EUV Spectro-Photometer (ESP)

(Some Details of the Instrument to Understand its Calibration Issues)

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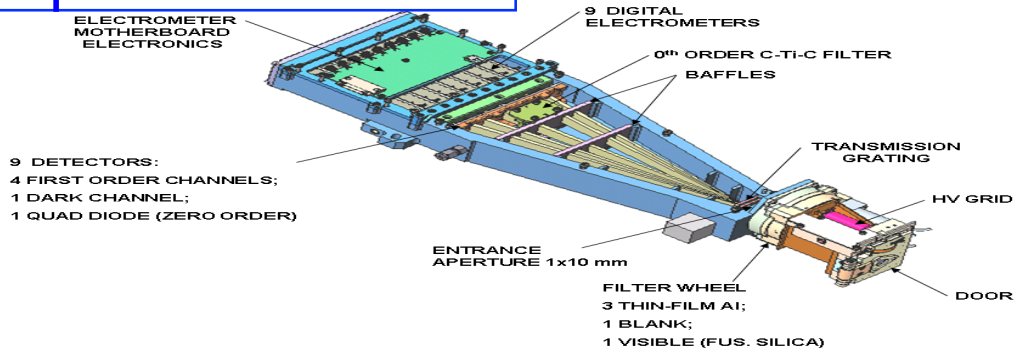
Outline

- ESP details and a comparison to SEM;
- Irradiance Equation: what is changing and what is calibrated/corrected;
- Calibration History;
- Details of SURF BL-9 and BL-2 calibrations;
- Flight daily and weekly calibrations;
- Efficiency profiles and spectral bands from SURF calibration and for solar observations

Details are in Sol Phys (2009), Didkovsky et al. doi 0.1007/s 11207-009-9485-8 , open access

ESP vs. SEM

