School of Physics & Astronomy
FACULTY OF MATHEMATICS & PHYSICAL SCIENCES

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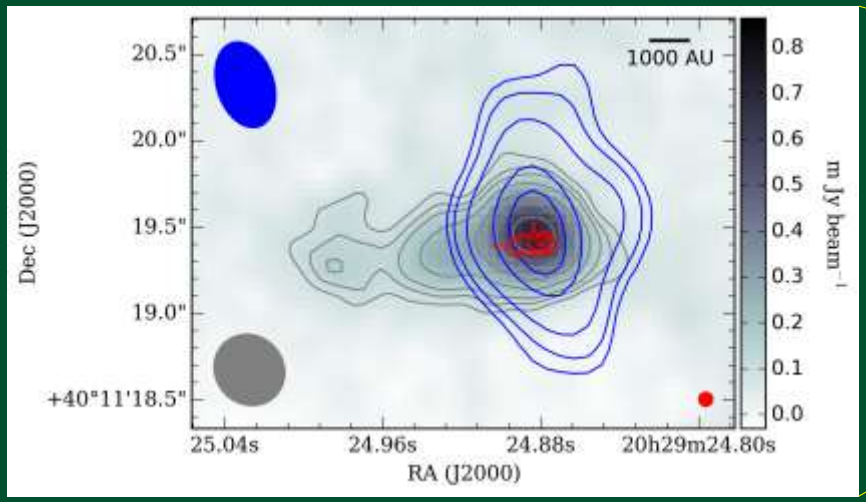
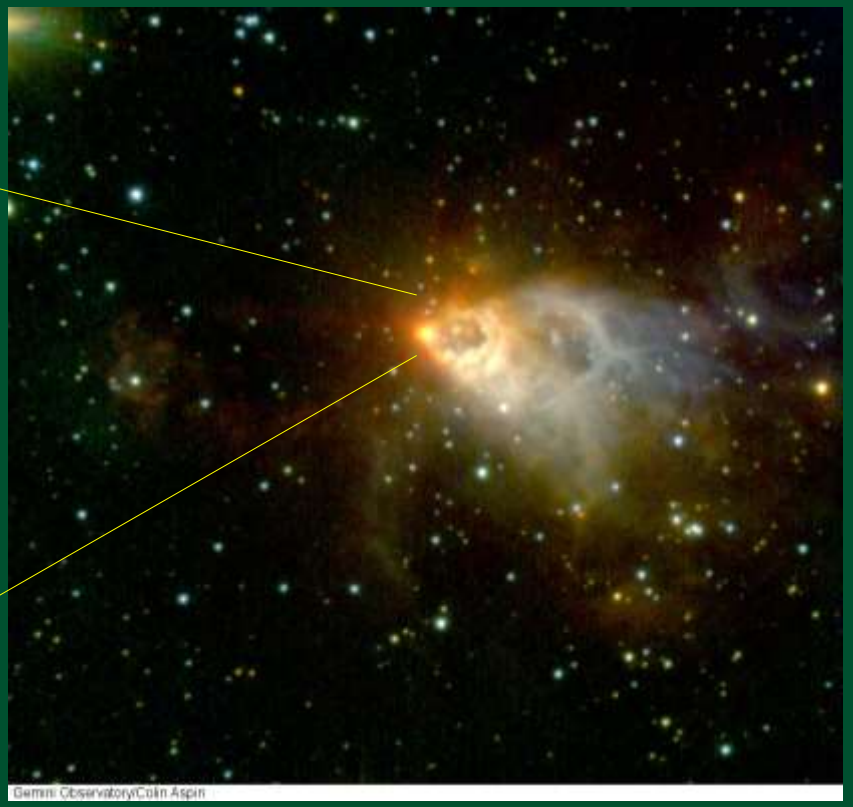
Radio Astronomy Research at Leeds

Melvin Hoare





Outline

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- Staff
- Massive Star Formation
- Jets and Winds
- e-MERLIN Survey
- UCHII Regions
- CORNISH Surveys

Staff at Leeds

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- 8 Academic staff in Astrophysics Group
  - All work mainly on star and planet formation
  - 4 observers covering radio, mm and opt/IR wavebands
  - 4 theorists doing numerical simulation
- 5 Postdoctoral researchers
- 15 Postgraduate researchers
- Links with Schools of Applied Mathematics and Chemistry

