Photon-dissociation Regions (PDRs) in proplyds

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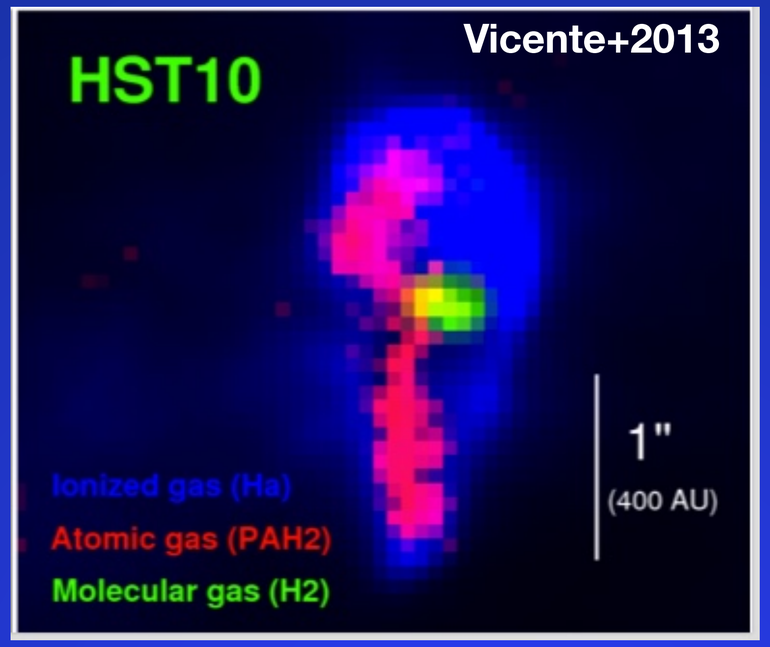
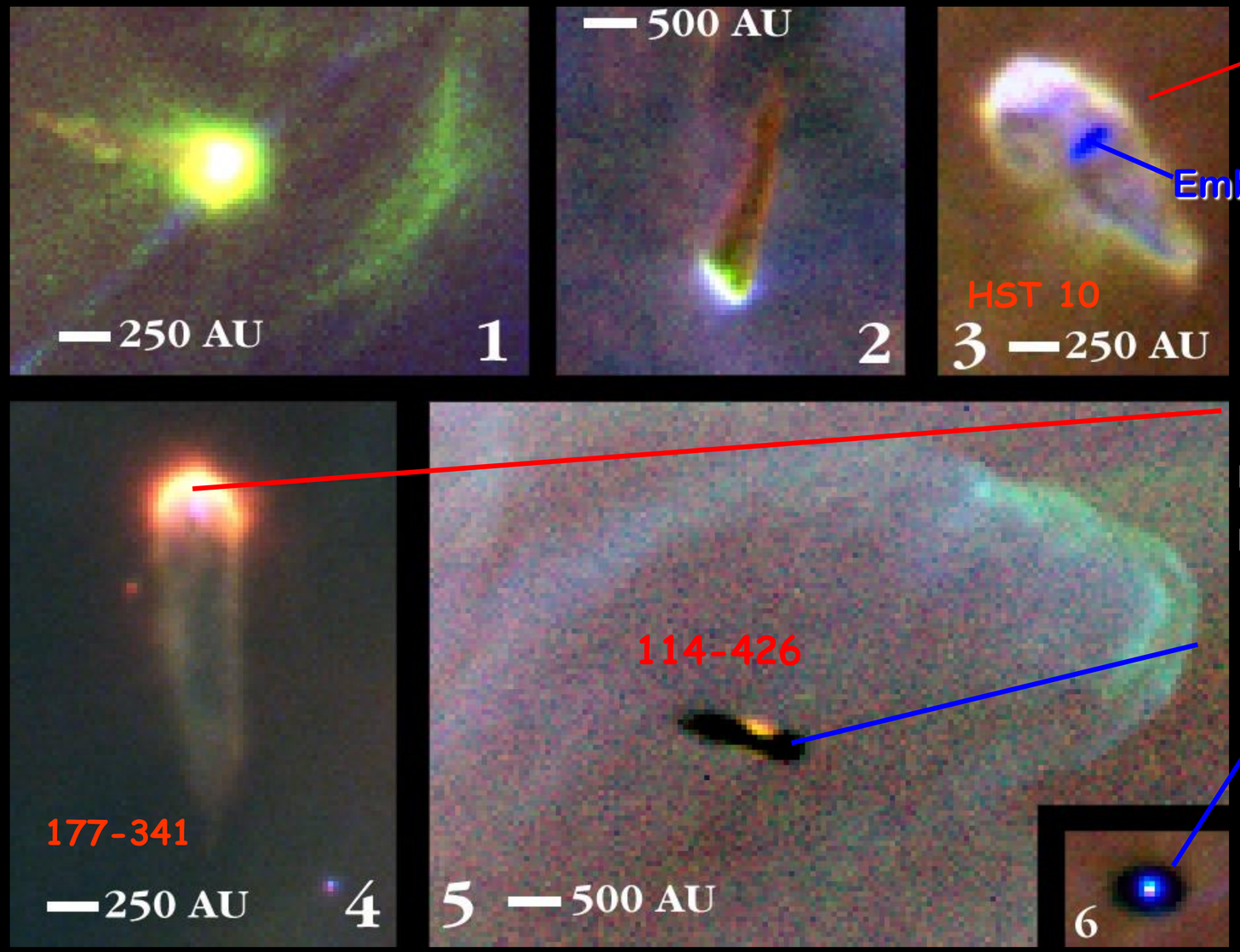


Threats from the Surroundings e-workshop @ ESO/Garching 10 - 12 Nov. 2020

PROPLYDS = Externally illuminated PROtoPLanetarY DiskS

~ 200

typical IF diameters 200 - 400 AU, tails < 2 250 AU



Bright proplyd

Embedded silhouette

bright in [OI] and

H2 n=1-0 S(1)

