AtomDB 2.0: New Atomic Data for X-Ray Astrophysics

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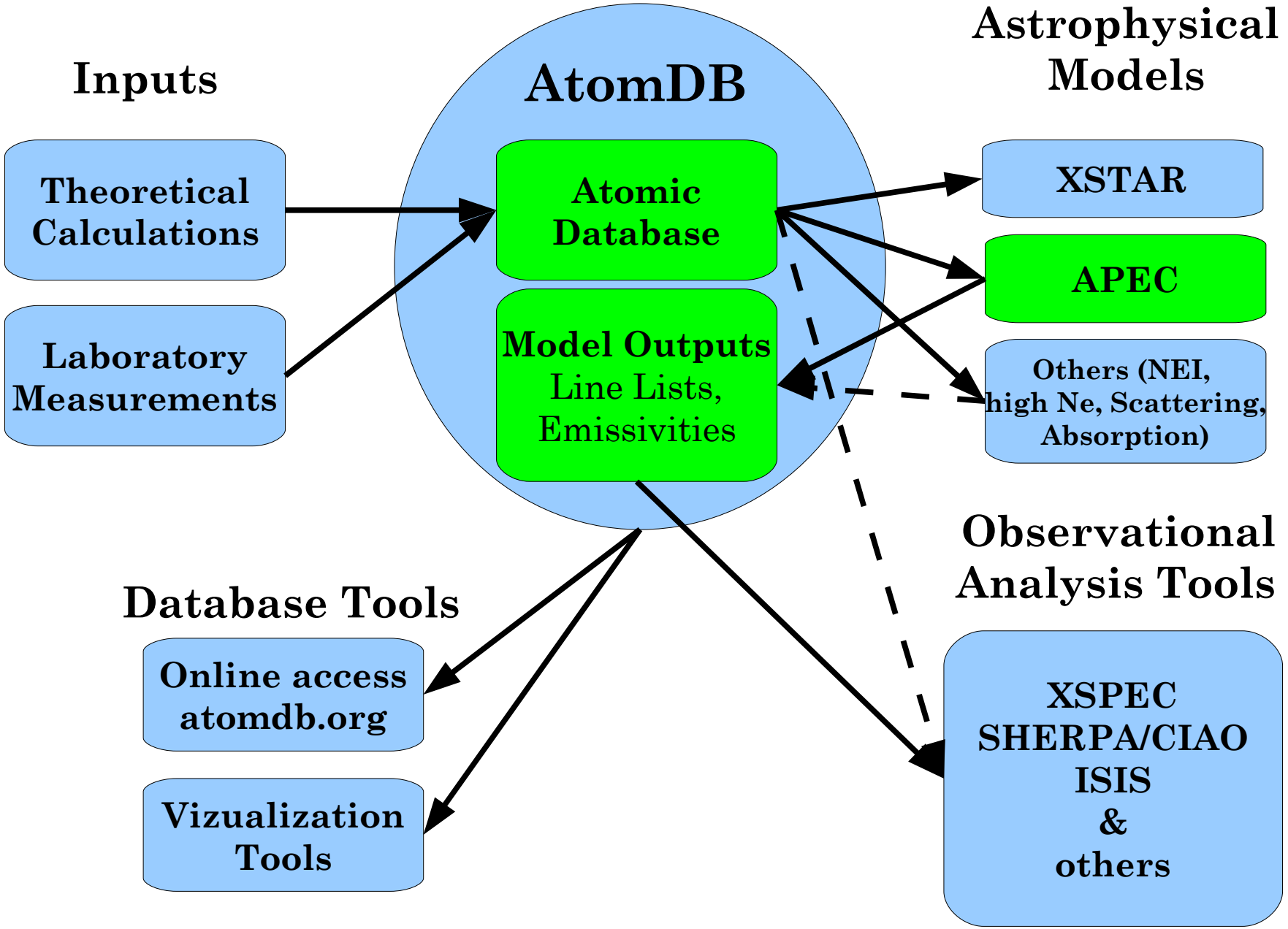
What is it?


Inputs
AtomDB
Astrophysical Models
Theoretical Calculations
Laboratory Measurements
Atomic Database
Model Outputs
Line Lists,
Emissivities
XSTAR
APEC
Others (NEI, high Ne, Scattering, Absorption)
Database Tools
Online access atomdb.org
Vizualization Tools
Observational Analysis Tools
XSPEC
SHERPA/CIAO
ISIS
&
others

Differences from ADAS?

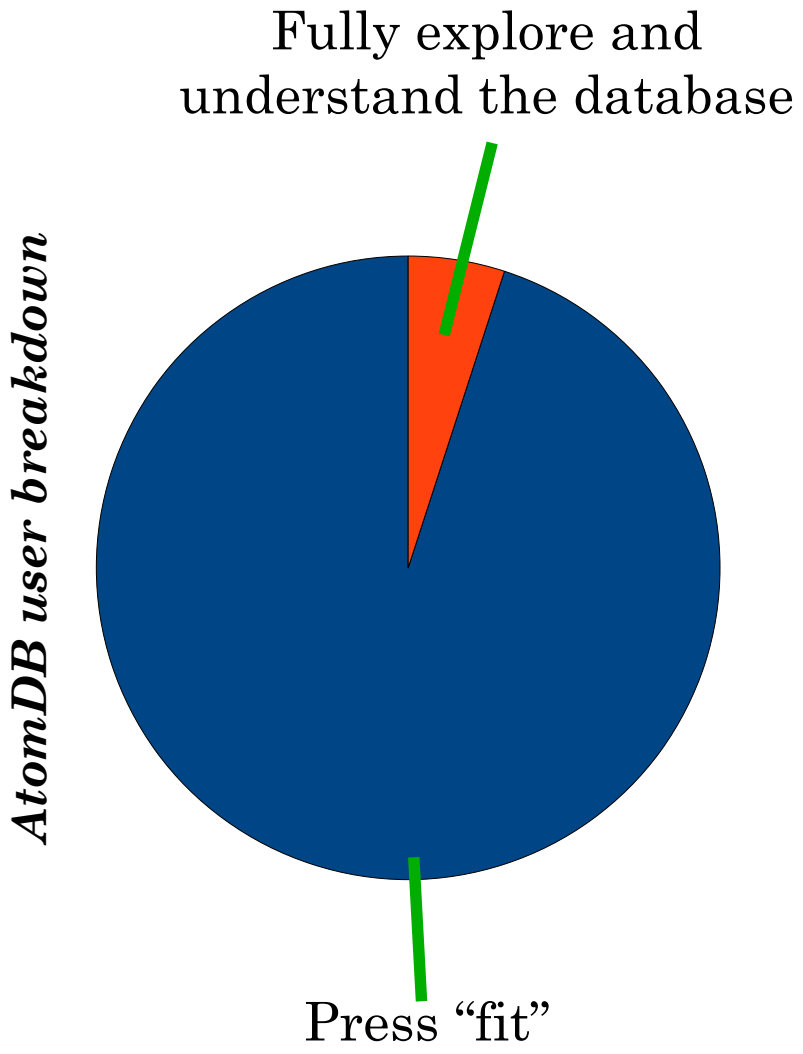
- No attempt to produce atomic data
- Focused on X-rays only, tied strongly to mission needs
- Value completeness over correctness [both preferable!]
- Must provide simple outputs for fitting codes
- Standard output is:

  emissivity * ion abundance * element abundances

User Breakdown

We have to select a “best” data set.

In reality, this is the only one that gets used in most cases.

