A deep XMM observation of M82

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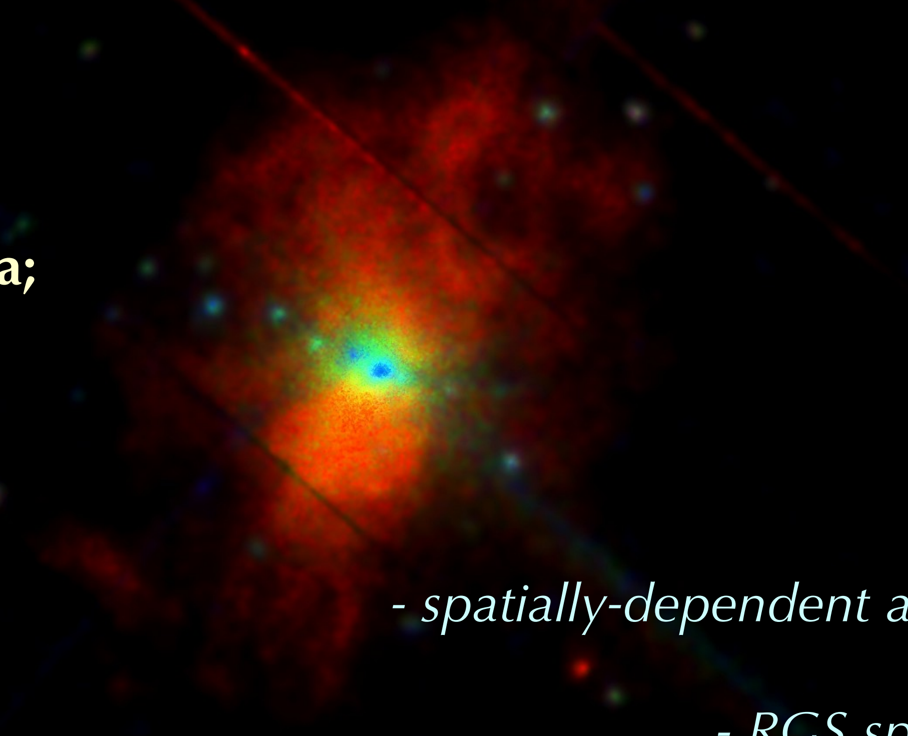
special thanks to:
K. Makishima (Tokyo)



Outline:

- spatially-dependent abundances

- RGS spectroscopy

- bimodal temperature distribution

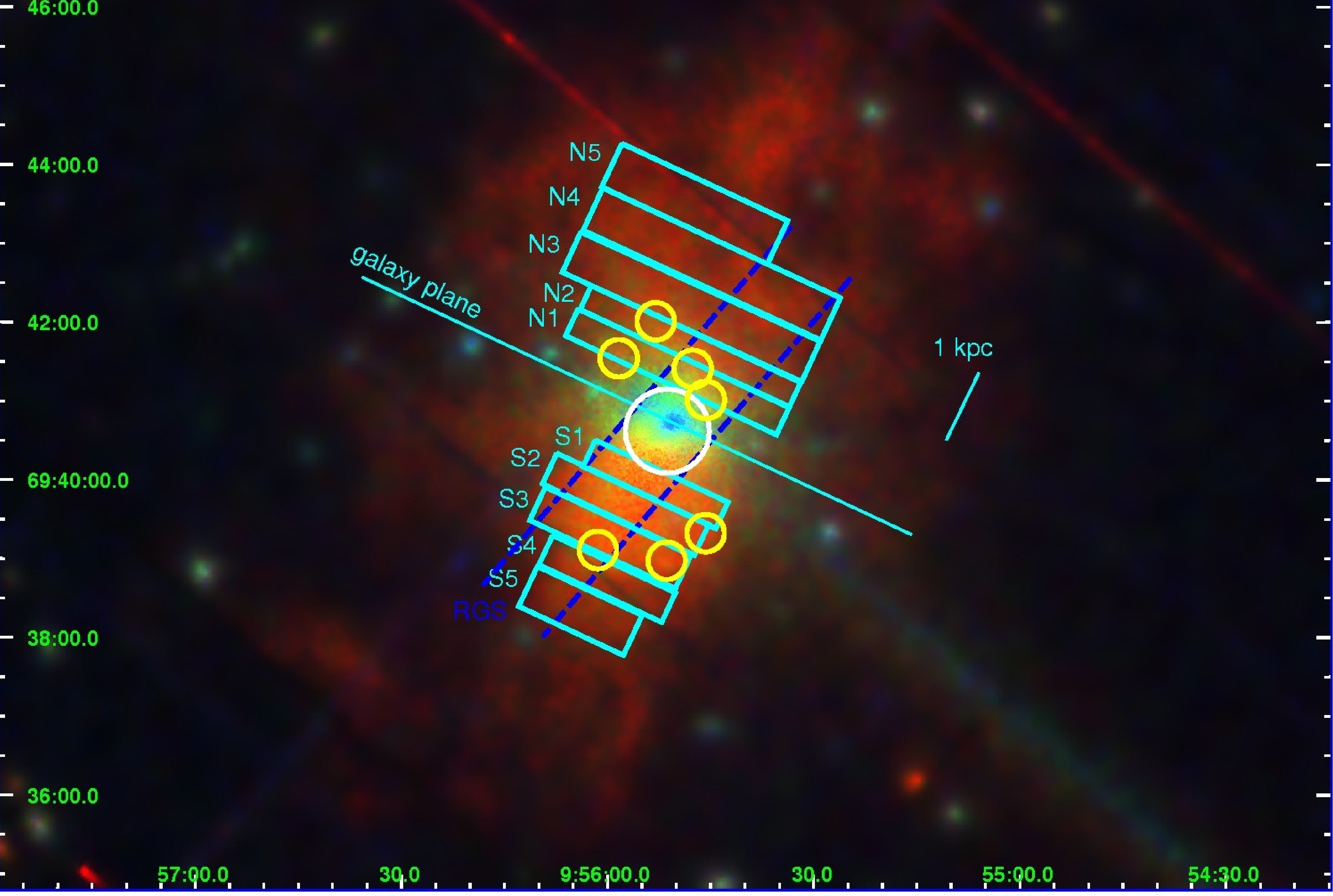
- charge-exchange

for all details, see paper:
MNRAS 386 (2008), 1464

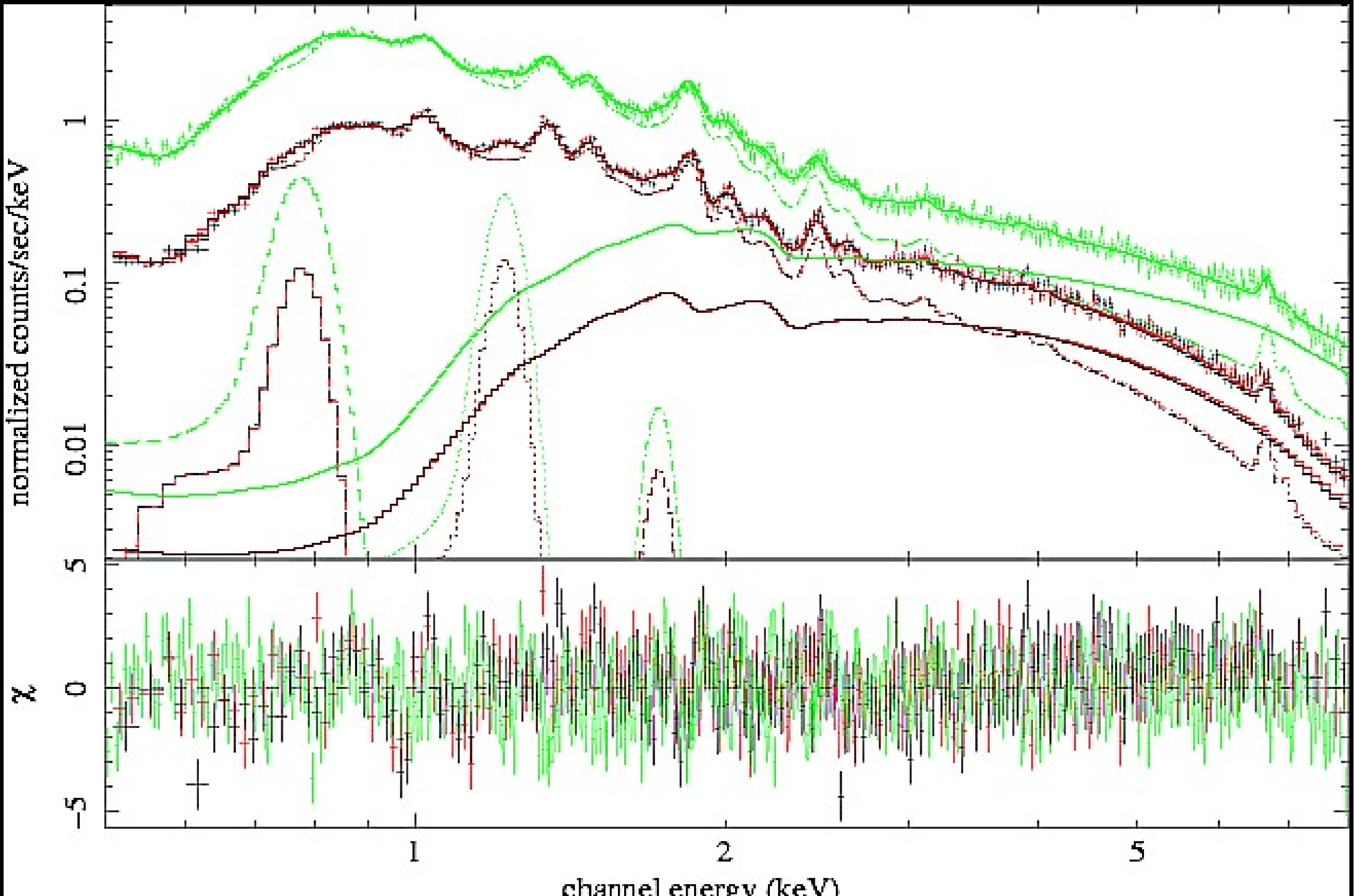
Please meet M82!

