Supernova remnants and the interstellar medium

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ON BEHALF OF W.G.3.4

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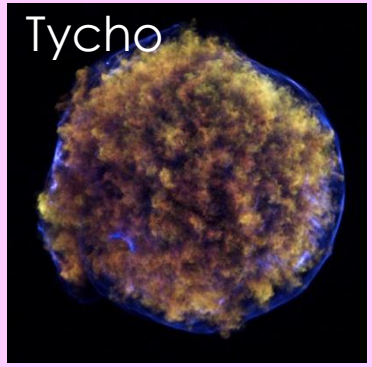
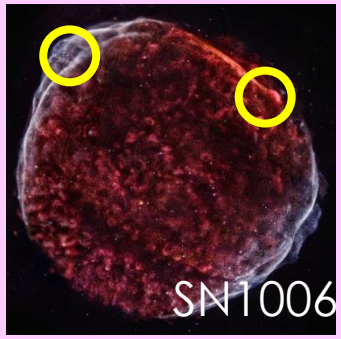
SNR

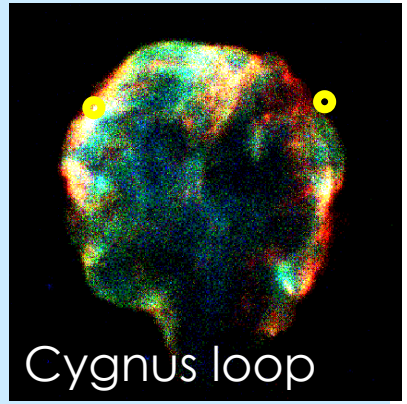
Type Ia





age of supernova remnants

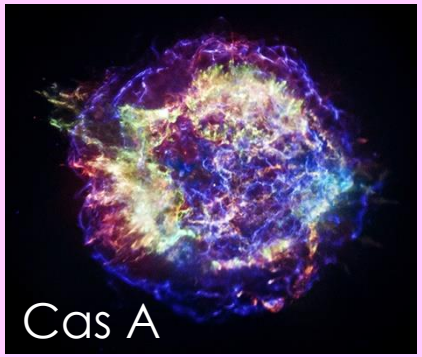
luminous Type Ia



Type CC

SN1987A

M33 SNR
or N132D

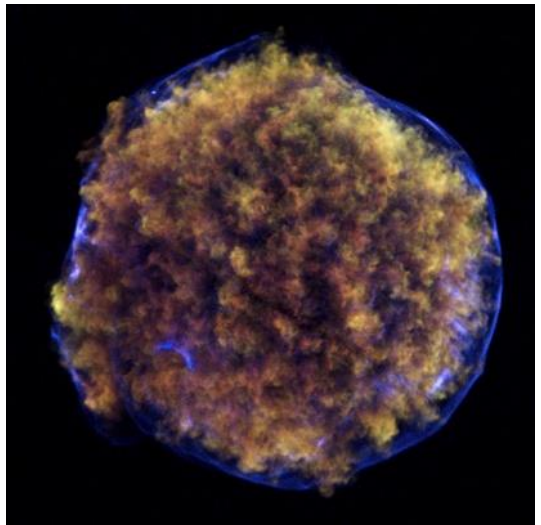


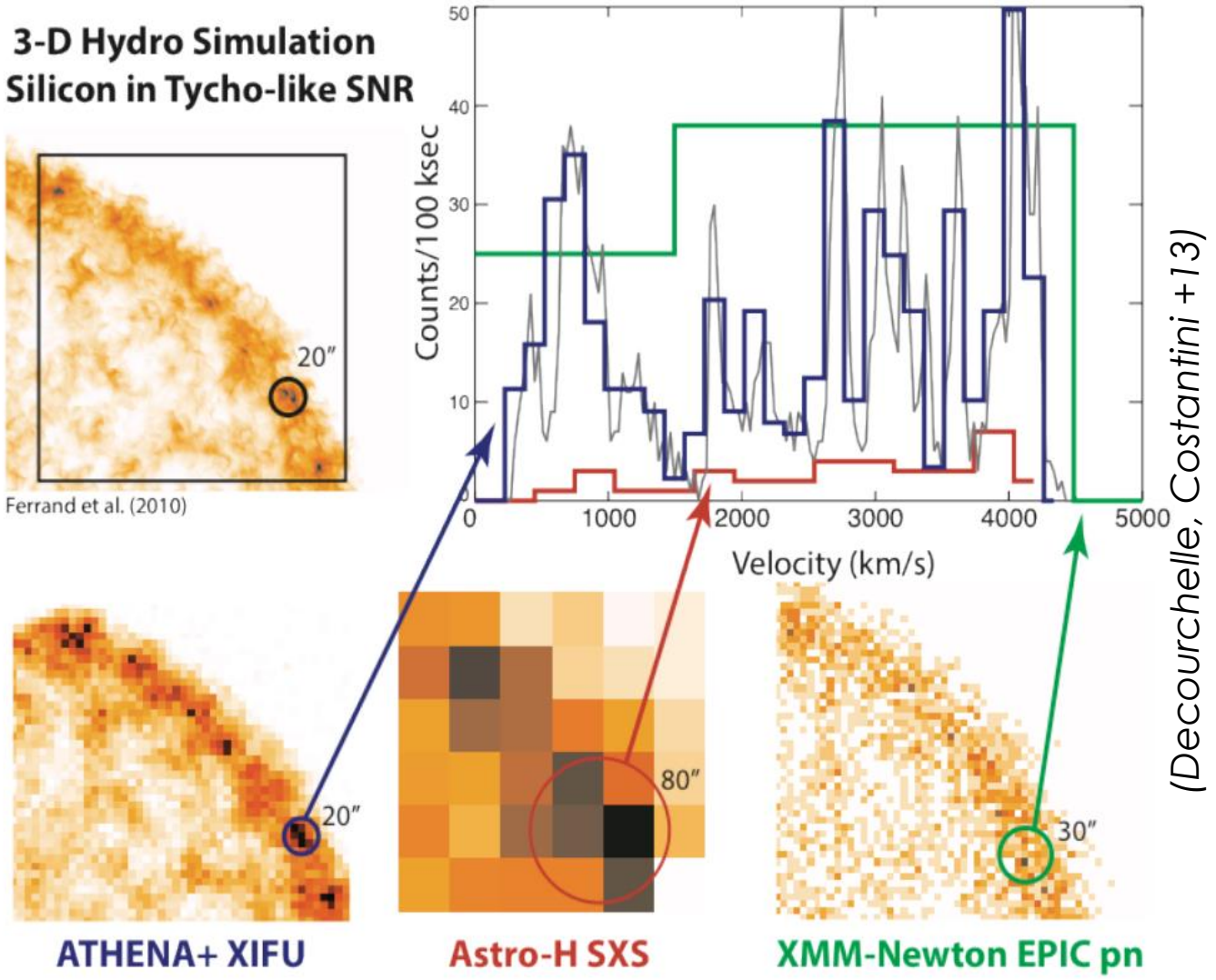
How SNe explode ? How heavy elements distributes ?