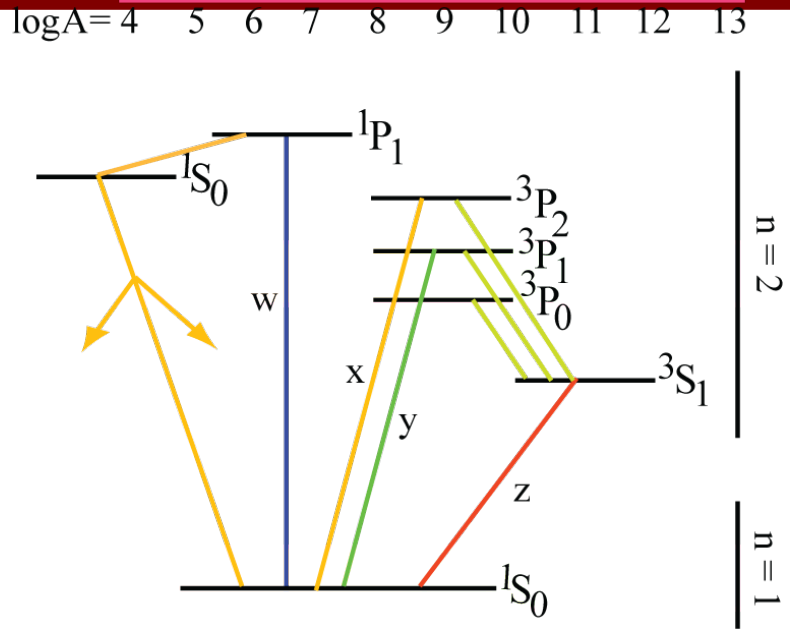


New in 2.0

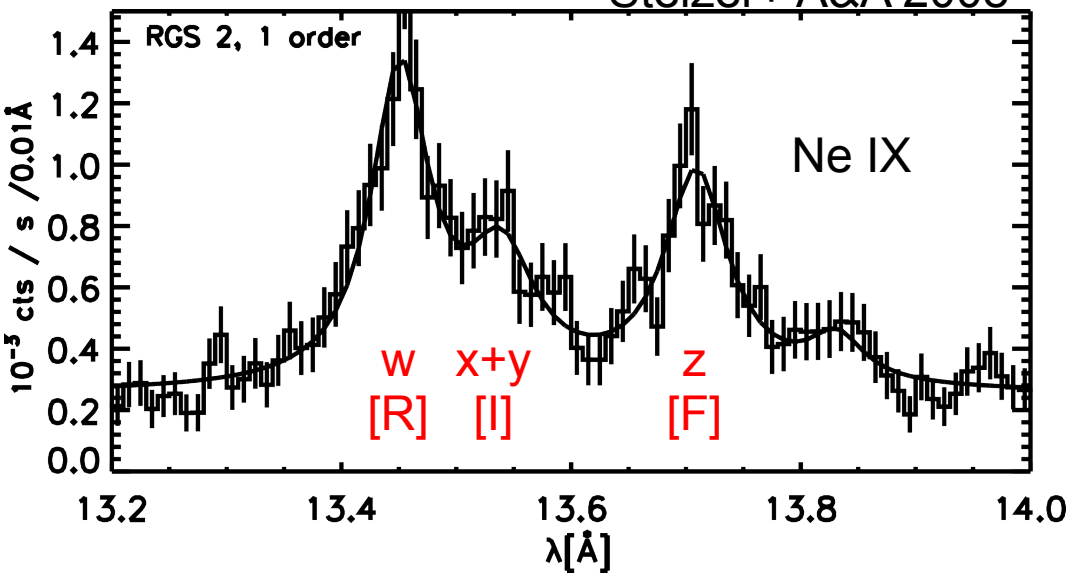
Nearly every single piece of data replaced:

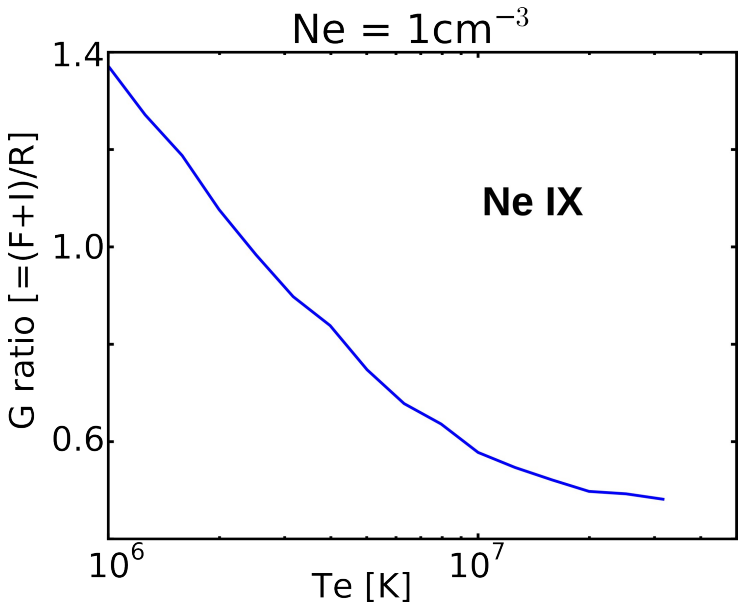
- He like data (Whiteford)
- H like data (various)
- Fe L-shell data (Iron Project)
- DR & RR data (Badnell)
- Ionization balance (Bryans)
- Data for (astrophysically) rare elements

