

Turbulence measurements in two giant elliptical galaxies

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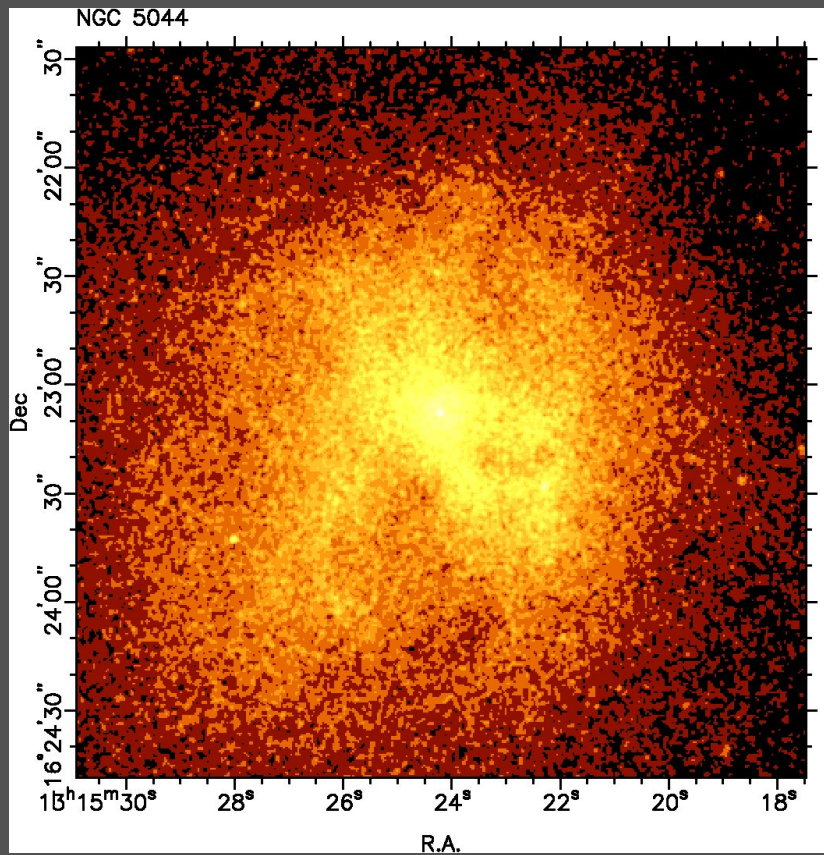
SRON

Netherlands Institute for Space Research

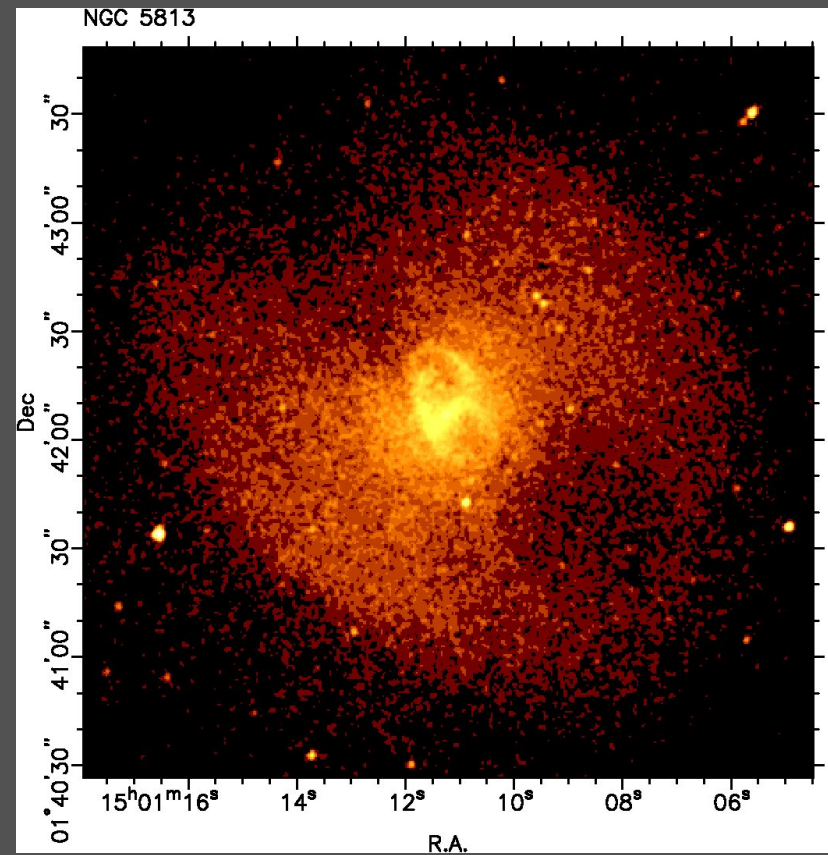
Netherlands Organisation for Scientific Research (NWO)

