Fe Atomic Data for NEI Plasmas

Kris Eriksen (LANL)

Collaborators:
Chris Fontes (LANL)
James Colgan (LANL)
Jack Hughes (Rutgers)
Hong Lin Zhang (LANL)
Aimee Hungerford (LANL)
Chris Fryer (LANL)
Carles Badenes (Pitt)
Randall Smith (CfA)

Tycho's SNR

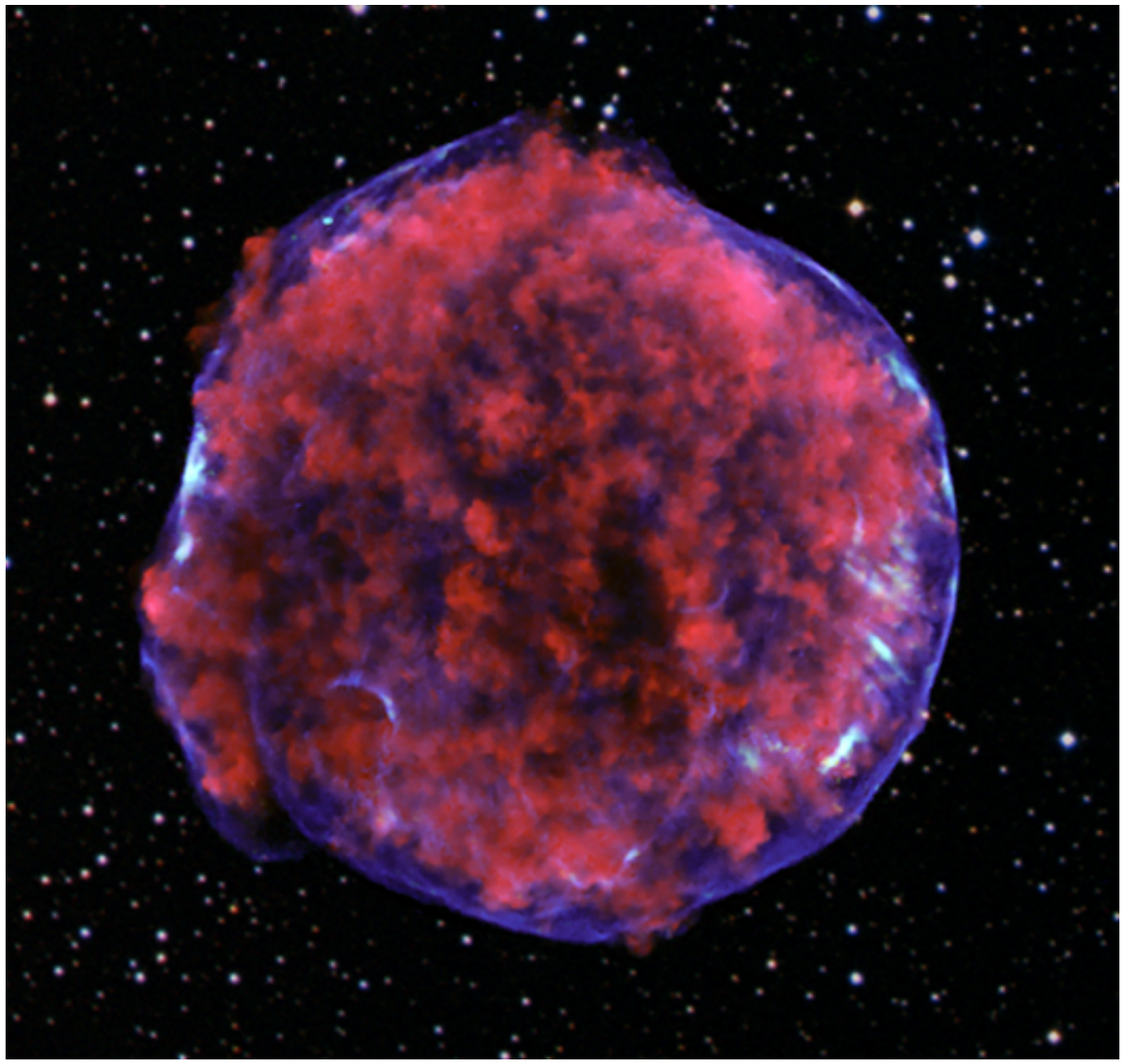
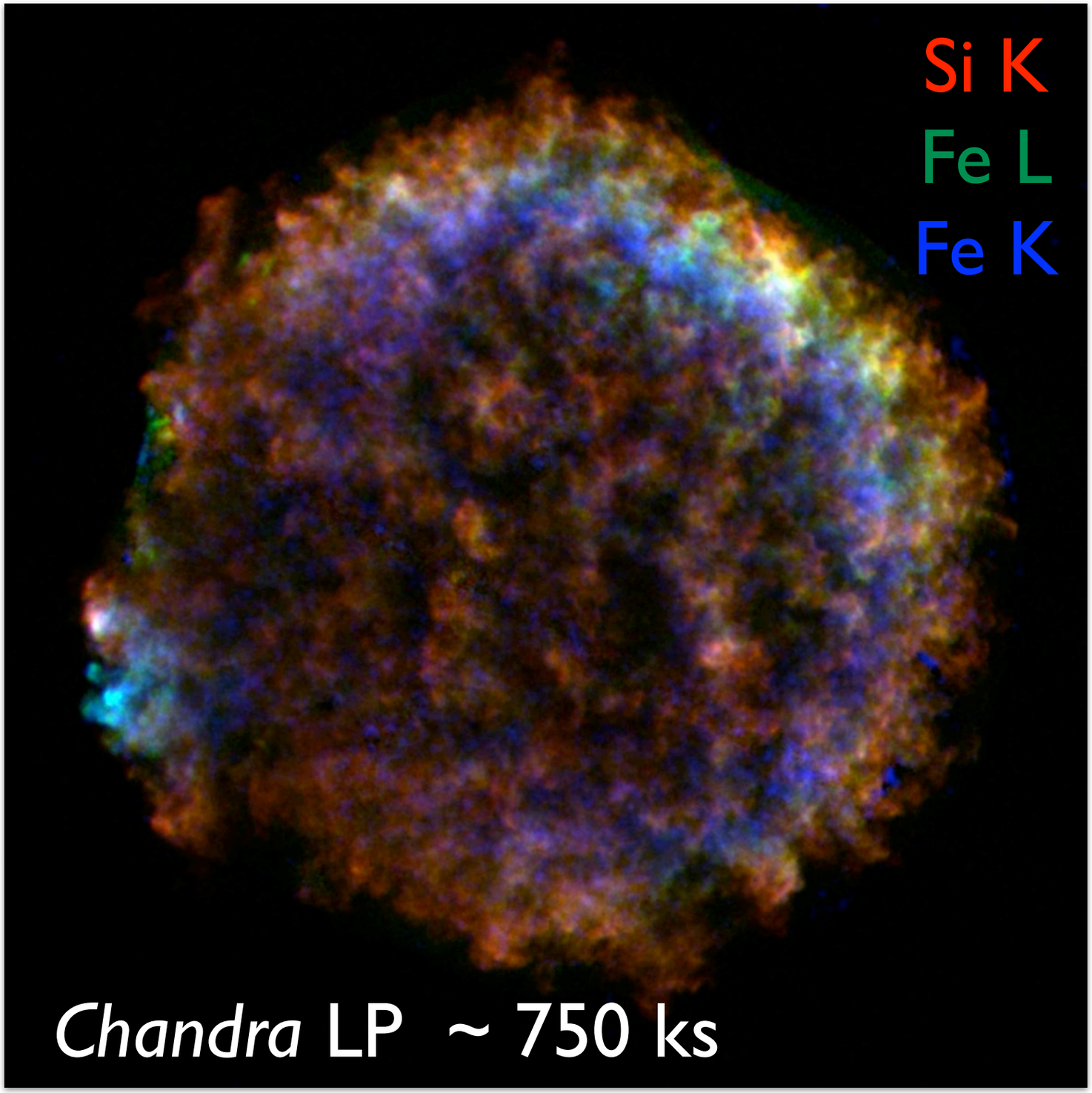


Image Credit: NASA/CXC/Rutgers/K. Eriksen+

Iron in Tycho's SNR

SN 1572,
normal SN Ia
(Badenes+ 2006,
Krause+ 2008)

over half of
ejecta mass
thought to be
^{56}Ni (now ^{56}Fe)