Details are in Sol Phys (1998), Judge, McMullin, Ogawa et al.



	SEM	ESP
Bands	3	9
Flt Wheel	No	Yes
Particle detector	No	Yes
QD	No	Yes
Daily calibrations	No	Yes
Gain calibration	No	Yes

ESP Irradiance Equation

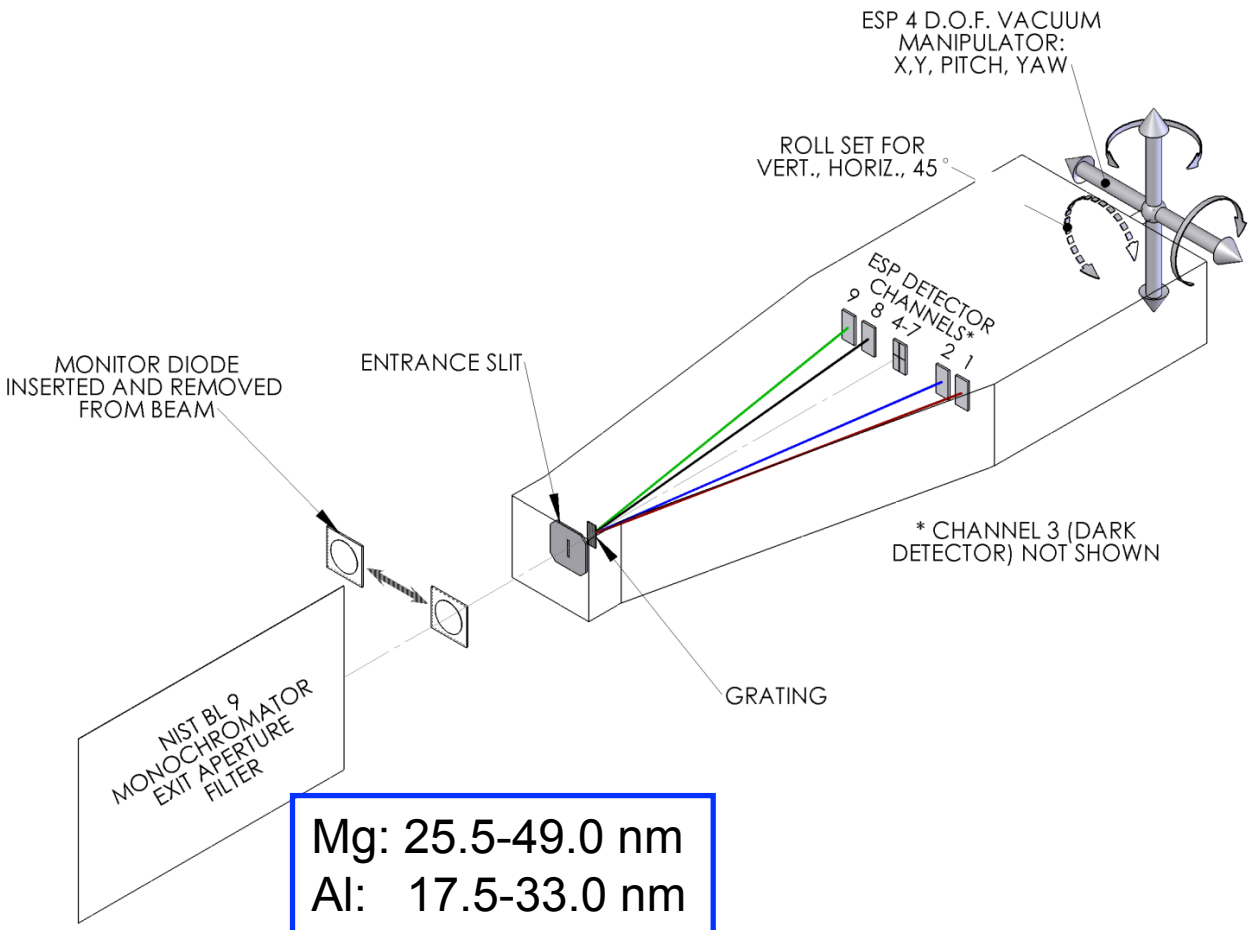
$$E(\lambda,t)=\frac{\frac{C_{ef}}{\Delta t}\cdot\left(1-\frac{dG(T,V,TID)}{\Delta t}\right)}{A\cdot\frac{\int_{\lambda_0-\Delta\lambda}^{\lambda_0+\Delta\lambda}R(\lambda,\alpha,\beta)\cdot\left(\frac{\lambda}{hc}\right)\cdot F(\lambda)d\lambda}{\int_{\lambda_0-\Delta\lambda}^{\lambda_0+\Delta\lambda}F(\lambda)d\lambda}\cdot f_{\deg rad}(channel,t)\cdot f_{1AU}(t)}-E_{OS}$$

