GREAT astronomy in the air

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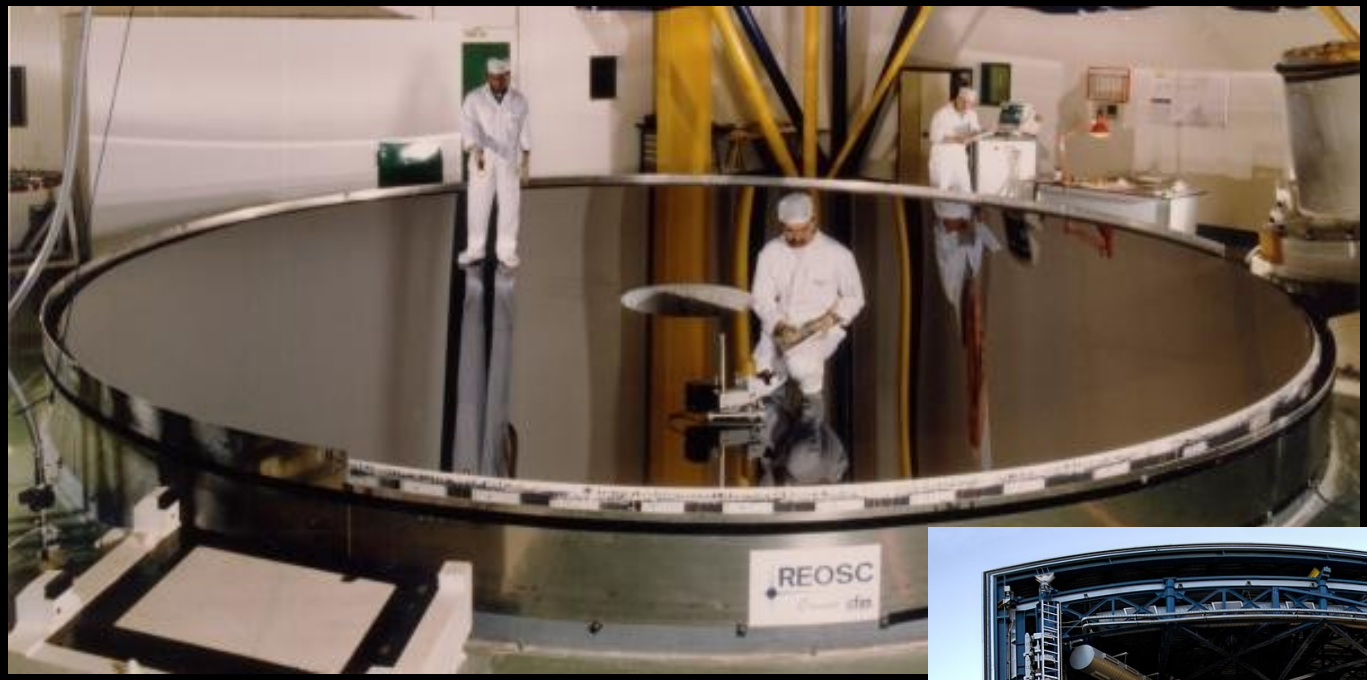
What do we want?