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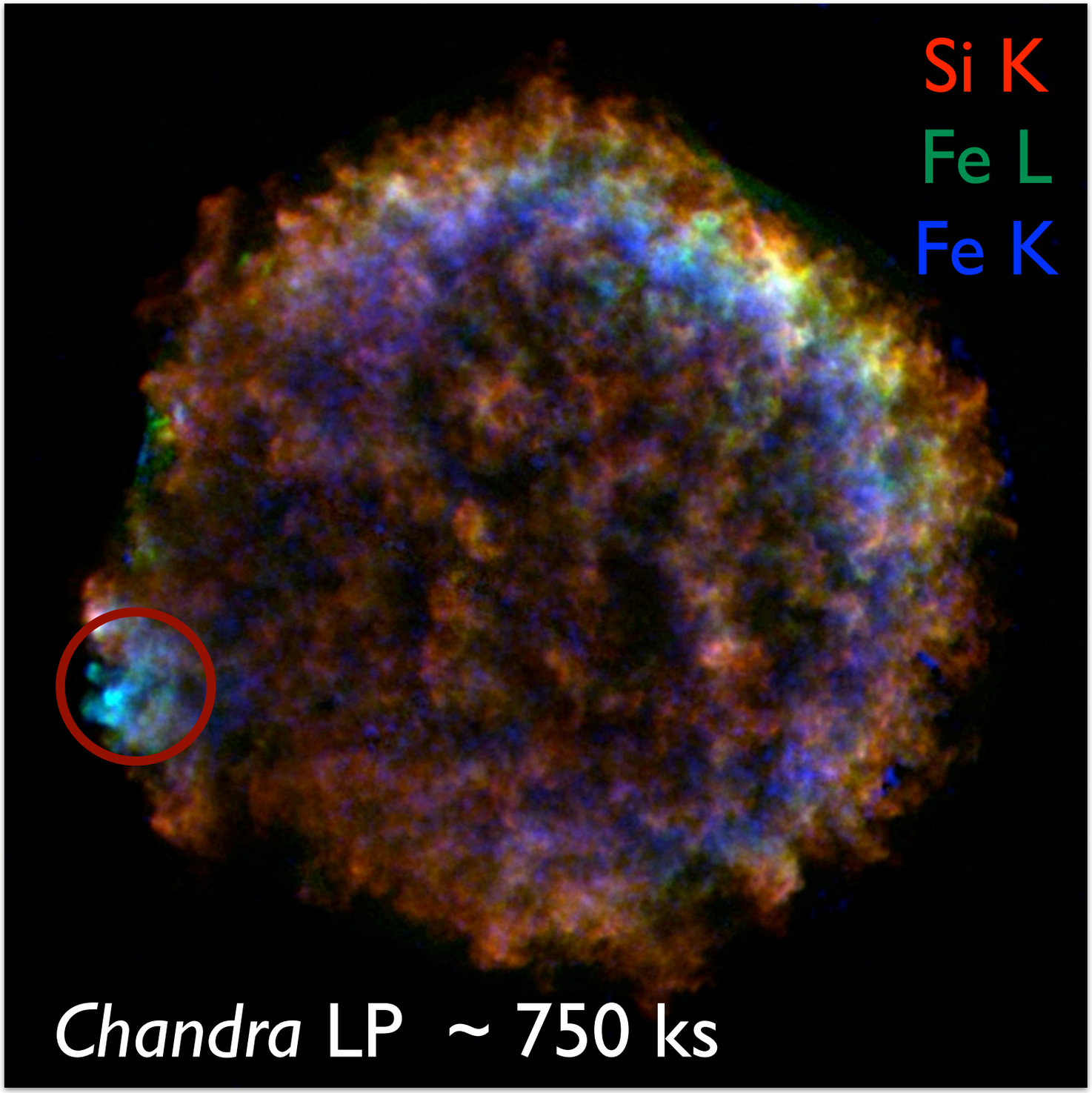

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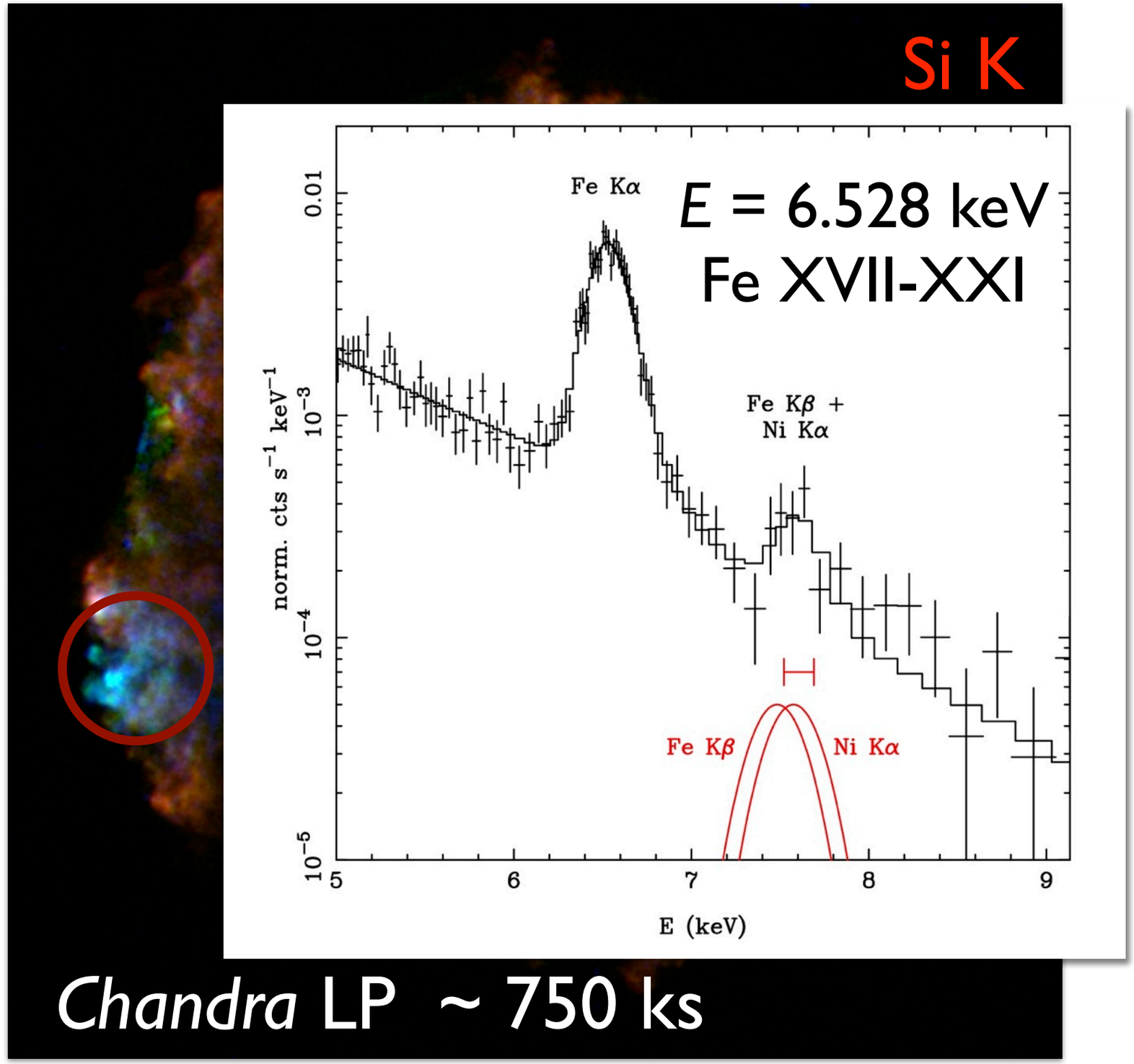
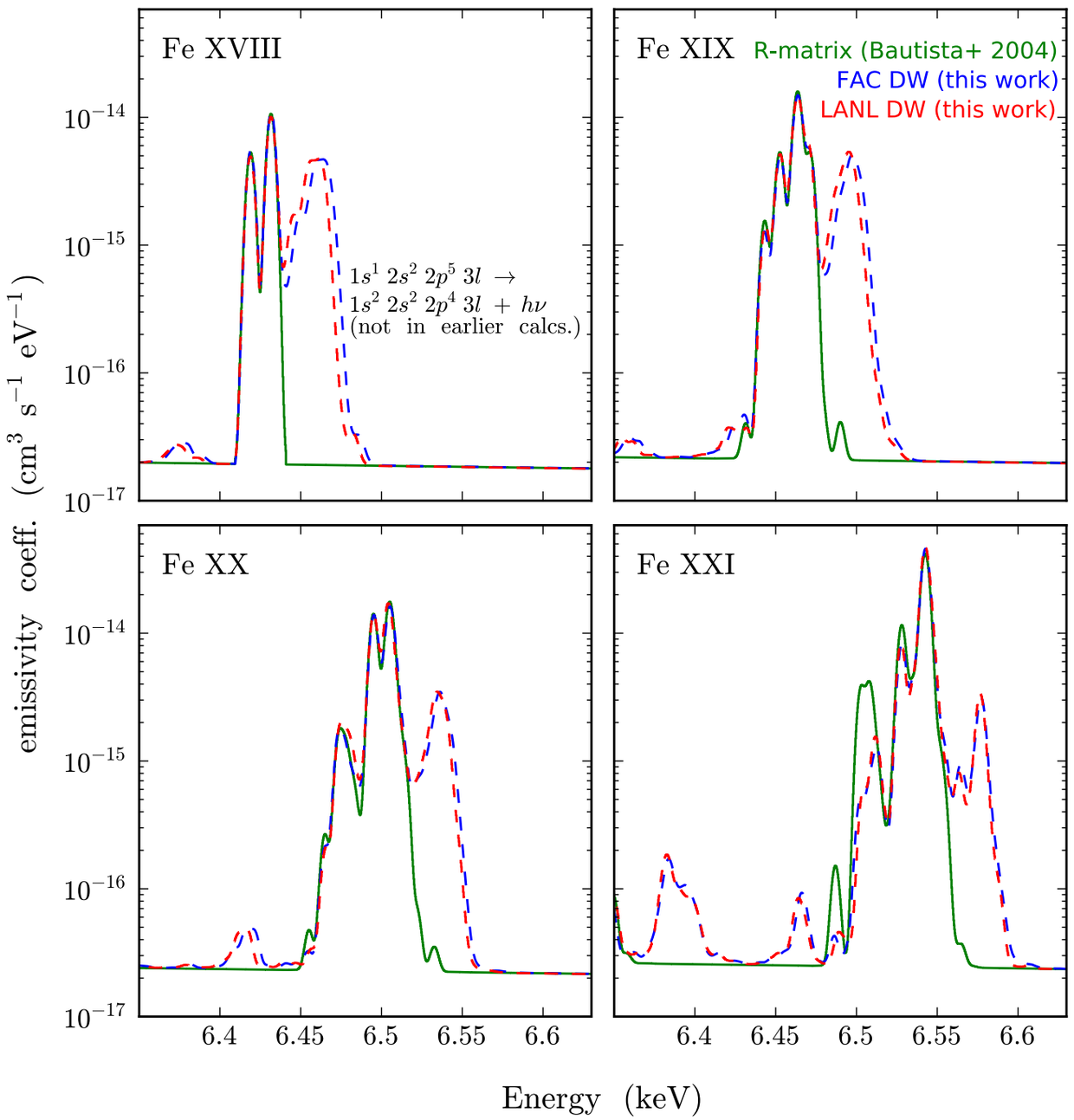


