Solar Dynamics Observatory (SDO)

Extreme-ultraviolet Variability Experiment (EVE) Status

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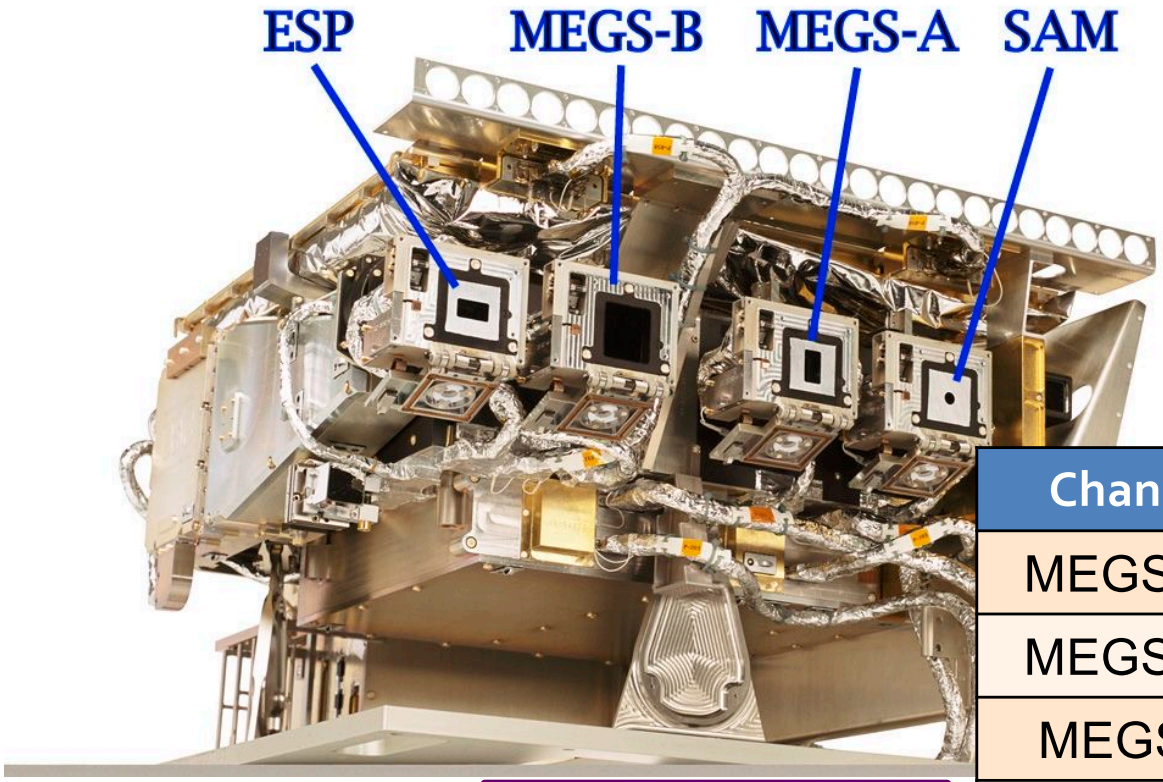
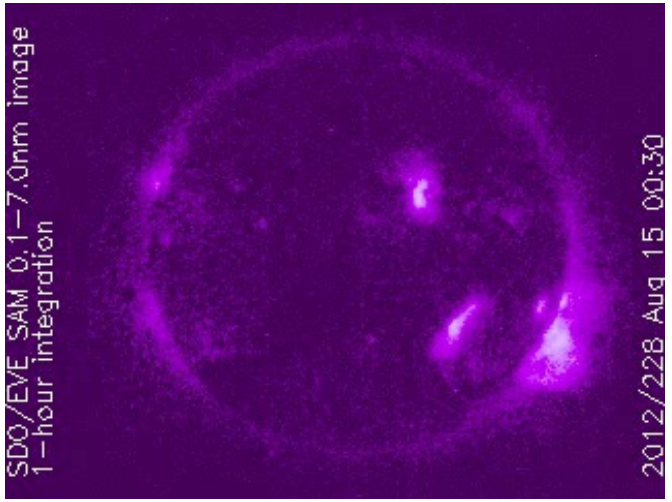
EVE measures solar EUV irradiance

LASP / USC / MIT-LL / SI built solar EUV irradiance instruments for the EVE suite with significant improvements in spectral resolution (0.1 nm) and time coverage (24/7, 0.25 s -10 s cadence)