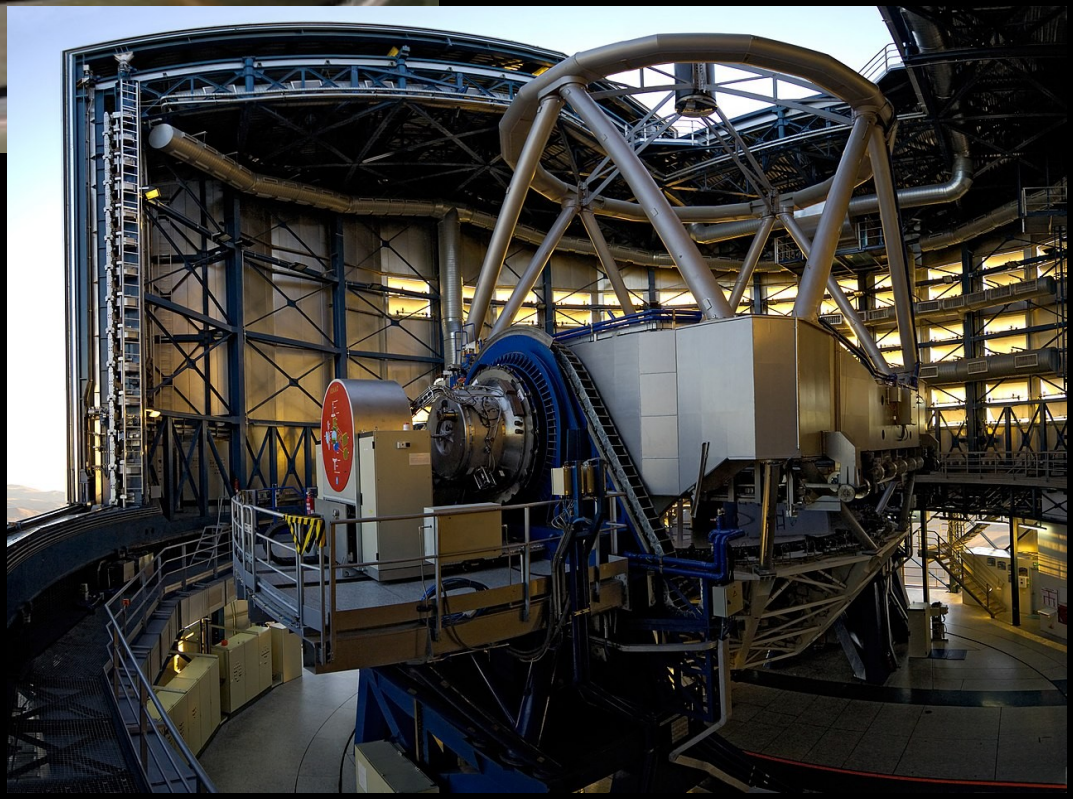
Telescopes

Galileo Galilei, 1564-1642

Bigger telescopes

Even bigger telescopes

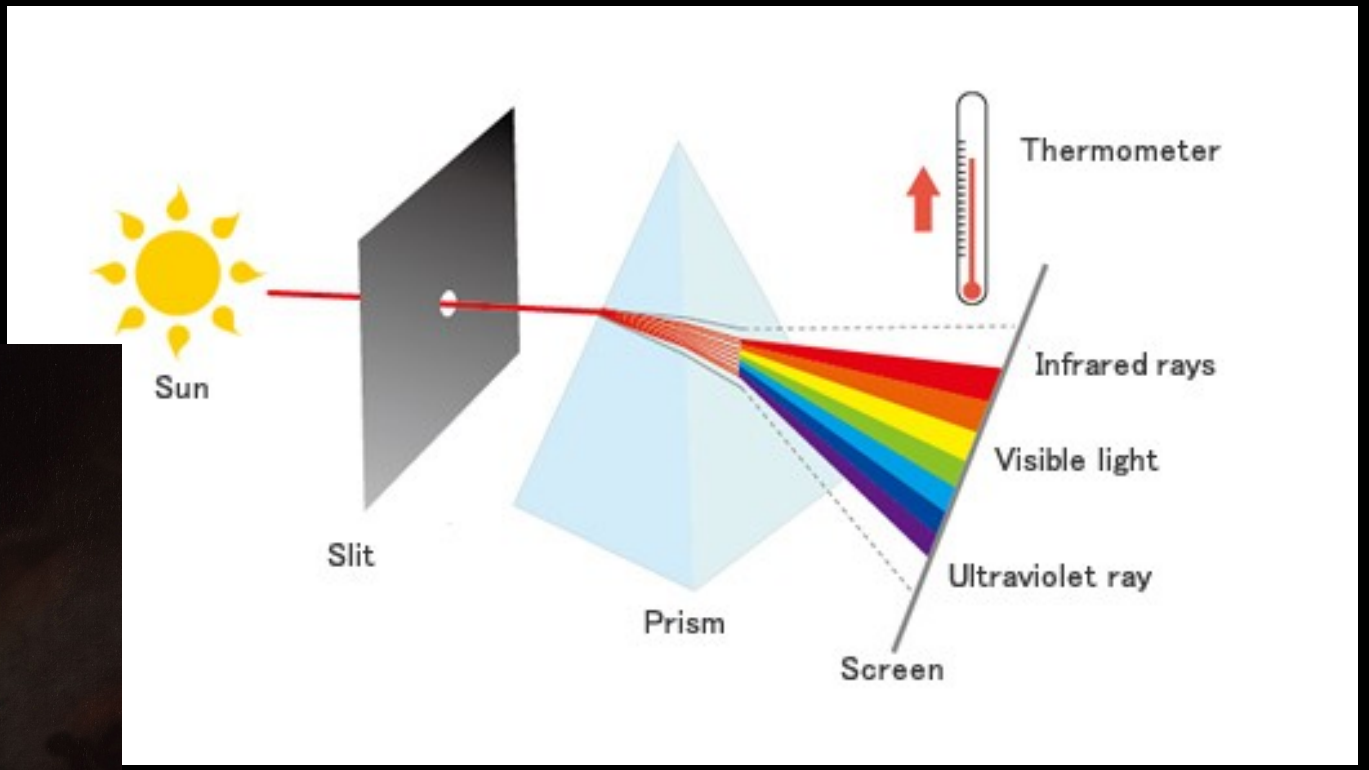




Very Large Telescope (VLT),
ESO, Cerro Paranal, Chile


NASA
DLR

There is more than just light