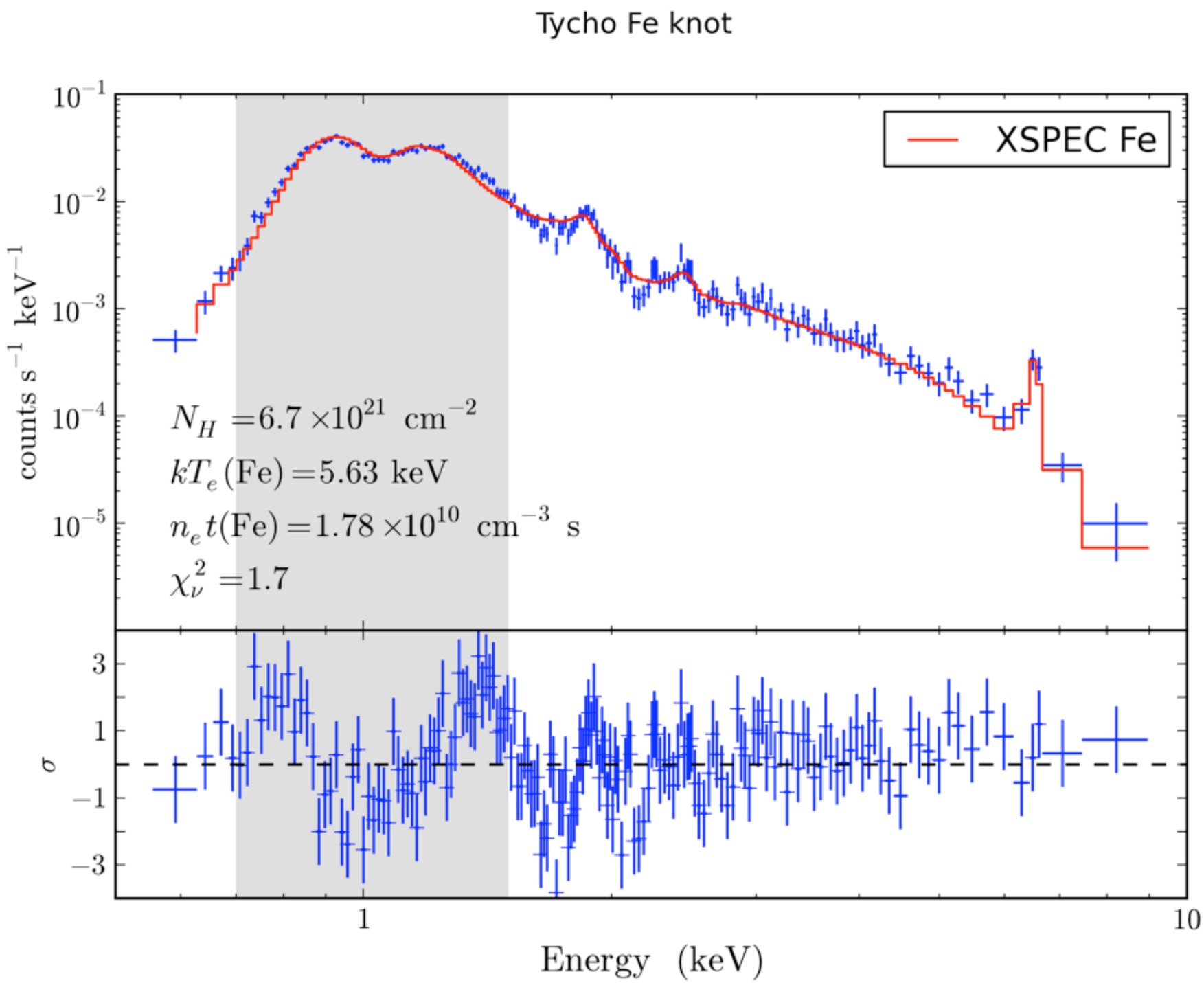
new FAC Calculations, Fe XVII-XXVI

	AtomDB v2			new FAC		
ion	K - *n*	L - *n*	levels	K - *n*	L - *n*	levels
Fe XVII	n/a	7	293	3	8	467
Fe XVIII	n/a	5	501	3	8	1570
Fe XIX	n/a	5	994	3	8	3212
Fe XX	n/a	5	1087	3	8	4073
Fe XXI	n/a	5	848	3	8	3540
Fe XXII	n/a	6	412	3	8	1955
Fe XXIII	n/a	7	302	3	10	996
Fe XXIV	n/a	7	124	3	12	225
Fe XXV	10	n/a	199	10	n/a	449
Fe XXVI	10	n/a	100	15	n/a	225