Rectangulars show what measured/calculated data are calibrated

Calibration History

- Synchrotron Ultraviolet Radiation Facilities (SURF) at NIST used for ESP calibration
- **ESP-Flight** calibration at BL-9 in 2006
- **ESP-Flight** calibrations at BL-2 in 2007 (2) (characterization of the Flight ESP)
- **ESP-Rocket** calibration at BL-2 in 2007 (found significant efficiency differences)
- **ESP-Rocket** calibration at BL-9 in 2008 (2) before and after replacement of the grating and Ch2 diode
- **ESP-Rocket** calibration at BL-2 in 2009 (Jan) and 2010 (Sep)

Synchrotron Ultraviolet Radiation Facilities (SURF) at NIST for ESP calibration: BL-9

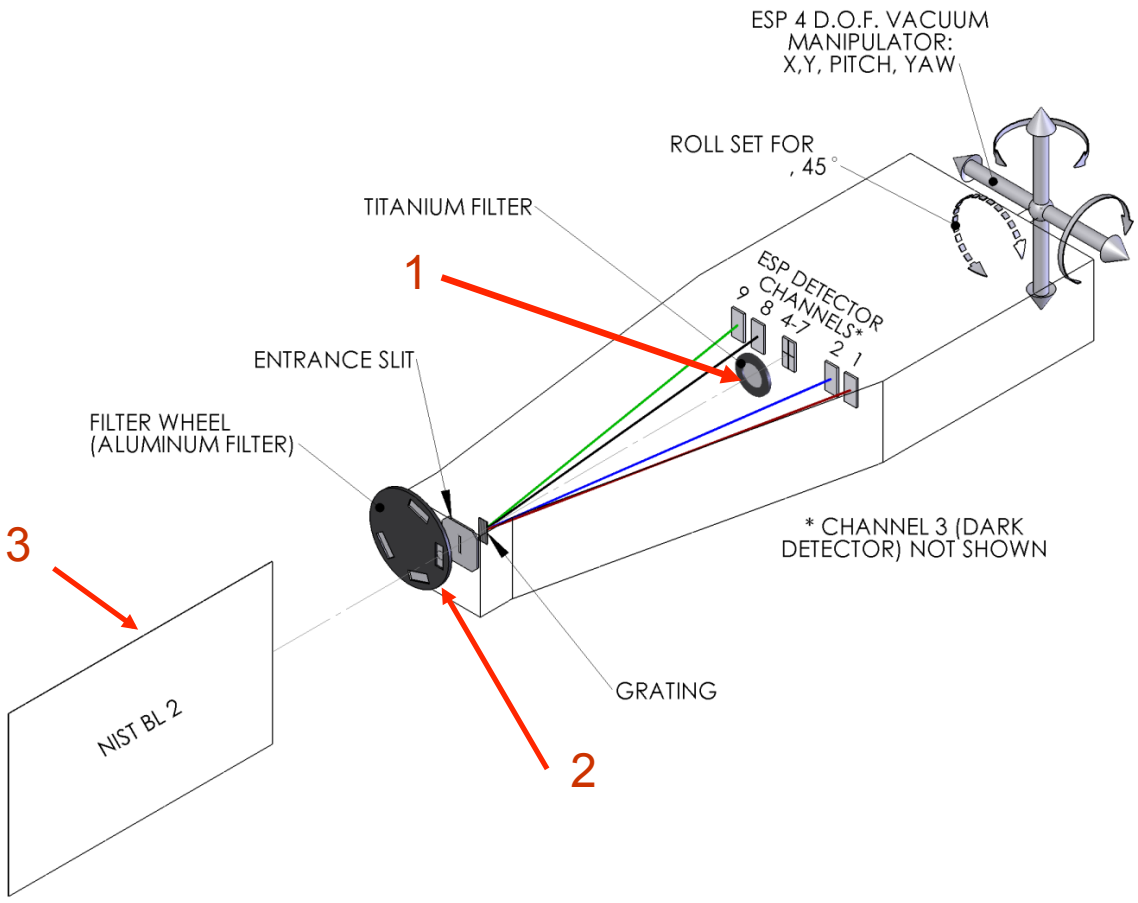


Mg: 25.5-49.0 nm
Al: 17.5-33.0 nm
Be: 13.6-21.5 nm

ESP is calibrated separately from the other EVE instruments in BL-9 (which accommodates only small instruments).

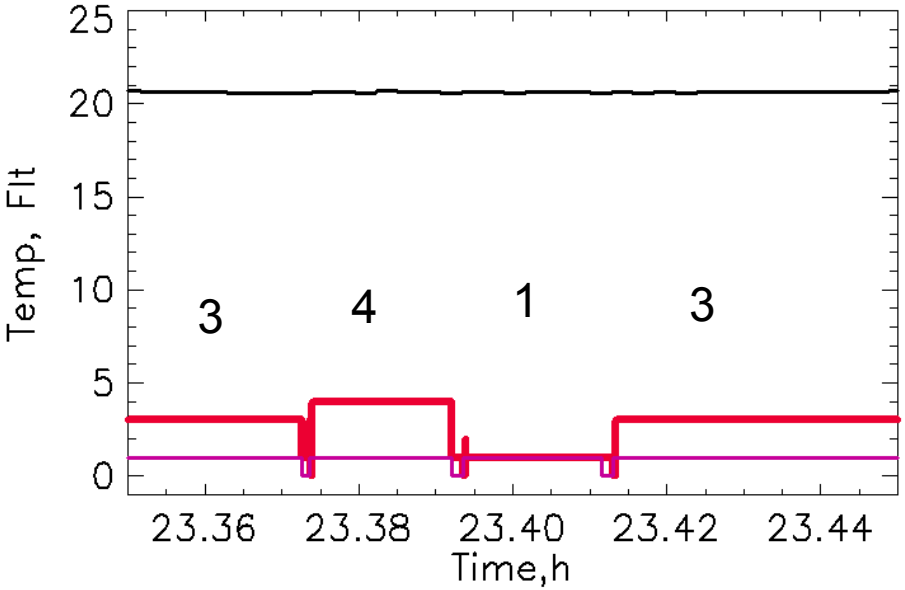
BL-9 provides narrow spectral beams from the monochromator.