He-like Diagnostic Ratios



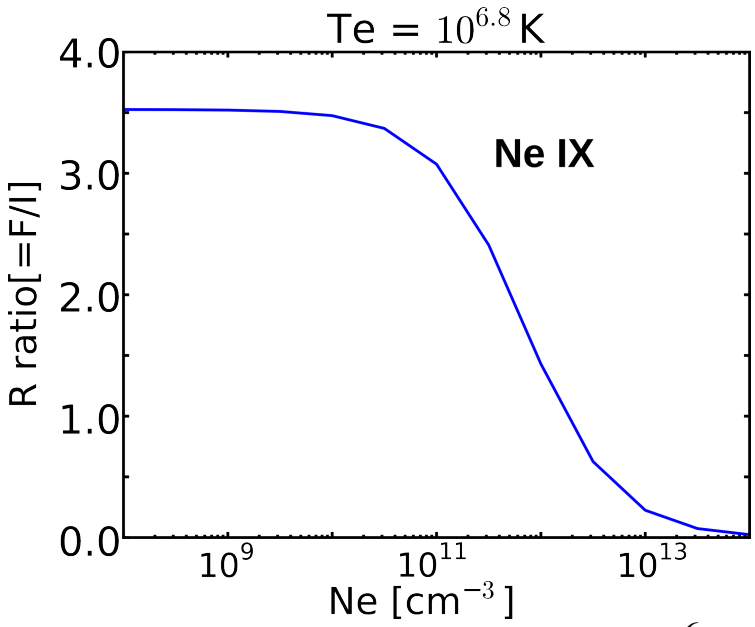
Stelzer+ A&A 2008





G = (F+I)/R

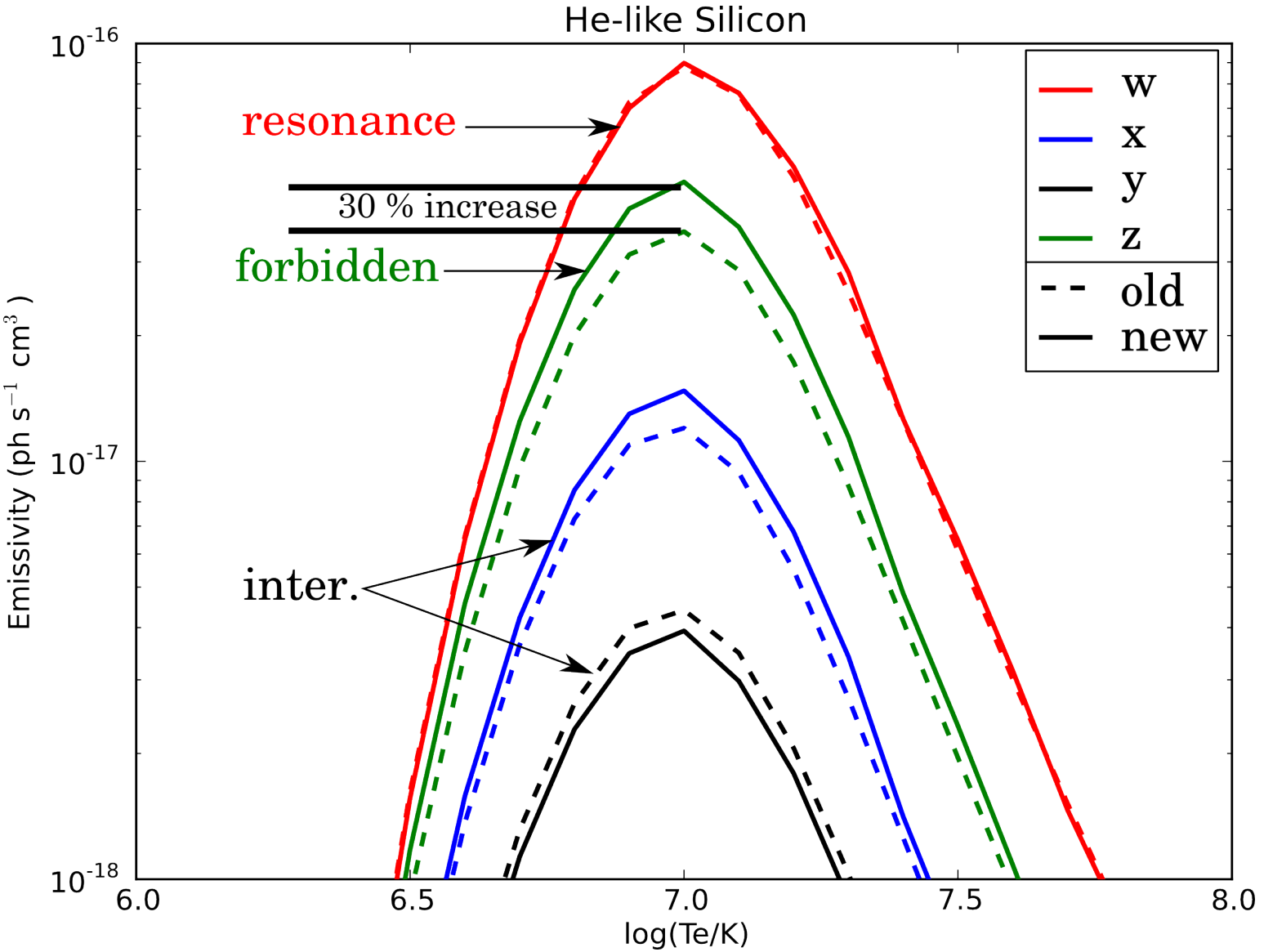
R = (F/I)



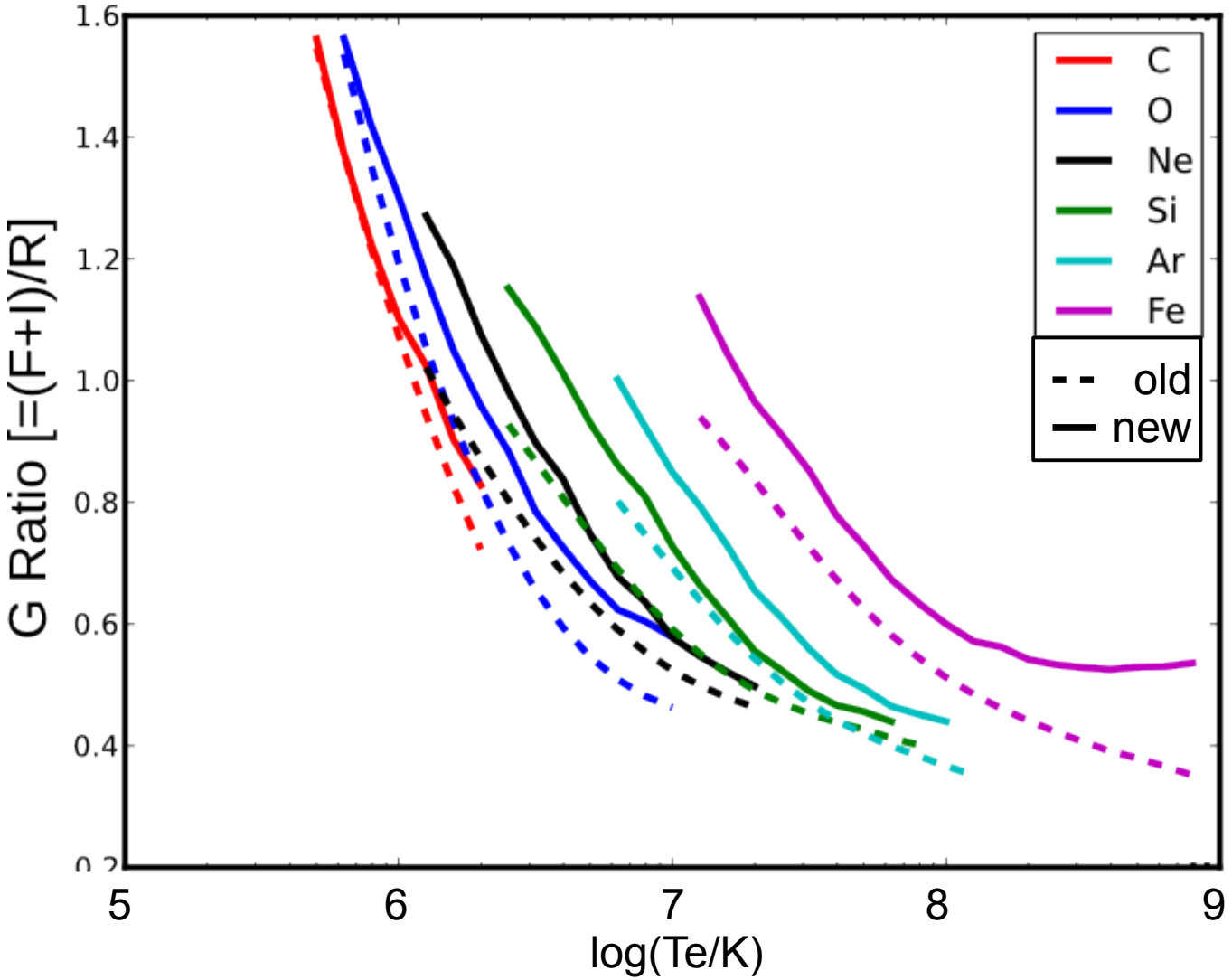
New He-like data

- Collision strengths for n<6 from ICFT R-matrix
- For 5<n<11 from FAC
- Energies and A-values from Autostructure.
- State selective recombination from RR, DR processes
- Projection matrices used for high n cascade
- New ionization balance