HCO^+(4-3), CO(3-2)

Manara+ (*in prep.*)
Chen+1998,
Vicente+2013

Champion+2017
Boyden+2020

Ionization Front

Hα, [OIII], [NII], [SII]

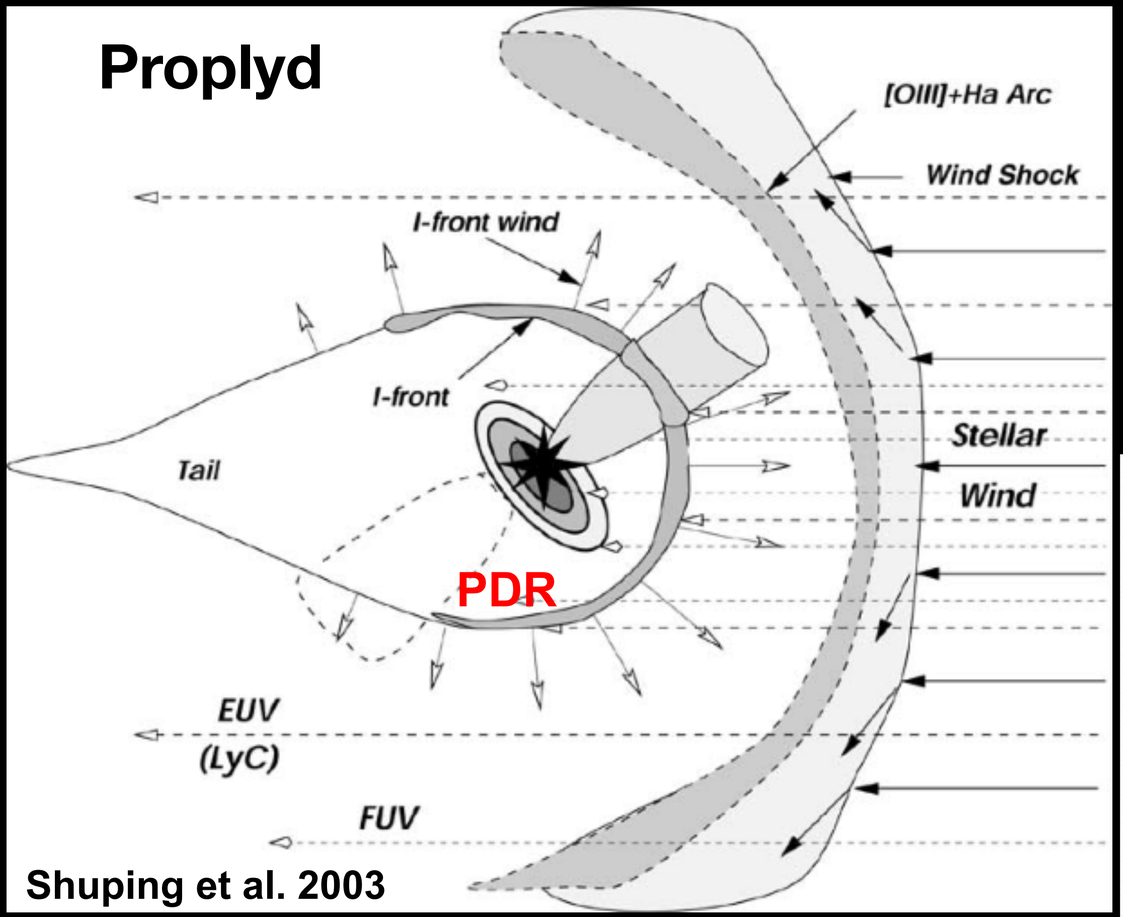
Paβ, Paα, Brγ, Brα

Pure silhouettes

J. Bally

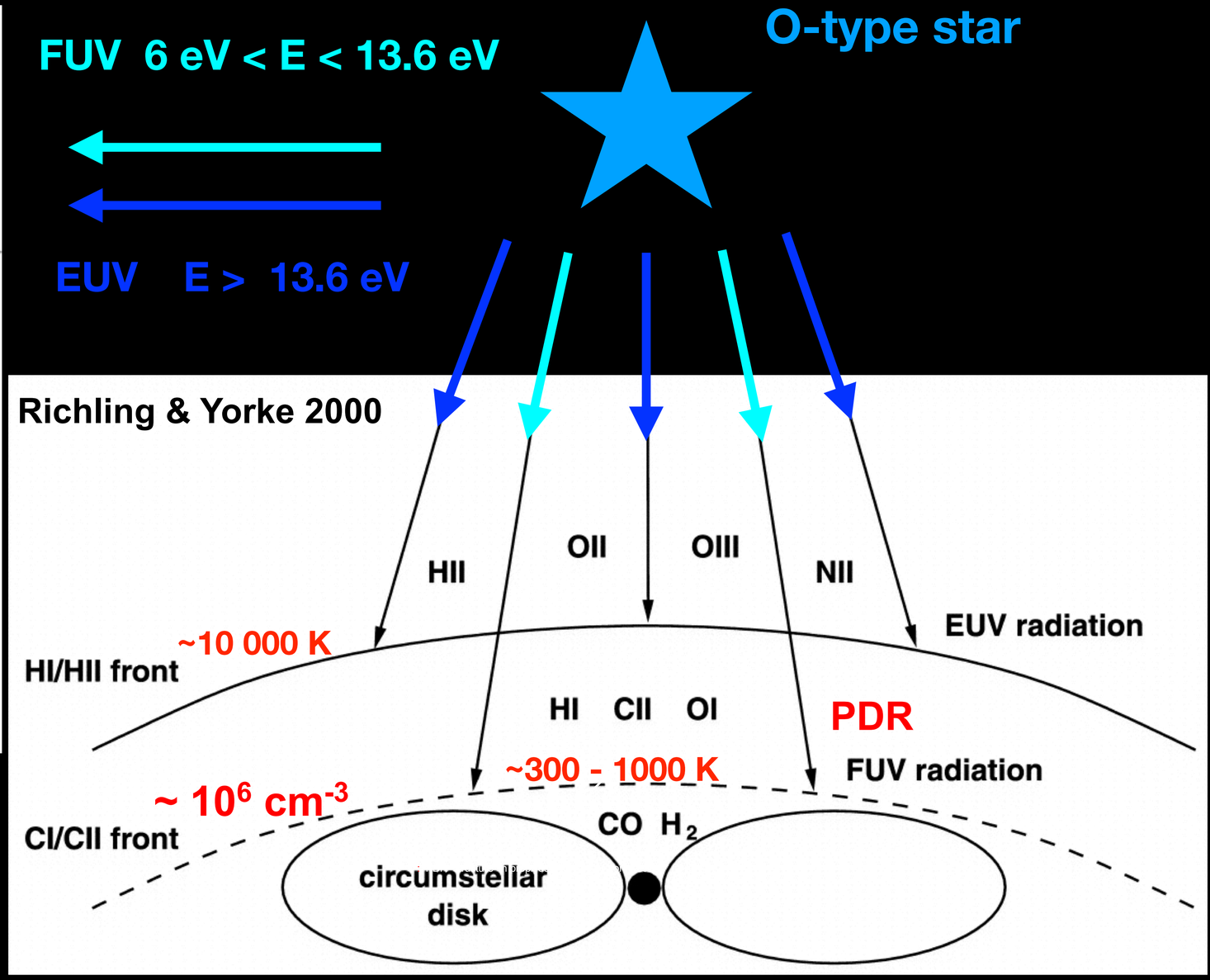