Measuring Doppler shifts of lines in filaments and knots

- 3D distribution of heavy elements
  how uniform ? how knotty ?
  difference among elements ?
- Detection of trace elements

→ Metallicity of progenitor



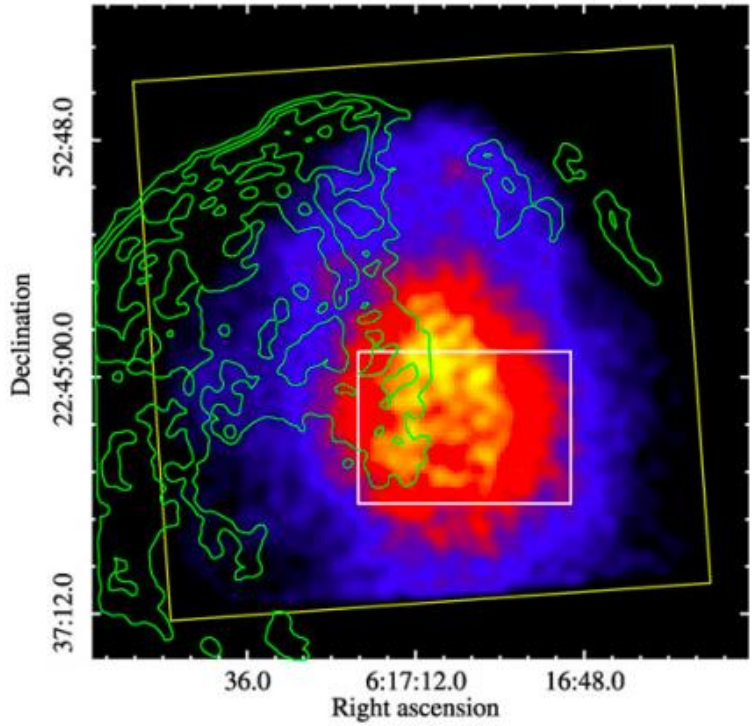


More precise understanding of plasma emission

Mixed morphology SNR are often associated with middle-aged SNR.
They have a radio shell only, they are often associated with dense surroundings,

- Some are Gamma-rays emitter (advocating for SNR as CR factories)
- Half present overabundance in the inner part (e.g. mixing not completed)
- the central part is X-ray bright and possibly overionized:

Rapid cooling?
Thermal conduction?
Particle acceleration?



(Vink+12, Yamaguchi+09, Long, Bamba+13)

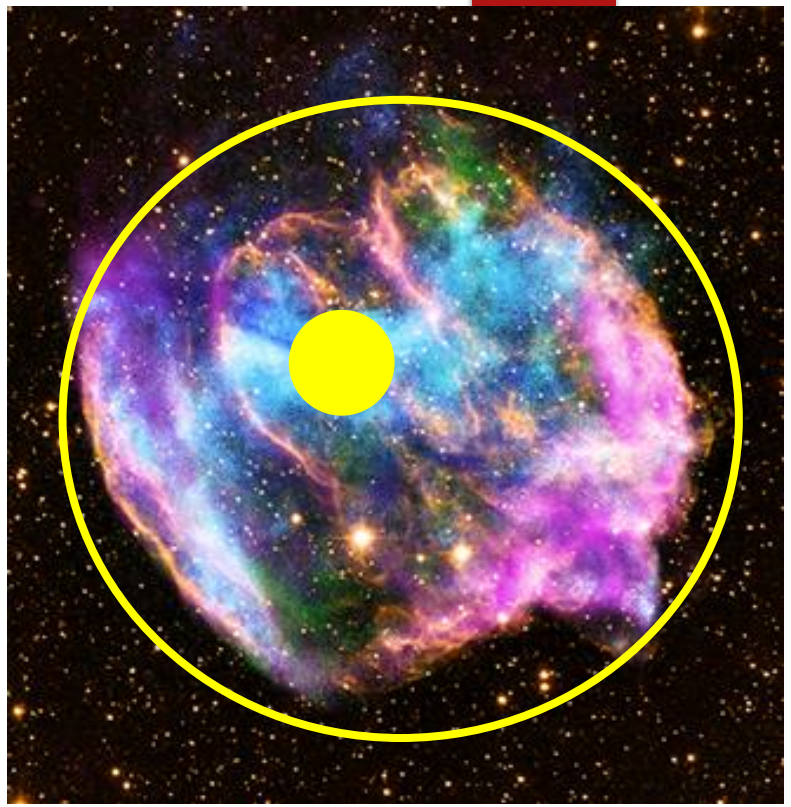
W49B is the only mixed morphology SNR to display bright iron complex

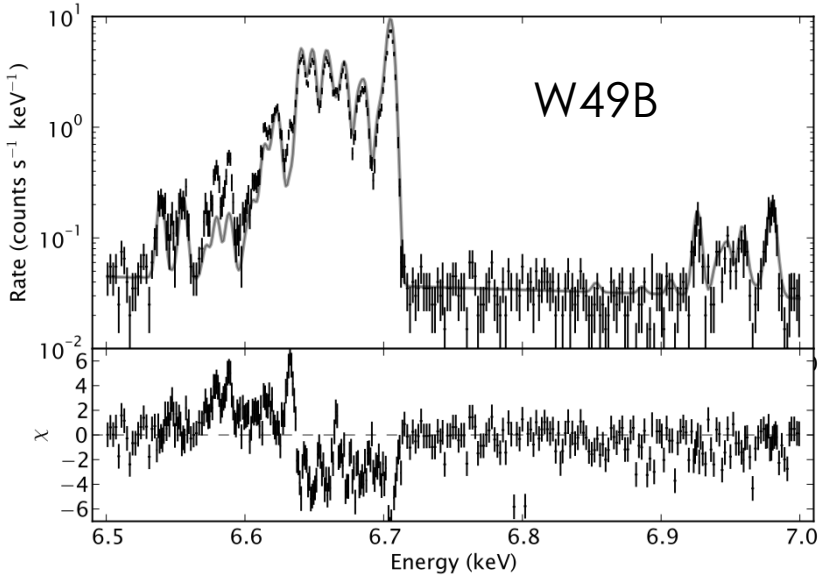
- Degree of ionization as indicator of evolutionary stage
- Dependent on initial temperature and age
- Thermal broadening as indicator of recombination mechanism

(adiabatic expansion vs conduction)

- Position dependence of these results

→ how the shock exchange thermal energy with interstellar medium.





