# A JWST IFU deep study of gas, dust, and PAHs in a prototypical externally illuminated protoplanetary disk


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## JWST Cycle2 GO 4332

**1) What is the composition, and hence reservoir, in gas, dust, and polycyclic aromatic hydrocarbon molecules (PAHs) in a typical externally illuminated protoplanetary disk (proplyd)?**

**2) What is the thermo-chemical structure of a proplyd Photodissociation Region (PDR)?**

**3) How does the external irradiation affect the process of planet formation in these disks?**

**4) And how their properties differ from those of disks found in more quiescent environments, such as Taurus-Auriga?**

These questions are addressed in our Cycle2 program GO 4332 (PI: S. Vicente) consisting in a JWST deep observations study of the EUV+FUV externally illuminated protoplanetary disk (proplyd) HST10 found in the Orion Nebula Cluster (ONC, d=400 pc) using the IFU modes of NIRSpec and MIRI-MRS. The JWST IFU observations will spatially resolve the disk, neutral cocoon, and ionization front simultaneously over the 0.9 – 11.7 micron spectral range providing key line, continuum and PAHs diagnostics to trace the physical conditions, the chemical composition and abundances under the effect of the external FUV-radiation. It is the FUV radiation that changes the thermo-chemical structure of the disk, creates the PDR and sets a photoevaporative wind with significant mass-loss rate (Fig. 1). By comparing our results to those of protoplanetary disks (TTauris) found in nearby low-mass star forming regions, one can start to assess the real effects of a FUV-dominant environment on protoplanetary disk evolution and planet formation.

This poster introduces program GO 4332 and shows preliminary results on the recent acquired MIRI-MRS observations.

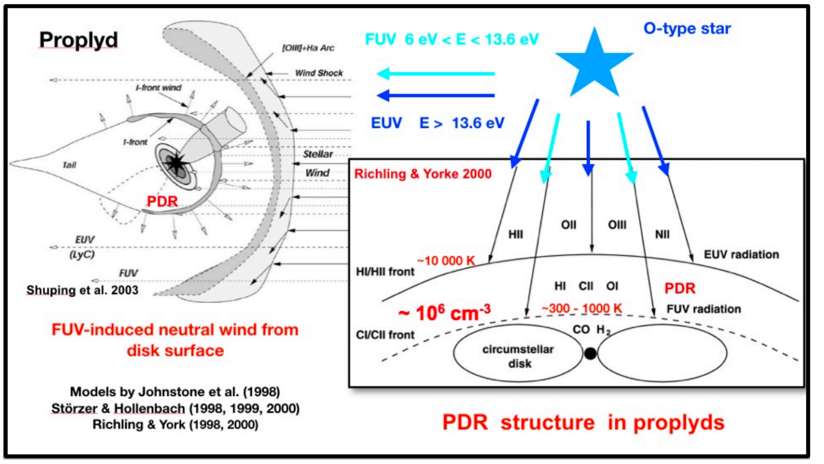



Figure 1: Schematics of a proplyd and its PDR structure. The FUV radiation from the O star reaches the disk surface, dissociates molecules, heats the gas, and drives an atomic wind. The surface layer, where most of the gas is converted from molecular to atomic, is called dissociation front. Richling & Yorke (2000) model above considers the HI/$H_2$ dissociation front, where most of the $H_2$ is photodissociated into HI, coincident with the CI/CII front. This layer emits ro-vibrational $H_2$ at 2.12$\mu$m and traces the surface of the gaseous disk (Chen+1998).