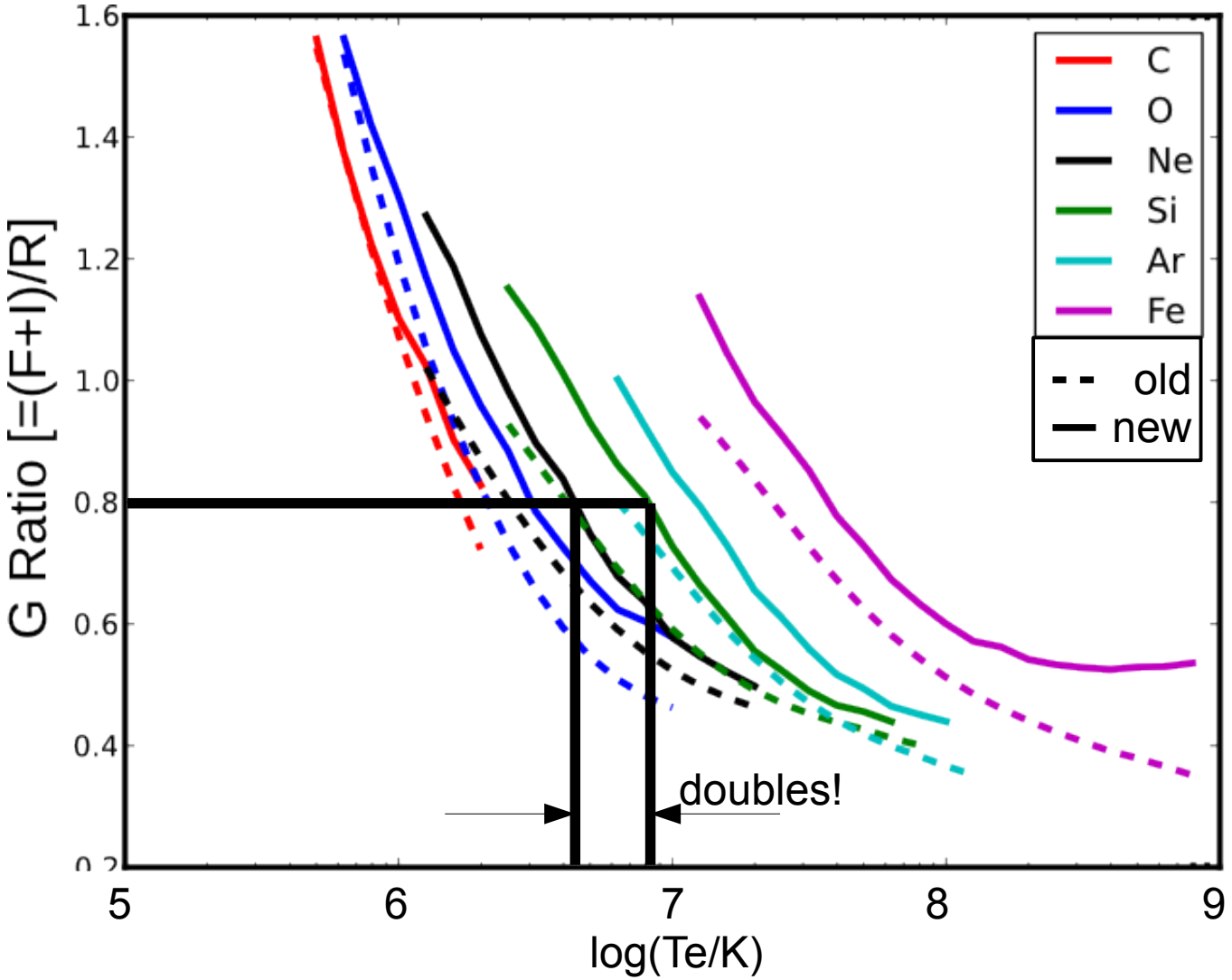
He-like Silicon



G ratios for He-like Ions

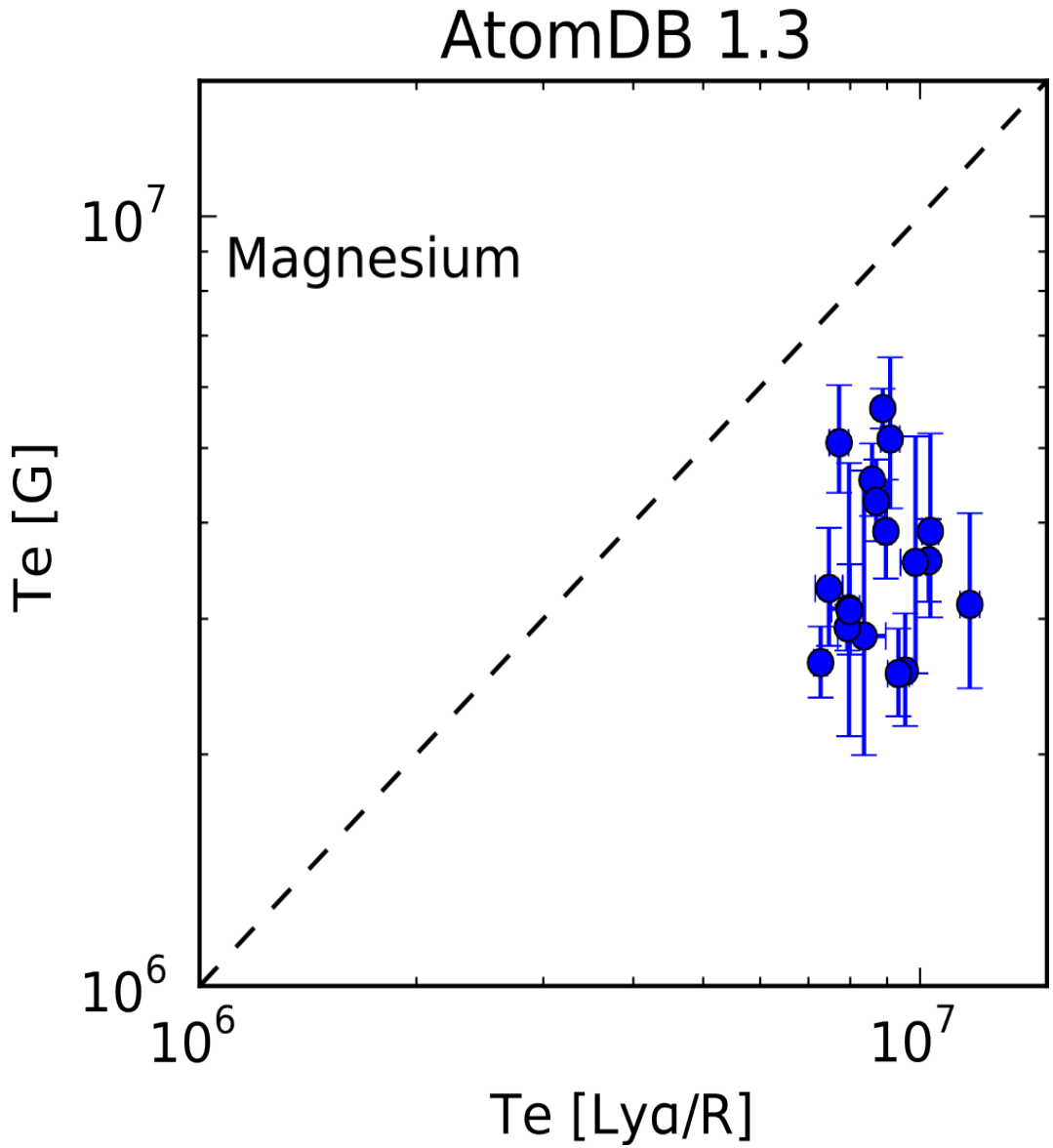


G ratios for He-like Ions



Identified Problem

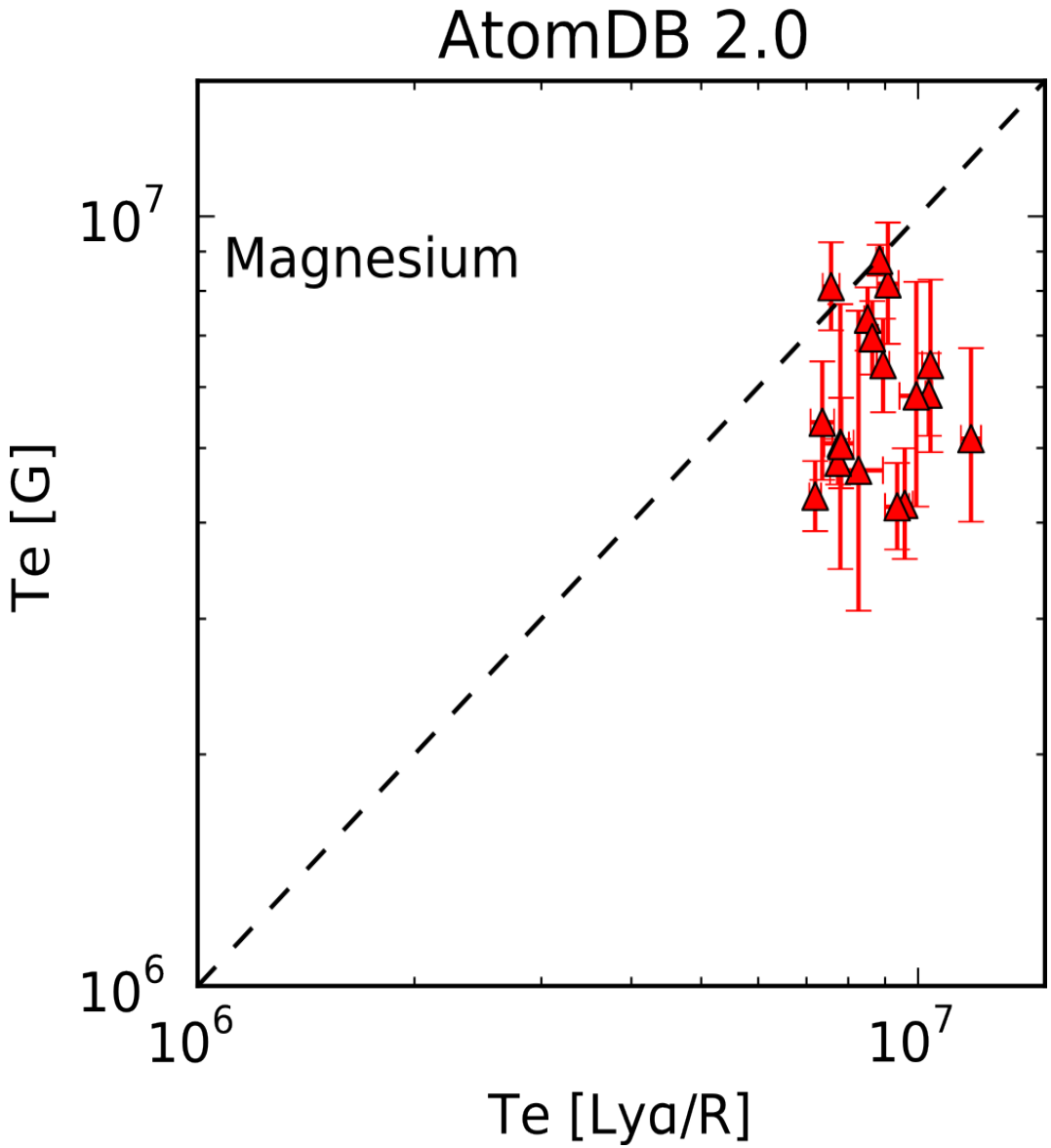