optical image by Subaru telescope

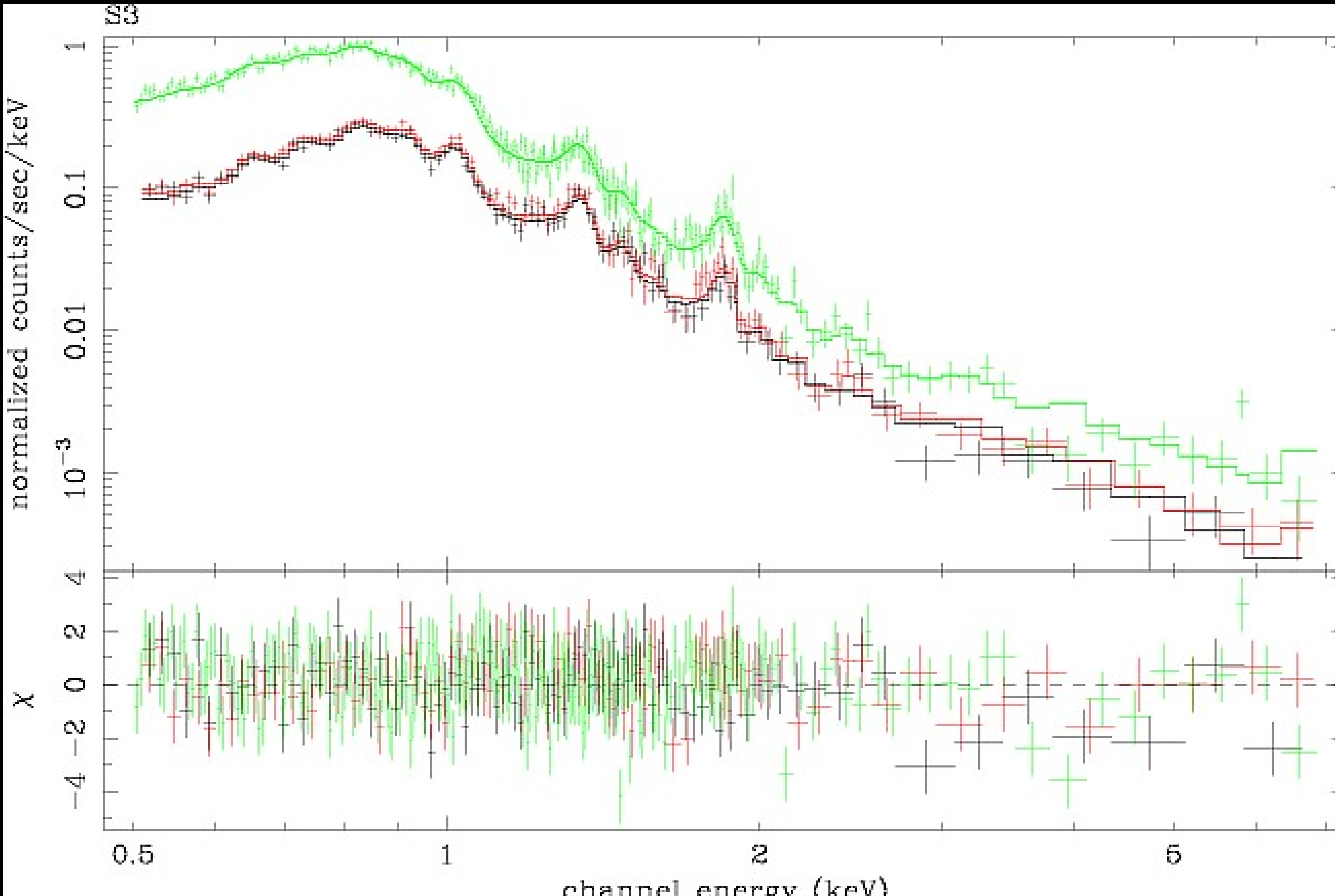
Spatially resolved spectroscopy with EPIC



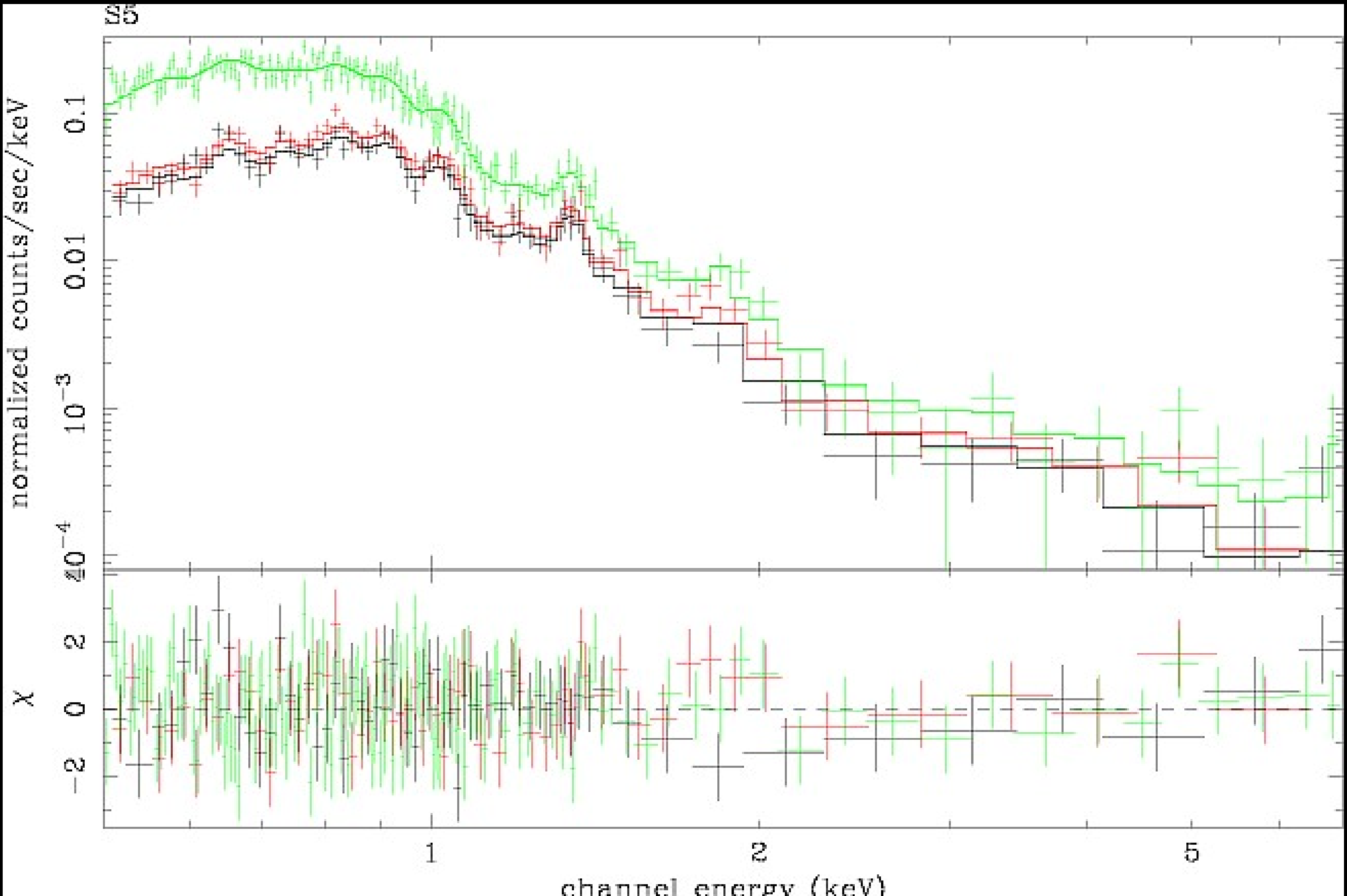
Gallery of spectra: centre ($4 \cdot 10^5$ counts)



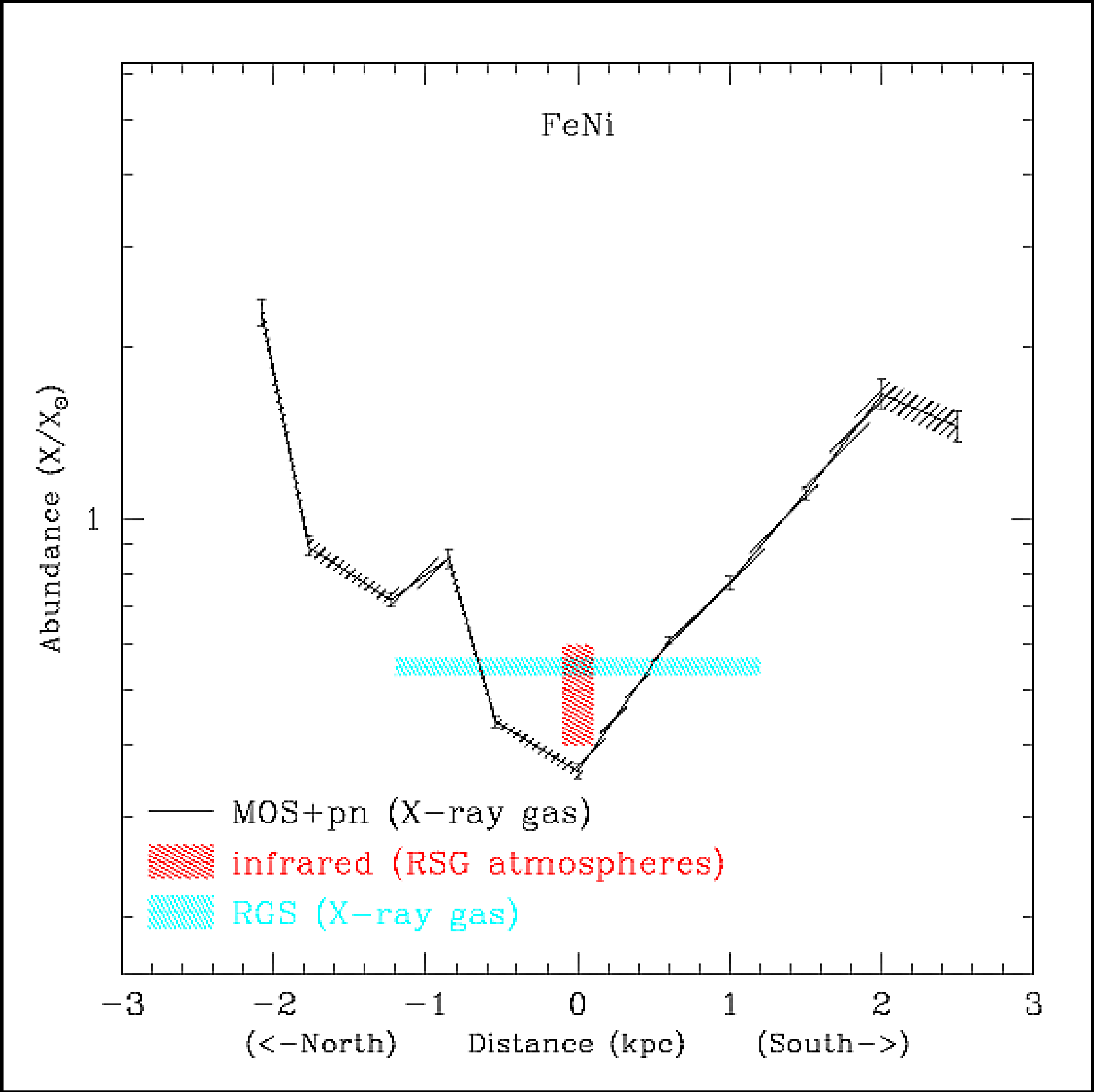
Gallery of spectra: S3 ($5 \cdot 10^4$ counts)



