

The EUV irradiance of the Sun from 1998 to 2010

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Results from a series of papers.

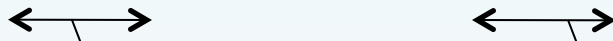
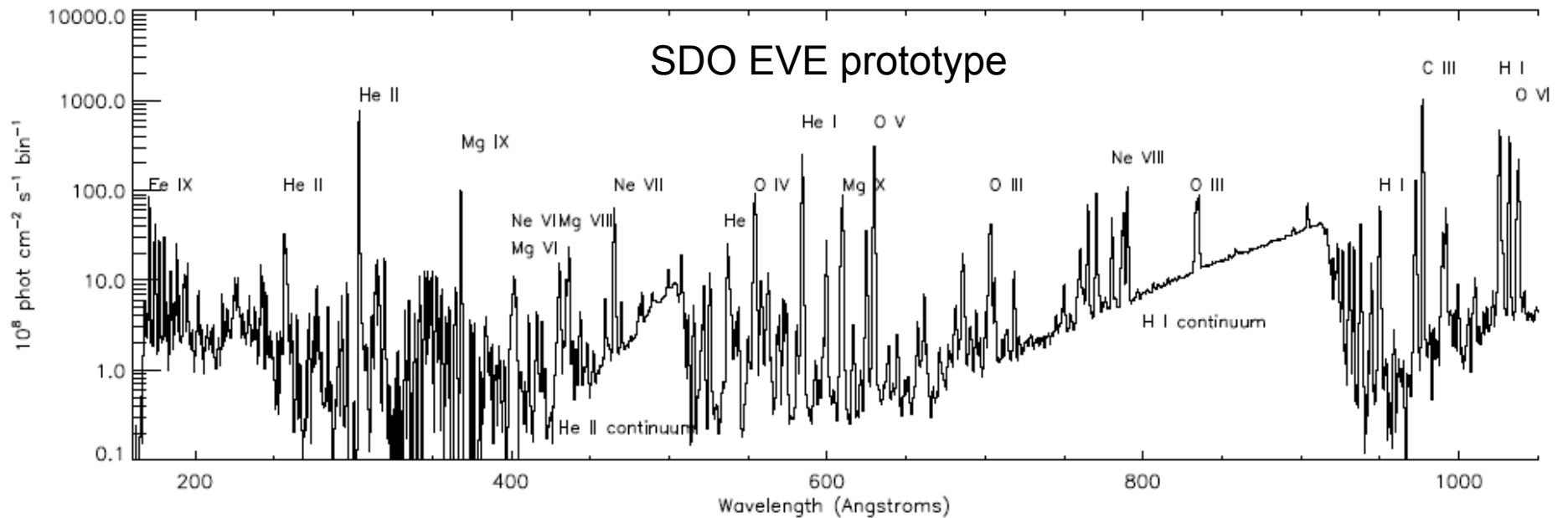
Del Zanna et al. (2005,2006, 2009). The main ones are:

Del Zanna et al. 2010, A&A, 518, A49

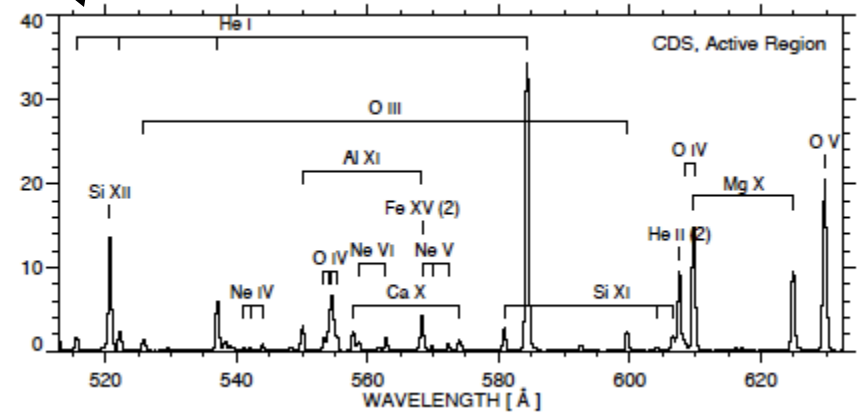
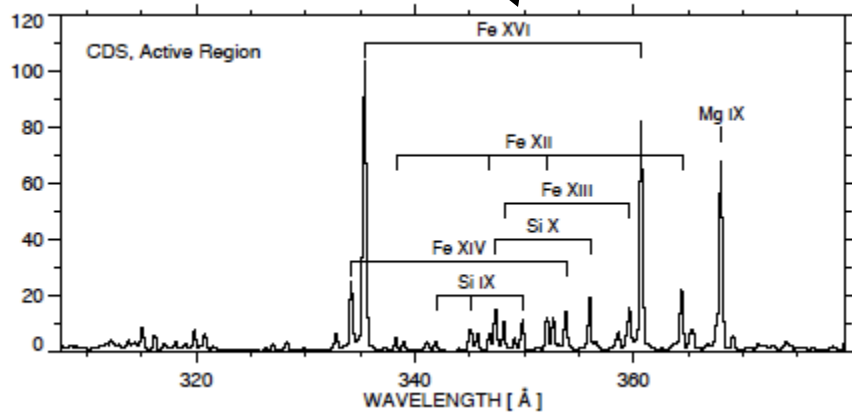
Del Zanna & Andretta,2011, A&A, 528, A139