Resonant scattering in groups of galaxies

NGC 5044

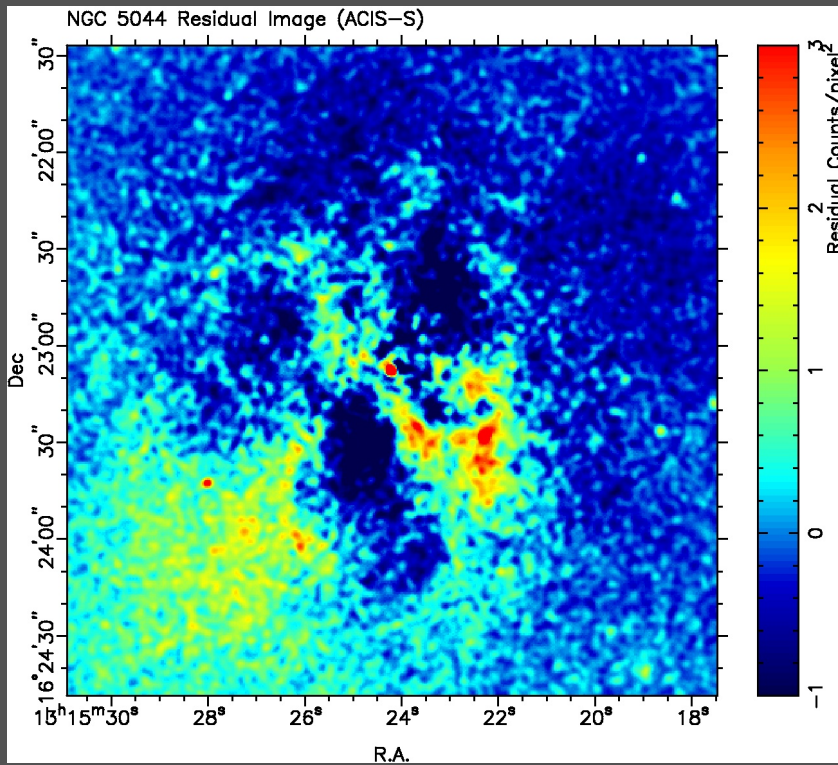