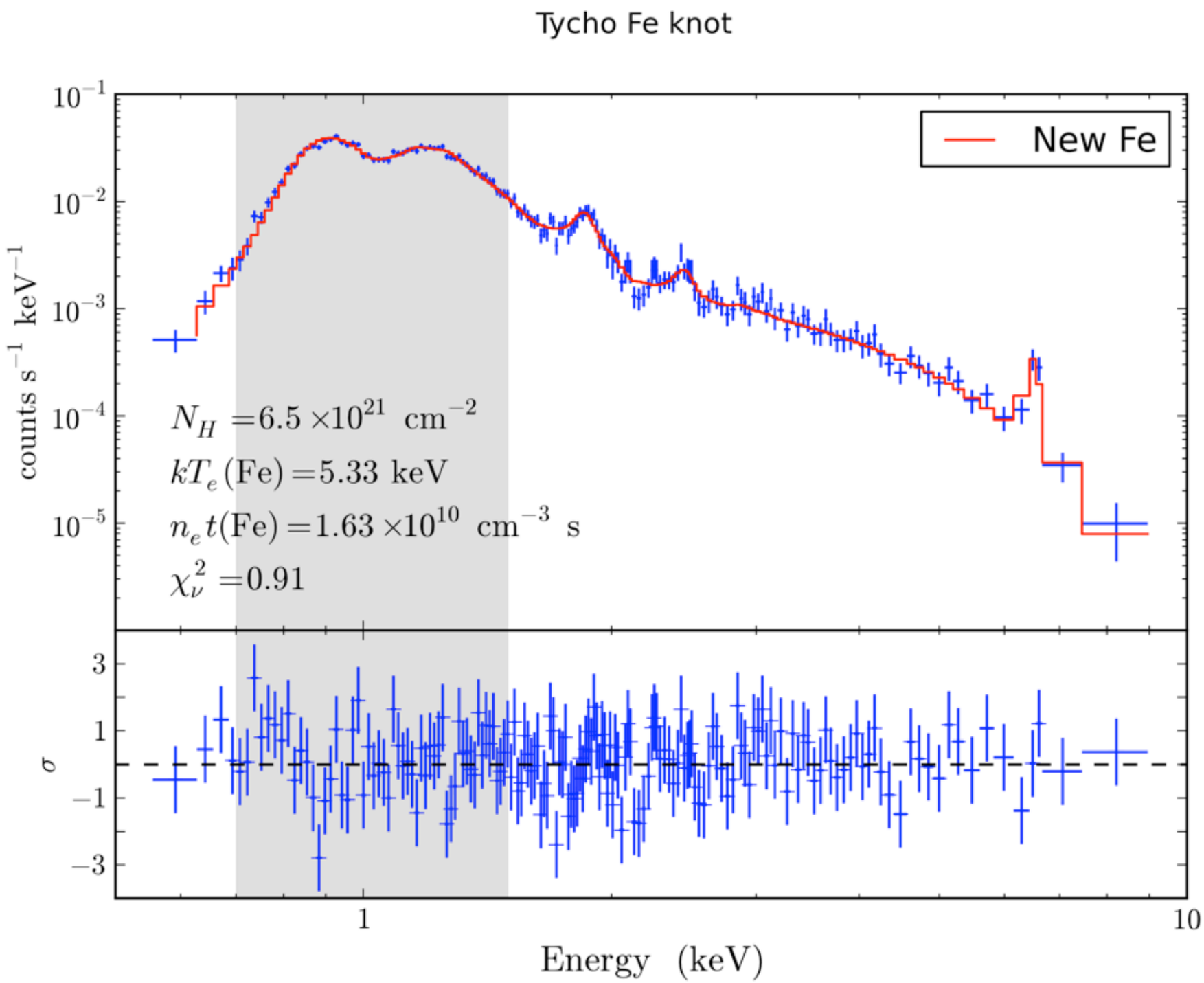
Agreement at Fe K



Tycho Fe knot - XSPEC model

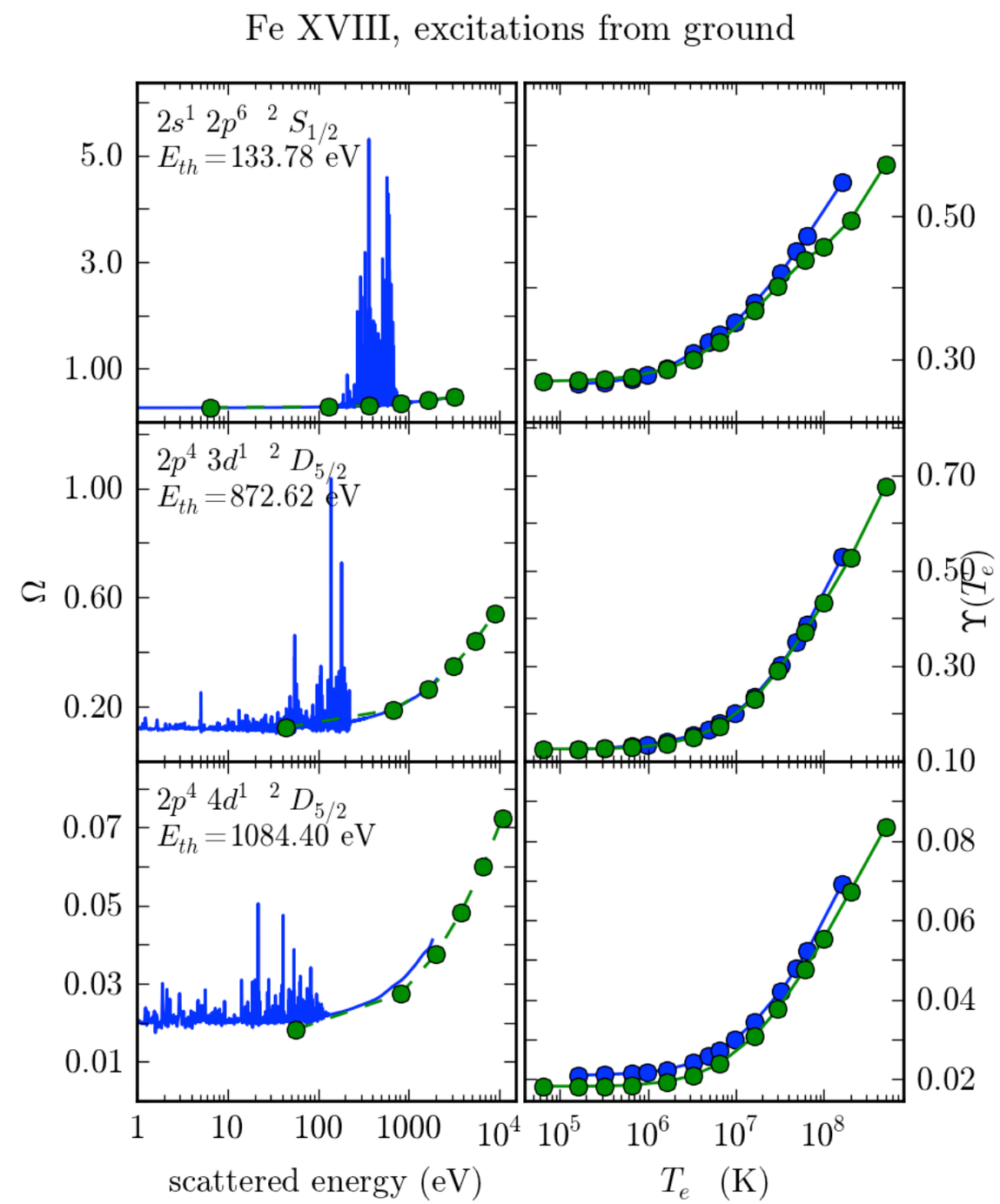


Tycho Fe knot - new Fe model

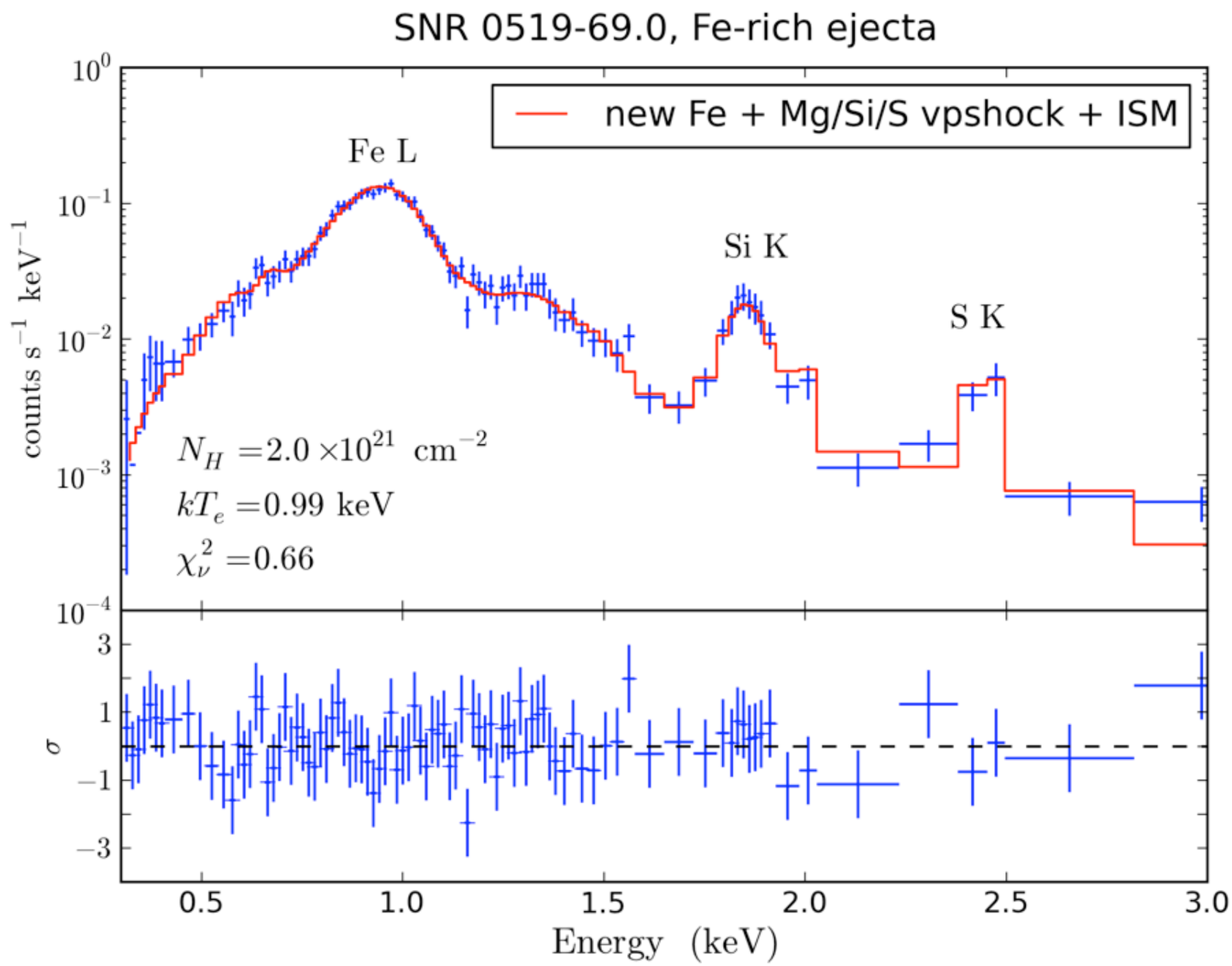


What About Resonances?

- Resonance structure affects the L-shell collision strengths near threshold.
- For high-T_e NEI plasmas, we're way beyond threshold.
- weak lines most affected -- at CCD resolution feel less effect.
- probably not true for low-T_e photoionized plasma.

