

Laboratory astrophysics as key to understanding the Universe



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Astro2020 committee Feb 4 2020

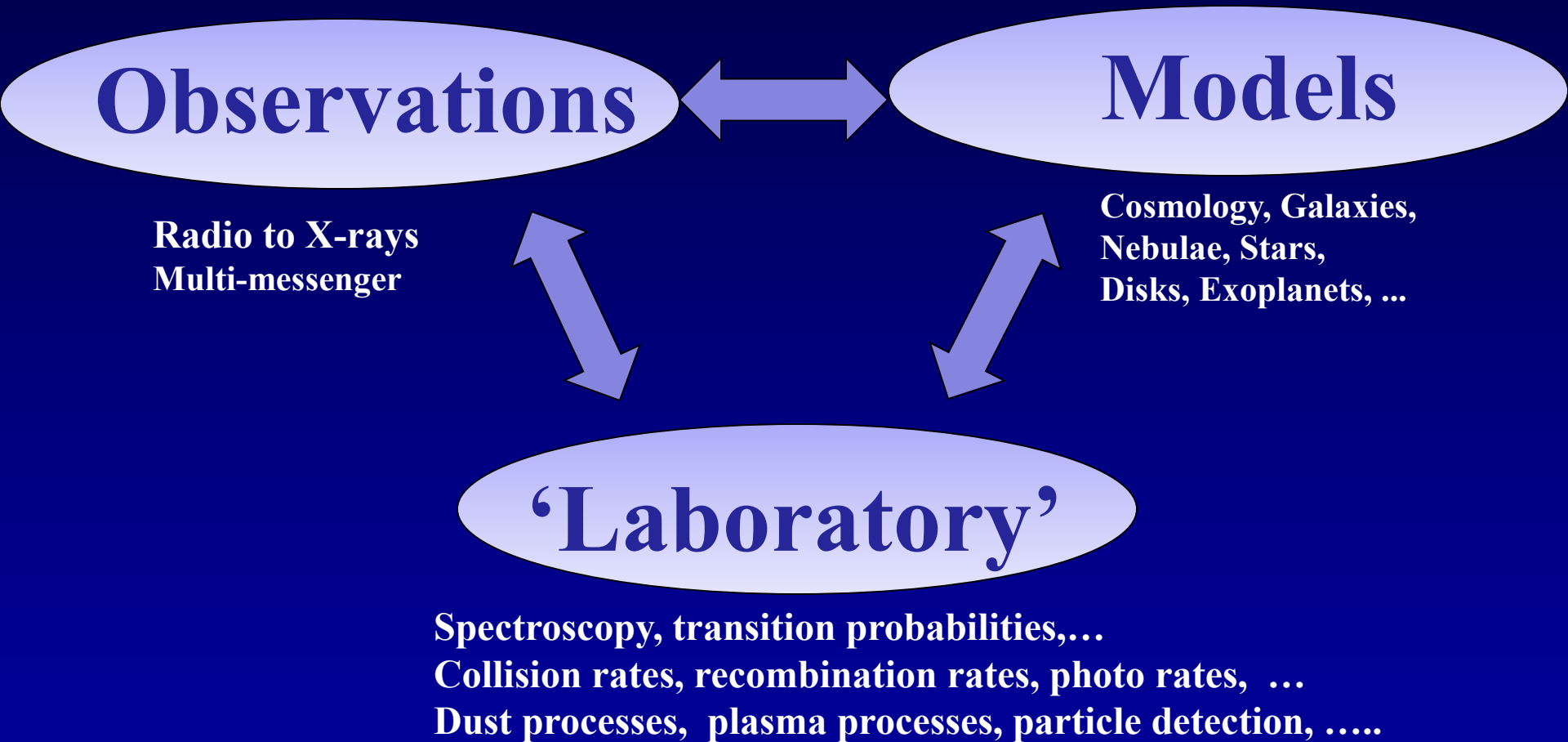
(based on IAU Symposium 350, April 2019)

