UNIVERSITAT DE BARCELONA

Master in Astrophysics, Particle Physics, and Cosmology

Academic year 2022-2023

Spring semester

Mon, Tue, Wed, Thur 15:20 – 16:20
Room A33M

Stellar Formation and Structure

Presentation

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Stellar Formation and Structure

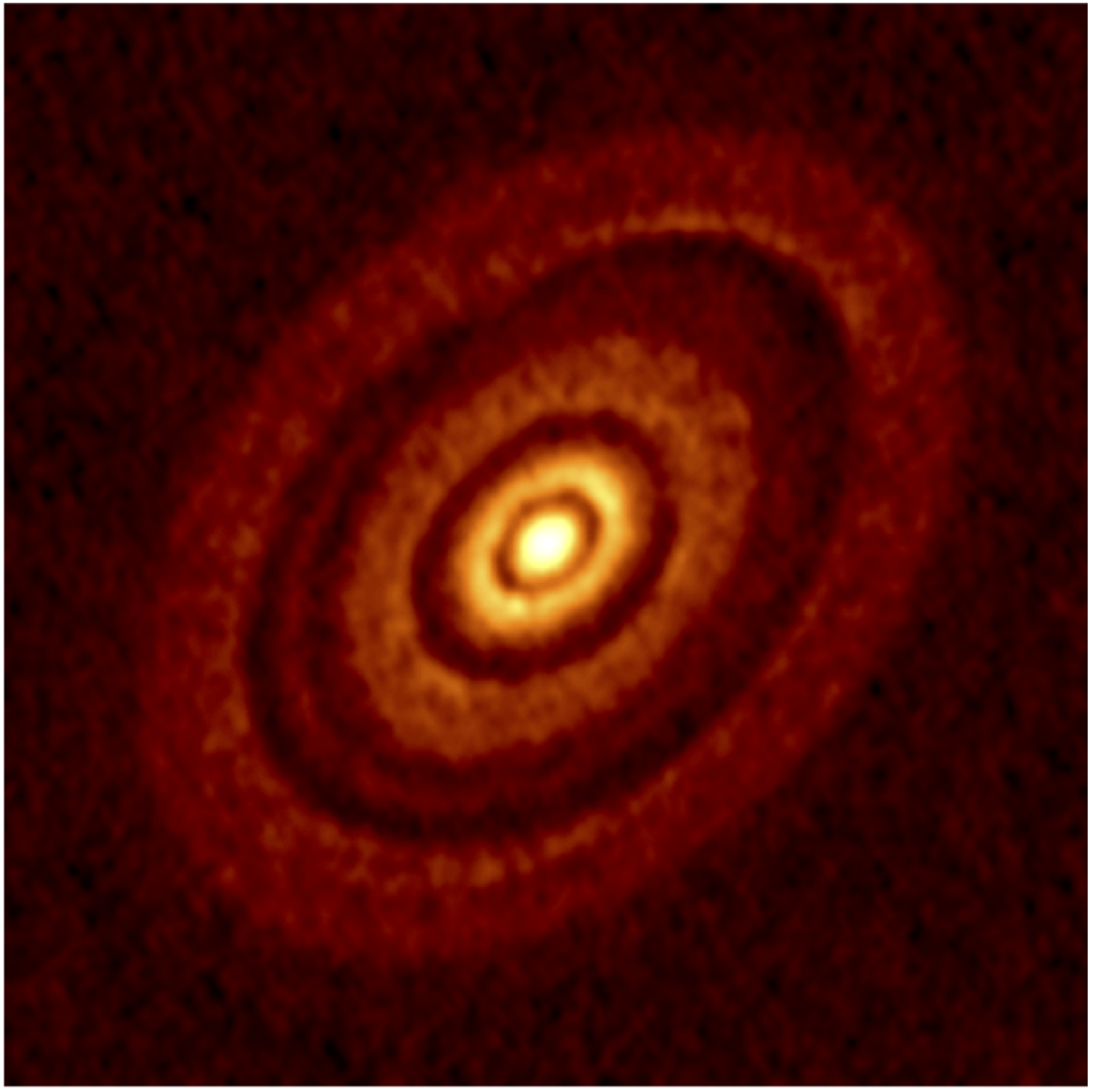
Rosario López
Gemma Busquet

professors of the Department FQA

and

Invited Lectures

by active researchers in the field of star formation



ALMA image of the HL Tau protoplanetary disk

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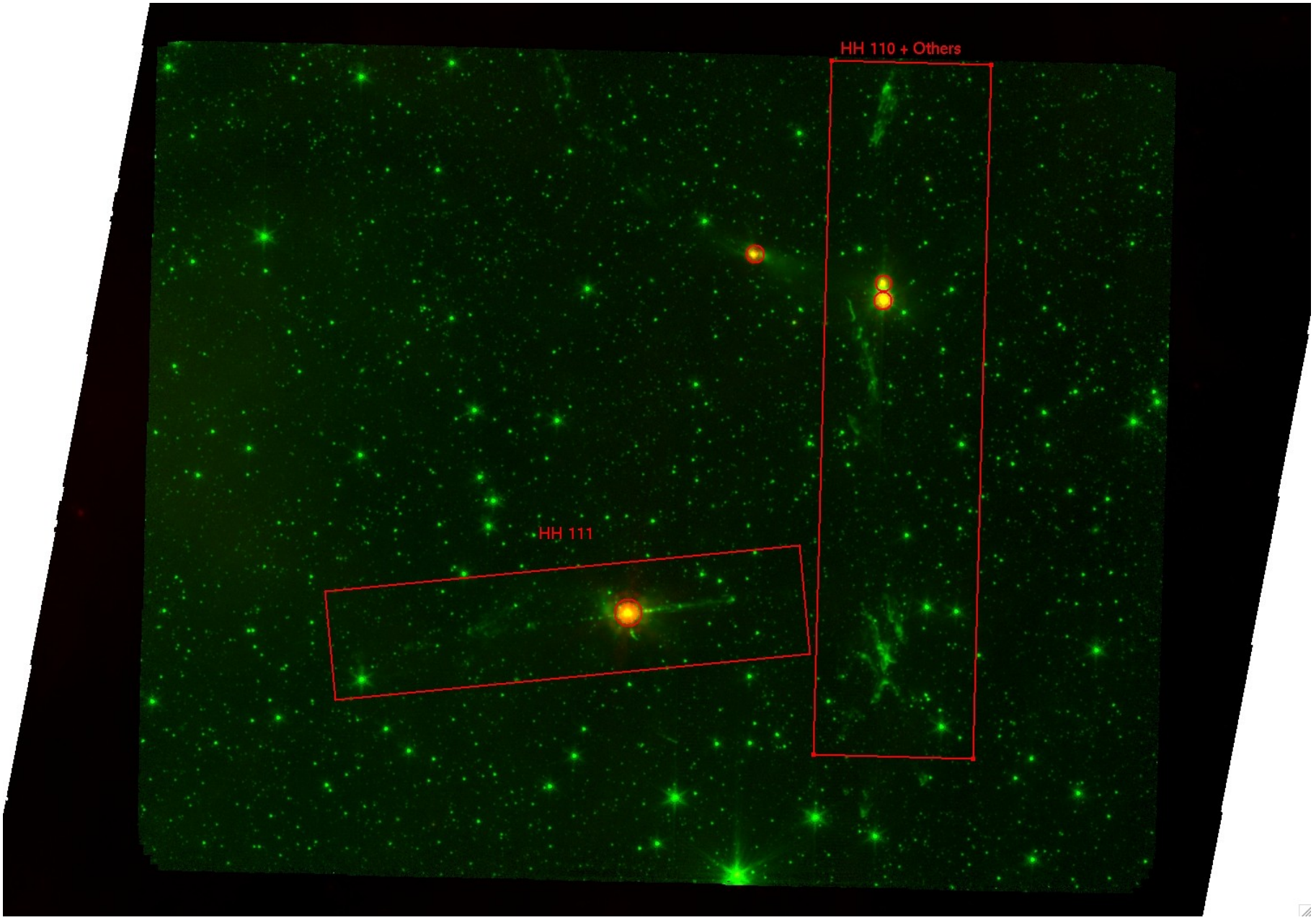
The tools: radio telescopes



HH111_HH110 at 4.5 + 24 μm from Spitzer

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Program

1. Introduction

- The Milky Way galaxy.
- The interstellar medium.

2. The tools: radio interferometry, optical and NIR astronomy

3. Interstellar medium and star-forming regions

- **Interstellar dust.** Composition, physical properties. Extinction, reddening, polarization. Thermal emission, mass estimation.
- **Atomic, ionized, and molecular gas.** Spectral line emission. Free-free emission and recombination lines of HII, physical parameters from HII emission. Chemistry of the molecular gas, formation of molecules. Molecular lines, physical parameters from molecular-line observations.
- **Energy balance in molecular clouds.** Singular isothermal sphere, Bonnor-Ebert sphere, Jeans mass. Virial theorem. Turbulence, magnetic field. Magnetically supported cores.
- **Molecular clouds.** Morphology, filaments, dense cores. Sites of star formation, examples of TMC, Orion.

4. Young stellar objects

- **Spectral energy distribution.** Classification of YSO. Observational properties.
- **PMS evolution.** Hayashi and Henyey tracks. ZAMS.
- **TTauri stars, AeBe stars.** Models and observations.
- **Interaction of YSO with their environment.** Jets, Herbig-Haro objects, bipolar molecular outflows.
- **Accretion and supersonic ejection processes** in YSO. Accretion disks. Observation and models.

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Invited Lectures

- Maite Beltrán (Osservatorio Astrofisico di Arcetri):
- Protoplanetary discs around high-mass protostars
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- Robert Estalella (UB)
- Interferometry

Álvaro Sánchez-Monge (OAN):
- Formation of high-mass stars

- Joao L. Yun (U. Lisboa)
- NIR observations

More lectures to be confirmed:

- Numerical simulations vs. observations of star formation

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Work required to the students:

- Class attendance
- Small exercises to be answered in writing.
- Discussion of a practical case elaborated from file data,
- applying observational techniques studied in the course.
- Oral presentation on a specific subject

1/3 of the final mark

- Final exam, consisting in questions on physical concepts, with a short answer

2/3 of the final mark