The E-ELT Science Case

Science Pep Talk #2

9 Prominent Science Cases

"Prominent" science cases are considered to be among the most important scientifically and are useful for defining capabilities of the telescope.

- Planets and Stars
  - **From giant to terrestrial exoplanets: detection, characterization and evolution**
  - **Circumstellar disks**
  - **Young stellar clusters**
- Stars and Galaxies
  - **Imaging and spectroscopy of resolved stellar populations in galaxies**
  - **Black holes and AGN demographics**
- Galaxies and Cosmology
  - **Physics of high redshift galaxies**
  - **First light – The highest redshift galaxies (z>10)**
  - **Is the low-density IGM metal-enriched?**
  - **A dynamical measurement of the expansion history of the Universe**

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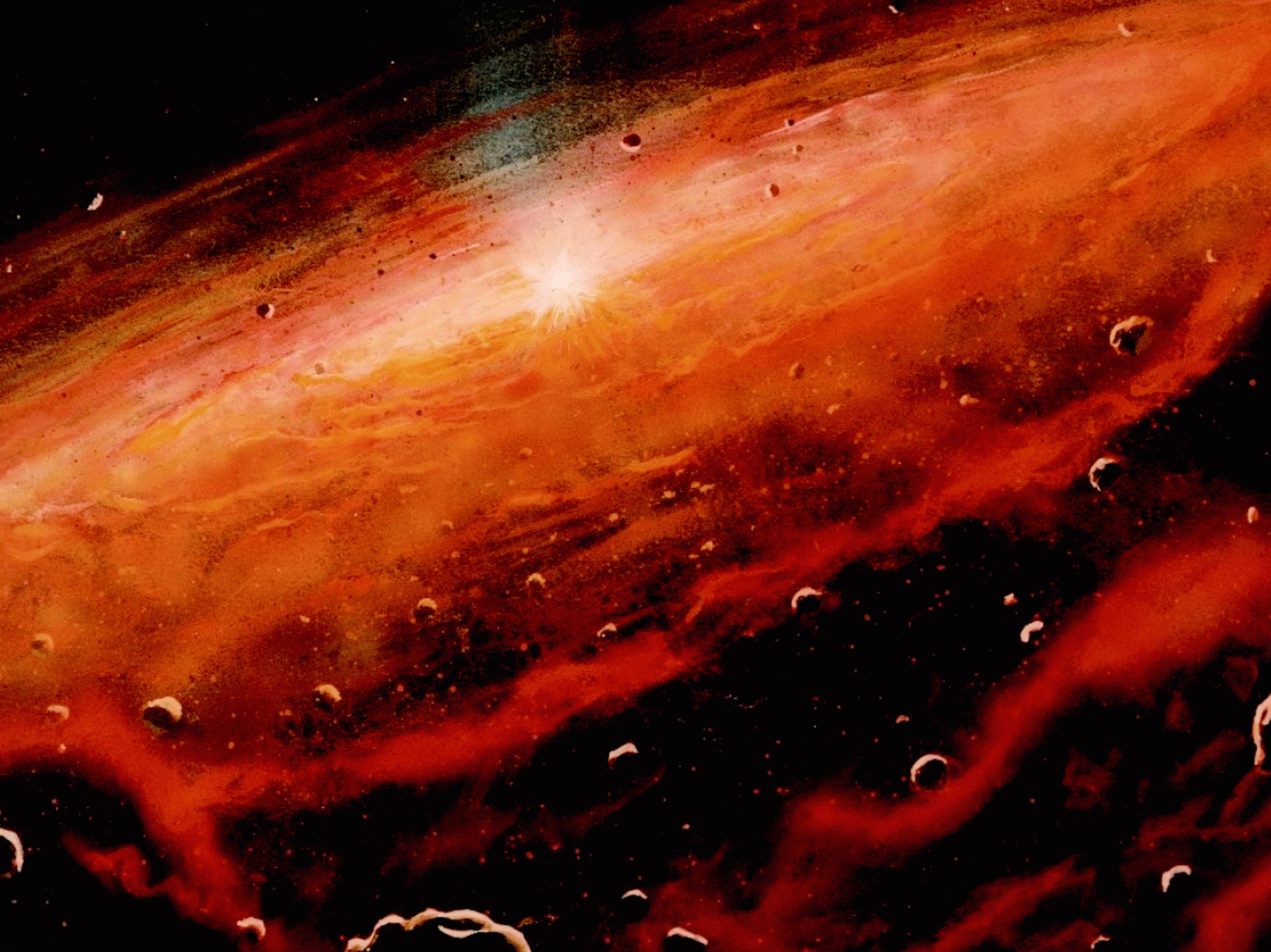
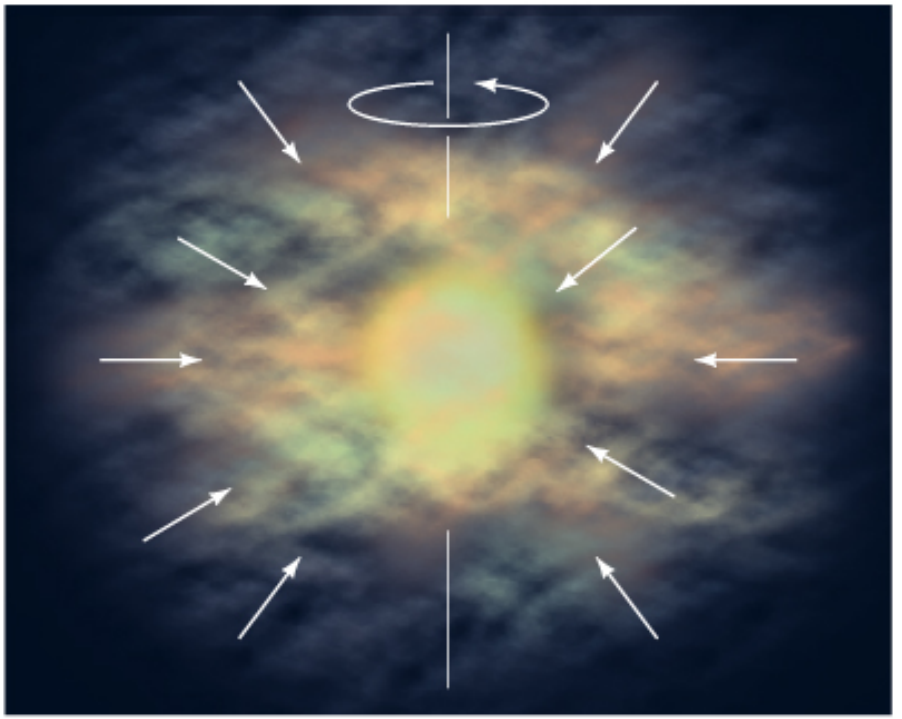
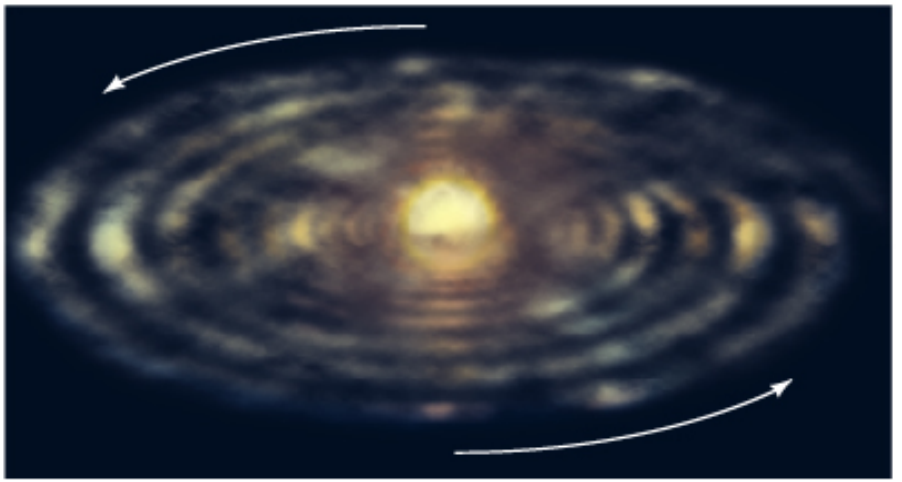


