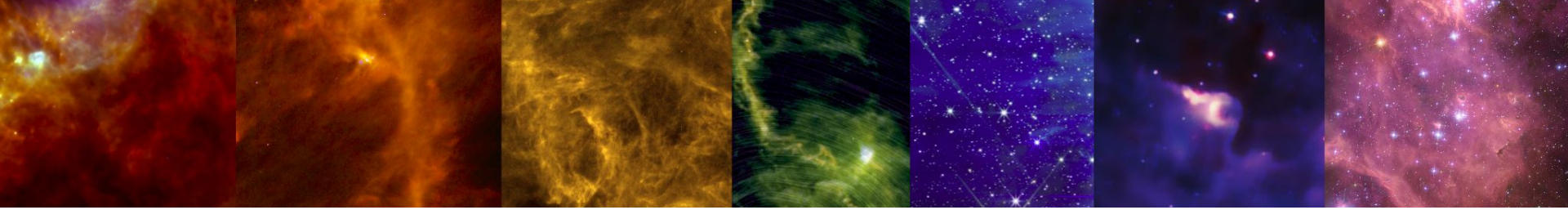
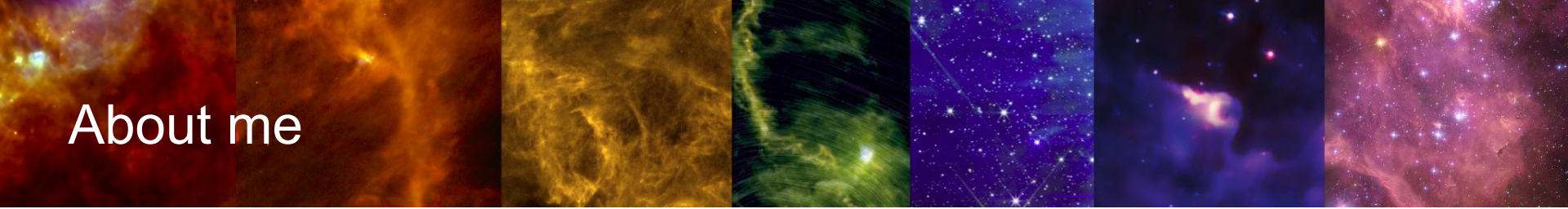


How to make a star

Star formation and the cold interstellar medium

Emma Mannfors
LGBTQ+ STEM day
Nov. 18, 2022



About me

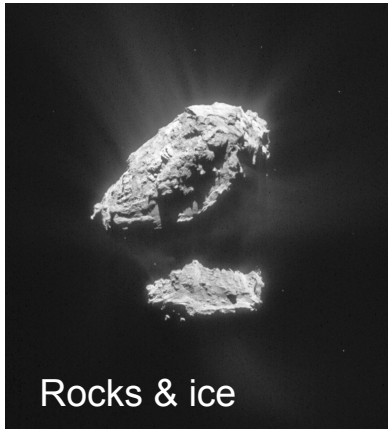
- PhD student in astronomy (Supervisor: Dr. Mika Juvela)
- Research topic: multiscale star formation
  - How do space clouds form stars?
  - How do processes happening on core scales (< 1 pc) and processes happening on galactic scales affect each other?
- Hobbies: Art, crafting, historical reenactment, talking about my cat (her name is Luna)

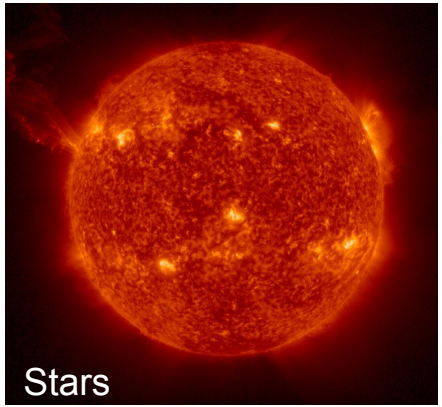
Recent papers:

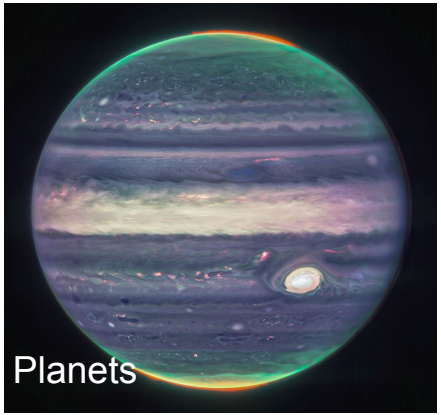
arXiv:2106.10114 Characterization of dense Planck clumps observed with Herschel and SCUBA-2

arXiv:2208.01894 Synthetic Next Generation Very Large Array line observations of a massive star-forming cloud

What (baryonic matter) is space made of?







Images:
Solar Orbiter/EUI Team/ESA & NASA
NASA, ESA, Jupiter ERS Team; image processing by Judy Schmidt
ESA/Rosetta/NavCam
ESA/Hubble & NASA, D. Jones

What is space made of?

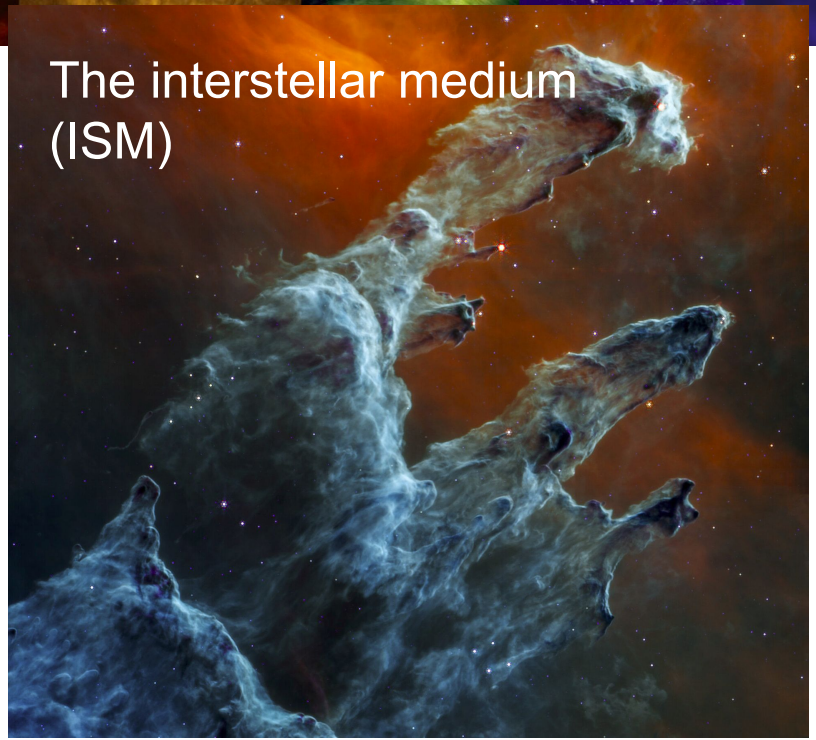
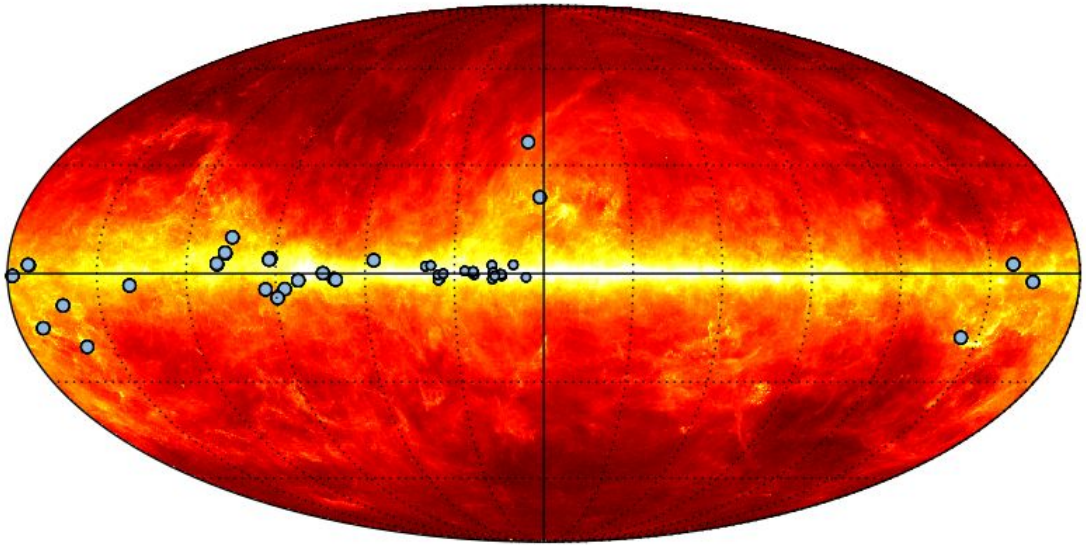