Gallery of spectra: S5 ($1.5 \cdot 10^4$ counts)



Abundances depend on height above the galaxy plane



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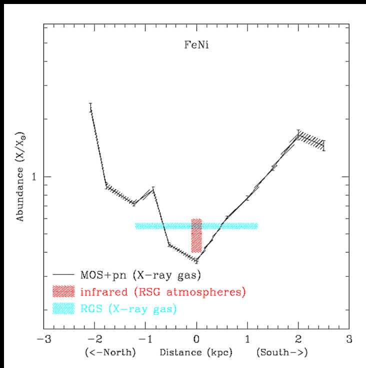

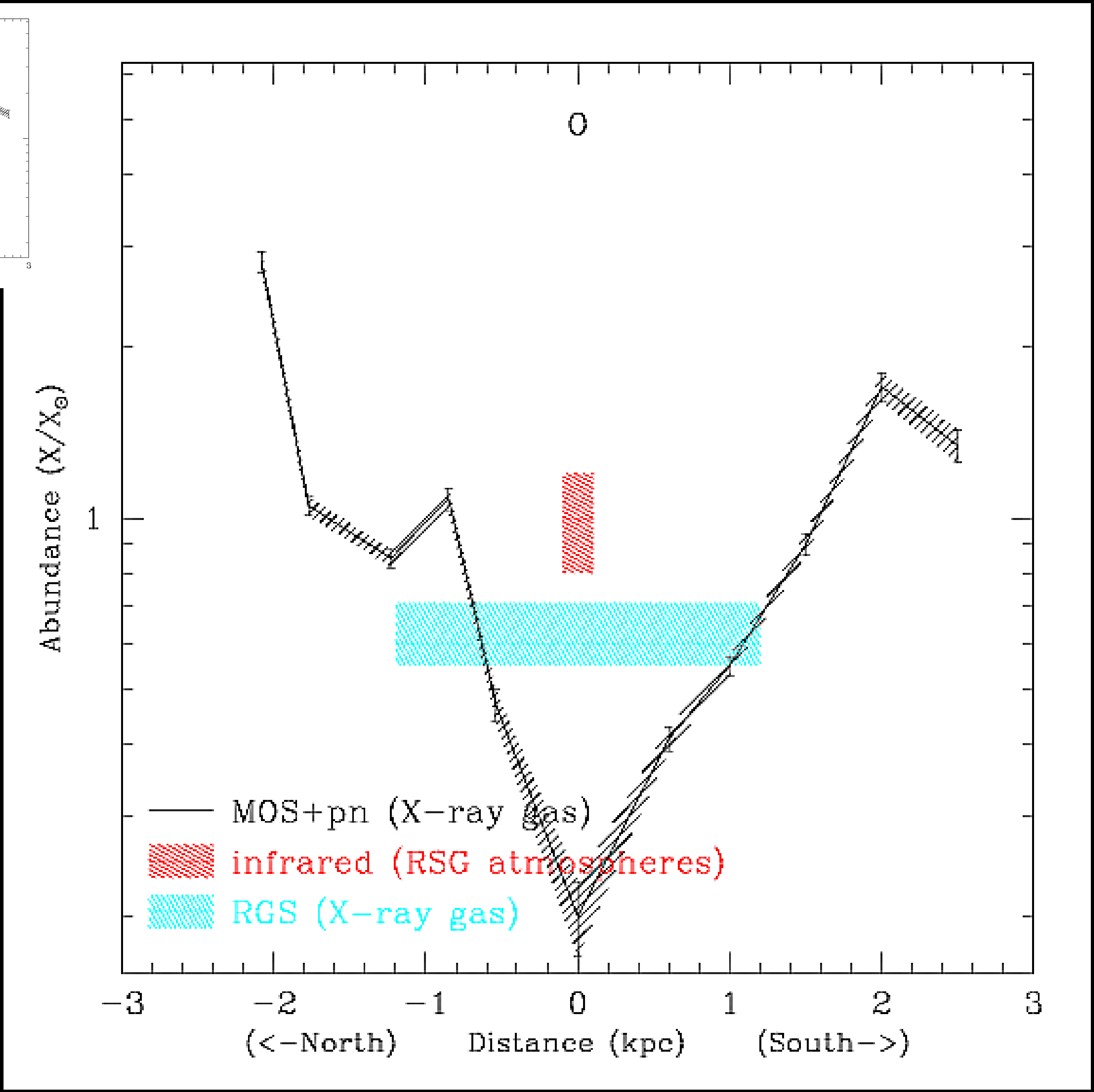

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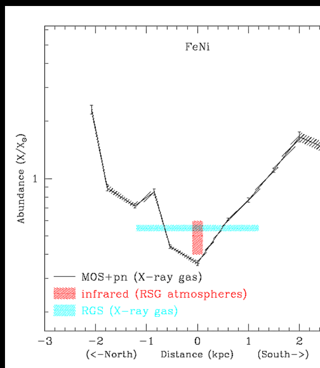

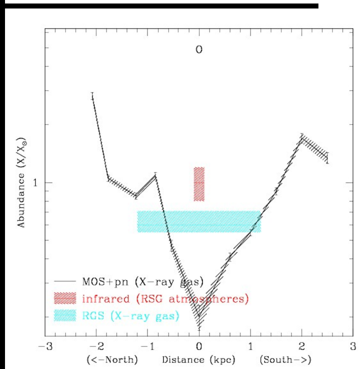

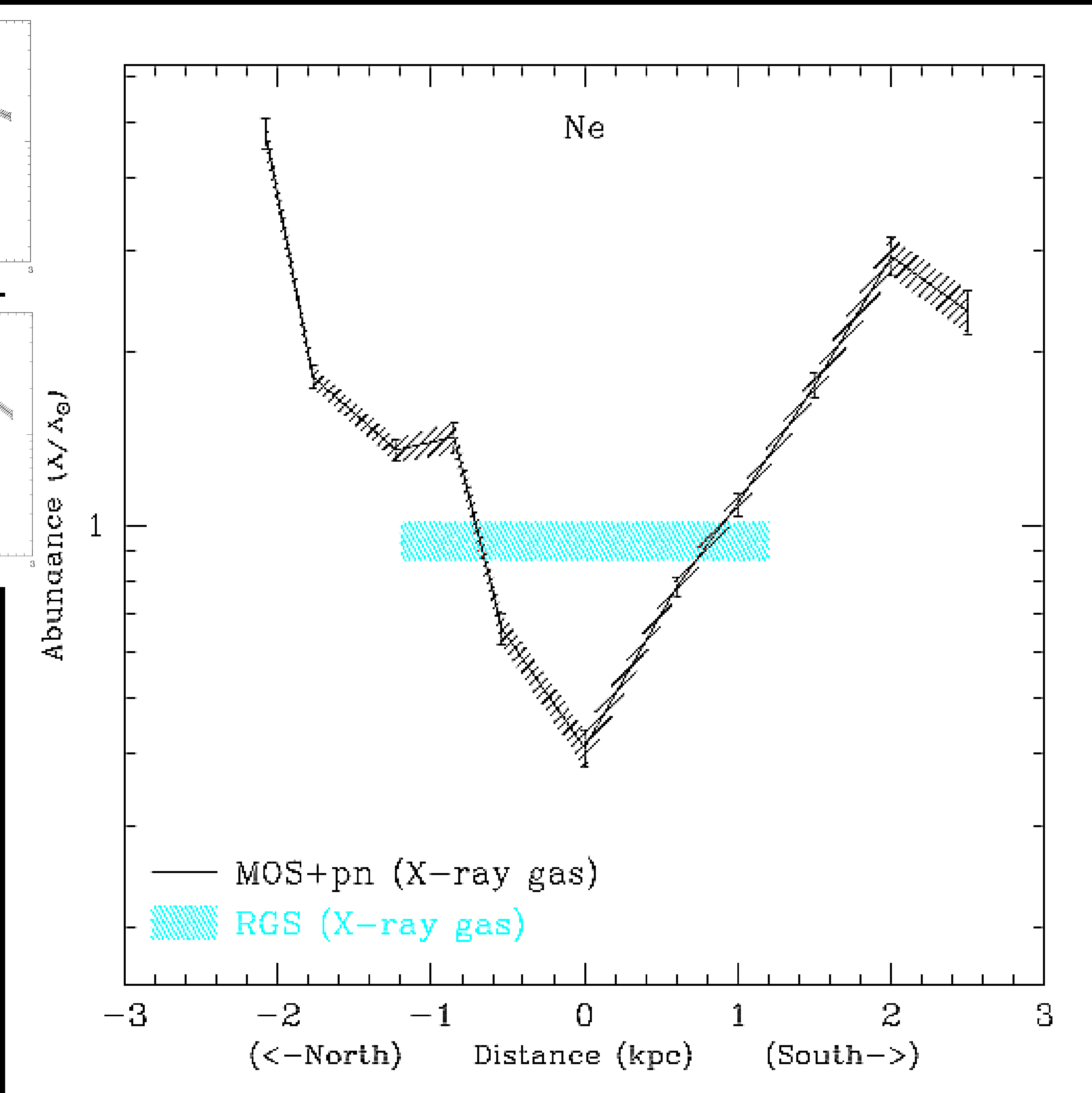

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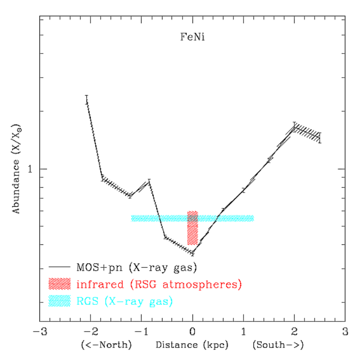