SDO EVE and SOHO CDS NIS



SOHO CDS NIS



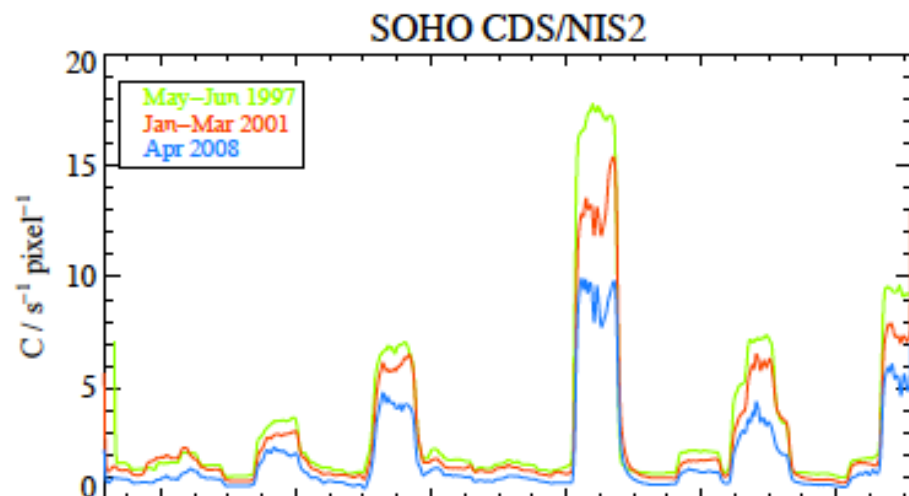
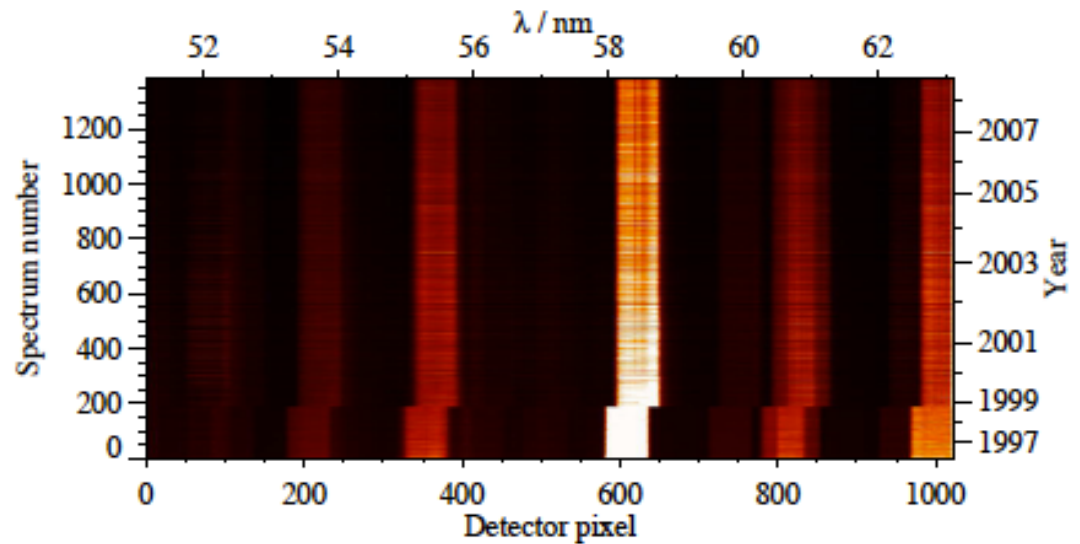
Long-term decrease in CDS NIS

New long-term corrections for the drop in CDS NIS responsivities (Del Zanna et al. 2010 A&A): **differences of factors of 2-3 compared to the previous ones, still the default in the SSW software.**