What are circumstellar disks?

- Rotating disks of gas and dust around young stars.
- Critical component in the formation of low-mass stars and their planetary systems.
- Supply a conduit for channeling gas onto the forming (proto-) star.
- Provide the reservoir of material from which planets form.
- Provide the launch platform for jets and outflows.





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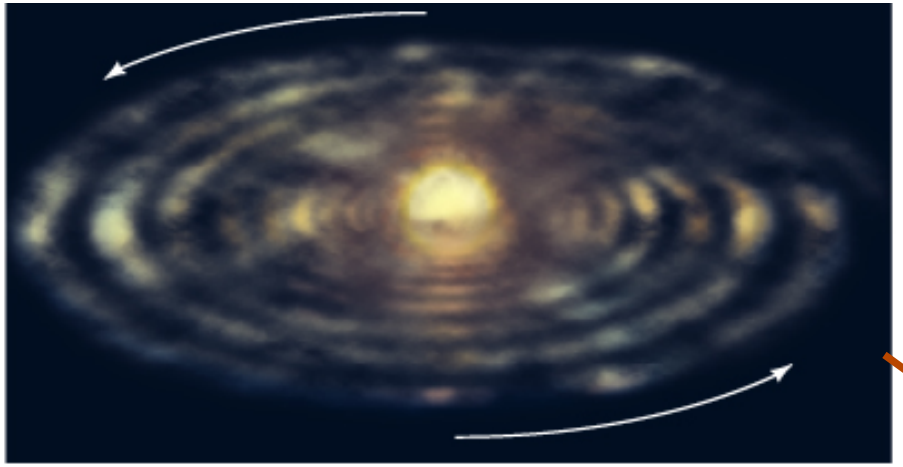
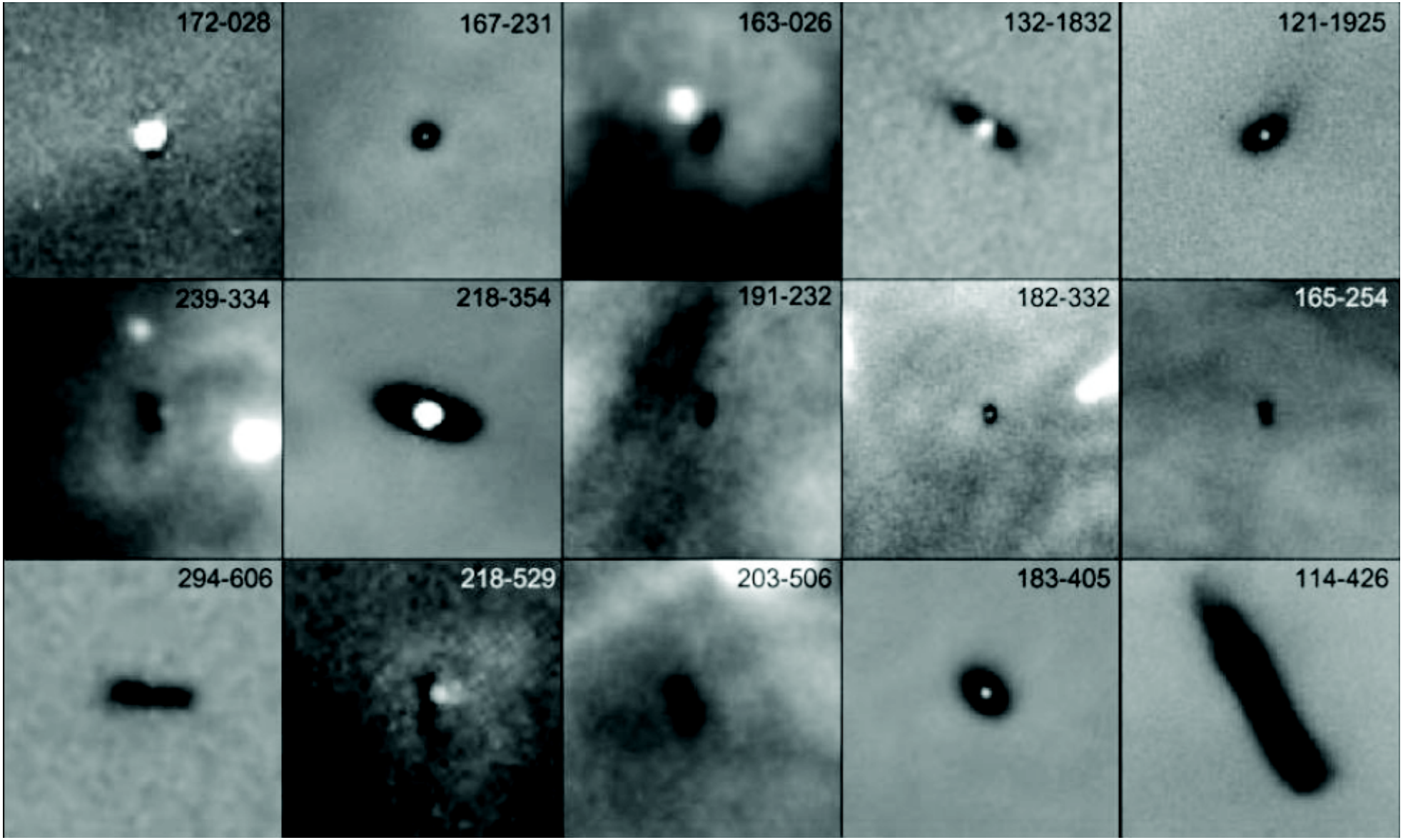


- Found around 30-50% of low-mass young stars.
- Sizes = 10-1000 AU
- Over the course of 10-100 Myr the initial gas-rich disks evolve into dusty debris disks.

