



THE OHIO STATE UNIVERSITY



**”THE OPACITY AND IRON PROJECTS: ATOMIC PROCESSES IN ASTROPHYSICAL PLASMAS”**

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# The OPACITY Project (OP) & The IRON Project (IP)

AIM: Accurate Study of Atoms & Ions, Obtain Opacities, Applications to Astrophysical Plasmas

- **THE OPACITY PROJECT - OP (1981 - 2006): ...**
- Earlier opacities were incorrect by factors of 2 to 5 → inaccurate stellar models → initiation of the OP in 1981
- OP Leader: Michael Seaton, University College London
- International Collaborations: France, Germany, U.K., U.S., Venezuela, Canada, Belgium
- W. Eissner, D. Mihalas, P. Burke, V. Burke, A.K. Pradhan, K. Berrington, Harry Nausbaumer, S.N. Nahar, D. Hummer, P. Storey, H. Saraph, C. Mendoza, C. Zeippen, Y. Yan, M. Bautista, H.L. Zhang, ..
- Studied radiative atomic processes for (E, f,  $\sigma_{PI}$ )
- Elements: H to Fe
- Calculated opacities of astrophysical plasmas
- **THE IRON PROJECT - IP (1993 -):**
- Collisional & Radiative processes of Fe & Fe peak elements
- **RMAX**: Under IP, study X-ray atomic astrophysics

## The OPACITY Project (OP) & The IRON Project (IP)

- Study included large sets of atomic data ( $n \leq 10$ )
- Solved many astrophysical problems
- Found new physics in photoionization
- Unified method for electron-ion was introduced
- Developed Atomic & Opacity Databases
- **TOPbase (OP)** at CDS:

<http://vizier.u-strasbg.fr/topbase/topbase.html>

- Energy levels, Oscillator Strengths, Photoionization Cross Sections

- **TIPbase (IP)** at CDS:

<http://cdsweb.u-strasbg.fr/tipbase/home.html>

- Data for Collisional Excitations, and Radiative Processes

- Includes fine structure effects

- **OPserver** for monochromatic opacities and program for mixtures at the OSC: <http://opacities.osc.edu/>

- **NORAD-Atomic-Data** for the latest radiative data (including electron-ion recombination) at OSU:

<http://norad.astronomy.ohio-state.edu>