SAM is X-ray Imager



Channel	λ Range	Δλ	Δt
MEGS-A1	6-18 nm	0.1 nm	10 sec
MEGS-A2	18-37 nm	0.1 nm	10 sec
MEGS-B	37-106 nm	0.1 nm	10 sec
MEGS-SAM	0.1-7 nm	(1 nm)	10 sec
MEGS-P	121.6 nm	1 nm	0.25 s
ESP	0.1-38 nm	4 nm	0.25 s

EVE Status July 2023

0.1 nm Spectral Resolution Spectrographs

Instrument	Status	Data Products Version 7	Degradation	
			Filter	Detector
MEGS-A1	Off	0C, 2S, 2L, 3	Minor	None
MEGS-A2	Off	0C, 2S, 2L, 3	Moderate	Minor
MEGS-B	Campaign Mode	0C, 2S, 2L, 3	None	Major > 70nm

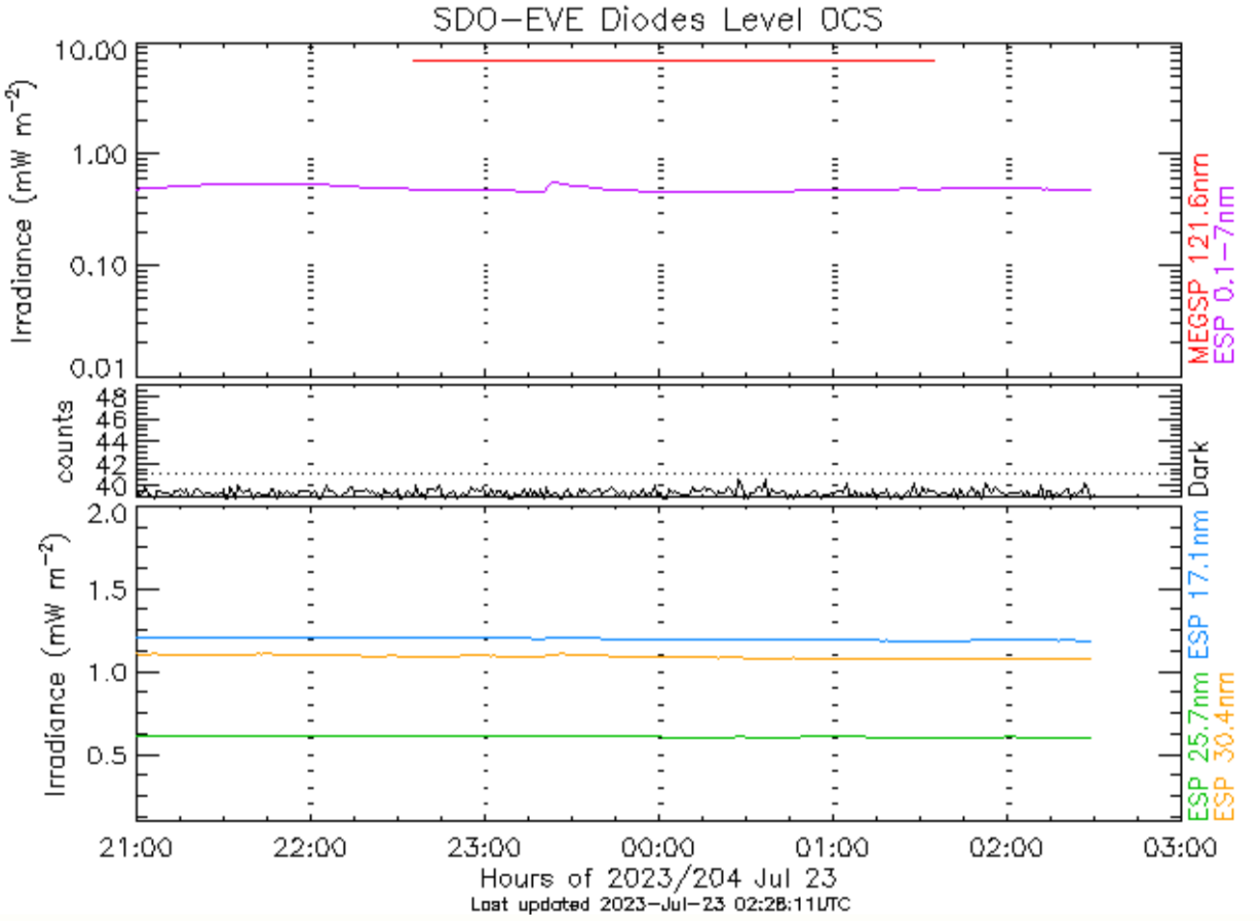
MEGS-A1/A2/SAM observations ended in June 2014. MEGS-B observations are now with 60-sec cadence during daily 3-hour campaigns and also for autonomous flare campaigns.