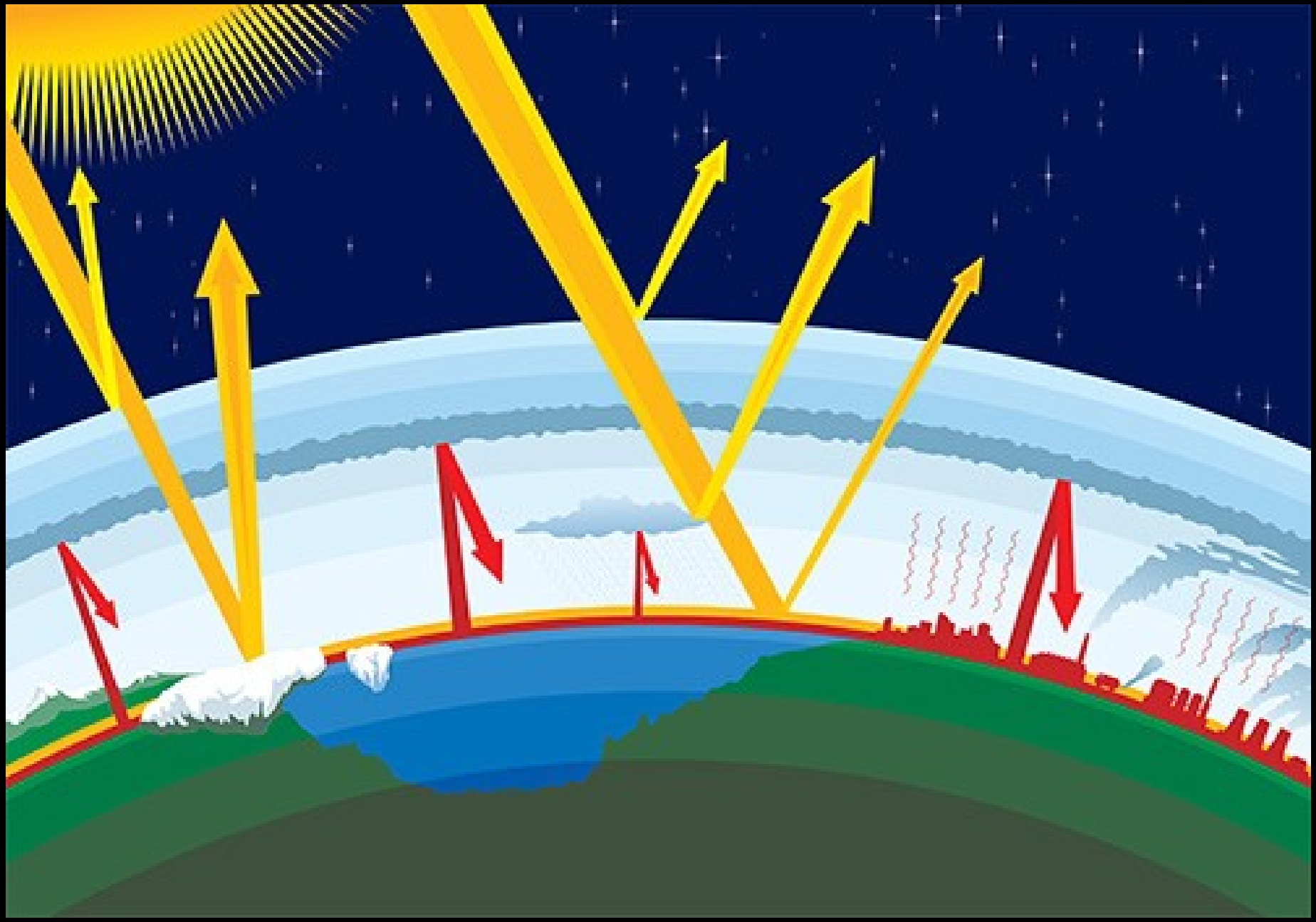


William Herschel, 1738-1822

Infrared light = Heat radiation

Transmission

Water



We **ARE** sitting in a greenhouse: greenhouse gases:

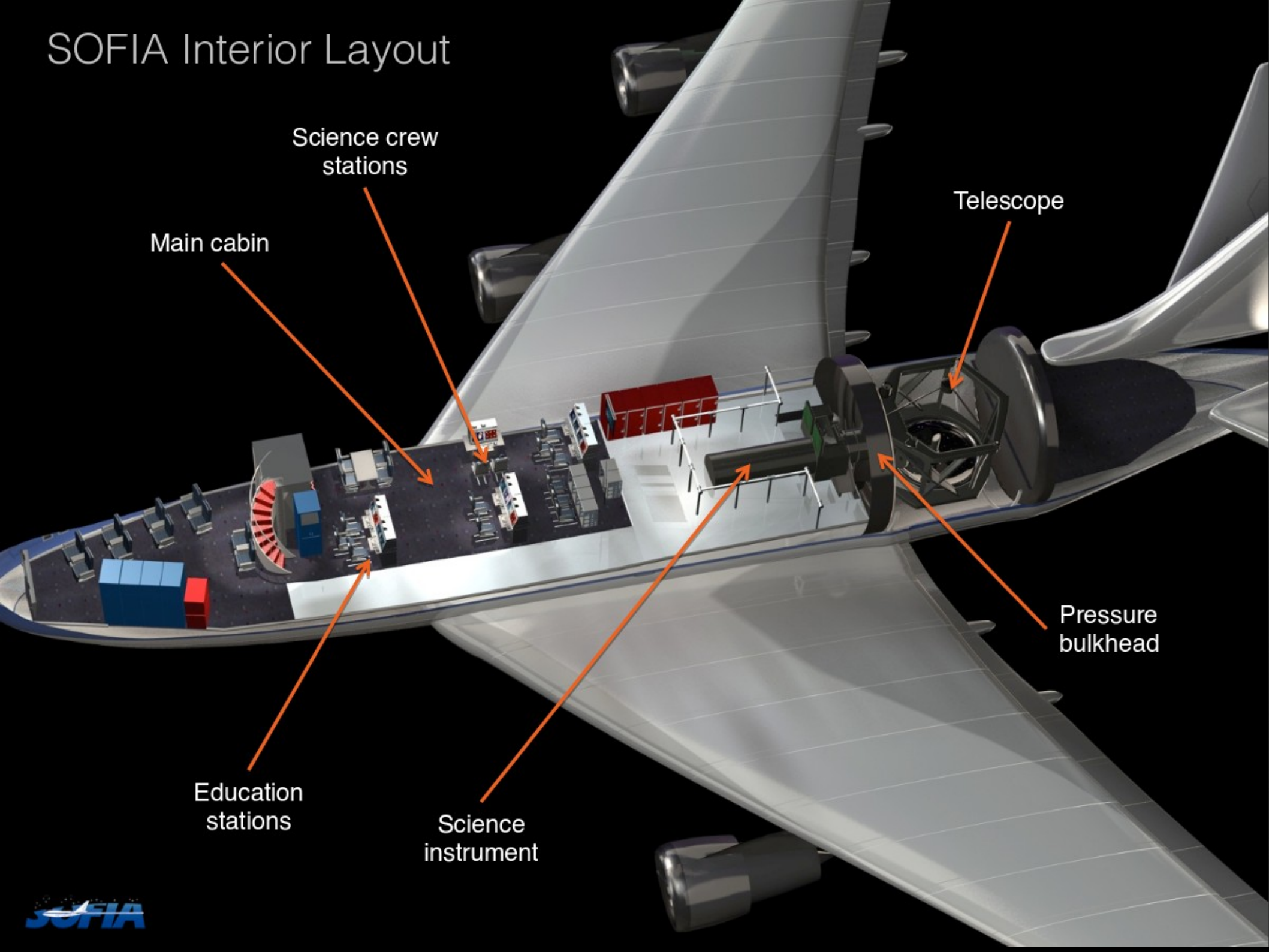
1) water vapour, 2) CO_2

No out = no in!