Testa+ 2004:
Temperatures obtained from G ratios are consistently smaller than those from the Ly-α to He-like resonance line ratio



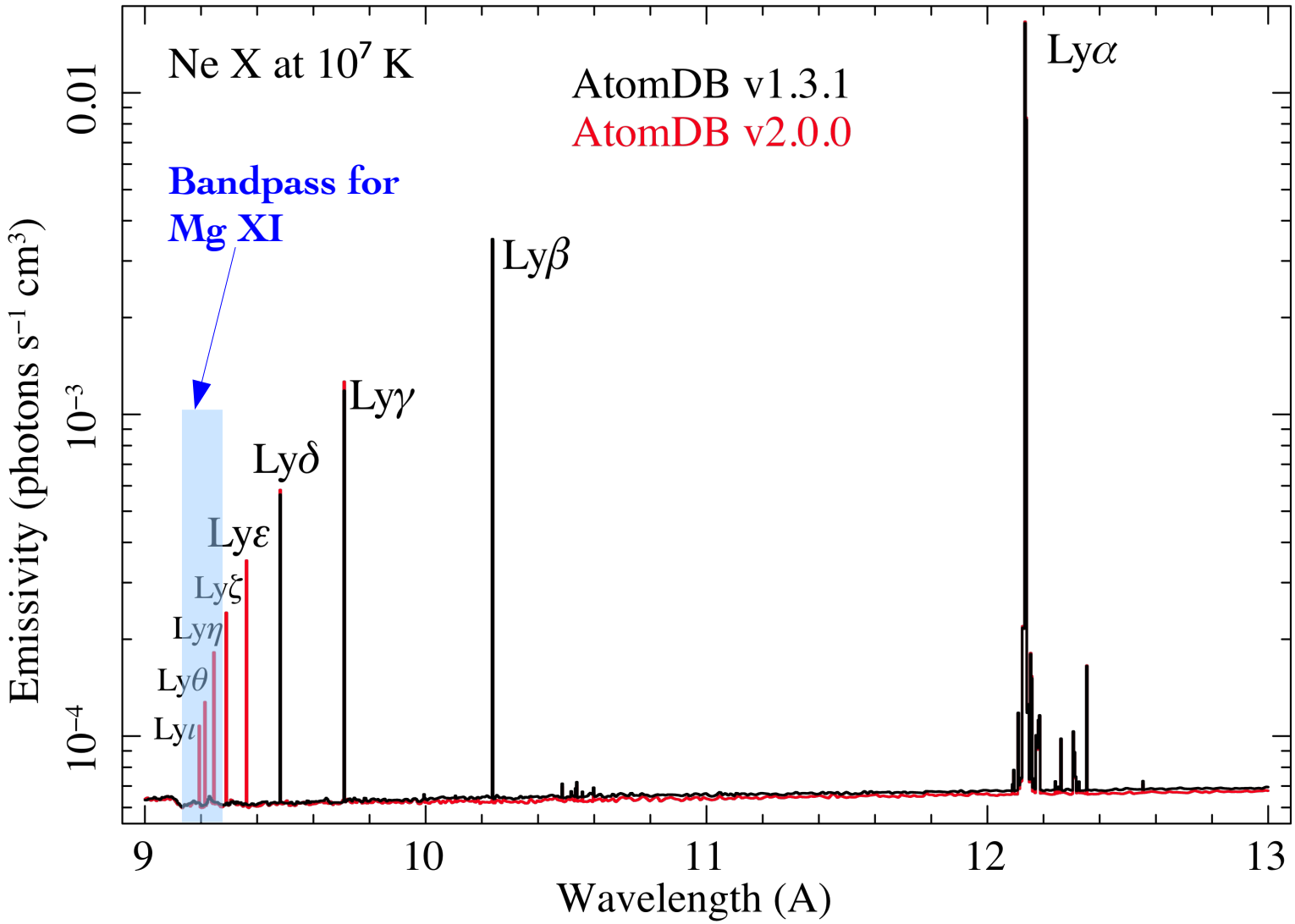
Solved Problem(?)

