X-ray gaseous emission in star forming galaxies

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&
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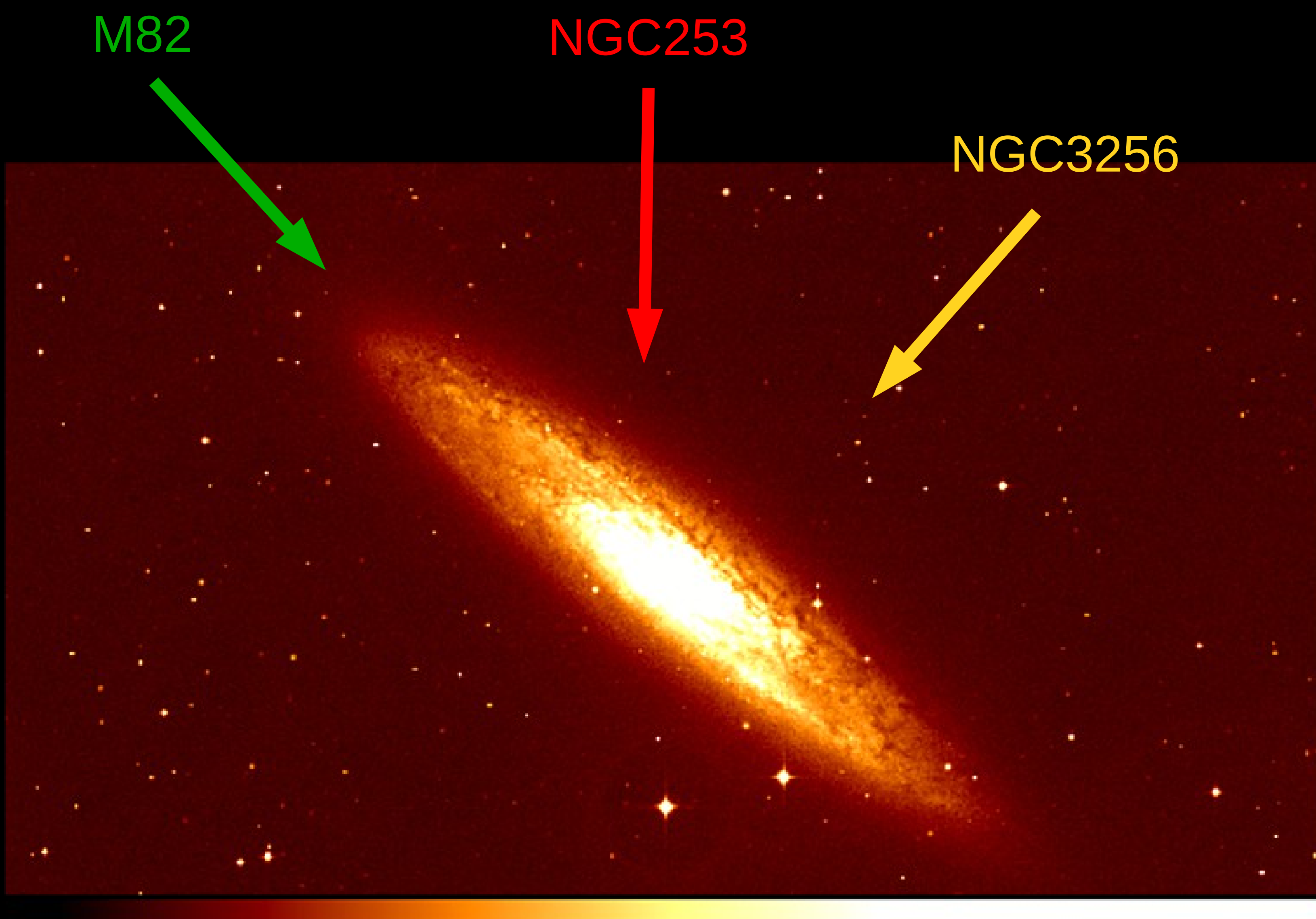
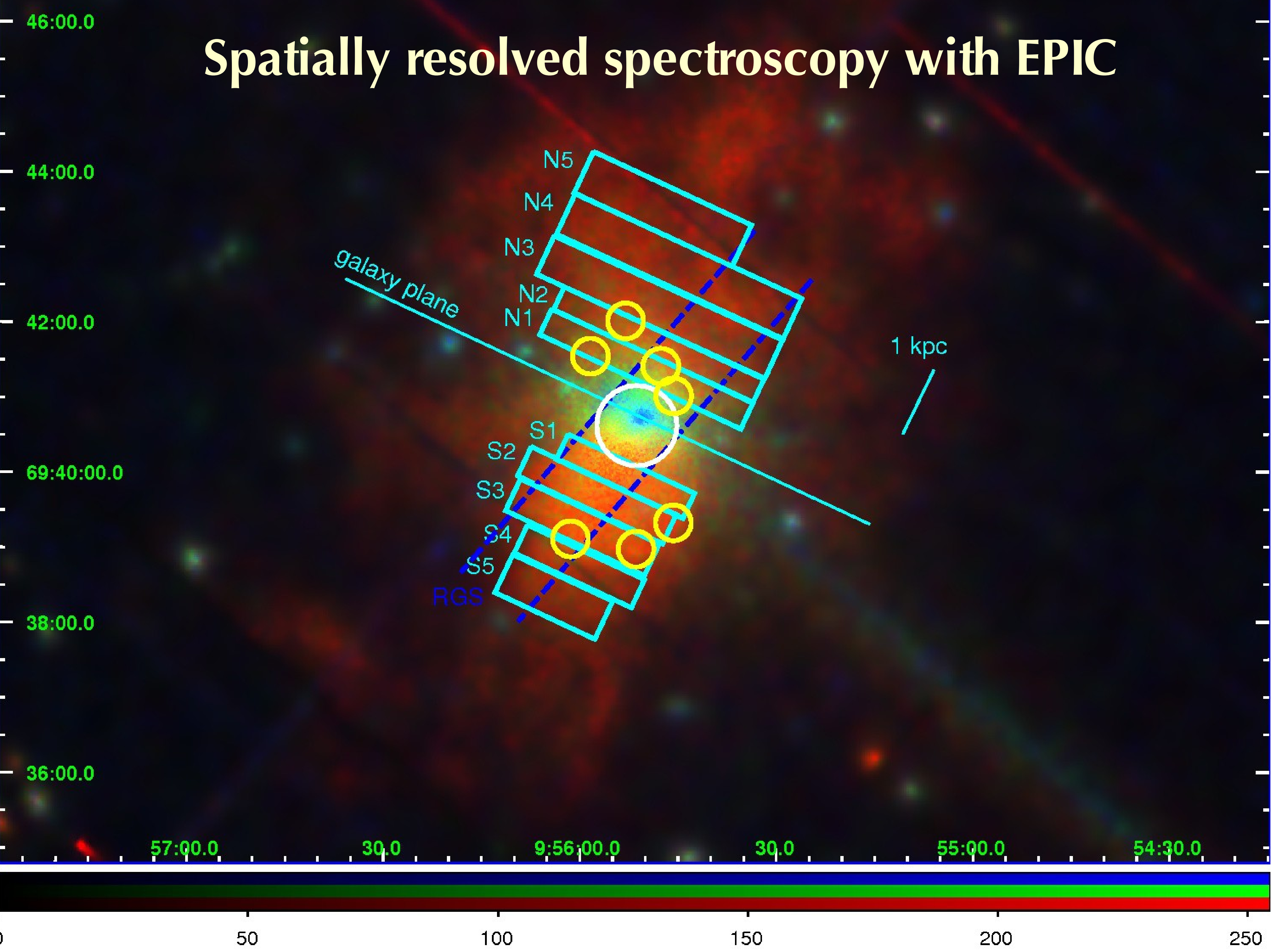
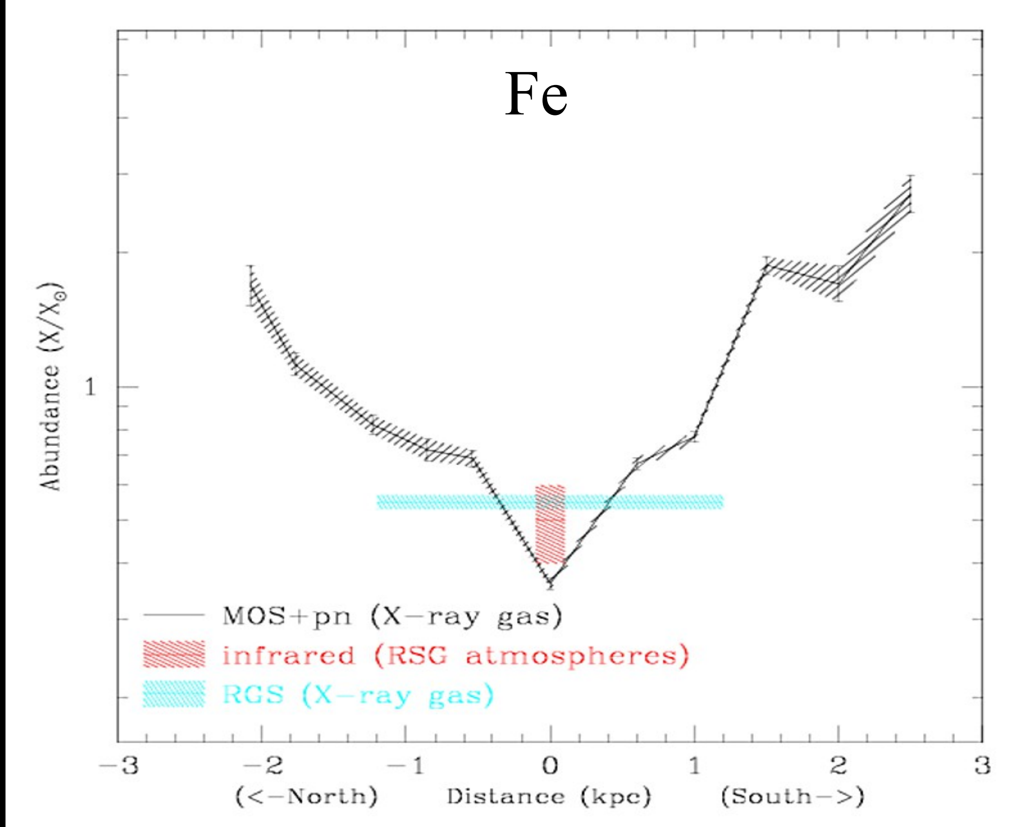
Different views of the same phenomenon