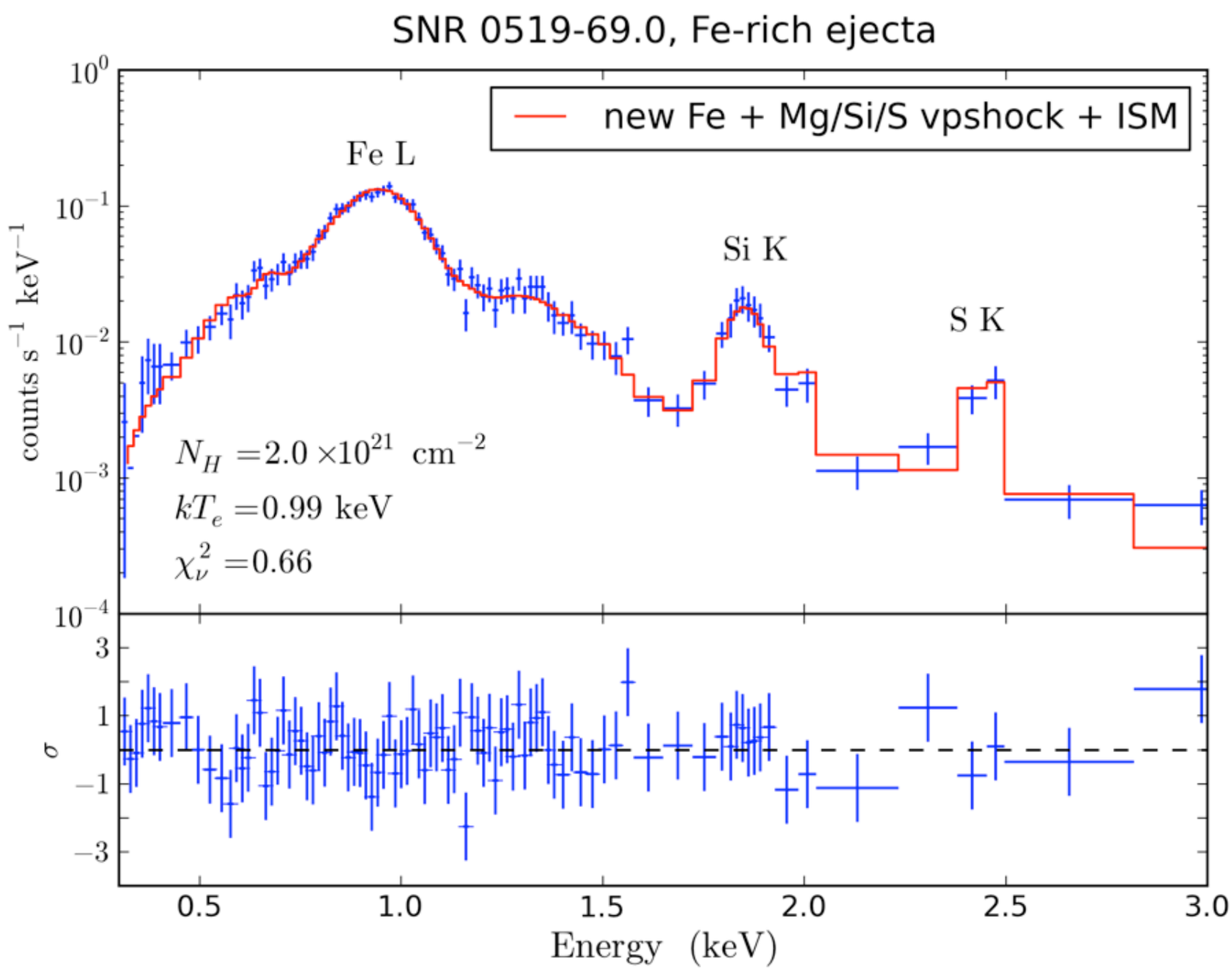


A near-threshold, CIE case: E0519



A near-threshold, CIE case: E0519

- Replaced FAC data with R-matrix data, where available
- < 3% difference in T_e, 5% in norm.