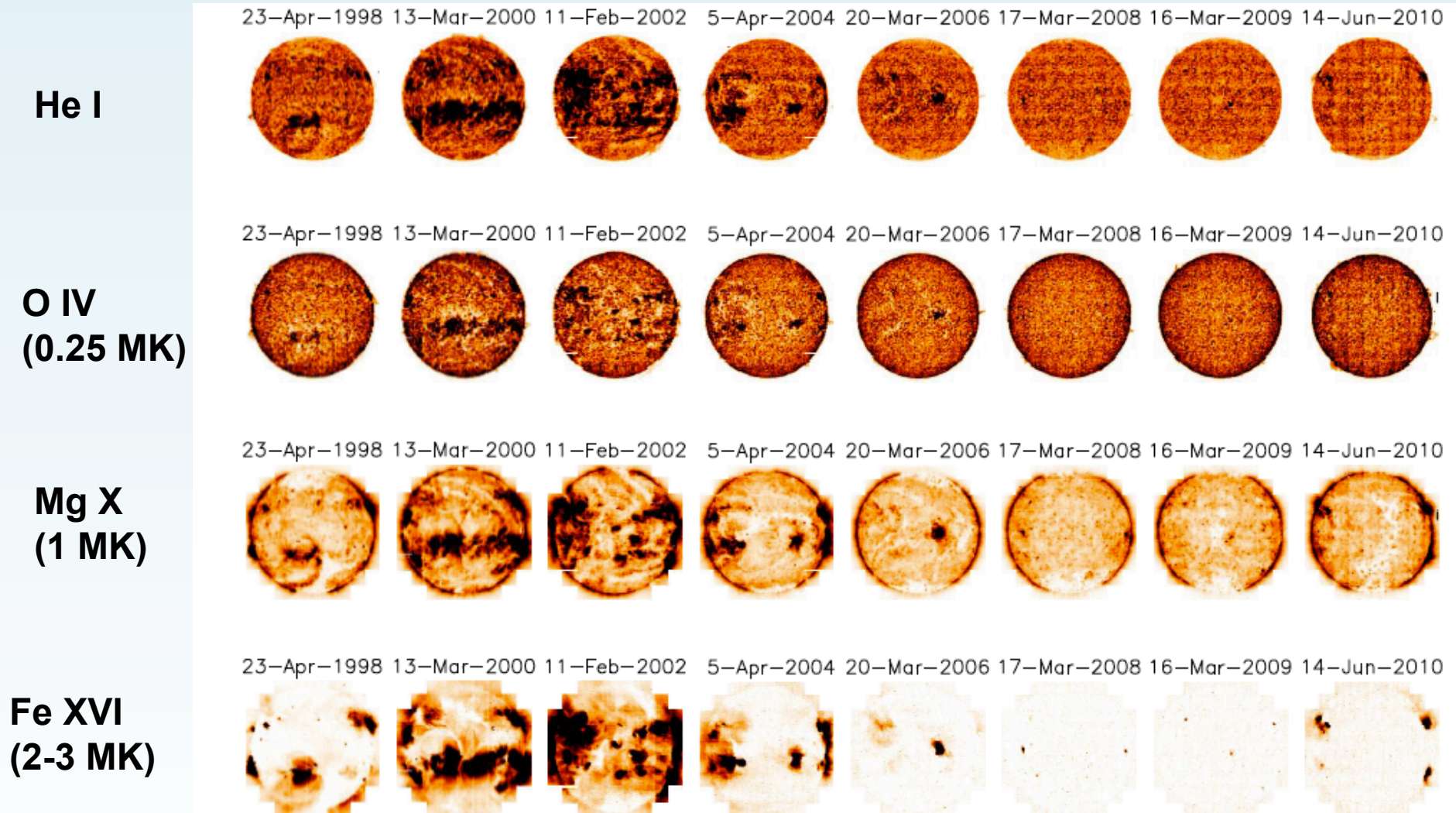
They can be applied with the /alt_slit6 keyword.

The new corrections have been found studying the behaviour of quiet Sun regions as observed routinely with the wide 90" slit (NIMCP monitoring) during 1996—2010.

The NIS sensitivity has dropped by only a factor of about two in 13 years. Very good indeed.