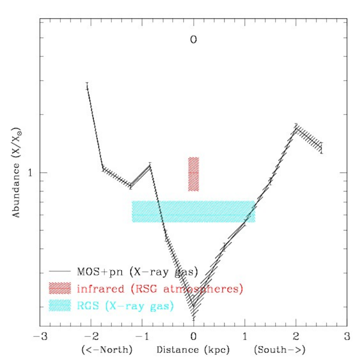

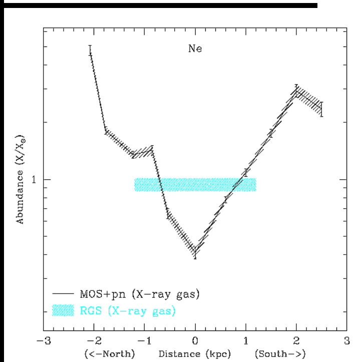

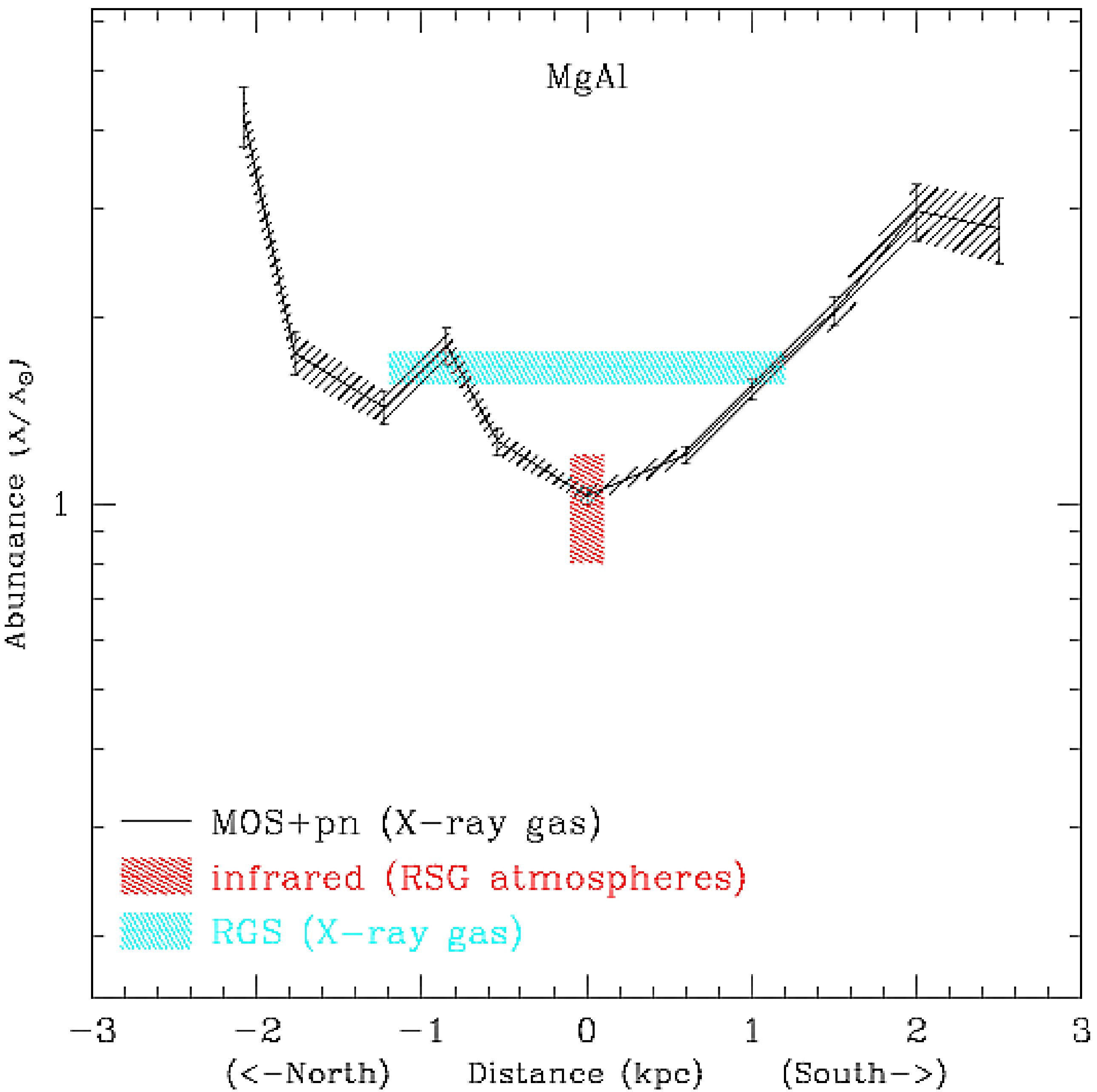

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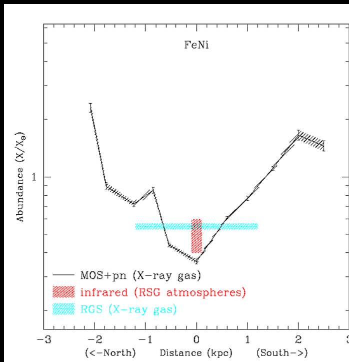

