

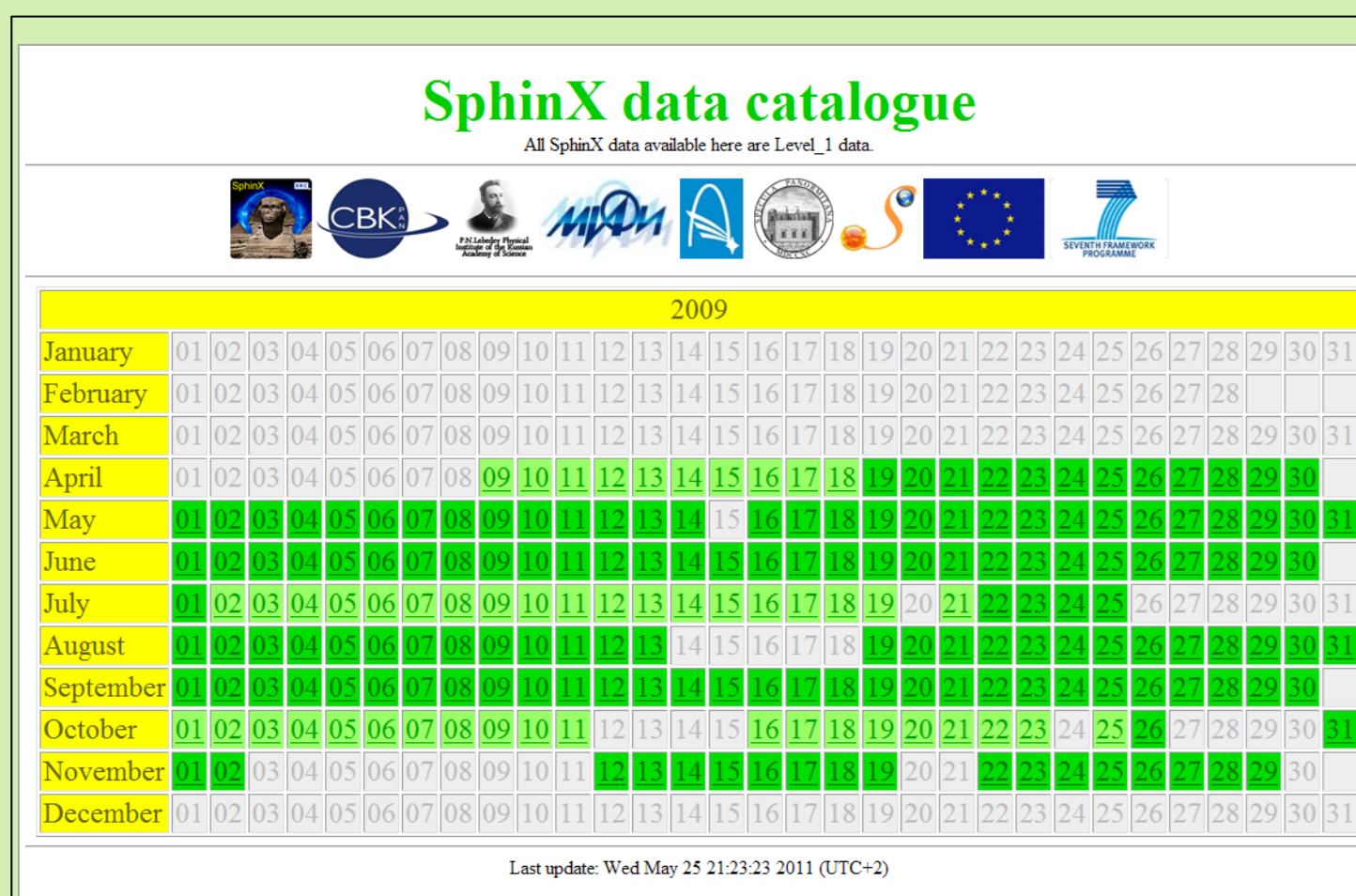
Solar coronal emission during last prolonged minimum activity as observed by SphinX

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ABSTRACT

SphinX is the Polish X-ray spectrophotometer for measuring soft X-ray emission from the Sun in the energy range between ~ 1 keV and 15 keV with the energy resolution better than ~ 0.4 keV. The instrument operated from February to November 2009 on **CORONAS-Photon** satellite during the prolonged solar minimum of activity. Despite the very low activity a substantial variability of the solar X-ray emission was observed. Summary plots, showing reduced **SphinX** observations, are presented. Micro-flare class of events and small brightenings observed by **SphinX** during its mission are shown as well.