SOHO CDS NIS USUN: first EUV radiances along a cycle



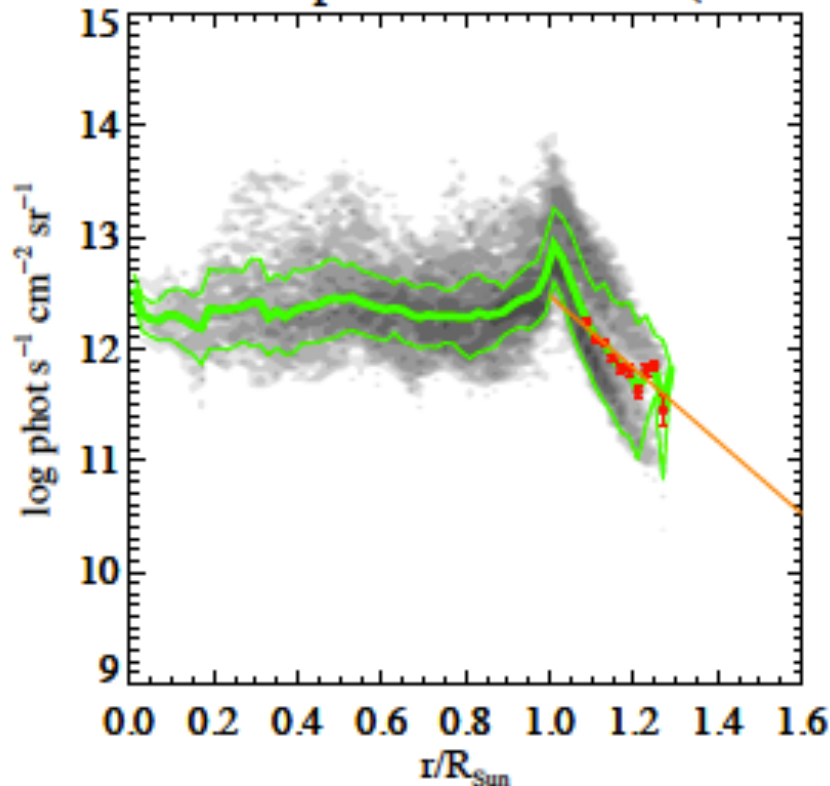
The radiances are obtained by automatic fitting on the photon-events and subtracting a background (scattered light). Most calibration factors are applied after.

Obtaining irradiances from radiances

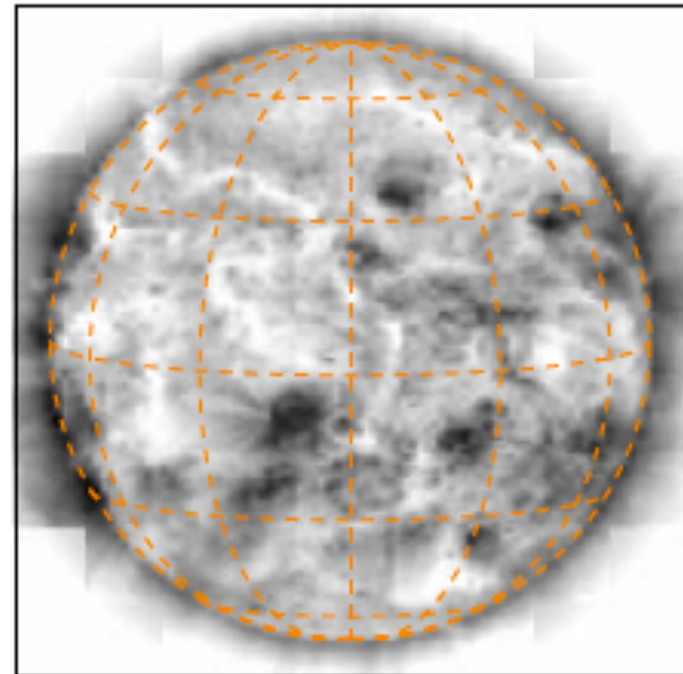
First, we interpolate the radiances (CDS subsamples the Sun by a factor of 4—6)

The radiances of the observed Sun are totalled, and an estimated contribution from the not observed off-limb corona is added. Typically, for coronal lines, this addition is just a few percent.

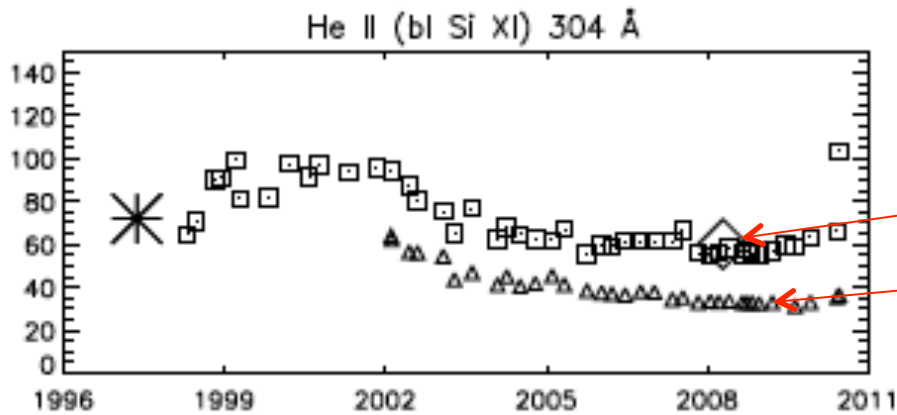
Off-limb extrapolation: +5.25% ($r < 1.6 R_{\text{Sun}}$)