HST/WFPC2

[OI] Hα [NII]



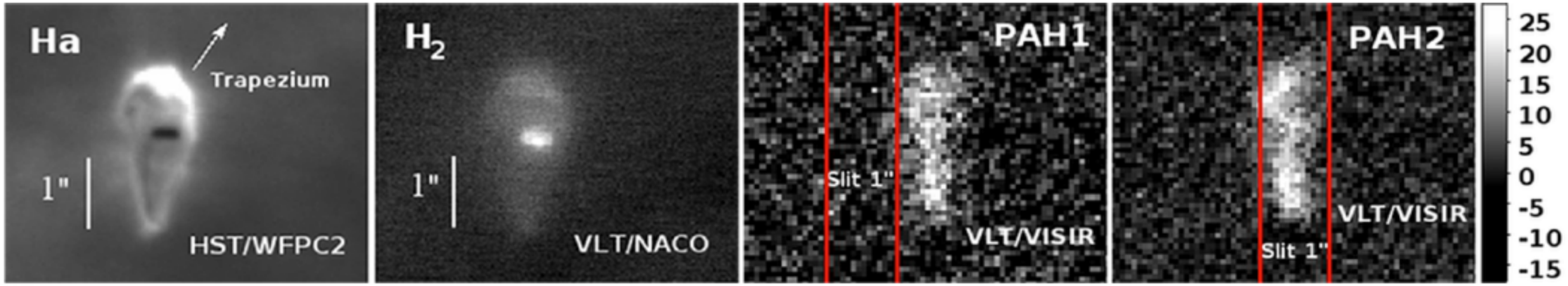
FUV-induced atomic wind from disk surface

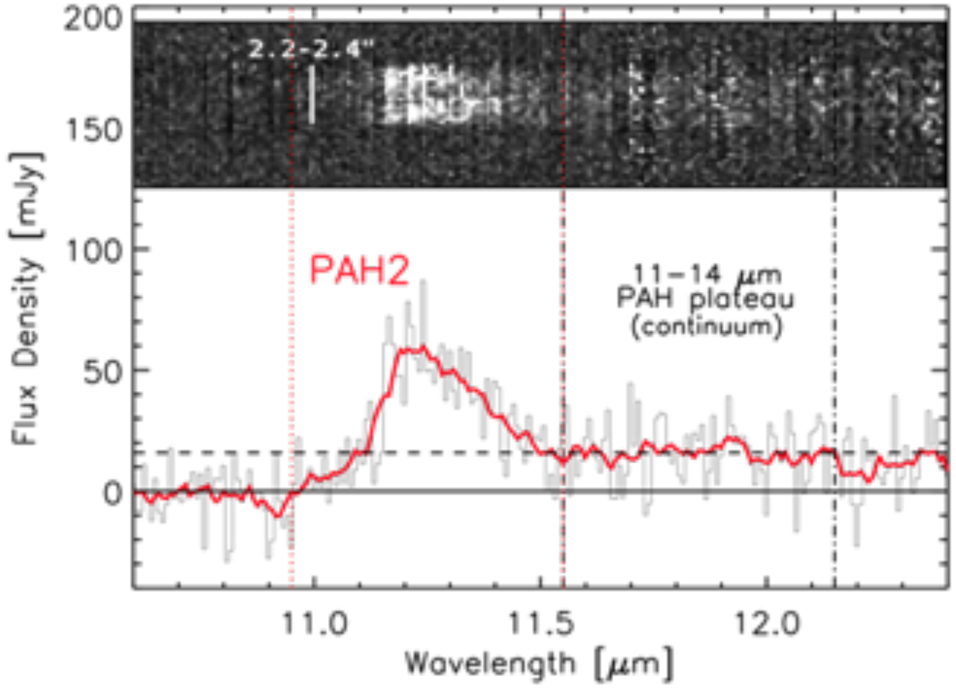
Models by Johnstone et al. (1998)
Störzer & Hollenbach (1998, 1999, 2000)
Richling & York (1998, 2000)

