AB Dor: the best X-ray spectrum

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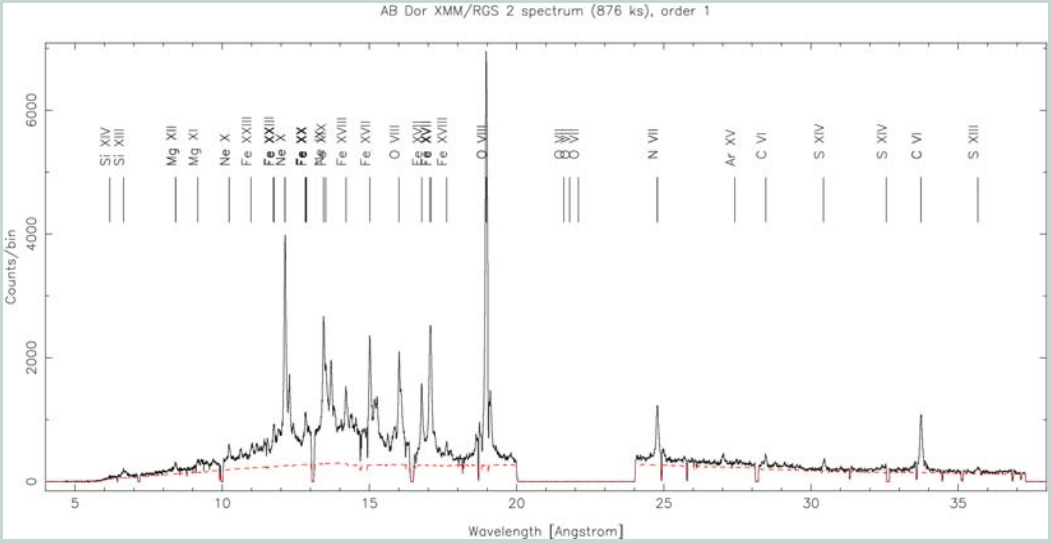

Fig. 1: XMM-Newton spectrum of AB Dor, RGS 2 (1st order) after summing all the observations (total of 876 ks). Now 127 lines were measured, instead of the 59 lines observed in a regular AB Dor RGS spectrum (like those in Sanz-Forcada, Maggio & Micela 2003, A&A 408, 1087). Specially remarkable are lines measured for λ> 18 Å, like those of Ca, S, Si, Ar or C. A red dashed line indicates the continuum applied for the measurements.

Introduction

After six years of observations as a calibration target, the active star AB Dor has accumulated almost 900 ks of XMM-Newton/RGS observations. Here we show the results of the analysis of the merged spectrum (using "rgscombine") of all the RGS observations of AB Dor, the best spectrum ever recorder in X-rays. The large statistics allows us to use also the second order of RGS, a highlight that increases the resolution power of the spectrum, enlarging substantially the number of lines separated.

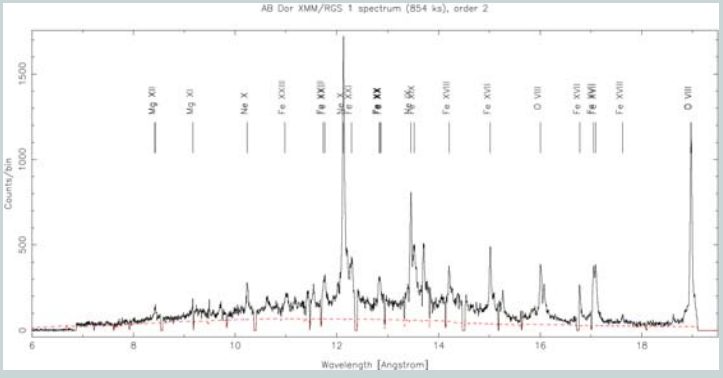

Fig. 2: Second order spectrum of AB Dor after adding up all observations. The good statistics in the first and second order, and the higher spectral resolution of the 2nd order allows us to identify now a 115% more lines.

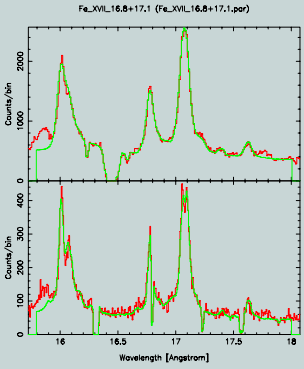

Fig. 3: Simultaneous fit to the Fe XVII lines in 1st (upper panel) and 2nd (lower panel) orders. The doublet at 17.051/17.096 is deblended in the 2nd order.

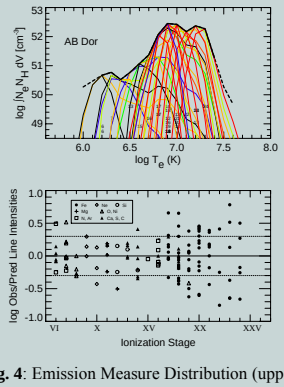

Fig. 4: Emission Measure Distribution (upper panel) using the summed RGS spectrum, with emissivity functions represented by thin colored lines. Observed to predicted flux ratio (log scale) is shown in the lower panel.

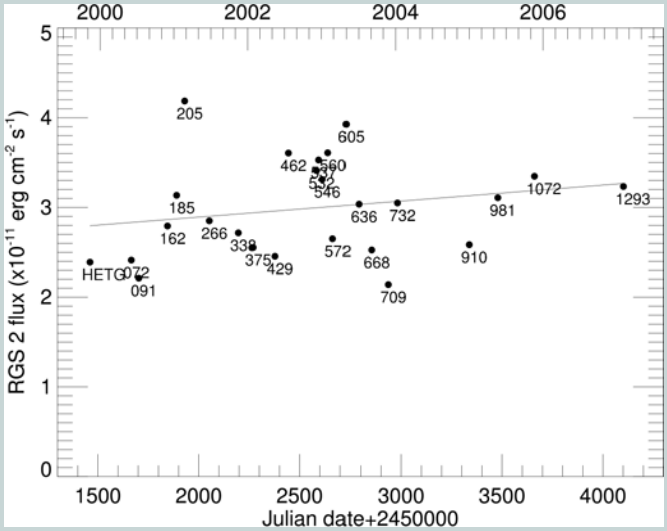

Fig. 5: Long term behavior of the X-ray flux of AB Dor as seen by XMM/RGS (a Chandra/HETGS observation is included in the chart). The orbit of the RGS observations are indicated. A solid line marks the linear regression fit to the data. Such fit seems to indicate an increase of activity in the corona of AB Dor, but not yet a cycle.

Results

The improvement in statistics given by longer exposures is of great help in any XMM spectral analysis. It adds up the identification of many new lines, specially at longer wavelengths, and the use of the 2nd spectral order helps to deblend many lines otherwise deblended.

Some of the results of the analysis are:

- Identification of 127 lines (instead of 59 lines in the case of a single AB Dor exposure) yields a better determined Emission Measure Distribution (EMD), confirming former results.
- The new lines identified allow us to calculate abundances of Ca or Ar, and many new S, Si or C lines improve the accuracy of the calculation of their abundances.
- Electron density calculated through the O VII triplet confirms a value of log n_e (cm^{-3})=10.3 with almost no error bars. Resolution in the 2nd order is not enough to deblend the Ne IX triplet.
- The long term behavior of AB Dor seems to indicate an increase in the level of X-ray activity during the last six years.