- far less than statistical errors



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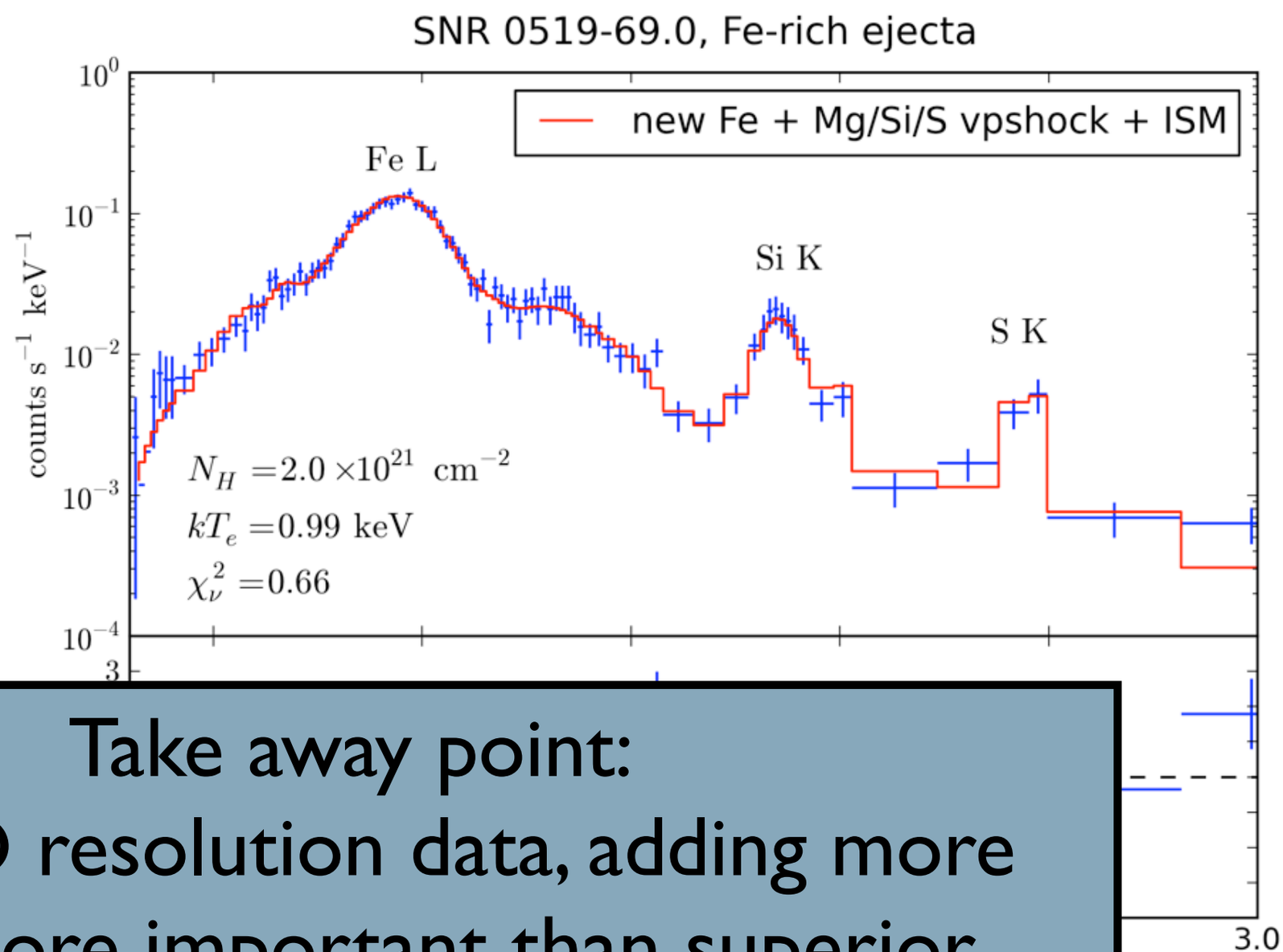
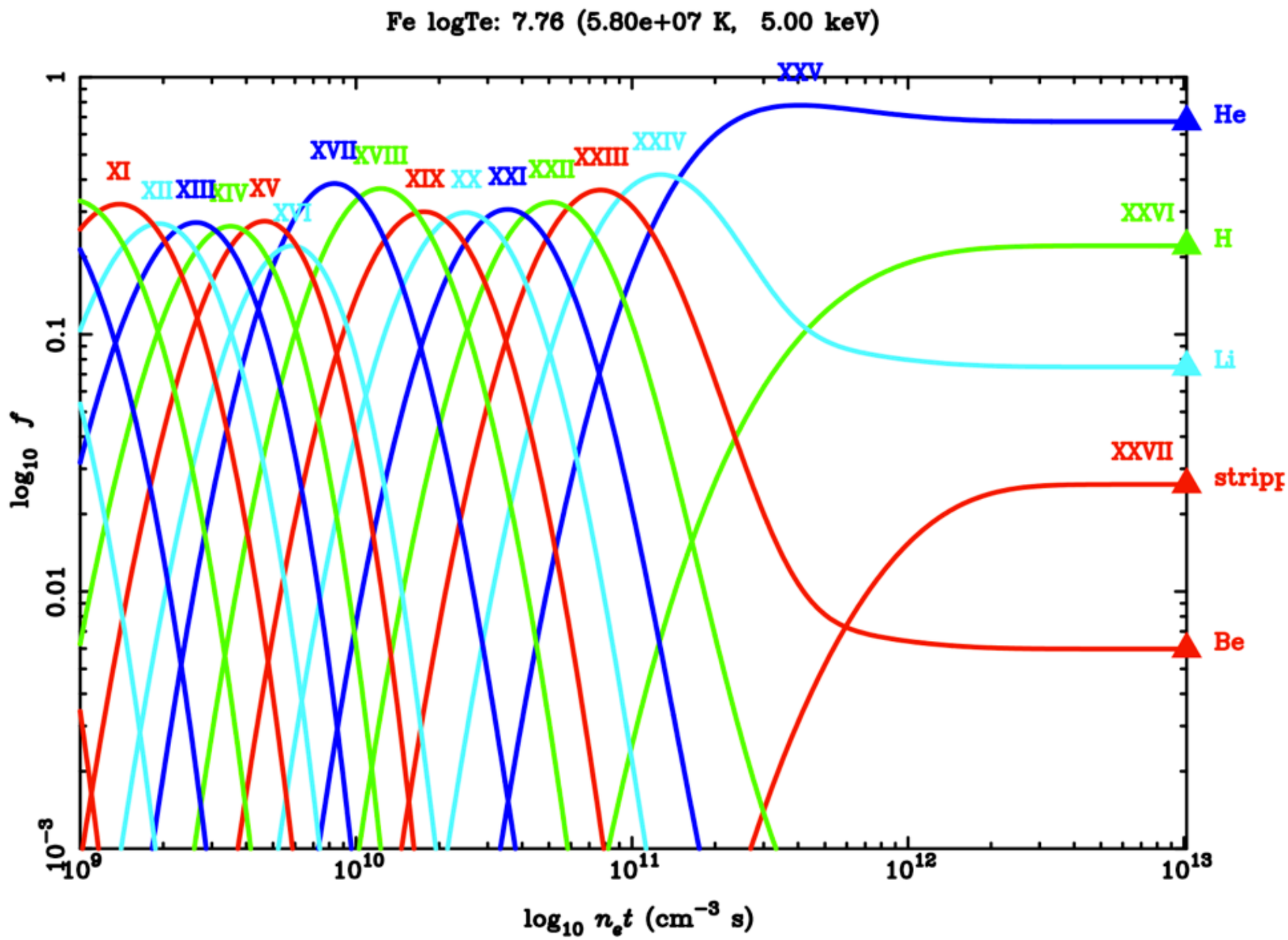
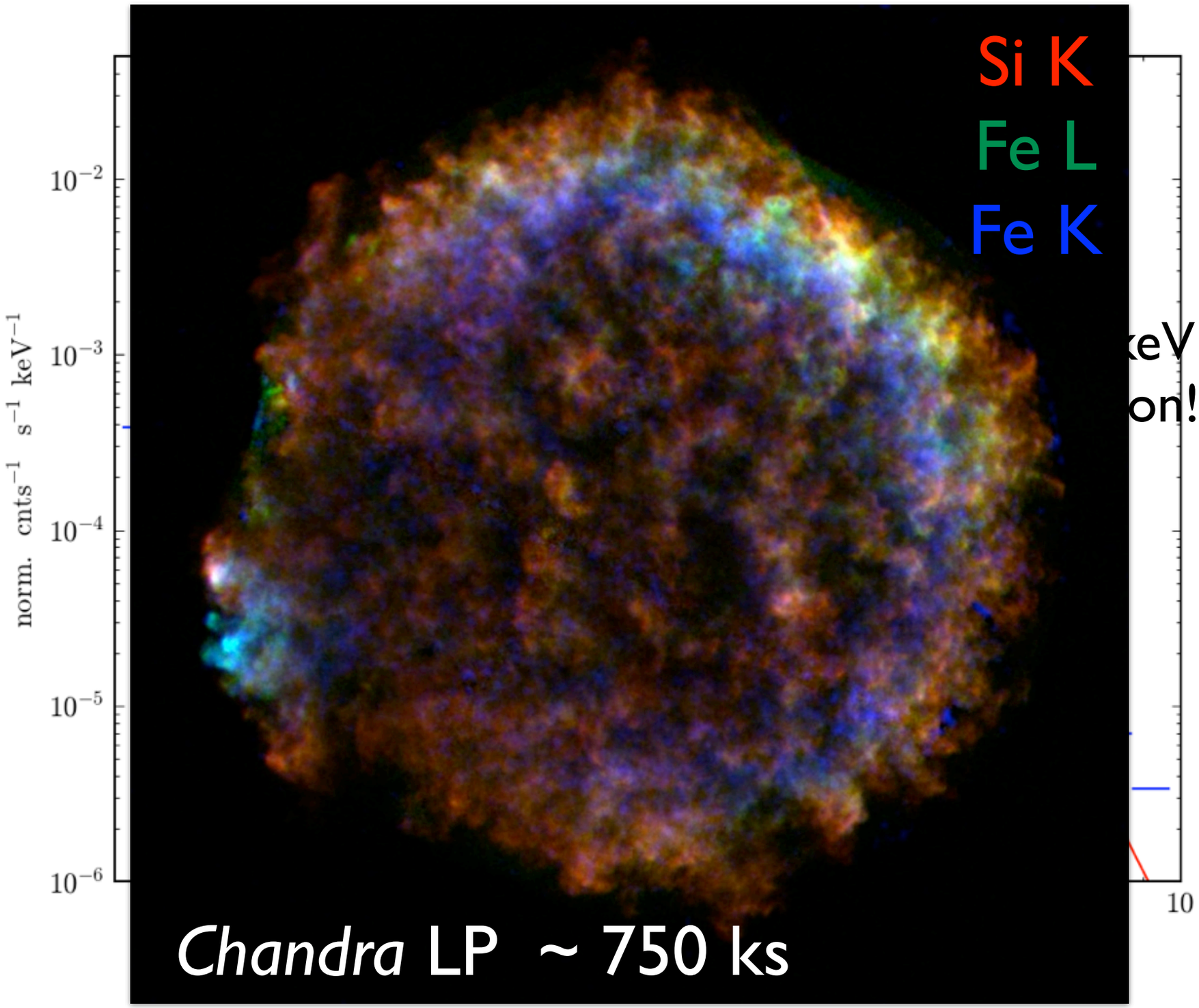