NGC 5813

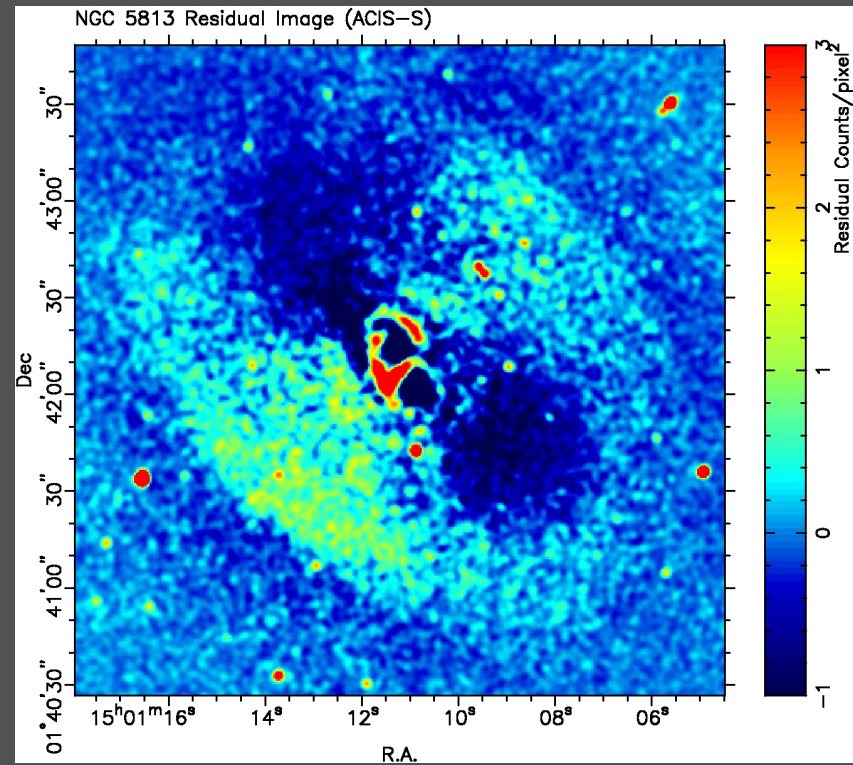


Chandra unsharp mask images

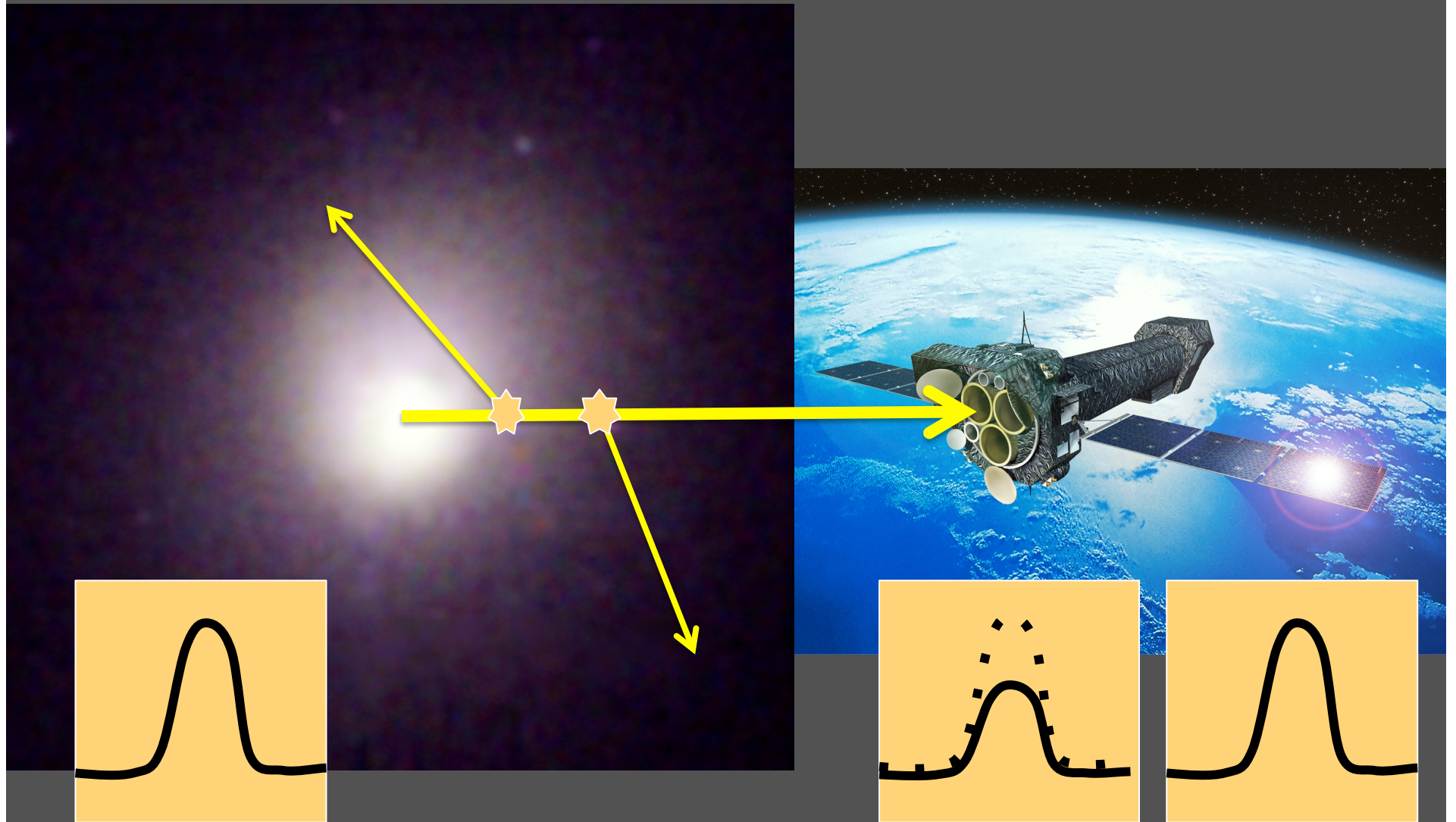
