Status and Initial Results of the DROXO (Deep Rho Ophiuchi XMM-Newton Observation) Project:

or .... using X-rays as a probe of YSO physics

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and the DROXO Collaboration

Some Standing Questions

- Can we distinguish between "pure" solar-like coronal and star-disk interaction activity ?
- What is the interplay between accretion and X-ray emission in YSOs ?
- How is the accretion channelled and regulated? There is any feedback at work ?
- "More Recently": What is the effects of X-rays on small (planetary) and large (mol. cloud) scale evolution ?
- What do X-rays on the chemistry of proto-planetary disks ?

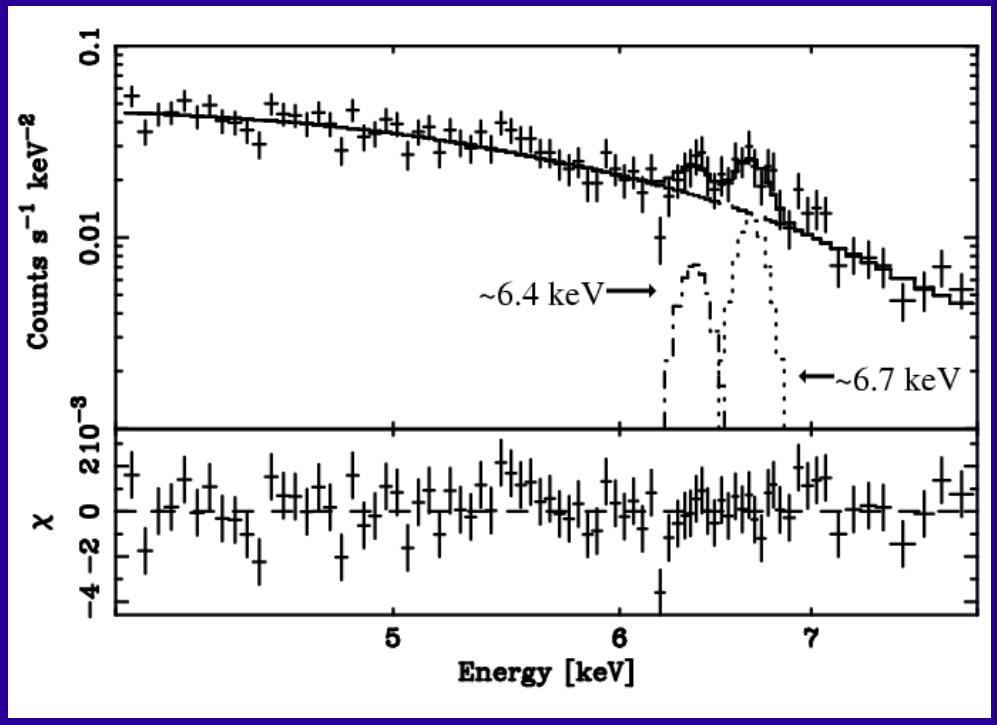
To answer we need top quality spectro variability data

Issues recently investigated

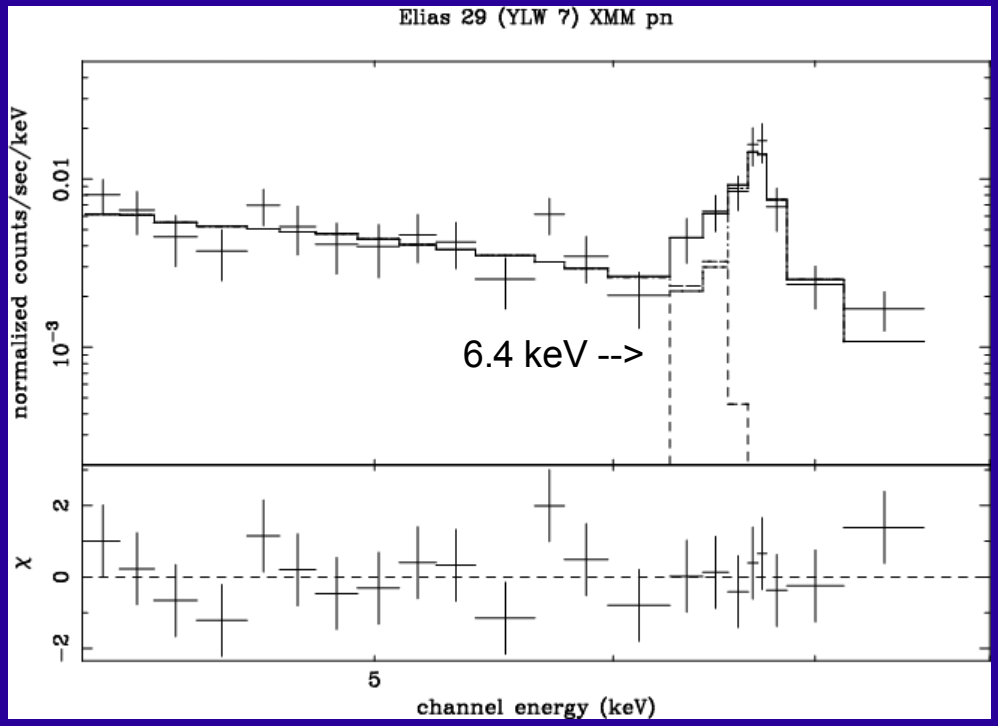
- X-ray fluorescence from YSOs disks
- Flares and sizes of magnetic structures in YSOs
- X-ray Emission from Class 0 YSOs
- Shock-driven X-ray emission in YSOs

- ***DROXO should allow us to improve our knowledge thanks to high quality X-ray spectra and light-curve***

Why we are so confident ....

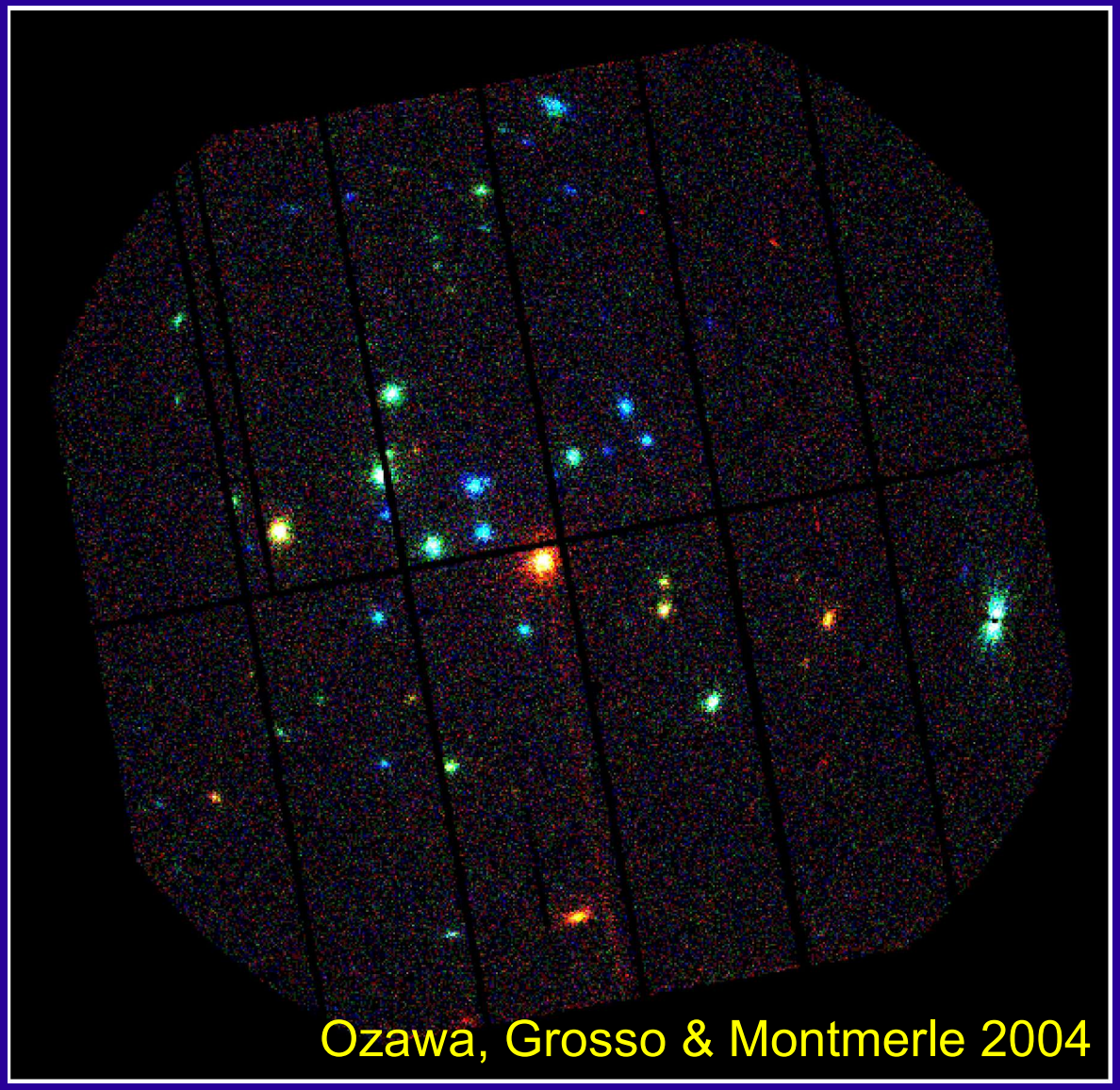


YLW16a -- Chandra Spectrum
(Imanishi et al., 2001)



Elias 29 – XMM-Newton Spectrum
(Favata et al. 2004)