How do we know circumstellar disks exist?



HST images of young disks silhouetted against the background of the Orion nebula.

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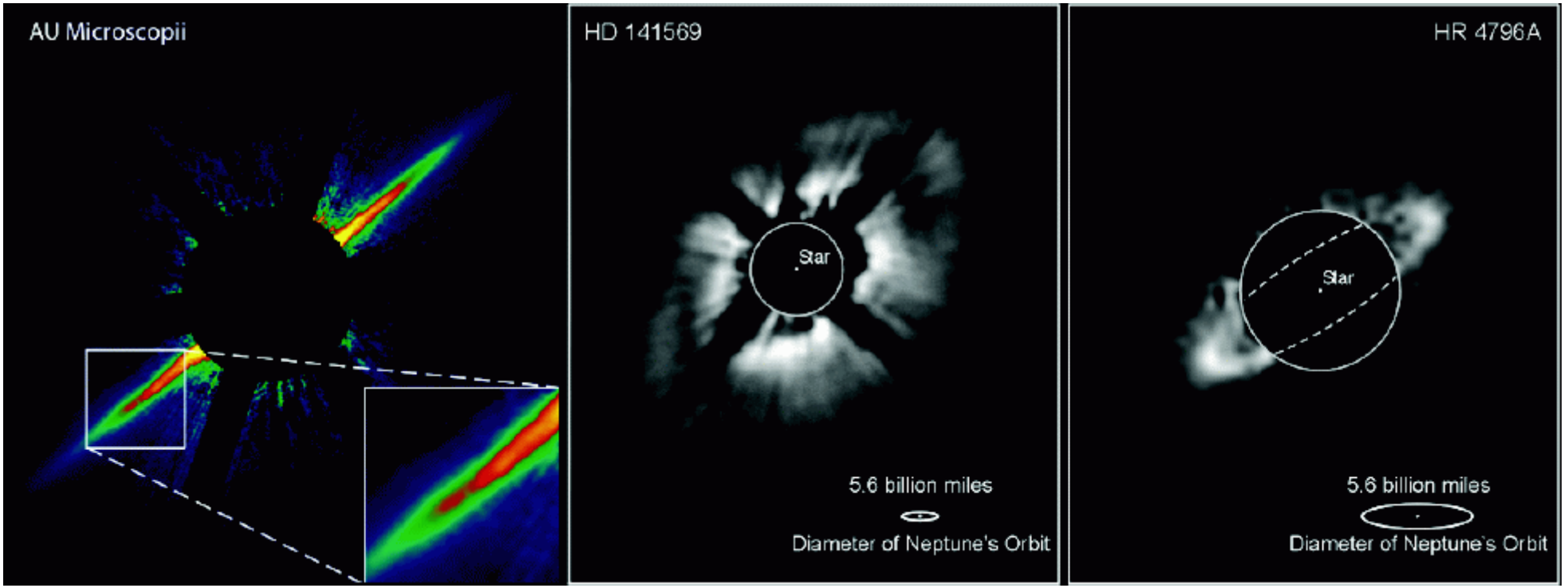


Coronographic Keck and HST images of debris disks.

Why do we want to study circumstellar disks?

Circumstellar disks play a crucial role in star formation!

Questions:

- How is material funnelled onto the forming proto-star?
- What is the impact of the central proto-star on the disk?
- How are jets collimated and do they rotate?

Why do we want to study circumstellar disks?

