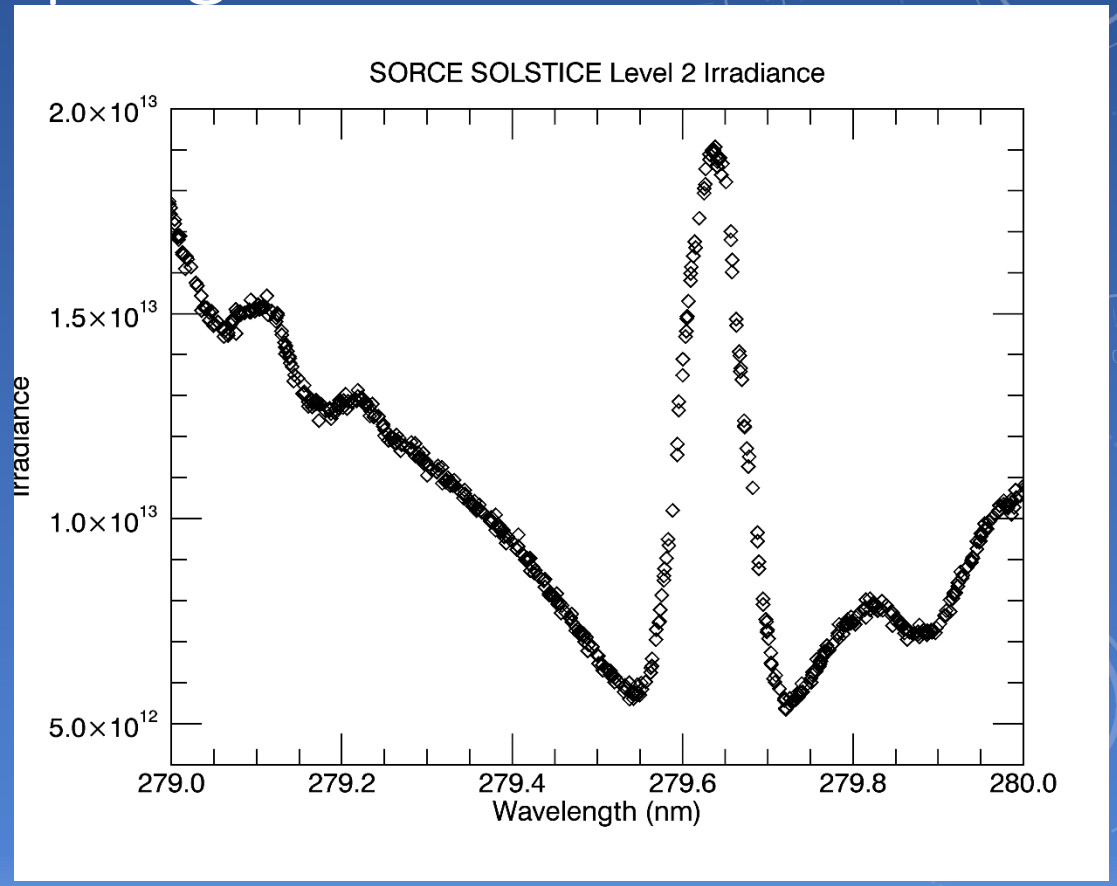




Snow et al. (2019) A revised magnesium II core-to-wing ratio from SORCE SOLSTICE, Earth & Space Science, doi:10.1029/2019EA000652

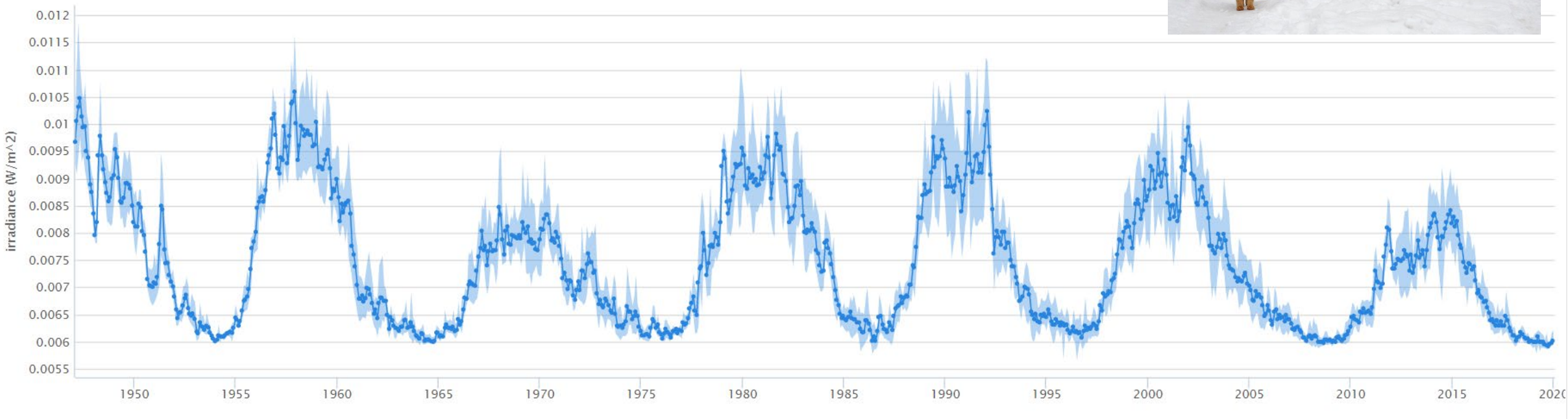
MgII spectral resolution and sampling





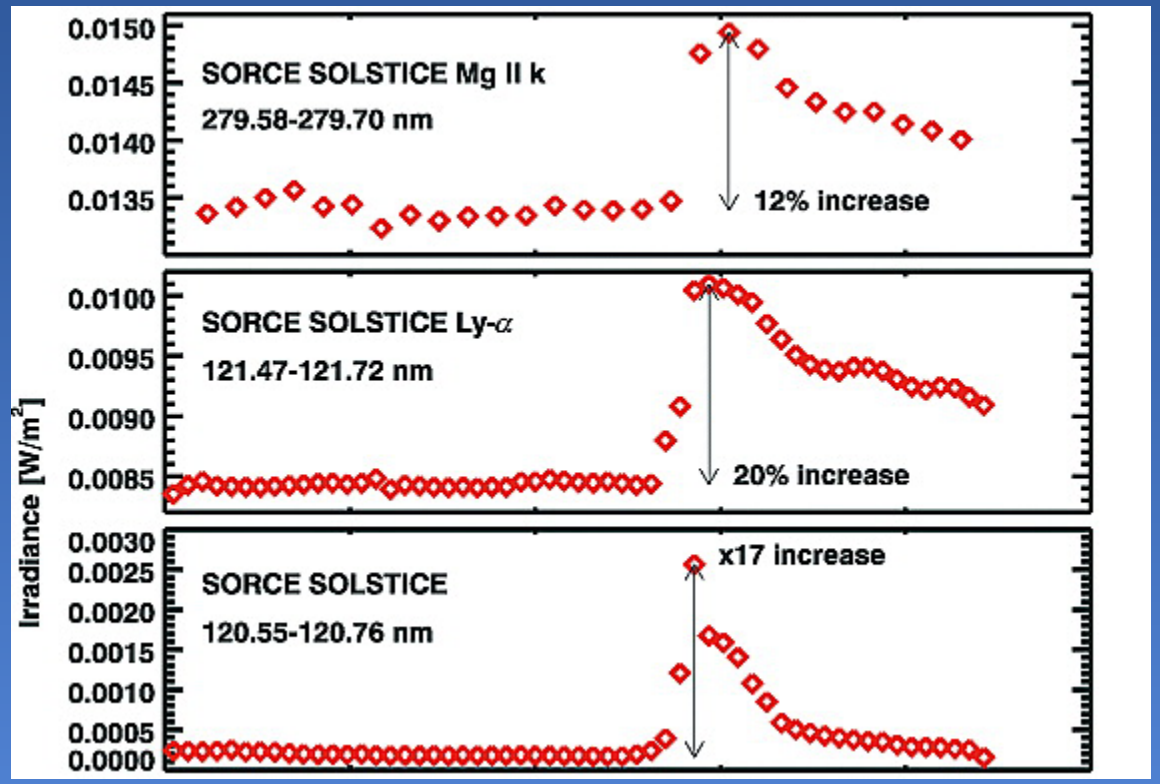
Snow & McClintock (2005) High time cadence solar magnesium II index monitor, SPIE, doi: 10.1117/12.617044

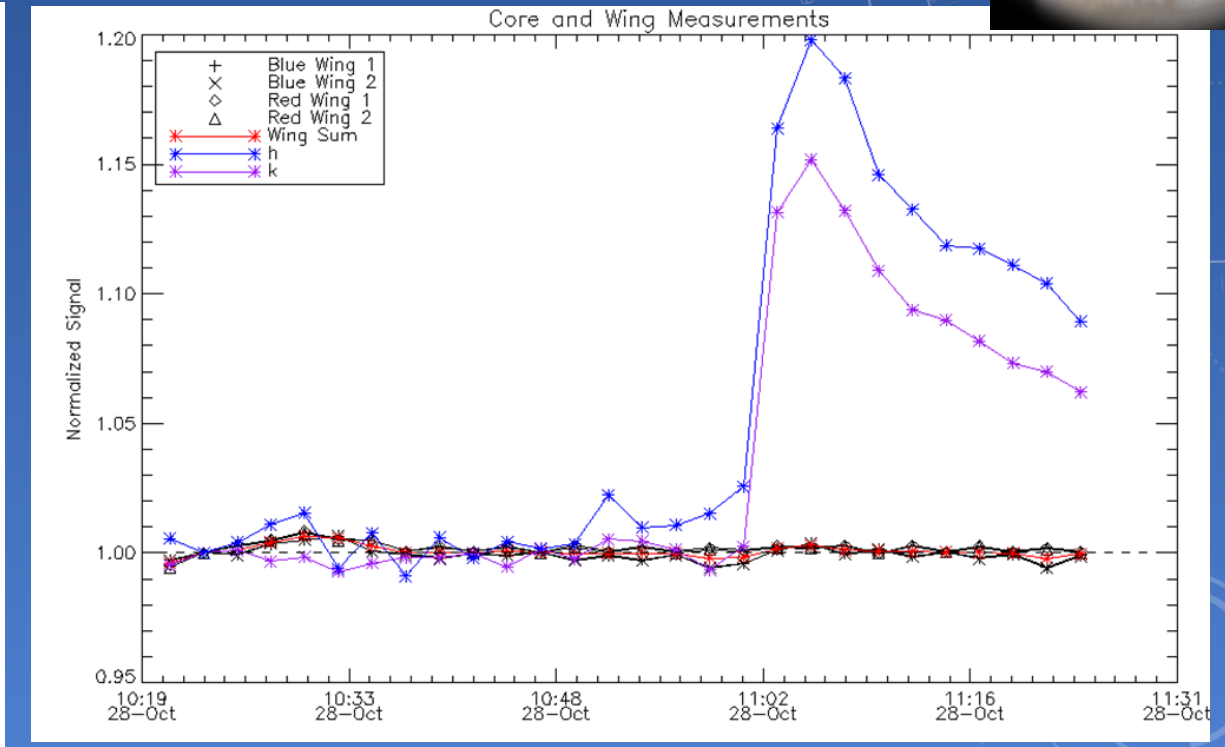
Recalibration of Lyman alpha composite



Machol et al. (2019) An improved Lyman-alpha composite, Earth & Space Science, doi: 10.1029/2019EA000648