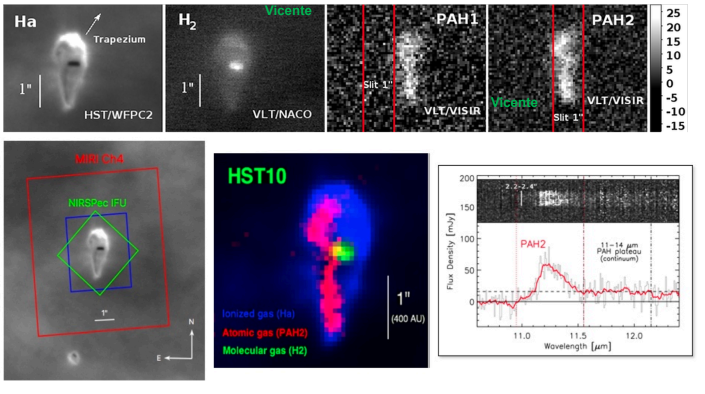
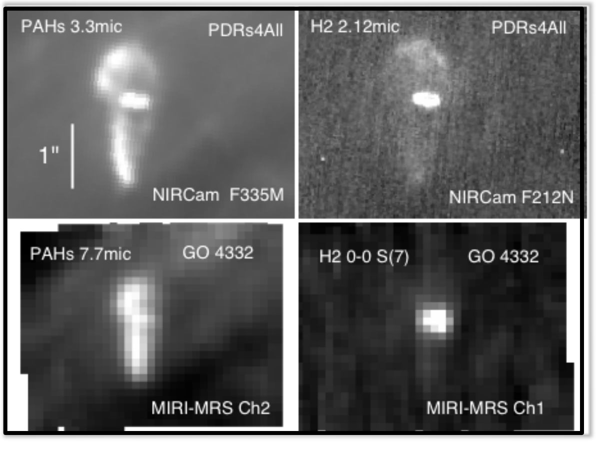



Figure 2: *From left to right:* JSWT IFU detectors (MIRI Ch1 in blue and Ch4 in red) overlaid on a HST/H$\alpha$ image. RGB image of the proplyd HST10 showing the ionized gas in H$\alpha$ (blue), the molecular disk in $H_2$ (green), and the PDR/atomic gas in PAHs (red) and the VLT/VISIR spectrum of the 11.3$\mu$m PAH band (Vicente+2013).

## MIRI-MRS and NIRCam

Figure 3: PAHs and H2 emission in proplyd HST10 obtained with JWST NIRCam (PDRs4All) and MIRI-MRS (GO 4332).

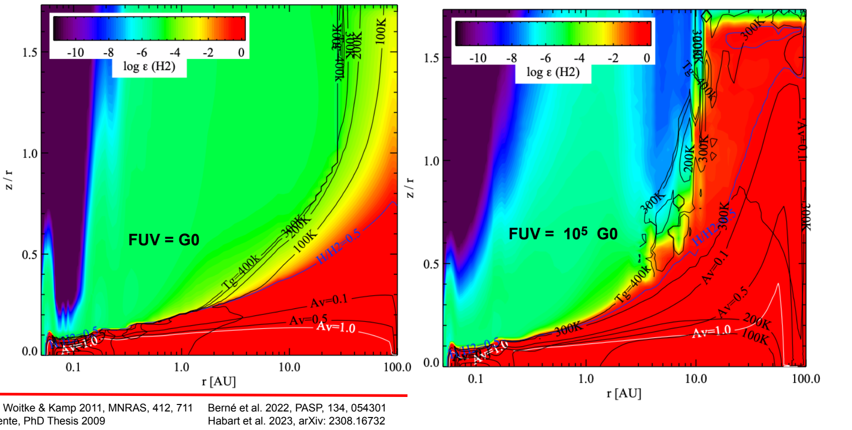



## Vicente+2013 and ProDiMo

Vicente+2013 N-band VLT/VISIR observations spatially resolved and determined PAHs abundances in a proplyd for the first time (Fig. 2). PAHs in proplyd HST10 are mostly neutral and underabundant by, at least, 50 times relative to the diffuse ISM. MIRI-MRS data of HST10 shows a multitude of aromatic infrared bands (AIBs) allowing for a detailed study of PAHs properties. H2 mid-IR line emission is observed only at the disk surface confirming previous observations with HST/NICMOS (Chen+1998) and VLT/NACO (Vicente+2013), sustaining the PDR structure of this object (Fig. 3).

ProDiMo, a 2D X-PDR hydrostatic model for protoplanetary disks (Woitke+2009, Kamp+2010, Thi+2011) shows that the physical structure, the H2 abundance and the HI/H2 dissociation front change significantly with increasing external FUV field (Fig. 4, G0=$1.6 \times 10^{-3}$ ergs$^{-1}$ cm$^{2}$). ProDiMo will be used to interpret the NIRSpec and MIRI-MRS IFU observations of proplyd HST10.

Figure 4: ProDiMo H2 abundances

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