Lab astro themes

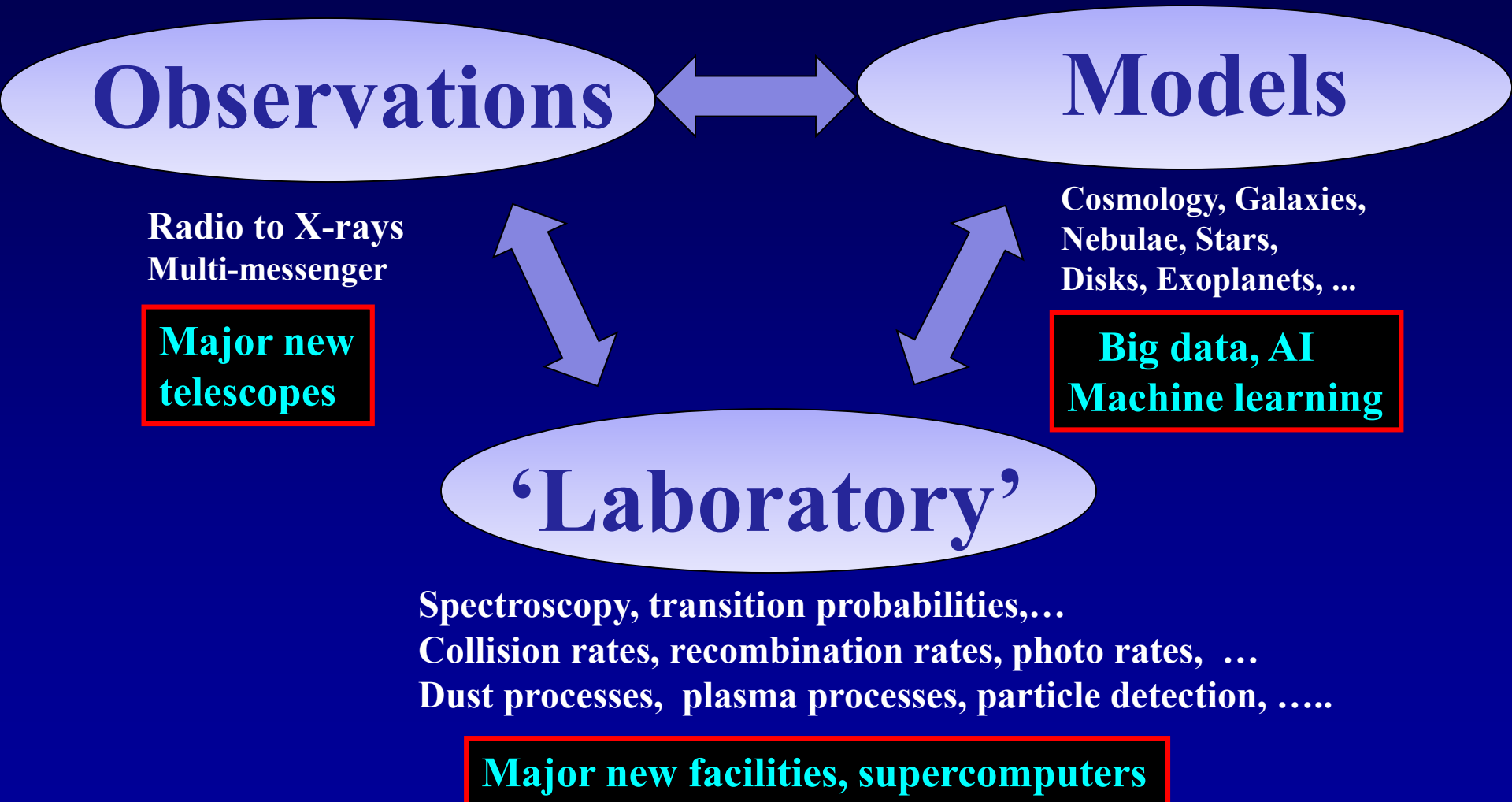
- Atomic physics
- Nuclear physics
- Planetary science
- Molecular physics
- Plasma physics
- Particle physics
- Geophysics, atmospheric physics
- Astrobiology
-

Lit: Savin et al. 2012 Rep. Progr. Phys.
van Dishoeck 2020, IAUS 350
AAS Lab Astro workshop presentations
Astro2020 white papers