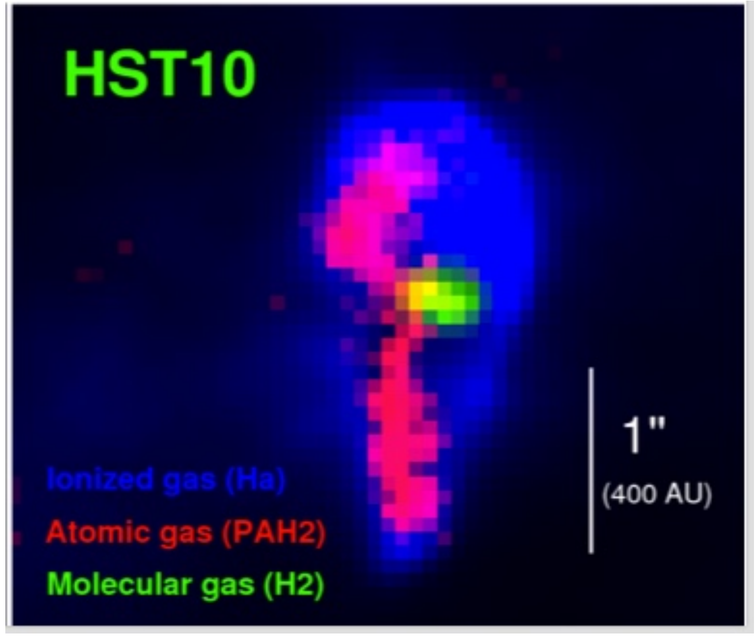


PDR structure in proplyds

Polycyclic Aromatic Hydrocarbon (PAHs) emission in the proplyd HST10:
What is the mechanism behind photoevaporation?







VLT/VISIR

* **PAHs under-abundant by > 50 times relative to the ISM**

* **PAHs mostly neutral**

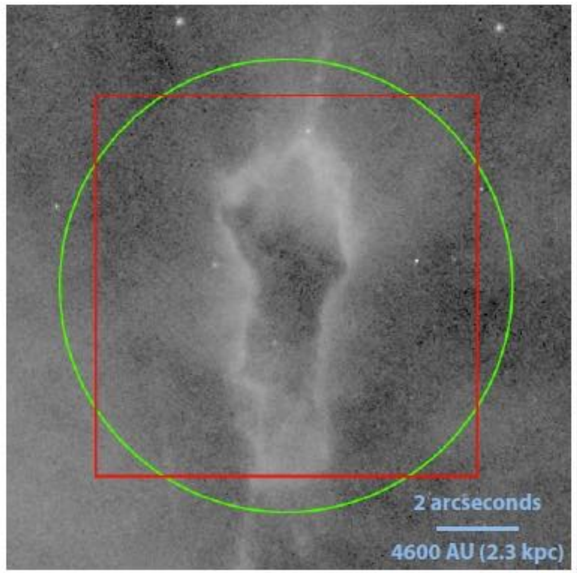
Vicente et al. 2013

Herschel PACS + HIFI observations of proplyds

Champion, Berné, Vicente et al. 2017

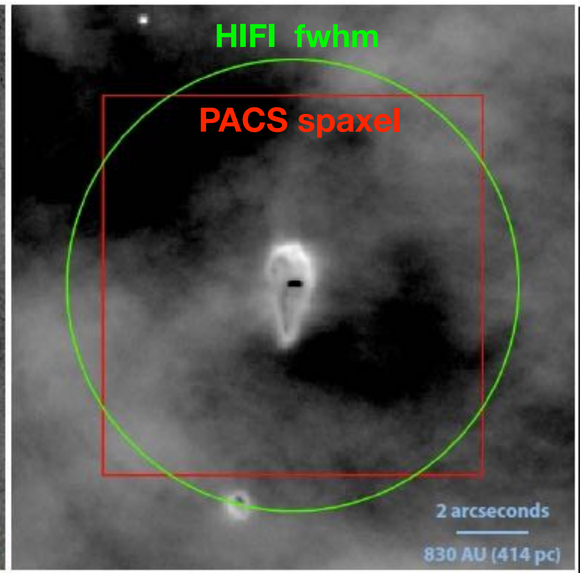
Far-IR cooling lines of [OI]63, [CII]158 and high-J CO