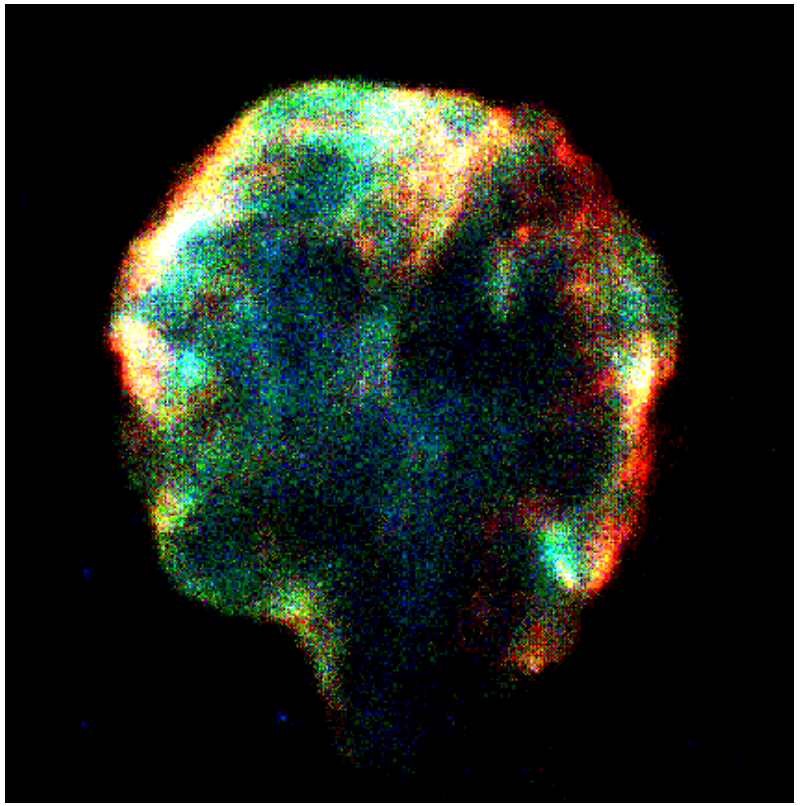
Plasma emission and interaction with the surroundings