A Shallow (34 ksec) XMM-Newton observation of ρ Oph core F



- 87 X-ray sources

Min PN ~ 2 x 10^{-3} cnt/sec

Min fx ~ 3 x 10^{-14} erg/s/cm^2

- 25 previously unknown
- 43 detected by XMM and Chandra
- 7 class I, 26 Class II, 17 Class III + 15 new Class III candid.
- 2 BDs detected: GY 310 & GY 141
- 17 pn Spectra >1000, 28 > 500 cnts

NEED HUNTING FOR MORE PHOTONS

The DROXO team as today

- S. Sciortino (PI), G. Micela, E. Flaccomio, B. Stelzer, F. Damiani, I. Pillitteri *@ INAF-Oss. Astronomico di Palermo*
- *F. Favata, G. Giardino @ ESA-ESTEC, RSSD*
- *T. Montmerle, N. Grosso @ Observatoire de Grenoble*
- *L. Testi, F. Palla @ INAF – Oss. Astrofisico di Arcetri*

Project Status

- Proposal submitted in reply to XMM-Newton AO4 as a Large XMM/Joint ESO Program
  - Constrains: To observe continuously for 4 subsequent XMM revolutions (~8 days) with a fixed roll angle
- *Approved in October 2004 with observation planned to be started in the second half of 2005*
- *XMM Team decided to start observing on March 8 2005 before the official AO4 opening*
- *Actual Observation spans 5 revolutions (~ 10 days) due to a TOO, pending since AO1.*

Project Status - continue

- *Observation started in March 8 at revolution 961, but …*
  - *after few hours observing …..*
  - *a micrometeorite struck onto one of the three XMM-Newton mirrors and ….*
  - *one of the external MOS1 CCD died*
- *The overall observation suffered bad "space weather", and (… taking an optimistic attitude) …*
  - *~ 50% of the observing time is "good" with quite low background*

Project Status - continue

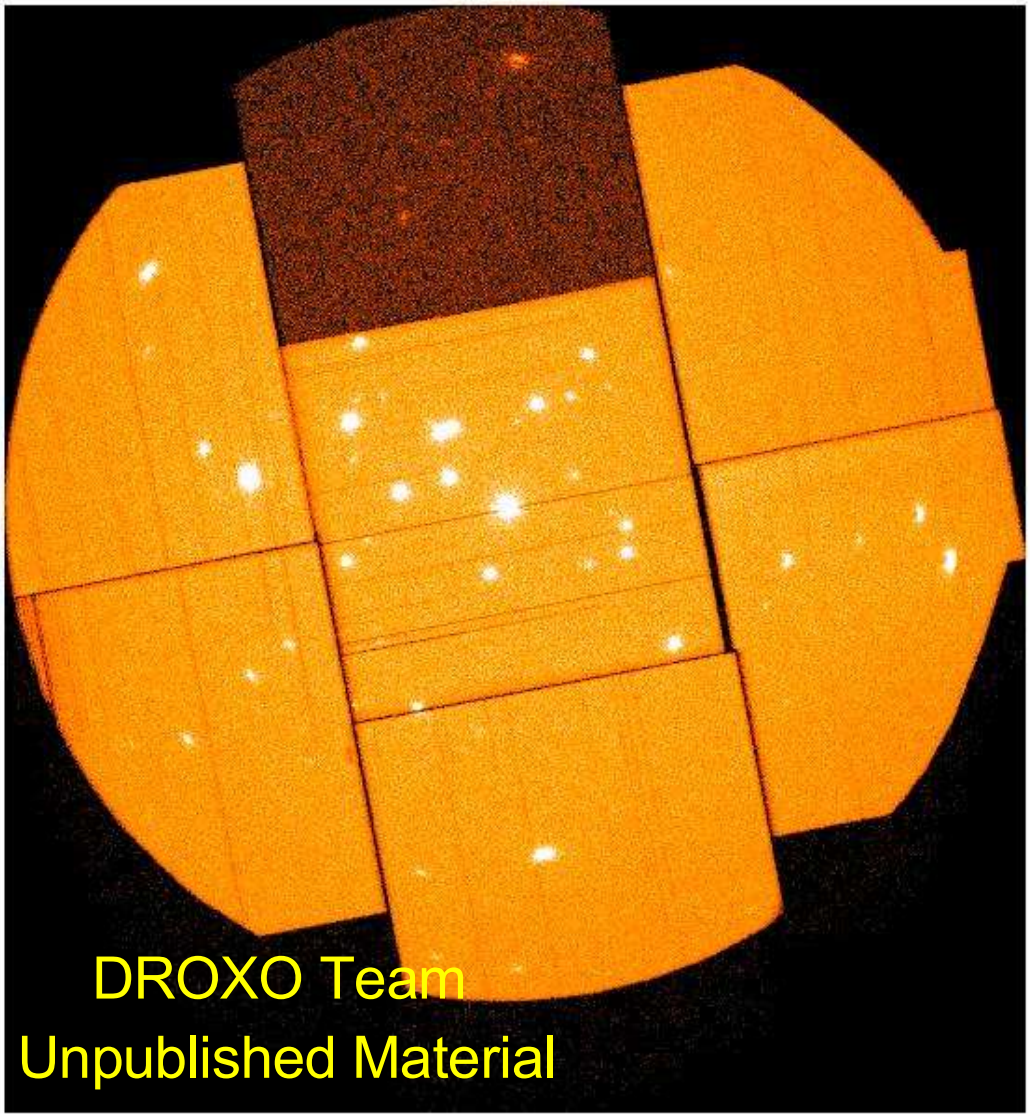
- *Granted also ESO VLT observing time in service mode (but non contemporary at XMM observation)*
  - *16 hours ISAAC (1 – 2.5 micron spectroscopy)*
  - *5 hours GIRAFFE/FLAMES in the 6470-6790 Ang band (i.e. Hα and LiI lines)*
- *VLT Observations performed and data just delivered*
- *High Res. (RGS) data available for WTT SR12ab*
- *OM 3ksec snapshots in the UVW1 (2500-3500 Ang), ~ 15 UV sources found x snapshot*

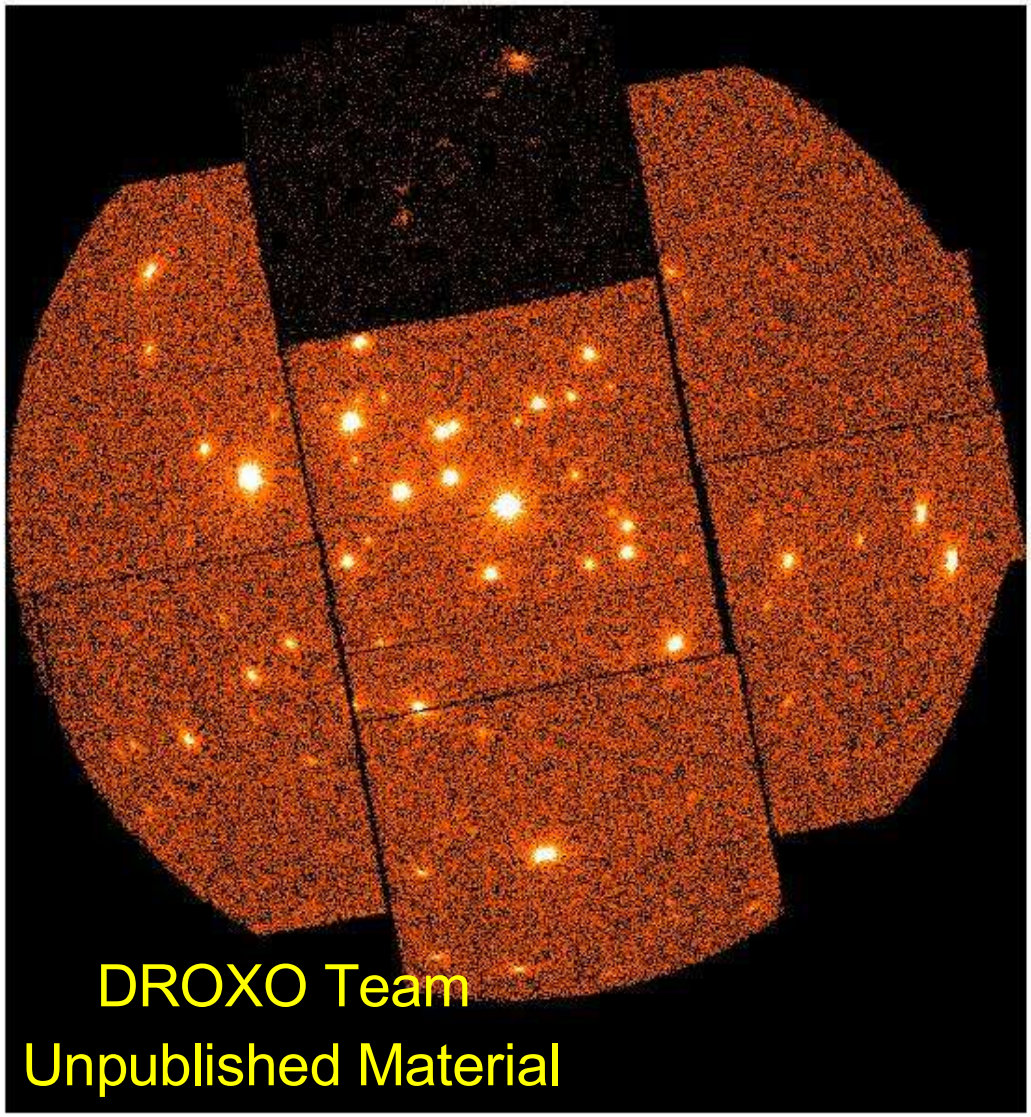
- ***<u>In the following just a quick look to EPIC data</u>***