1-7 nm Passband Photometers

Instrument	Status	Data Products Version 7	Degradation	
			Filter	Detector
ESP	24/7 (0.25-sec)	0CS, 1P, 2L, 3	Moderate	None
MEGS-P (Ly-α)	Campaign Mode	0CS, 1P, 2L, 3	Minor	None
MEGS-SAM	Off	0C-SAM	None	None

MEGS-B Flare Campaigns

- EVE on-board flight software triggers MEGS-B Flare Campaigns (3-hour observations) whenever EVE-ESP Quad-Diode (1-7 nm passband) intensity and rising slope exceeds preset levels equivalent for M1 flare.
- Multiple Flare Campaigns can happen per day.
- Daily 3-hour observation is planned in case there are no flare campaigns.



SDO EVE Data Products – Version 7

http://lasp.colorado.edu/home/eve/data/

Level	Description	Components	Wavelength Coverage	Wavelength Sampling	Temporal Sampling	Time Span of Data File	Daily size (GB)	Latency of Availability
L0C	**Space Weather Product:** Crudely calibrated irradiances* (from Ka-Band data)	ESP bands + quad (flare location)	0.1-7, 18.2, 25.6, 30.4, 36.6 nm	broadband ~4-nm	1-min	Latest 15-min and current 1-day (growing file)	0.004	**<15 min**
		MEGS-P	121-122 nm	1-nm				
		MEGS-A, B	6-106 nm	1-nm	1-min		0.005	
		MEGS-A, B, proxies	Select lines and bands**	Varies by band	1-min		0.01	
L0CS	**Fastest Space Weather Product**: Crudely calibrated irradiances* with least latency (from S-Band)	ESP bands + quad (flare location)	0.1-7, 18.2, 25.6, 30.4, 36.6 nm	broadband ~4-nm	1-min	Latest 15-min and current 1-day (growing file)	0.005	**< 1 min**
		MEGS-P	121-122 nm	1-nm				
		XRS & SEM proxies	Proxies	Varies by band				
L1-P	**Photometer Data:** fully calibrated and corrected photometer irradiances	ESP	0.1-7, 18.2, 25.6, 30.4, 36.6 nm	~4-nm	1/4-sec	1-hour	0.03	1 Day
		SAM	0.1-7 nm	7-nm	1- & 5-min		varies	
		MEGS-P	121-122 nm	~1-nm	1/4-sec		0.006	
L2-S	**Spectra**: fully calibrated spectral irradiances at instrument resolution	MEGS-A, B	6-106 nm	0.02 nm	10-sec & 60-sec	1-hour	1.2	1-2 Day
L2-L	**Lines & Broadband irradiances:** fully calibrated photometer irradiances and extracted spectral features	MEGS-A, B, P, ESP	select lines & bands	Varies by band	10-sec & 60-sec	1-hour	0.01	1-2 Day
L3	**Merged Spectra:** fully calibrated, corrected, and merged spectral irradiances	ESP, SAM, MEGS-A, MEGS-B, MEGS-P	0.1-106 nm	0.02, 0.1 & 1 nm	1-day	1-day	<0.001	1-2 Day
L4	**Model Spectra**	ESP QD Proxy	0.1-106 nm	0.02 nm	60-sec	1-day	1.2	1-2 Day

*All products are corrected to 1-AU except L0C and L0CS.