Mg X 624.9 Å



SOHO NIS irradiances vs. EVE and TIMED/EGS

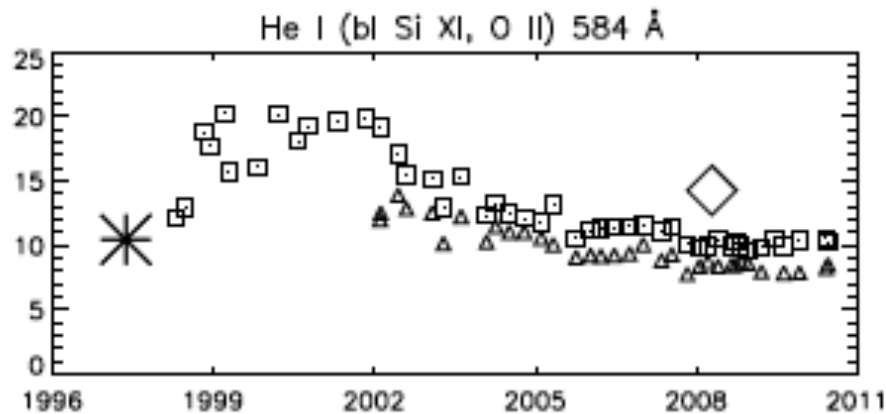


Boxes:CDS NIS

SDO/EVE prototype

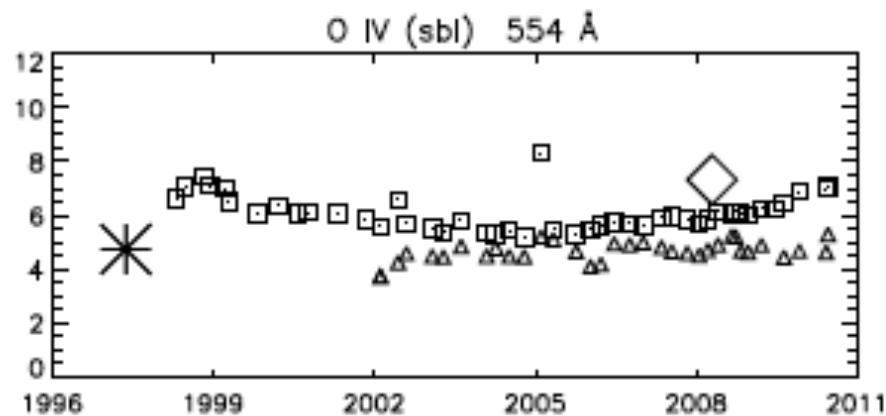
TIMED/EGS

Overall good agreement !



`Chromospheric' helium lines

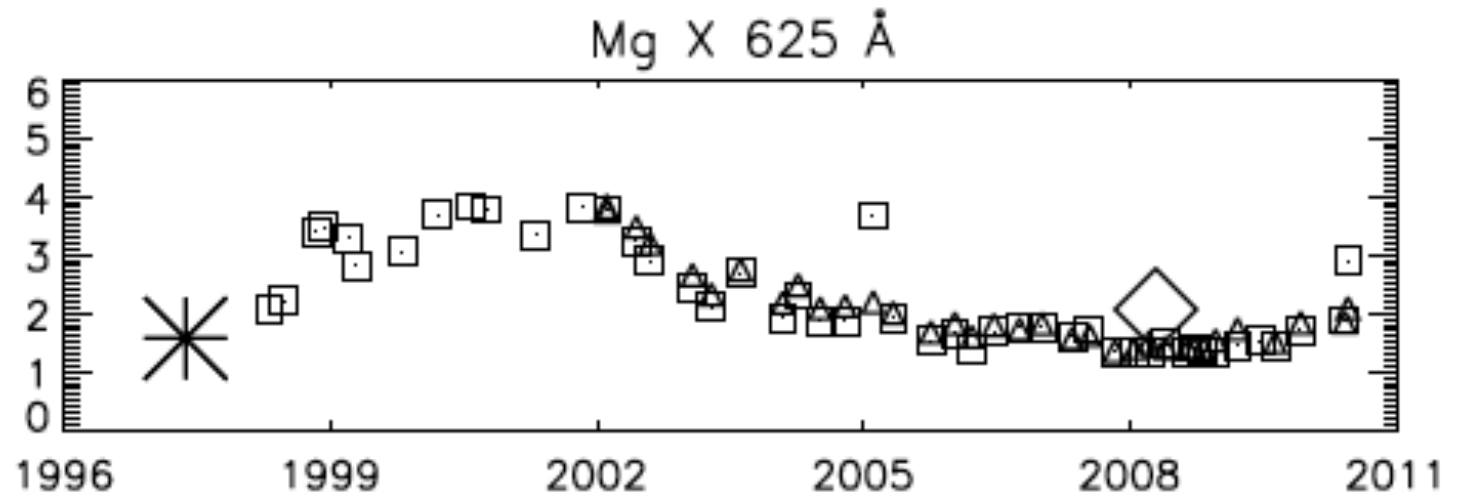
Note: the NIS He II irradiance is obtained with a new suggested responsivity (Del Zanna & Andretta 2011)