Solution: Into the air

- SOFIA (Stratospheric Observatory For Infrared Astronomy)
  - 14km altitude = above most water vapour

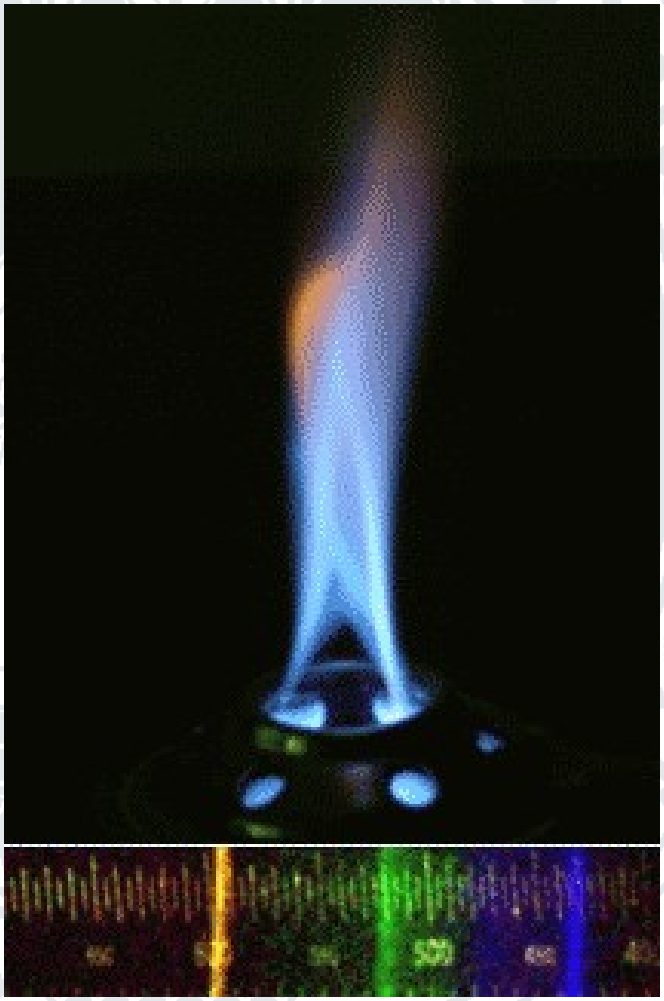
SOFIA Interior Layout



What can we observe?

What can we observe?

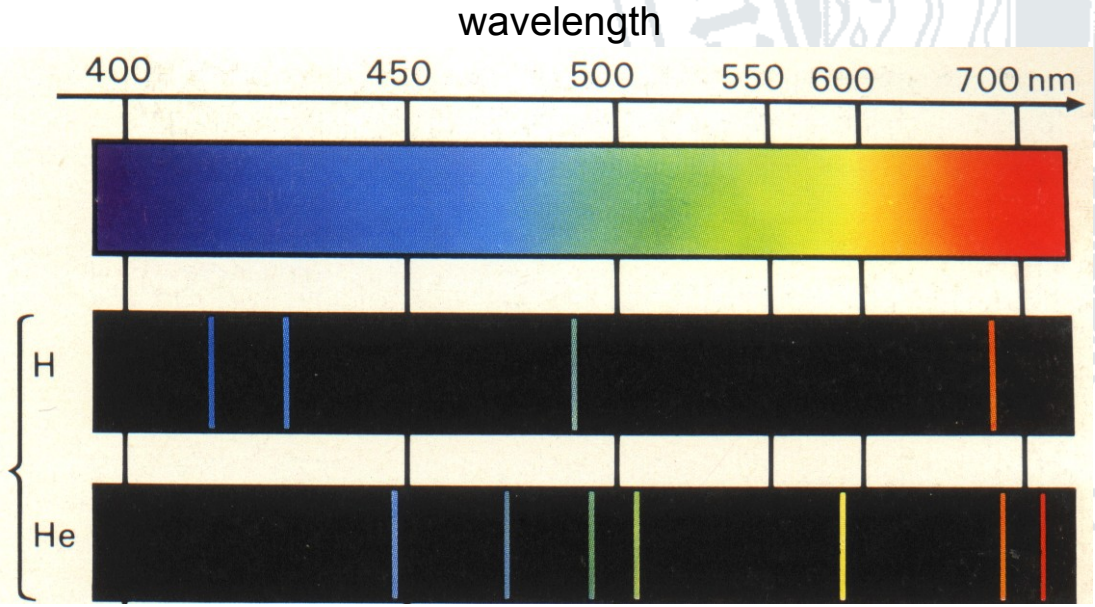
- **Interstellar gas**
  - Atoms and molecules radiate at specific frequencies → like radio