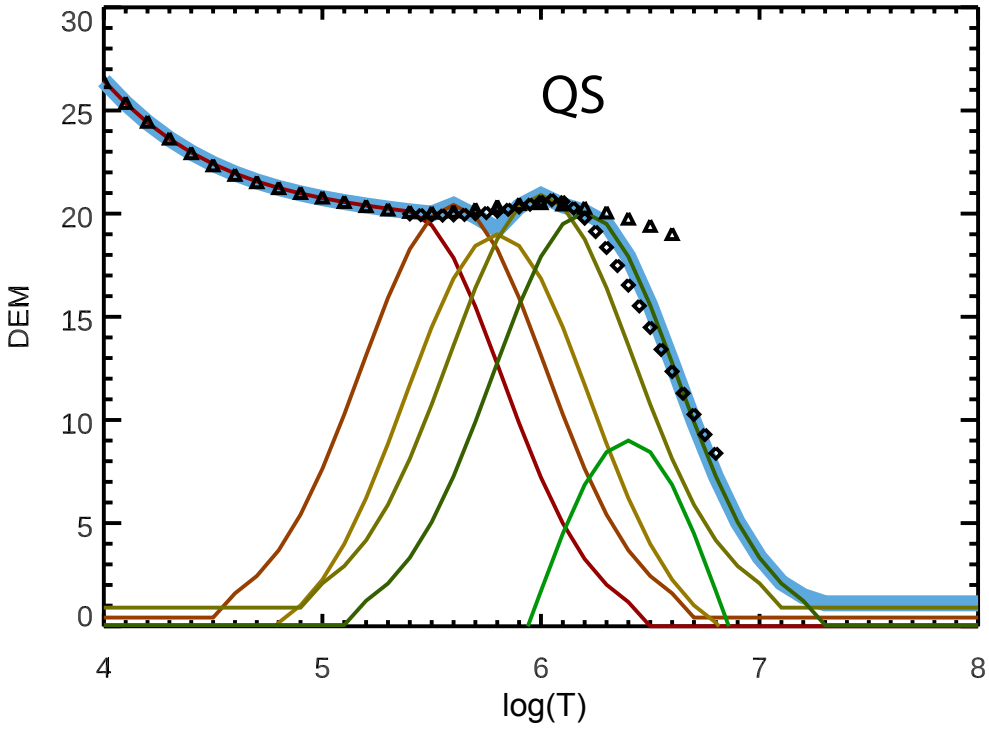
** Lines spanning Log T = 3.8-7.1, plus AIA and ESP bands.

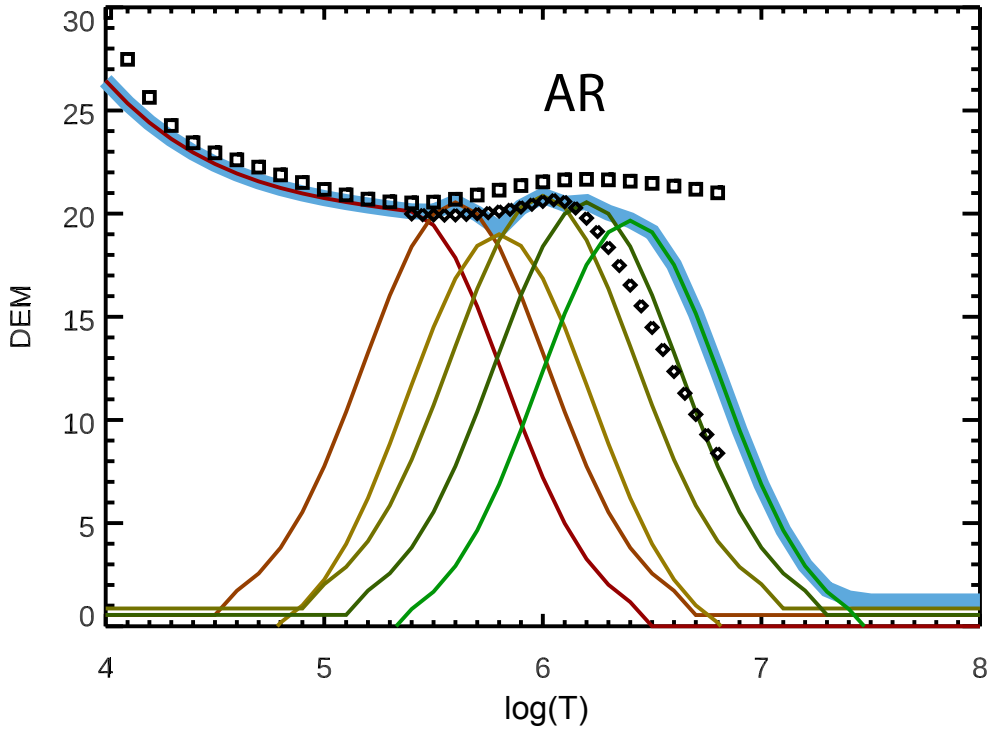
SDO EVE Level 4 Model Spectra Product

- With limited wavelength and temporal coverage for some EVE channels, we decided to provide model spectra for all EUV wavelengths and for all times when there are EVE-ESP observations.
- Use 3 component spectra model based on Quiet-Sun (QS) and Active-Region (AR) reference spectra for daily variability and Flare (FL) reference spectra for 1-min cadence spectra.
  - Woods & Elliott (*Solar Phys*., 2022) provides model details for SORCE-XPS, and this XPS Level 4 model is also applied for EVE-ESP as the proxy.