Take away point:
For CCD resolution data, adding more levels more important than superior accuracy atomic data

Why Stop at Ne-like?



Outside the Tycho Fe knot



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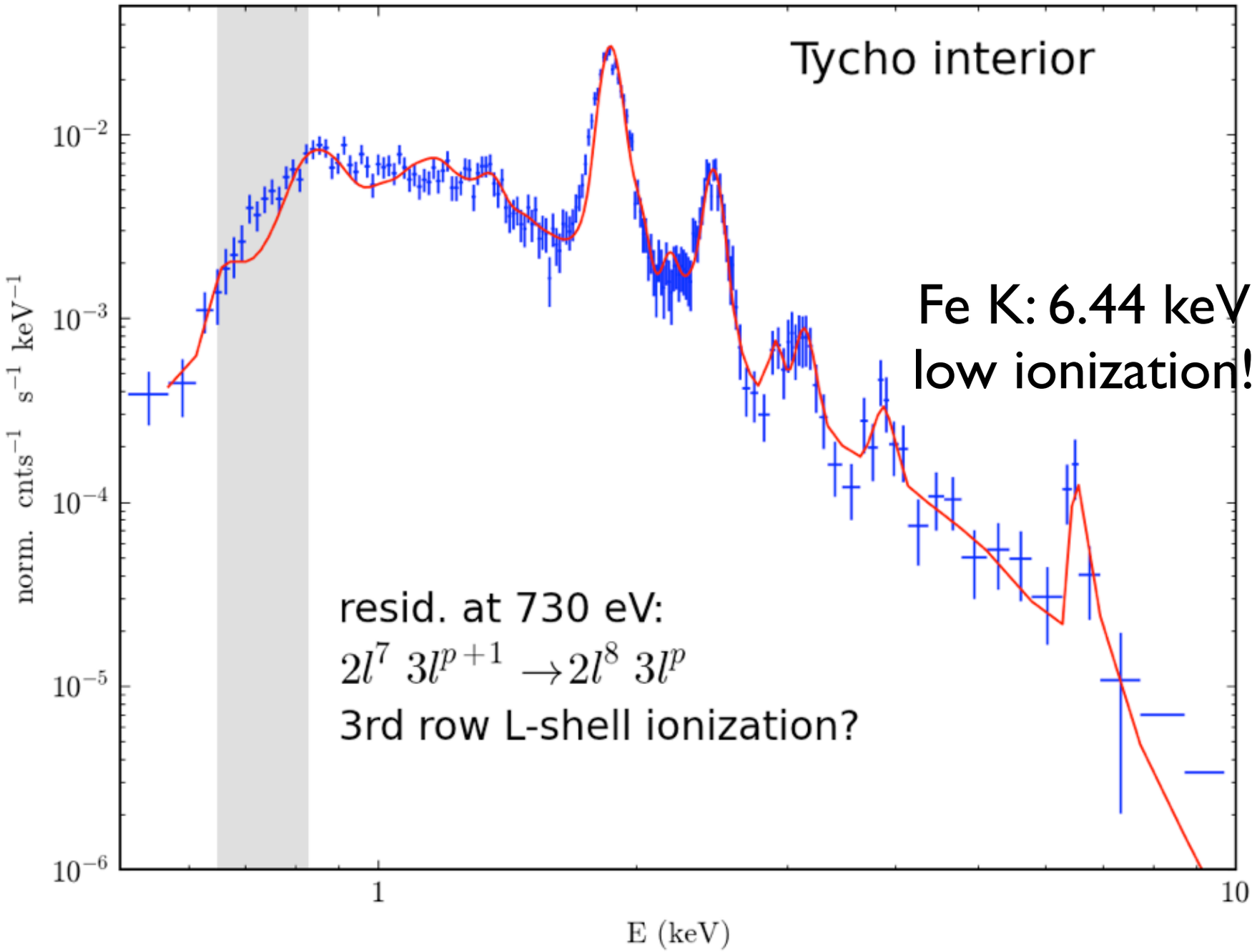
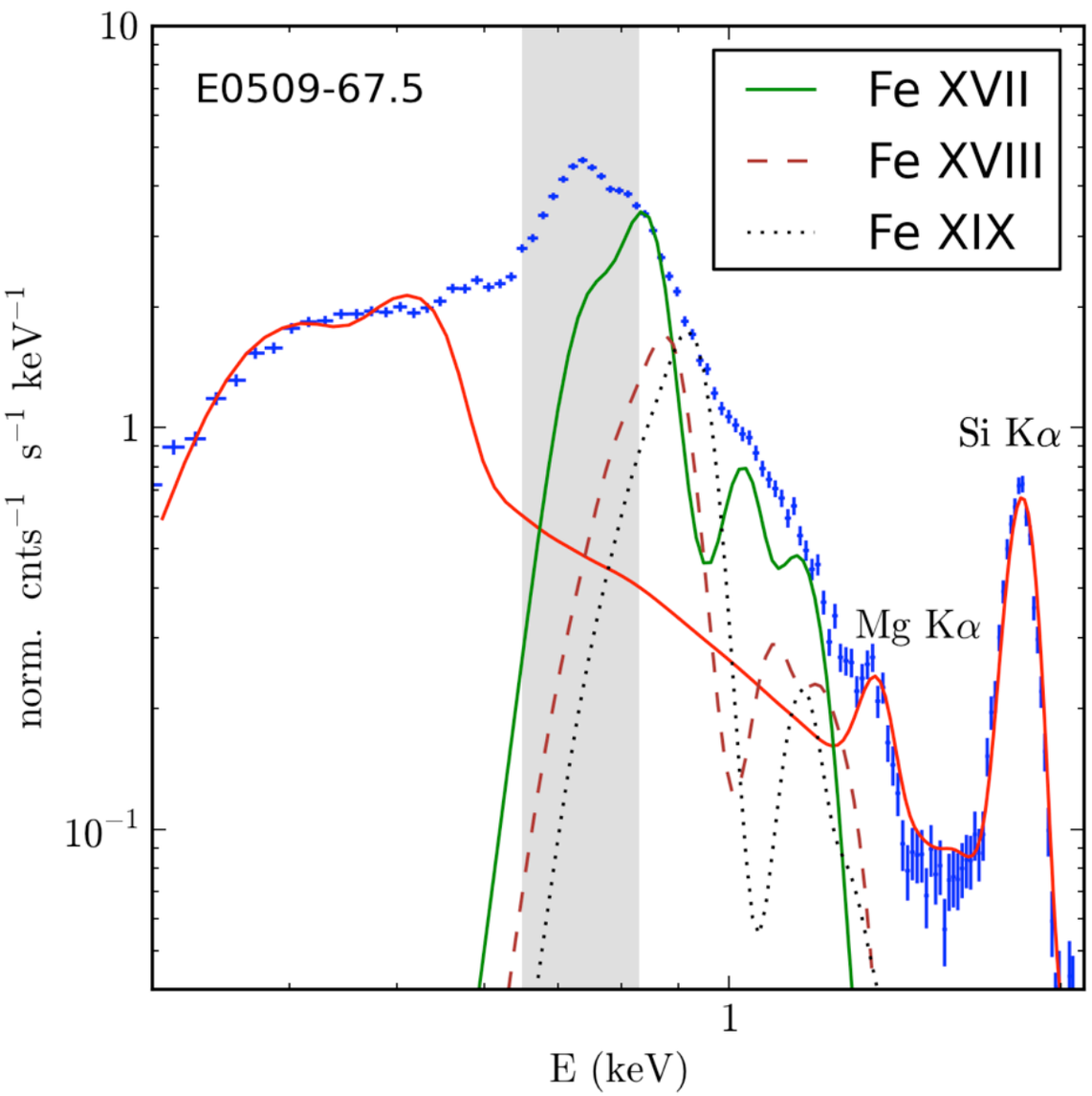
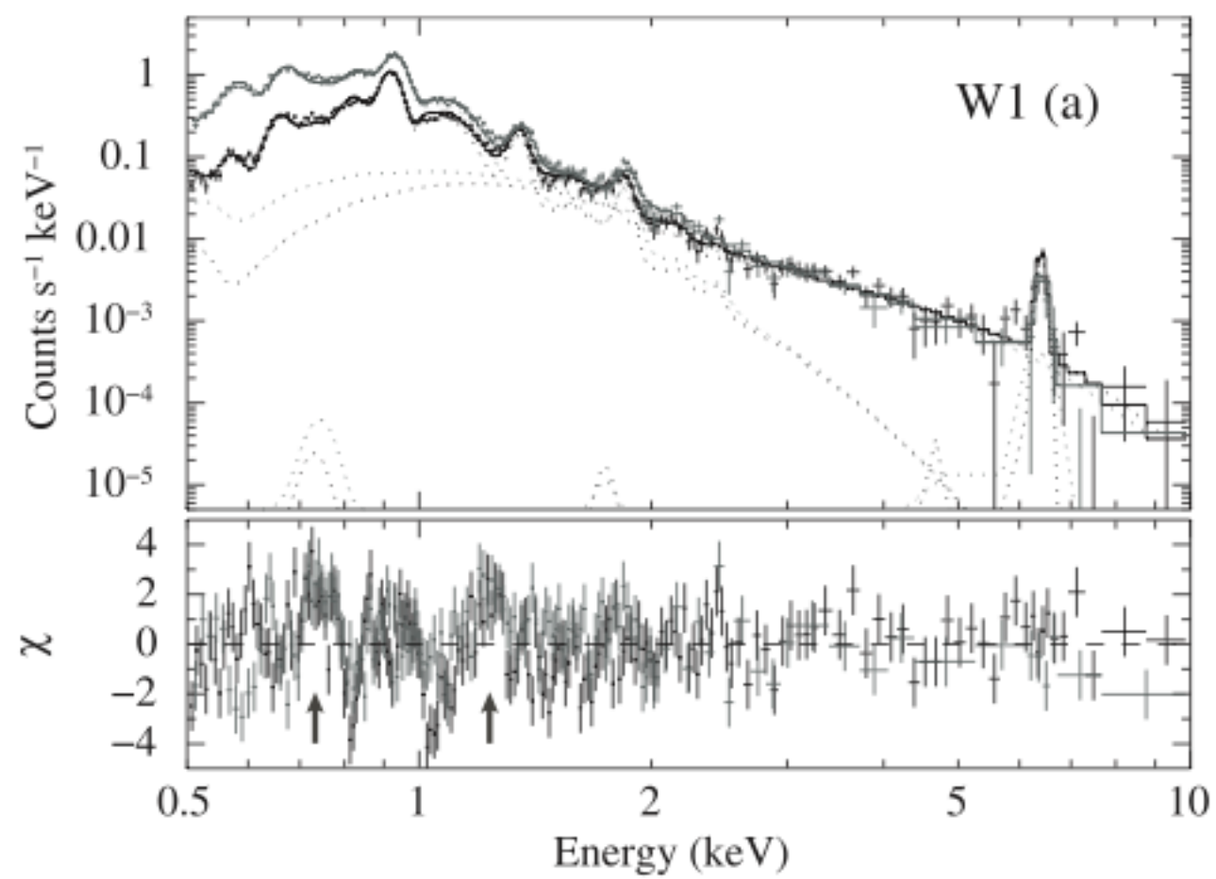


Same 730 eV residual



RCW 86 (Yamaguchi+ 2011)

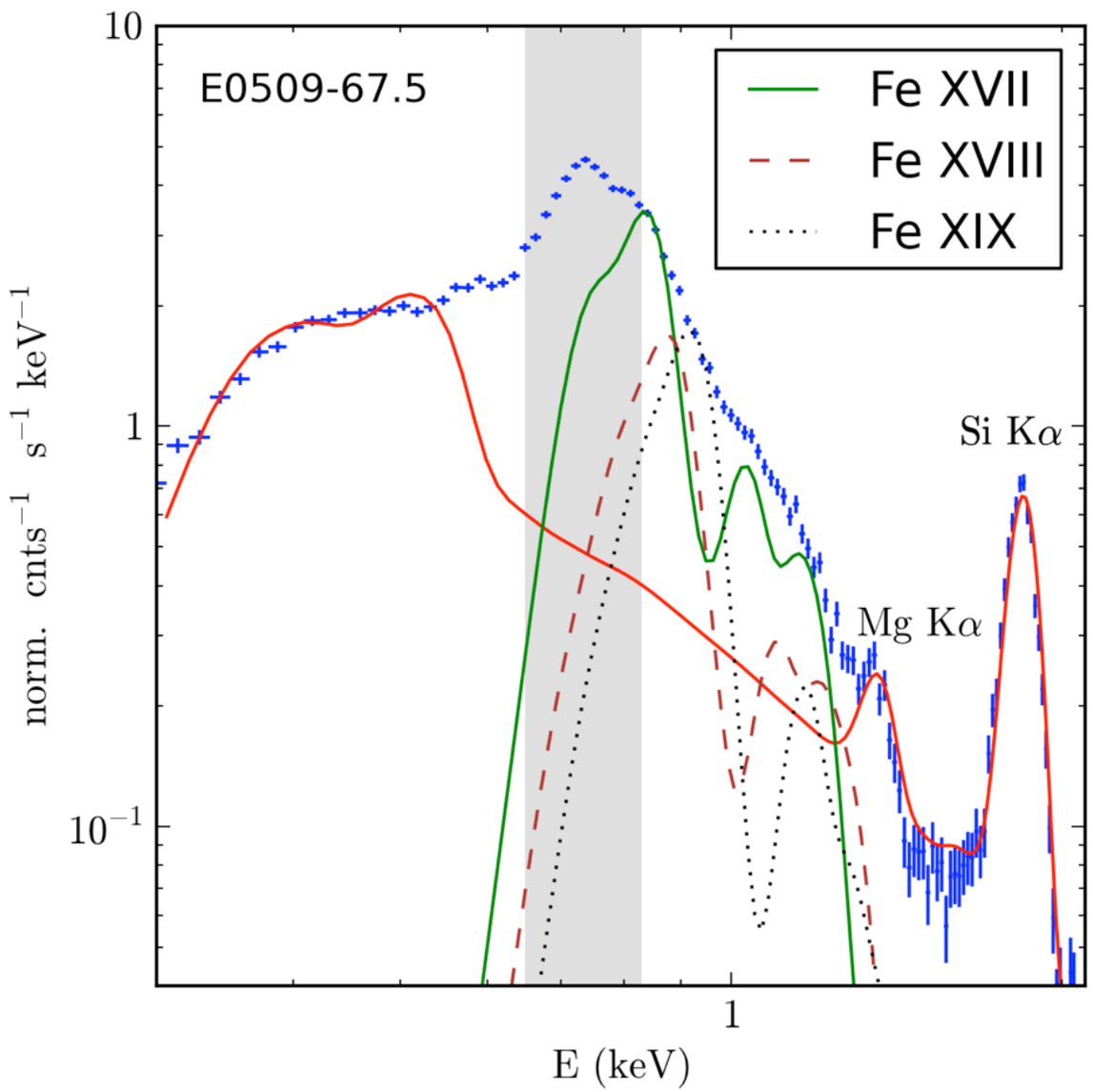


New FAC Calculations

ion	n_{max}	levels	spectrum
Fe XX	8	4073	converged, for comparison
Fe XVI	5	7101	maybe converged?
Fe XV	3	1463	not converged
Fe XIV	3	4936	not converged