Flame spectrum: Emission lines determine color

Solid body emission

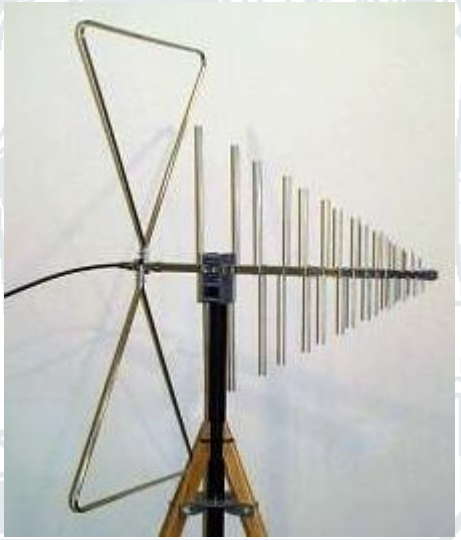
Gas emission



- All frequencies → Composition of the gas

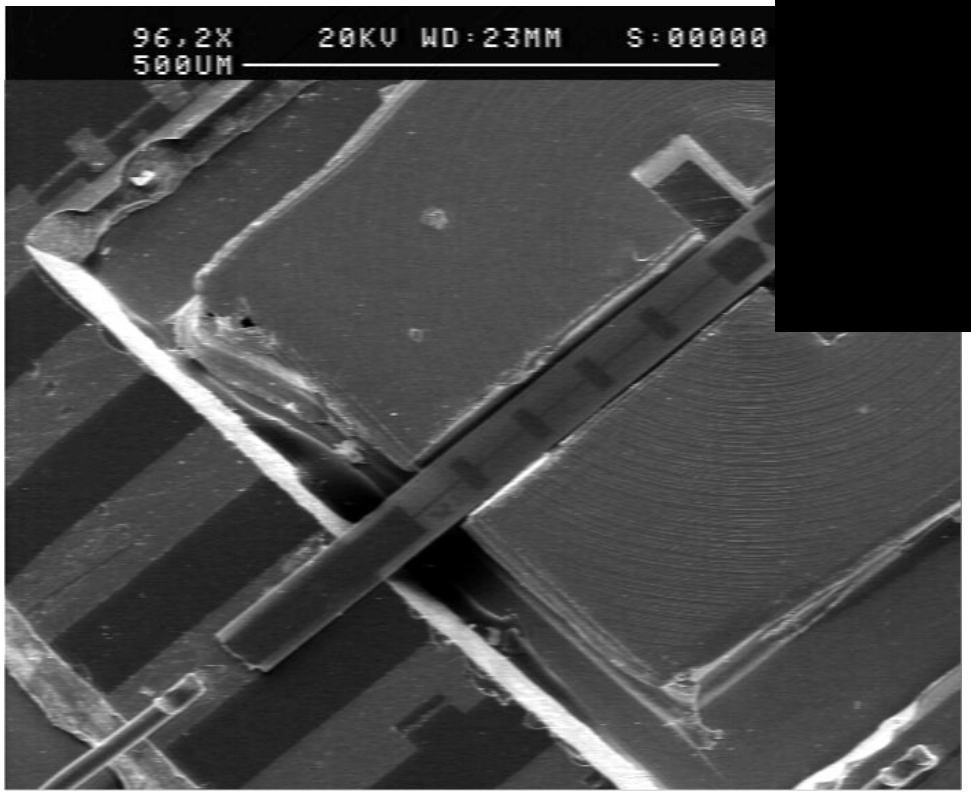
Radio receiver for the infrared

- **3 problems**
  - Antenna size must match wavelength:
    - < 100µm
  - Receiver must be cold:
    - < 10K (-260°C)
  - Infrared frequency cannot be directly amplified:
    - THz regime