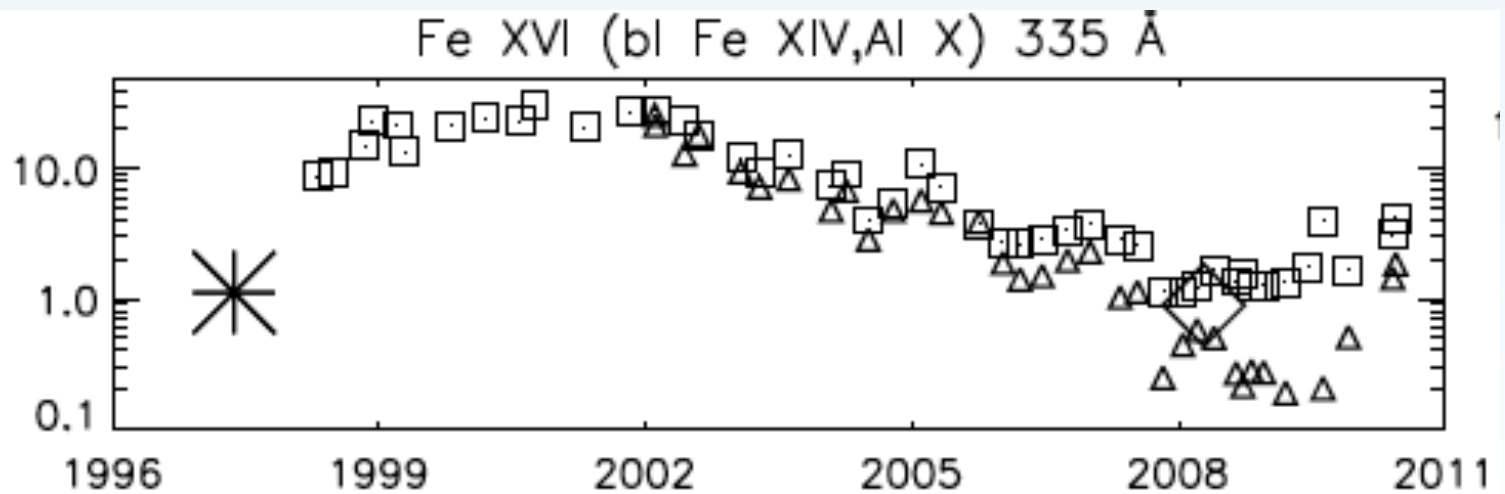
`TR' line

CDS NIS irradiances

1 MK



2-3 MK



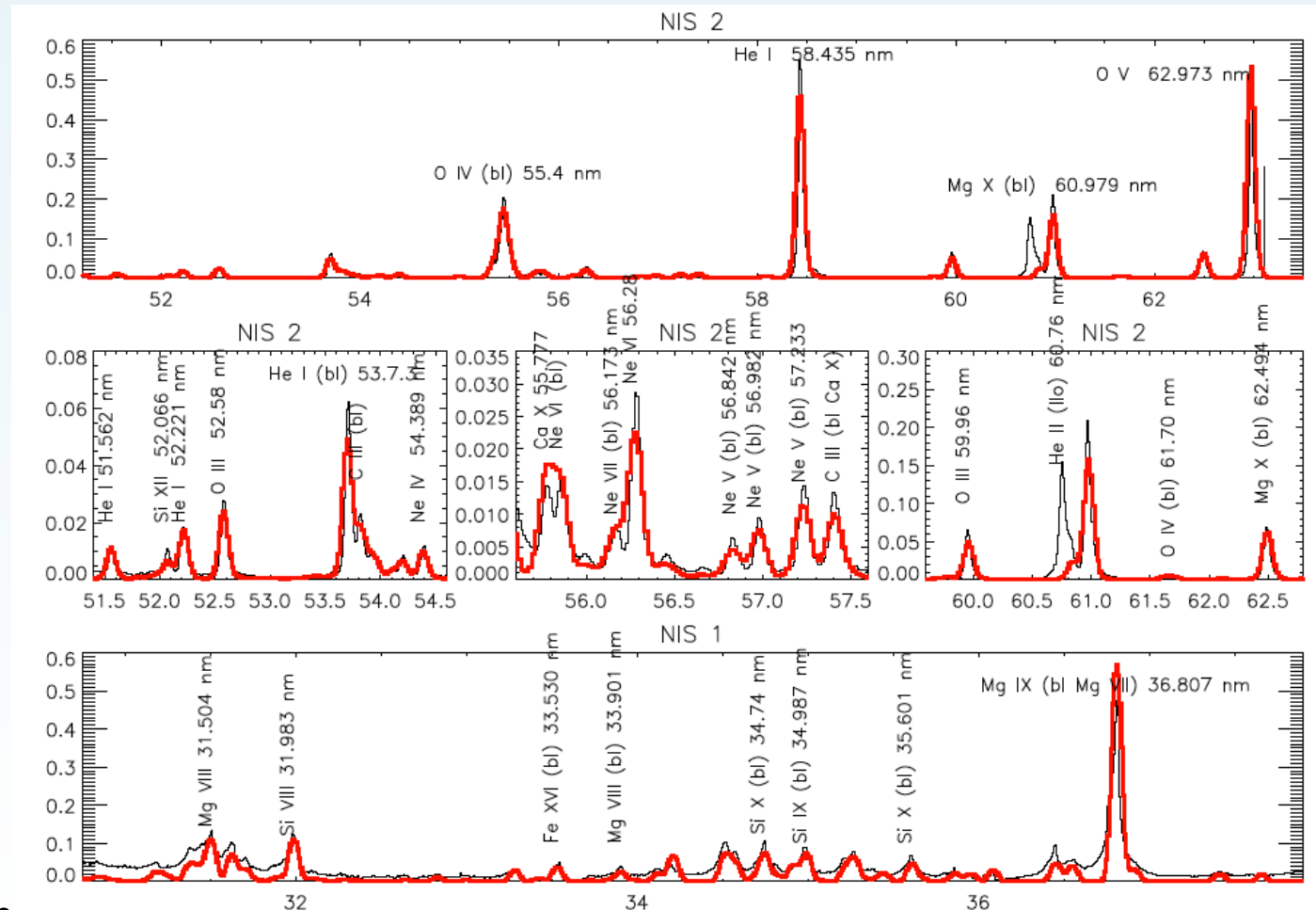
Obtaining spectral irradiances

For a direct comparison with SDO/EVE spectra, spectral irradiances are also obtained. The spectra are first interpolated, then totalled. The calibration