Short timescale variability

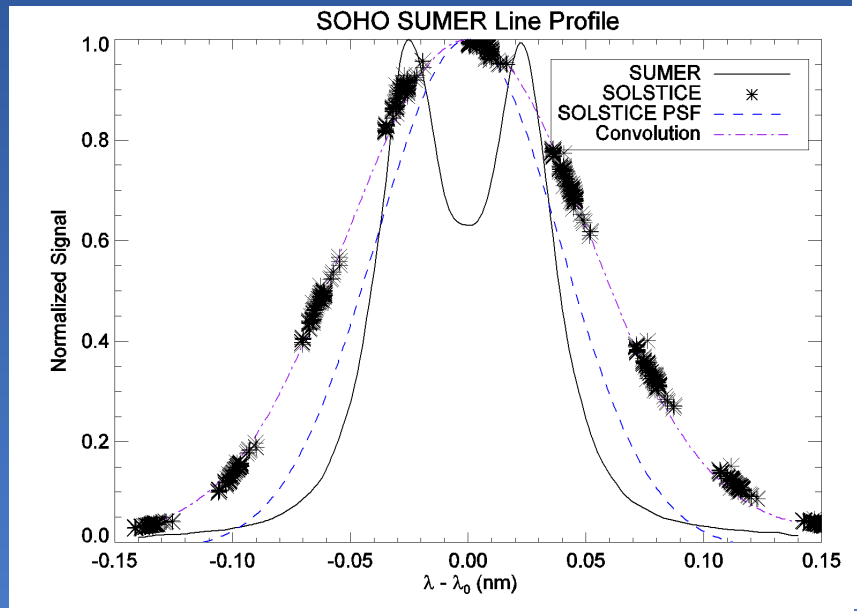


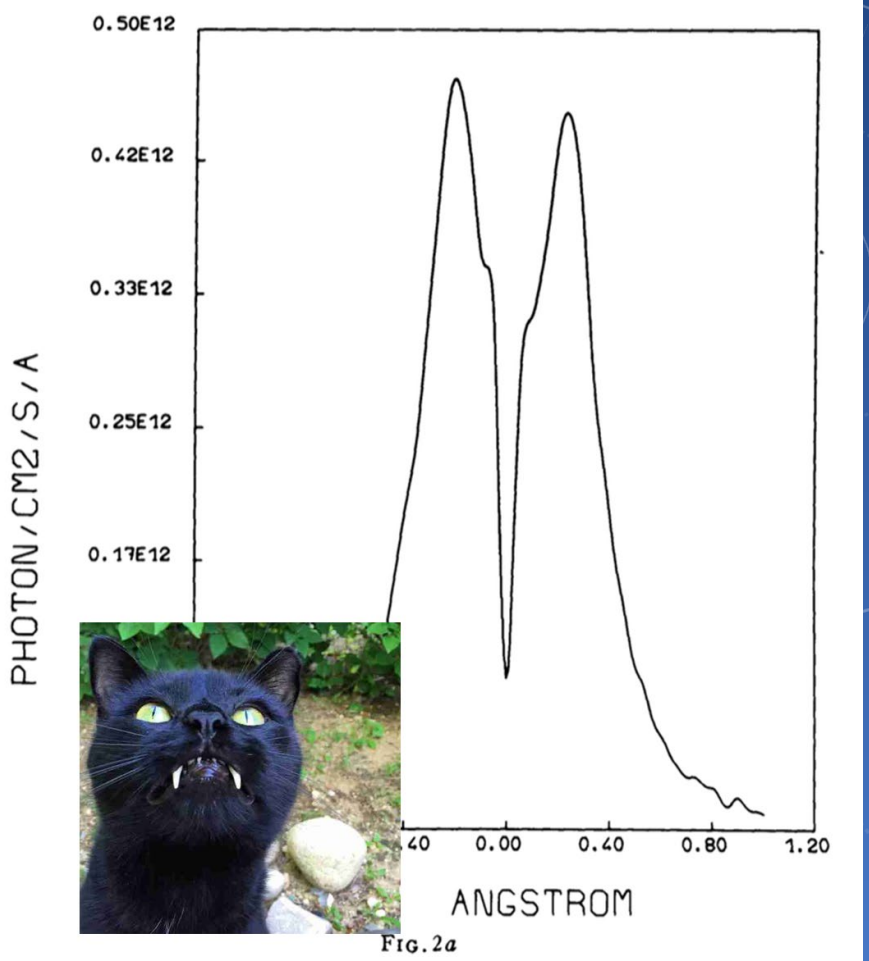


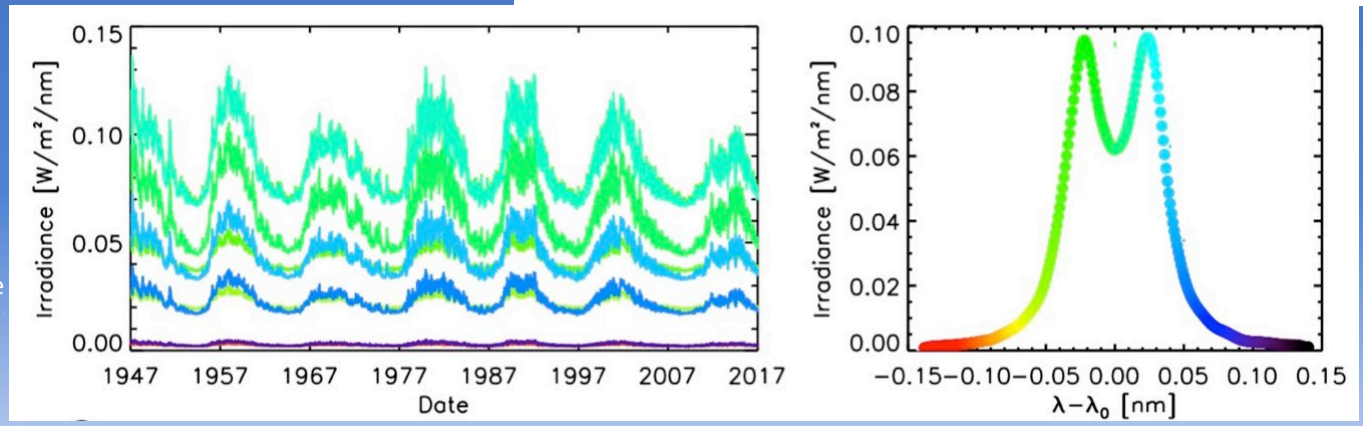
Woods et al. (2004) Solar irradiance variability during the October 2003 solar storm period, GRL, doi:10.1029/2004GL019571

Lyman alpha profile model

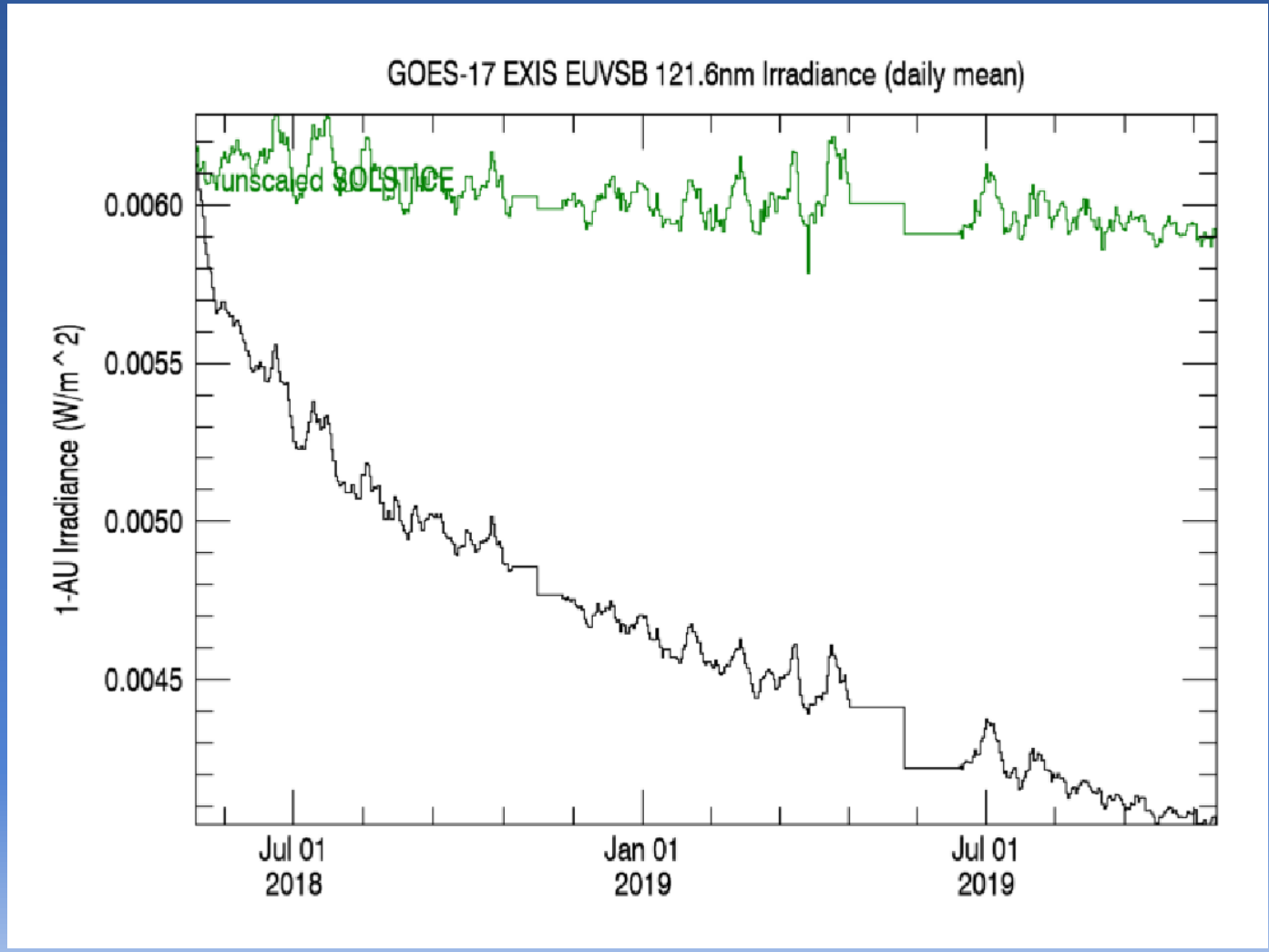
Kretzchmar, Snow, & Curdt (2018) An empirical model of the variation of the solar Lyman-alpha spectral irradiance, GRL, doi: 10.1002/2017GL076318