Circumstellar disks play a crucial role in

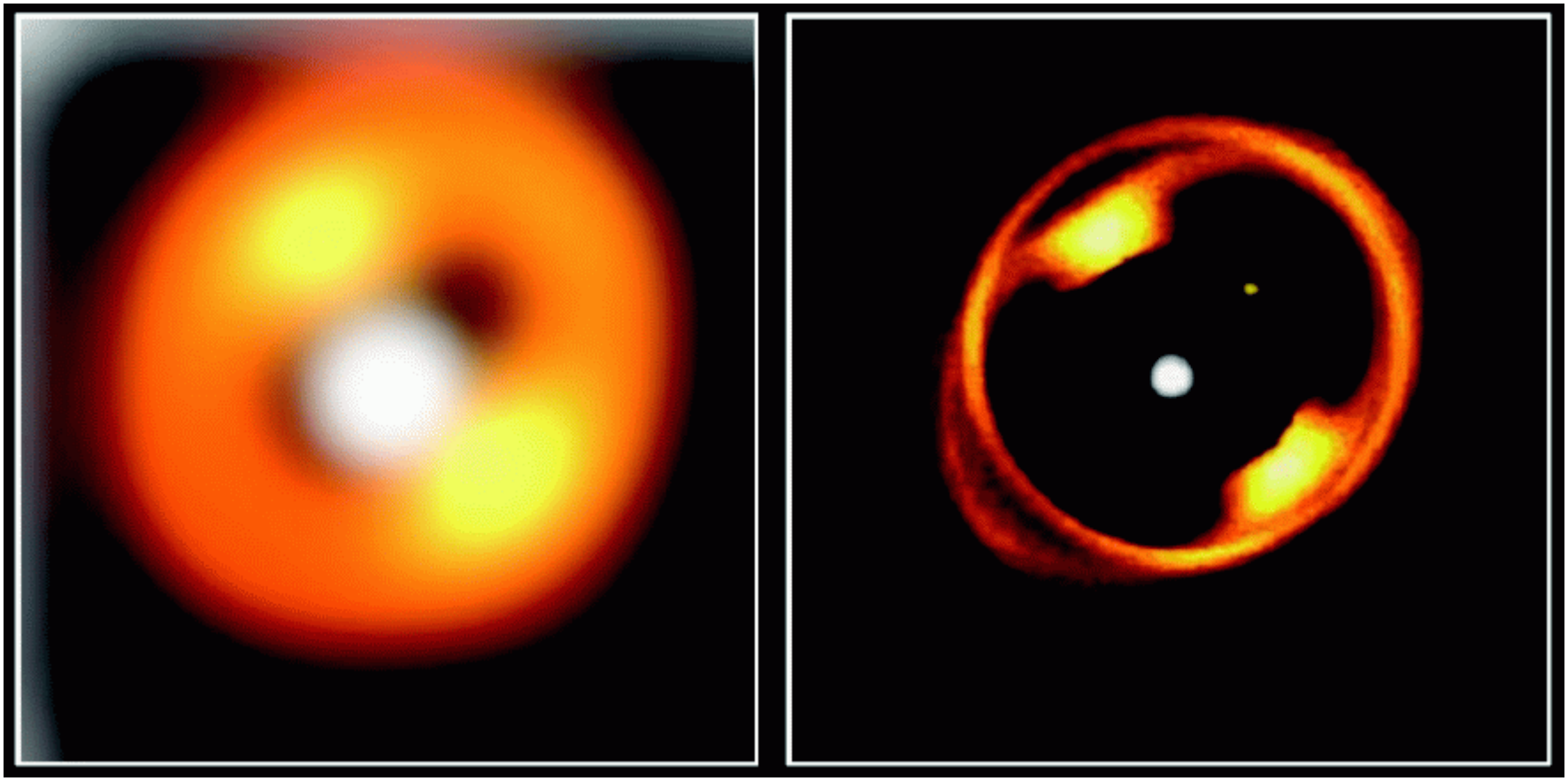
planet formation!

Questions:

- How does planet assembly work? (Dust agglomeration, gas accretion)
- What are the timescales?
- What is the influence of environment?
- How do planets interact with each other and with the disk?
- Can we understand observed planetary systems?

What will E-ELT bring?

High spatial resolution!



JWST diffraction-limited E-ELT diffraction-limited

Simulation of a dusty debris disk at 40 pc.

What will E-ELT bring?

High spatial resolution!