Testa+ 2004:
Temperatures obtained from G ratios are consistently smaller than those from the Ly-α to He-like resonance line ratio

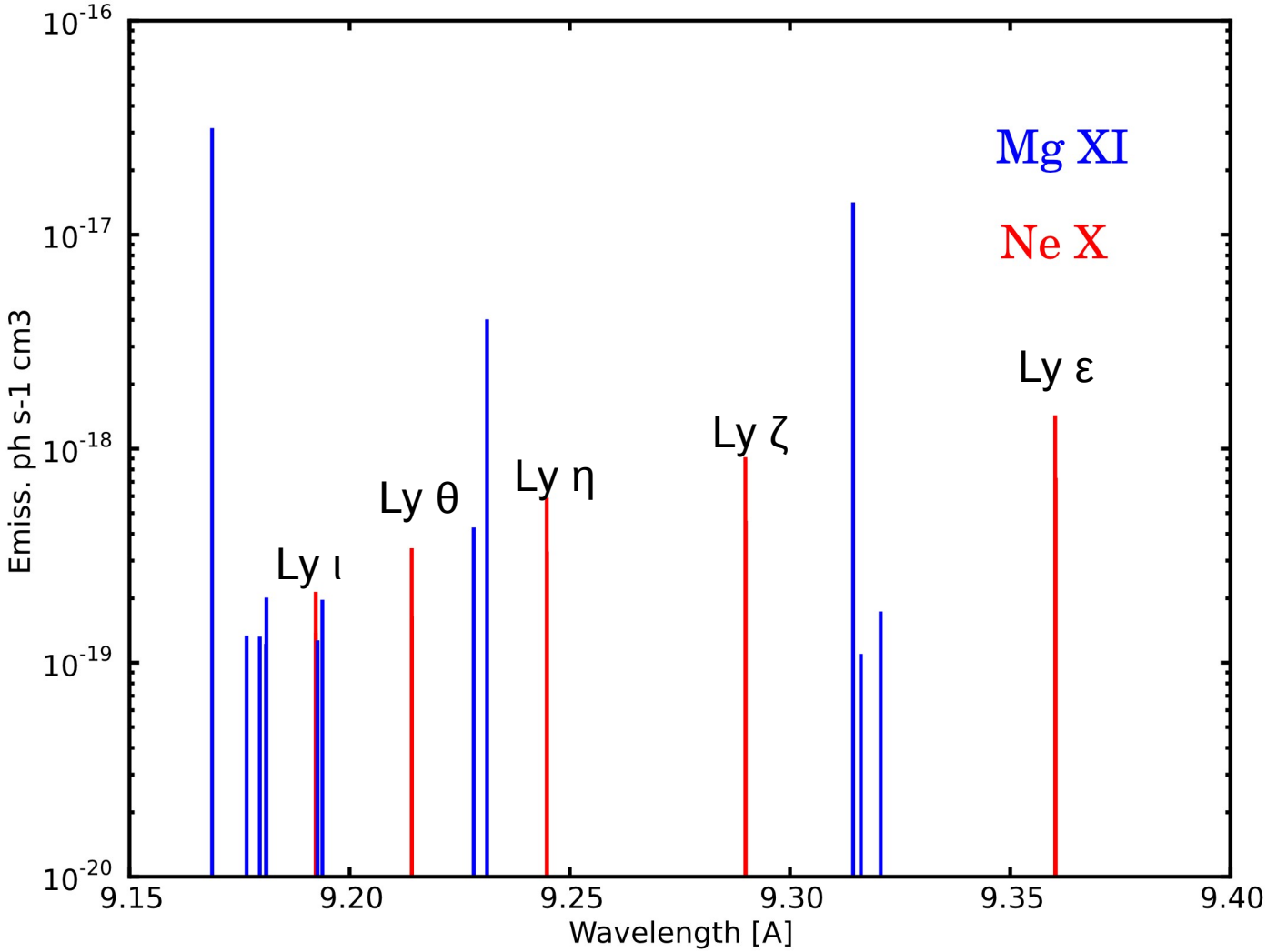
New data significantly reduces this discrepancy



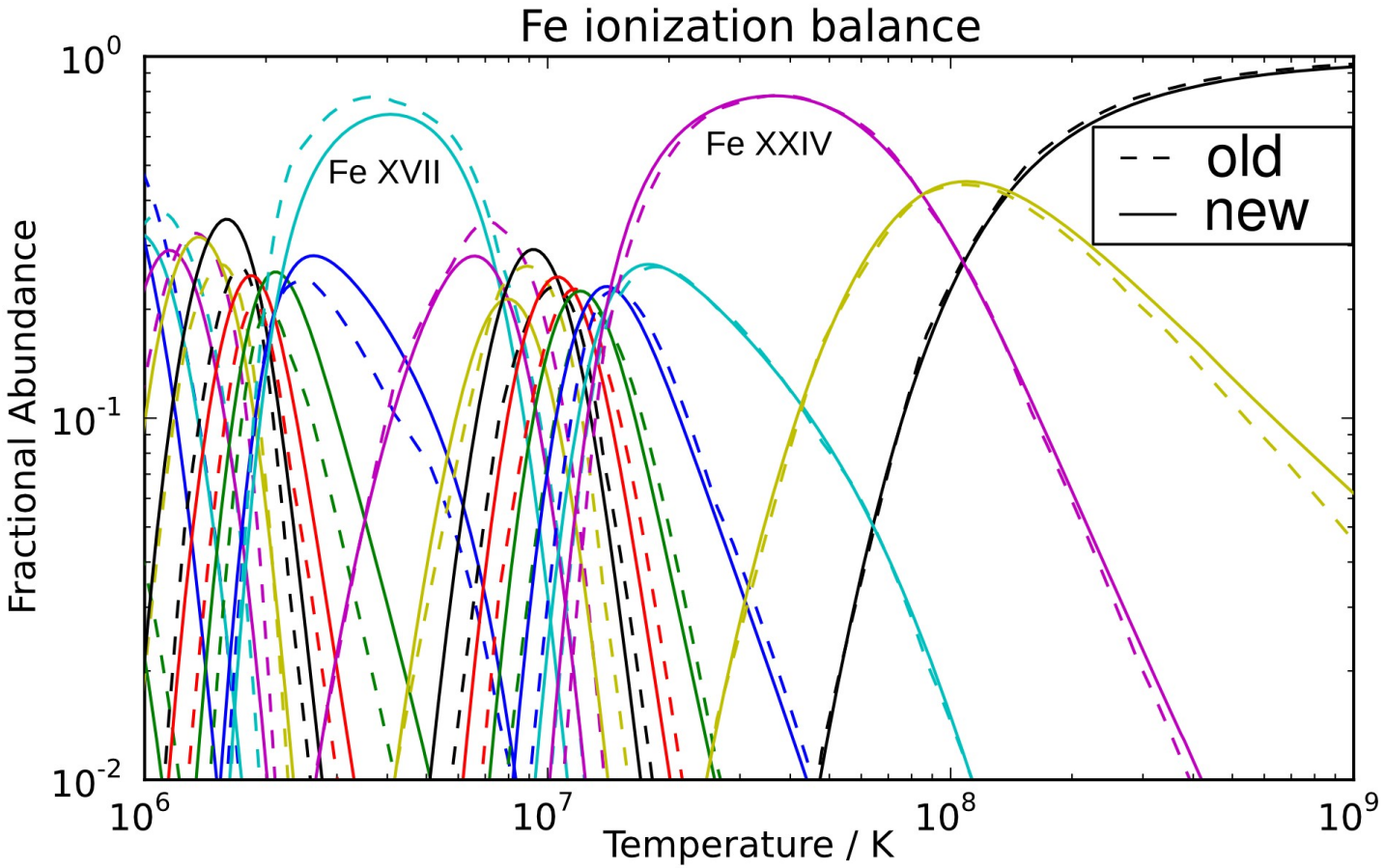
H-like Neon


Ne X at 10^7 K
AtomDB v1.3.1
AtomDB v2.0.0
Bandpass for
Mg XI
Lyα
Lyβ
Lyγ
Lyδ
Lyε
Lyζ
Lyη
Lyθ
Lyι
Emissivity (photons s^{-1} cm^3)
0.01
10^{-3}
10^{-4}
9
10
11
12
13
Wavelength (A)