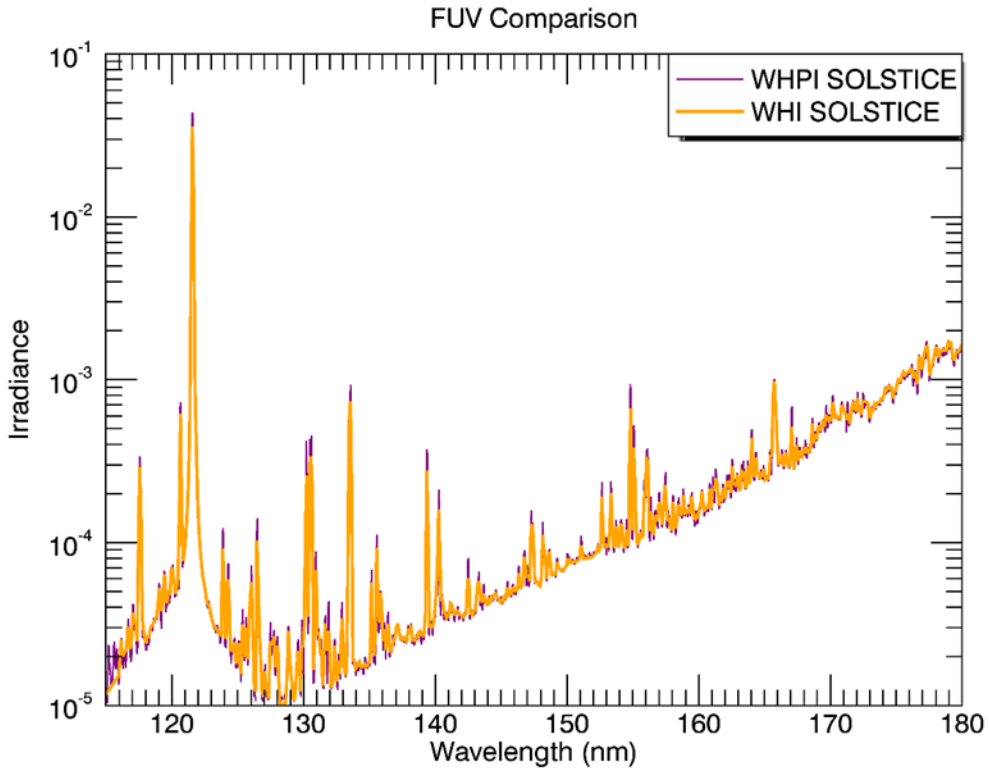


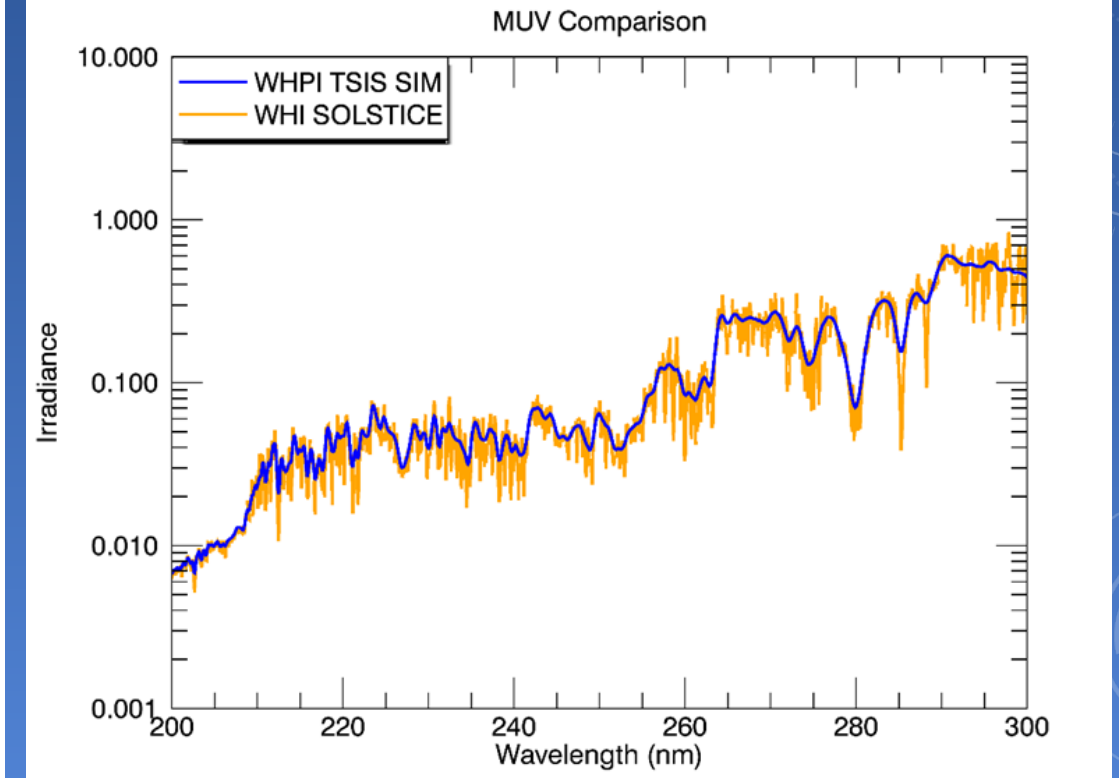
SOLSTICE calibrates GOES-R Lyman alpha



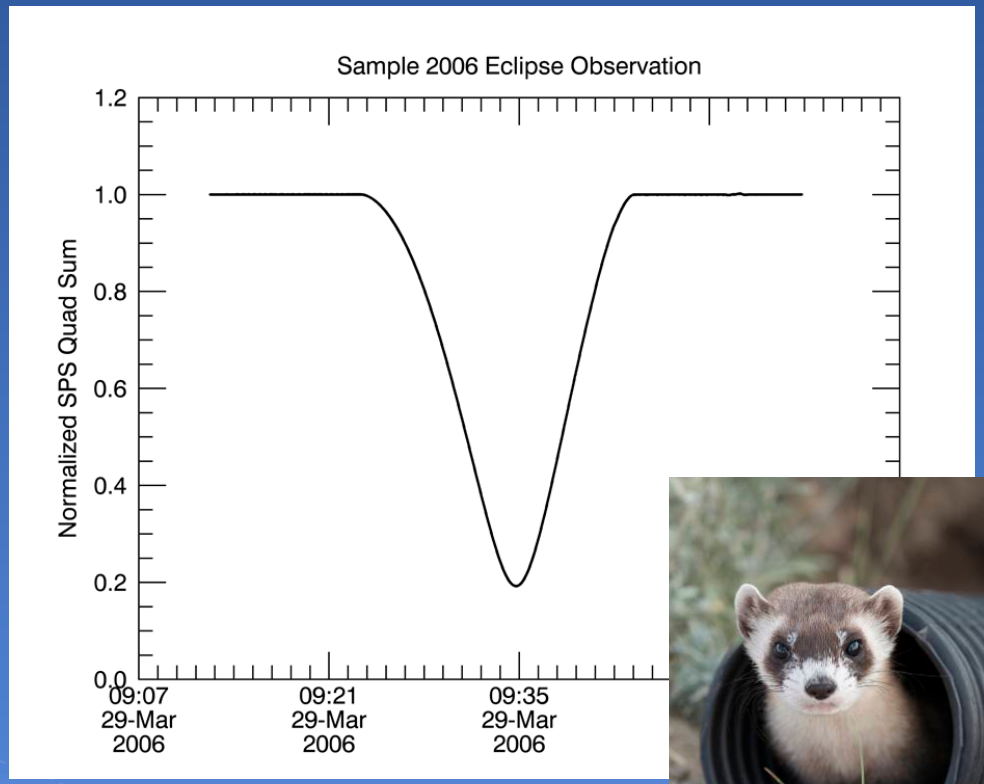
Calibration for
IRIS
SATIRE-S
NRLSSI2
…and all the rest!