High Background - EPIC/MOS 1

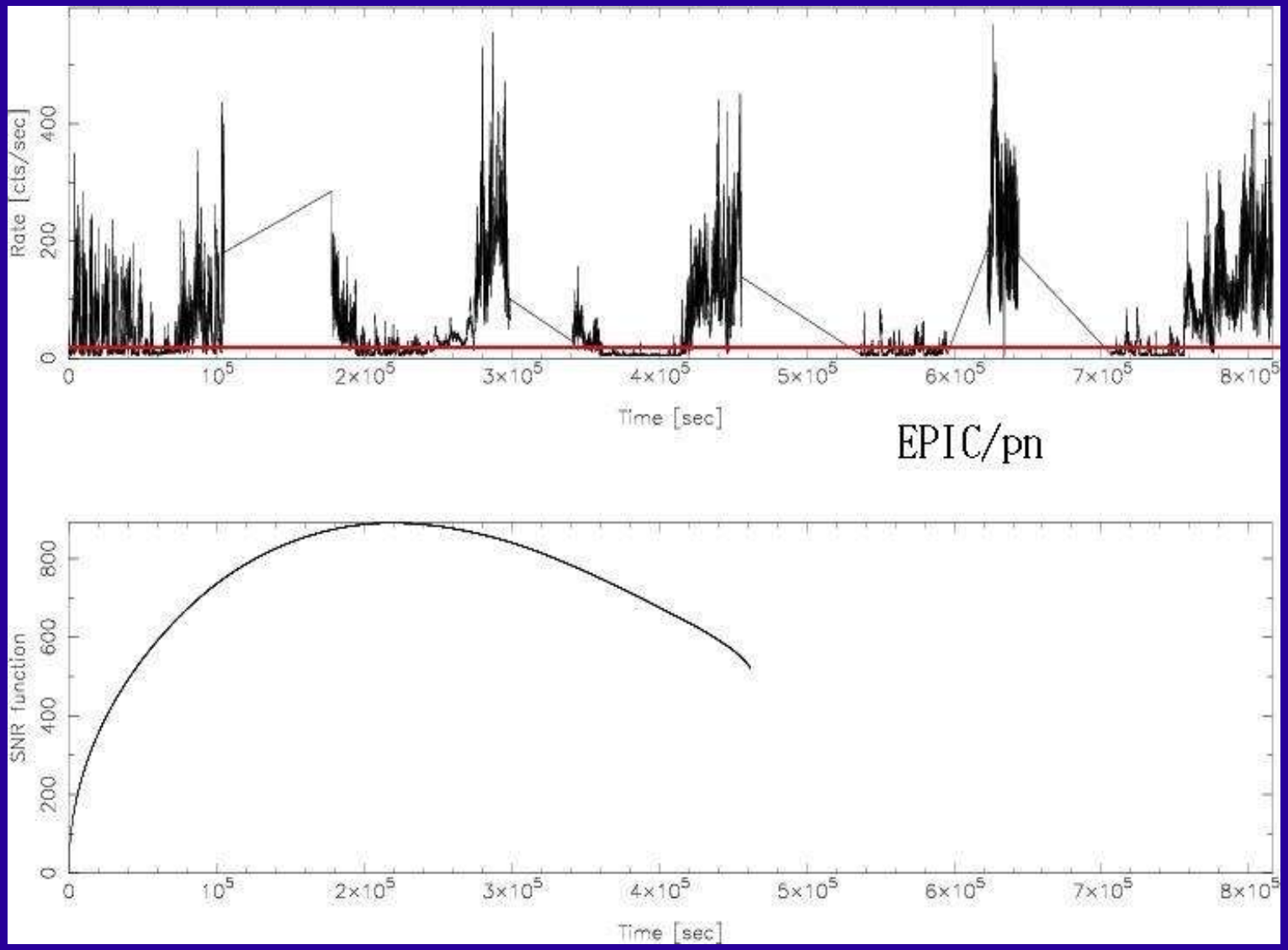
Entire 500 ksec

Optimally Screened ~ 250 ksec





The Bad "Space Weather"

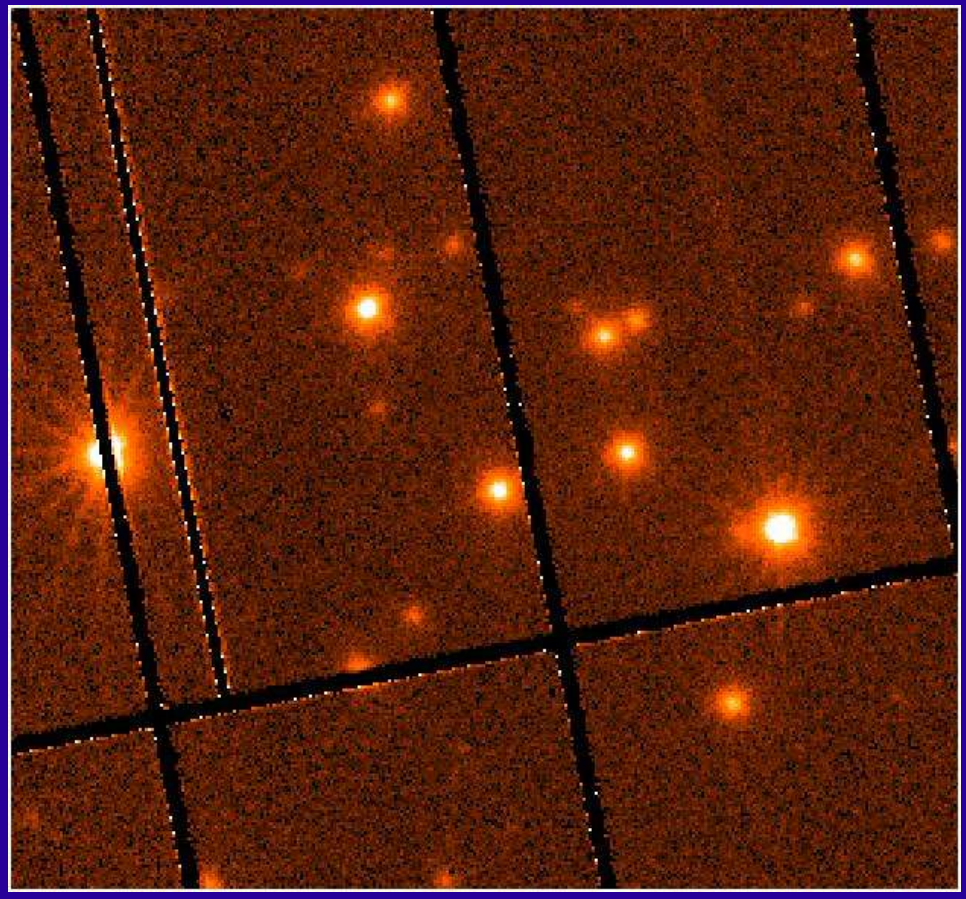


Bottom RED line signs the image rate rejection level for optimal weak source detection.

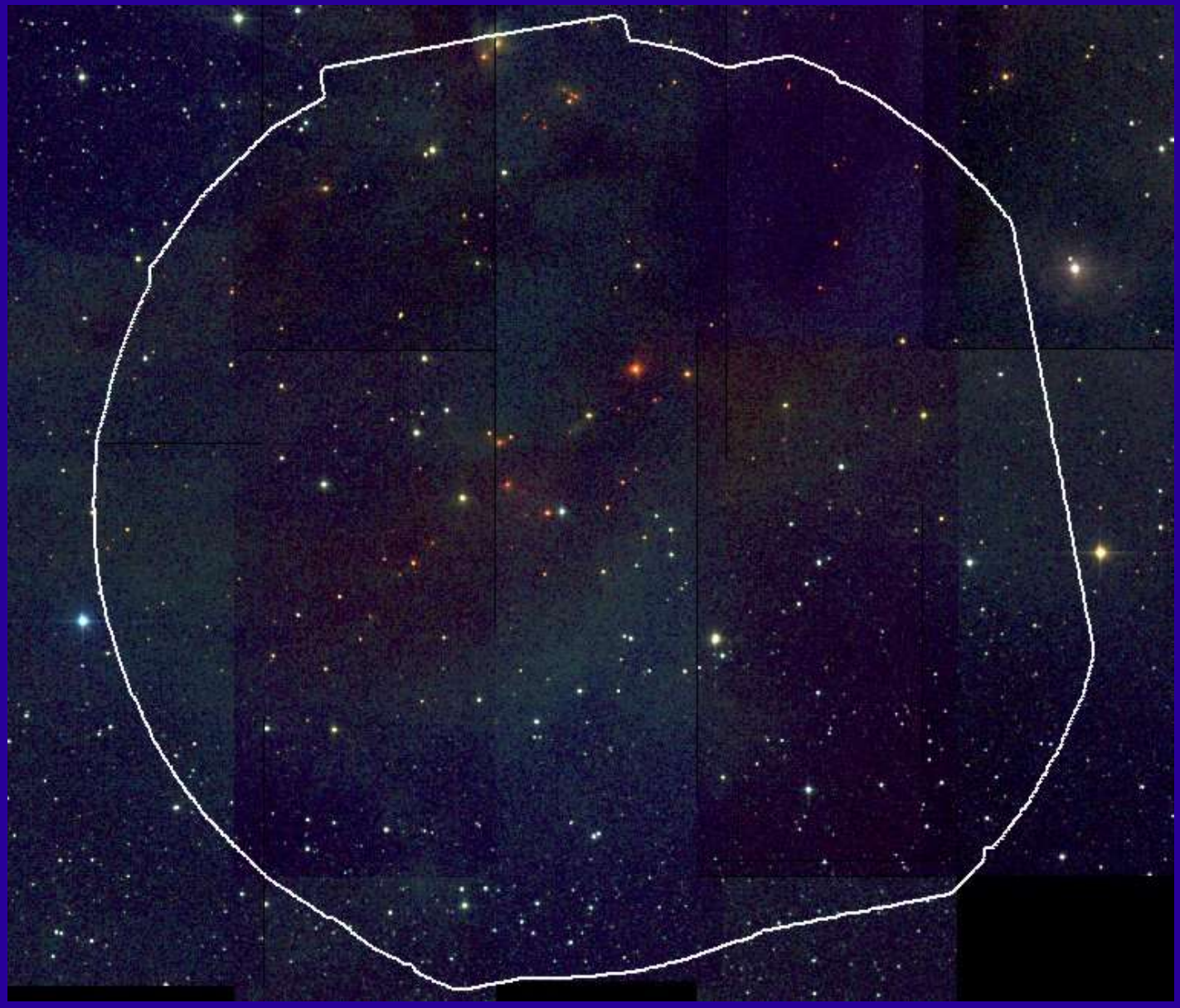
The rejection level for spectra can be more relaxed and need a fine "tuning".