CX: by neutrals (ISM) and ionized particles heated by shock

→ only around the shock

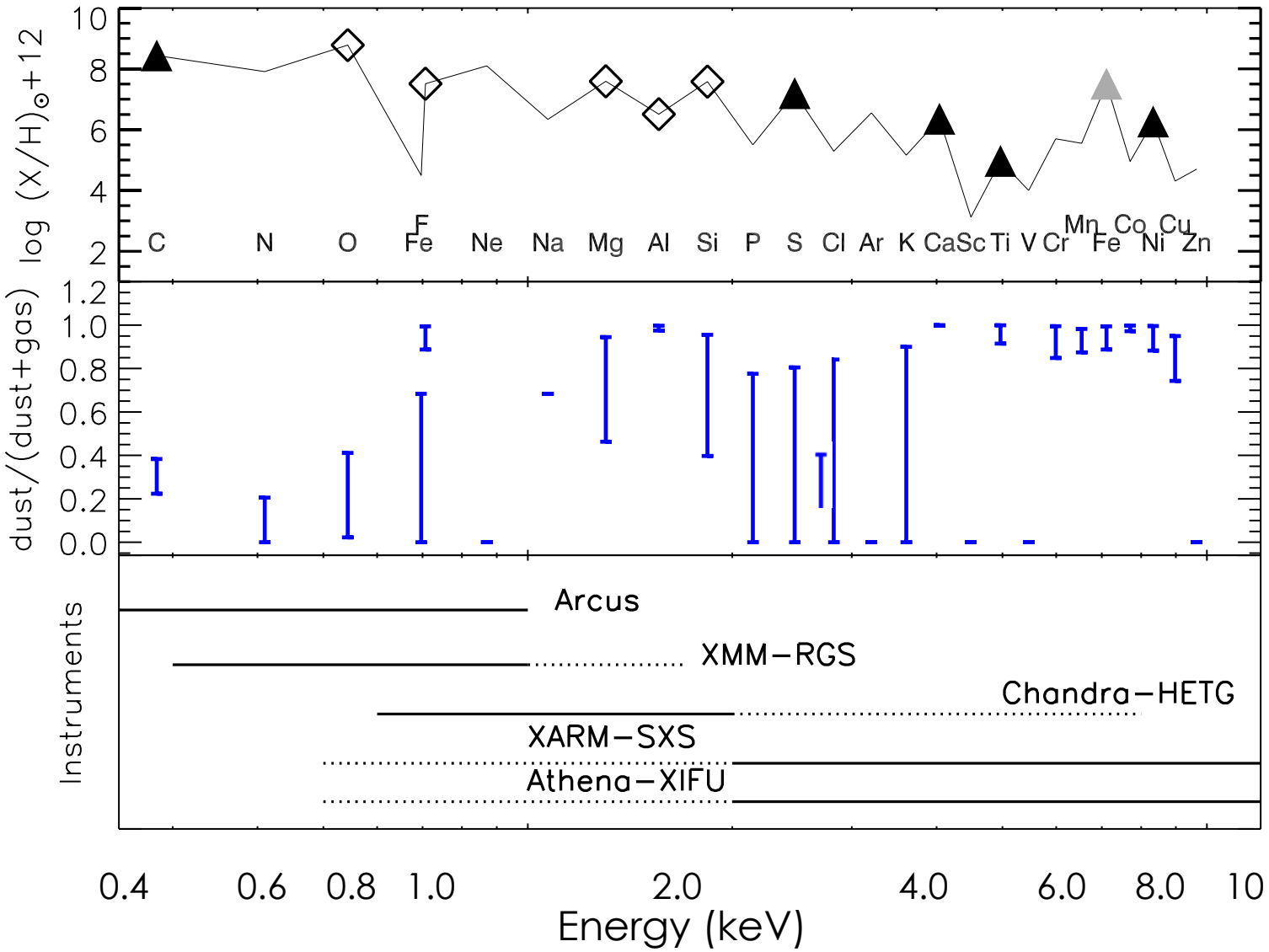
RS: by column density of the plasma

→ important at the bright (inner) shell



Interstellar Dust

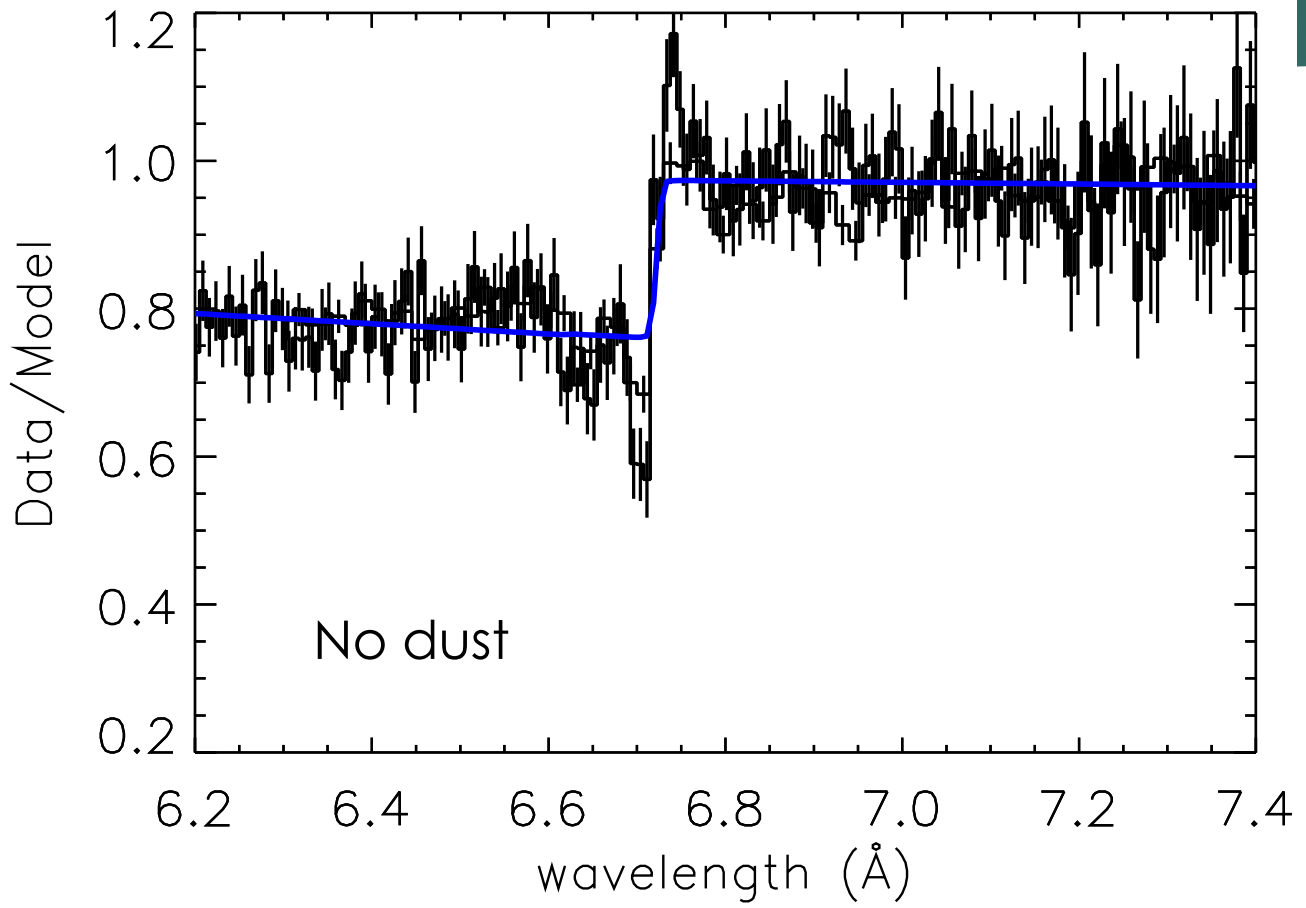
What can we study in the X-rays



(Costantini, Zeegers 2018 A&A subm,)

Si K edge measurements

$N_H=3x10^{22}cm^{-2}$



(Zeegers, Costantini+ 2017)

Laboratory data

(Zeegers, EC, 17, 18
Rogantini, EC, in prep)

LUCIA
Mg K at 1.3 keV
Si K at 1.84 keV

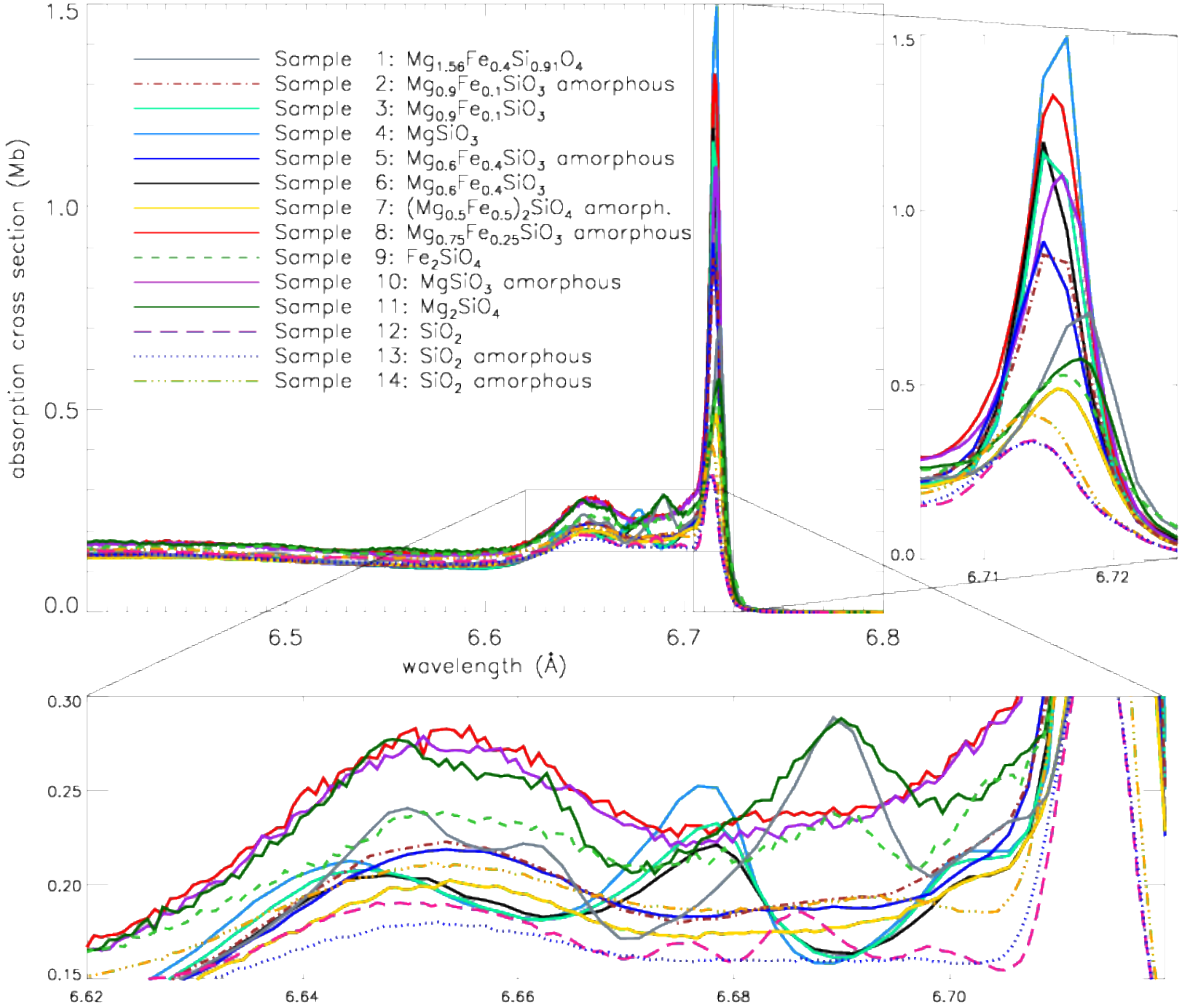
(Psaradaki, EC in prep)