SDO EVE Level 4 Model Spectra Product

- Quiet-Sun (QS) and Active-Region (AR) reference spectra are based on EVE MEGS and MinXSS CubeSat spectra and 1-5 nm spectral gap filled using the DEM fit to EVE+MinXSS spectra.
  - Woods & Elliott (*Solar Phys*., 2022)
  - EVE+MinXSS QS DEM agrees very well with EIS QS DEM

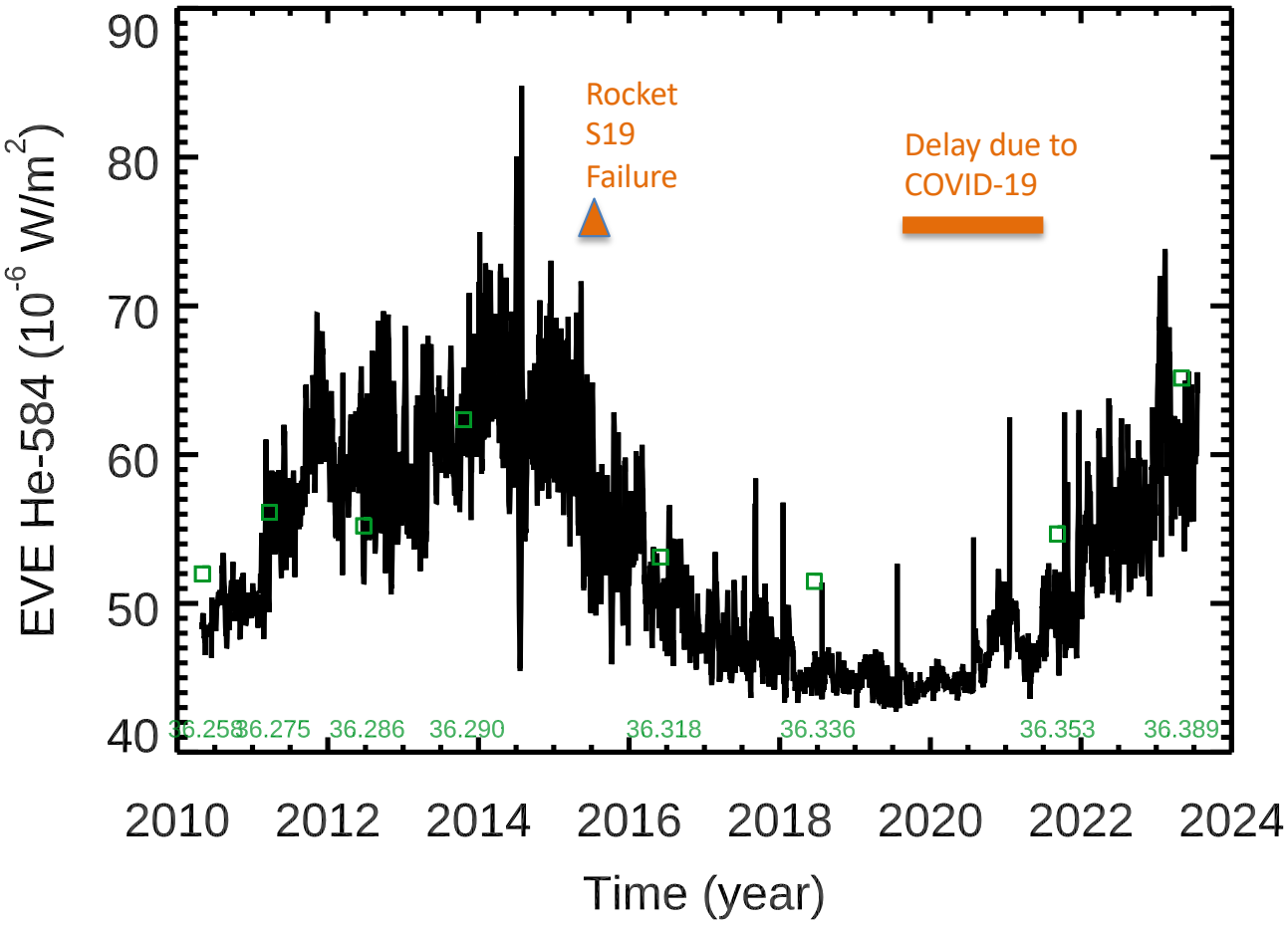




Triangles = CHIANTI standard QS DEM
Squares = CHIANTI standard AR DEM
Diamonds = EIS QS DEM