Some additional problems ....

- Pointing claims to be the same across the 5 observations, but in reality a "small" increasing drift is present
  - Very annoying -->
  - Collected Counts and computed Exposure Map do not match
  - Data need to be properly registered and shifted



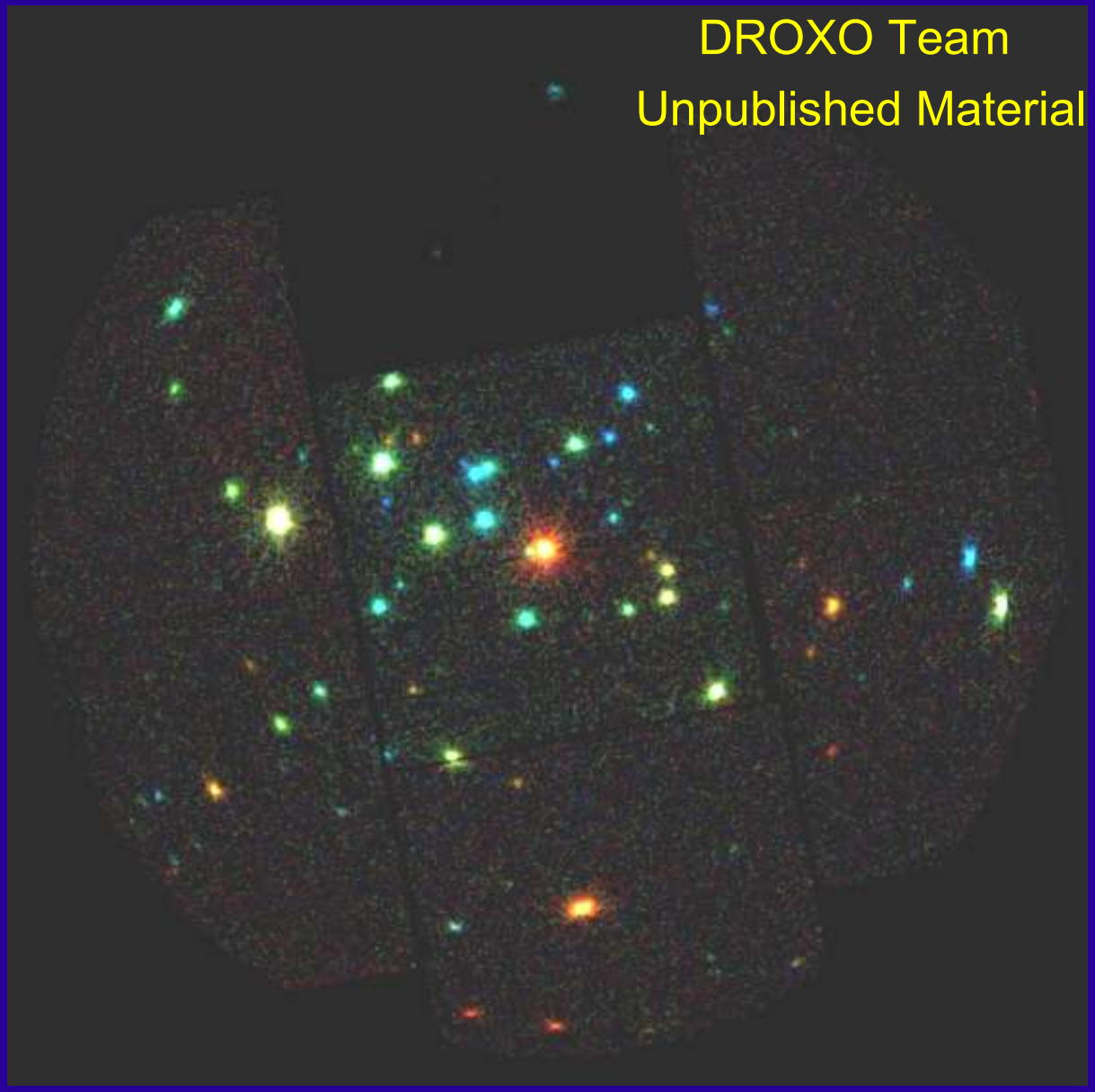
Pointing Toward ρ Oph core F



Red : H (2Mass)
Green: K (2Mass)
Blue : J (2Mass)