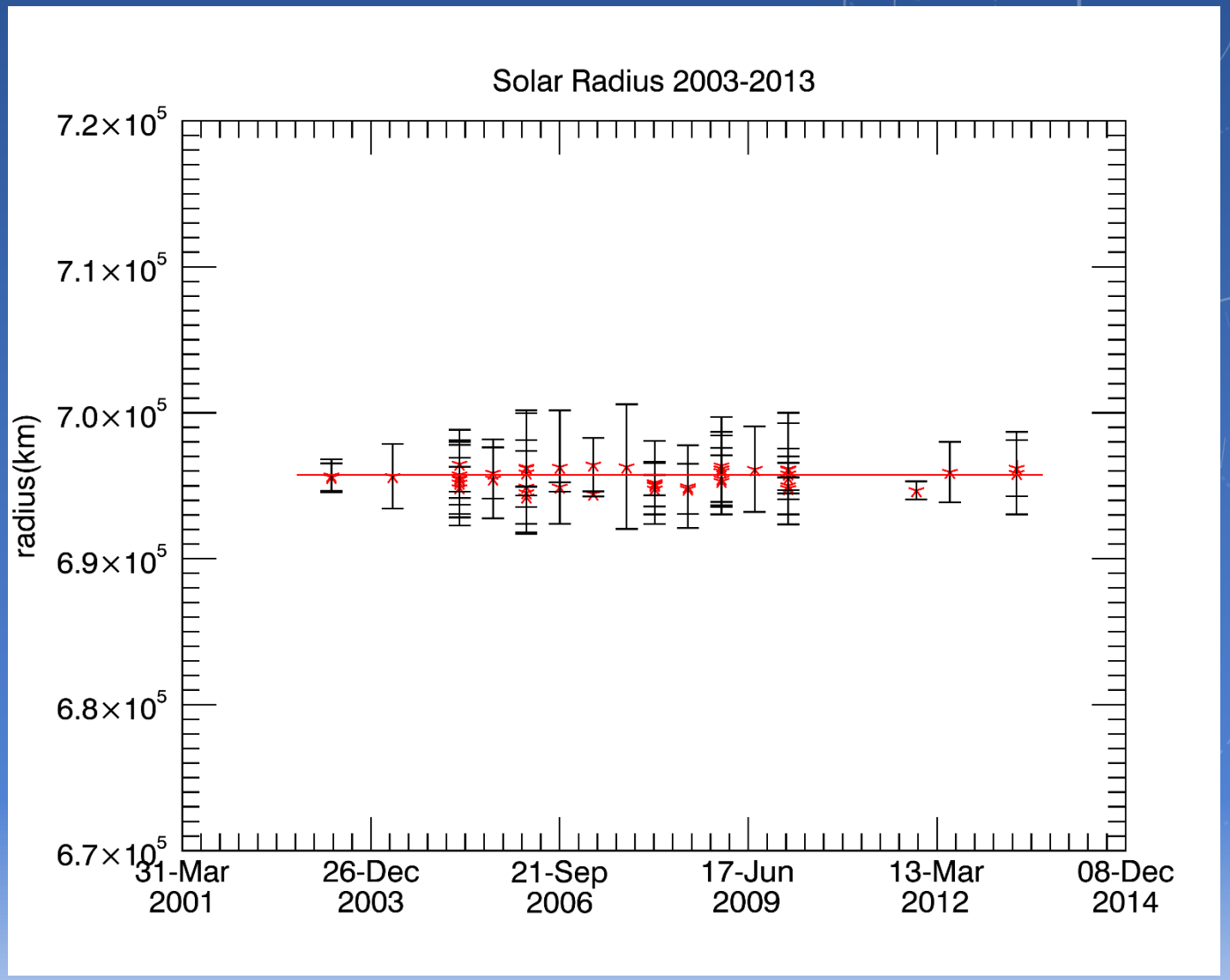
Reference spectra: WHI and WHPI





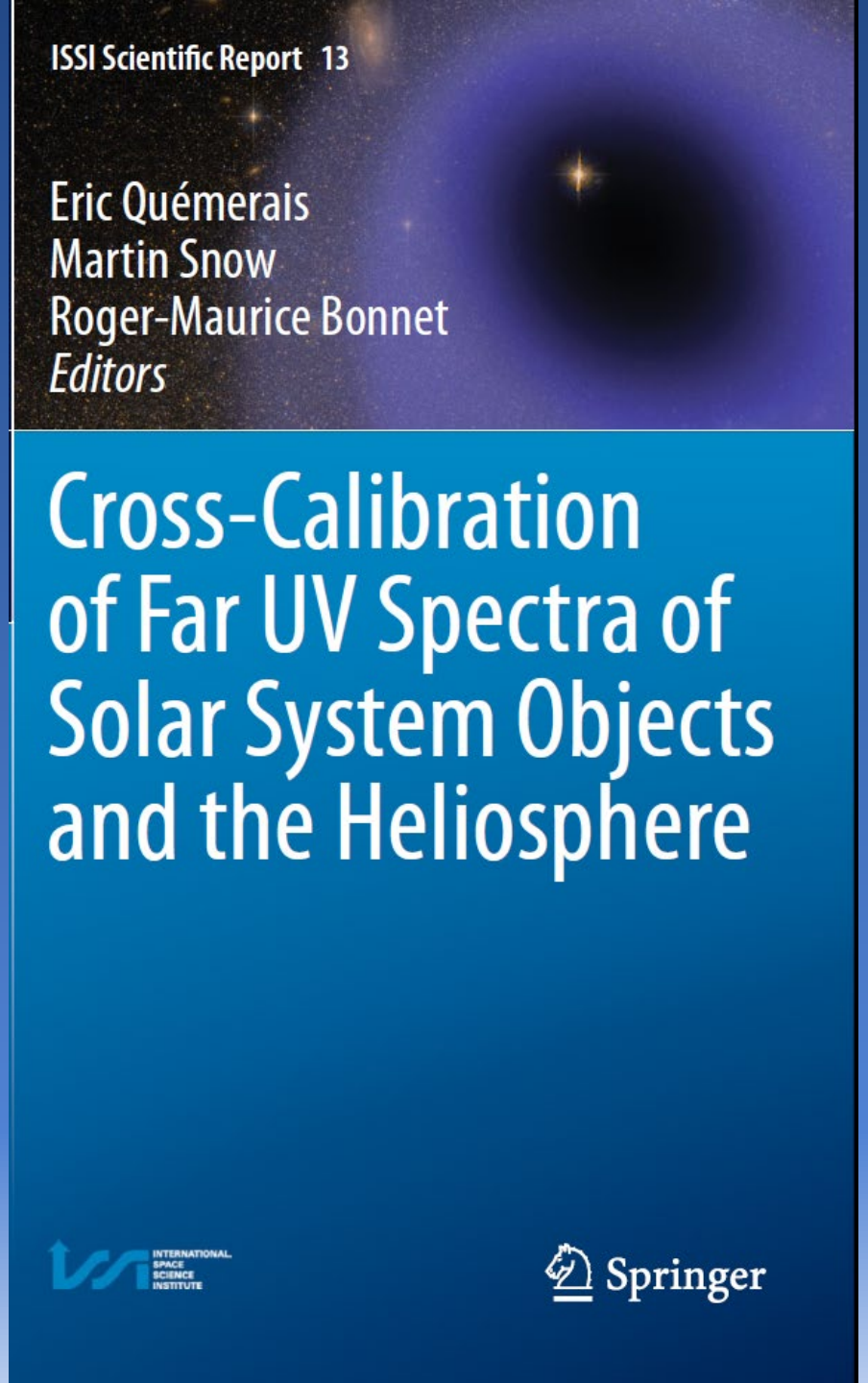
Solar Diameter using SPS



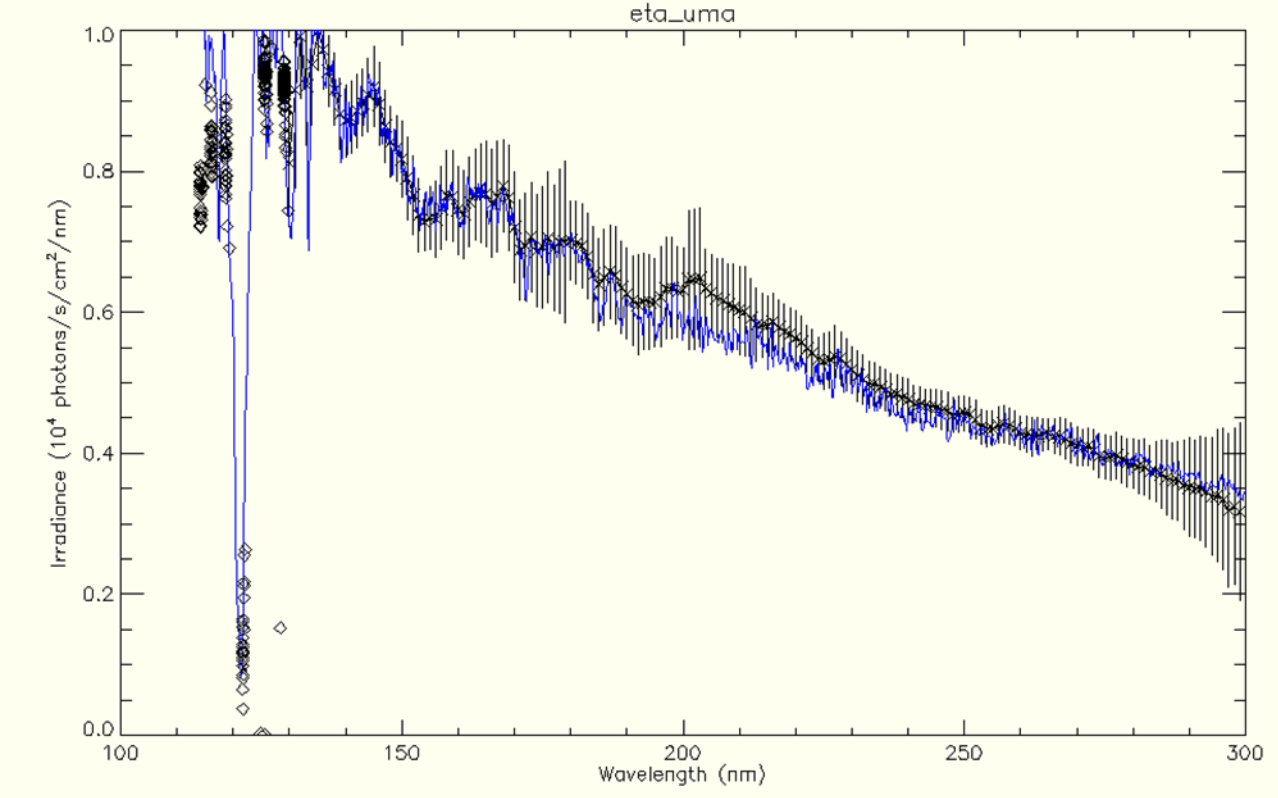


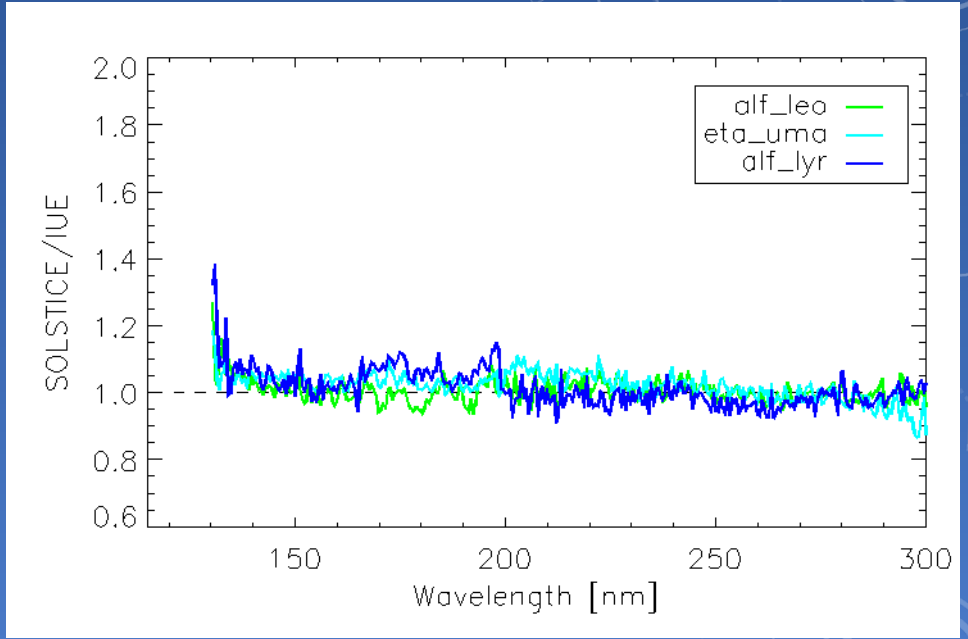
Stars, the Heliosphere, and Beyond!