Spatially resolved spectroscopy with EPIC

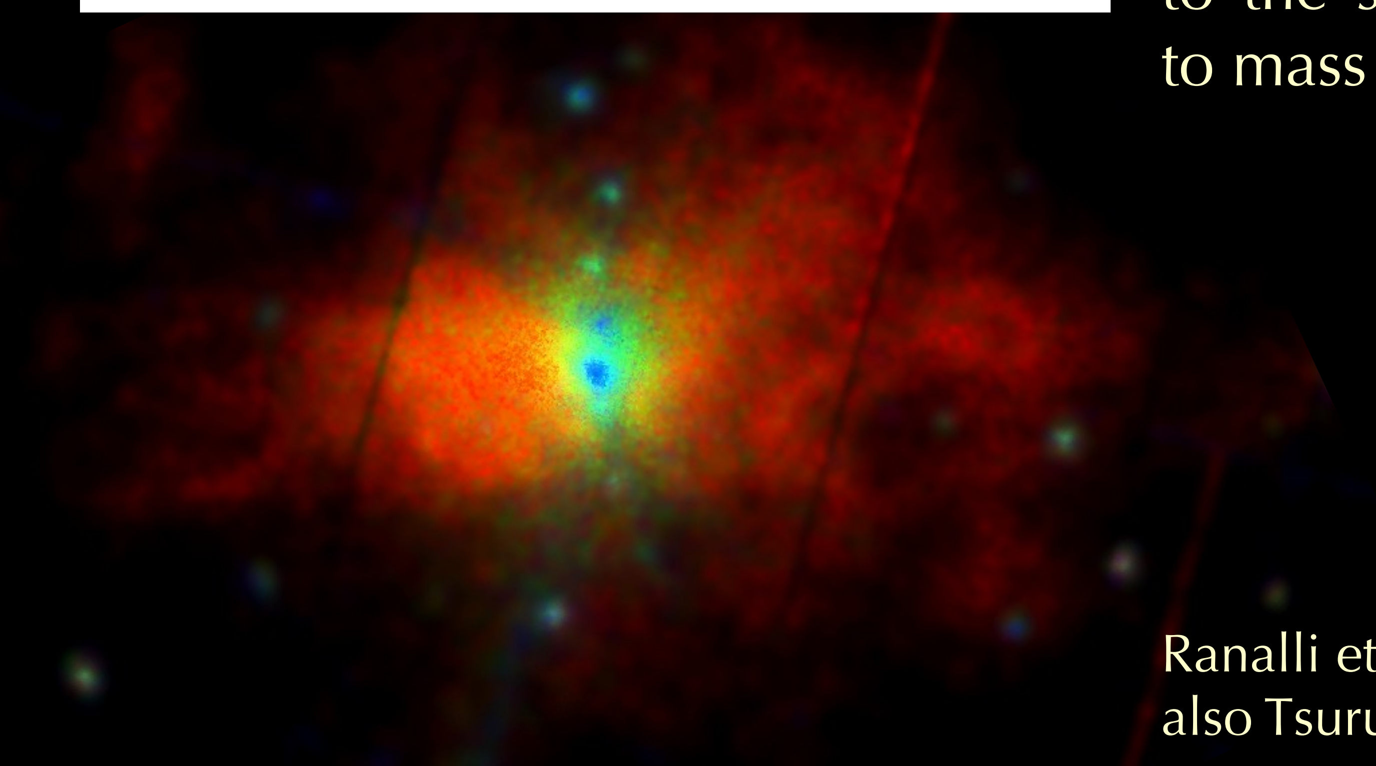




Understanding chemical evolution and enrichment

The spectral parameters of the outflow plasma in M82 are spatially dependent (Ranalli et al. 2008).

They are probably connected to the supernova yields and/or to mass loading



Ranalli et al. 2008 MNRAS 386, 1464
also Tsuru et al. 2007

NGC3256

L_X~10^{41} erg/s, observed face-on => cannot slice the outflow (outflow is superimposed on the centre)

Chandra:

NGC3256

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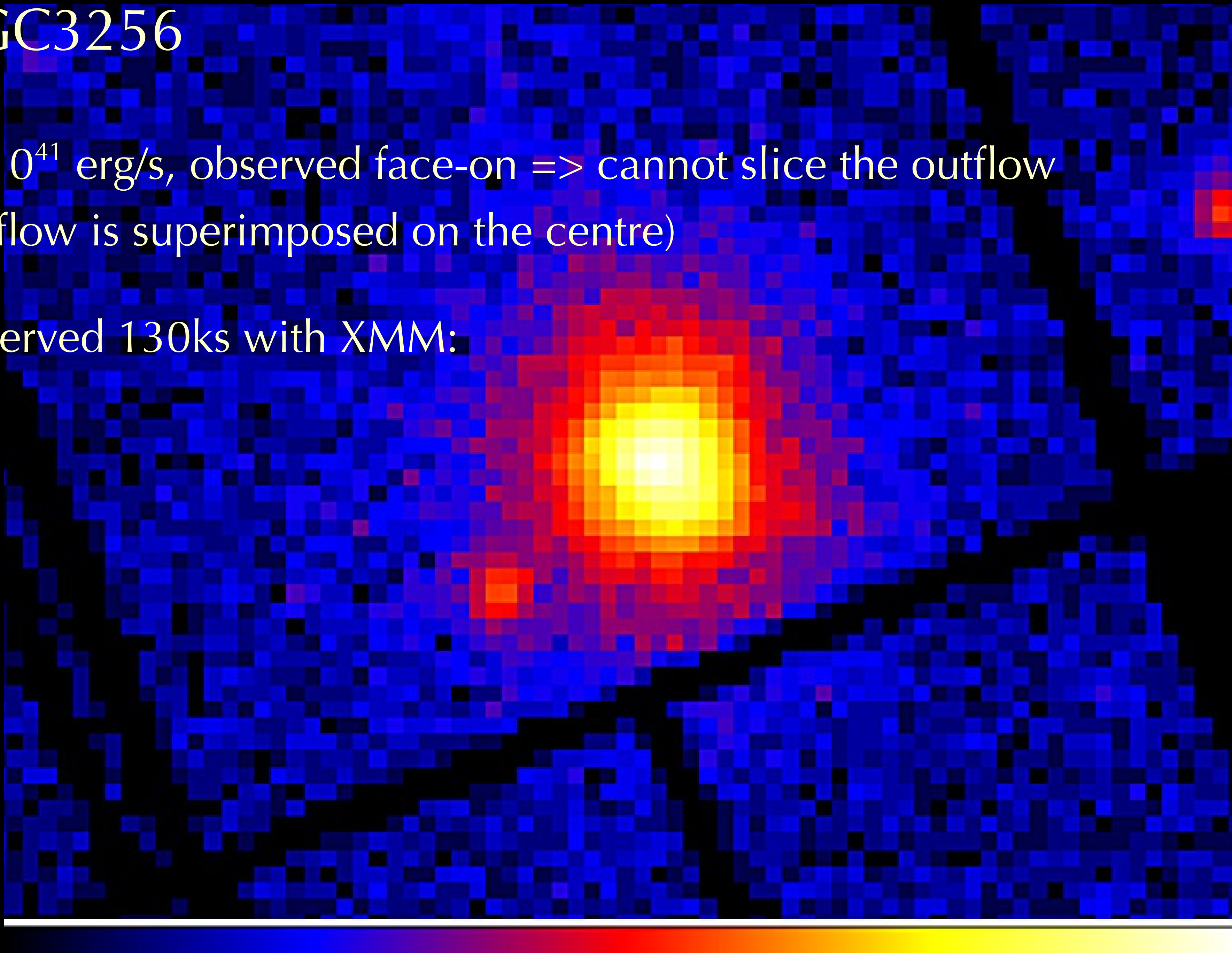
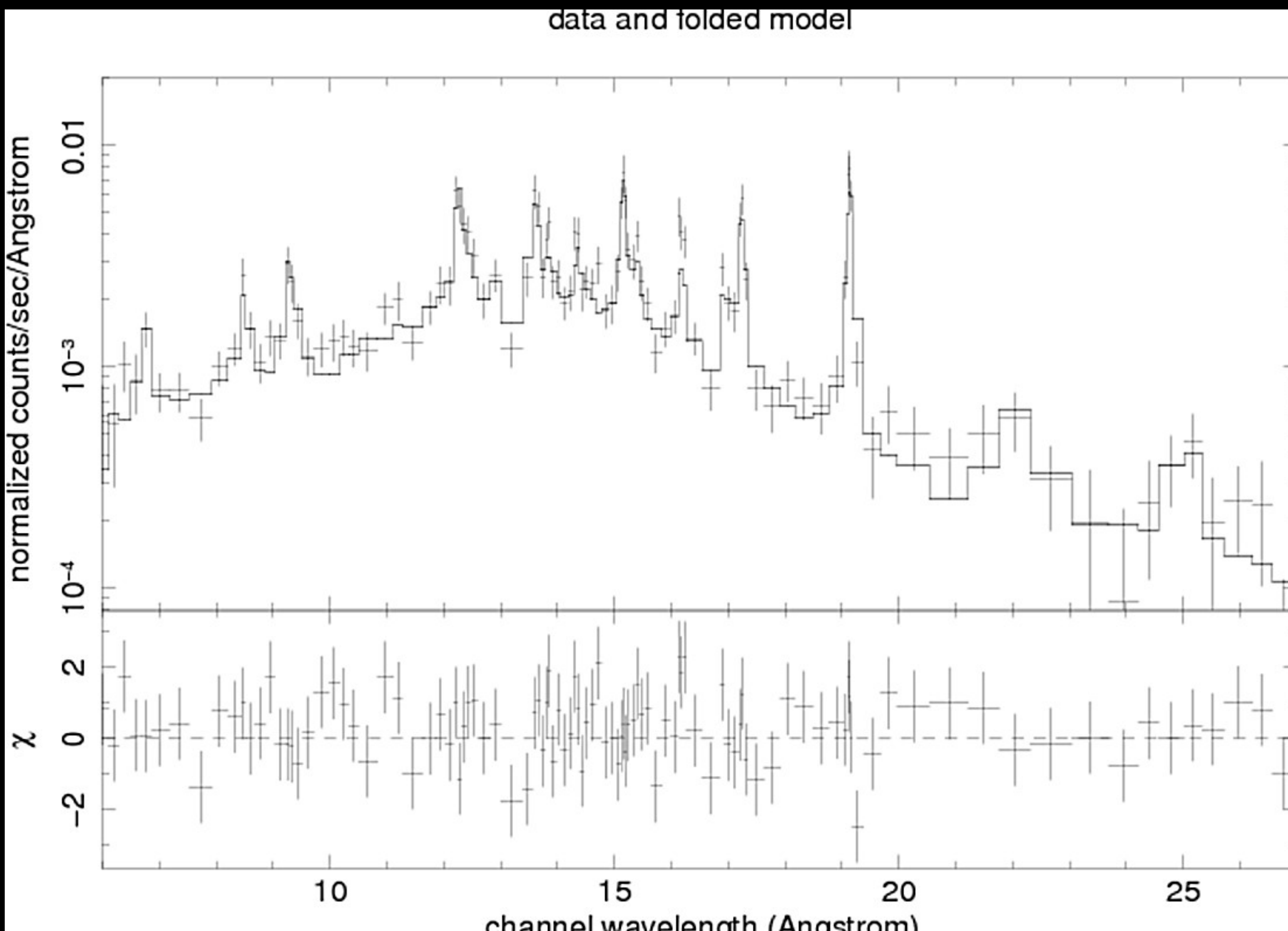
Observed 130ks with XMM:



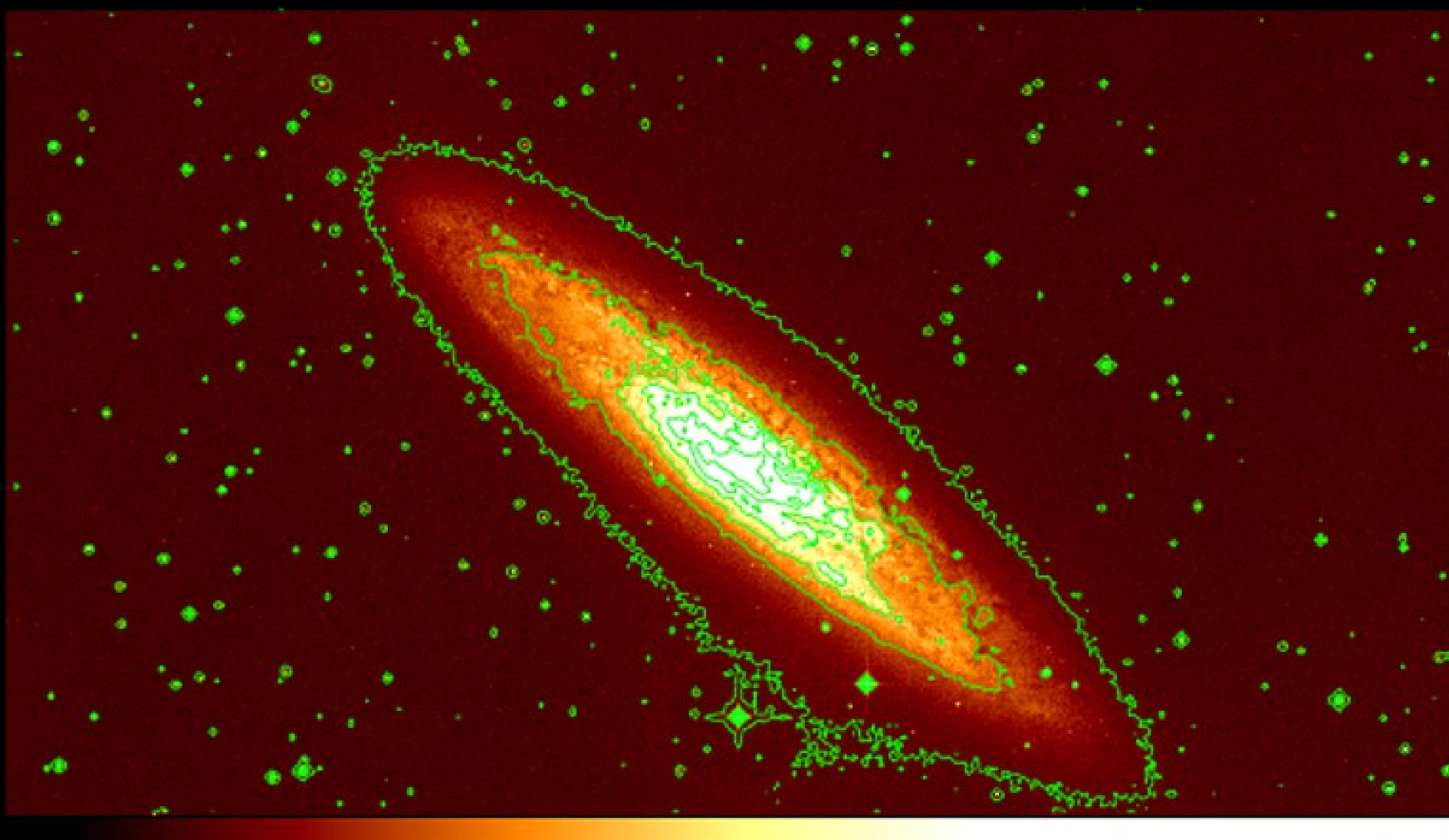
NGC3256

$L_X \sim 10^{41}$ erg/s, observed face-on => cannot slice the outflow
Highly (3-5 x) super-solar abundances
OVII triplet shows CE on top of thermal



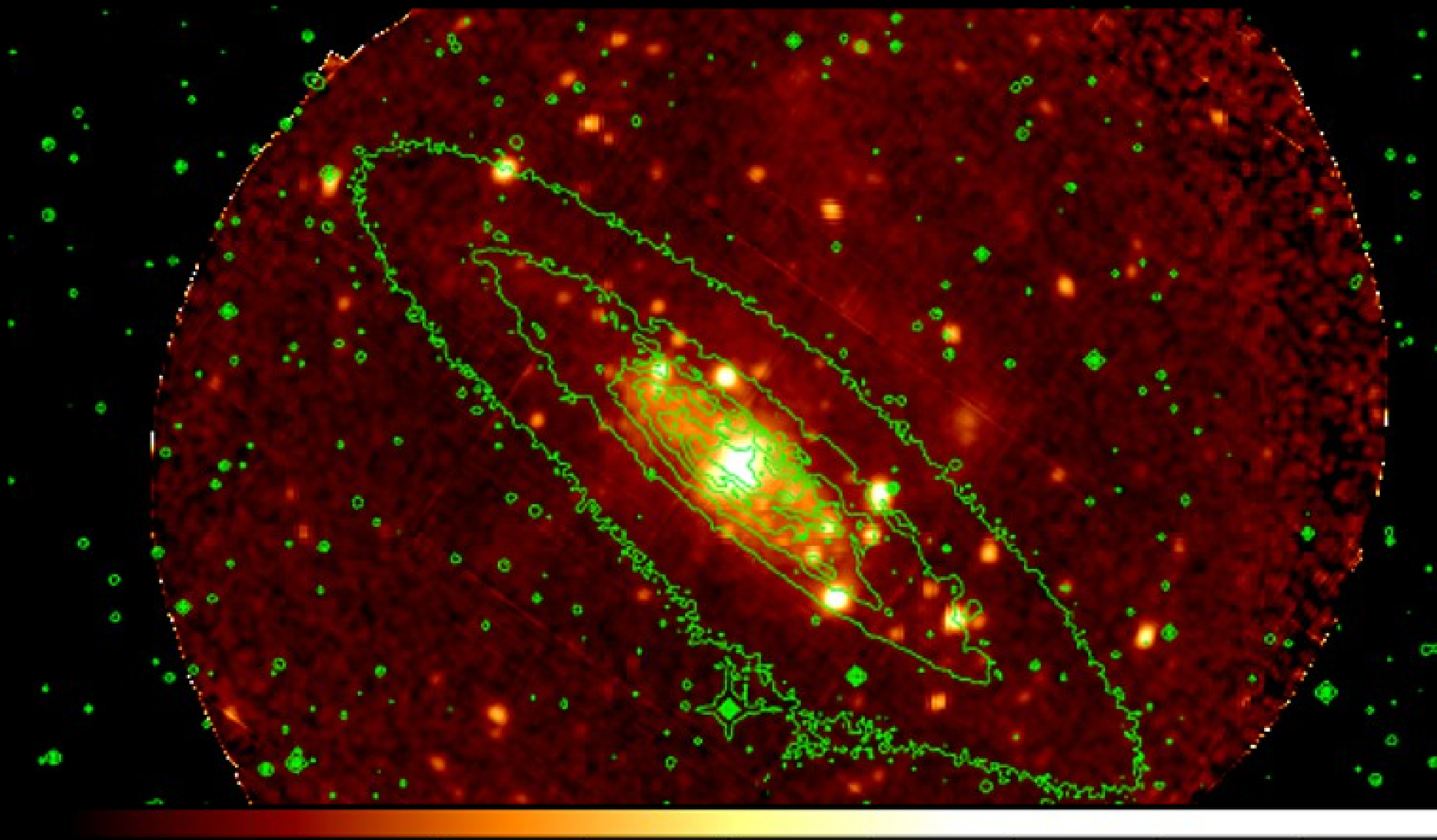
NGC253

NGC253



NGC253

170 ks with XMM:



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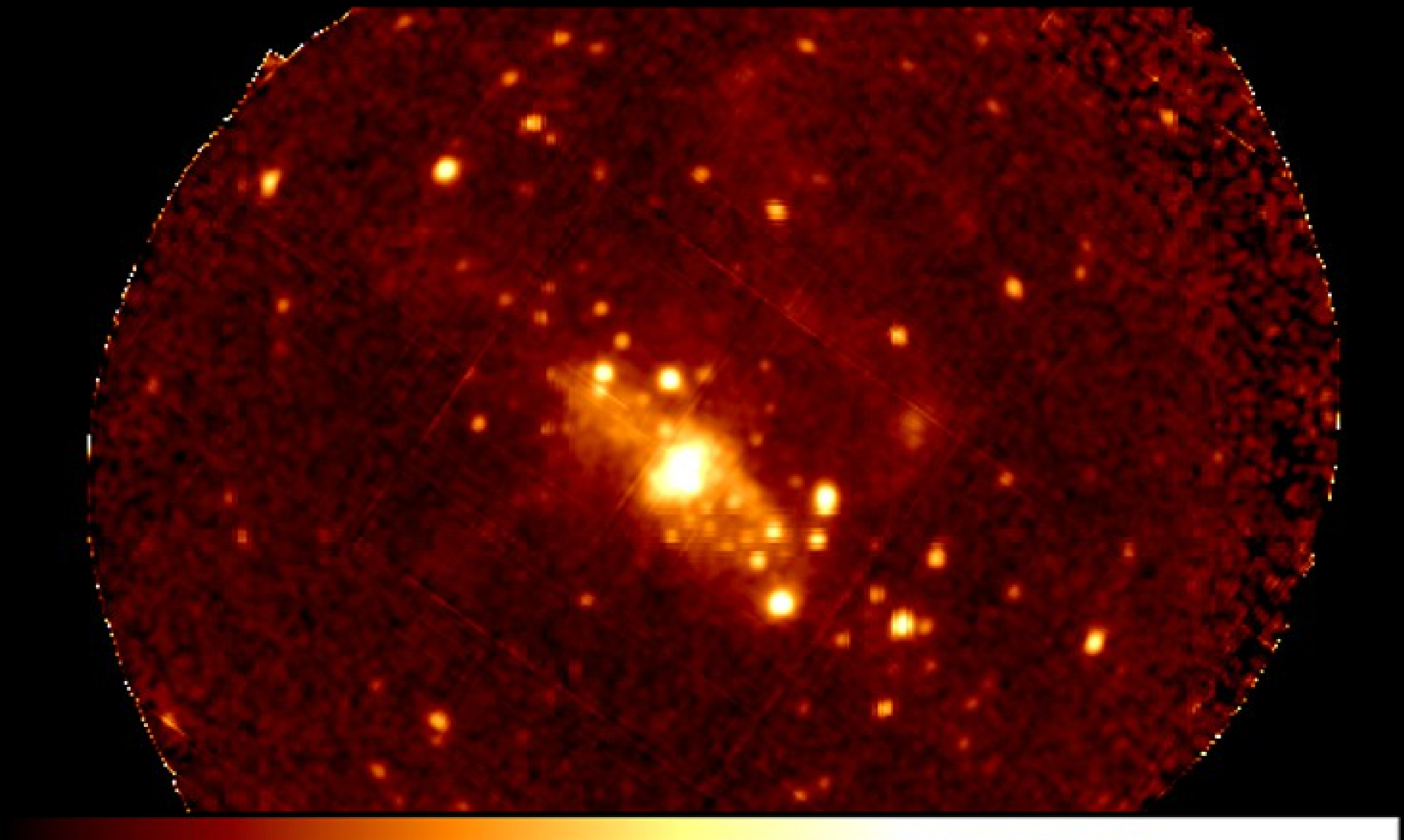
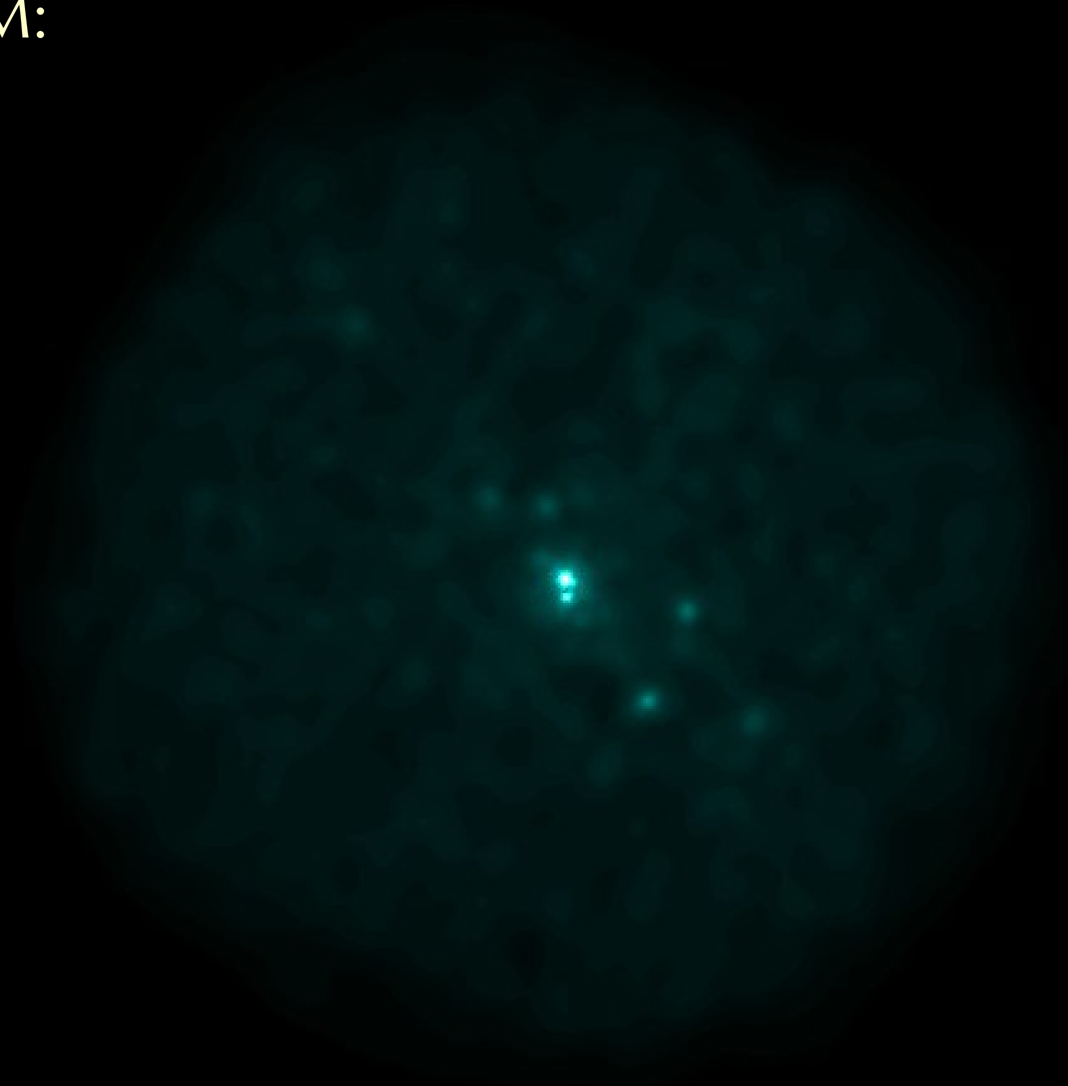


NGC253

170 ks with XMM:

Fe K   +XXVI

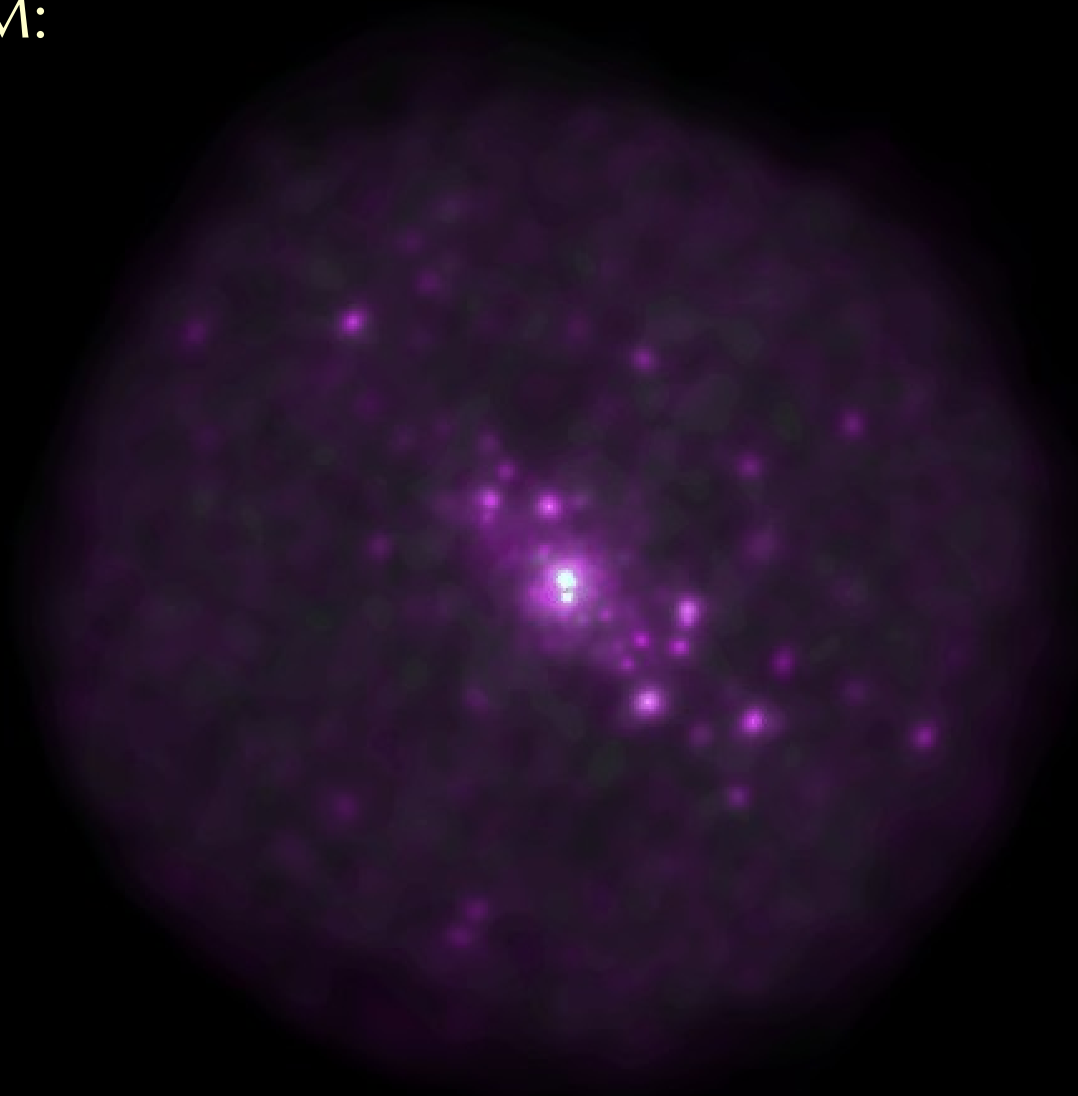


NGC253

170 ks with XMM:

