

30 Years of Photodissociation Regions:

A symposium to honor David Hollenbach's lifetime in science
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INVITED TALK

PDR Diagnostic Diagrams: Guides to the Underlying Physics of FUV Illuminated Gas in Galaxies

Michael J. Kaufman¹

¹ Department of Physics & Astronomy, San José State University, San Jose, CA 95192

E-mail: Michael.Kaufman@sjsu.edu

The fundamental physical processes controlling Photodissociation Regions were identified 30 years ago (Tielens & Hollenbach 1985), and soon thereafter the first precomputed grids of PDR models appeared (Wolfire, Tielens & Hollenbach 1990), focusing on the FIR line and continuum tracers of PDR surfaces (e.g. OI, CII, FIR continuum). These diagnostic diagrams could be used (a) to understand the regimes of UV field and density in which different physical processes were important, and (b) to infer the physical conditions in galaxies from observations. Subsequent work (Kaufman et al. 1999) extended the modeling to include FIR and sub-millimeter tracers of the atomic-to-molecular transition and fully-molecular regions of PDRs (e.g. lines of CI and CO). More recently, grids of models have been produced for diffuse clouds (Le Petit et al. 2006), ensembles of cloud sizes (Röllig et al. 2006), galactic nuclei subject to intense X-ray radiation (Meijerink, Spaans & Israel 2007), gas with non-solar metallicities (Kaufman et al. 2006), and the chemistry of molecular ions (Hollenbach et al. 2012).

When used appropriately, diagnostic diagrams allow observers to determine PDR properties including gas density, FUV field strength, number of cloud surfaces in the beam, volume filling factors, masses of atomic and molecular gas, abundances of trace species, and the cosmic ray ionization rate. I will review the basic use of PDR diagnostic diagrams for determining these properties, while also pointing out some limitations and potential pitfalls of using pre-computed results. Galactic and extragalactic examples will be discussed.

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