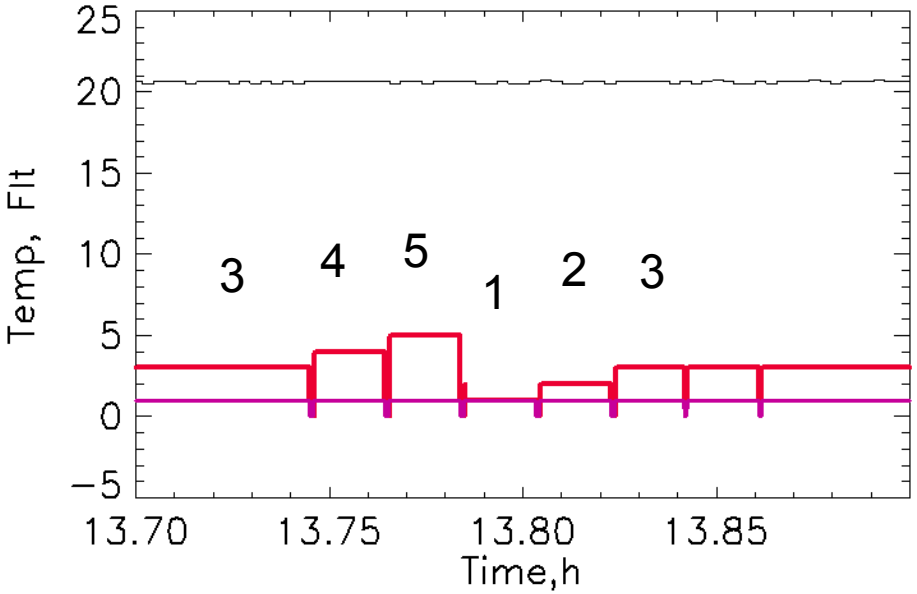
Synchrotron Ultraviolet Radiation Facilities (SURF) at NIST for EVE and ESP calibration: BL-2



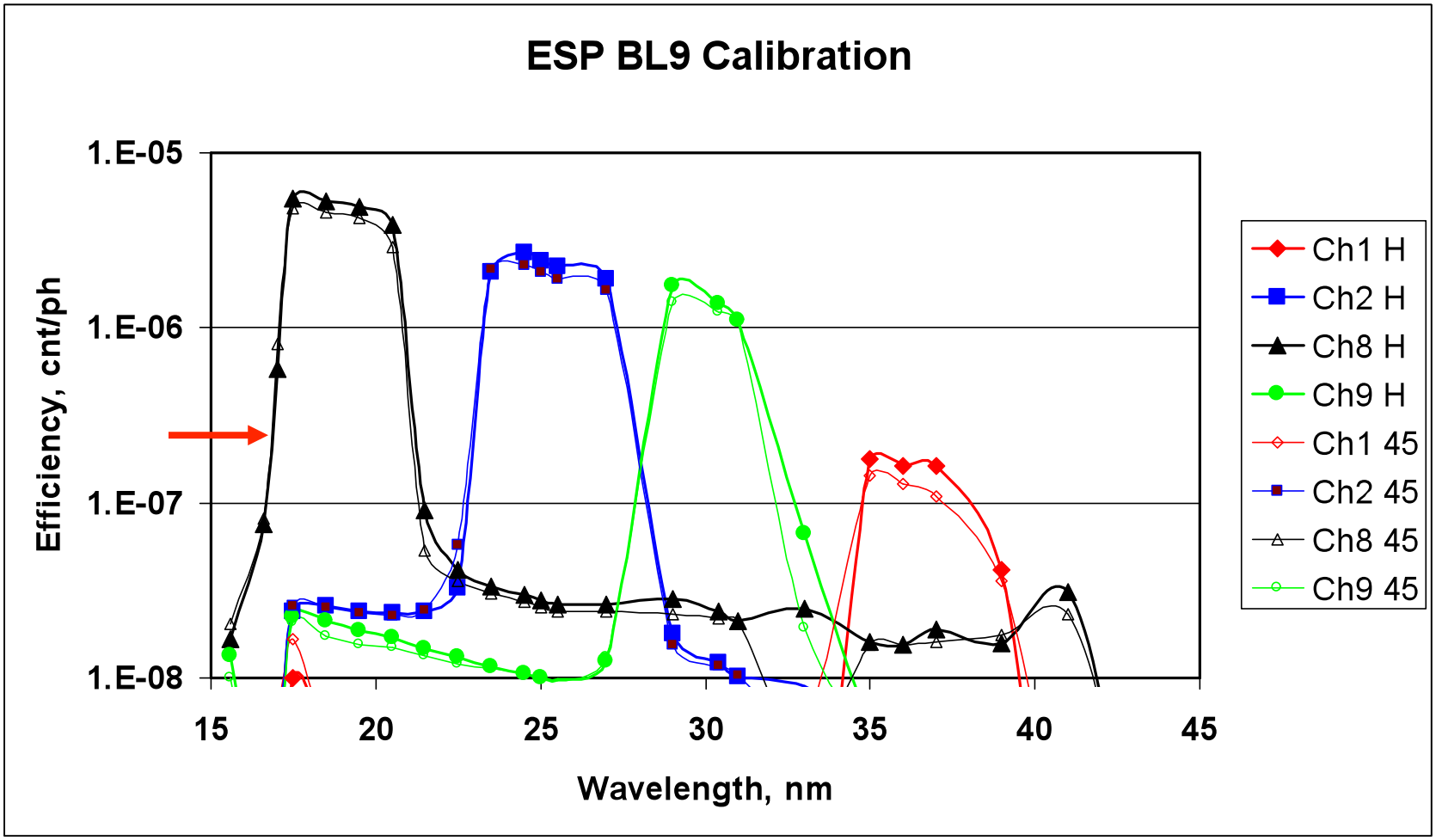
ESP is assembled to EVE for BL-2 calibration. BL-2 provides a combined response to a wide spectrum of EUV radiation. This is a 'radiometric' calibration.

