An Atomic and Molecular view of the diffuse/dense interface in the local ISM

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The past decades have witnessed a radical change in our view of the interstellar medium. A static notion of this medium has made way to our current concept of a turbulent and structured medium. The rich and filamentary structures that are observed reflect the processes by which stars form, and also on the stellar dynamic and radiative impact in the interstellar environment. The intimately mixed nebular atomic and molecular gas, that are ionized and heated by the young stars, see their energetic budget profoundly modified. Photon Dominated Regions (PDRs) sit at the interface between the stars and opaque cores of molecular clouds, where the heating and chemistry are regulated by the penetrating far ultraviolet photons of the ionising source(s). Using Herschel observation, and as part of the Herschel key program "The evolution of Interstellar Dust", we have spatially resolve and map the emission of the main cooling lines ([CII] 158um, [OI] 63 and 145um) and high excited molecular species such as CO, CH+, and OH in a representative sample of PDRs covering a range of physical conditions and phases of the ISM. These observations give us an unprecedented view to the chemistry and energetics of these regions, which are closely related to that of starburst galaxies where they can be used as a template. During this talk we will present a detailed study of the variation of atomic lines in relation to their geometry and density structures of the PDRs, including a study of the origin of the [CII] line (ionized or neutral medium). We will show the role of the different cooling lines ([CII], [OI], CO, H2, H20) as a function of radiation and density to obtain the cooling fraction. Finally we will present a how the rotationally excited lines of CO, OH and CH+, which probe the warmest PDR gas layers, provide a strong constraint for the modeling of both the complex physics and chemistry driven in the presence of FUV fields.