Almost same pointing of previous shallow XMM observation

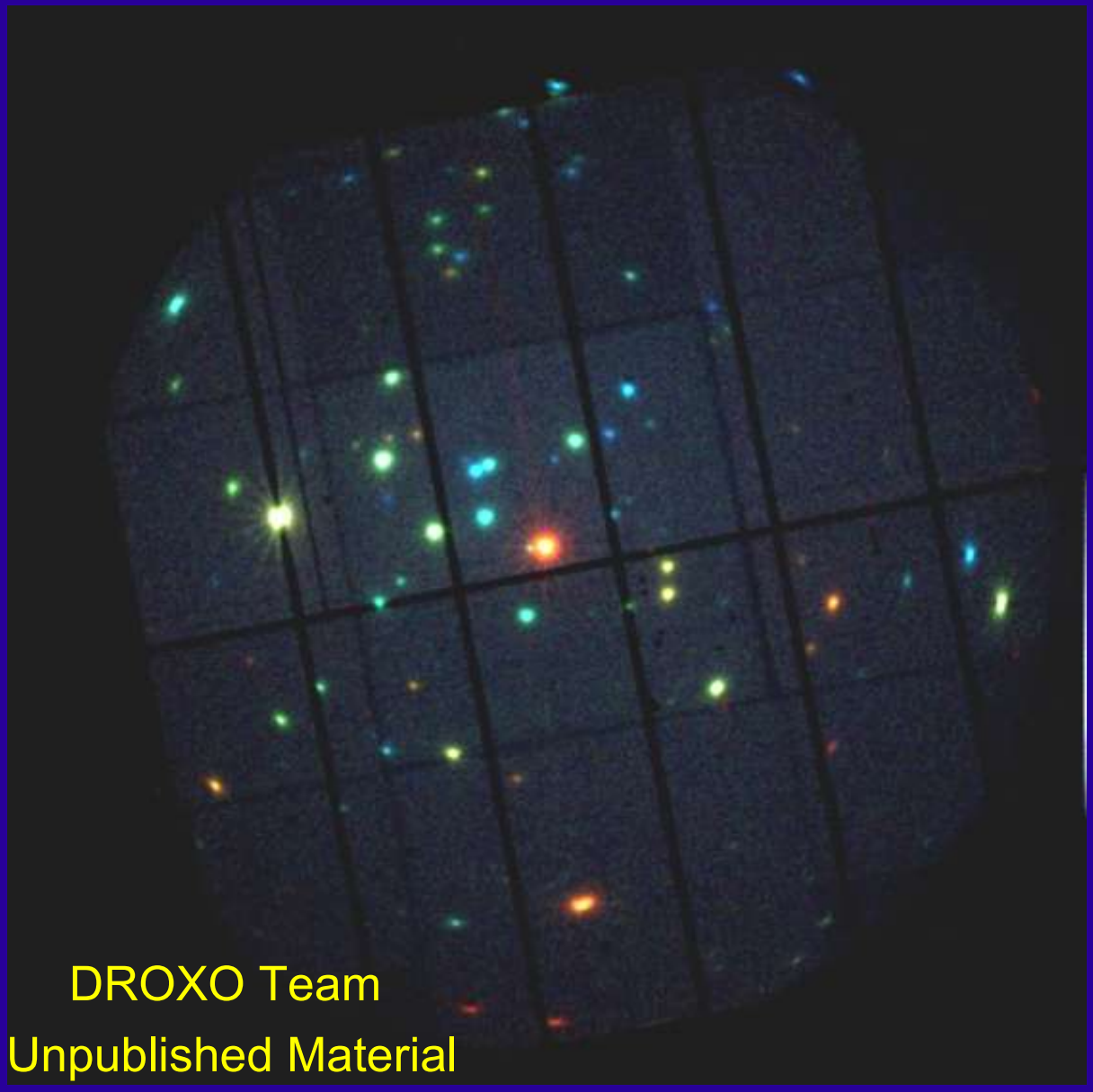
A look to the best data – Mos 1



Red : 0.25 – 1.8 keV
Green: 1.8 – 3.7 keV
Blue : 3.7 – 7.5 keV

Almost same pointing of previous shallow XMM observation

A look to the best data



DROXO Team

Unpublished Material

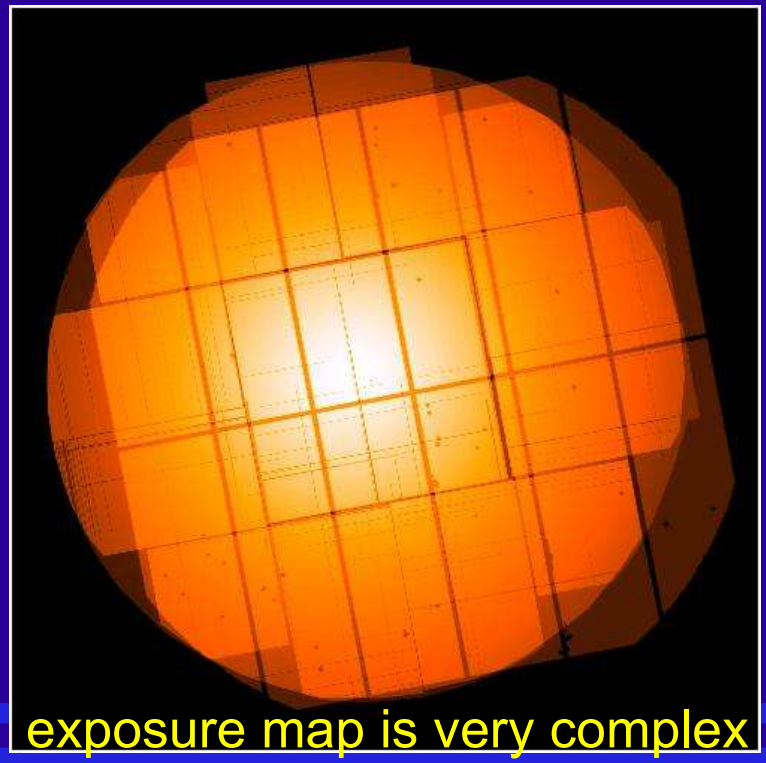