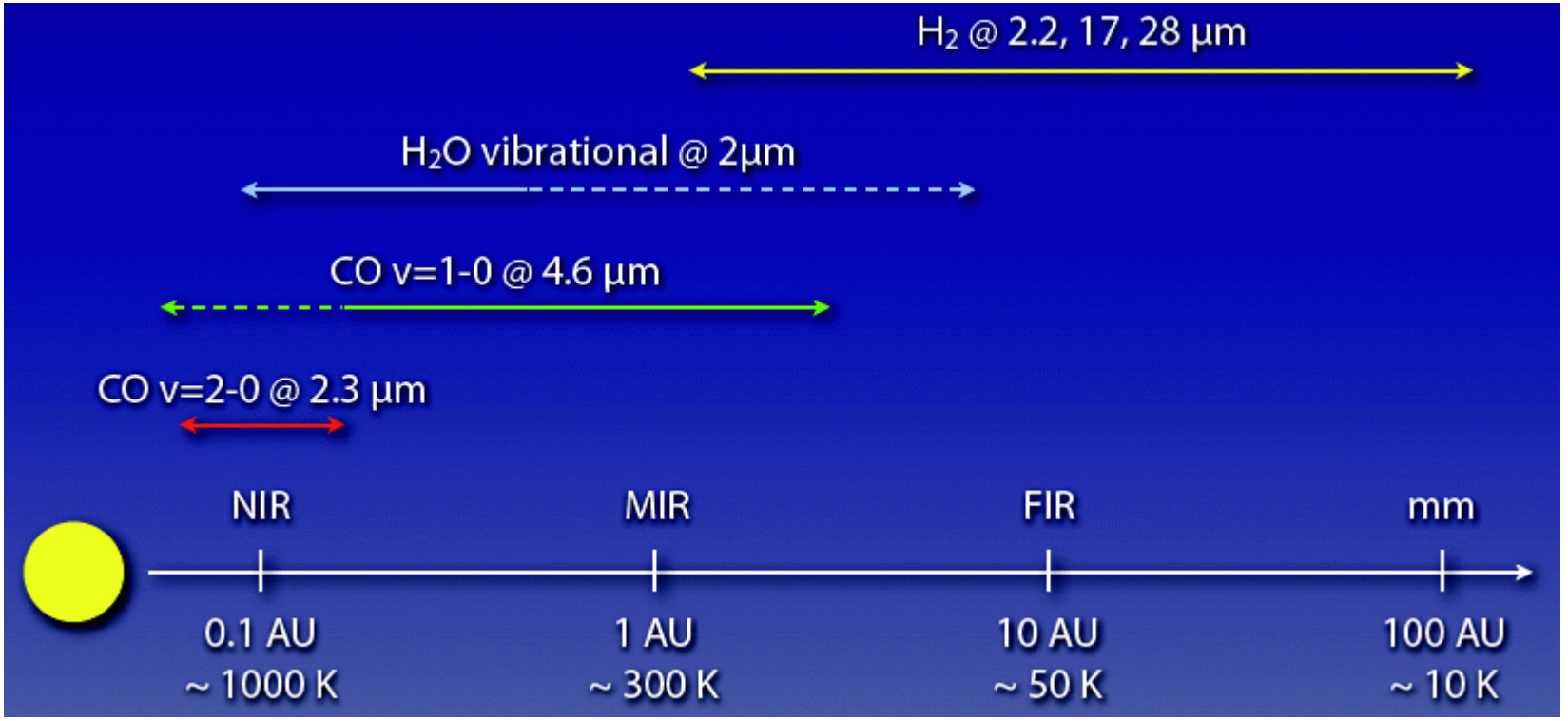
- Direct imaging of structures indicative of ongoing planet formation
- Gaps
- Rings
- Warps
- Spiral density waves

42m E-ELT diffraction-limited spatial resolution

	Ang	20 pc	150 pc	500 pc
2 µm	12 mas	0.24 AU	1.8 AU	6 AU
5 µm	30 mas	0.6 AU	4.5 AU	15 AU
10 µm	60 mas	1.2 AU	9 AU	30 AU
20 µm	120 mas	2.4 AU	18 AU	60 AU

What will E-ELT bring?

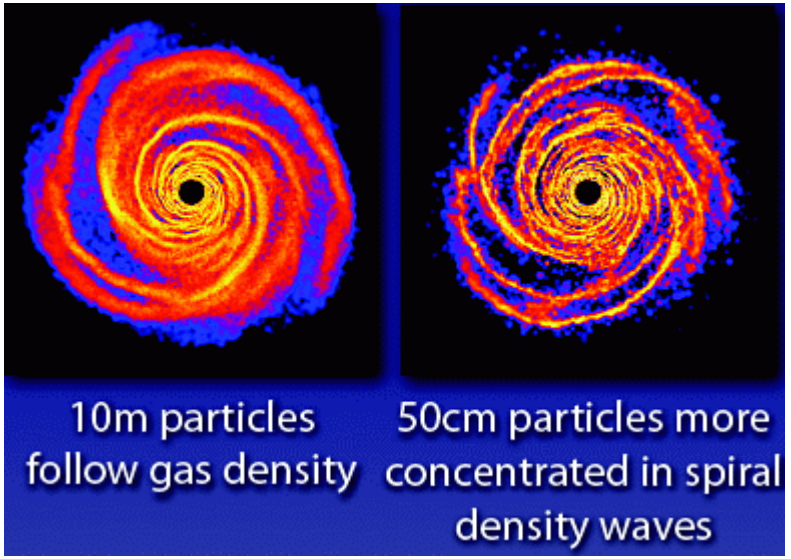
Wavelength coverage from 2-20 μm!