SphinX L1 Data Catalogue



SphinX Level1 data catalogue is available for general use on Solar Physics Division website or directly at following URL:
http://156.17.94.1/sphinX_l1_catalogue/SphinX_cat_main.html

The catalog is arranged in daily order. Each daily page contains visualisation of basic plots in terms of count rates as well as the spectra. There are also auxiliary orbit plots with flag marks. In addition to daily plots a separate catalogue pages are available for each data file. These pages contain more details which can be useful for scientific purposes. All available data files are stored in FITS format. The catalog has been already updated to the end of SphinX mission.

FIGURE 1 SphinX Level 1 catalogue year page.

New Flare Classes

SphinX as a high-sensitivity X-ray spectrophotometer was able to record small flares and brightenings below GOES threshold level (3.7×10^{-9} W/m², S 3.7 class). To describe these events we extended the scale of GOES flare classification and introduced two new classes: **S** class ($S1 = 10^{-9}$ W/m²) and **Q** class ($Q1 = 10^{-10}$ W/m²). The lowest level of activity observed by **SphinX** D1 was about 2×10^{-10} W/m² (Q 2.0). In FIGURE 2 we present few examples of S class events much below GOES threshold.

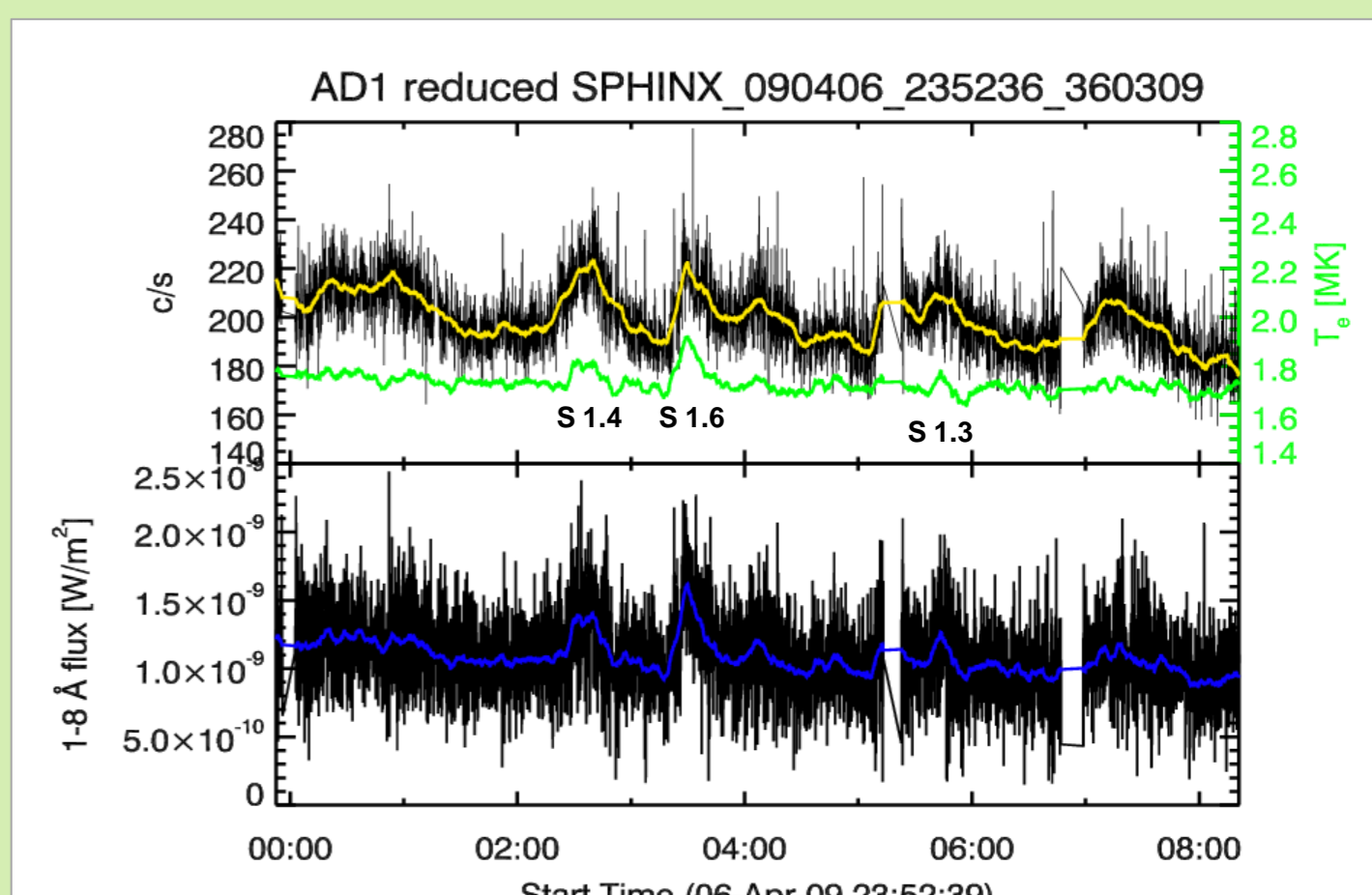


FIGURE 2 SphinX lightcurve and total solar flux in 1-8 Å of tiny flares at S class level.

Summary plots of solar activity as seen by SphinX detector D1

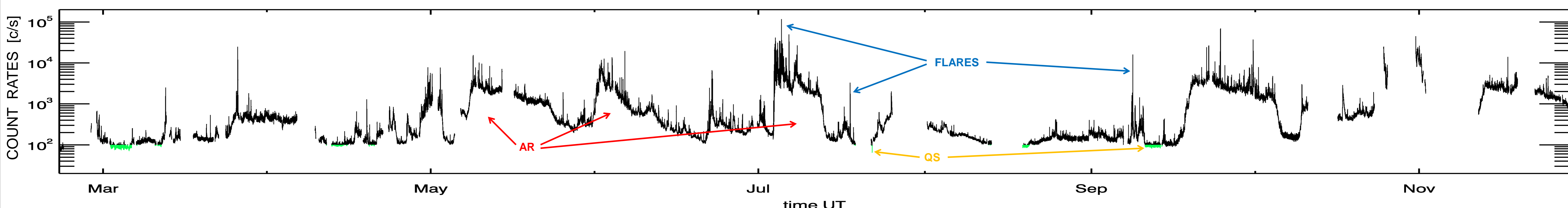


FIGURE 3 SphinX D1 detector count rate during entire mission (from 20 February to 29 November). Green color indicates time intervals for which count rate was less than 100 counts per sec. We call these quiet Sun levels (QS).

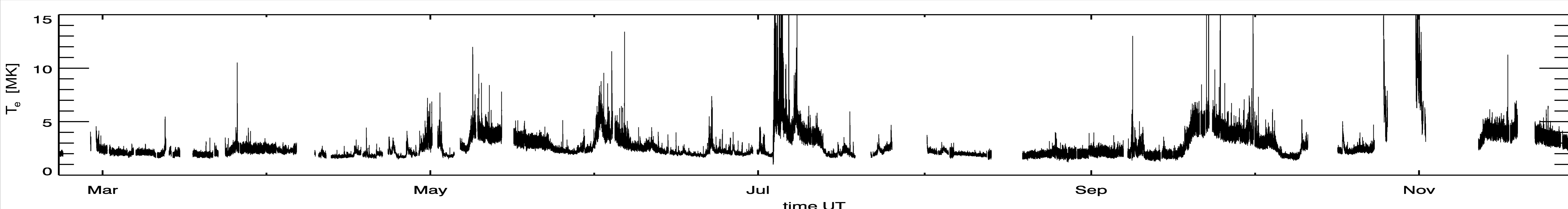


FIGURE 4 Solar mean temperature variations for mission long time period as calculated from SphinX spectra using isothermal approximation. All but few of flares observed by SphinX have temperatures below 10 MK.

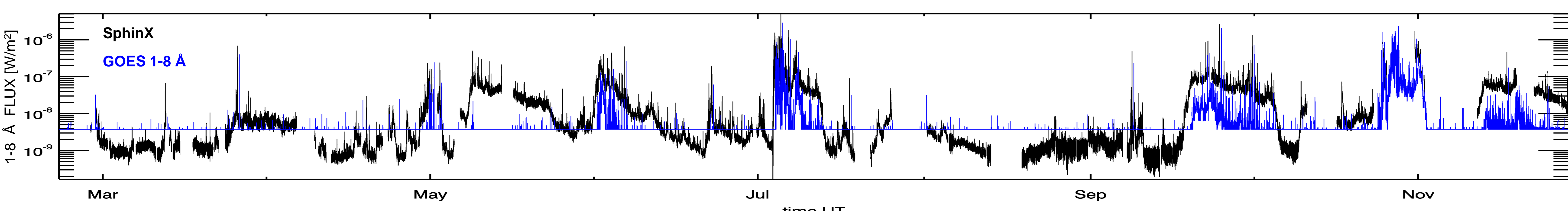


FIGURE 5 Solar fluxes in 1-8 Å energy band calculated from SphinX data compared with those observed by GOES (blue colour).

