Comparison of solar EUV irradiance observed by LYRA and EVE

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PROBA2: a technology demonstrator

Both the S/C and its payload have true innovations: With LYRA, diamond detectors in space for the first time!

<table>
<thead>
<tr>
<th>Channel 1</th>
<th>Channel 2</th>
<th>Channel 3</th>
<th>Channel 4</th>
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<tbody>
<tr>
<td>Ly</td>
<td>Hz</td>
<td>Al</td>
<td>Zr</td>
</tr>
<tr>
<td>Unit 1</td>
<td>MSM</td>
<td>PIN</td>
<td>MSM</td>
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<tr>
<td></td>
<td>Si</td>
<td>Si</td>
<td>Si</td>
</tr>
<tr>
<td>Unit 2</td>
<td>MSM</td>
<td>PIN</td>
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<td>Si</td>
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</tbody>
</table>

Long term calibration  
Nominal  
Special Campaign

Launched on Nov. 2 2009, LYRA first light on January 6 2010
Huge degradation in the two first channels of the nominal unit.

For the two other channels, back up units are used to monitor the degradation.

which is corrected by addition.
We use TIMED/SEE and SDO/EVE data to simulate LYRA ch2-3 and ch2-4 and compare with our results.

M. Kretzschmar

Comparison PROBA2/LYRA & SDO/EVE

EUVWG Brussels, April 2013
Both LYRA and PROBA2 have innovative features that reflect themselves in the data.

Diamond detectors + LARs

Slow response time

Reboots

Eclipse and occultations

Needed to compute daily average value.

Lyra Ch2-4 (Zr)
Ch2-3: long term

✓ Agrees with manual selection of daily value.

✓ Absolute value is ok.

✓ Much larger variations with solar activity for SDO/EVE.

✓ Use SDO/EVE to investigate the degradation of different spectral ranges.
✓ EUV contribution to ch2-3 has strongly decreased.
✓ The additive correction for degradation corrects for absolute level but not for the variability.
✓ Using a multiplicative correction for degradation would artificially increase the LYRA flare flux.

✓ Can we retrieve the EUV component of ch2-3 with LYRA only?
Modeling of the degradation of the EUV component of ch2-3

The difference between channel3 and channel4 matches the EUV component of ch3.

\[ \text{Ch2-3} - \text{Ch2-4 (from EVE)} \]

\[ \text{Ch2-3, } \lambda > 19\text{nm} \]

\[ \text{Ch2-3, } \lambda < 19\text{nm} \]

\[ \Rightarrow \text{ch23}^{\text{deg}} - \text{ch24} = \text{degraded EUV component of ch3} \]

M. Kretzschmar

Comparison PROBA2/LYRA & SDO/EVE

EUVWG Brussels, April 2013
Modeling of the degradation of the EUV component of ch2-3

The simulated EUV component of ch3 is very well correlated with the simulated channel4:

\[ \frac{\text{Ch3/EUV}}{2.8 \times 10^{-3} + 0.726 \times \text{Ch4}} \]

(Ch3/EUV - Ch4) / (2.8 \times 10^{-3} + 0.726 \times \text{Ch4}) = \text{degradation curve for the EUV (DC)}

\[ \frac{\text{Ch3/EUV}}{2.8 \times 10^{-3} + 0.726 \times \text{Ch4}} \text{ (and normalisation)} = \text{degradation curve for the EUV (DC)} \]

\[ \frac{(\text{ch3}^{\text{deg}} - \text{ch24})}{(2.8 \times 10^{3} + 0.726 \times \text{ch24})} = \text{degradation curve for the EUV (DC)} \]

\[ \frac{(\text{ch23}^{\text{deg}} - \text{ch24})}{DC + \text{ch24}} = \text{ch23} \]
This confirms that the lower variability wrt to EVE in LYRA ch2-3 is due to the loss of EUV sensitivity.

This can be recover (as far as the SNR is sufficient..) by using a multiplicative correction for degradation.
Ch2-4: long term

✓ Agrees with manual selection of daily value.

✓ Absolute value is good.

✓ Slightly stronger trend with solar cycle for SDO/EVE.

✓ But both degradation correction are version 2 only.

✓ Up to now, increase by a factor of 2.

Kretzschmar et al., 2012
3.9 \times 10^{-4}
Conclusion

• Lyra ch2-3 has lost of its EUV signal above 17nm. It is just the SXR contribution scaled to the EUV level, does it make sens ?

• Lyra ch2-4 observes a lower increase with solar activity (-0.04% / day) wrt EVE + TIMED see.

• Other uncorrected effects appear in LYRA ch2-4, during eclipse season and annual: temperature effects ?
Now preliminary comparison of flare observations

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Why looking at flares and degradation?

➡ Looking at flares might help to monitor the SXR and EUV contribution in time.
- Good correlation. Does not look dependent on time..
- Absolute value for LYRA might be OK IF background is substracted correctly.
- Ratio rather constant but larger SXR flare have relative smaller signal in LYRA. To be confirmed..
Channel 4 vs GOES

- Inconclusive for now, need more work and (good thoughts)