NGC 5044



NGC 5813



Resonance scattering in optically thick lines

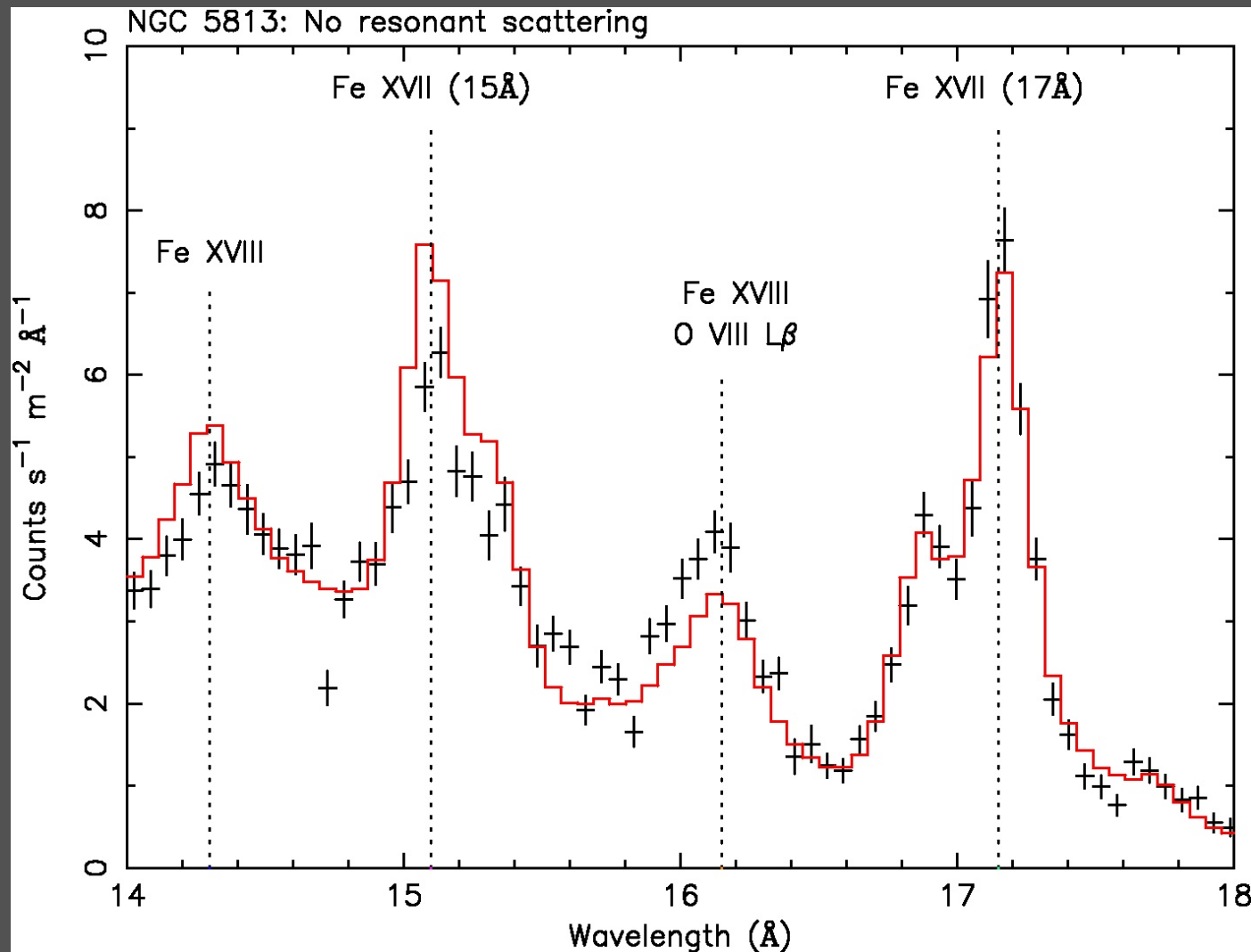


SRON

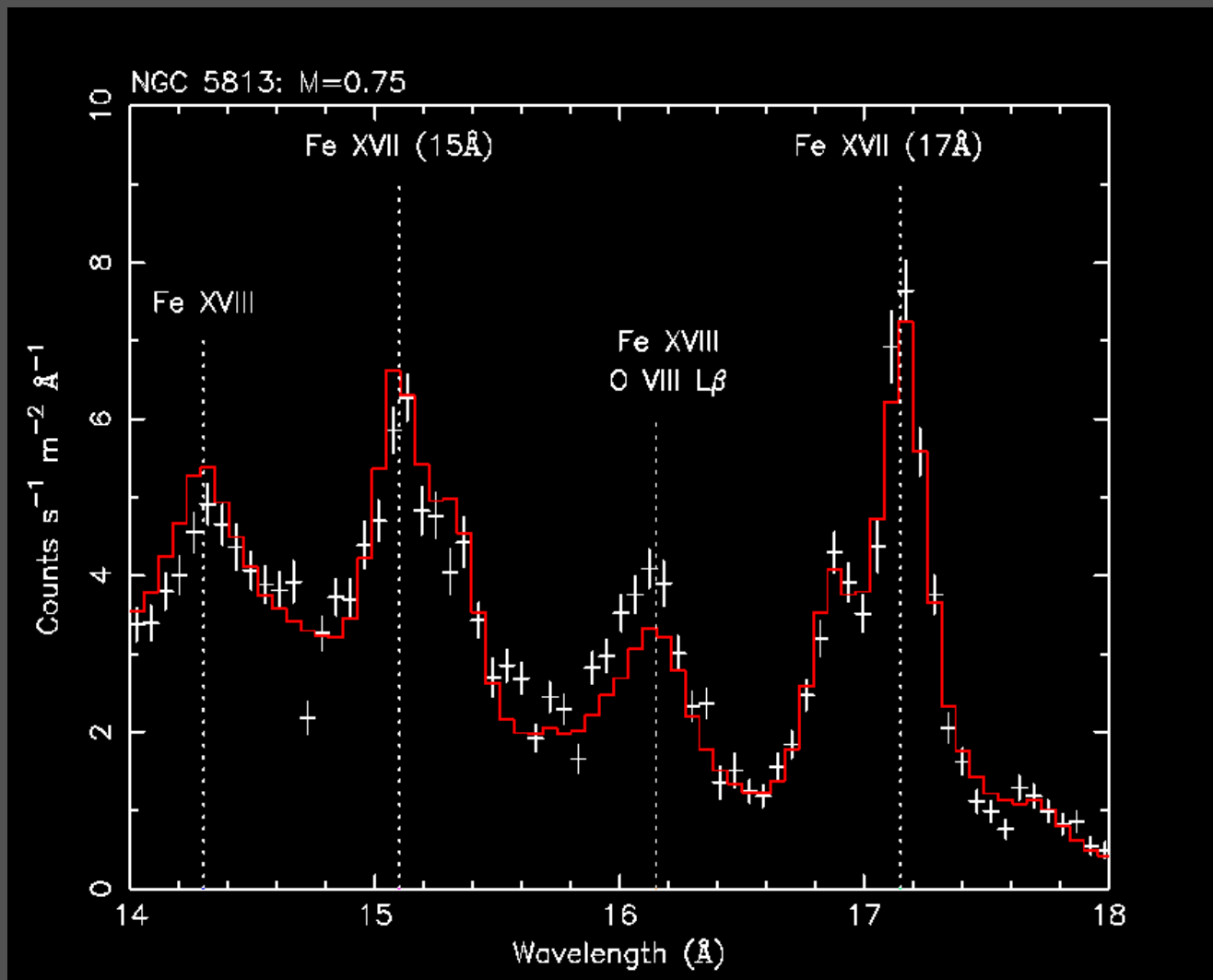
No turbulence