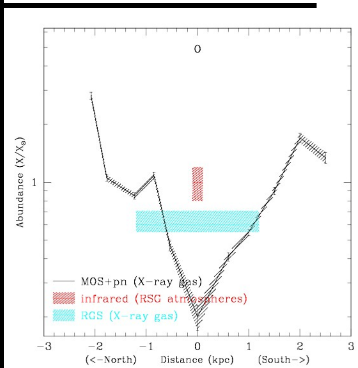

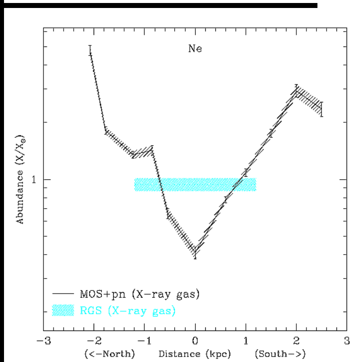

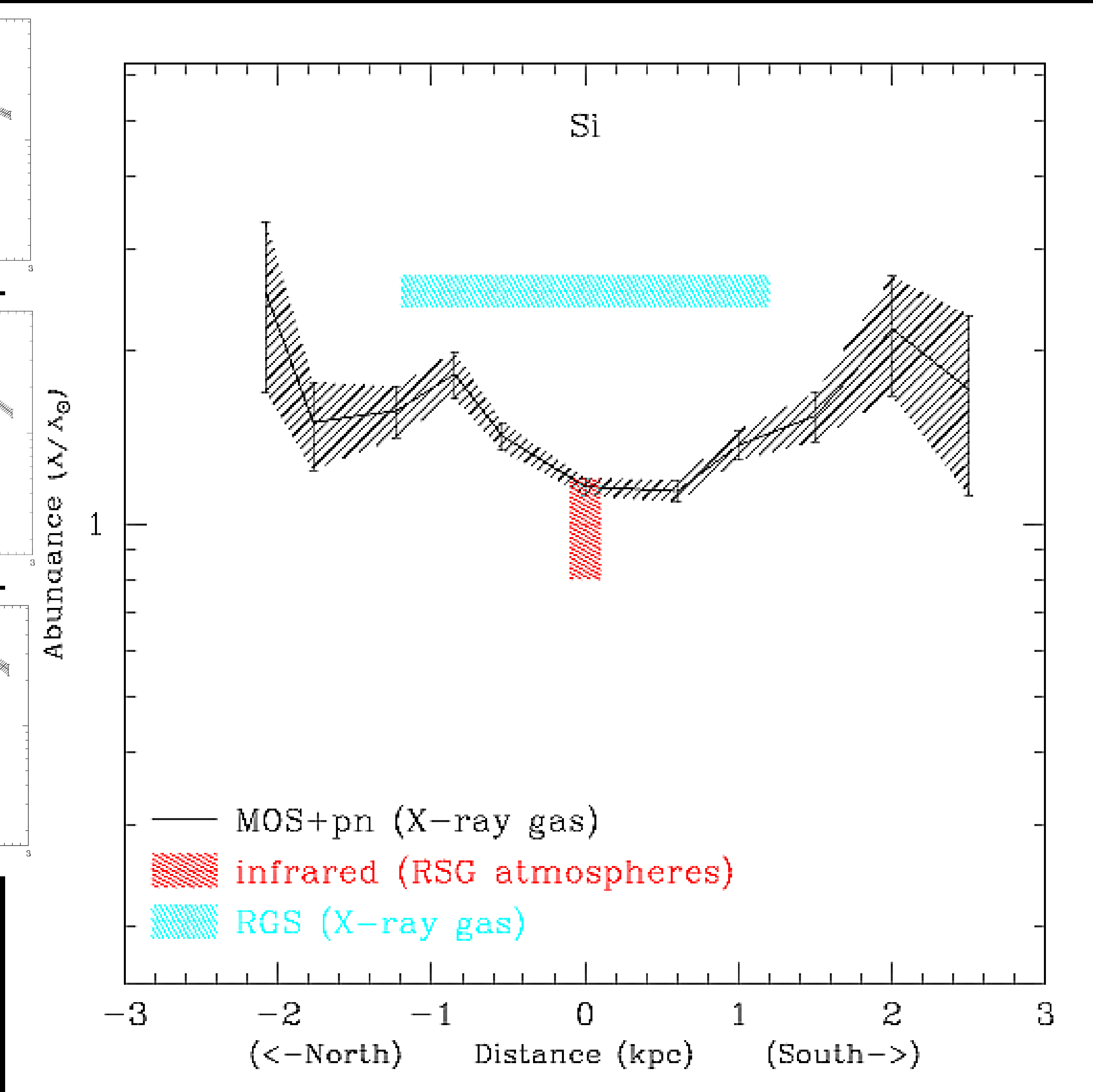

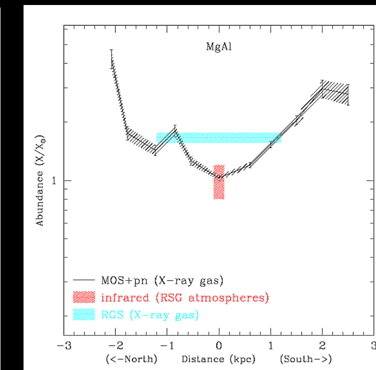

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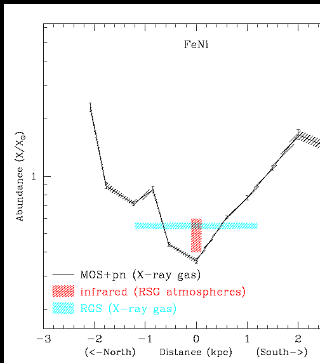
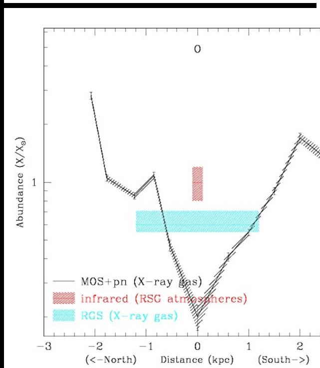
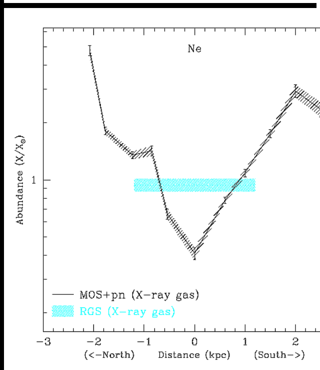
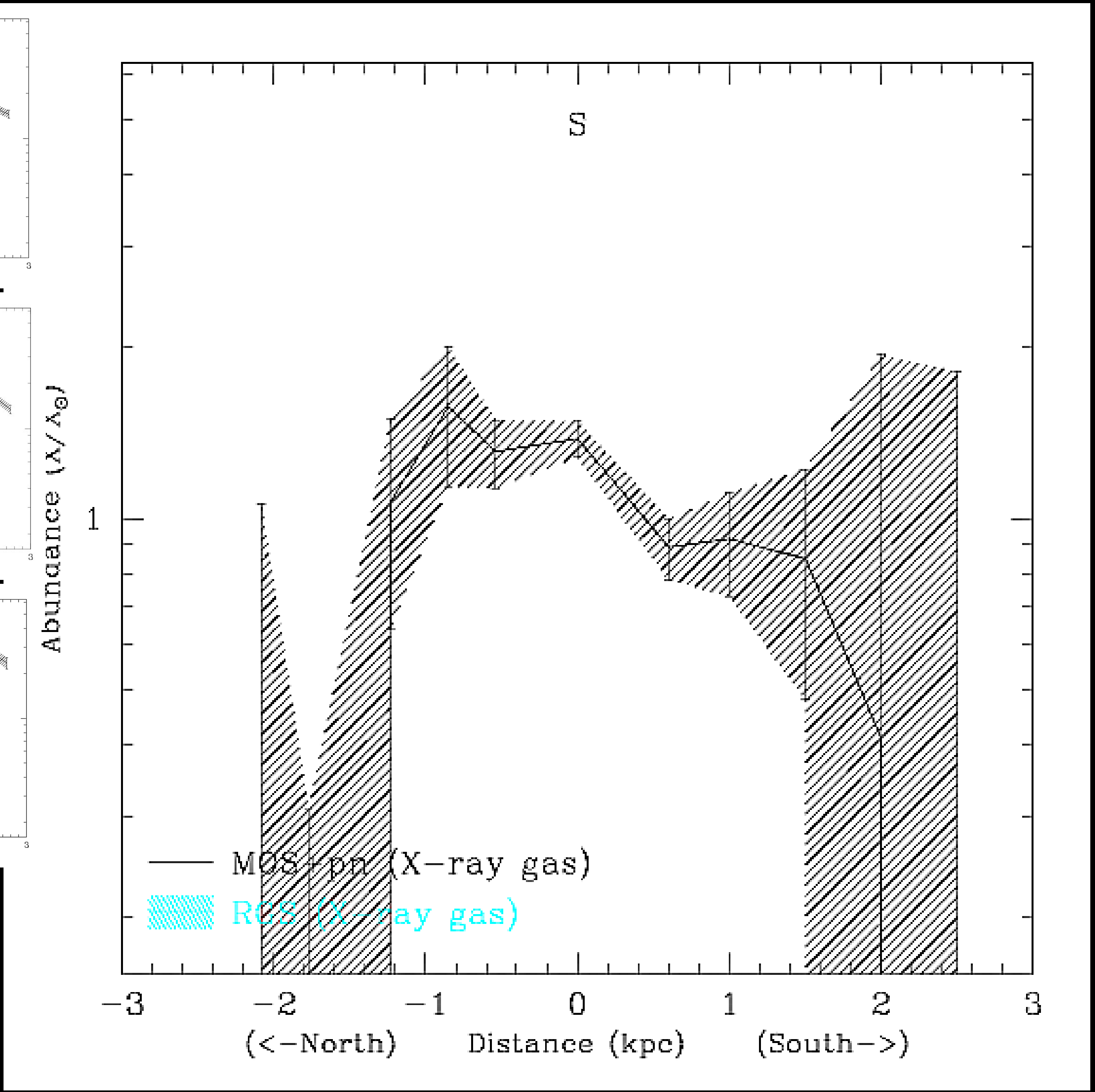
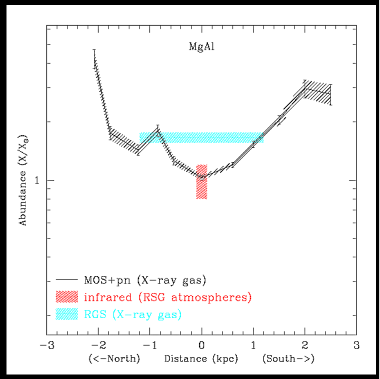
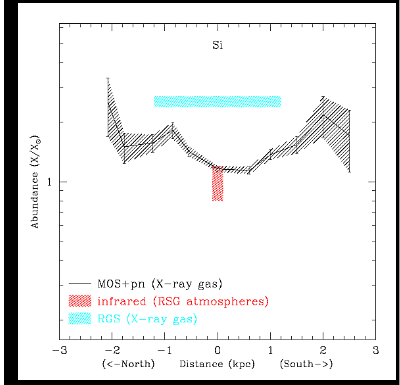


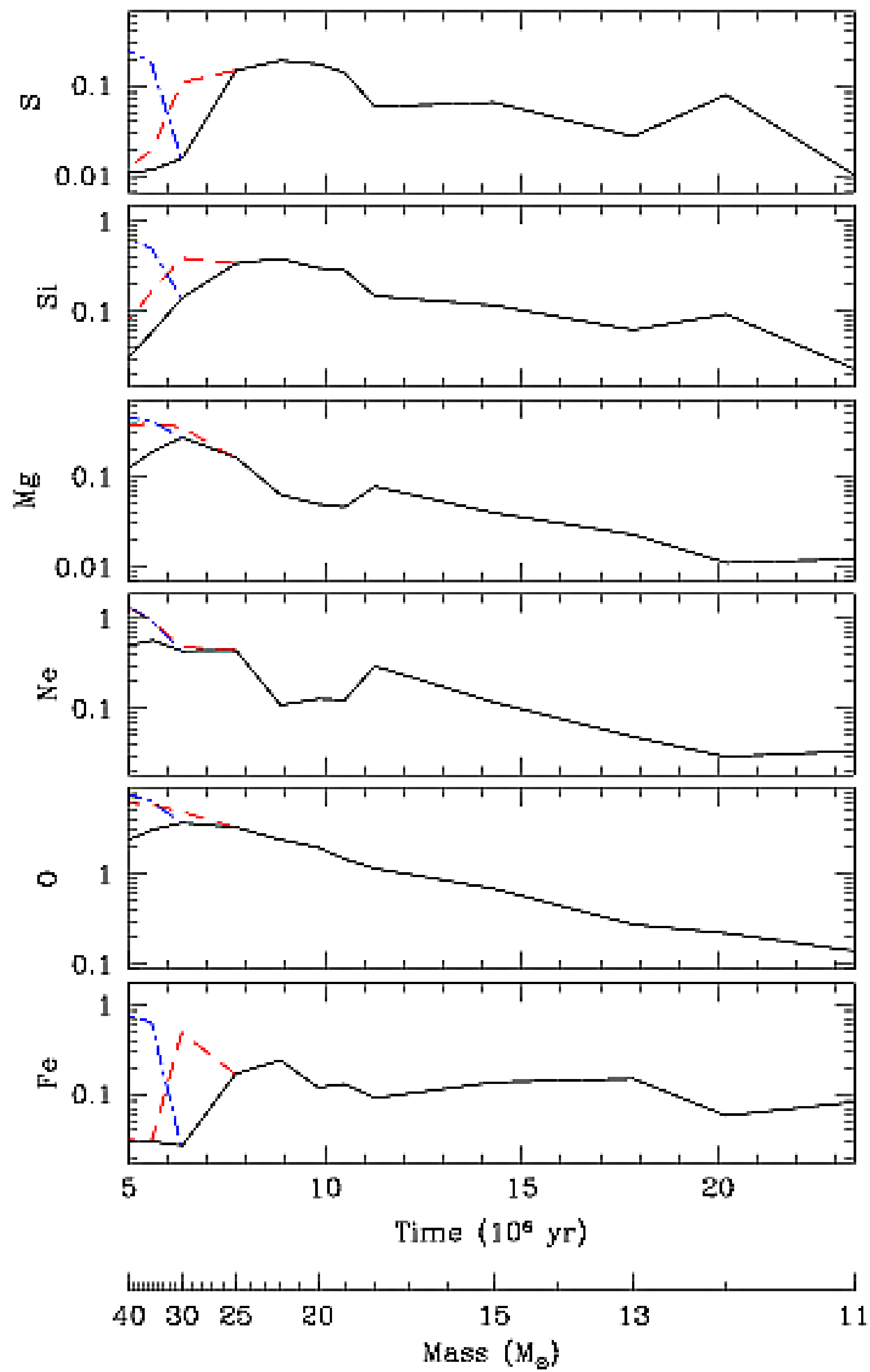












Interpretation framework:

SN yields as a function of progenitor's lifetime, from Woosley & Weaver 95.

most massive stars explode first

⬇

their ejecta can be found furthest in the outflow

⬇

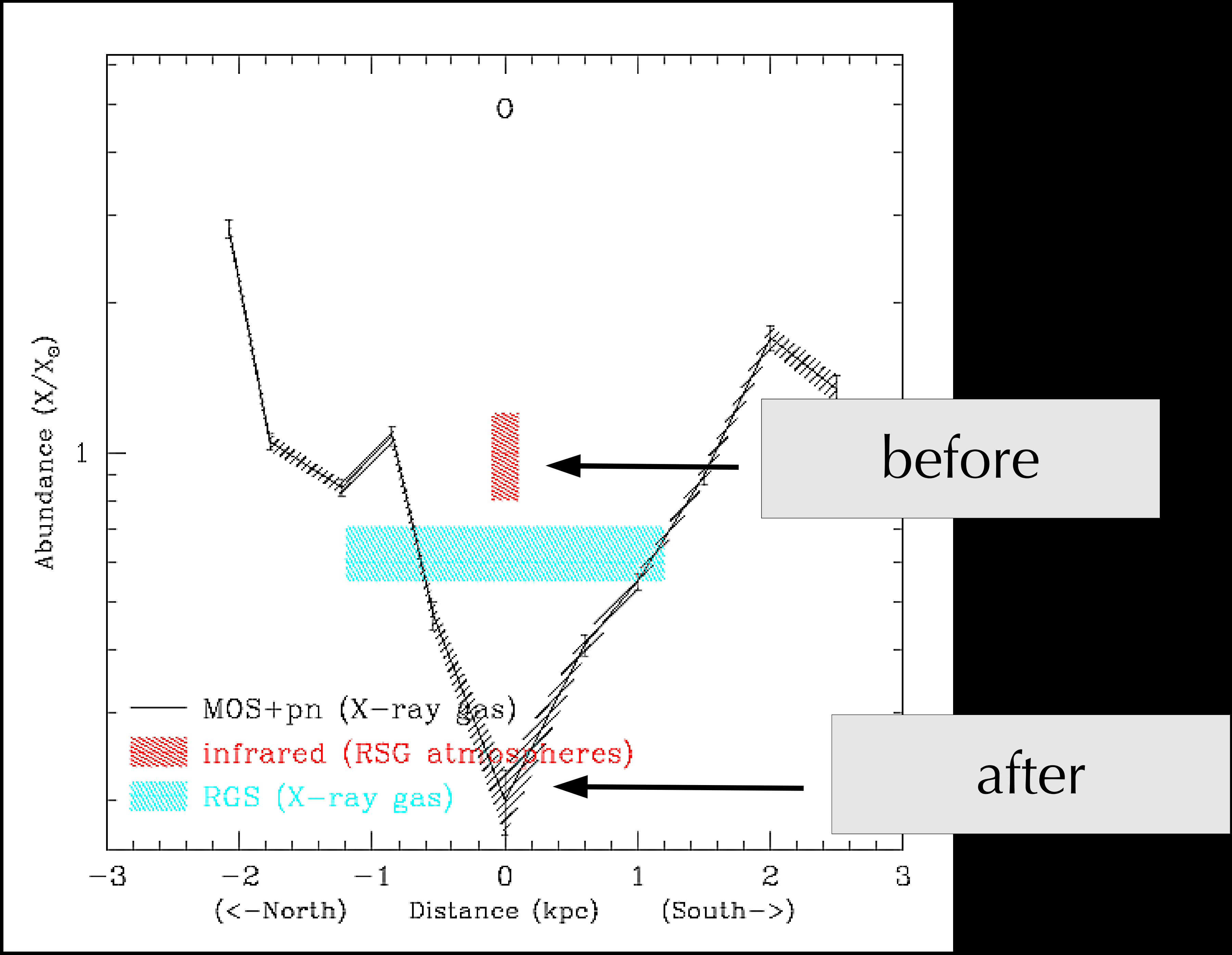
they have higher yields

⬇

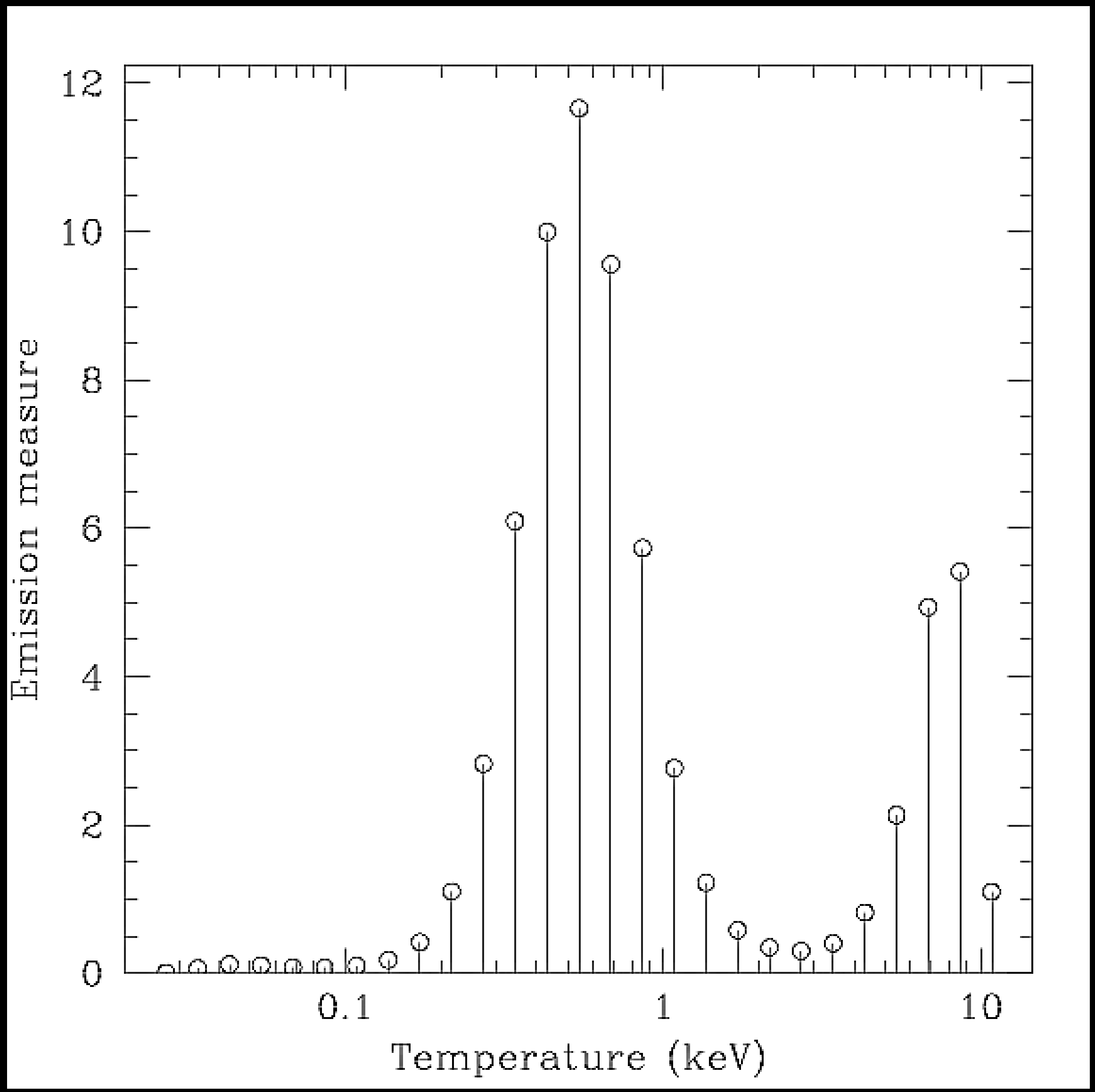
abundances in the external outflow are higher