Fe K +XXVI

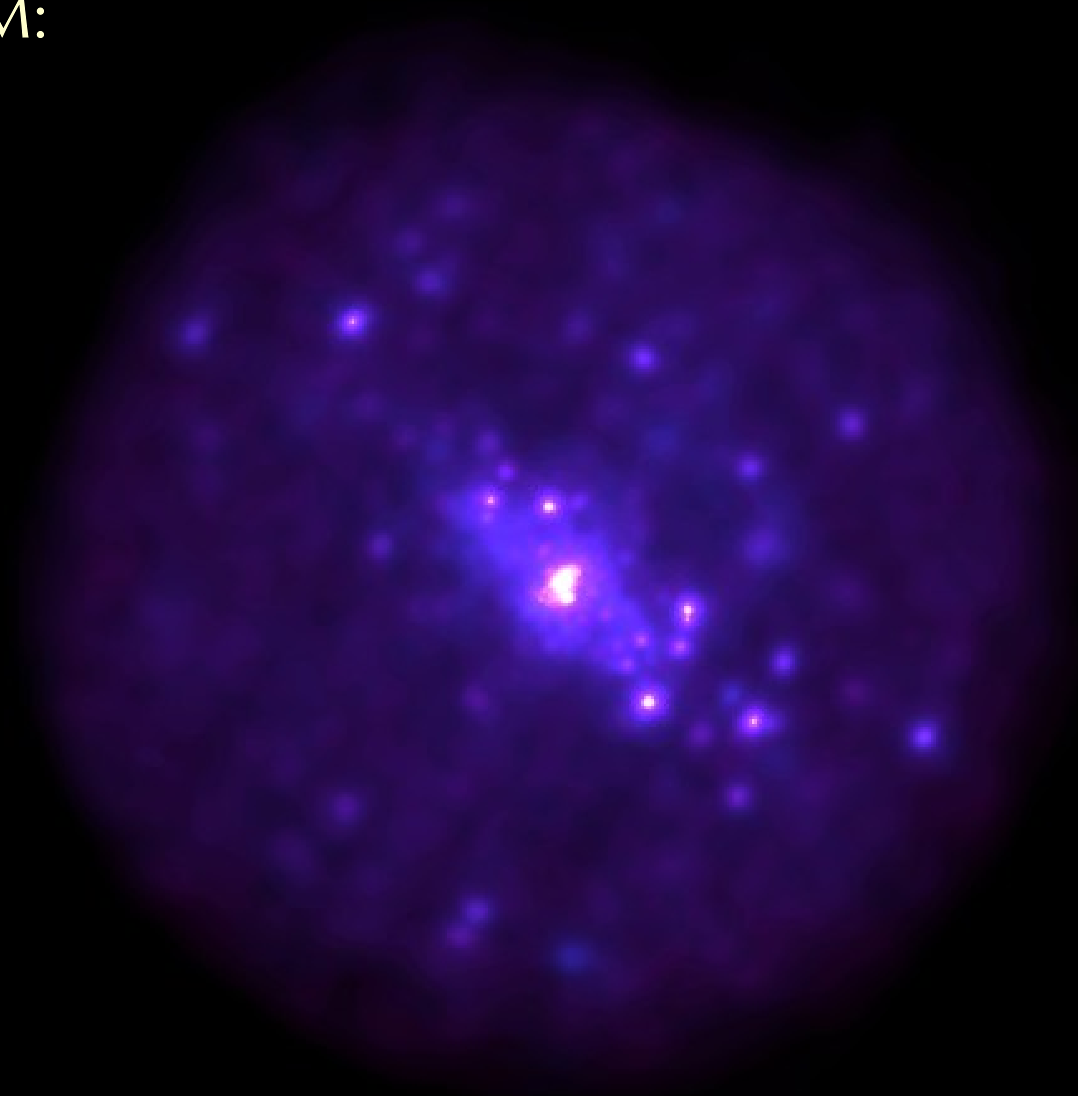
Mg



NGC253

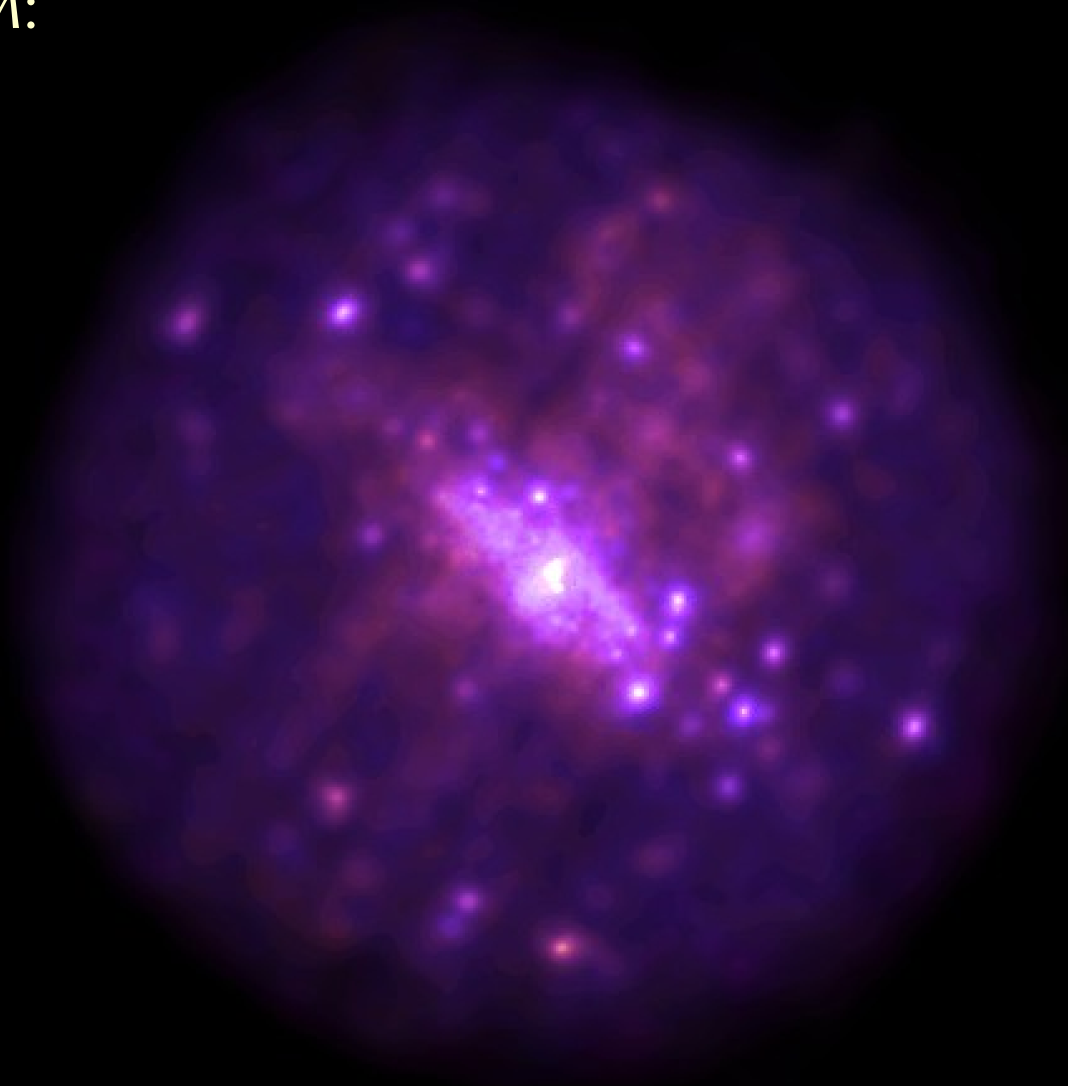
170 ks with XMM:

Mg
Ne



NGC253
170 ks with XMM:

Mg
Ne
Fe XVII (L shell)



NGC253

170 ks with XMM:

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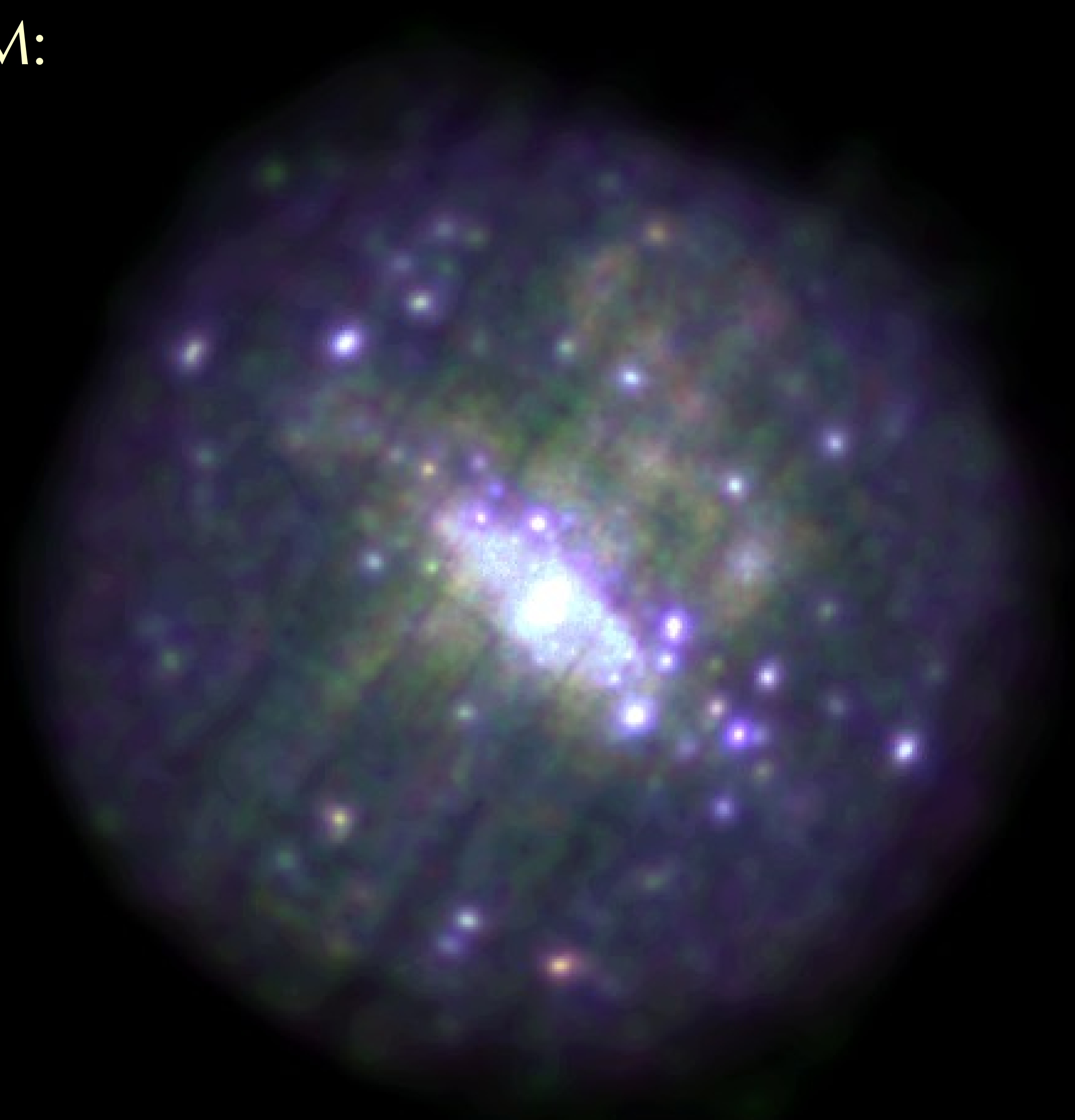
Ne
Fe XVII (L shell)
O VII+VIII