unwieldy for FAC, LANL codes work in progress

Low Ionization Fe: E0509-67.5



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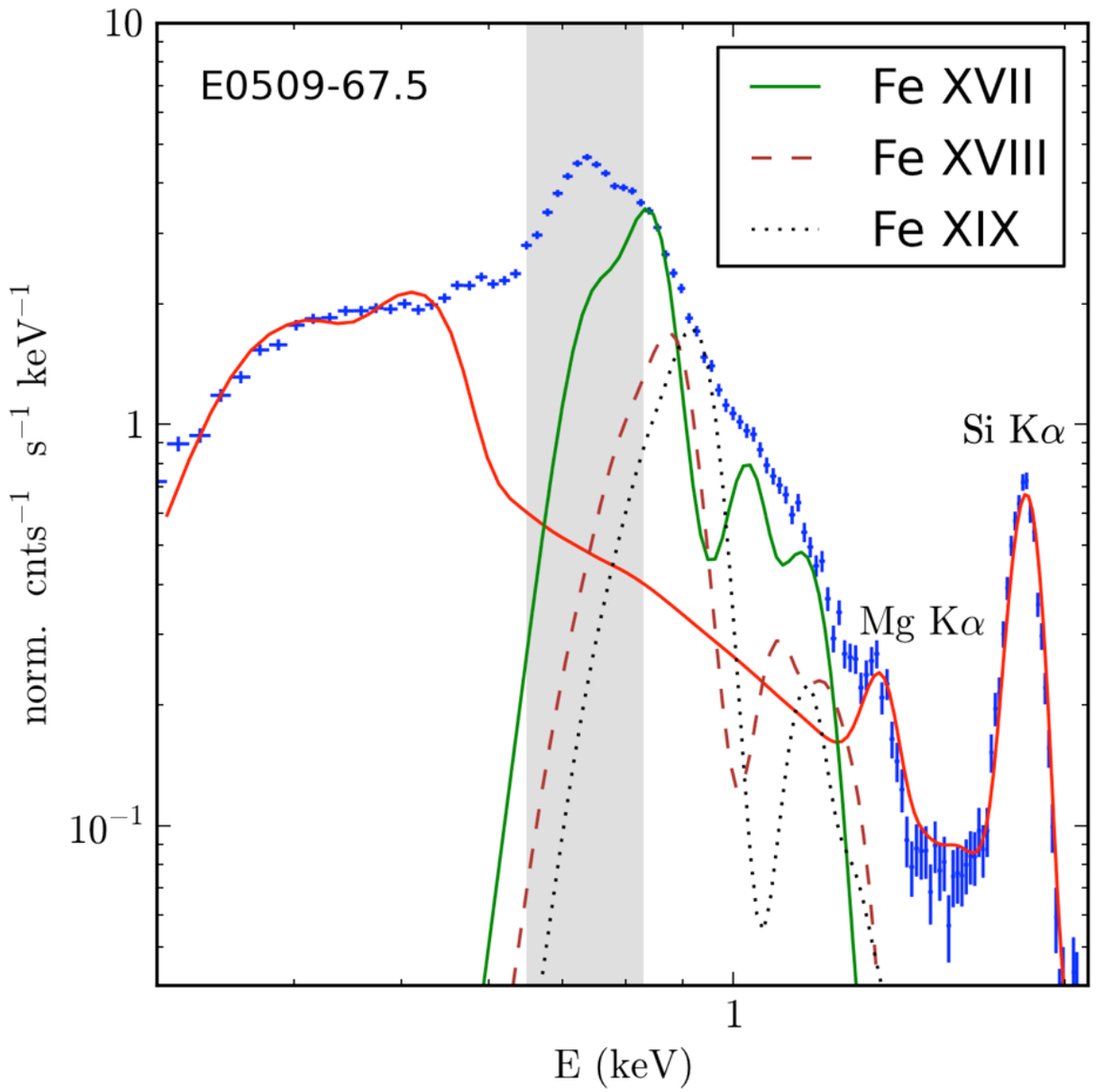

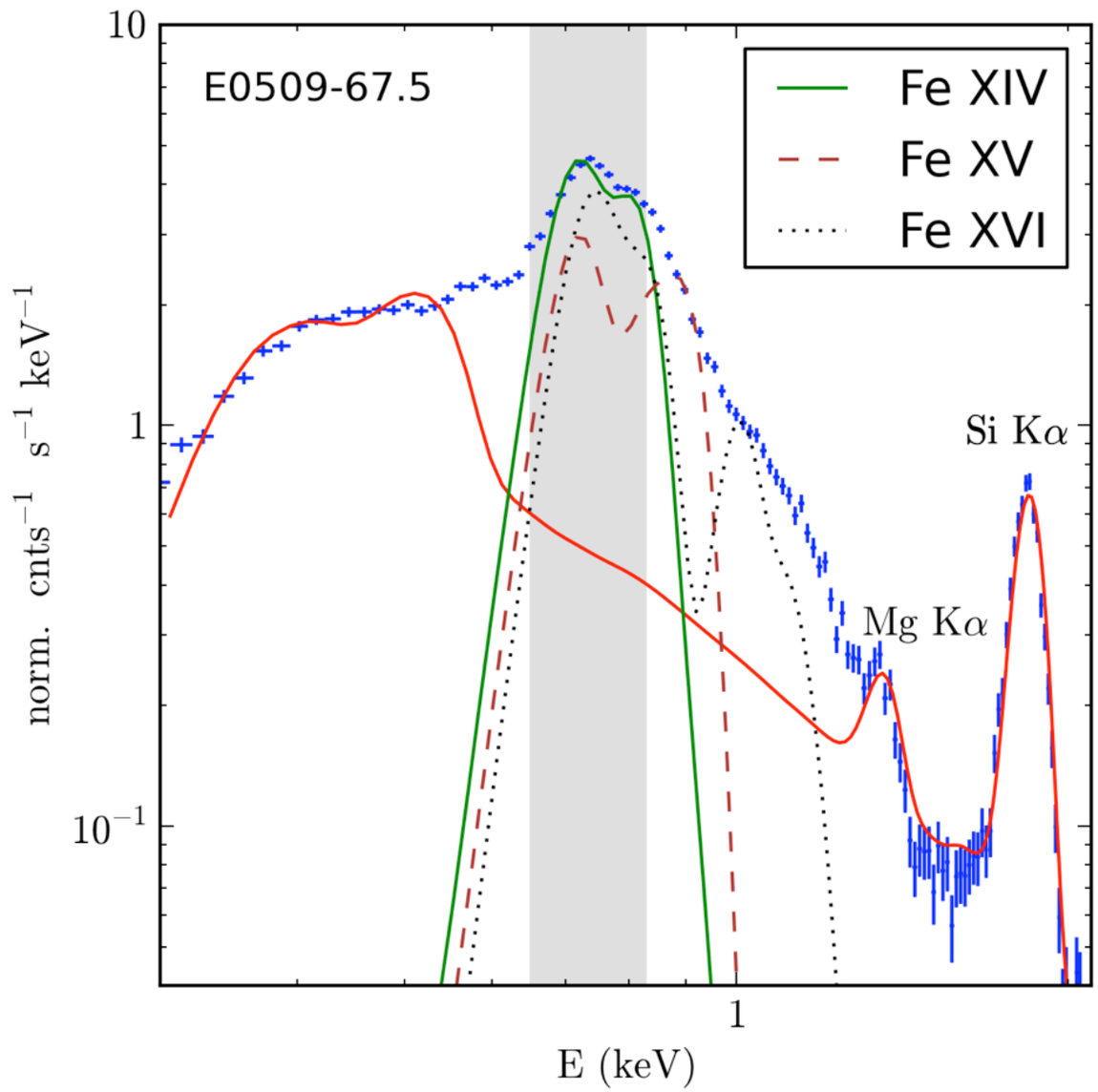

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Summary

- New Fe XVII-XXVI data ready, paper coming soon.
- Major improvement over what's currently available, due to much larger structures
- Will be incorporated into AtomDB soon.
- Some young SNRs show evidence for lower Fe ion states
  - much more challenging atomic physics problem: can guarantee that what's in XSPEC now is not very good.
  - be very cautious of low $n_e t$, know your charge states!
  - minor Fe-peak elements (Cr, Mn, Co, Ni) calculations complete as well