Cadiz (TITAN)
O K at 0.543 keV
Fe L at 0.7 keV

DUBBLE
Fe K at 7.11 keV

(Rogantini, EC, 18)

NWO
Vidi scheme



Zeegers, EC, 2018 in prep

Si K edge measurements

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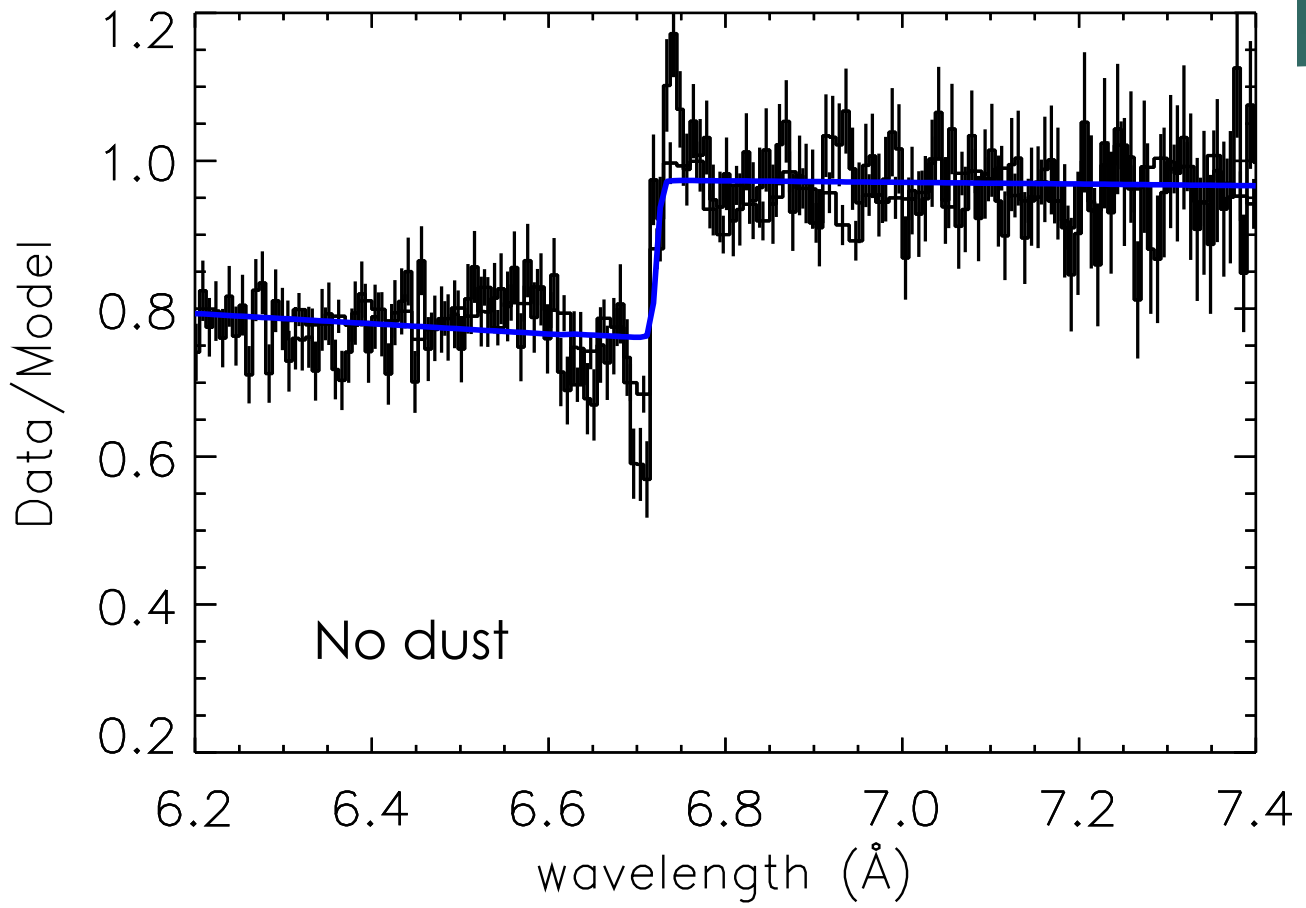

(Zeegers, Costantini+ 2017)