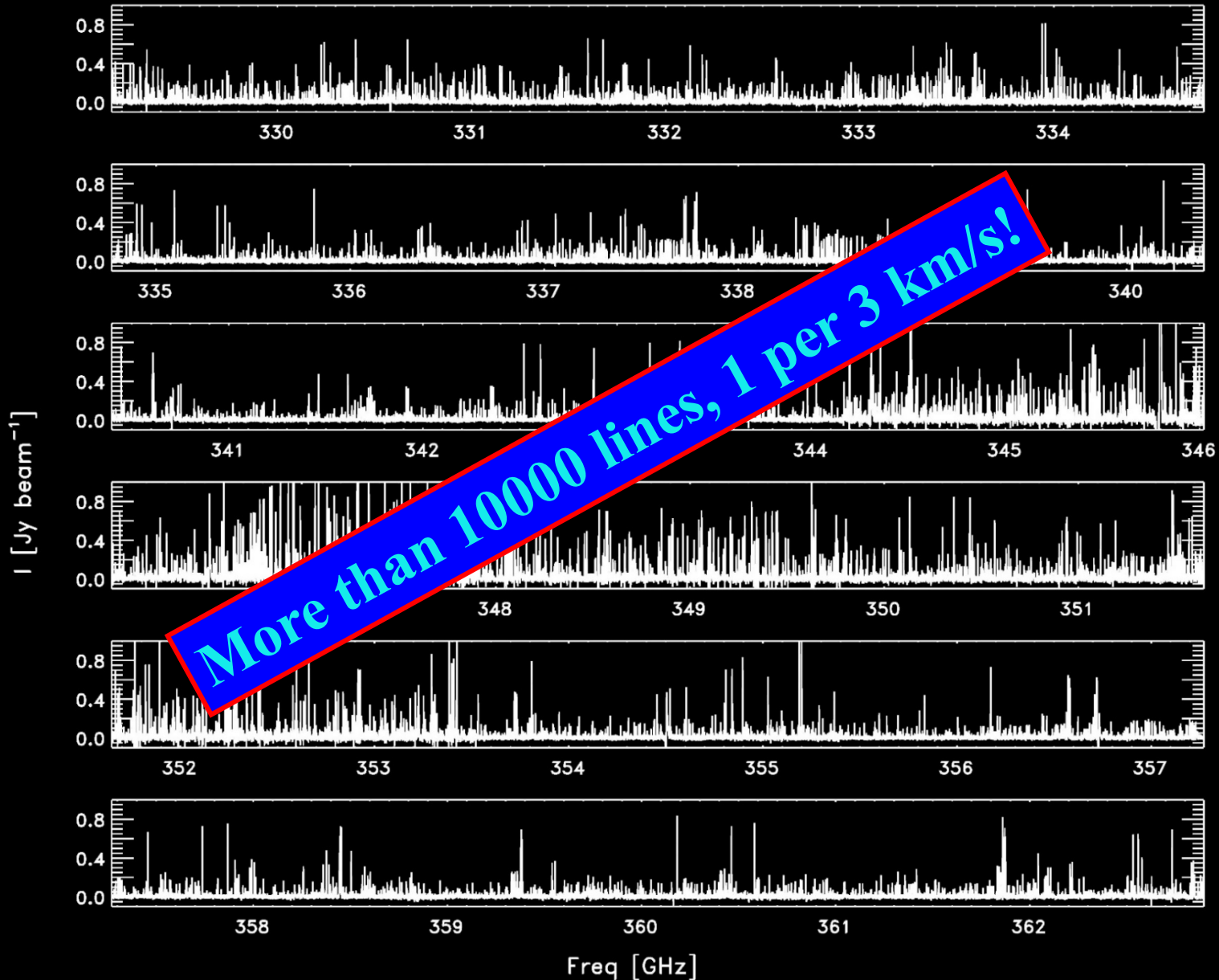
The central role of laboratory astrophysics



The central role of laboratory astrophysics



ALMA spectral survey of a young disk: IRAS 16293–2422B



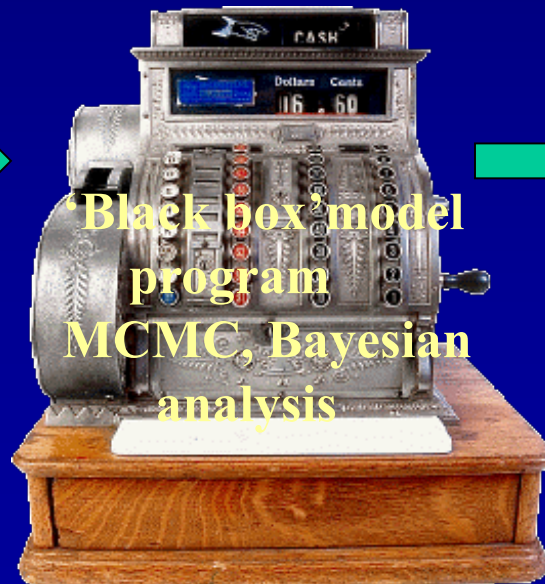
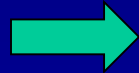
Need spectroscopy, collisional rate coefficients

Jørgensen+ 2016, 2018

But.....

- Budgets for lab astrophysics under stress
 - Much funding used to come from physics, chemistry but often no longer the case
- Do astronomers still appreciate the importance of basic data and their uncertainties, and the hard work needed to get them?