MOS1 + MOS2 + PN

Red : 0.25 – 1.8 keV

Green: 1.8 – 3.7 keV

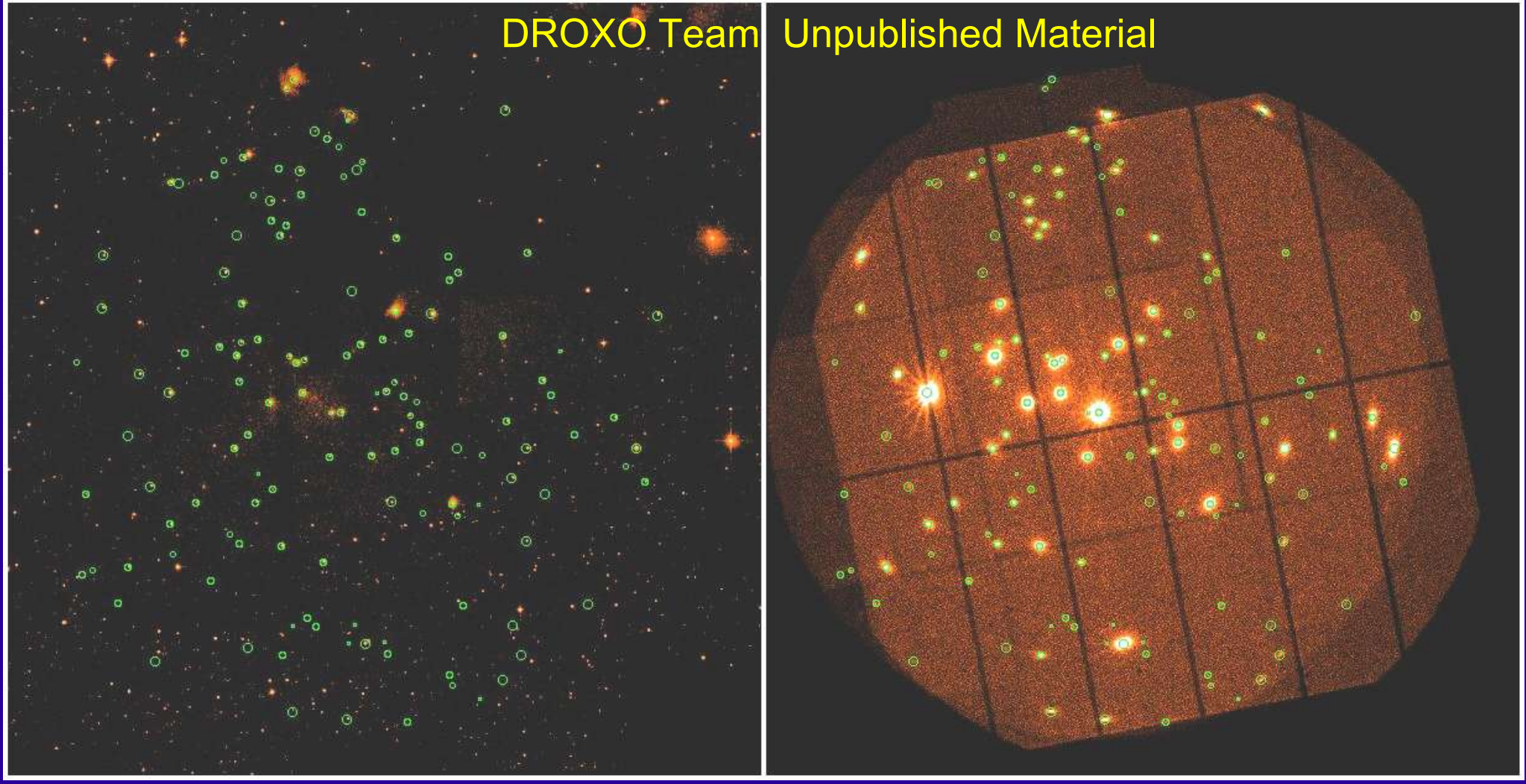
Blue : 3.7 – 7.5 keV

- 133 Sources found in the combined data



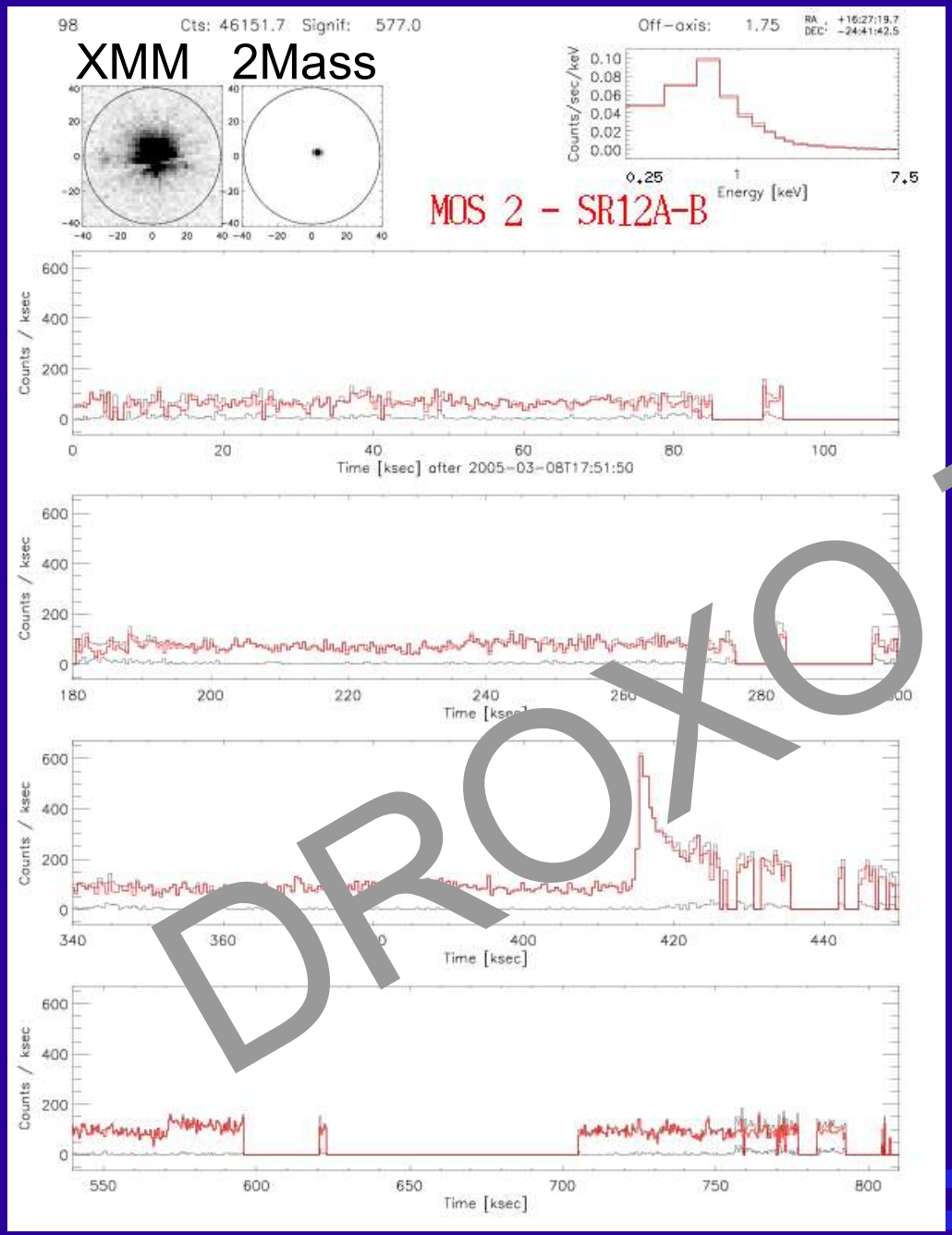
exposure map is very complex

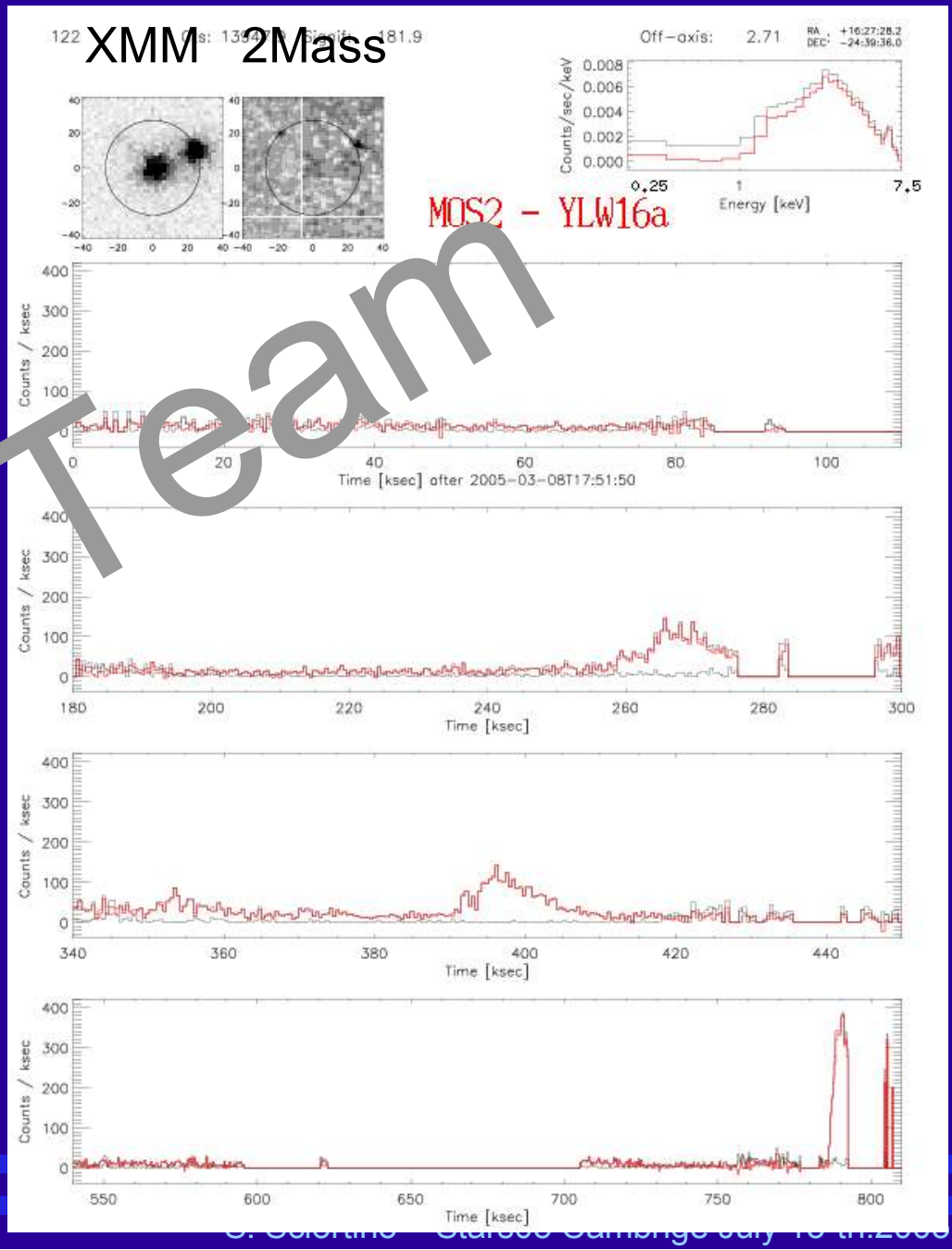
2Mass K – EPIC comparison



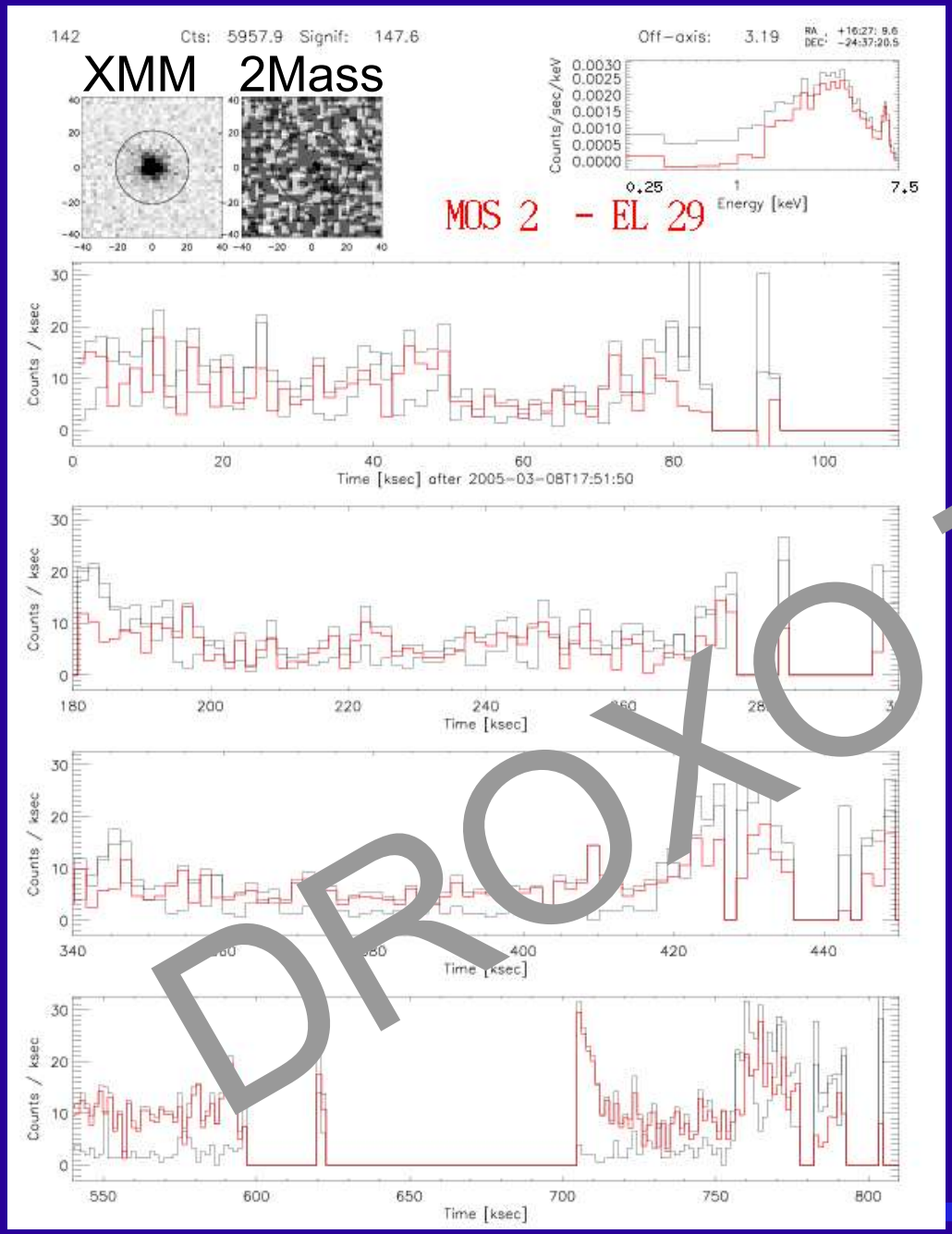