turbulence

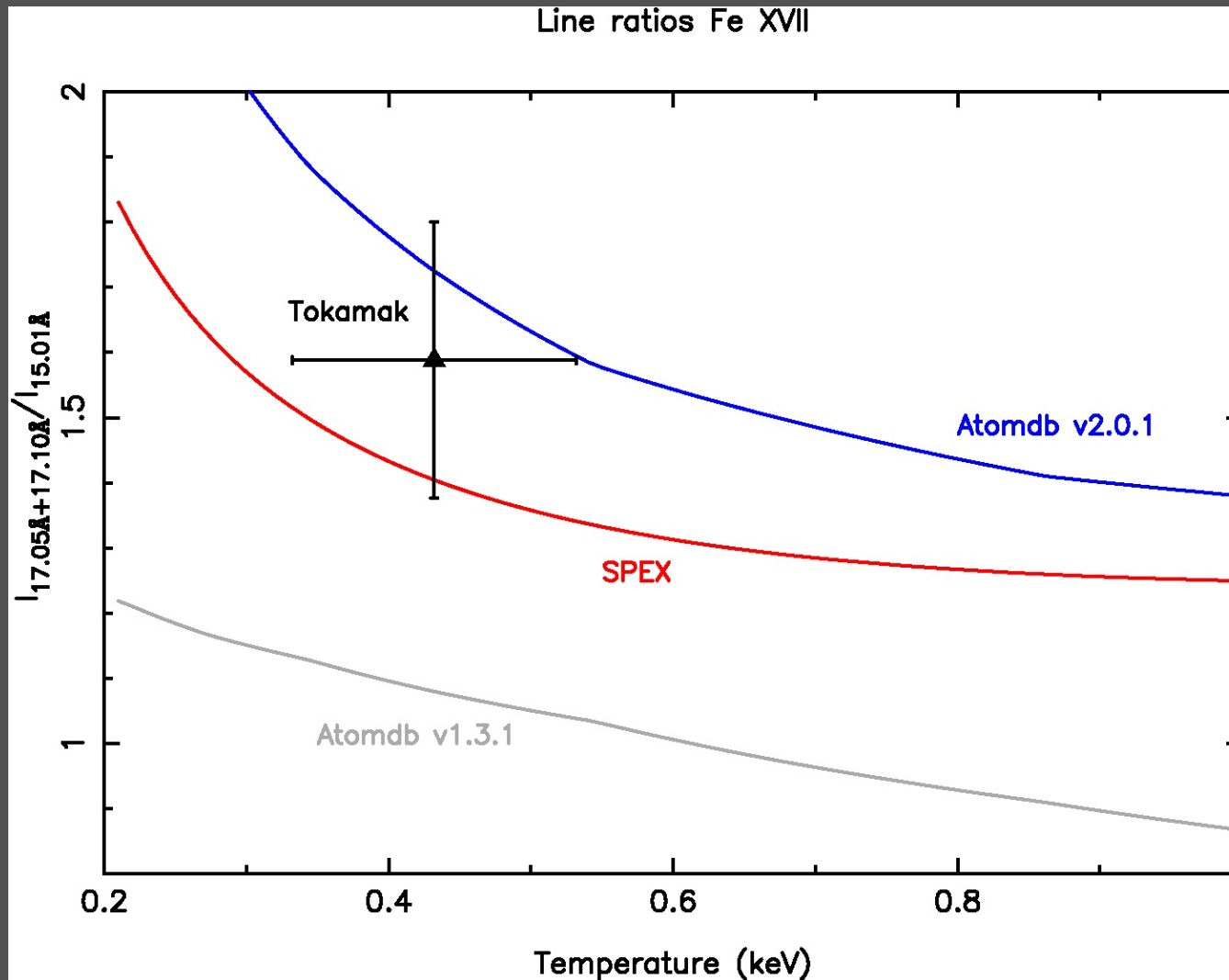
Resonant scattering of Fe XVII lines through RGS