- Absolute calibration of stellar uv spectra
- Calibration of heliospheric observations and models
- Comet P/Holmes
- South Atlantic Anomaly (Magnetosphere)



Stellar spectra validate white dwarf calibration model





Snow et al. (2013) A new catalog of ultraviolet stellar spectra for calibration, ISSI Scientific Report Series vol 13, doi: 10.1007/978-1-4614-6384-9_7

SOHO/SWAN Heliospheric observations calibrated by SOLSTICE

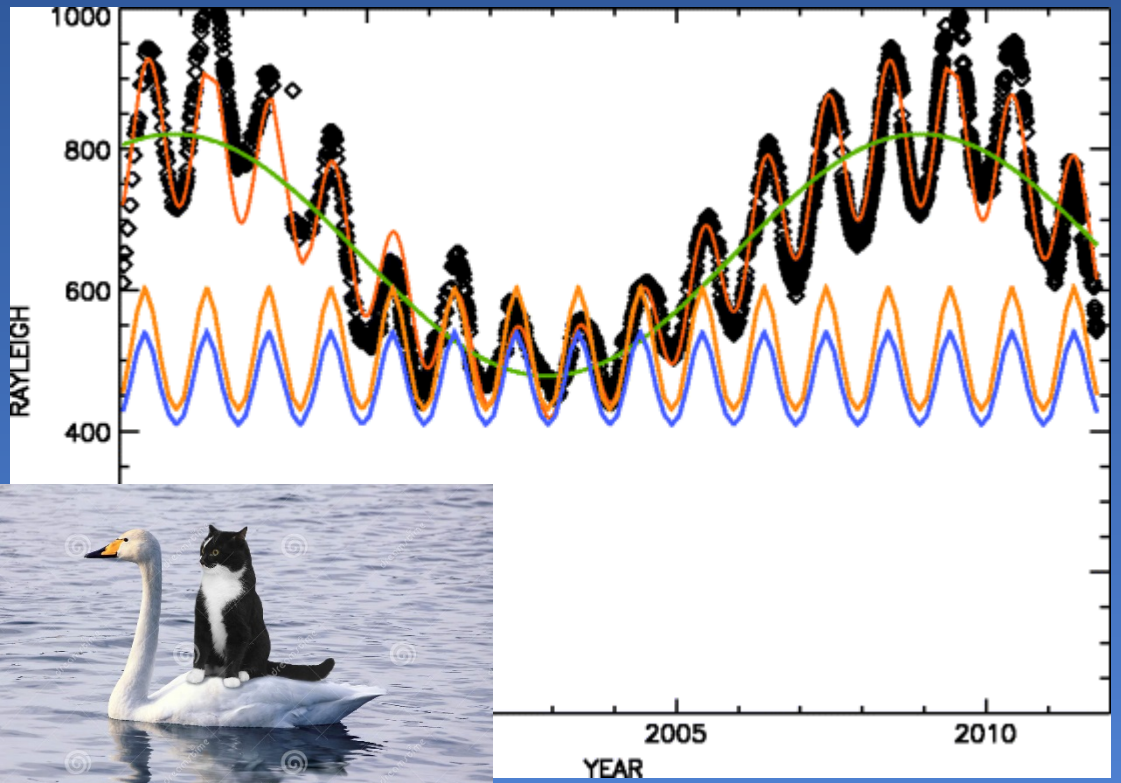
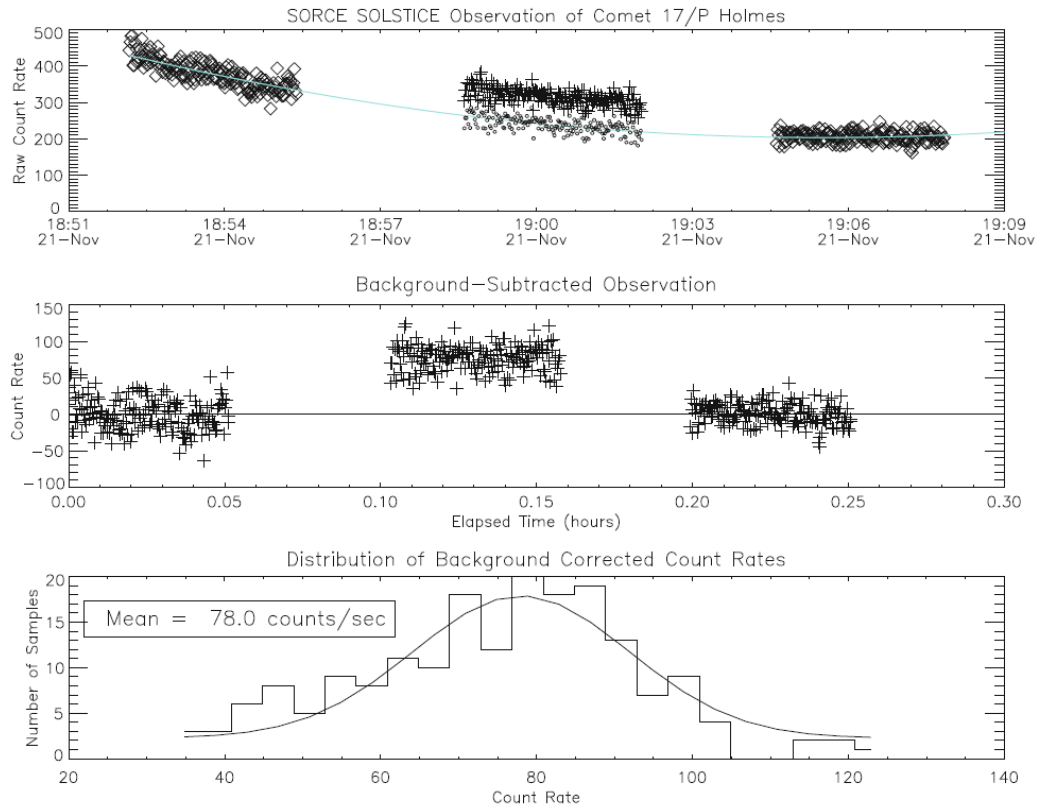


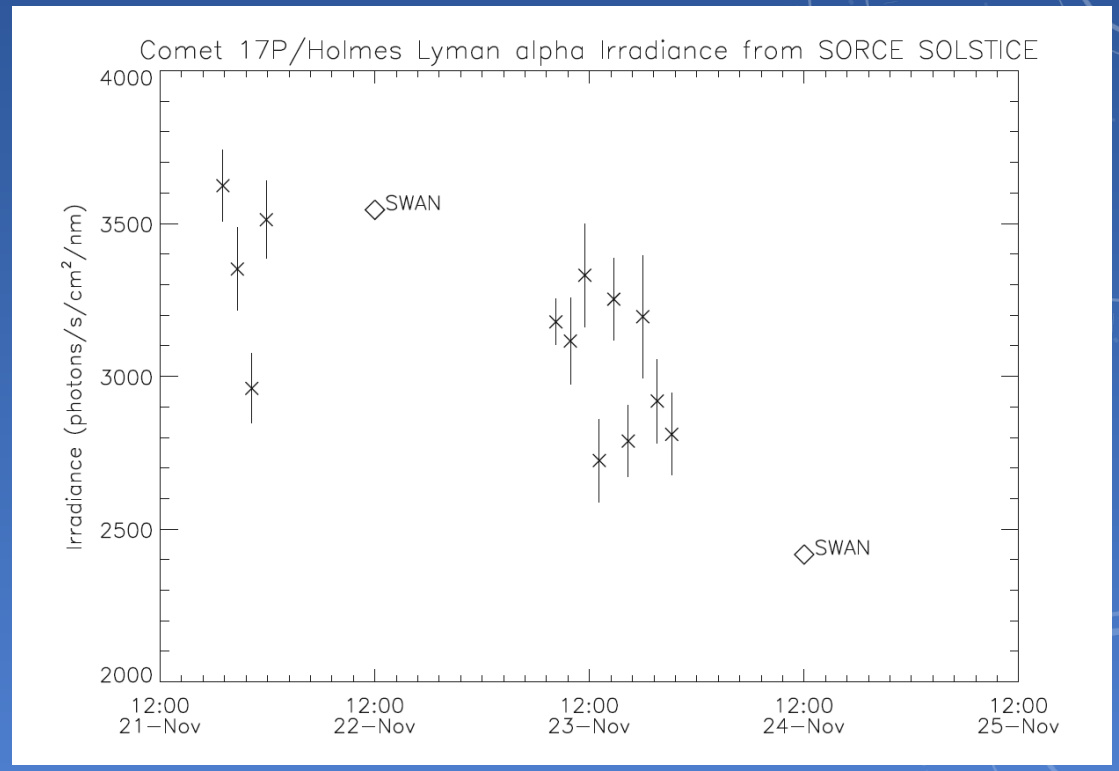
Figure 4.6 Plot of the IPH intensity recorded by SOHO SWAN between 1996 and 2011 in the direction of the North ecliptic pole as a function of time (*diamonds*). The values are corrected for solar flux variations based on the SORCE SOLSTICE measurements.

Quemerais et al. (2013) Thirty years of interplanetary background data: a global view, in ISSI SR-13, doi: 10.1007/978-1-4614-6384-9_4