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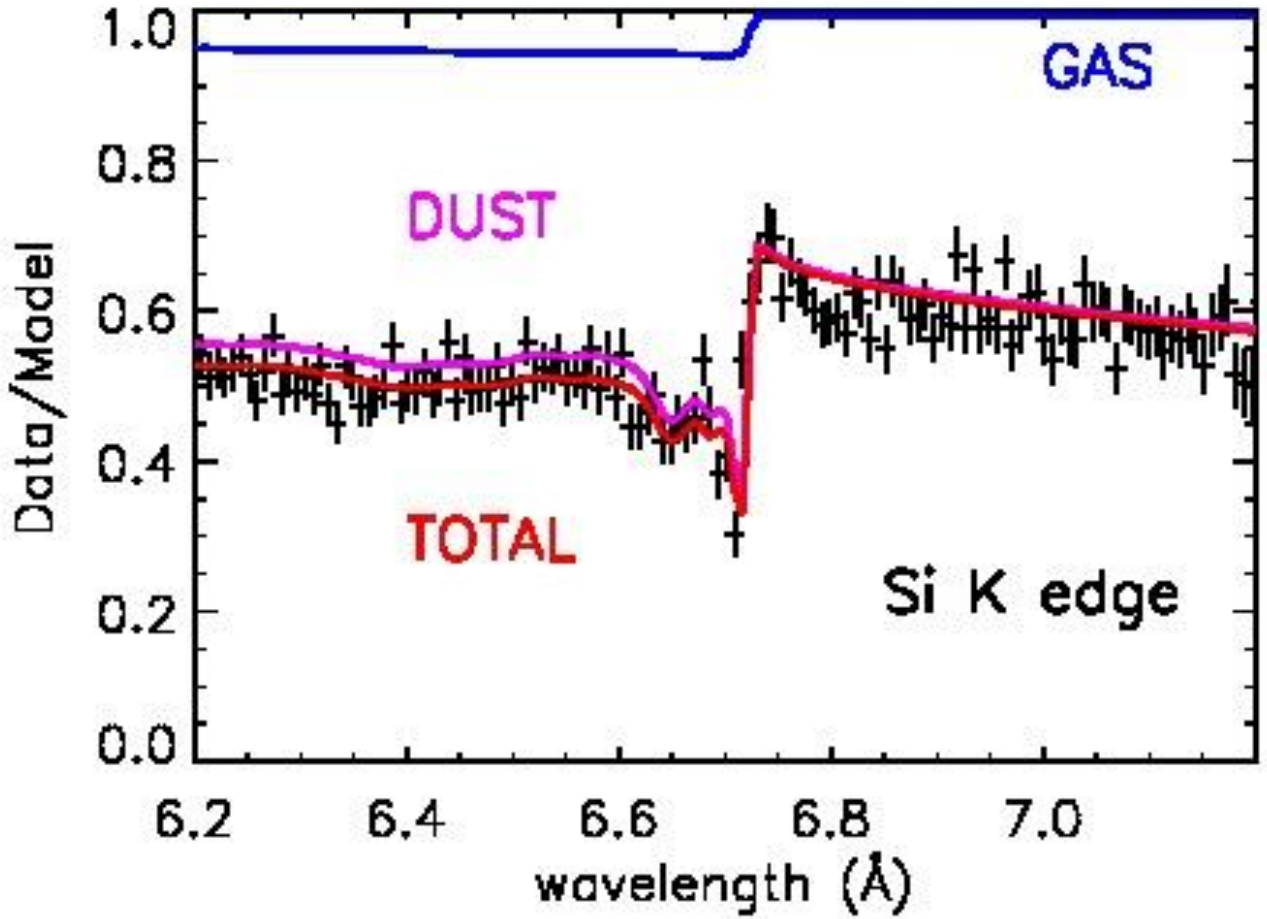
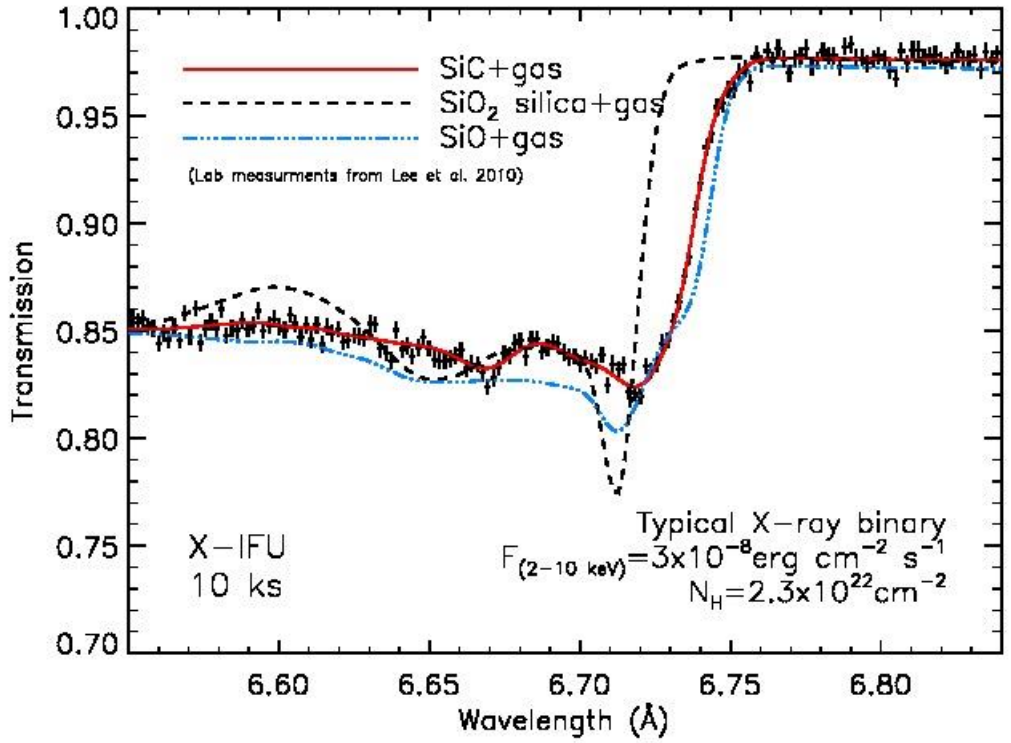


(Zeegers, Costantini+ 2017)