NGC253

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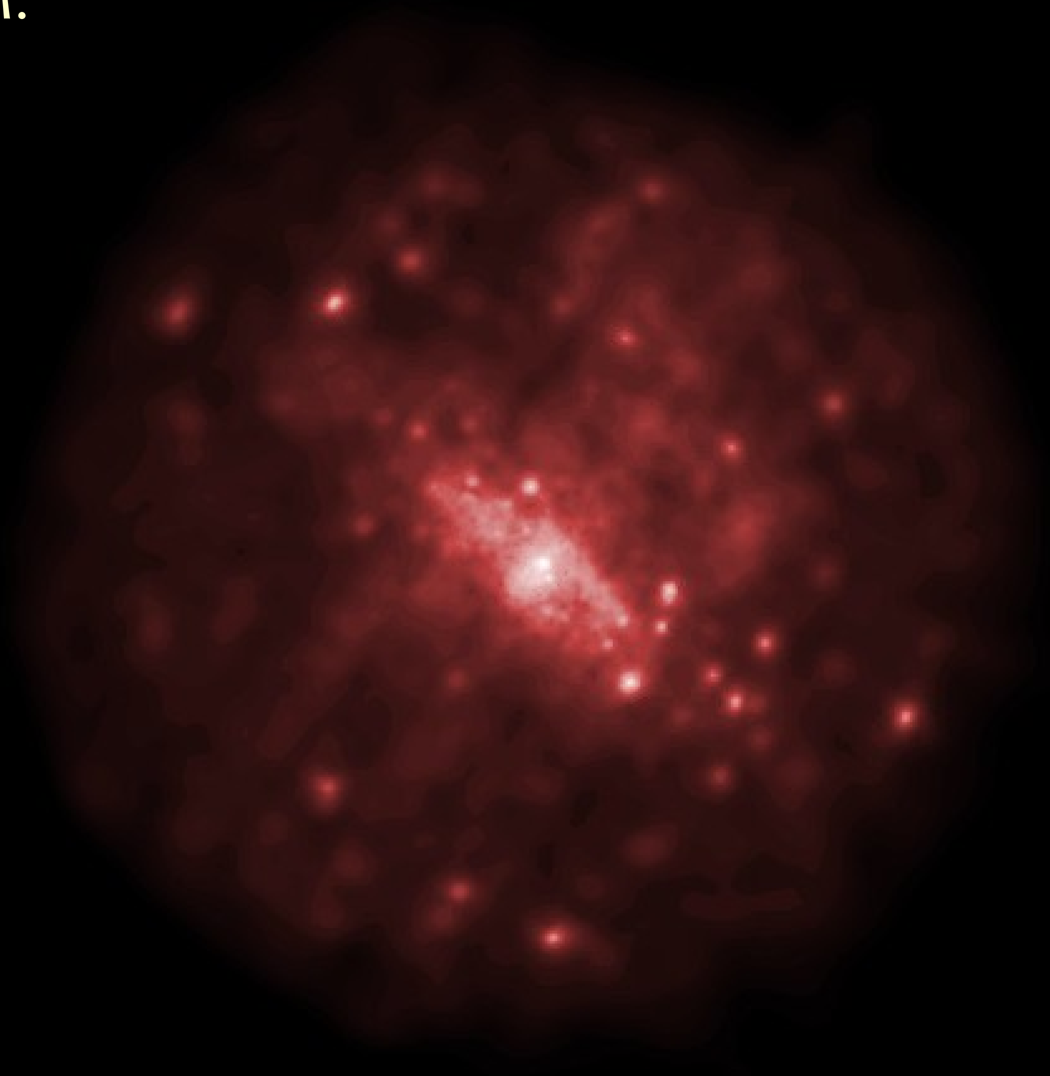

NGC253

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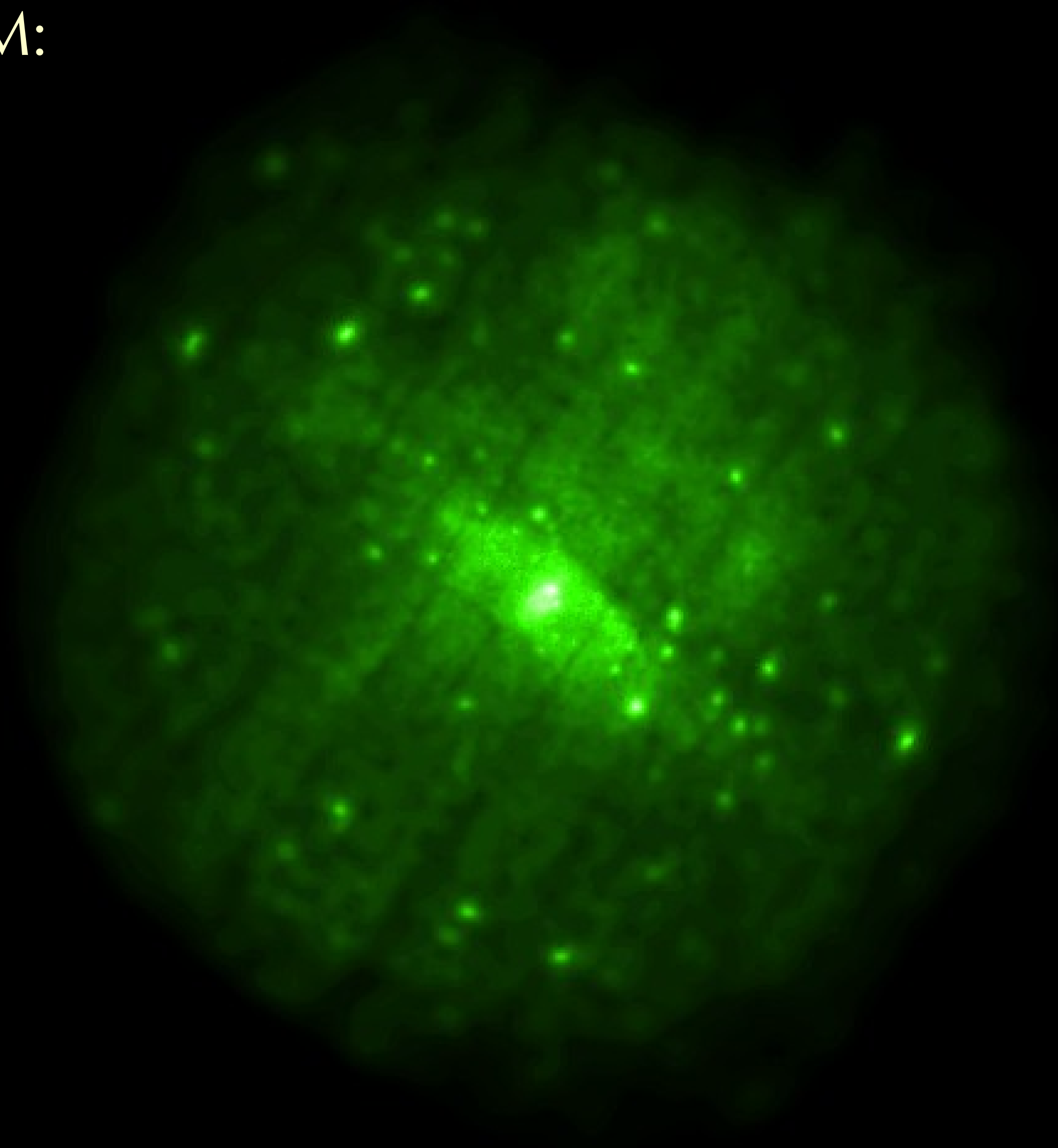


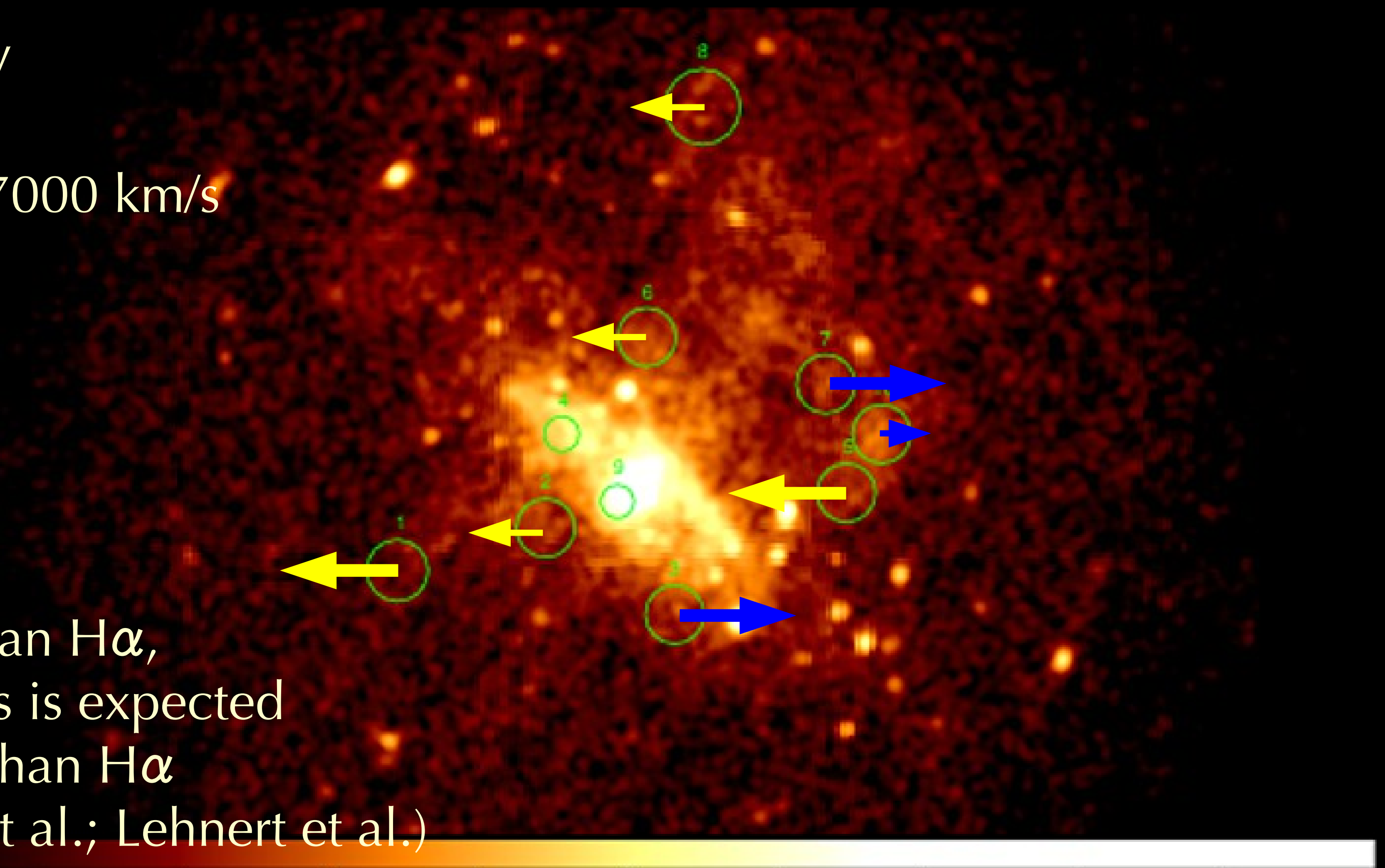
NGC253

170 ks with XMM:

α/Fe ~ 1.2

kT ~ 0.2 keV

-2000<Δv<7000 km/s



10x faster than Hα,
but X-ray gas is expected
to be faster than Hα
(Strickland et al.; Lehnert et al.)