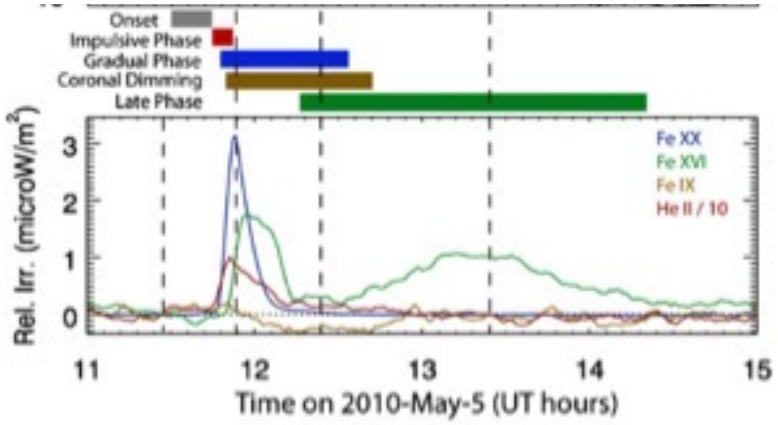
SDO EVE Underflight Calibration Experiment

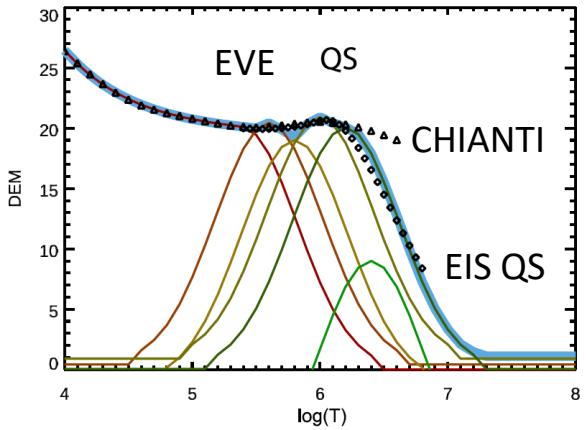
- NASA 36.389 is most recent rocket calibration flight on May 3, 2023 from White Sands Missile Range
- Future flight is planned for June 2025 (*pending SDO 2022 Senior Review results*)
- WARNING: Version 7 EVE products do not include latest rocket calibration results !

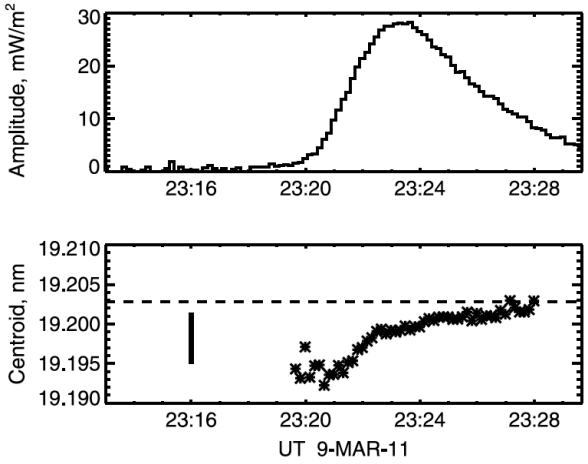


EVE Science Highlights

- There will be several presentations during this workshop that will highlight EVE science results
  - Solar EUV irradiance modeling
  - Flare observations / modeling
  - H I Lyman-alpha observations
  - Doppler results
  - Space weather products / modeling
  - EUV Instrument degradation