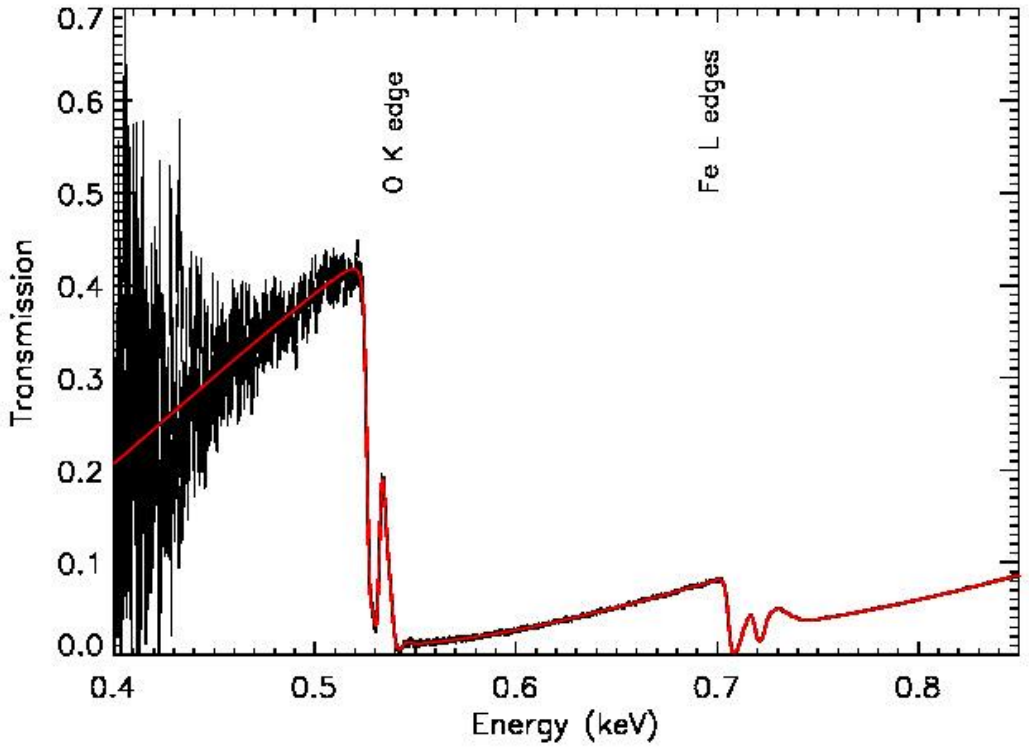
Athena

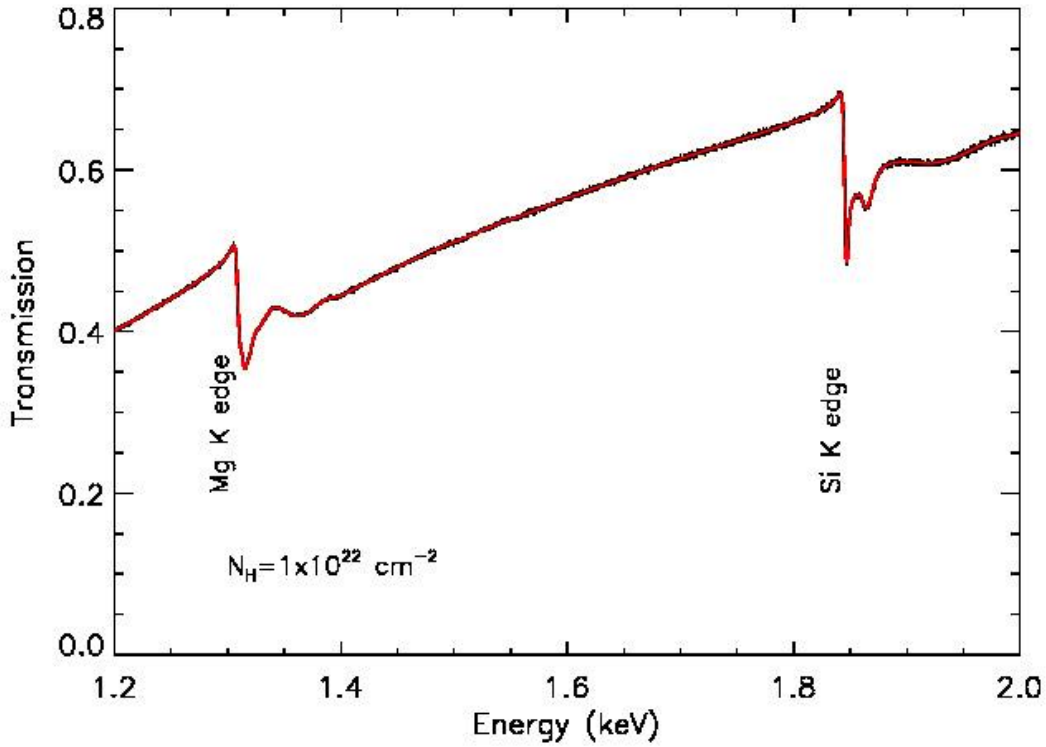


(Decourchelle, Costantini+13)

Athena

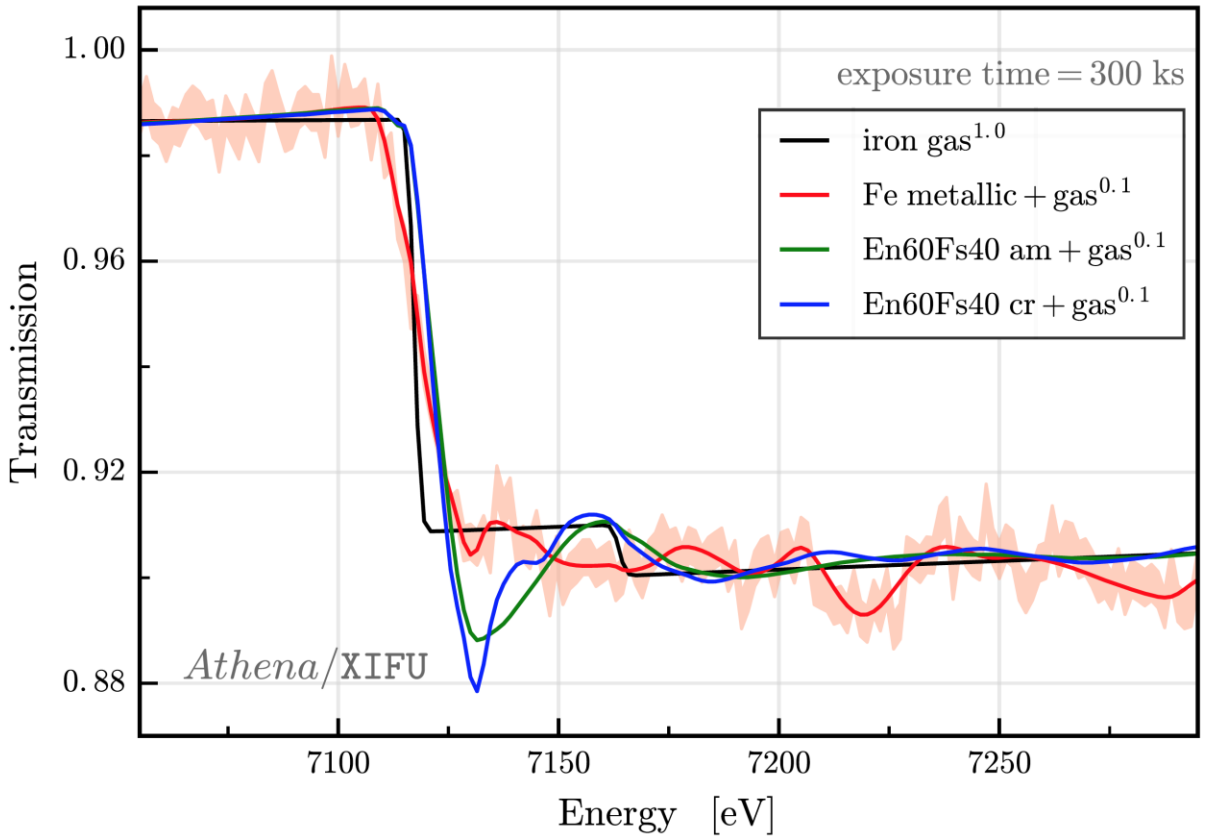
So far column density determined which edges you were allowed to study
With Athena even with high column density all the silicates edges (4!!) will be accessible!