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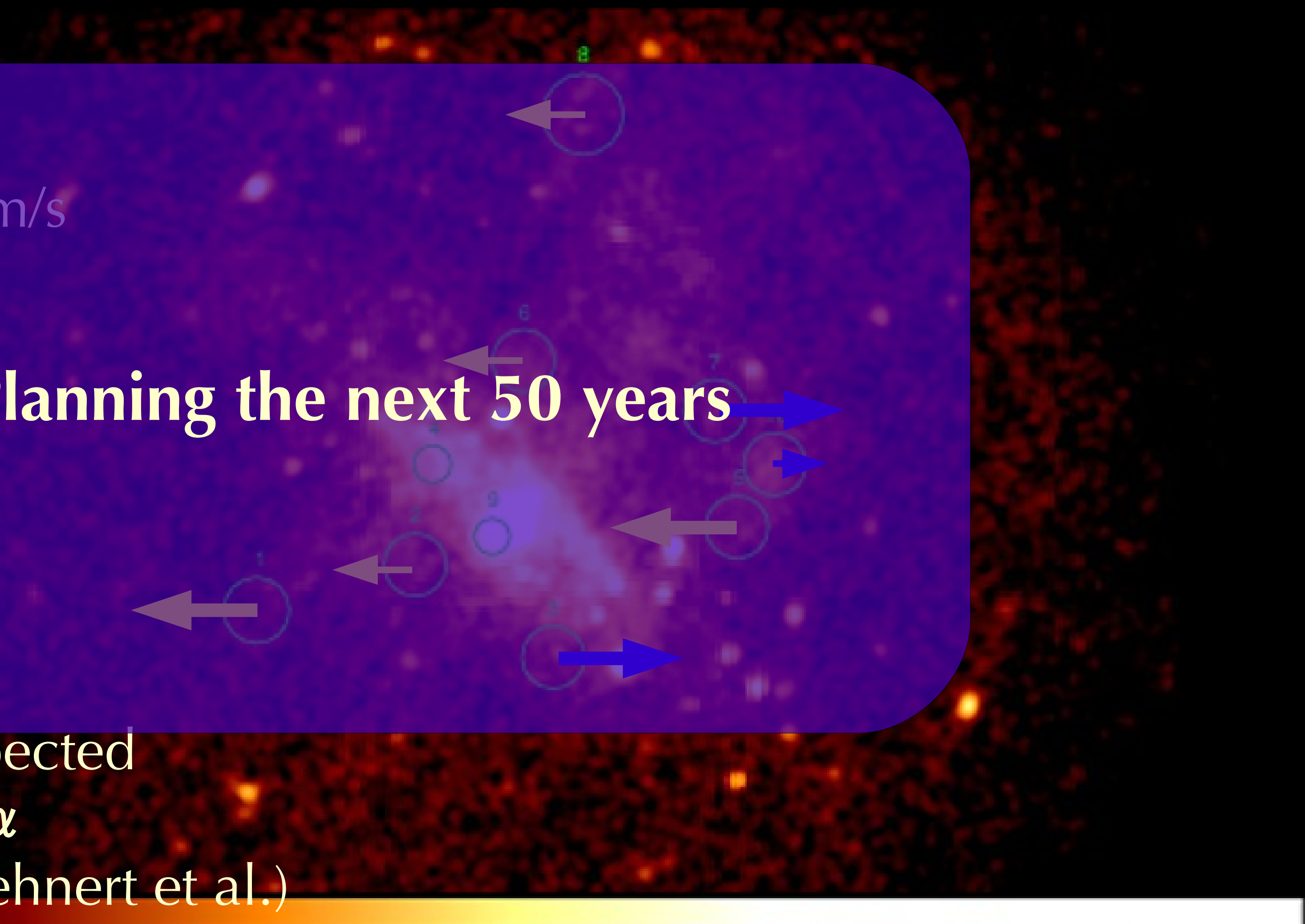

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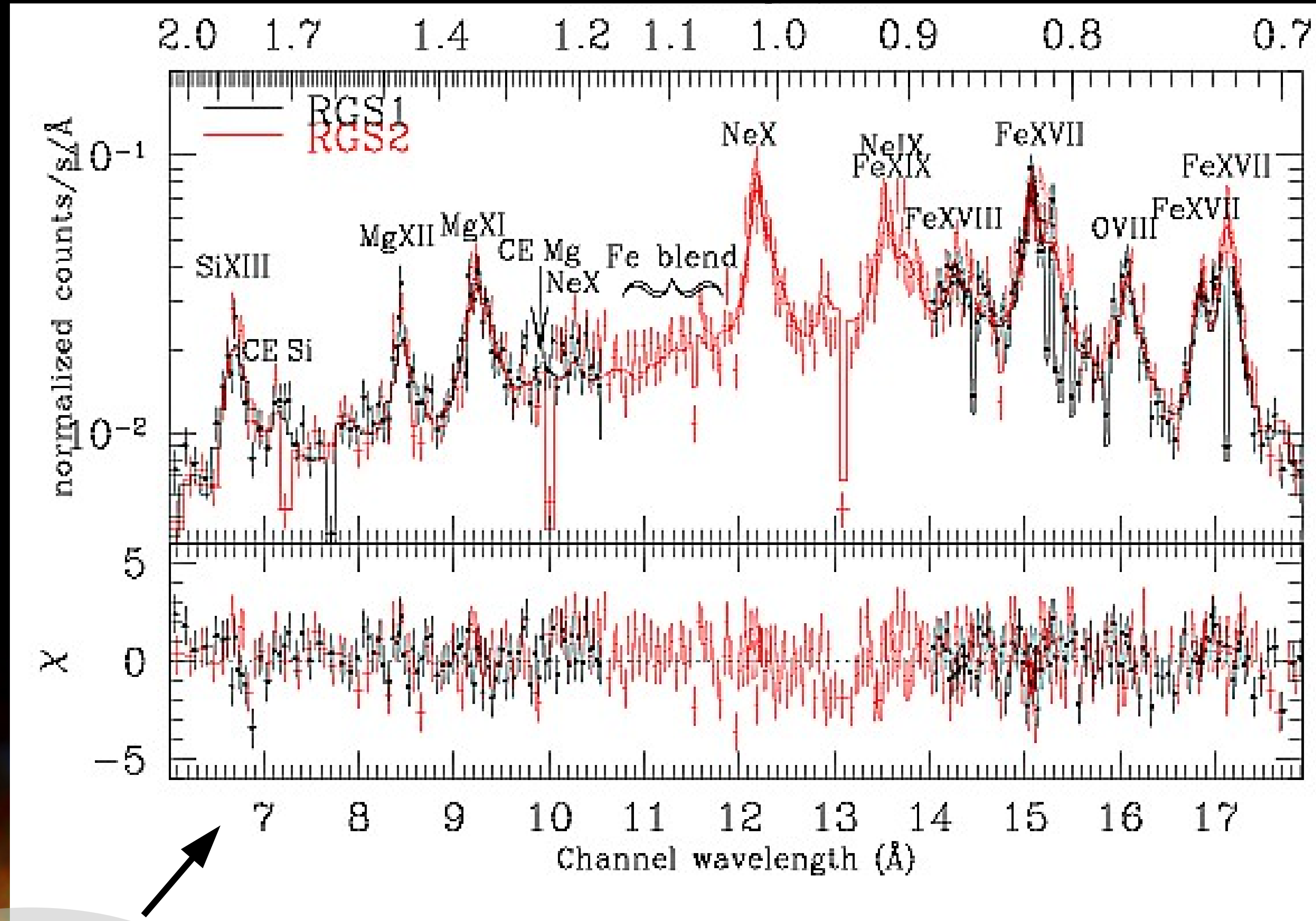
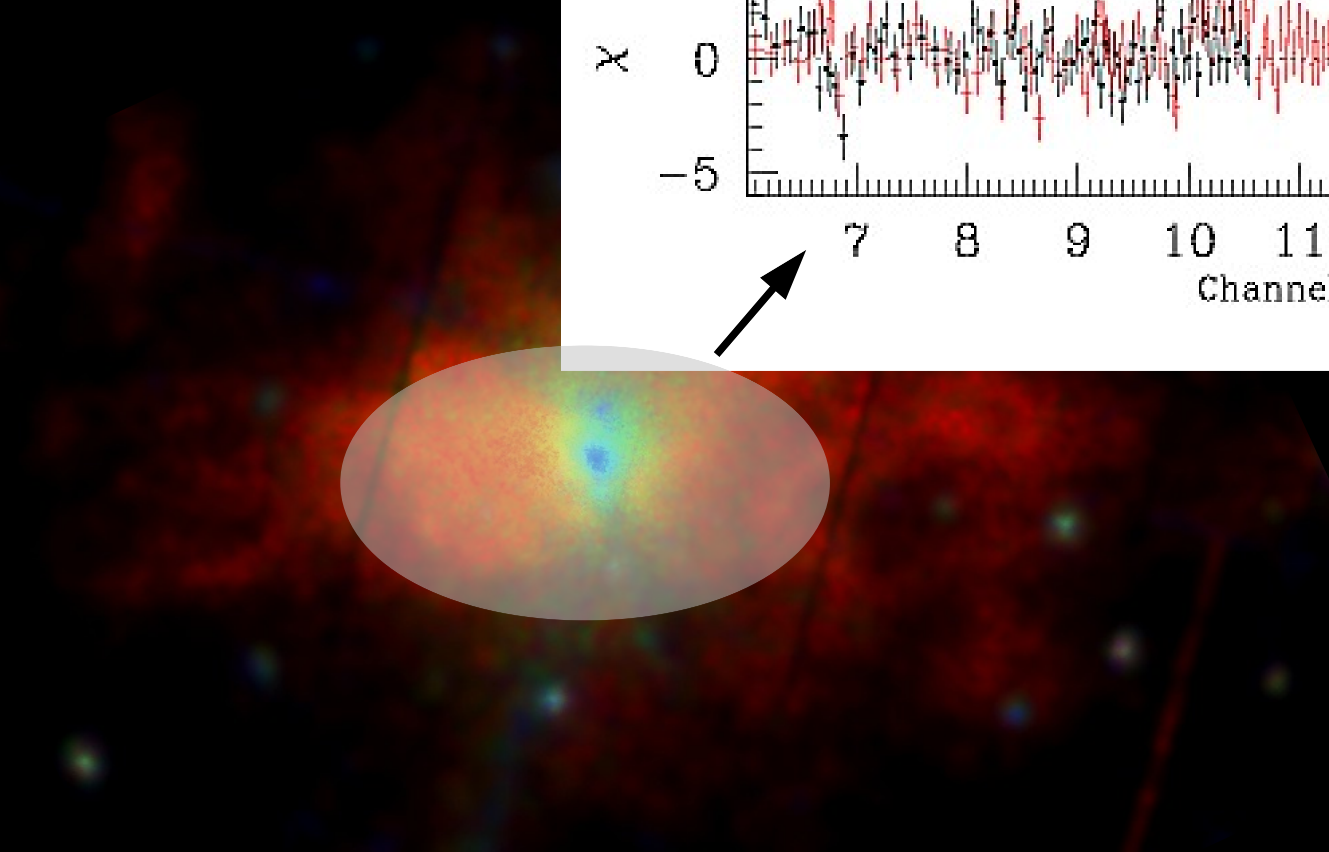
The XMM/RGS has produced a beatiful **average** spectrum which is extremely difficult to analyse