H-like Neon

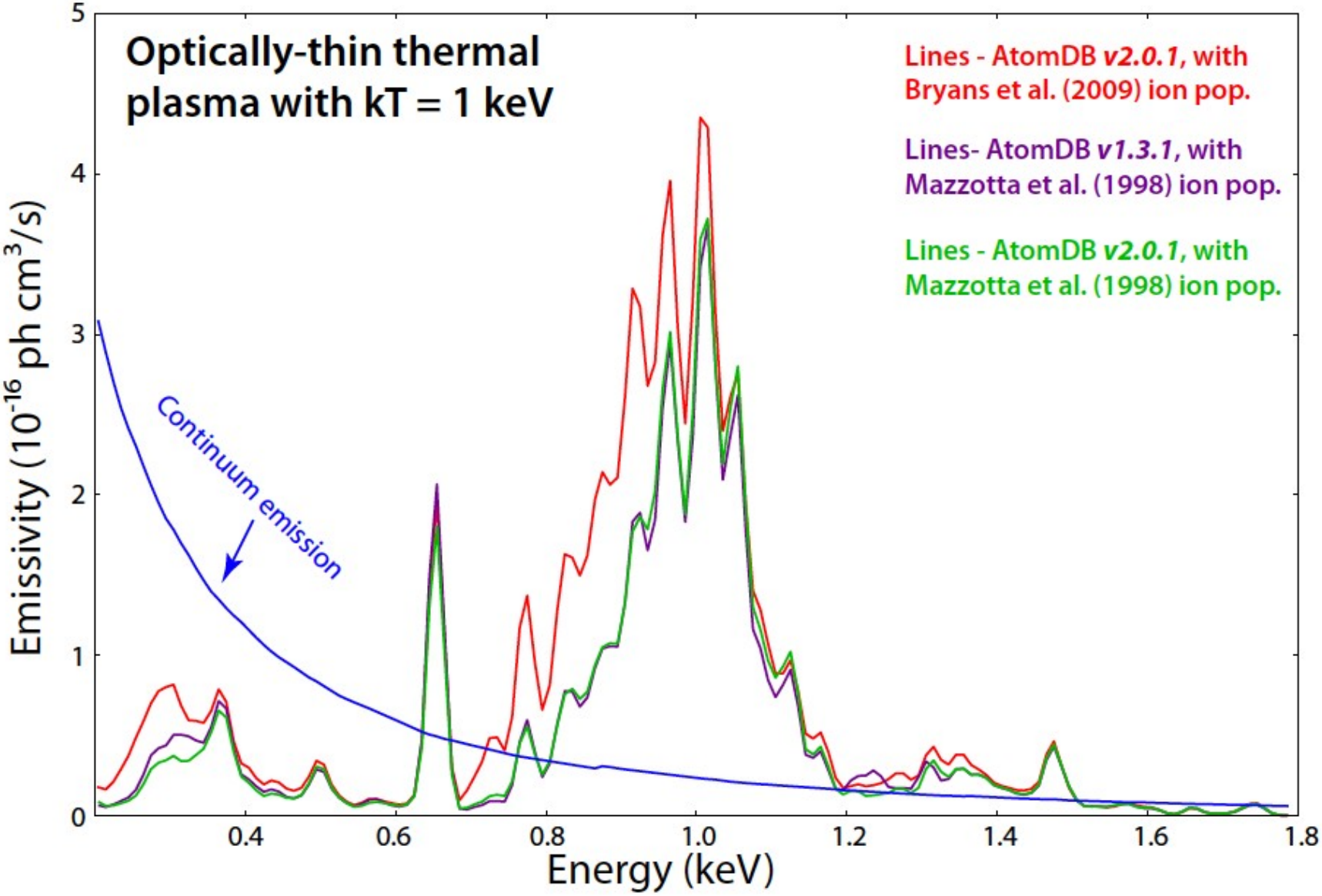

Mg XI
Ne X
Ly ε
Ly ζ
Ly η
Ly θ
Ly ι
Emiss. ph s-1 cm3
Wavelength [A]
10-16
10-17
10-18
10-19
10-20
9.15
9.20
9.25
9.30
9.35
9.40

