

Data bases

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Hierarchy of terminology

Data base – Library - Collection

Data base: electronic; multiple sources (may include both observational and theoretical data); perhaps uncalibrated; of mixed quality

(**Data bank:** collection of data organized for rapid search and retrieval – as by computer)

Library: collection of multiple sources; uncertain or mixed quality; well kept over time

Collection: an accumulation of objects gathered for study, comparison or exhibition (display purposes only); no demand on quality; no time requirement

Spectral Line Data

Atomic data associated with spectral lines:

λ wavelength, ν frequency or wavenumber

E_i energy levels, Q_i partition function, χ ionization potential

I intensity, BF branching fraction

τ energy level lifetime, A transition probability, f oscillator strength

γ, Γ damping constants (theoretical but natural broadening can be computed from lifetime data.

Collision cross sections

Photo-ionization cross sections

(Continued)

Evaluating experimental atomic data does not have to a fearful experience !!

Certain cautions should be exercised when choosing data. Consider the following:

-- **Wavelengths**: observed or computed from energy levels (Ritz) or theoretical

Observed wavelengths can be influenced by line blending and structure, and data quality (noise, resolution). Ab initio theoretical wavelengths are not accurate.

-- **Energy levels**: determined from observed spectral lines or theoretically determined ?

Theoretical levels and line wavelengths have no meaningful error estimates.

-- **Branching fractions** → from line intensity measurements

- *Are saturation effects important ?*

- *Are the data intensity calibrated ?*

- *Are there missing lines (residual intensity can be important) ?*

-- **Lifetime measurements**

- *Is the technique selective (ex. lasers vs beam-foil), and if not, are the proper corrections applied (ANDC).*

Photo-ionization databases:

Collision cross-section databases:

Mixed: f-values and cross-sections:

TipTopBase (TIPBASE, TOPBASE) Opacity project, Iron project
18 elements, several ions for some of these elements
gf values & energy levels computed for a limited number of terms,
and photo-ionization cross sections

Previously mentioned data bases:

DREAM Database on Rare-Earths at Mons University, mostly II but some I, III, articles and line data, experimental and theoretical data

w3.umh.ac.be/~astro/dream.shtm

'Kurucz' line lists for atomic and molecular data, no longer accessible from Harvard/CfA

NIST Atomic data and bibliographies www.nist.gov

VALD Vienna Atomic Line Database ('Kurucz' + some others)

HITRAN database for molecules important for earth atmosphere research, must register on web

There are other important sources of data that are typically **more current and well documented:**

- Specific web sites of interest

 - institutions or personal web sites

- Publications

 - physics journals (JOSA, Eur. Journal Physics, Physica Scripta, Phys Rev., Atomic and Nuclear Data Tables, Hyperfine Interactions,...)

 - astronomy journals (A&A, ApJ) are becoming data friendly

- IAU Commission 14 triennial reports

- Google it!

New work tends to first appear in the literature and astronomers usually wait for it to be incorporated into databases.

Websites serving as libraries or databases:

Atomic Data for Astrophysics: nothing new since year 2000 (?), but can still connect to established or standard references or tools (ex. Kurucz data base)

www.uky.edu/~verner/atom.html

Plasma Gate: Databases for Atomic and Plasma Physics

plasma-gate.weizmann.ac.il/DBfAPP.html

This site lists many sources of atomic data, including GENIE, the General Internet search Engine for atomic data: 8 data bases are accessed here, 4 for cross sections

www-amdis.iaea.org/GENIE/

Bibliographic Data Bases

National Institute for Standards and Technology

physics.nist.gov/PhysRefData/contents-atomic.html

- 1) Bibliographic Database on Atomic Transition Probabilities
- 2) Bibliographic Database on Atomic Spectral Line Broadening and Shifts
- 3) Bibliographic Database on Atomic Energy Levels and Spectra

BIBL, Bibliography database on atomic spectra

das101.isan.troitsk.ru/bibl.htm

Most complete from year 1983

- 1) Spectra of atoms and atomic ions,
- 2) Cross sections of the collision processes

Remark: Major frustrations with on-line data resources include:

- Information is not updated in a timely fashion (if at all)
- Servers are discontinued, leaving no forwarding address
- There is occasionally confusion among web sites (poor design)

Remark: There is much available data that will never be used !

- Data can be difficult to identify and locate.
- Data collectors do not always identify with their users, often providing data of insufficient quality or scope, making them useless.

What databases do you use ?

What are your experiences with them ?

What do you need ?