Quiet Sun SphinX D1 spectra

The Solar Photometer in X-rays (**SphinX**) was able to measure the high quality spectra of entire solar corona in 256 energy bins between ~ 1.0 and ~ 15 keV with the time resolution of 1-5 sec. In FIGURE 6 there is an example of spectrum obtained by **SphinX** for period of very low activity (during September, 11-17 period), when count rates was less than 100 counts per sec.

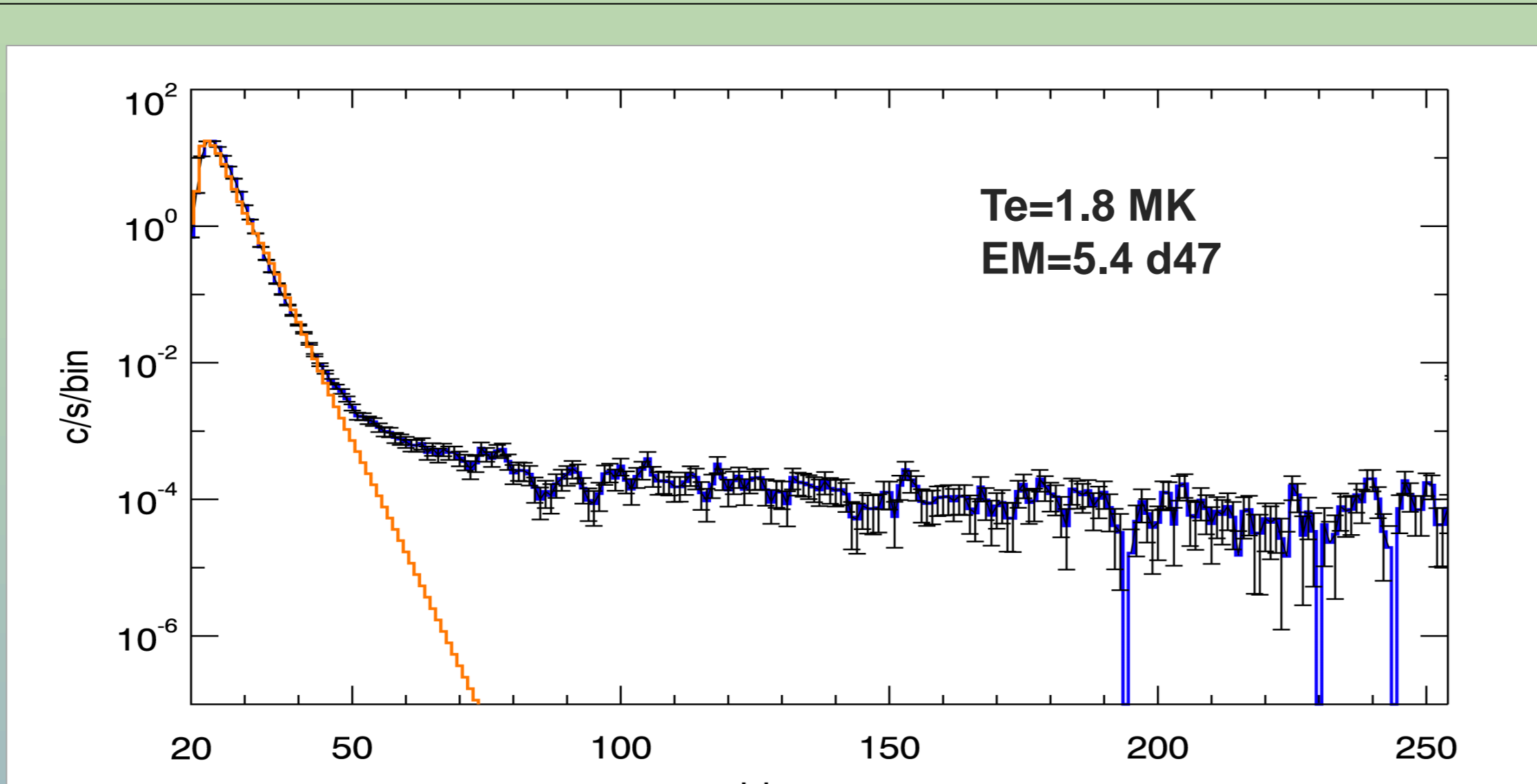


FIGURE 6 Quiet Sun (<100 c/s) spectra averaged on September 11-17, 2009 (blue line) with errors. Orange line shows one temperature fit to spectra.