See also Emma Lieb's poster on SALSA

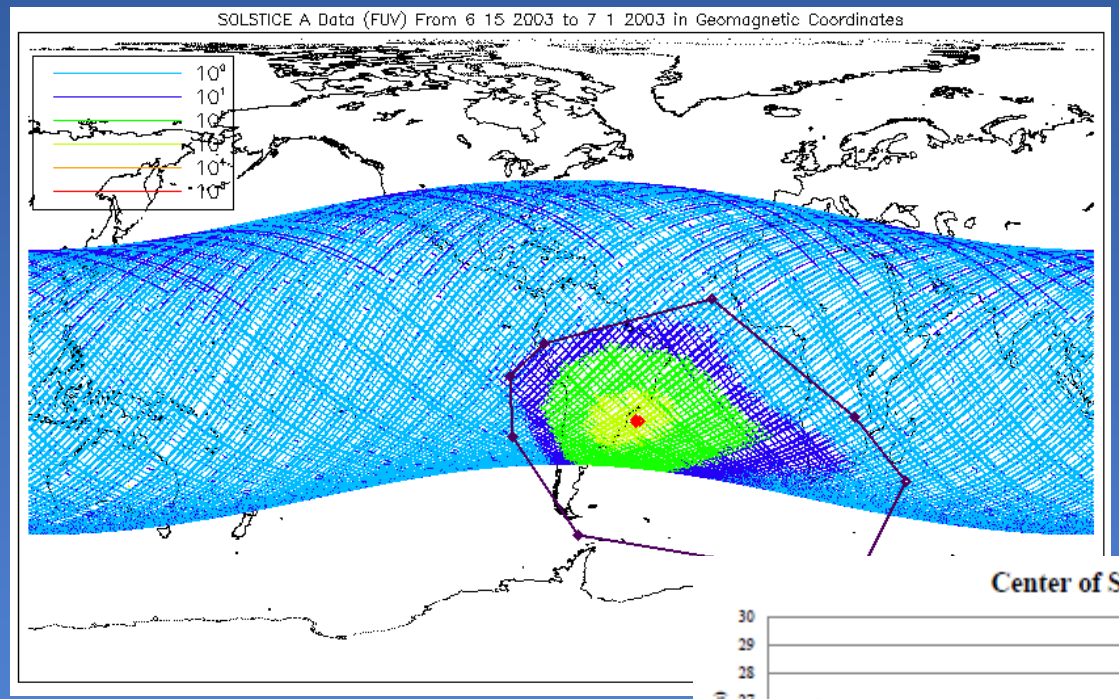
Comet P/Holmes

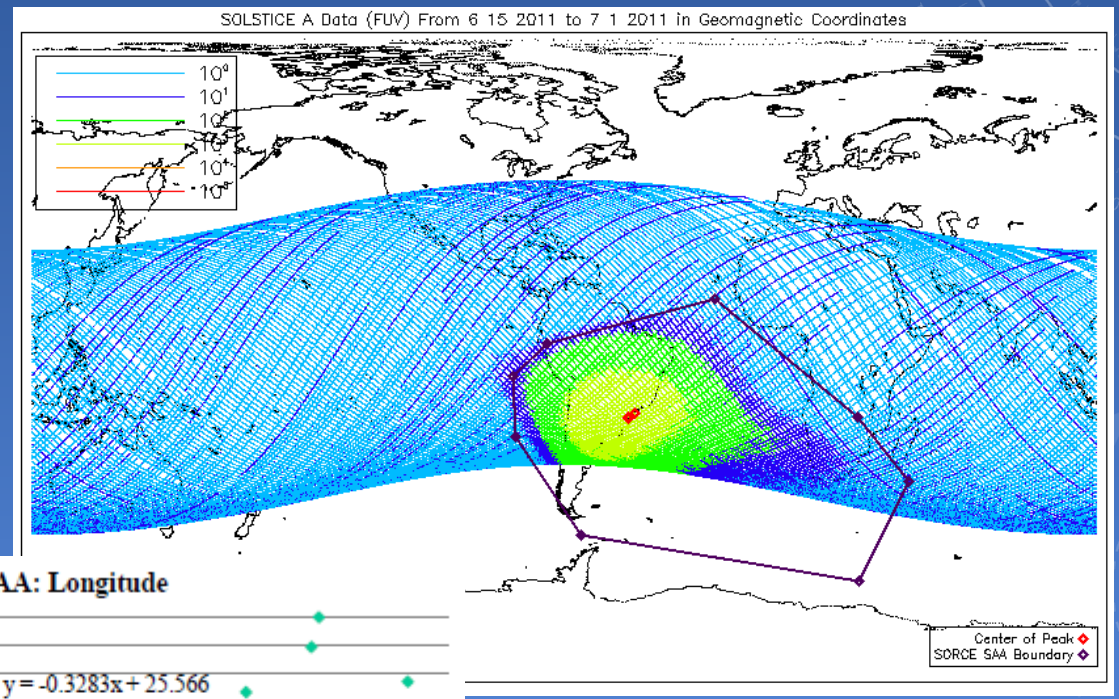


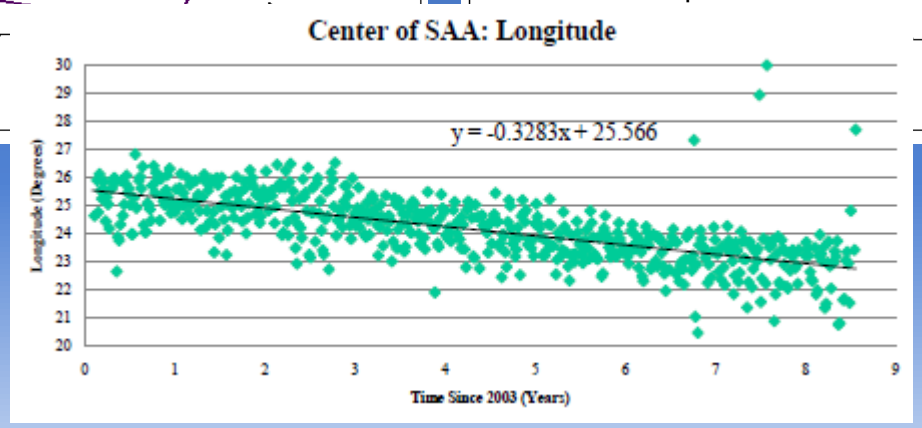


Pryor et al. (2013) Lyman-alpha observations of comet Holmes from SORCE SOLSTICE and SOHO SWAN, in ISSI SR-13, doi: 10.1007/978-1-4614-6384-9_9