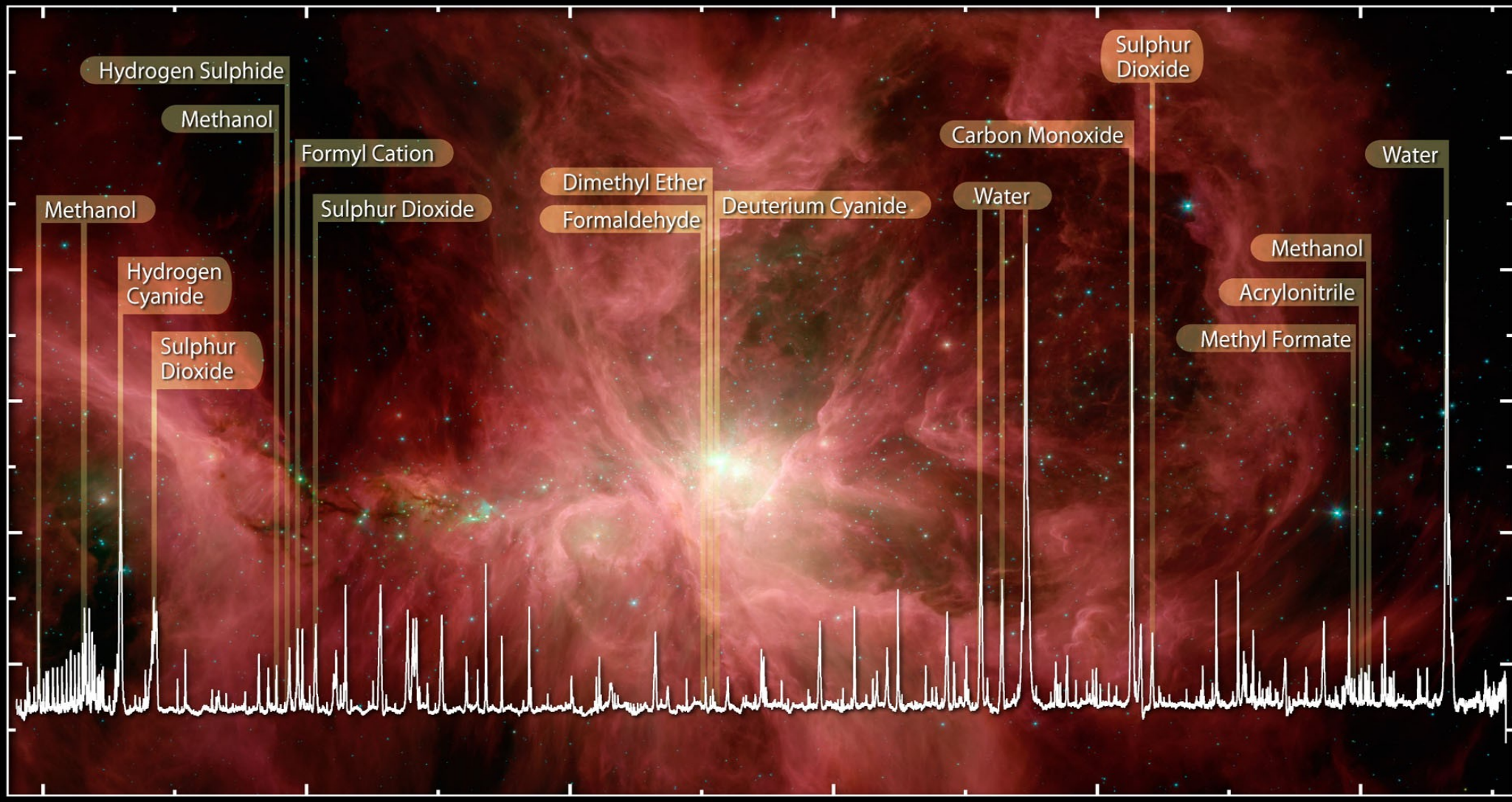
Solution: GREAT

- **G**erman **RE**ceiver for **A**stronomy at **T**Hz-frequencies
  - Built by Uni Köln & MPIfR Bonn