'Micro-flare' class events

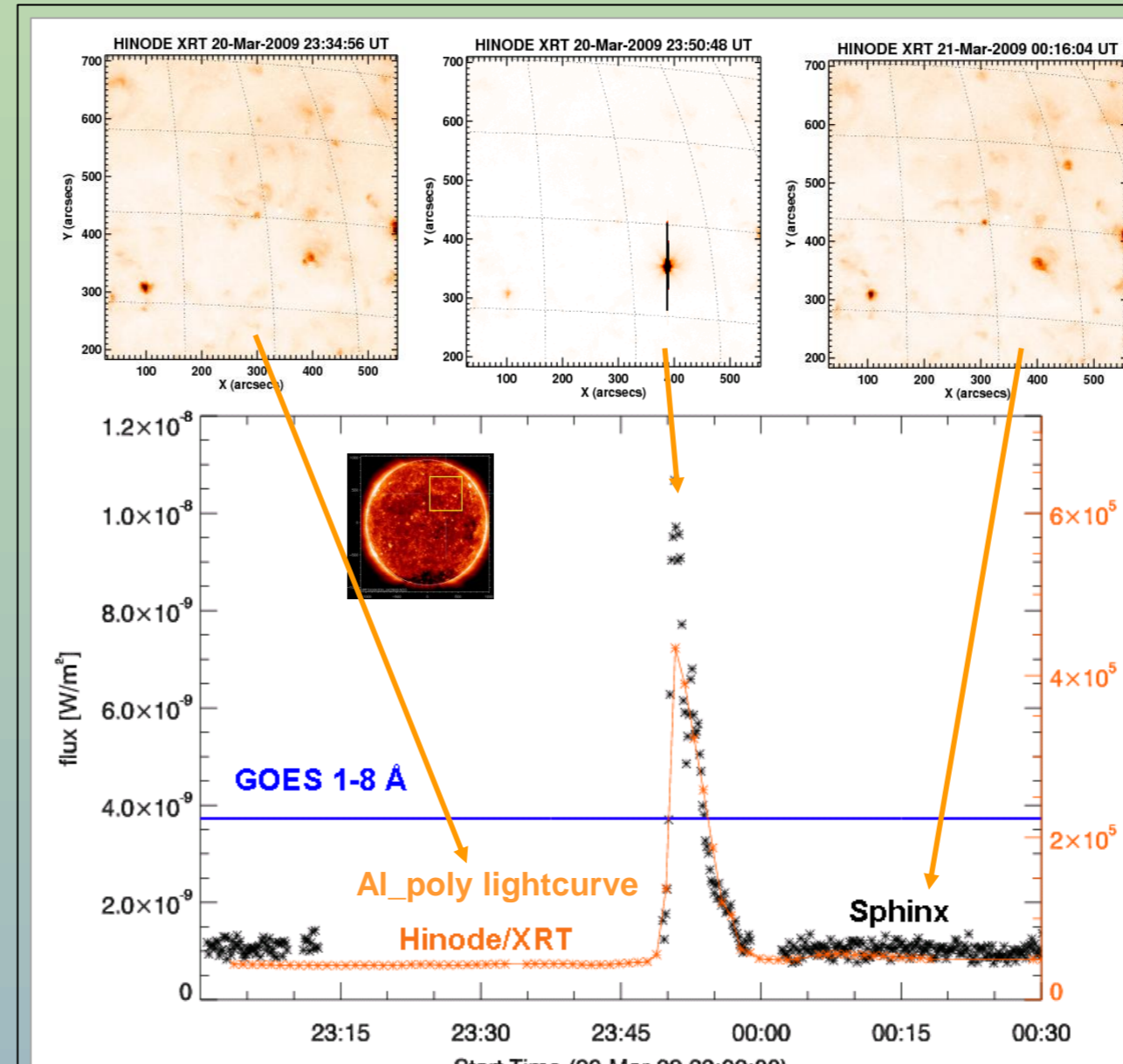


FIGURE 7 Example of SphinX observations, 21 March, 2009.

Many of tiny events observed by **SphinX** were also observed by XRT on Hinode satellite. Example of A1.1 flare observed in a X-ray bright point is shown in Figure 7. Emission from this source was too weak to be detected by GOES. Hinode observations provide spatial information about such events. Usually these brightenings are observed either in small active regions and coronal bright points (BP). **SphinX** provides better spectroscopic information what gives better insight into small brightenings plasma characteristics and physical parameters. Analysis of event observed simultaneously by **SphinX** and XRT is in progress.

Acknowledgements:

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