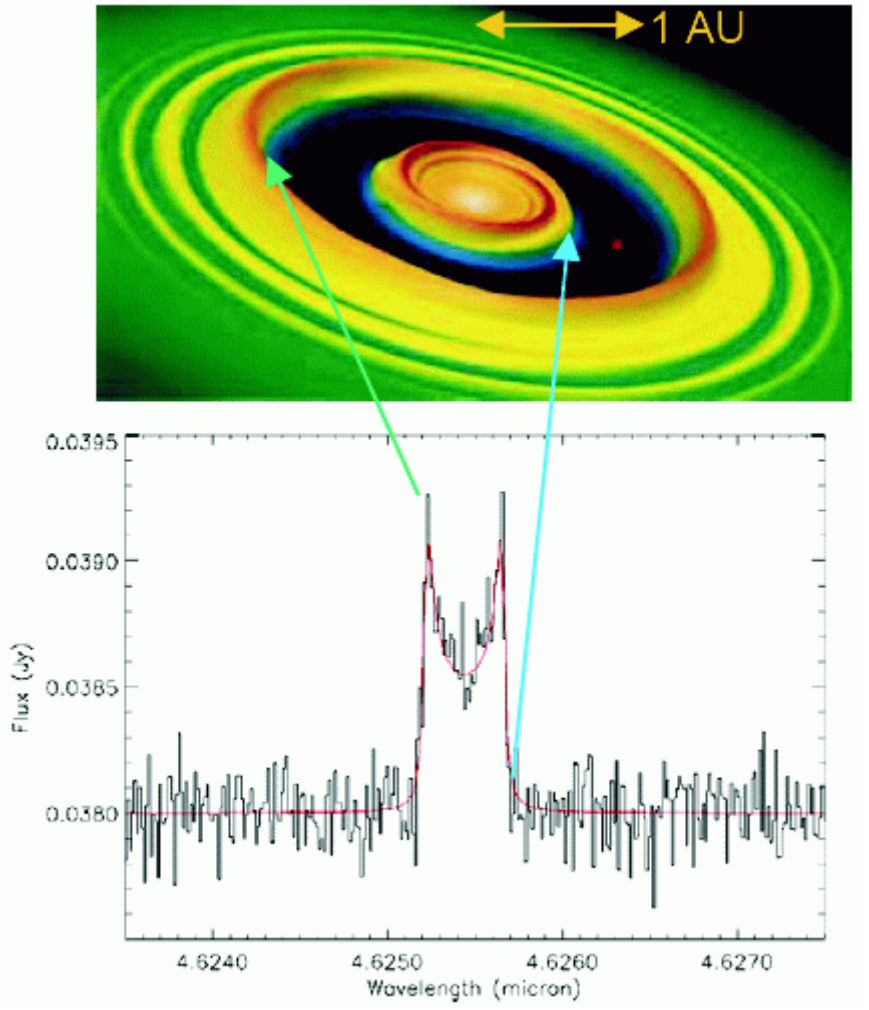


What will E-ELT bring?

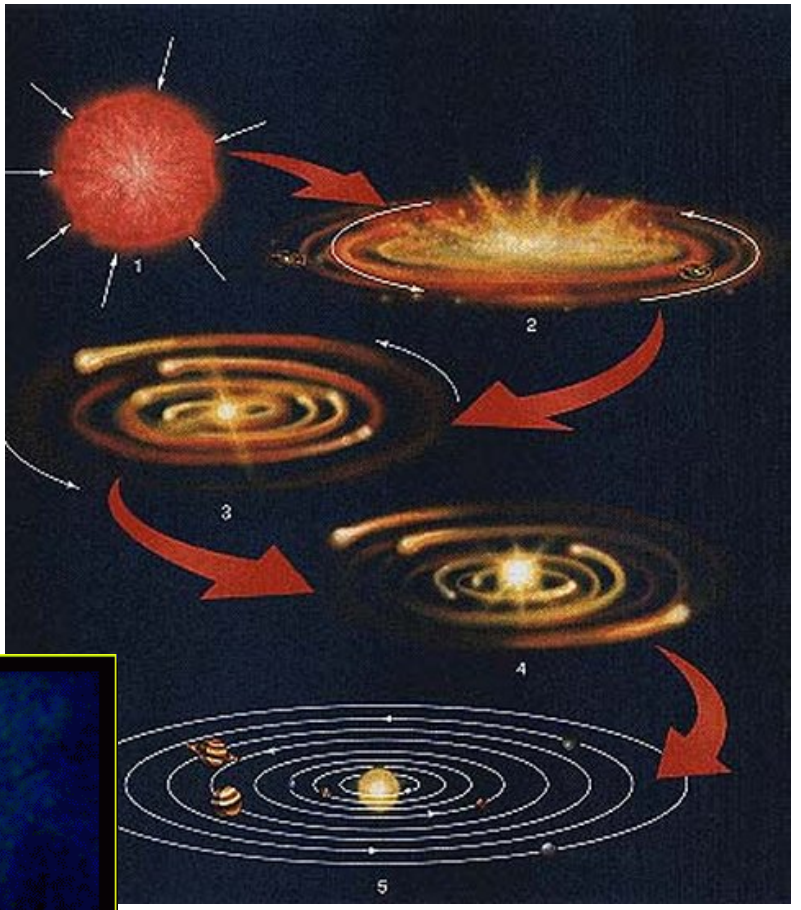
High sensitivity for high-resolution spectroscopy!