Carina



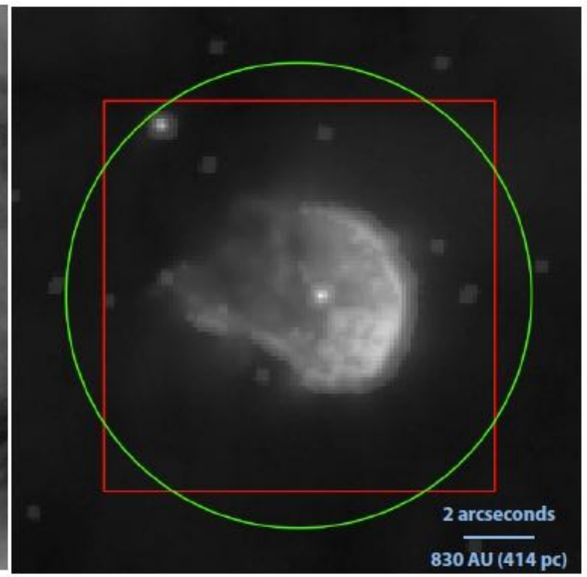
(a) 105-600

Orion



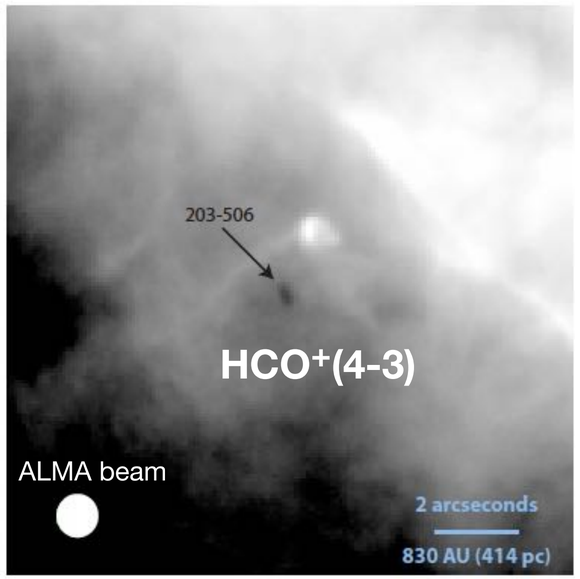
(b) HST10

Orion



(c) 244-440

Orion/ALMA

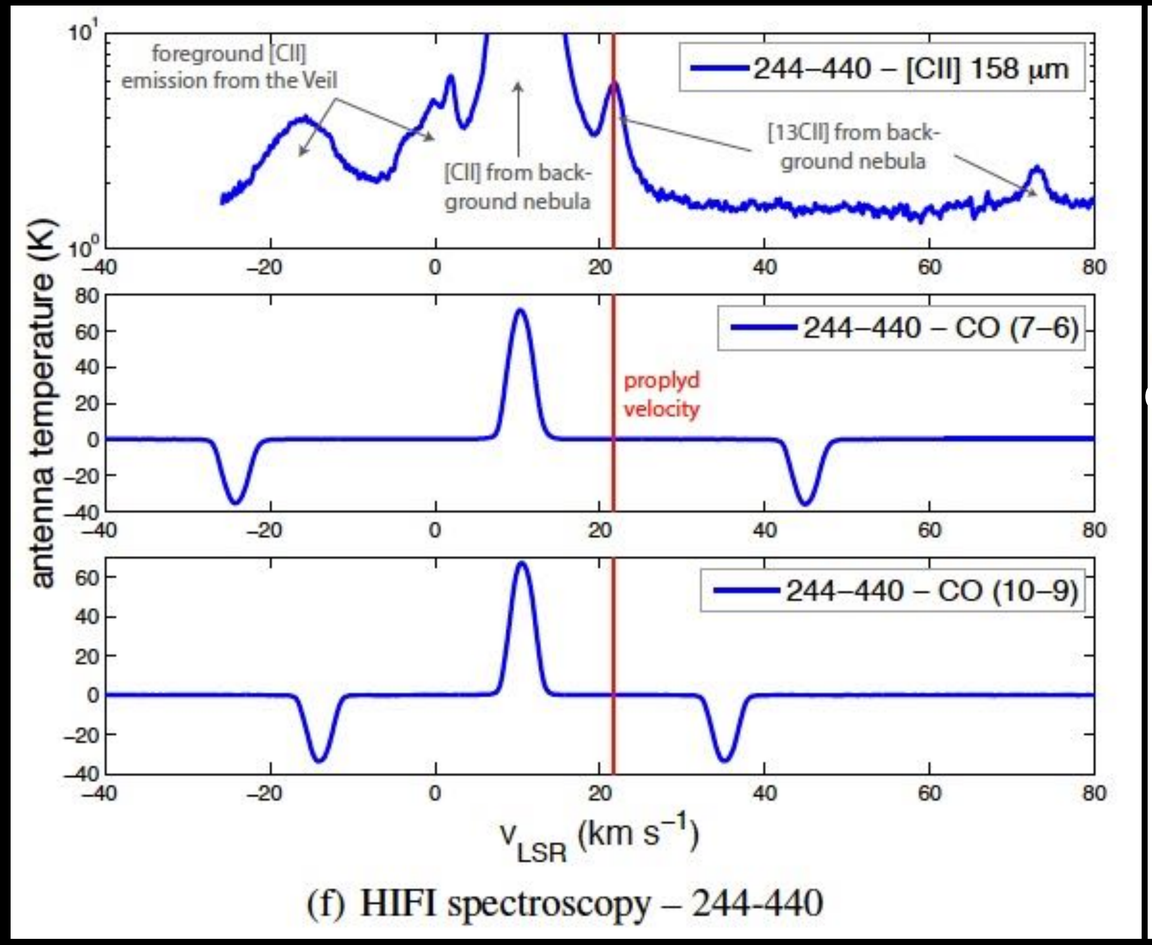


(d) 203-506

Goicoechea+2016

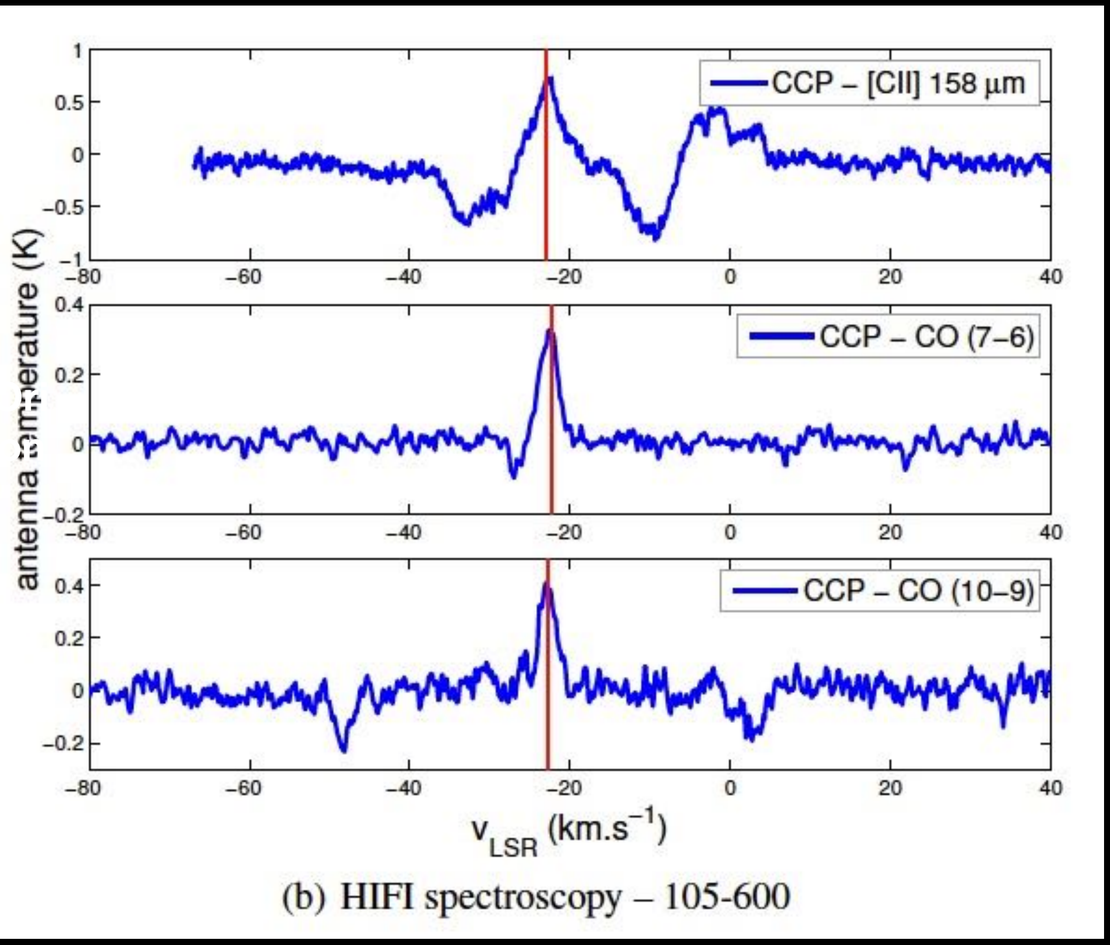
HIFI spectroscopy

ORION



(f) HIFI spectroscopy – 244-440

CARINA



(b) HIFI spectroscopy – 105-600

Beam dilution and nebula contamination!