Image: NASA, ESA, CSA, STScI, J. DePasquale (STScI), A. Pagan (STScI)

The ISM

COLD ISM:

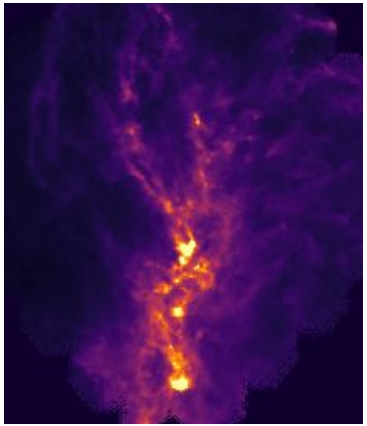
- T ~ 10-20 K
  - Up to ~100 K
- Dense (compared to the rest of space)
- Concentrated in the Galactic plane
- Visible in the infrared/microwave/radio wavelengths



Planck 857 GHz (~350 um) Galaxy
Mannfors et al., 2021

The ISM

- Forms complex filamentary structures
- Magnetic fields, turbulence, gravity, stellar winds from young stars & supernovae mold filaments
- How do filaments form?
- How do they develop?



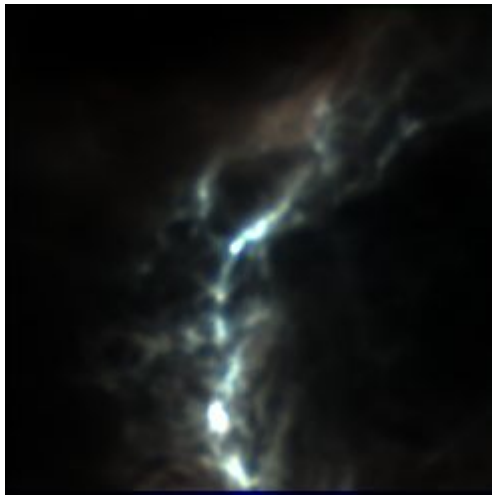


Image: E. Mannfors

Image: ESA/Hubble & NASA

From clouds to stars 1: Fragmentation begins

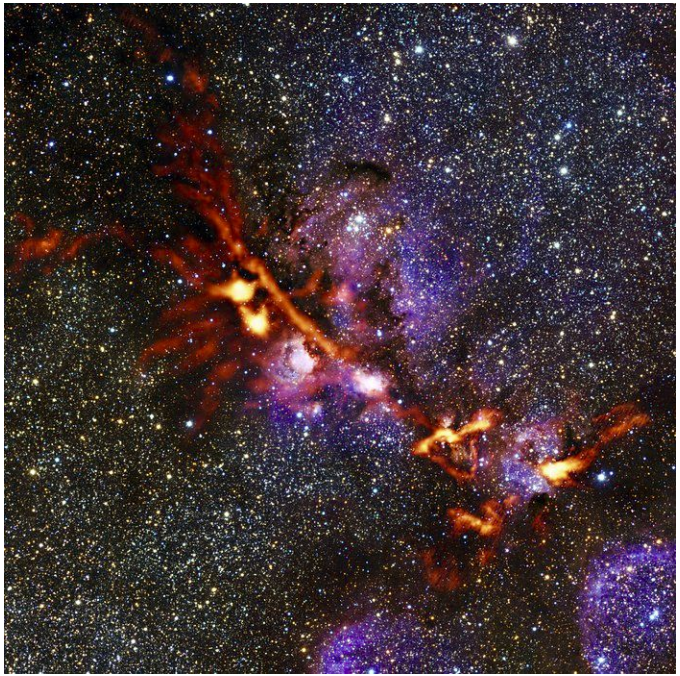


Image: ArTeMiS team

From clouds to stars 2: Cores begin to form

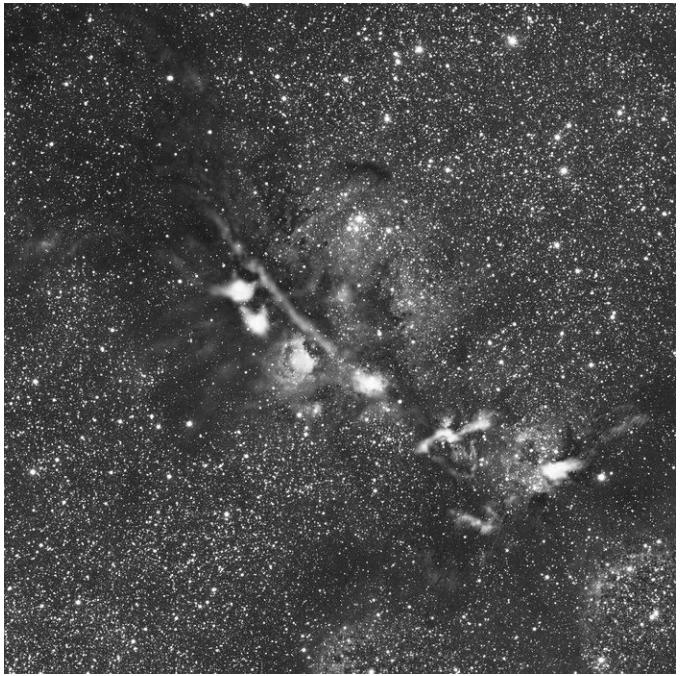


Image: Baby stars in Orion Nebula
Credit: ESA/PACS/NASA/JPL-Caltech/IRAM

From clouds to stars 3: Cores start to collapse under gravity

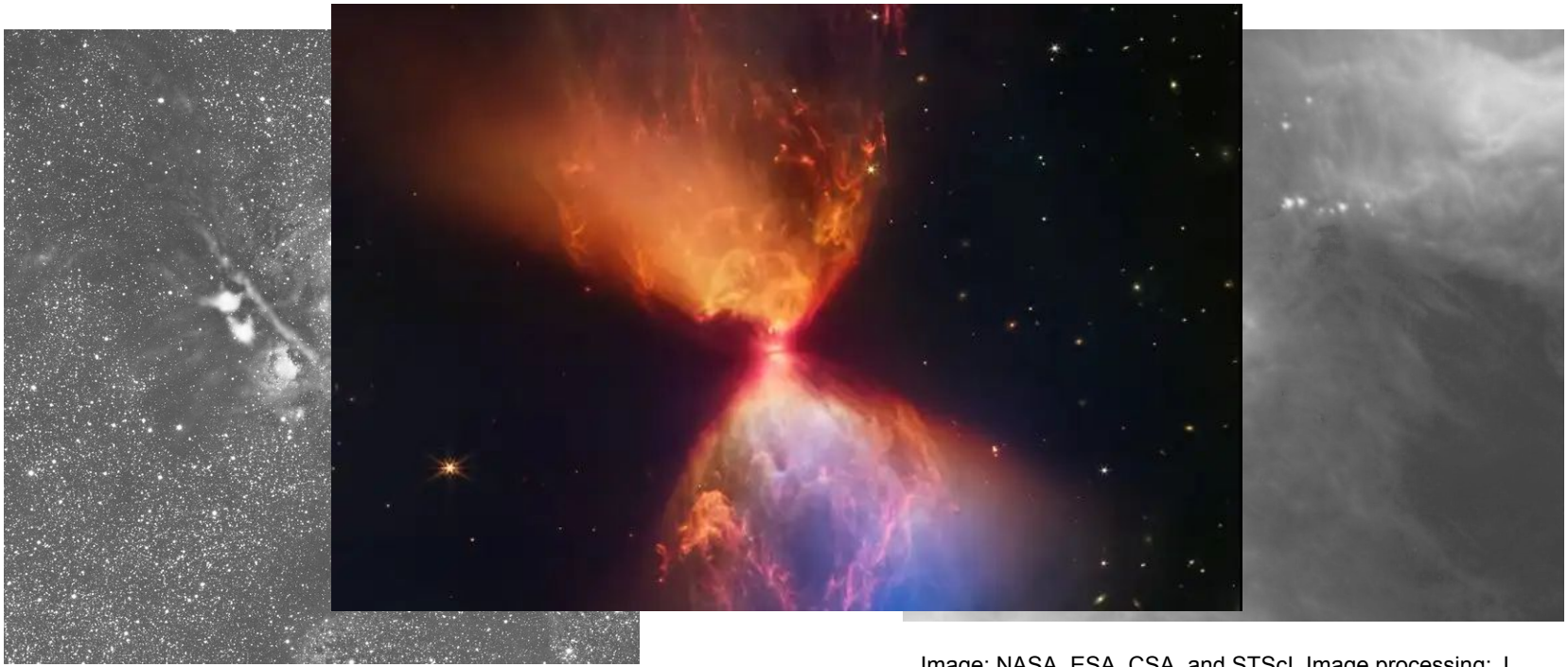


Image: NASA, ESA, CSA, and STScI. Image processing: J. DePasquale, A. Pagan, and A. Koekemoer (STScI)