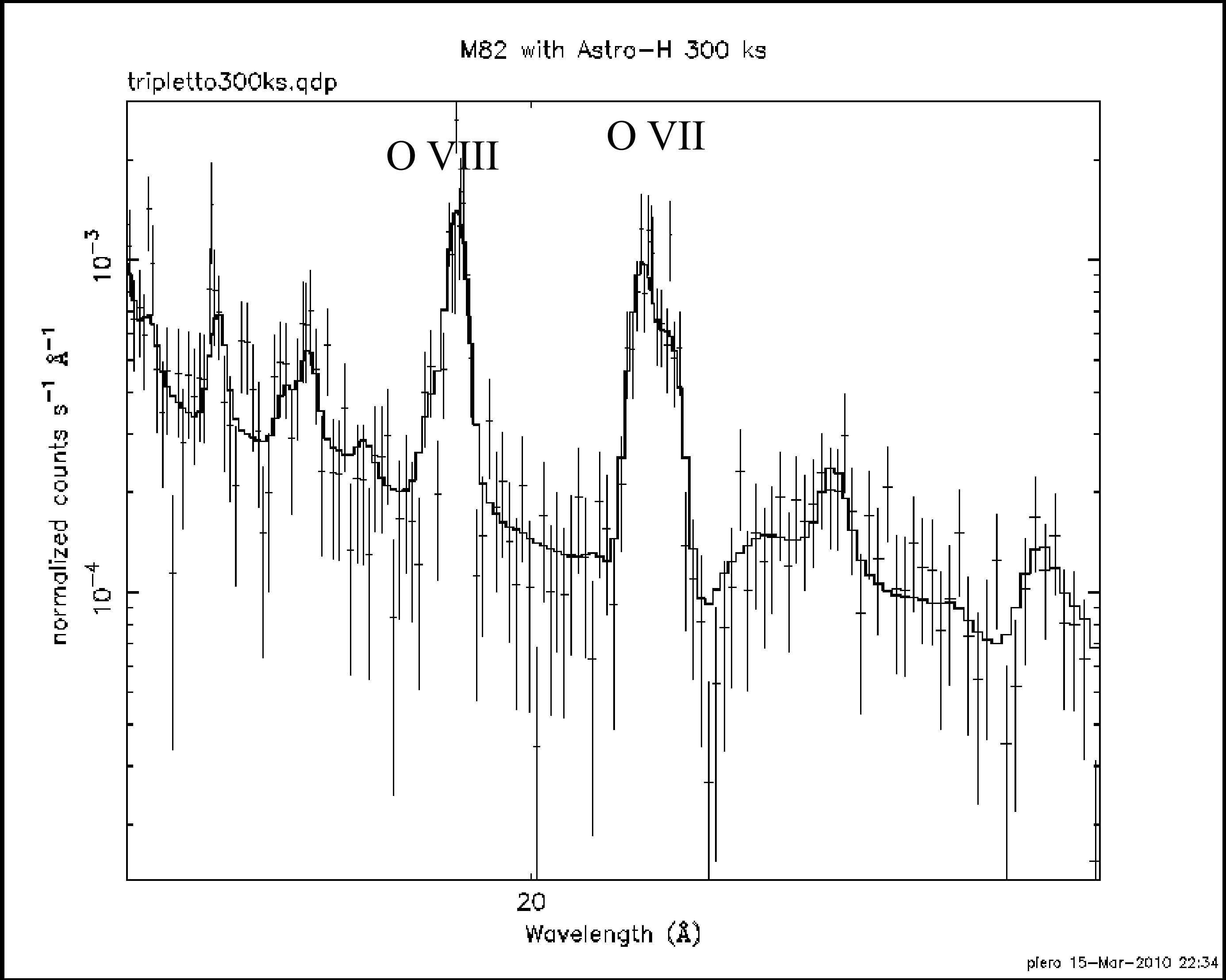




The future / 1 : Astro-H

The calorimeter in development for Astro-H (FOV ~3', ΔE ~7 eV) performs almost like the XMM RGS does for point sources.
Same performance for point and extended sources.

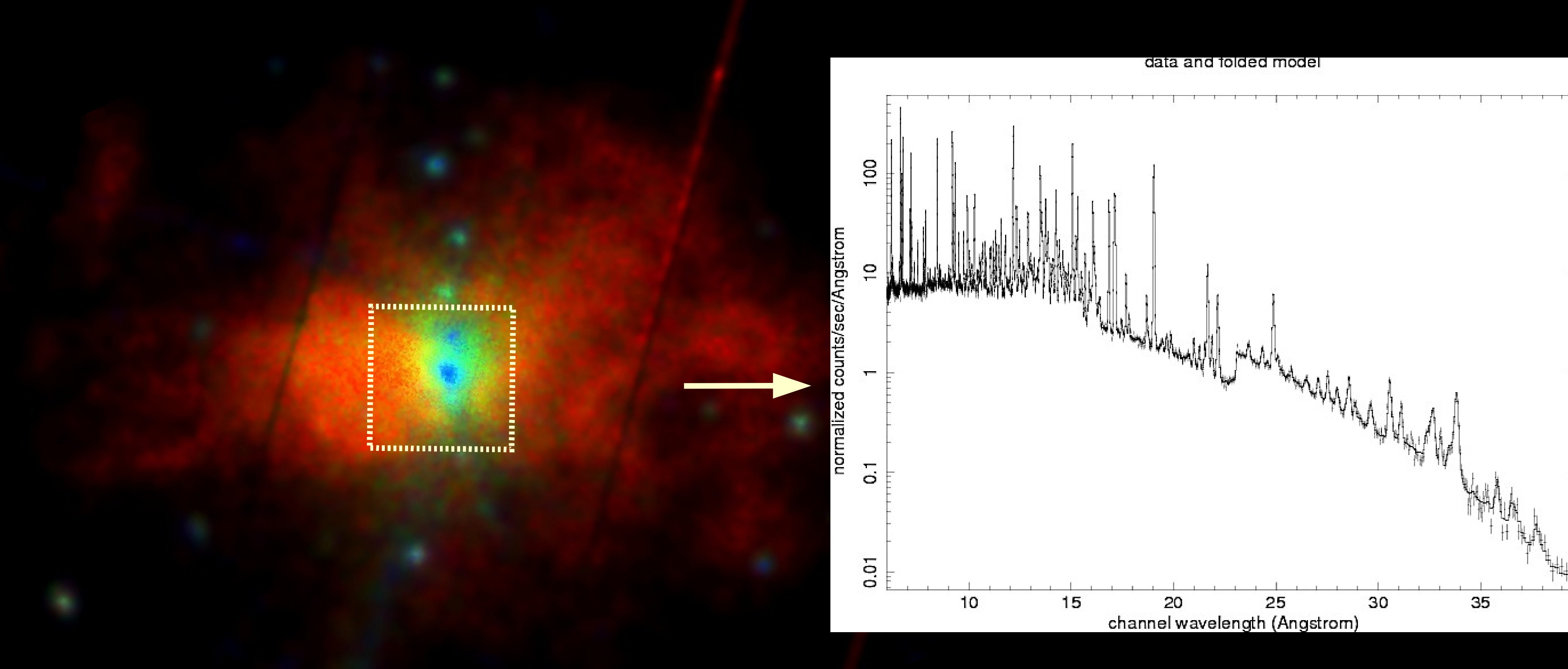
There is sufficient resolution in the OVII triplet to identify the origin (thermal or CE)



The future / 2 : XEUS→Athena···›(Pollon?)

A calorimeter as proposed for Athena (~5' FOV, ΔE~1.5--2.5 eV) performs more or less like the XMM RGS does for point sources **and** allows the separation of different patches of the sky (**and, hopefully, exclude point sources**)

E/ΔE @ 1 keV: EPIC/PN~7 RGS~300 (point sources)
ASTRO-H~150 Athena~400--700



Conclusions:

M82

- chemical abundances depend on distance from the galaxy centre
- shows chemical enhancement in the far outflow
- bimodal temperature distribution => nonthermal electrons?
- detection of CE
- O cooling by CE?

NGC3256

- spectrum shows CE on top of thermal
- super-solar abundances => can compare with stellar (NIR data available)

NGC253

- α/Fe ~ 1.2
- blueshifts in the outflow