Turbulent velocity and 15A line suppression



Theoretical & measured Fe XVII line ratios

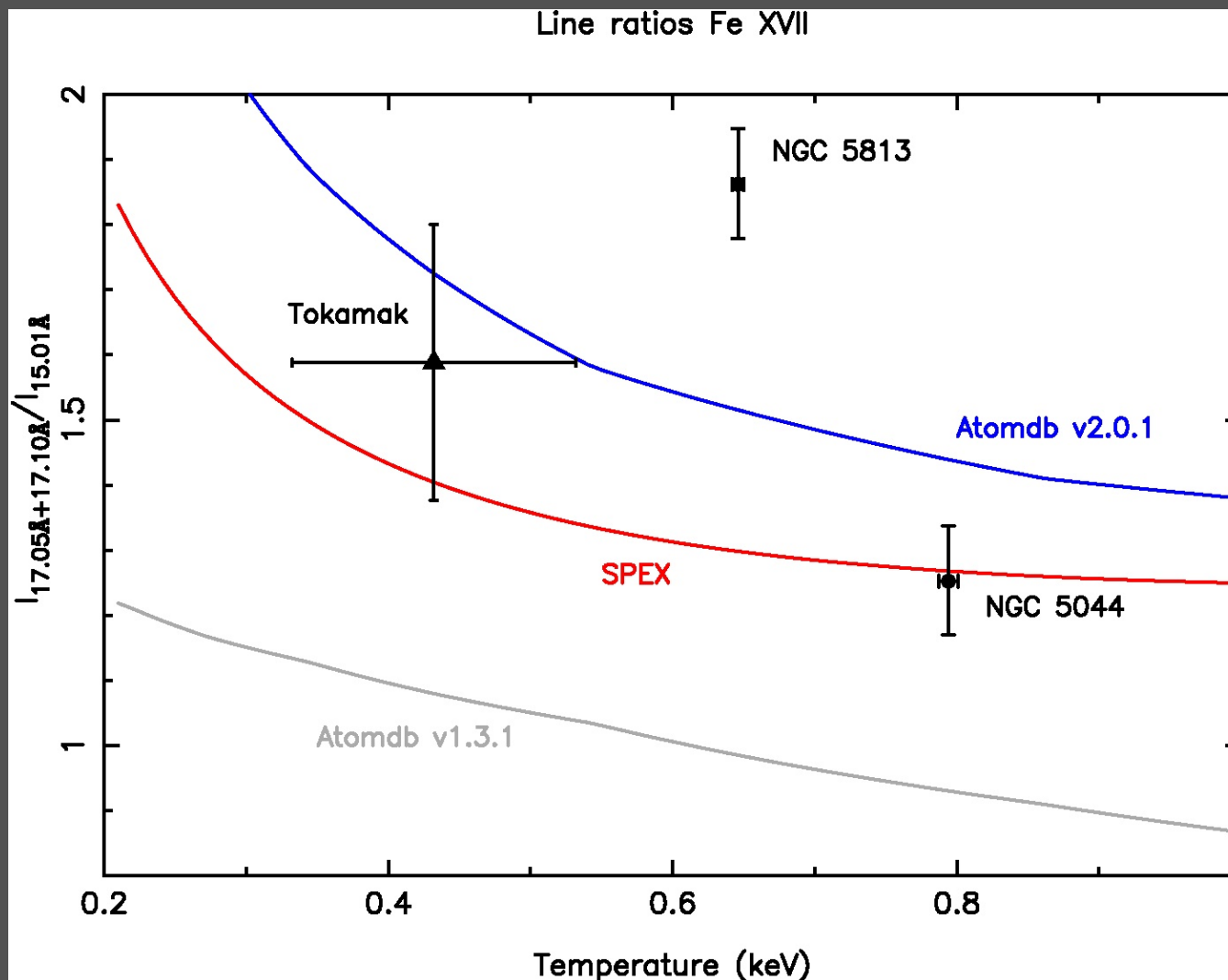


Theoretical line ratios Fe XVII (17A/15A)

- **Atomdb 1.3.1**: 'basic' di-electronic recombination (DR) & radiative recombination (RR)
- **Mekal (Xspec)**: DR & RR estimated through scaling laws
- **Mekal (SPEX)**: DR & RR included (Doron & Behar 2002)
- **Atomdb 2.0.1**: DR & RR included (calculated internally)