factors are then applied. These spectral irradiances do not contain a correction for the missing off-limb contribution, which is negligible for cool lines, and up to a few percent for coronal lines.

Black: NIS USUN

Red: SDO/EVE
2008 prototype

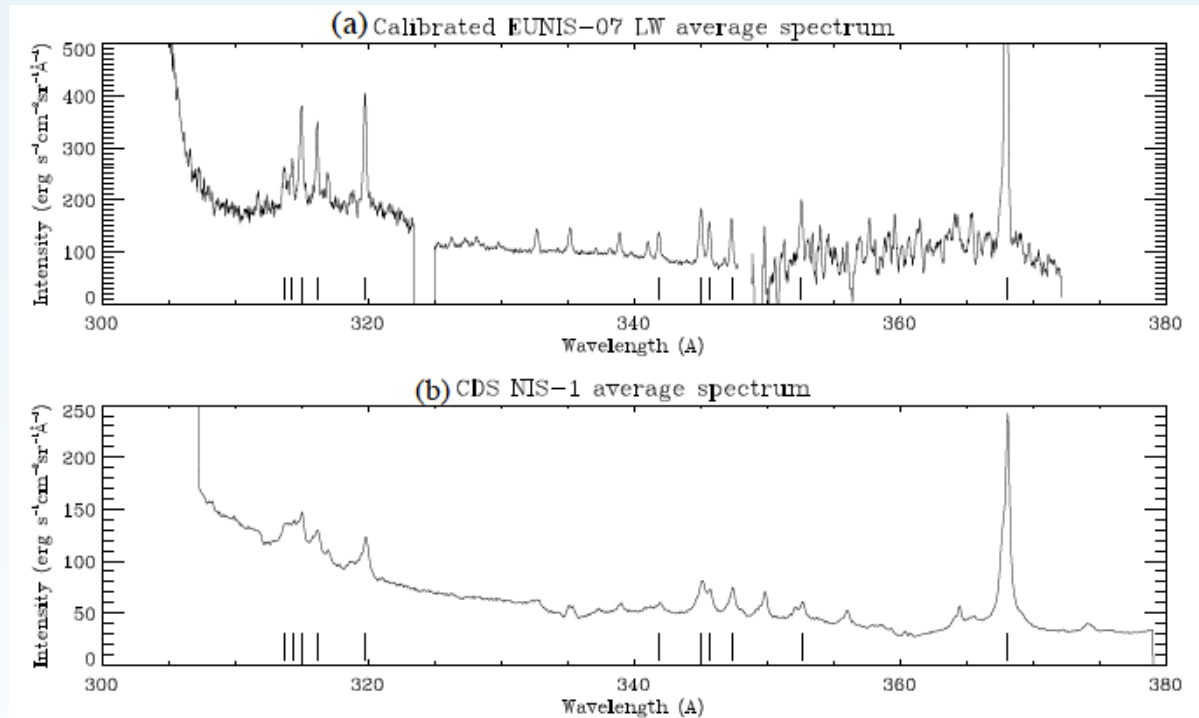
(Del Zanna et al.
2010)