South Atlantic Anomaly: moving west at 0.328°/year

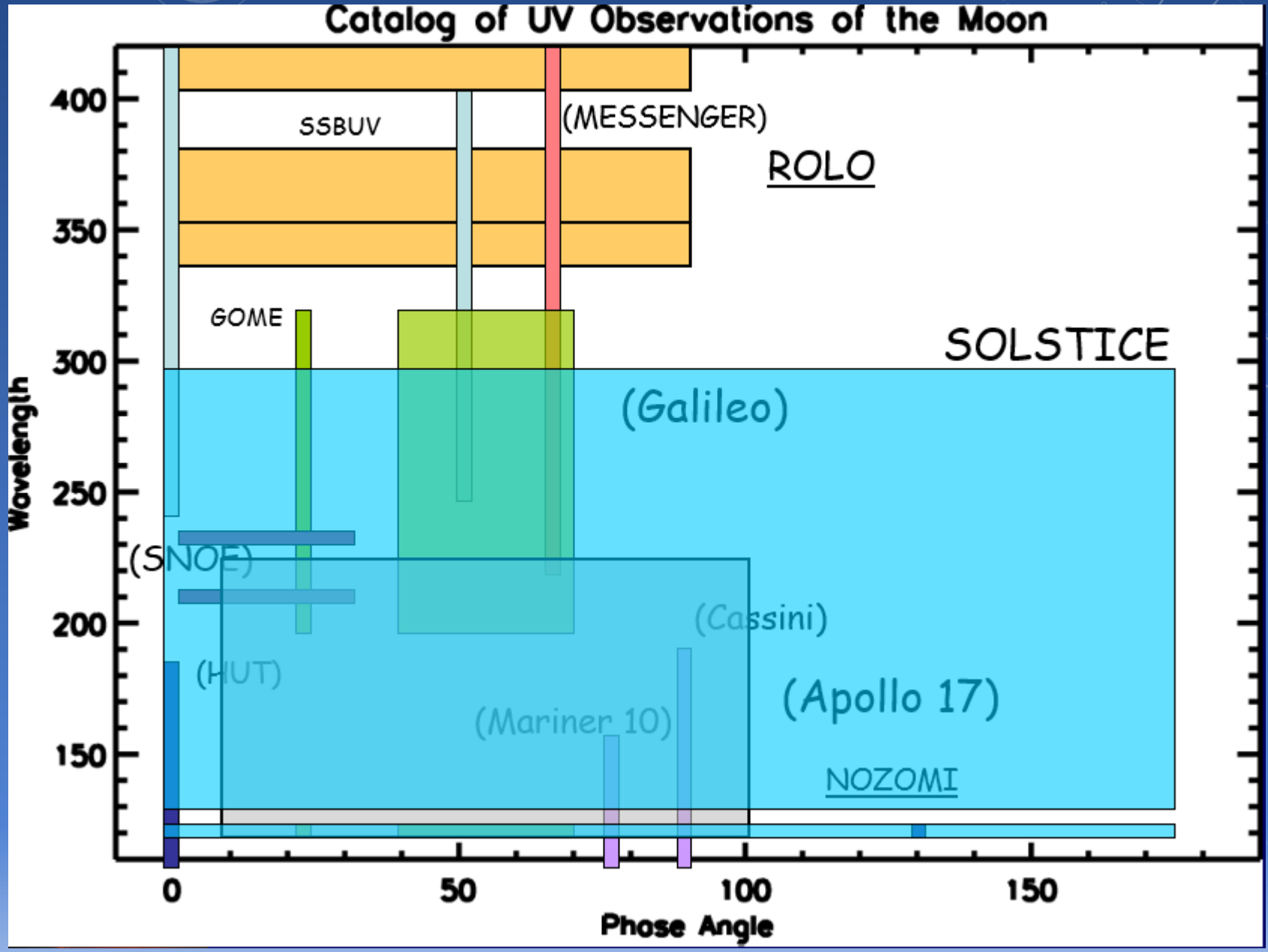




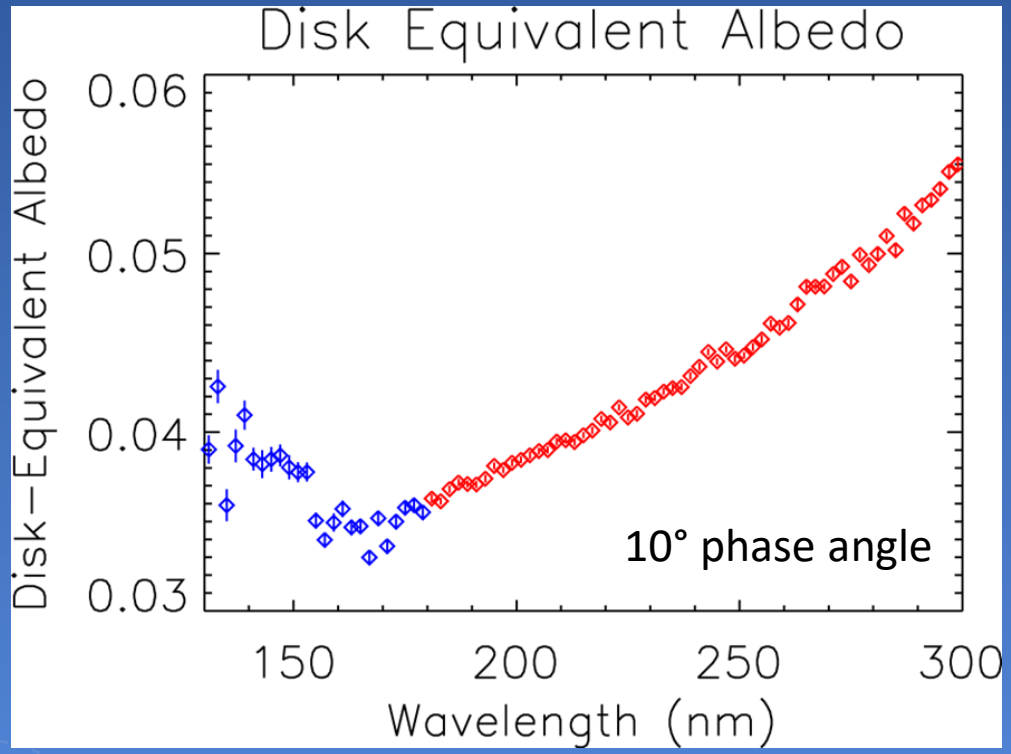


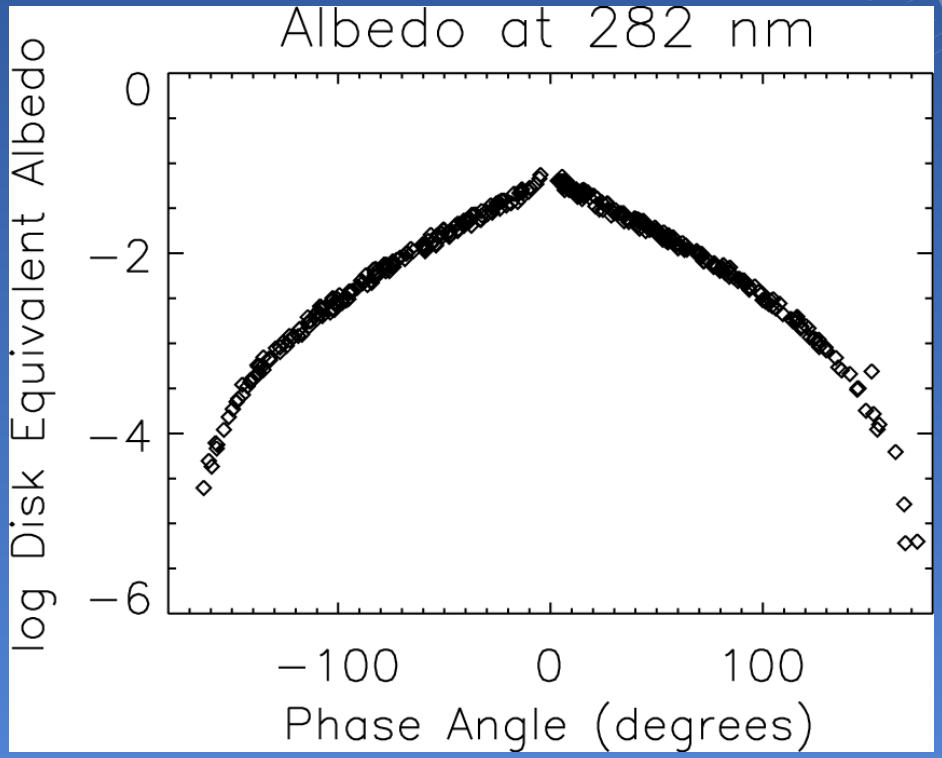
The Moon

- Albedo
- Polarization



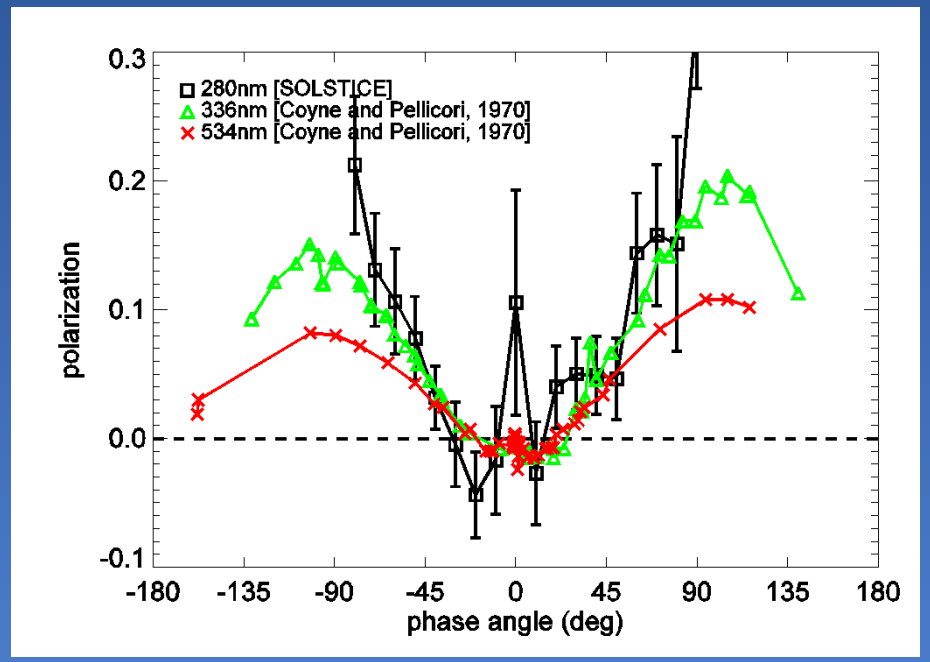
Lunar albedo: measured using stellar mode

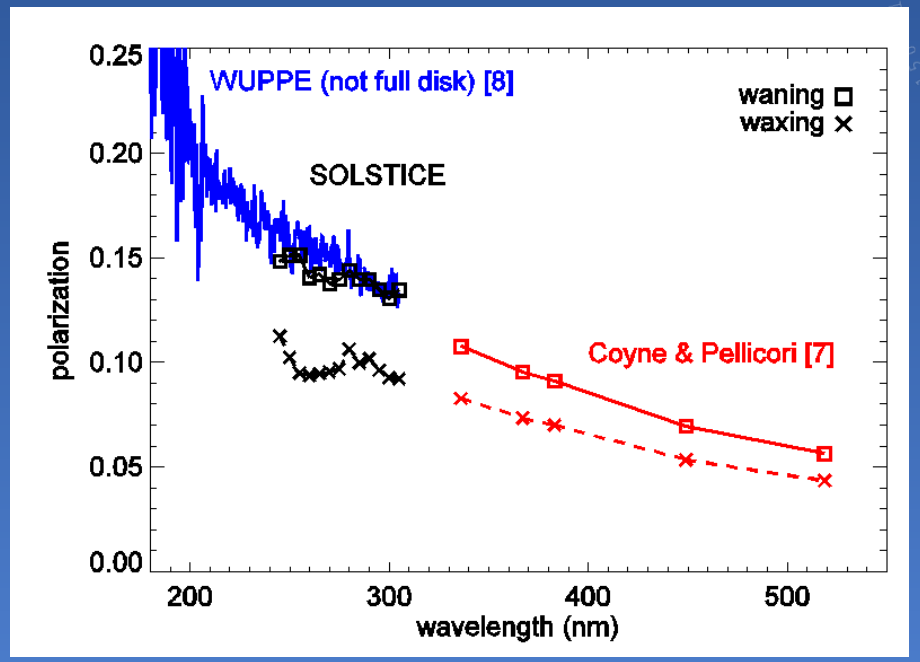




Snow et al. (2013) Absolute ultraviolet irradiance of the Moon from the LASP Lunar Albedo Measurement and Analysis from SOLSTICE (LLAMAS), in ISSI SR-013 doi: 10.1007/978-1-4614-6384-9_8

Polarization of lunar irradiance



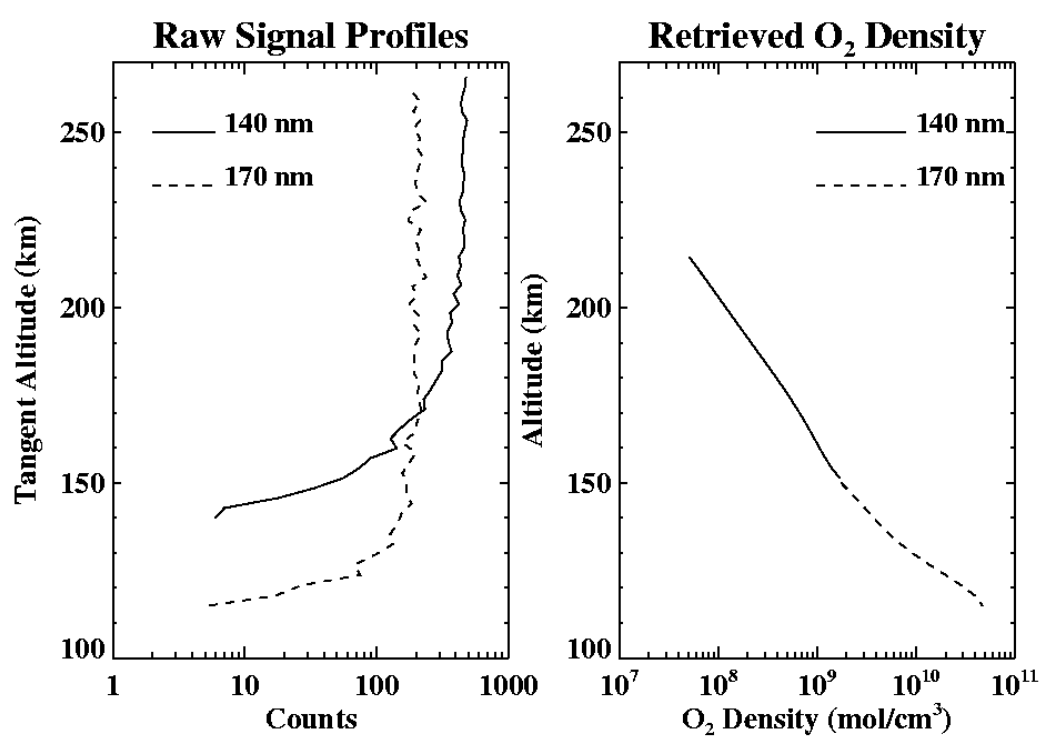


Snow et al. (2013) Absolute ultraviolet irradiance of the Moon from the LASP Lunar Albedo Measurement and Analysis from SOLSTICE (LLAMAS), in ISSI SR-013 doi: 10.1007/978-1-4614-6384-9_8

The Atmosphere

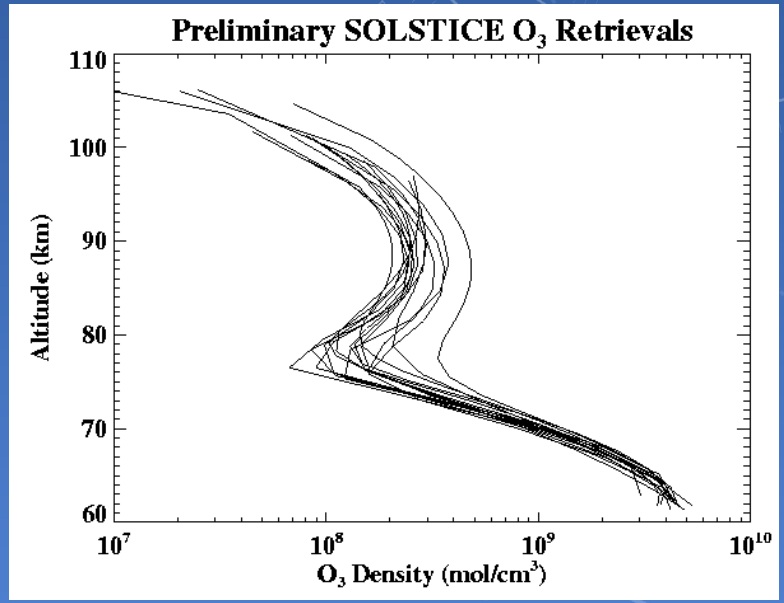
- Stellar occultations
  - Ozone (240 & 290 nm)
  - Molecular oxygen (140 & 170 nm)
- Hydrogen exosphere
  - Airglow
  - Dayside scattering

Oxygen (O_2) and Ozone Retrievals



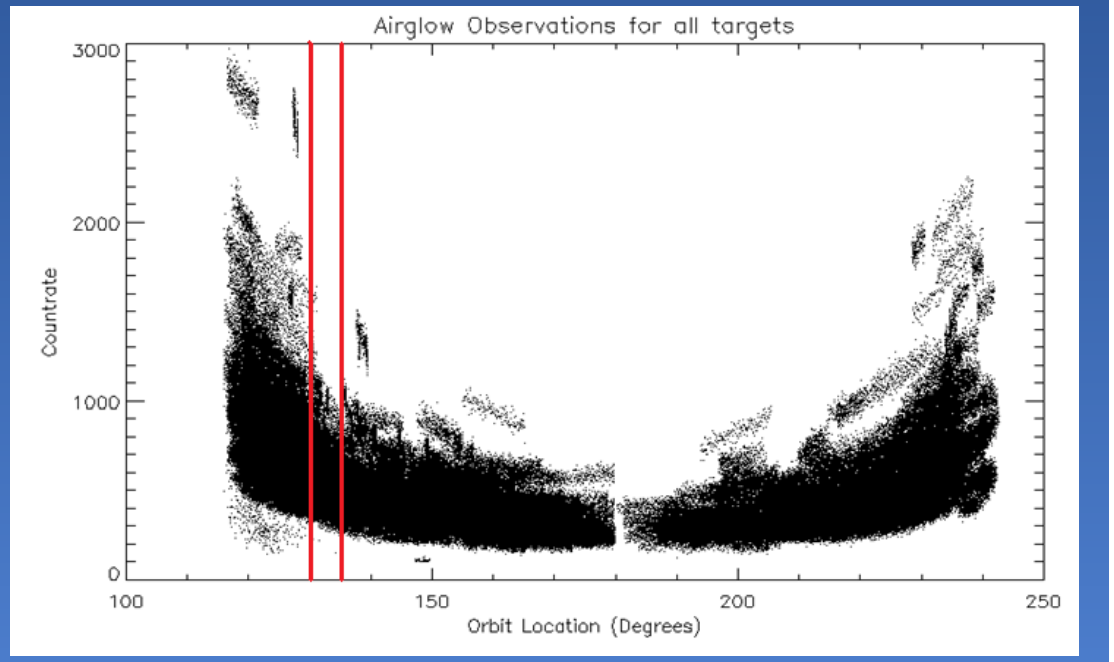
Observations at 140 and 170 nm sample O2 from 100 to 200 km