Fe K feature

Check poster by ROGANTINI



Fe K will be visible by future ESA instruments (Athena)

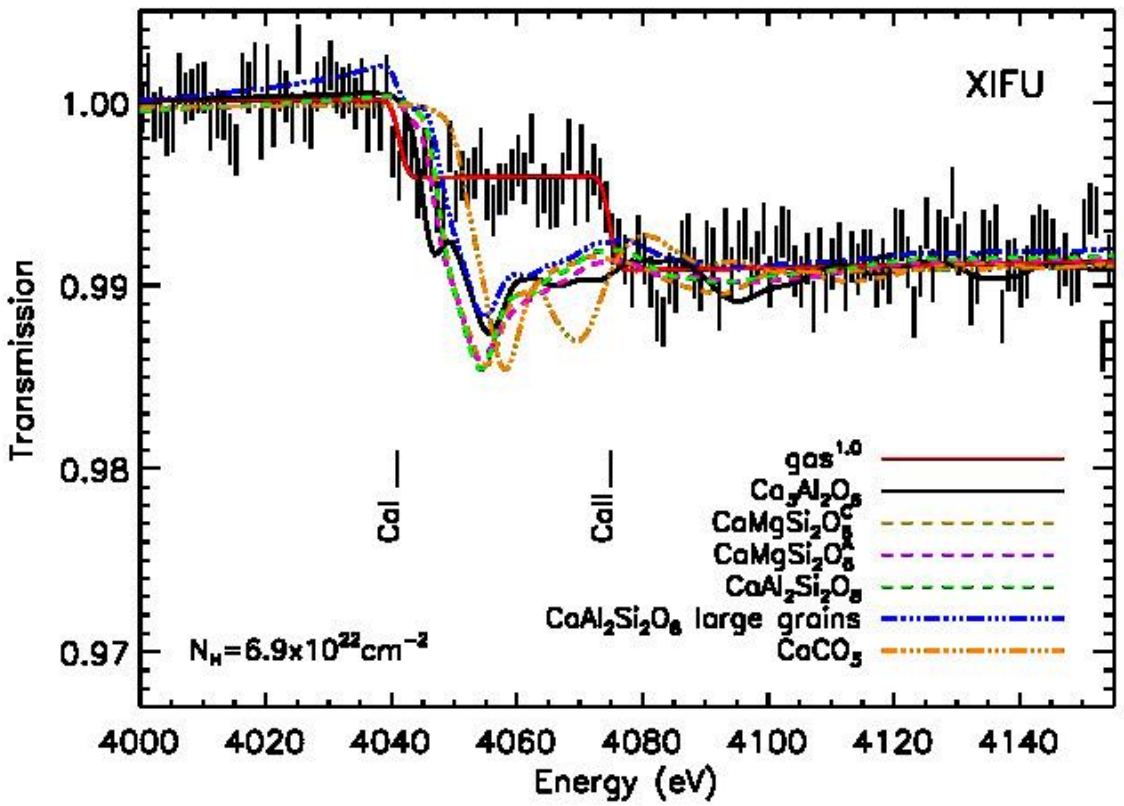
- Not sensitive to grain size
- Not sensitive to dust shape
- → ideal for dust chemistry

- The only chance to investigate very dense environments (extinction too high for optical/UV/IR studies) like the Galactic Centre

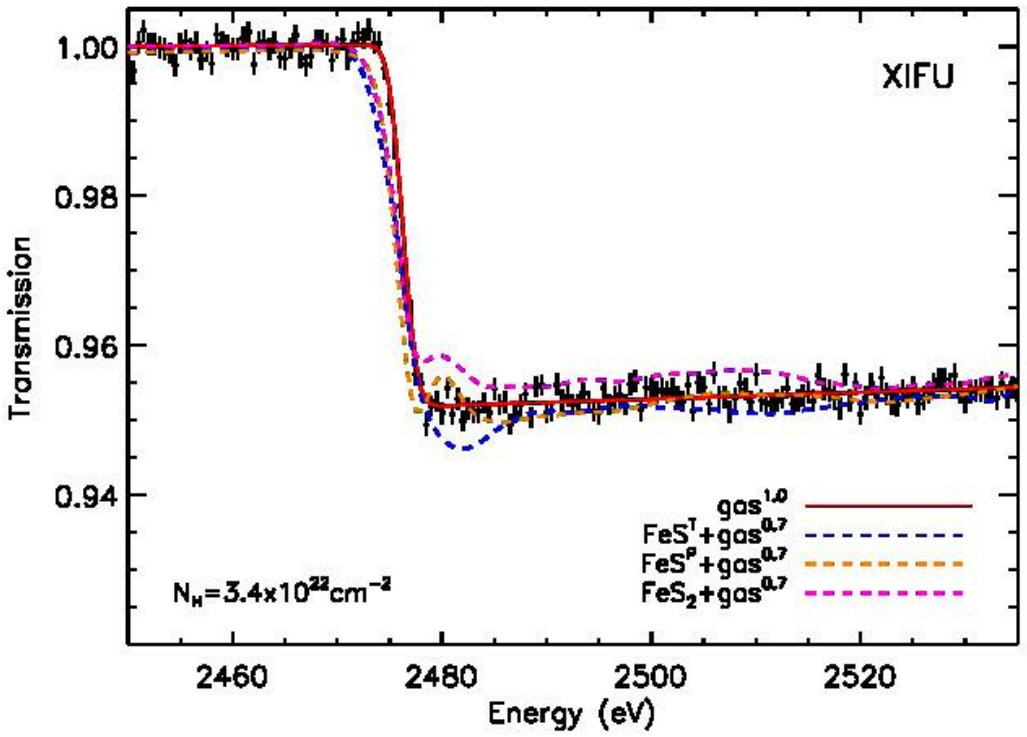
(Rogantini,EC+2018)

Trace elements

Calcium



Sulfur



(Costantini + 18, A&A submitted)

Conclusions

- 3D characterization of SNR
- SNR Emission mechanisms and interaction with the surrondings

- Characterization of silicates in the ISM.
- Abundances and depletion of trace elements