Superconducting Detector

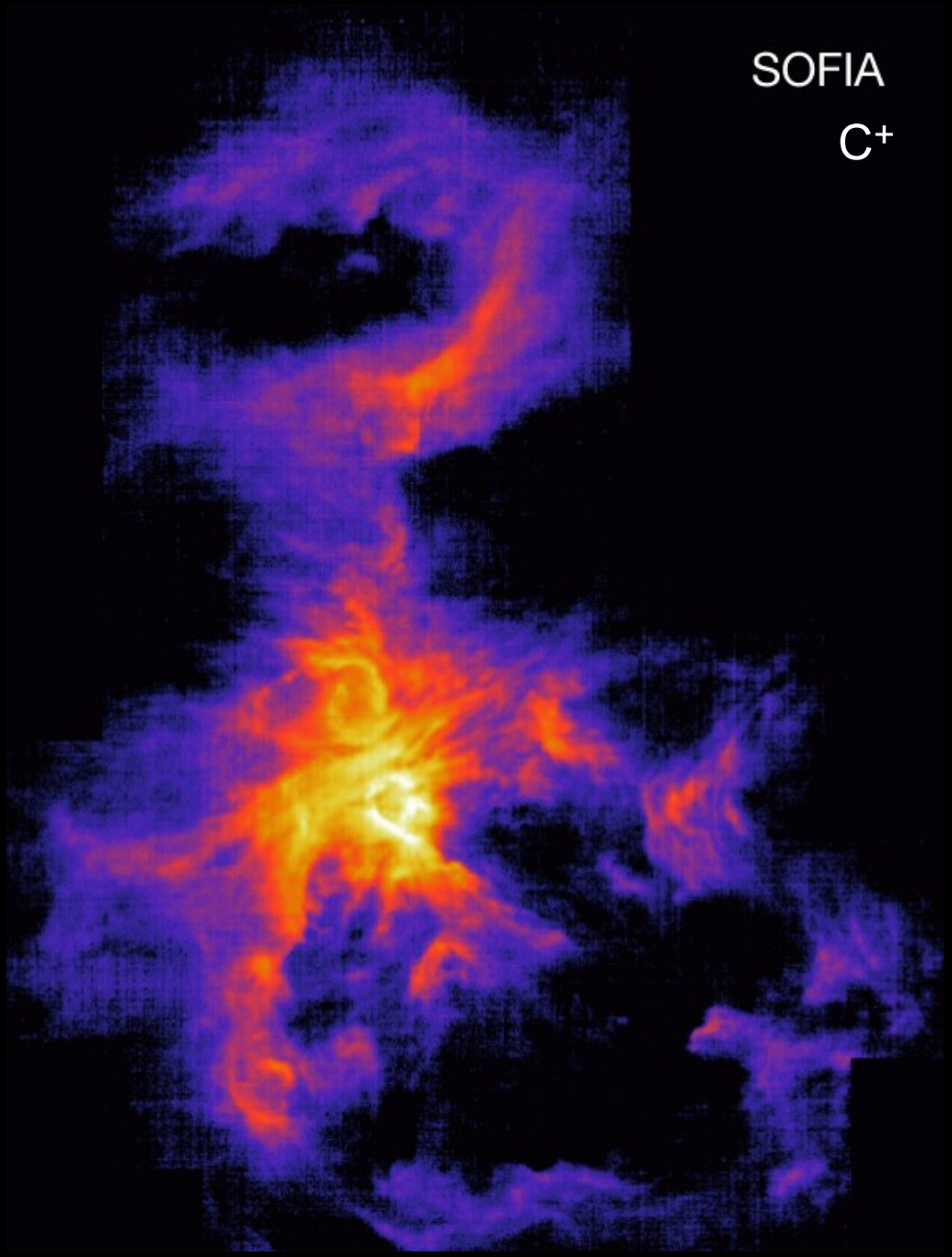
- At 3K (-270°C)
- Structures < 2µm



HIFI Spectrum of Water and Organics in the Orion Nebula

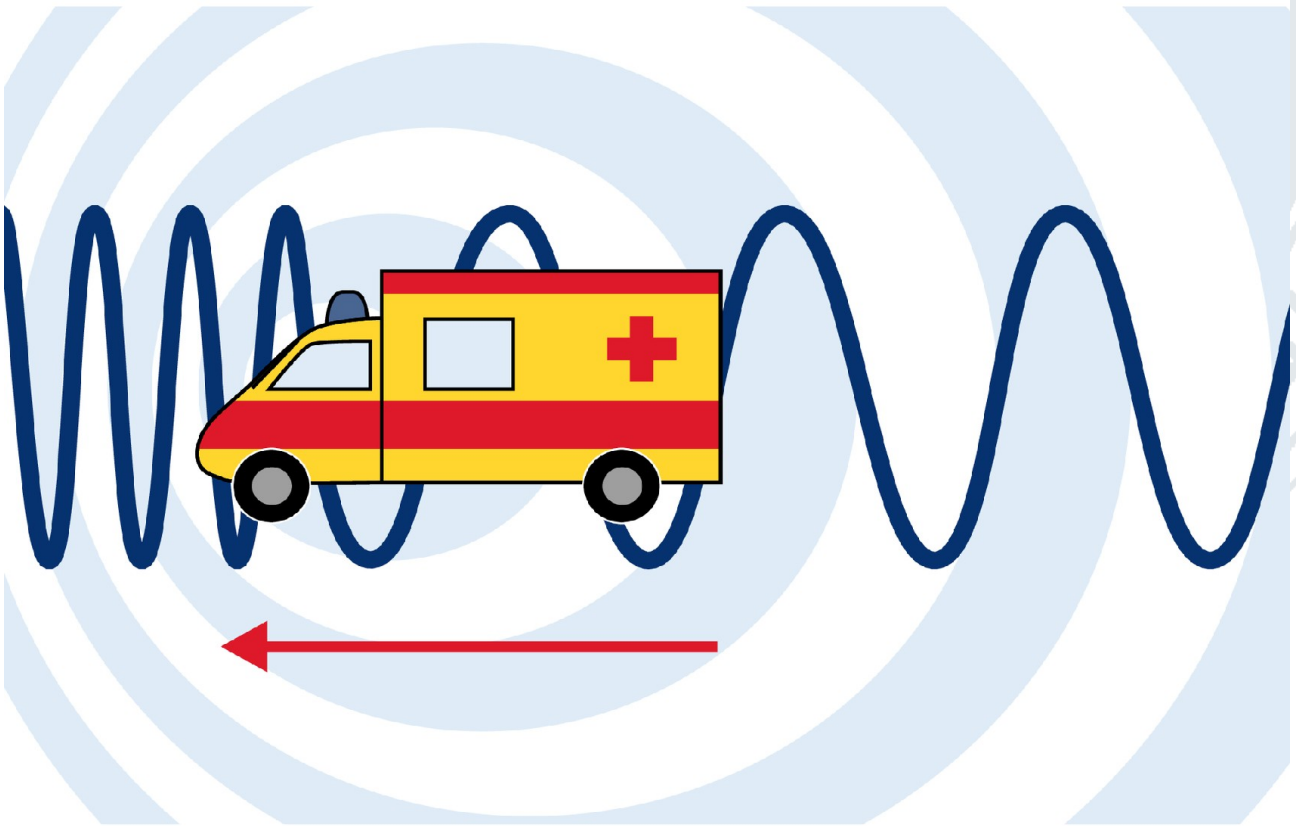
E. Bergin

Every species shows a different picture



Even more information

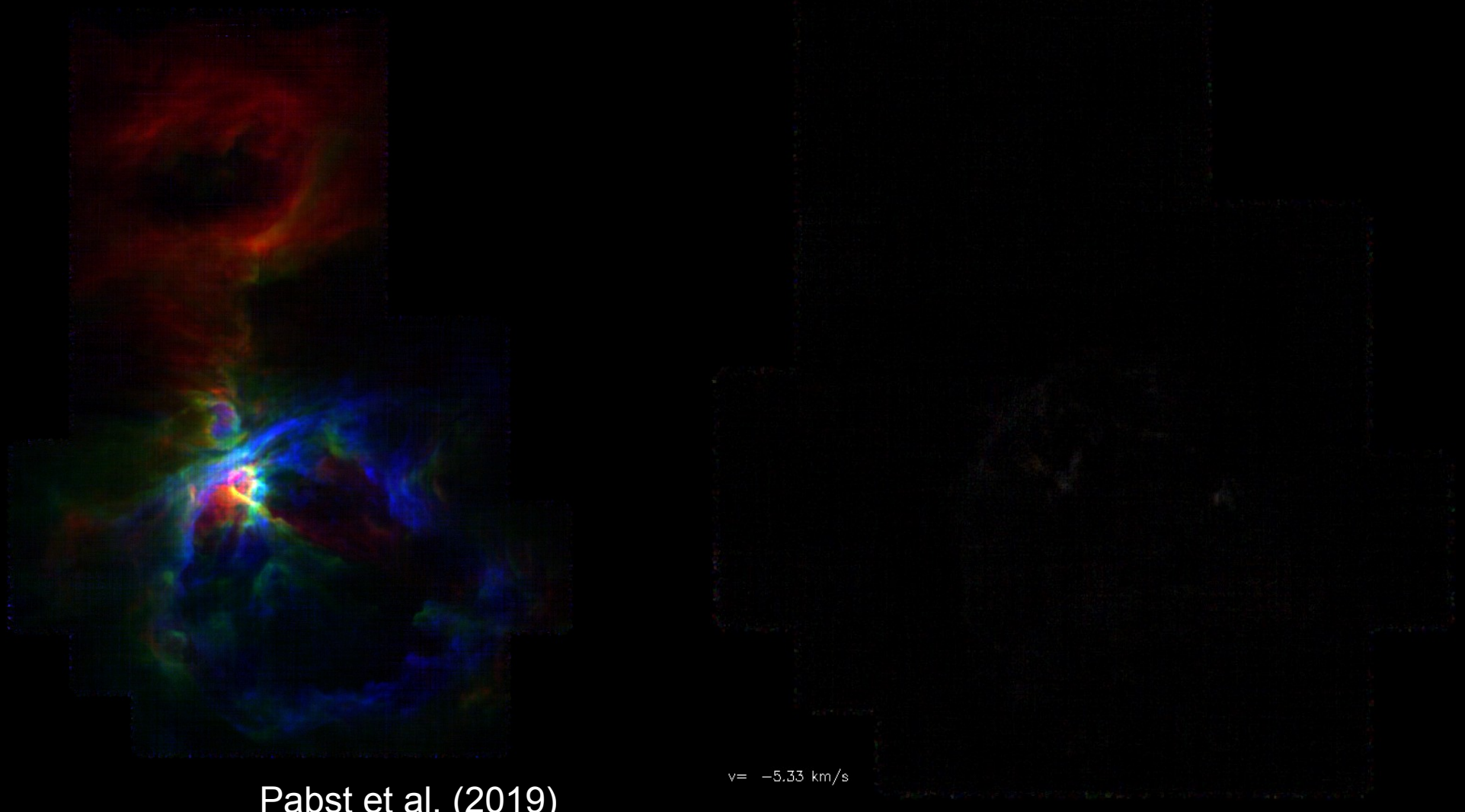
- **Doppler effekt**
  - Observed frequency changes with velocity of the sender