Observations vs. Model

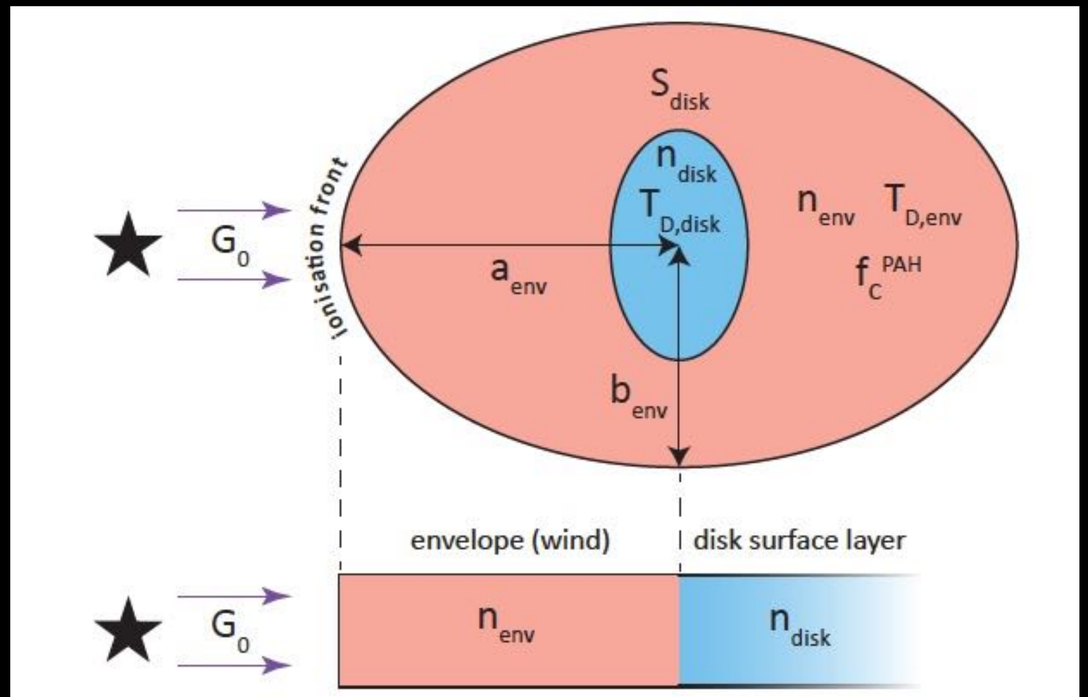
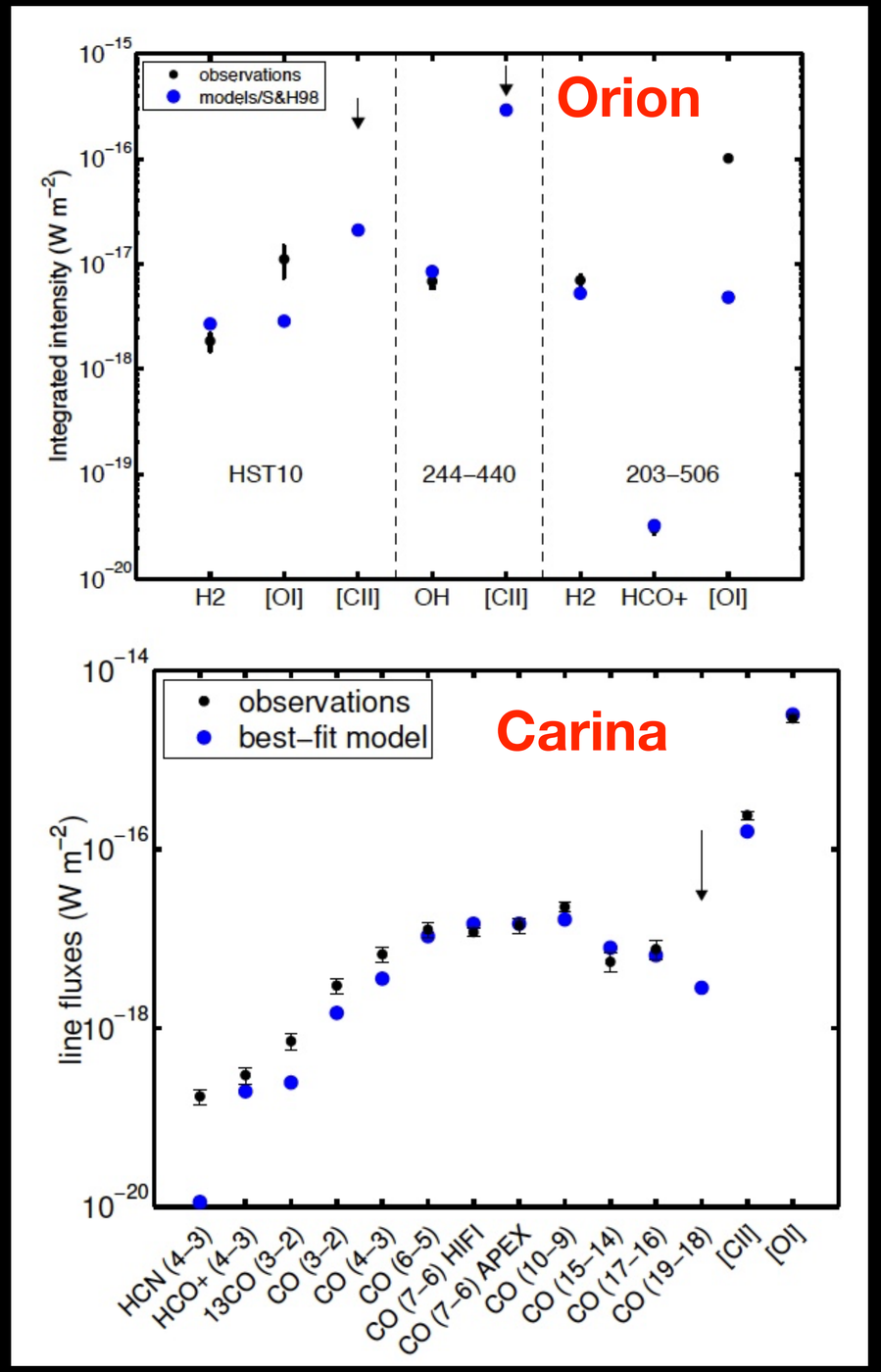
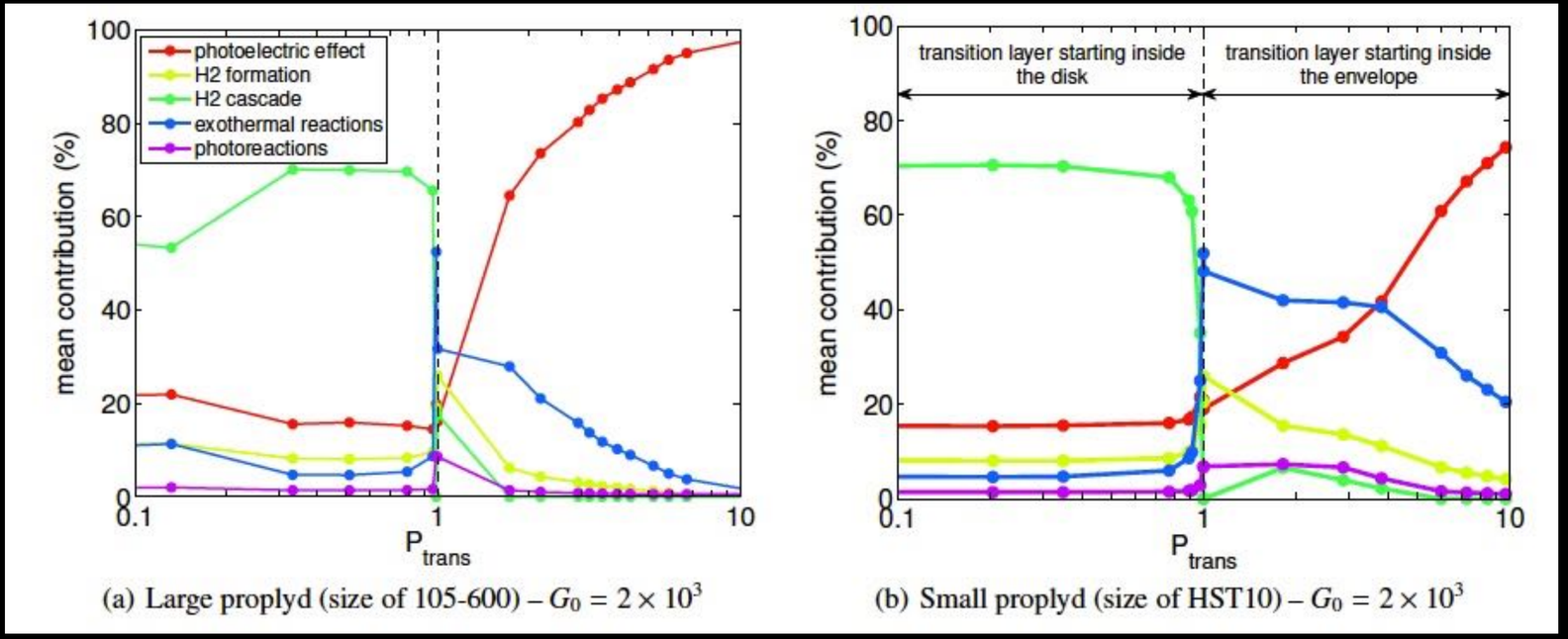


Fig. 3. *Top*: schematics of the apparent 2D geometry with parameters used in our adapted model of an externally-illuminated protoplanetary disk composed of a disk (blue) surrounded by an envelope (red). *Bottom*: 1D corresponding slab used to model the PDR of the proplyd.



