MEGS-P Calibration Overview

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MEGS-P Algorithm

- SURF Responsivity Algorithm

$$R_P(\alpha,\beta,filter) = \frac{C_P(\alpha,\beta,filter,E_{beam}) - D_P}{F(121.6nm,E_{beam}) \bullet I} \bullet \frac{\Delta\lambda_{sun}}{\Delta\lambda_{SURF}(E_{beam})}$$

$$\Delta\lambda_{SURF}(E_{beam}) = \int_{all\ \lambda} \frac{F_{SURF}(\lambda,E_{beam})}{F_{SURF}(121.6nm,E_{beam})} \bullet P_G(\lambda) \bullet P_F(\lambda) \bullet P_D(\lambda) \bullet d\lambda$$

$$\Delta\lambda_{sun} = \int_{all\ \lambda} \frac{F_{sun}(\lambda)}{F_{sun}(121.6nm)} \bullet P_G(\lambda) \bullet P_F(\lambda) \bullet P_D(\lambda) \bullet d\lambda$$

- Solar Irradiance Algorithm

$$F_{sun}(121.6nm) = \frac{C_{sun}(\theta,\phi) - D_{dark} \bullet f_{C/D} - C_{vis-sun}(\theta,\phi)}{R_{Center} \bullet f_{FOV}(\theta,\phi) \bullet f_{1au} \bullet f_{\deg rade}}$$

MEGS-P Calibration Results

Parameter	Source	Flight MEGS-P	Rocket MEGS-P	Uncertainty
Signal, C_p	SURF measured	~350 DN/s	~350 DN/s	1%
Dark, D_p	SURF measured	~200 DN/s	~200 DN/s	1%
SURF Flux, F	Theory (calculate)	-	-	0.2%
Beam Current, I	SURF measured	-	-	1%
Bandpass, $\Delta\lambda_{SURF}$	Analysis (calculate)	10.6 nm	10.6 nm	10% (+ ?)
Bandpass, $\Delta\lambda_{Sun}$	Analysis (calculate)	1.02 nm	1.02 nm	10% (+ ?)
Responsivity, R_p	Calculated	1421 DN/(W/m^2)	1922 DN/(W/m^2)	14%
FOV Factor, f_{FOV}	SURF measured	0.02% / arc-min	0.02% / arc-min	2%

Table 4. MEGS P Spectral Bandpass Widths

Source Function	Bandpass Width ($\Delta\lambda$)
SURF 183 MeV	10.641 nm
SURF 380 MeV	10.618 nm
Sun – Solar Cycle Min	1.023 nm
Sun – Solar Cycle Max	1.016 nm
Sun - average	1.020 nm

MEGS-P Irradiance Uncertainty

Parameter	Uncertainty
Signal, C_{sun}	1%
Dark, D_p	1%
Dark Factor, $f_{C/D}$	1.4%
Visible, C_{vis}	1%
Responsivity, R_p	14% (5%)
FOV Factor, f_{FOV}	(not used)
1 AU Factor, f_{1AU}	< 0.05%
Degradation, $f_{degrade}$	1%/year
Irradiance, F_{Sun}	15% (8%)

Responsivity Uncertainty

$$\sigma_{R_P}^2 = R_P^2 \bullet \left[\left(\frac{\sigma_{C_P} + \sigma_{D_P}}{C_P - D_P} \right)^2 + \left(\frac{\sigma_F}{F} \right)^2 + \left(\frac{\sigma_I}{I} \right)^2 + \left(\frac{\sigma_{\Delta\lambda_{SURF}}}{\Delta\lambda_{SURF}} \right)^2 + \left(\frac{\sigma_{\Delta\lambda_{Sun}}}{\Delta\lambda_{Sun}} \right)^2 \right]$$

Irradiance Uncertainty

$$\sigma_{F_{sun}}^2 = F_{sun}^2 \bullet \left[\left(\frac{\sigma_{C_{sun}} + \sigma_{D_P} + \sigma_{C_{vis}}}{C_{sun} - D_P - C_{vis}} \right)^2 + \left(\frac{\sigma_R}{R} \right)^2 + \left(\frac{\sigma_{f_{FOV}}}{f_{FOV}} \right)^2 + \left(\frac{\sigma_{f_{1AU}}}{f_{1AU}} \right)^2 + \left(\frac{\sigma_{f_{degrade}}}{f_{degrade}} \right)^2 \right]$$

Note: the uncertainty values in parentheses () represent expected results if transfer SORCE SOLSTICE calibration to MEGS-P