→ **Gas velocity**

Observations

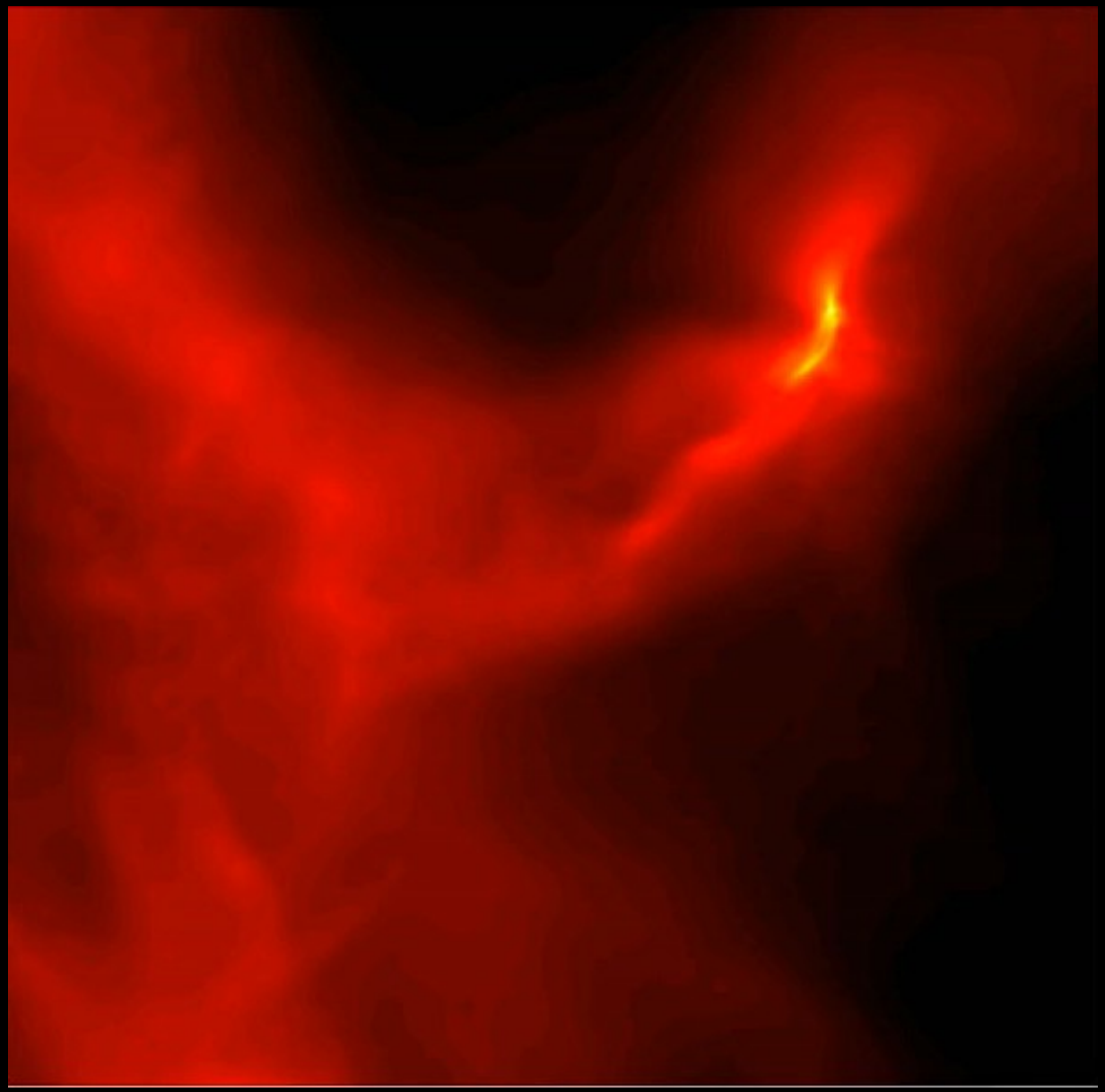
Scan through velocities
in Orion



Pabst et al. (2019)

Final goal

Follow the evolution of star formation



Matthew Bate,
Univ. Exeter

Thank you for watching