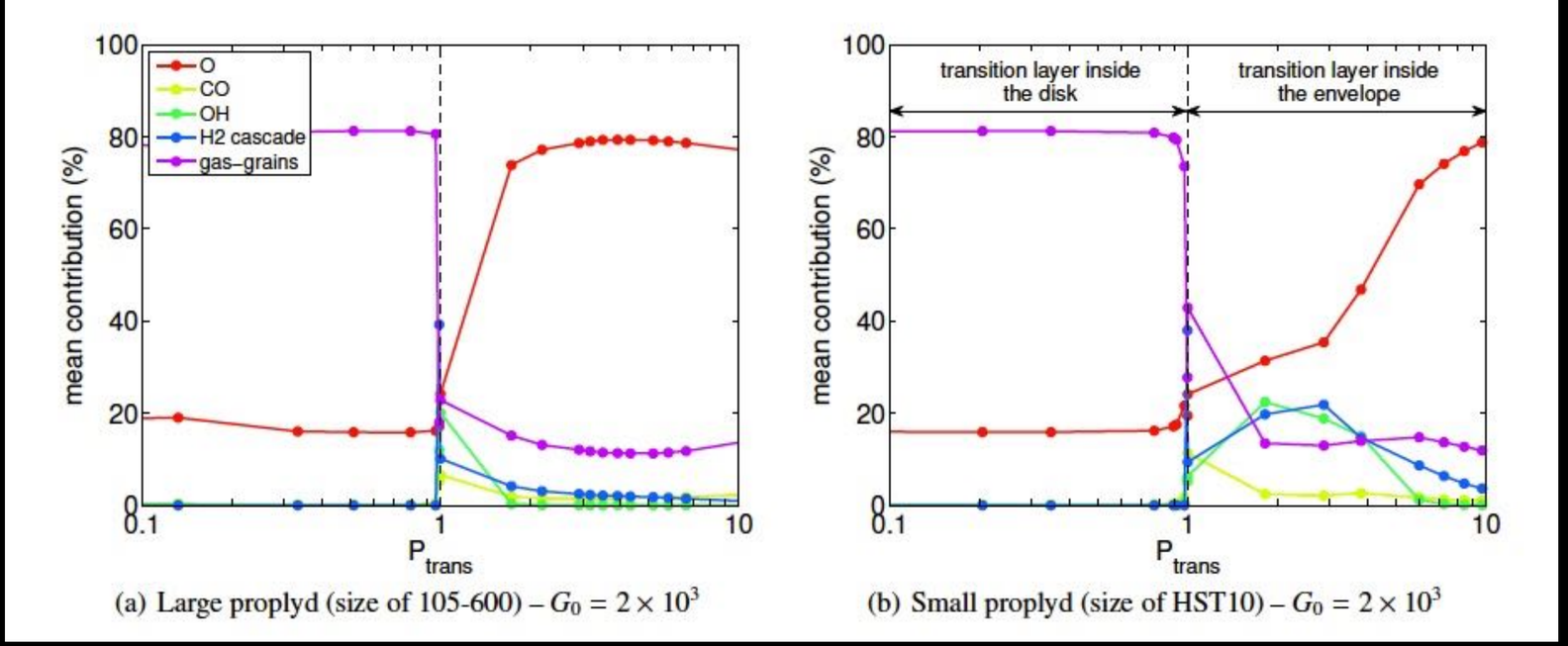
* model reproduced most observations
* provided (T, n) at disk surface and M_loss rates



(a) Large proplyd (size of 105-600) – $G_0 = 2 \times 10^3$ (b) Small proplyd (size of HST10) – $G_0 = 2 \times 10^3$

Heating

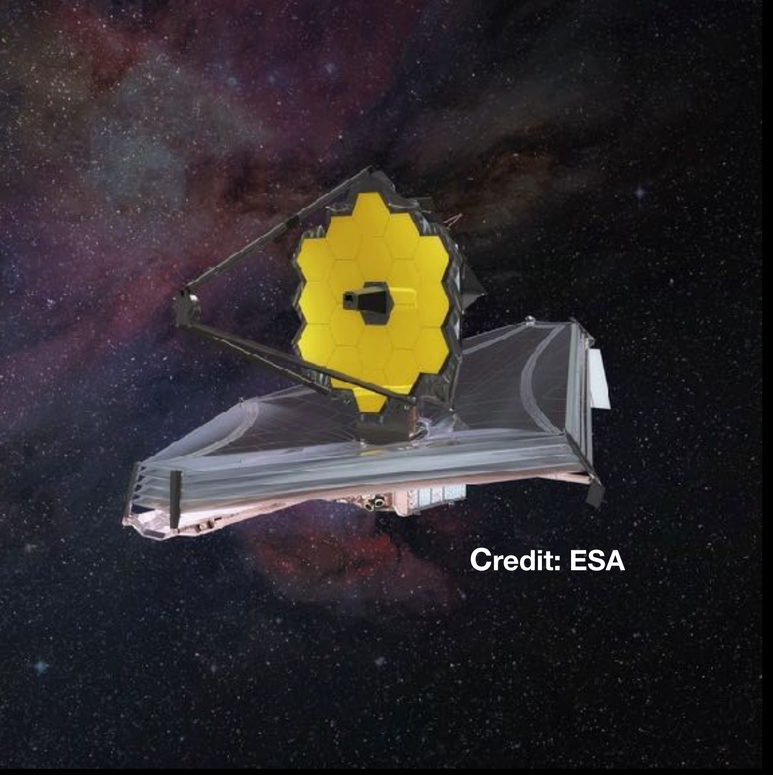
Check paper for further details!



(a) Large proplyd (size of 105-600) – $G_0 = 2 \times 10^3$ (b) Small proplyd (size of HST10) – $G_0 = 2 \times 10^3$

Cooling

JWST - ERS program on PDRs



Credit: ESA

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