Observations

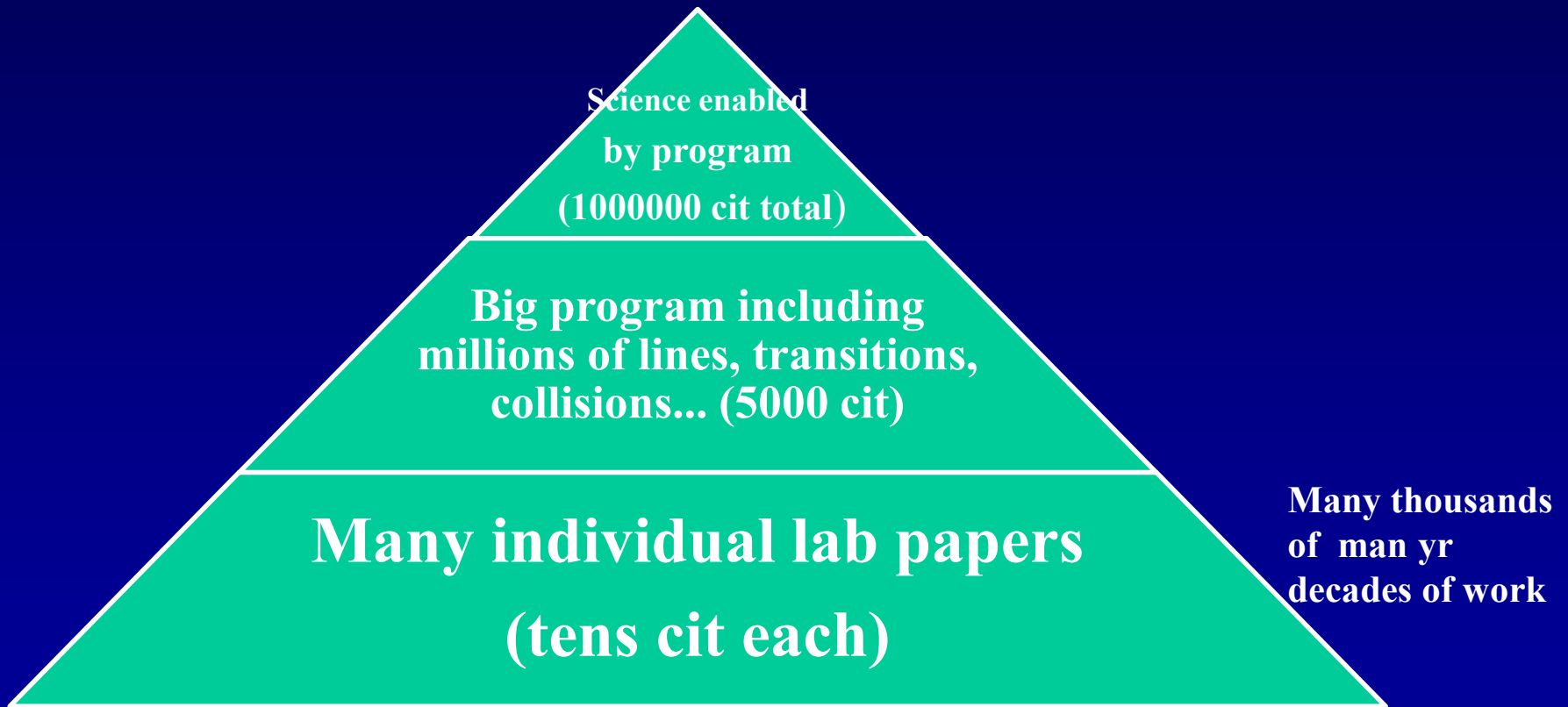


Physical parameters
(n , T , I , ff , f_{esc} ...)

Answer only as good as
the basic data that go
into the model

The citation pyramid

CLOUDY *as an example*



Thanks to G. Ferland

Lab astrophysicists need citations to advance their careers and get funding

Organizing the community

- **AAS Lab Astrophysics Division**
- **ACS Astrochemistry Division**
- **IAU Commission B5 Lab Astrophysics**
 - **Also Astrochemistry Commission H2**
- **Various European networks**
 - **EU-based: Mol Universe, Lassie, EuroPAH, ...**
 - **National: French-PCMI, NL-DAN, Germany....**
- **Asia?**

Databases

- Importance of comparisons of numbers + methods to obtain them
 - Latest value is not always best
 - Need for critically evaluated numbers
- Extrapolations often necessary
- Quantify uncertainties
- Integrate with astrophysical tools
 - Referees need to understand both!

Model tools / programs

- Importance of code comparisons
- Initial cost of writing is a tiny fraction of long-term cost for improvement, maintenance and support + training
 - Will become your career if widely used
 - Tough to get academic position → national centers, institutes

e.g., CLOUDY, XSPEC,

Issues

- **Keeping** existing expertise and labs healthy and focused on astrophysically relevant problems
- **Training** and career prospects of new lab astrophysicists
 - PhD focus on astronomy or physics/chemistry/other?
 - Majority new PhDs end up in career outside astronomy
- **Collaboration** between astronomy, physics and chemistry to reap the scientific harvest from billion \$/€/Y facilities
 - Joint programs on mutually interesting programs (e.g., complexity)?
 - Small investment goes a long way
 - Prioritization important



‘playing tennis with a net’