New Ionization Balance

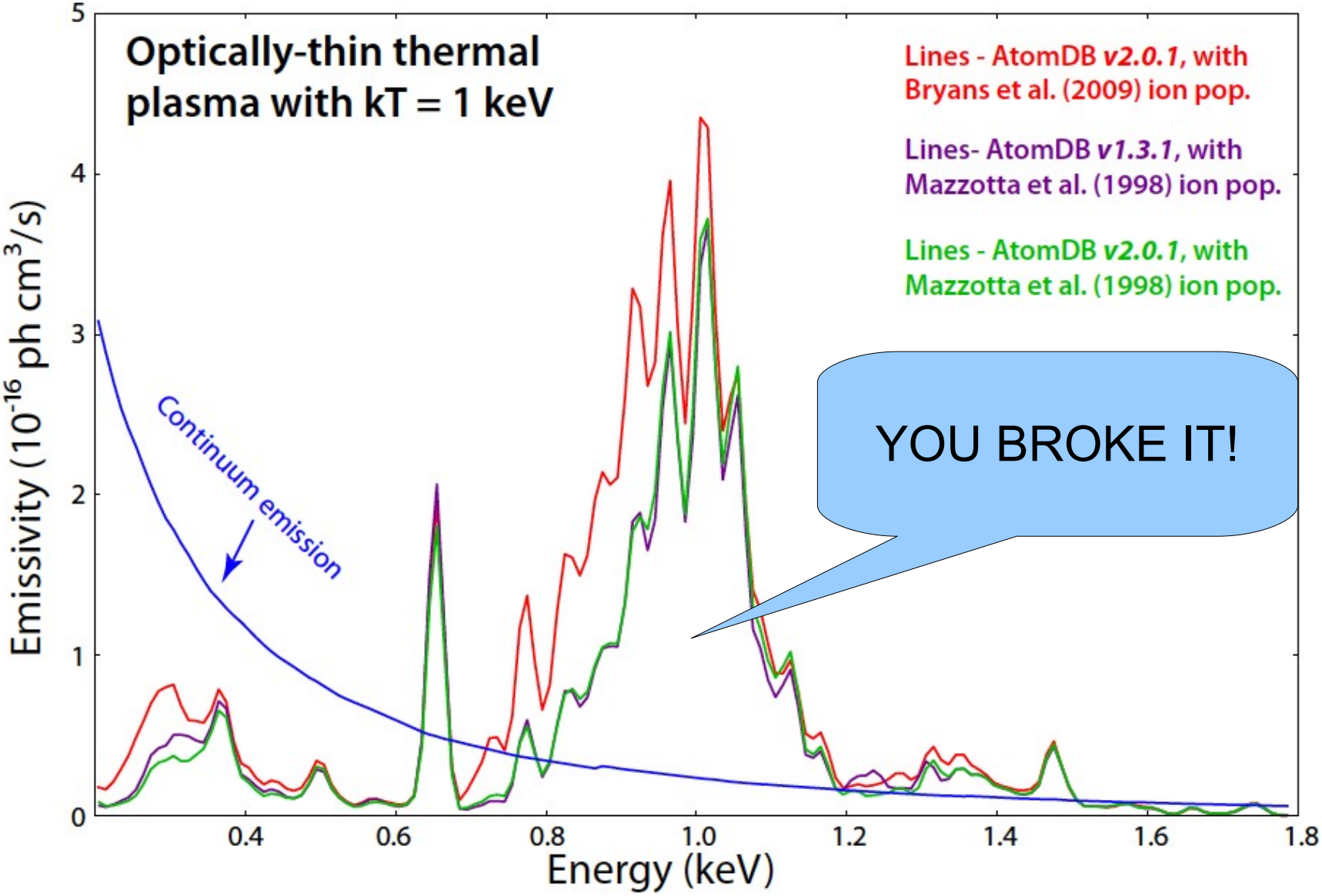


From Mazzotta 1998 to Bryans 2009

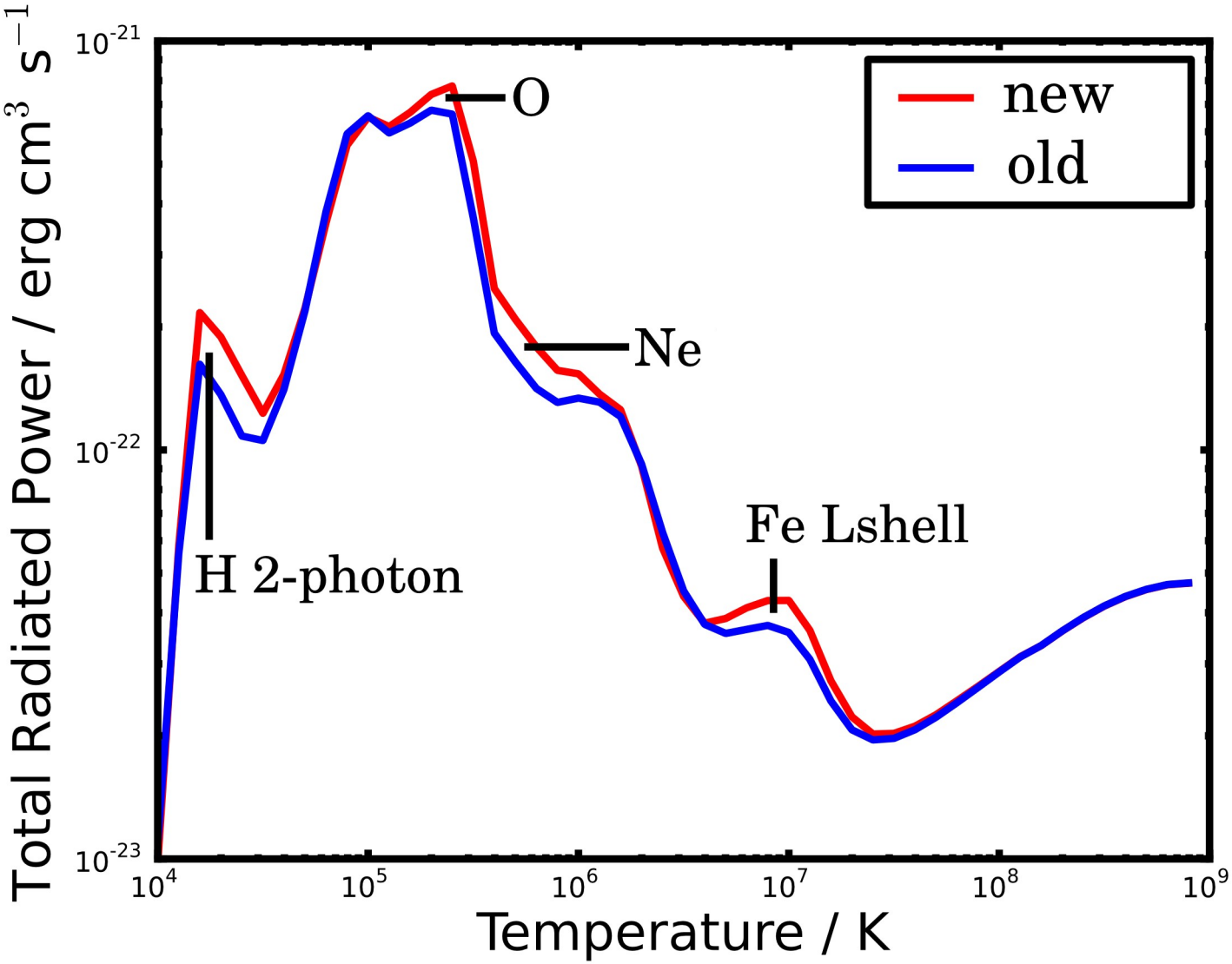
Ionization balance effects



Ionization balance effects



Cooling Power



www.atomdb.org

ATOMDB Atomic Data for Astrophysicists

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Searching for lines between 7.3 and 7.7 Å

9 lines found.

Ion	Wavelength Å	Upper Level	Lower Level	Emissivity ph $cm^3 s^{-1}$	Te peak K	Relative Intensity
Mg XI	7.310	37	1	2.205e-18	6.310e+6	0.34
Fe XXIV	7.370	19	2	2.415e-18	1.995e+7	0.37
Fe XXIV	7.437	20	3	4.432e-18	1.995e+7	0.68
Fe XXIV	7.457	16	3	1.757e-18	1.995e+7	0.27
Fe XXIII	7.472	176	5	2.442e-18	1.585e+7	0.37
Mg XI	7.473	23	1	4.611e-18	6.310e+6	0.70
Fe XXIII	7.478	104	1	6.550e-18	1.585e+7	1.00
Fe XXIII	7.498	168	5	1.496e-18	1.585e+7	0.23
Fe XXII	7.681	233	1	3.472e-18	1.259e+7	0.53

Data for version 2.1

Aim to release 1 version per year – next Jan 2011

- Concentrating on NEI issues
- Li-like inner shell excitation (Liang)
- Fluorescence line emission (Kaastra, Gorczyca)
- New H and He like data for Cr, Mn, Fe, Co, Ni (Loch, Alzate)

Astro-H

SXS: micro-calorimeter

7 eV resolution in the 0.3-10 keV band

Large area (2 OOM > Chandra) – identify rare elements

Launch 2013-2014

Future Missions: ~~IXO~~

NASA Decadal review: IXO ranked 4th of 3 big missions.

Still some seed funding.

then...

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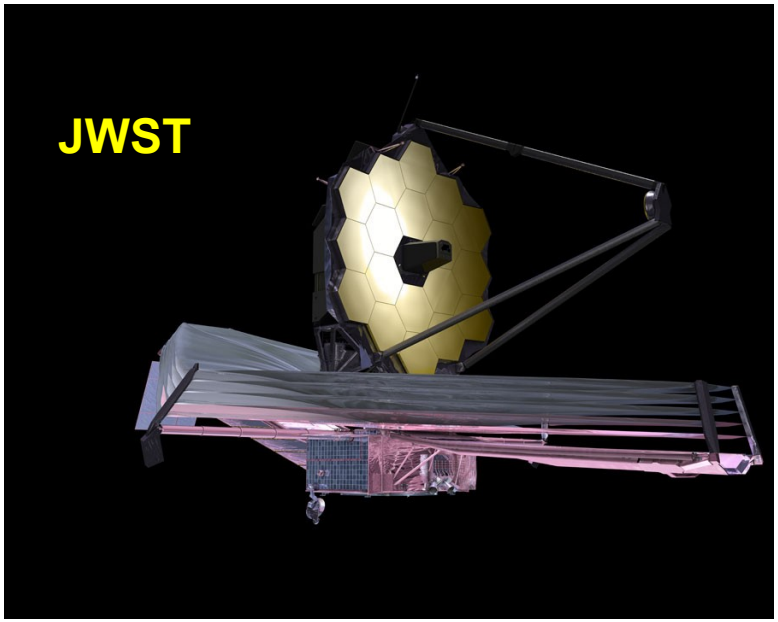

New IXO-lite missions

Serious planning stage:

- Athena (ESA) : calorimeter + wide field imager
- AXSIO (NASA) : calorimeter + grating

Several other potential mission:

- Smart-X (NASA) : high ang. resolution calorimeter+ grating
- Extreme Physics Explorer: Large area, small no. calorimeter pixels
- XGO: IXO grating