A few interesting sources

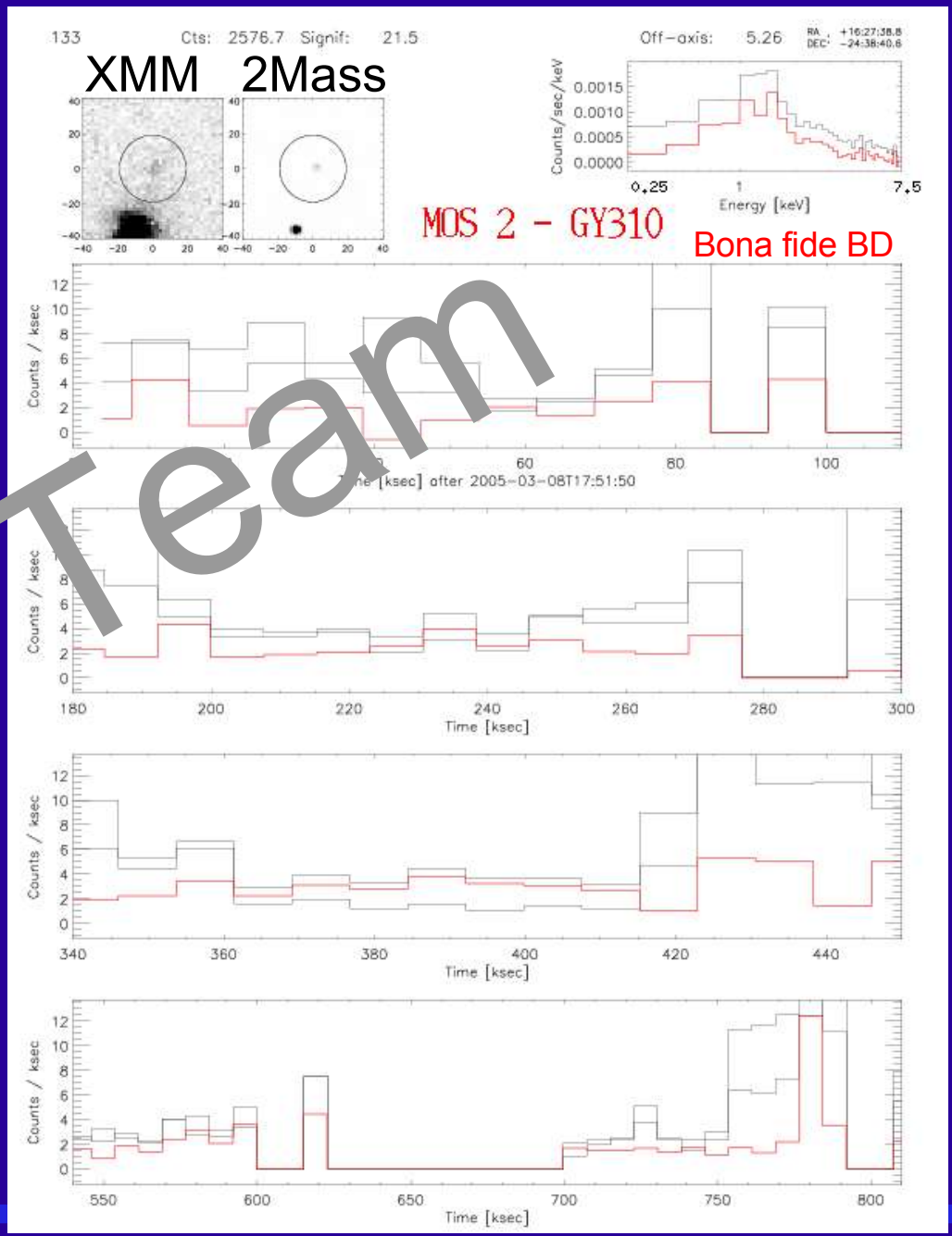
RED LINES == Background subtracted



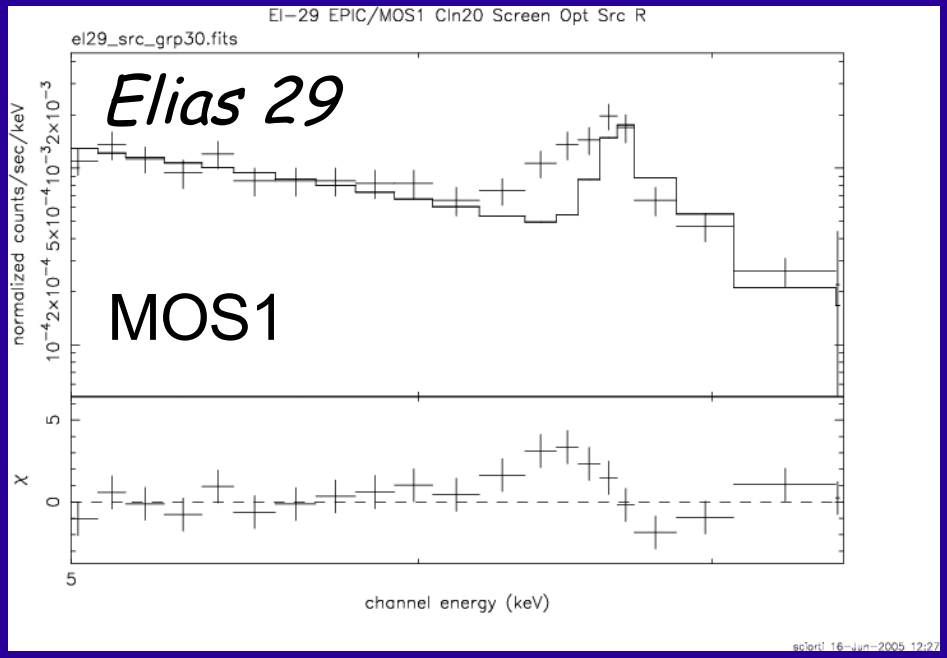


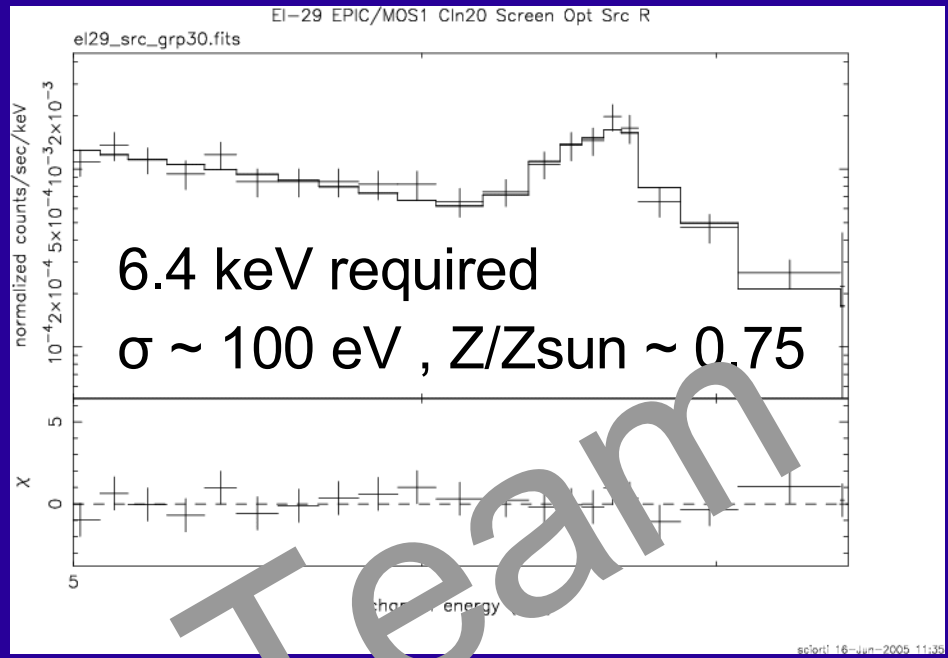
A few interesting sources .. continue

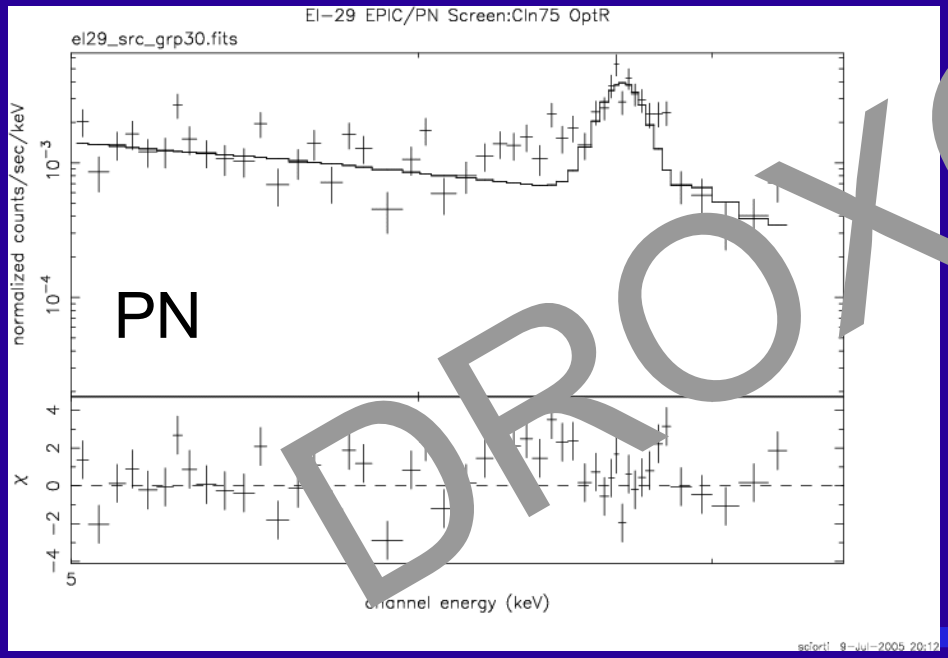


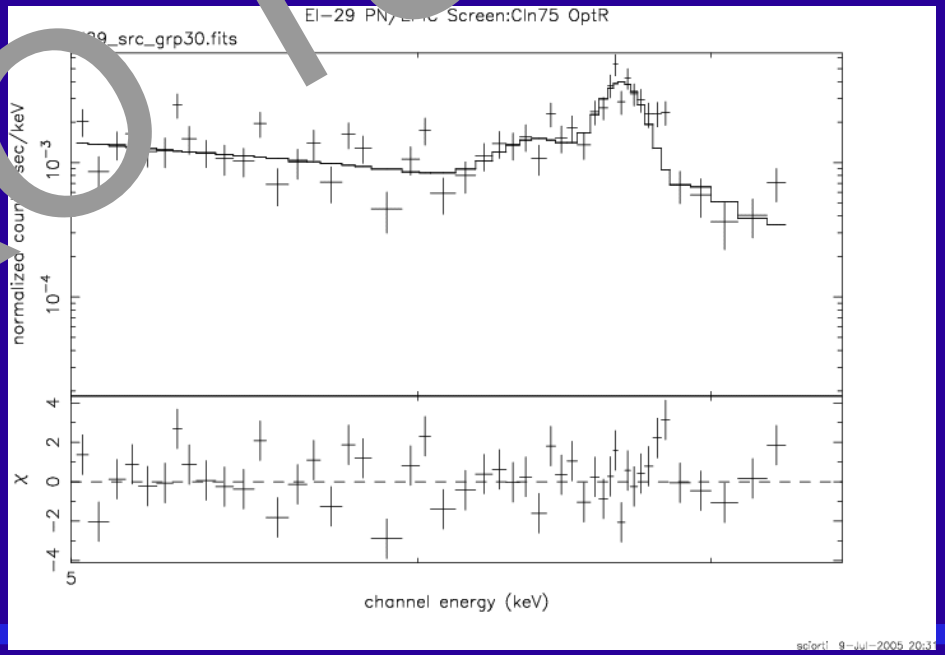


A few interesting spectra ...