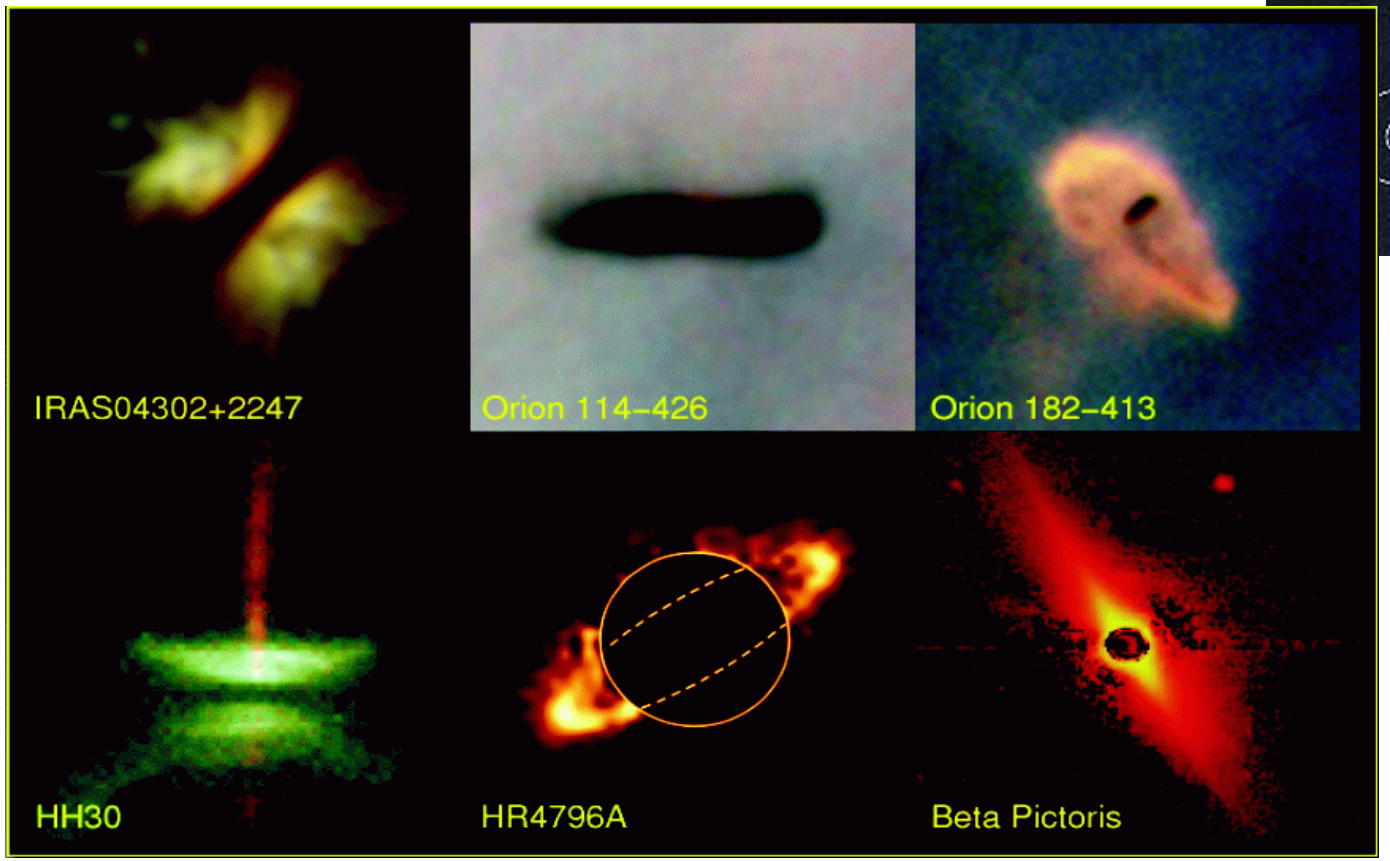
- Tracing dynamical, physical and chemical evolution.
- Probing dust and planetesimal size distributions as a function of radius and time.
- Probing disk structure.





From cores to disks to planets:
studying circumstellar disks provides fundamental insights into the formation of stars and their planetary systems.





Excellent example of a research area that will benefit from the synthesis of E-ELT, ALMA and JWST.