Daily / Weekly Calibrations

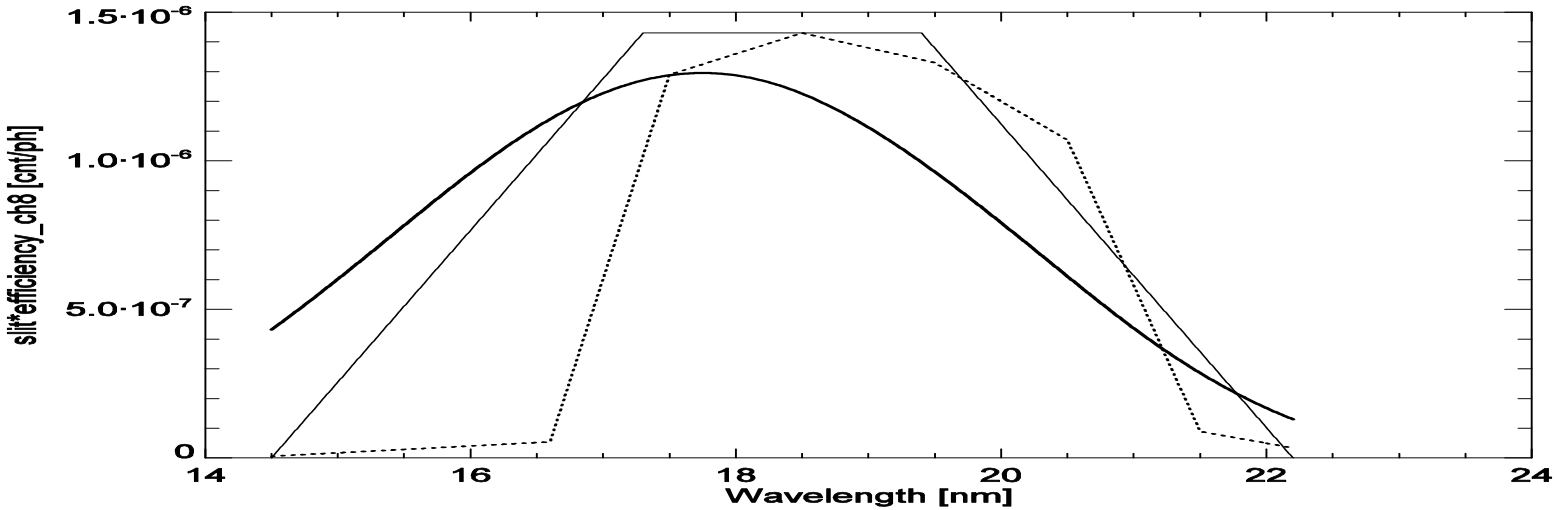




ESP-Flight calibration at BL-9 in 2006



Correction of the Efficiencies



←Entrance Slit

Convolved→

←BL-9

Flight and Rocket WL

ESP Ch	Conv-ed, nm	Band, nm	WL, nm	Conv-ed, nm	Band, nm	WL, nm
1	33.0-40.3	7.3	36.7	33.0-40.3	7.3	36.7
2	22.0-29.2	7.2	25.6	22.0-29.2	7.2	25.6
8	14.5-22.2	7.7	18.4	14.5-22.2	7.7	18.4
9	26.7-33.8	7.1	30.3	26.7-33.8	7.1	30.3
QD	0.1-7.0*	7.0*	3.5*	0.1-7.0*	7.0*	3.5*

EVE/ESP-Flight Calibration at BL-2 in 2007 (Characterization Results)