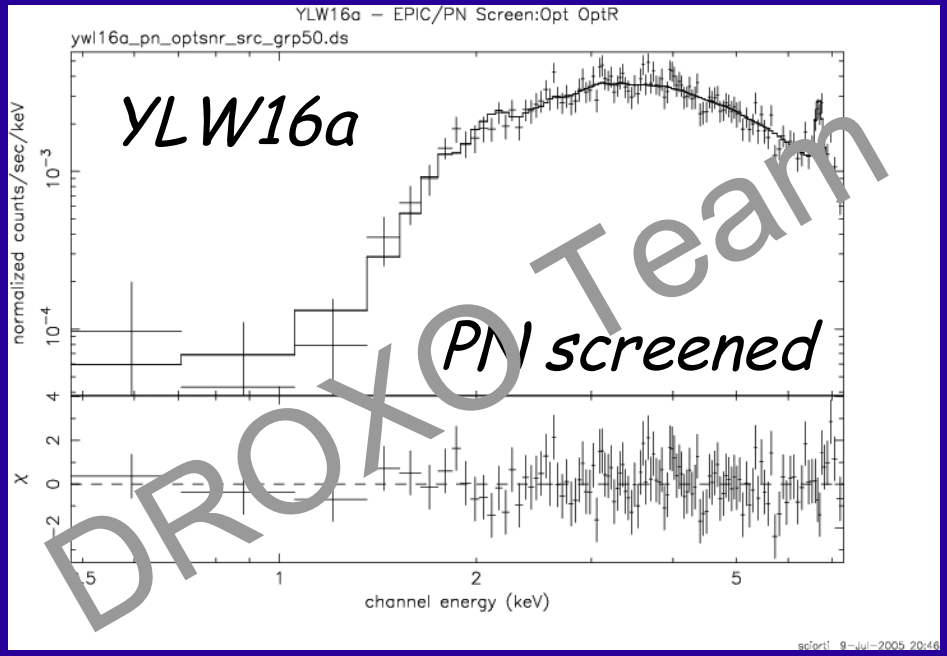








A few interesting spectra ...

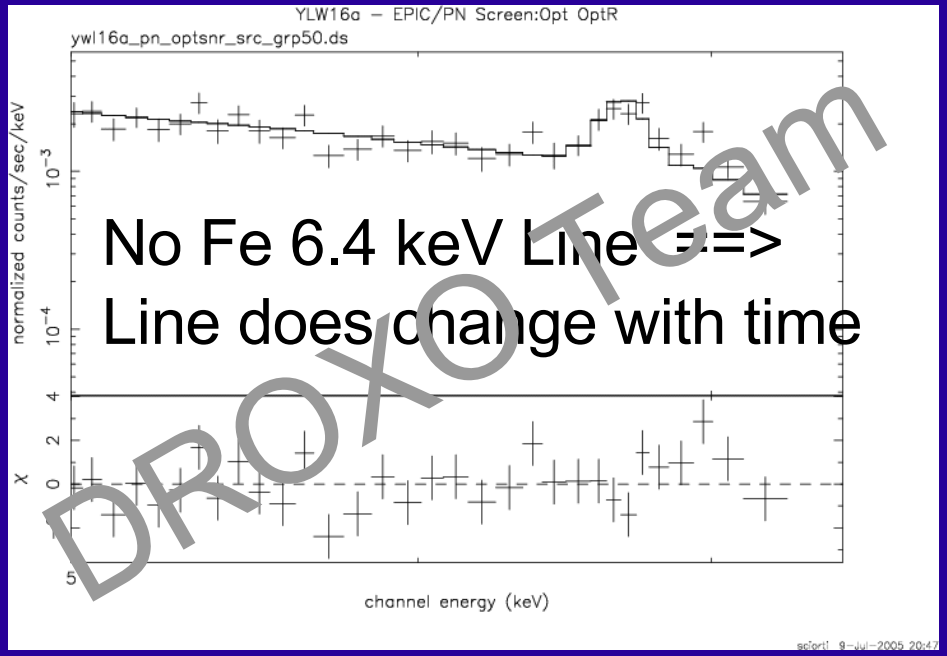


1 T absorbed APEC model →

N_H (10^22) = 6.6 +/- 025

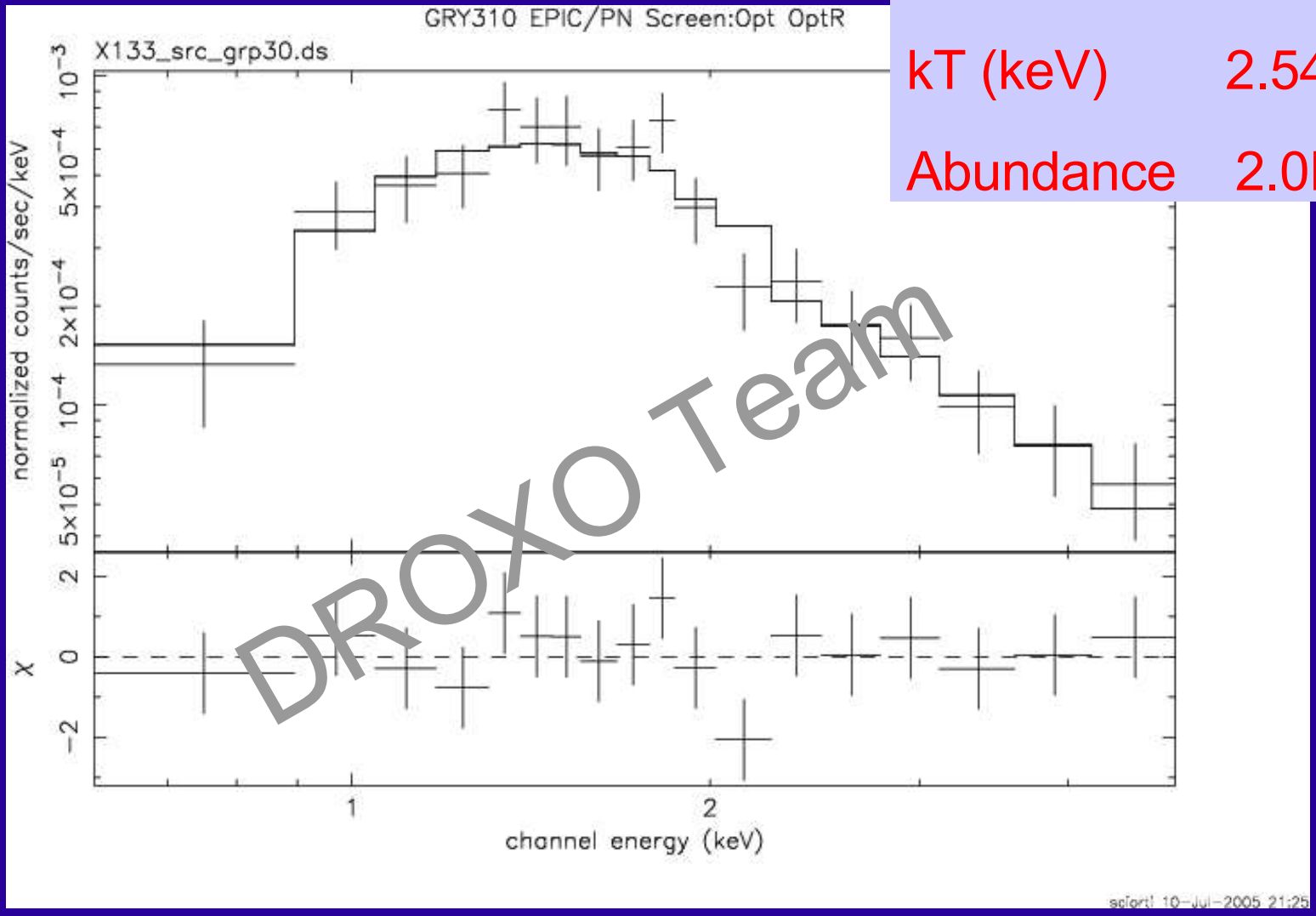
kT (keV) = 4.1 +/- 0.3

Abundance = 0.21+/- 0.03



A few interesting spectra ...
GRY310, a brown dwarf

nH (10^22)	0.72	+/- 0.11
kT (keV)	2.54	+/- 0.66
Abundance	2.0E-05	+/- 0.32



What next ... still a lot of analysis

- DROXO is providing new data for making accessible new, unique diagnostics of YSOs physics
- Disk heating, chemistry, orientation
  - Fluorescence
- Size and location of magnetic structures funnelling accreting plasma
  - Flare analysis
- X-ray spectra from very young BDs

- and much more that is still hidden into the data ....

THE END … for the moment