SDO EVE Workshop History

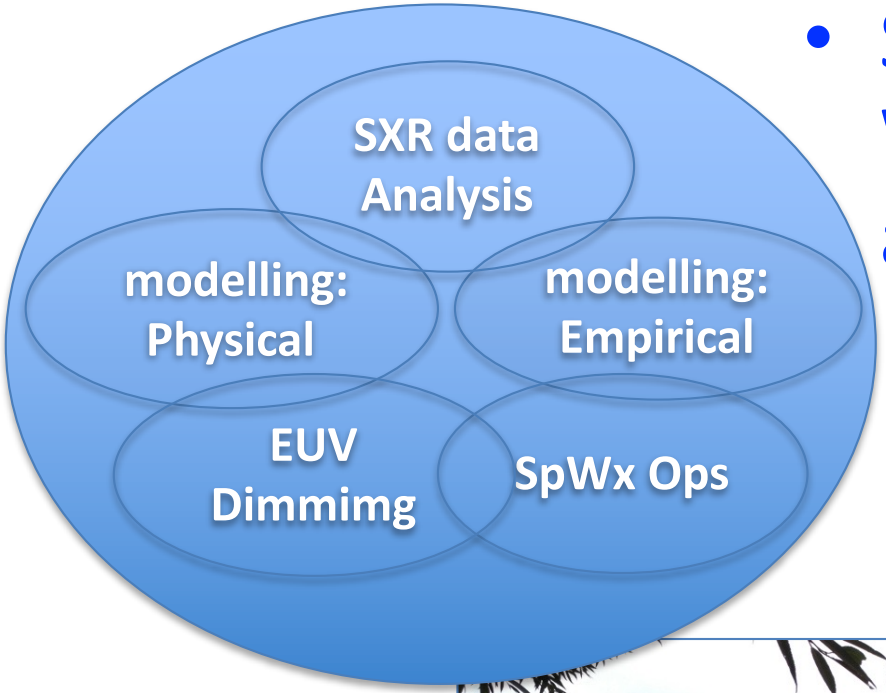
https://lasp.colorado.edu/eve/science/meetings-workshops/

- 2005 – EVE Science Team Workshop - Warner Springs, CA
- 2007 – EVE Science Data Processing Workshop – Boulder, CO
- 2008 – EVE Science Team Workshop - Blacksburg, VA
- 2009 – EVE Science Data Processing Workshop - Boulder, CO
- 2010 – EVE Space Weather & Operations Workshop - Boulder, CO
- 2011 – EVE Calibration and Validation Workshop – Boulder, CO
- 2012 – EVE Calibration Workshop - Yosemite, CA
- 2013 – EVE Working Group Meeting - Boulder, CO
- 2014 – EVE Science Team Workshop – Part of LWS Meeting in Portland
- 2018 – EUV Calibration Workshop – Part of SDO Meeting in Belgium

Annual EVE Science Team Workshops ended in 2015 when SDO began its extended mission phase due to reduction in funding for SDO science Co-Is.

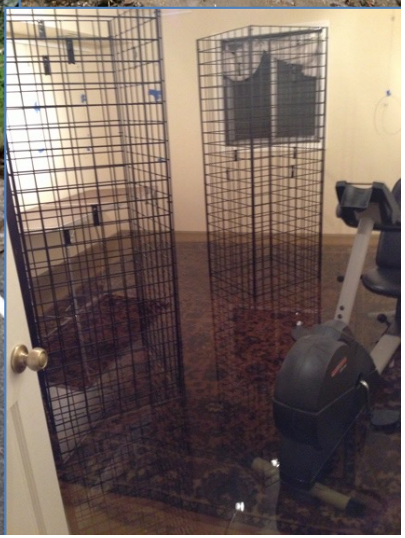
- **Thanks Phil for organizing this EVE Science Workshop !**

Flashback – Remember EVE Workshop in 2013?



- Some of those 2013 EVE Working Group topics are still active for this workshop.

Boulder 2013 100-year Flood Pictures



SDO EVE Summary

- EVE Operations are nominal (new normal since July 2014)
  - ESP solar observations at 4 Hz
  - MEGS-B solar observations with 1-min cadence for 3-hours daily plus automated flare observations (> M1)
  - MEGS-P (Lyman-alpha) observations are tied to MEGS-B
  - MEGS-A & MEGS-SAM ended in June 2014 (CCD anomaly)
- Rocket EVE calibrations are planned for every other year
  - Recent flight was May 3, 2023; Next one is June 2025
- Version 7 is current EVE data product
  - New Level 4 Spectral Model (based on QS, AR, Flare reference spectra and ESP Quad-Diode as proxy input)
- Version 8 release is planned for this fall
  - Improvements in calibrations for MEGS-B and ESP
  - New Level 4 Lines product in development