but this is probably too simple to be true

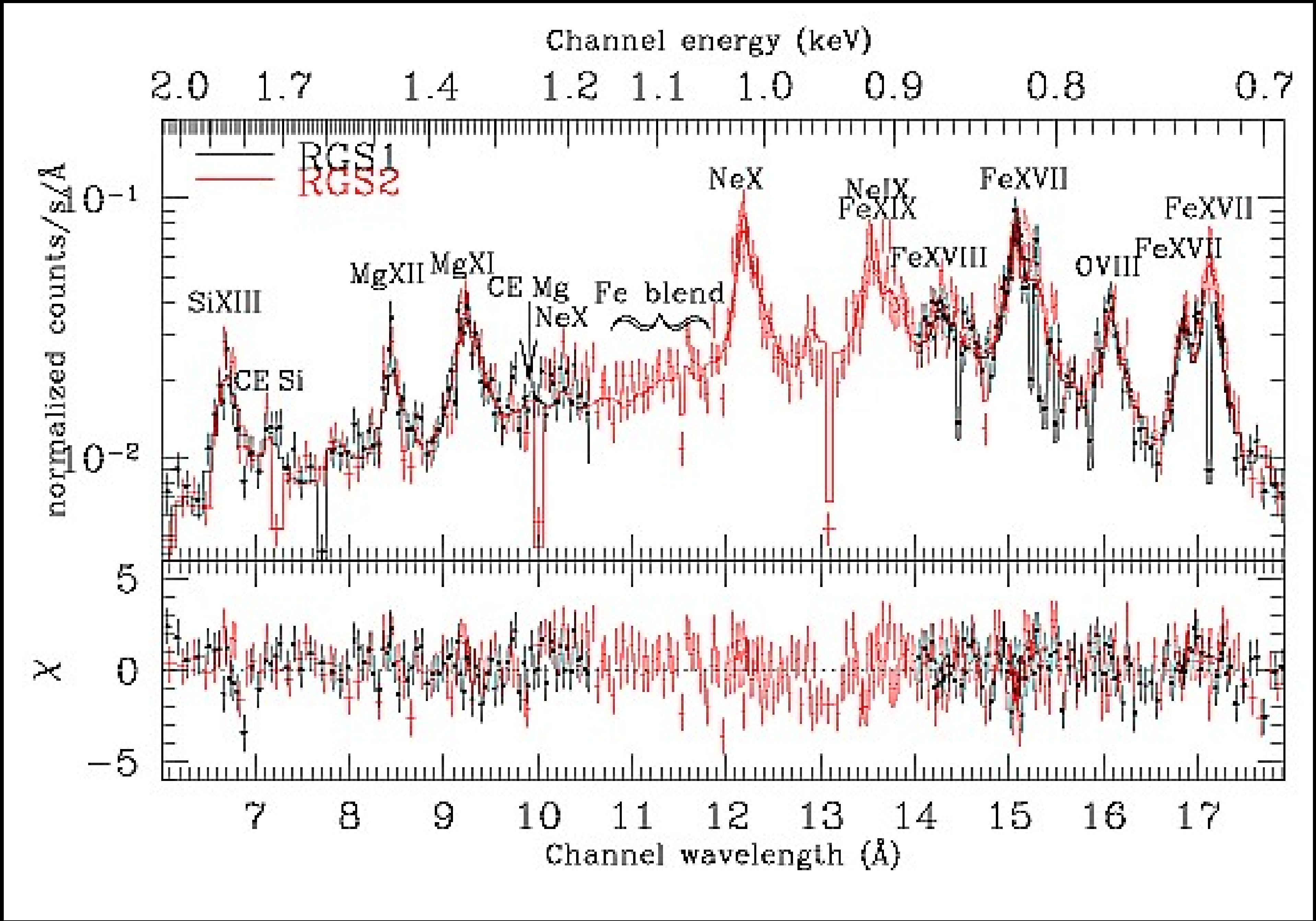
Where has the oxygen gone?



Differential emission measure (i.e. “the temperature”) has a bimodal distribution

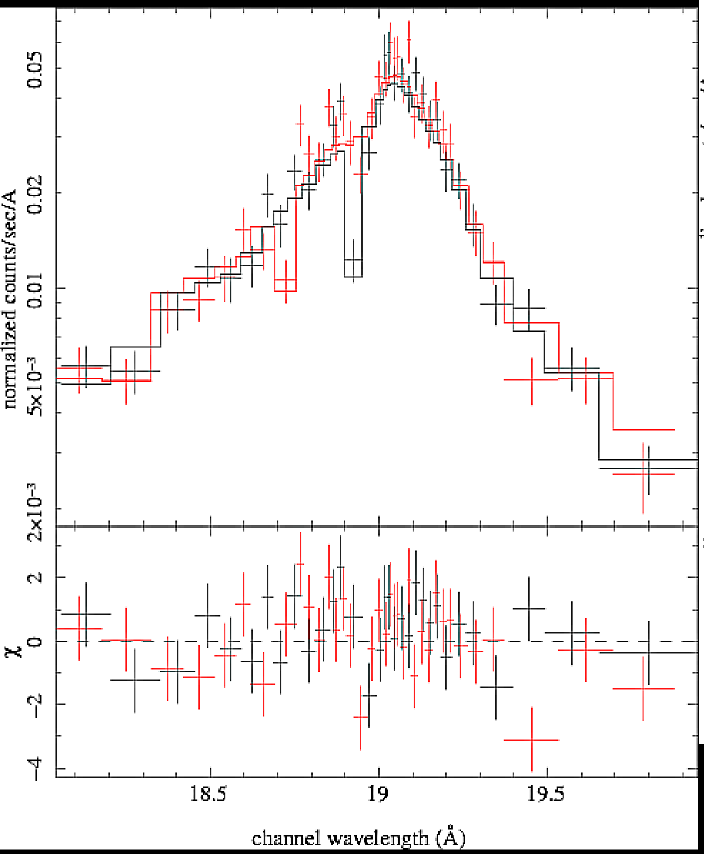


Gallery of spectra: RGS ($3 \cdot 10^4$ counts)

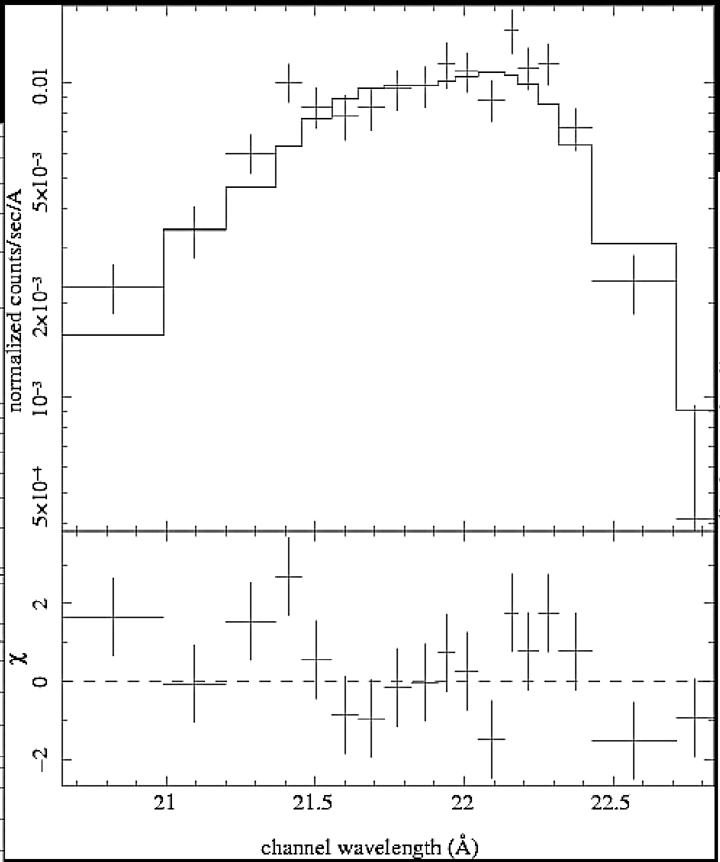


Gallery of spectra: RGS ($3\cdot10^4$ counts)