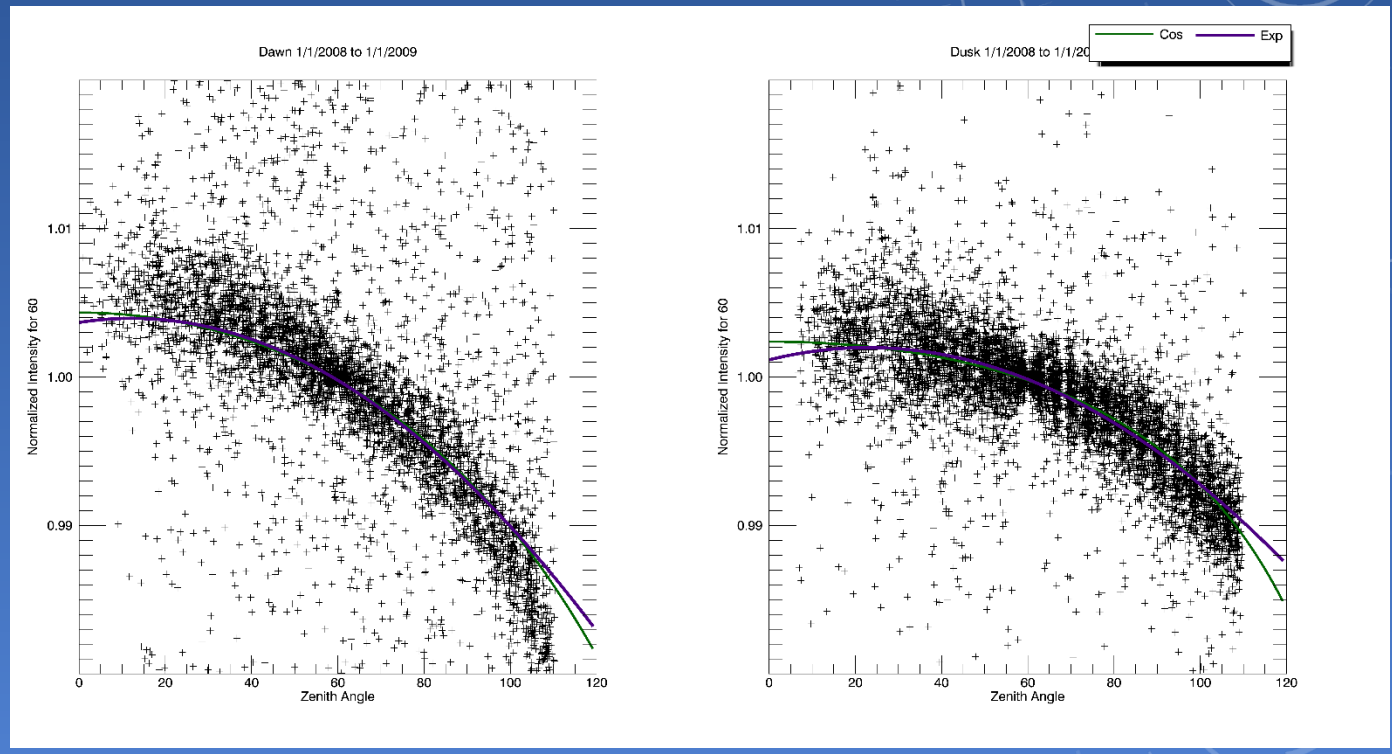
Observations at 250 and 290 nm sample Ozone from 60 to 110 km



Lumpe, Floyd, Snow, & Woods (2006) Thermospheric remote sensing by occultation: comparison of SUSIM and SOLSTICE O2 measurements, AGU Fall Meeting

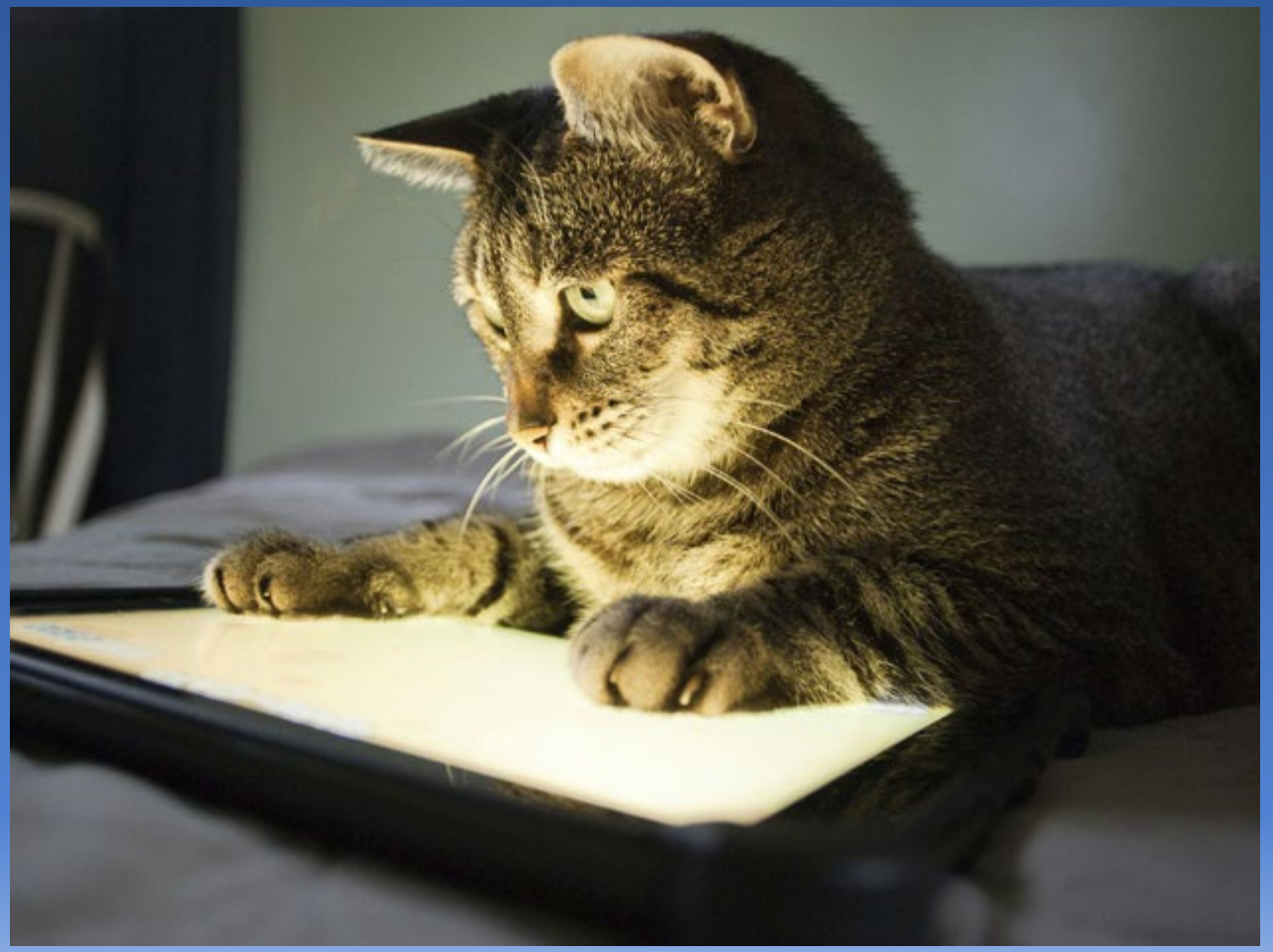
Hydrogen exosphere at night and during the day



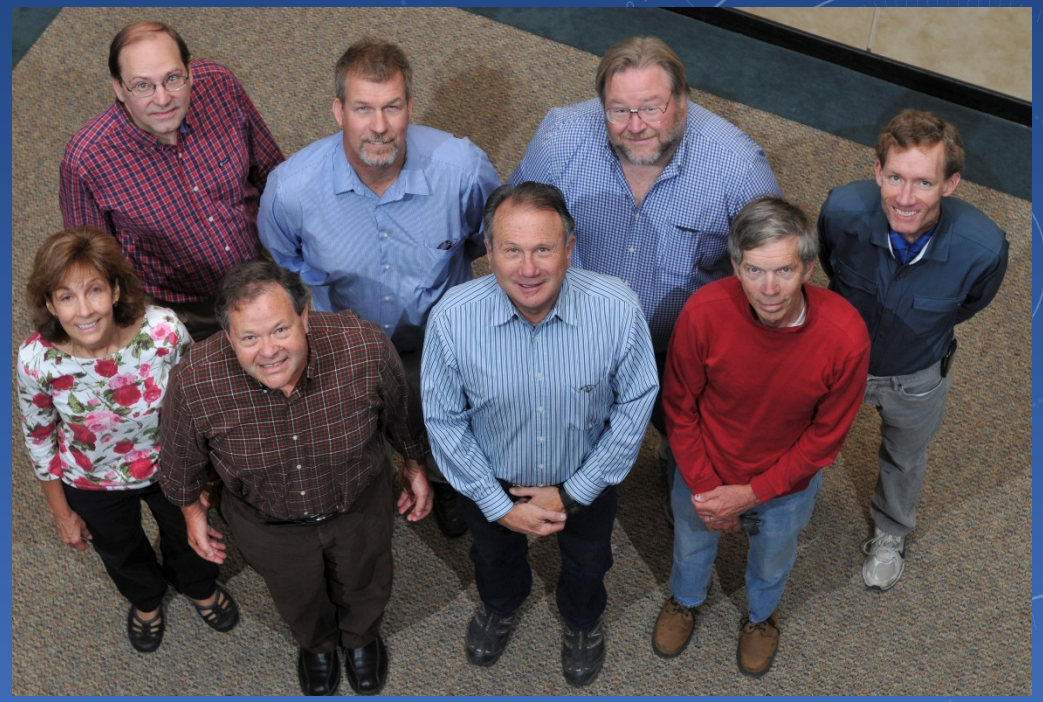


Perrat, Snow, & Machol (2020) in prep.

SOLSTICE has been a busy cat!



Summary



- Solar spectral irradiance measurements every day
- Stellar mode provides absolute calibration to astronomical observations
- Near-Earth environment (particle and photon) observations
- Absolute cross-calibration for other solar measurements
- Brilliant design by Rottman, Woods, and McClintock