From clouds to stars 4: protostar and debris disk

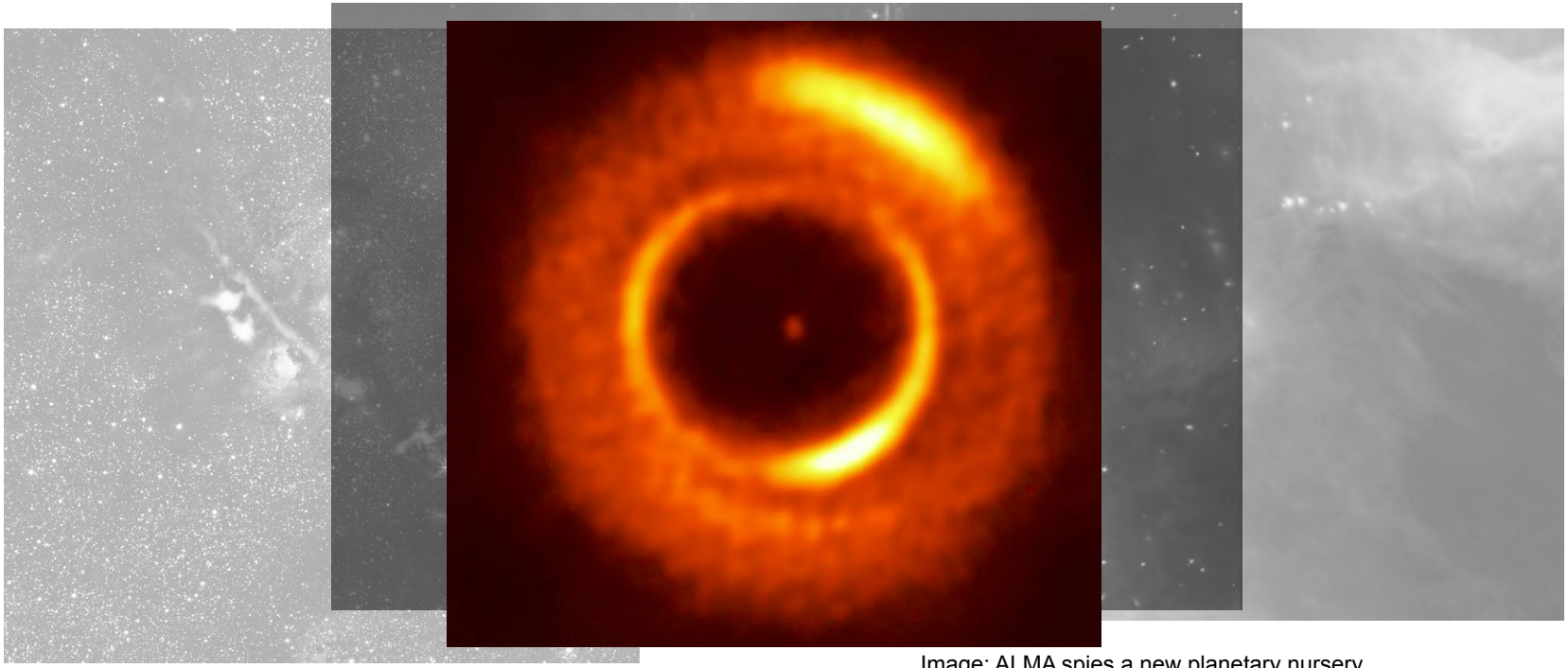


Image: ALMA spies a new planetary nursery
Credit: ESO/R. Dong et al.; ALMA (ESO/NAOJ/NRAO)

Current project: What do filaments look like?

In preparation

Analyzing massive filaments using *Herschel* and ArTéMiS/ Comparison of *Herschel* and ArTéMiS observations of massive star-forming filaments

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Received Month Day, 1996; accepted Mo dd, 1997

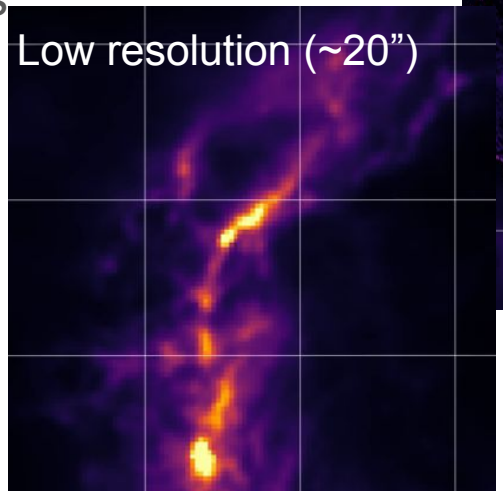
ABSTRACT

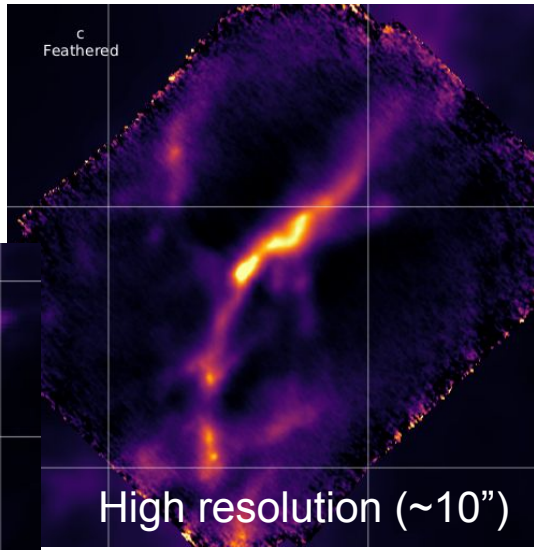
Context. ESA's *Herschel* space telescope has made great progress with the study of interstellar filaments, however its resolution is too poor to study structures on smaller scales (or at learge distances). Higher-resolution data are needed, but preferably without loss of large-scale structure that occurs with ground-based instruments.
Aims. How does the inclusion of high-resolution data change derived filament properties? What can we say about fragmentation scales, hierarchial structure of ISM?
Methods. Column densities and temperatures are estimated with the modified blackbody fitting. ArTéMiS and *Herschel* data are feathered to create high-resolution images.
Results. We notice hierarchial structure in Orion. The addition of high-res data narrows filaments. Column densities are higher.
Conclusions.