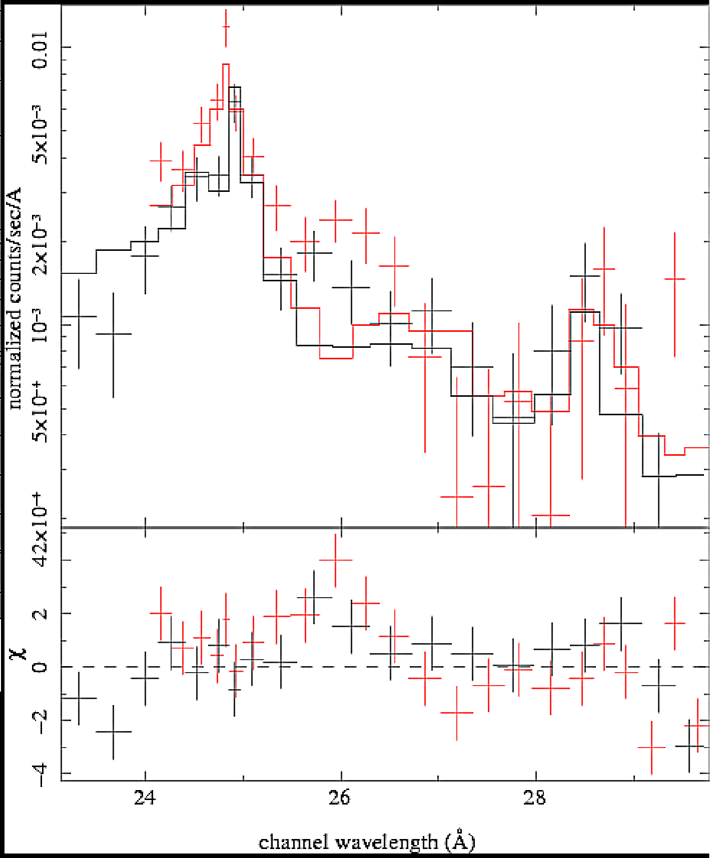
O VIII



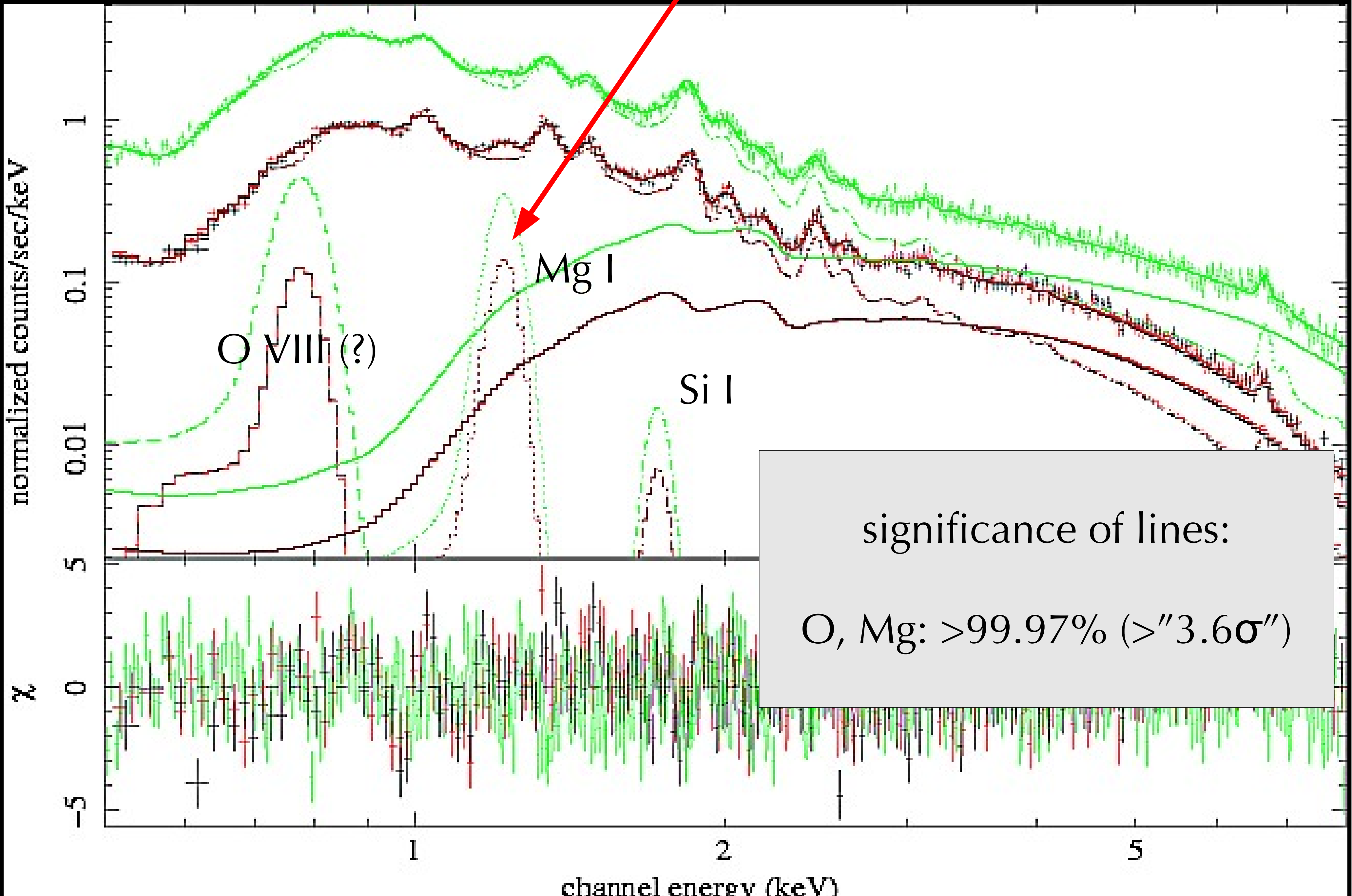
O VII



N VII & C VI



Detection of charge-exchange emission



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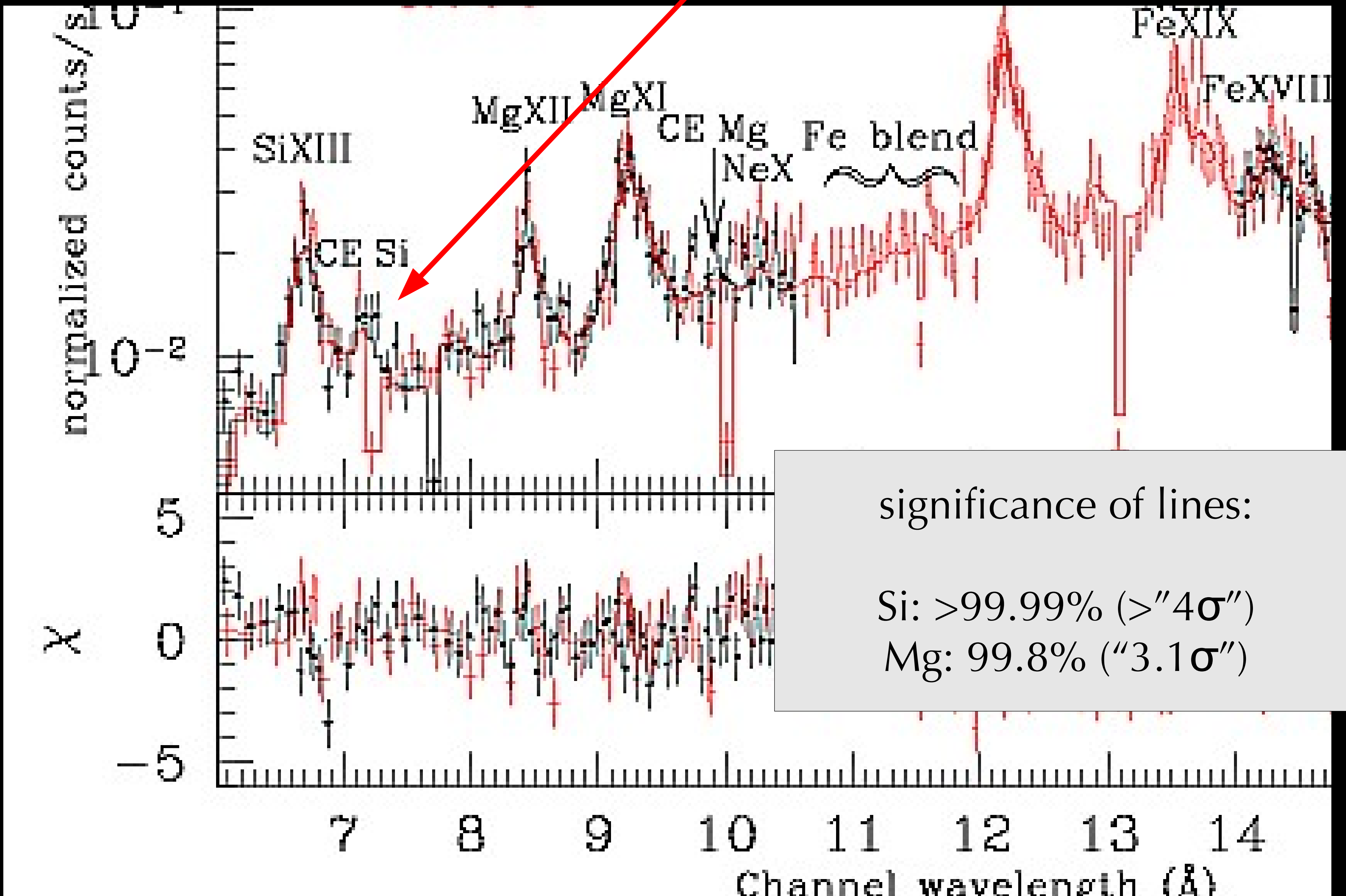
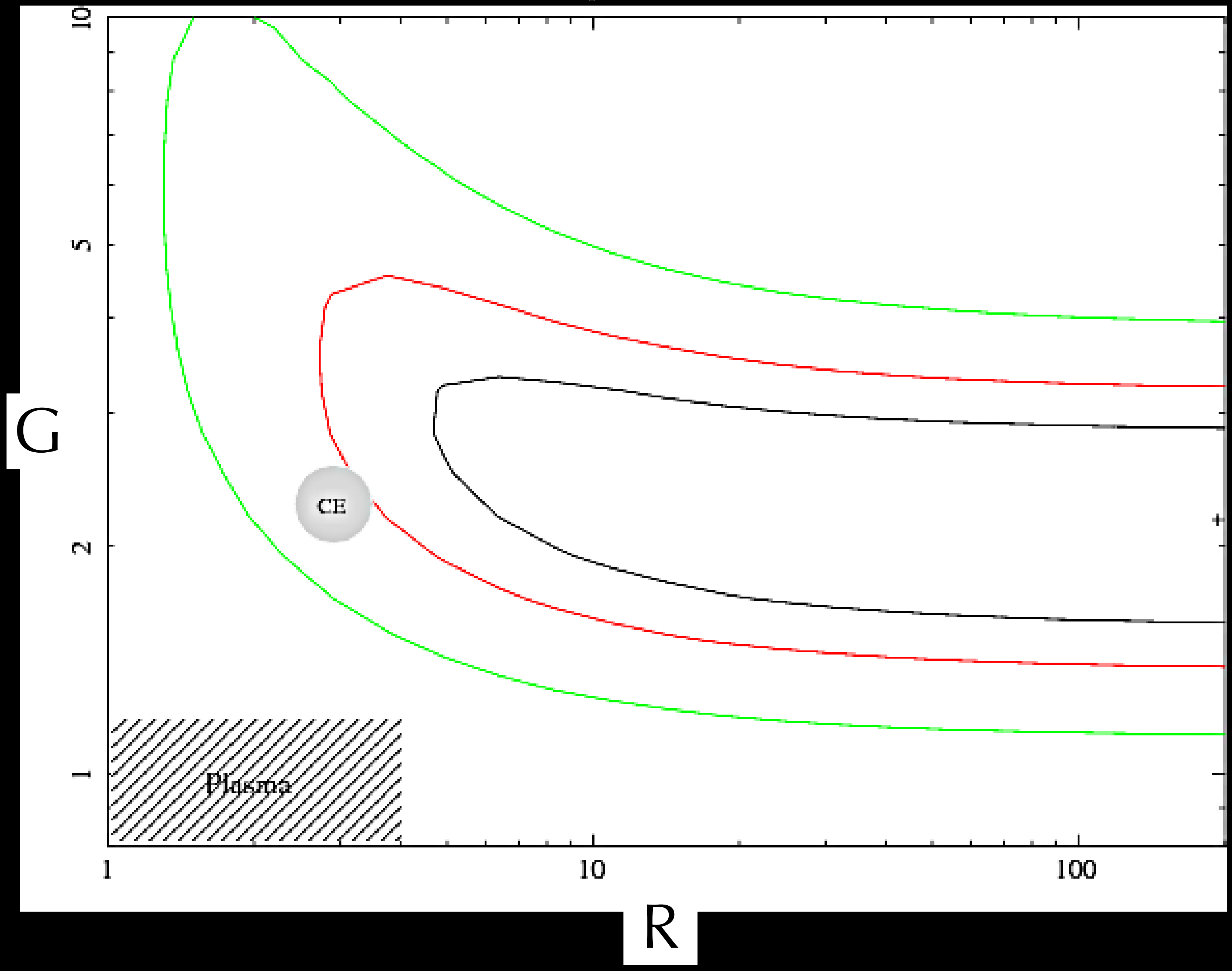


significance of lines:

Si: >99.99% (>"4σ")
Mg: 99.8% ("3.1σ")

Detection of charge-exchange emission (the O VII triplet line ratios)



Conclusions:

- chemical abundances depend on distance from the galaxy centre
- bimodal temperature distribution
- possible detection of charge-exchange
- RGS spectroscopy confirms results from EPIC

for all details, see paper:
MNRAS 386 (2008), 1464