EUNIS vs. CDS NIS 1

EUNIS was flown in 2007 and calibrated on the ground in may 2008 at RAL using the same secondary standard used for CDS, which was calibrated against the synchrotron BESSY-II.

Near-simultaneous CDS NIS observations of the quiet Sun were obtained.



Very good agreement (10%) between the radiances of the strongest line (Mg IX 368 Å) is found when the Del Zanna sensitivities and long-term corrections are applied.

Details in Wang et al. 2011: <http://arxiv.org/abs/1109.6598>

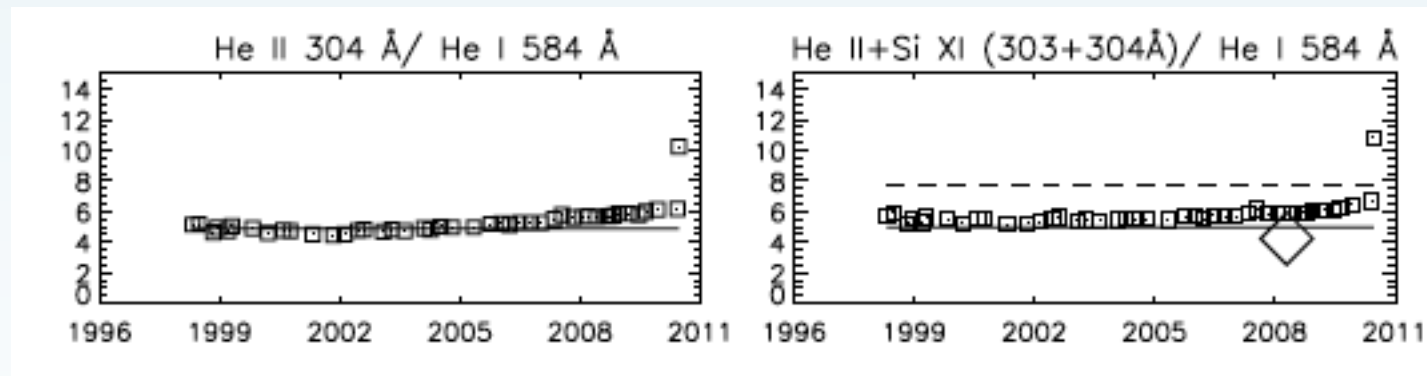
The problems with the He II 304 (1)

Historically, there have been large discrepancies between measurements obtained by various instruments.

The early CDS/TIMED-EGS and SDO/EVE 2008 flight comparisons (Del Zanna et al. 2010) were not good. The 304 is observed in second order by CDS/NIS.

Del Zanna & Andretta (2011) assumed that the NIS responsivity at 584 Å (based on a 1997 LASP EGS flight) was correct, and adopted a responsivity for the He II 304 that would produce a 304/584 ratio as measured by Heroux et al. (1974).

This ratio is known to be very stable:



The resulting He II irradiances are in good agreement with those measured by the SDO/EVE 2008 prototype. Del Zanna & Andretta (2011) suggested that previous Skylab ATM, TIMED/SEE, SERTS and EUNIS measurements were incorrect.

The problems with the He II 304 (2)

Comparisons between our CDS NIS measurements and EUNIS measurements led to the discovery in 2001 of two significant software errors, one in the EUNIS and one in the CDS software (for the second order lines). Not all the CDS published measurements were affected though. Certainly not those of Del Zanna et al.

The EUNIS 2007 flight observed the He II 304 in first order on the quiet Sun.

Excellent agreement, within a relative 6%, between the EUNIS 2007 and CDS radiances is found, when the Del Zanna et al. (2010) NIS long-term corrections and the Del Zanna & Andretta (2011) sensitivity are adopted. This is shown in Wang et al. (2011).

So for the first time we now have good agreement between EUNIS, CDS, and SDO/EVE. Is this the end of the story ?

Data for the workshop

Two CDS NIS USUN observations, taken on 2010-05-31 and 2011-03-23 have been processed (GDZ) and made available, in the form of Tables of line irradiances and calibrated spectral irradiances. Details are in a README file.

Best wishes,

Giulio Del Zanna