Key words. ISM: individual objects: G16, G17, G202, G208, Orion – ISM: clouds – Methods: observational – Infrared: ISM –

Current project: What do filaments look like?

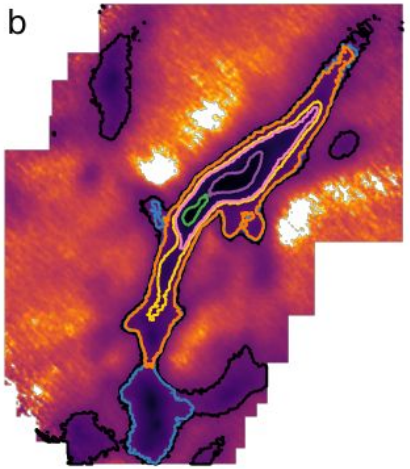
- A filament in the Orion Molecular Cloud
- Does resolution of our observations affect the properties of our filament?
- What can the different scales tell us about the physics in the filament?

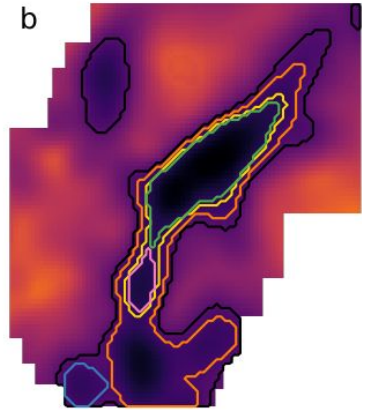


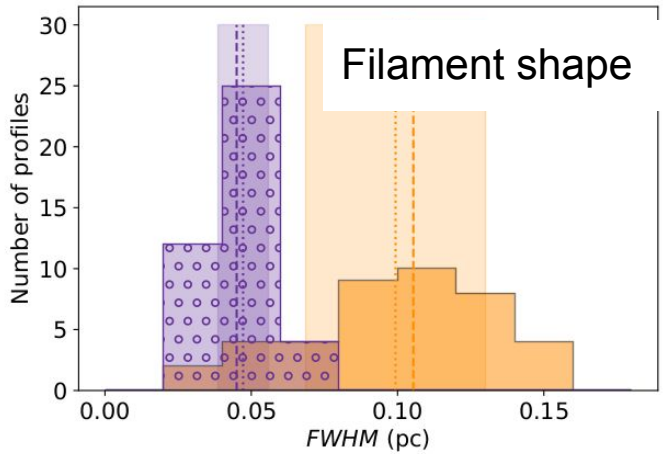


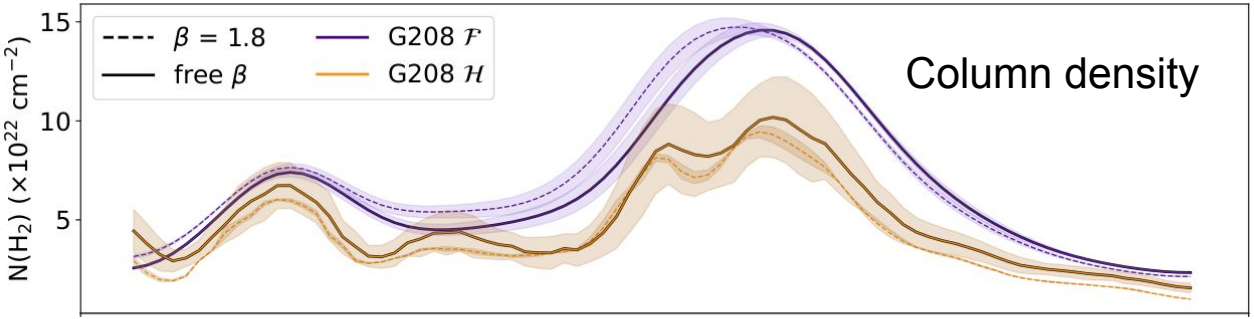
Do the properties change? How?

Substructures









Thank you!