April 2008 Rocket MEGS-P Results

- Rocket MEGS-P Lyman-α Irradiance is 3.9 mW/m^2
- This is 30% less than the SORCE/SOLSTICE 121-122 nm irradiance result of 5.7 mW/m^2
- Why so different?
  - Suspect the bandpass width (both solar and SURF) as cause for difference

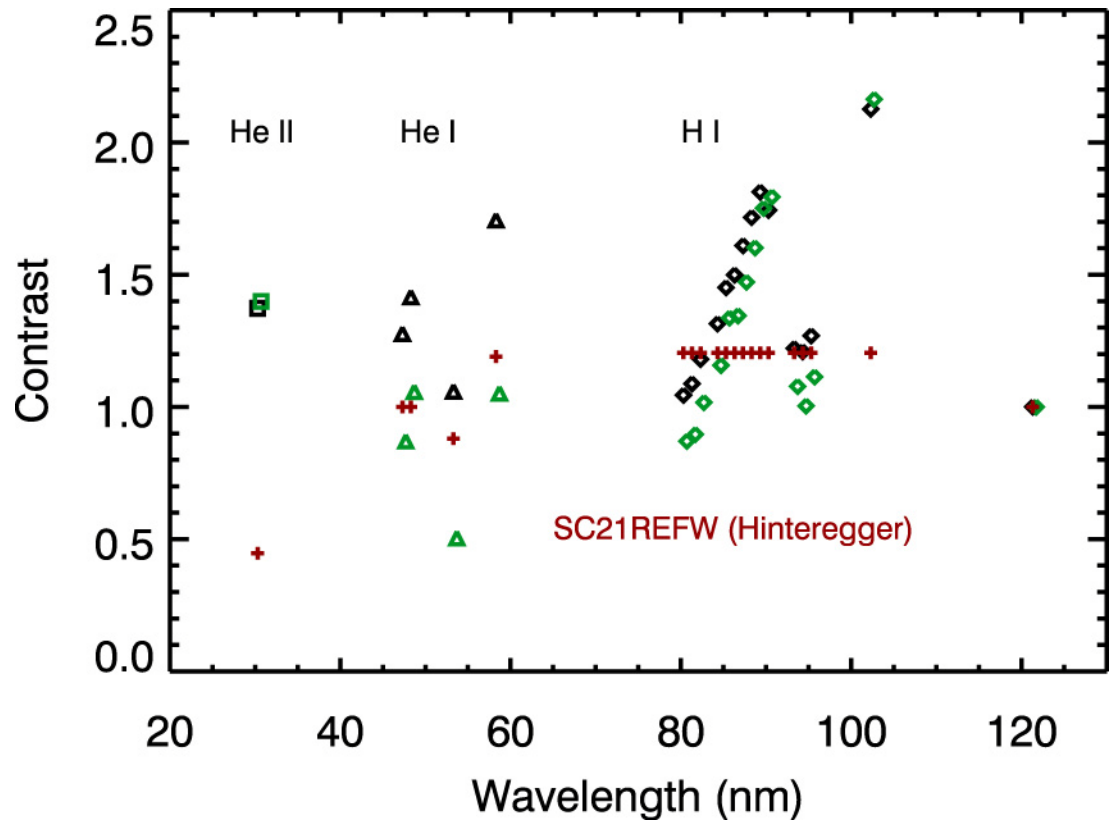
SDO MEGS-P Initial Validation Effort

- Validate MEGS-P irradiance with Rocket EVE, TIMED SEE, SORCE SOLSTICE, GOES-14 EUVS, ESA SOL-ACES, and ESA LYRA
  - SORCE SOLSTICE has best accuracy
- First underflight EVE calibration is on May 5, 2010
  - Expect difference between MEGS-P and SORCE SOLSTICE to persist. If so, then plan to update the SDO and Rocket MEGS-P calibration parameters (probably SURF / Solar band widths) so MEGS-P has same irradiance as SORCE SOLSTICE on rocket day

- **Suggest an EVE Validation and First Results Workshop for June 2010**

Long-Term Calibration Plan with MEGS-P

- Relative changes in MEGS-P irradiance will be used to estimate the relative trends of H and He emissions for use in between the underflight rocket measurements (5/10, 11/10, 10/11, 4/13, 4/15)
- Short-term contrast ratios derived from TIMED SEE are shown in this figure. Same, possibly more accurate, ratios can be derived from SDO EVE after 3-6 solar rotations.

Short-term Contrast (to be used)
Long-term Contrast (validation)

SC21REFW (comparison)