Differences between models do not arise from DR & RR alone

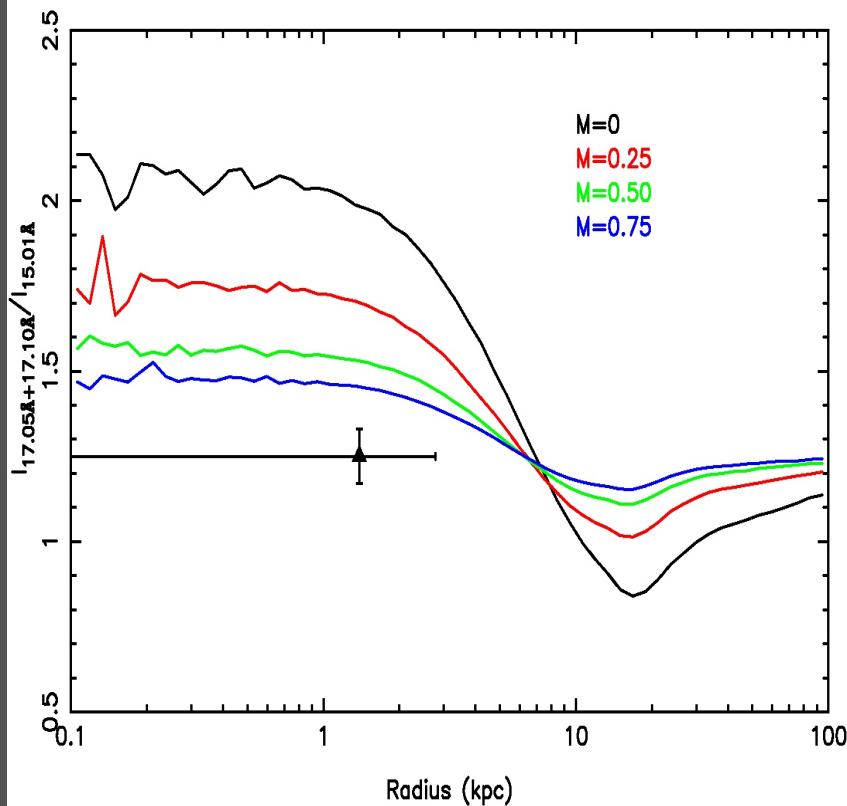
NGC 5813 & NGC 5044 line ratios



Modeling resonant scattering

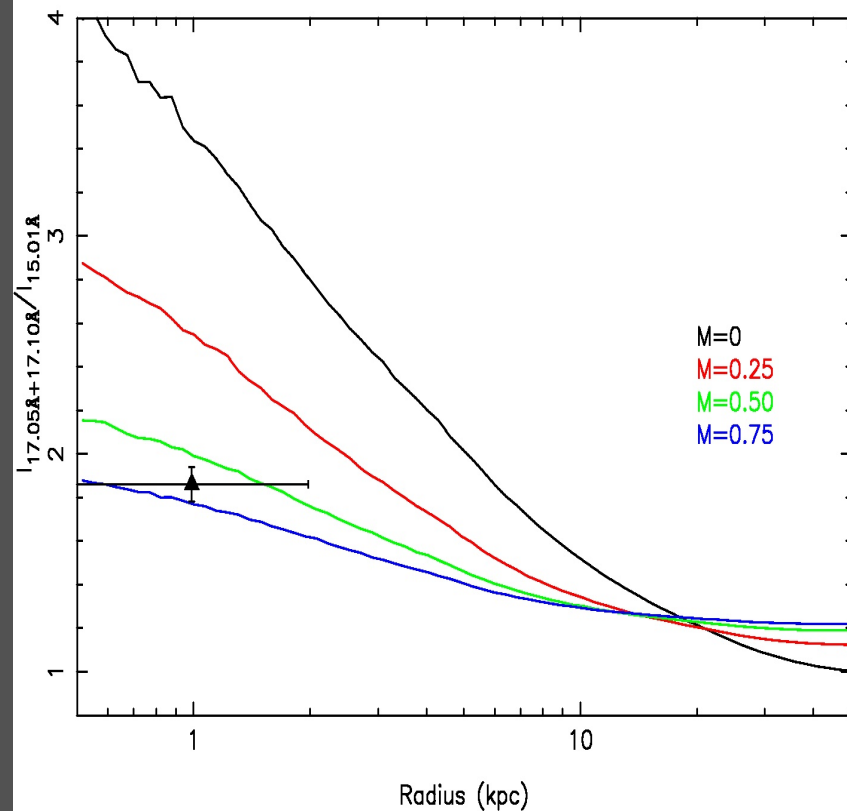
NGC 5044

NGC 5044 Model Fe XVII ratios



NGC 5813

NGC 5813 Model Fe XVII ratios



Velocity estimates assuming Doron & Behar line ratios

Parameter	NGC 5044	NGC 5813
Sound speed	~460 km/s	~420 km/s
Line width (90% conf)	< 775 km/s	< 500 km/s
Resonant scattering	> 230 km/s	250 ± 100 km/s

Warning: preliminary numbers!

Conclusions

- Turbulence in NGC 5044 and NGC 5813 constrained
 - NGC 5044: $230 < v_{\text{turb}} < 775$ km/s
 - NGC 5813: 250 ± 100 km/s
- Connection to group morphology – sloshing/swirling
- Mekal/Atomdb 1.3.1: ‘basic’ DR and RR underestimate ratio
- Atomdb 2.0.1: Appears to overestimate line ratio (2 sig. level)
- Doron & Behar 2002 reasonable estimate (Fe XVII 17/15 A)