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Incorporating Atomic Data Uncertainties into Spectral Analysis

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1. Estimates of atomic data uncertainties
2. How much do atomic data errors affect your results?
3. Treating uncertainties in the analysis

Estimates of Atomic Data Uncertainties

Data Type	Typical	Goal *
Collisional Ionization Rates	50%	20%
Photoionization Rates	? 50%	20%
Continuum Emission	<10%	10%
Radiative Recombination Rates	10%	10%
Dielectronic Recombination Rates	50%	20%
Oscillator Strengths	20%	10%
Collisional Excitation Rates	10-20%	5-10%
Wavelengths: H- and He-like	<.001 Å	
Laboratory-measured	.005 Å	
Unmeasured	.10 Å	.005 Å
Missing Flux from a given ion (but local!)	10%	(specific)
Missing Processes	???	0

*Support Laboratory Astrophysics

How much do atomic data errors affect your results?

- **Best Case Collisional Plasma**

Global Fit Temperatures	**0.1 dex**
Abundances	**x 2**

- **Photoionized Plasma Properties: worse than Collisional (b/c physics less well understood)**

Systematic errors from atomic data are likely to be more important to your analysis than statistical or calibration errors.

Treating atomic data uncertainties in the analysis

- Sensitivity testing is essential. Take your fit and look at what typical errors would do.
- Use all the information (including results from other wavebands) to see if result is sensible.
- Statistical methods assume random and uncorrelated errors. Atomic data errors are neither.
- An exception: laboratory wavelengths.

It’s not clear how to treat uncertainties: it’s a research project.

ATOMDB files include errors on atomic data (or placeholders for such), so different approaches can be tested.

http://cxc.harvard.edu/atomdb