Massive Star Formation

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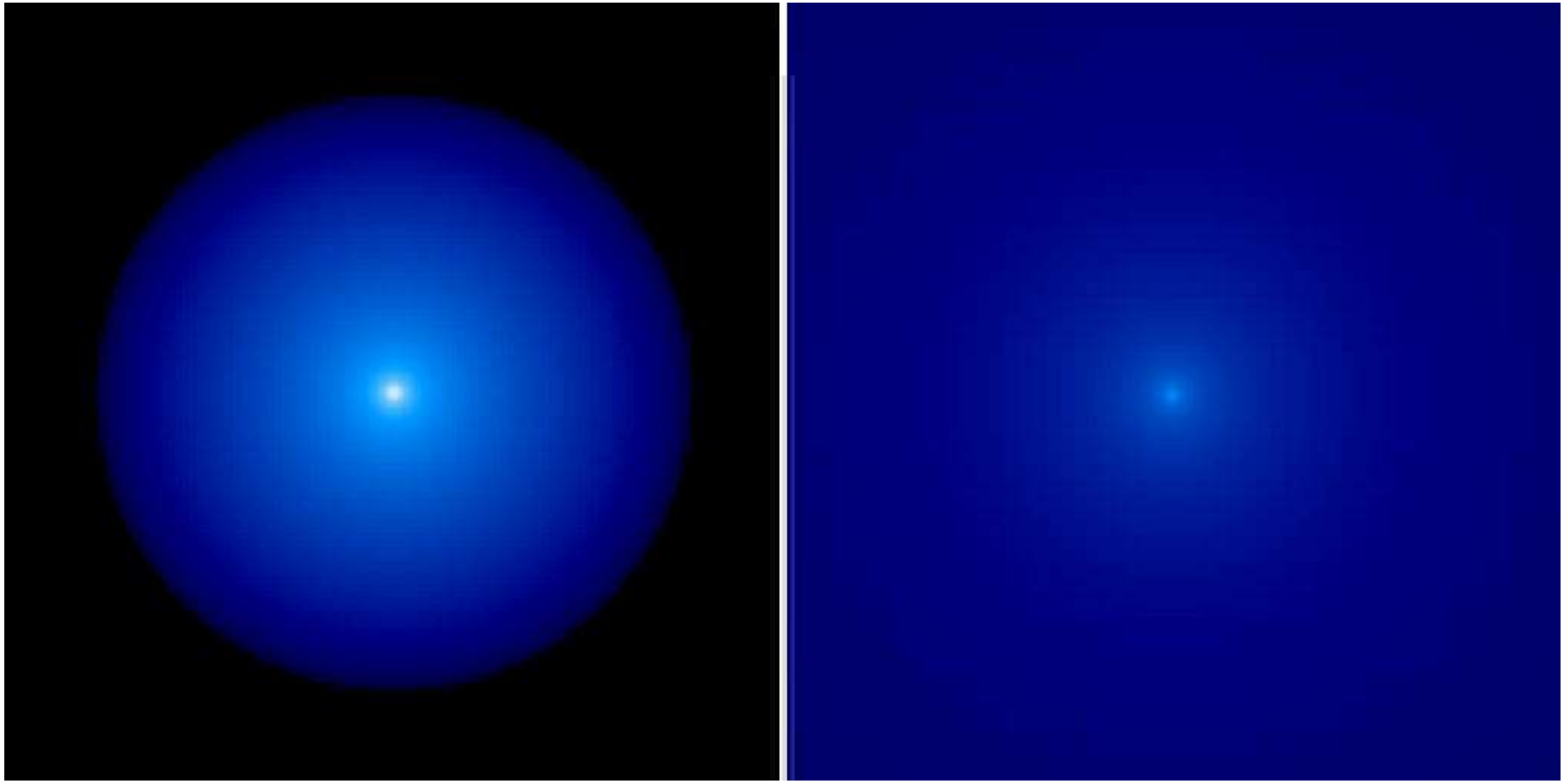

Krumholz et al (2007) 3D AMR radiation-hydrodynamics

Accretion Discs & Ionized Jets

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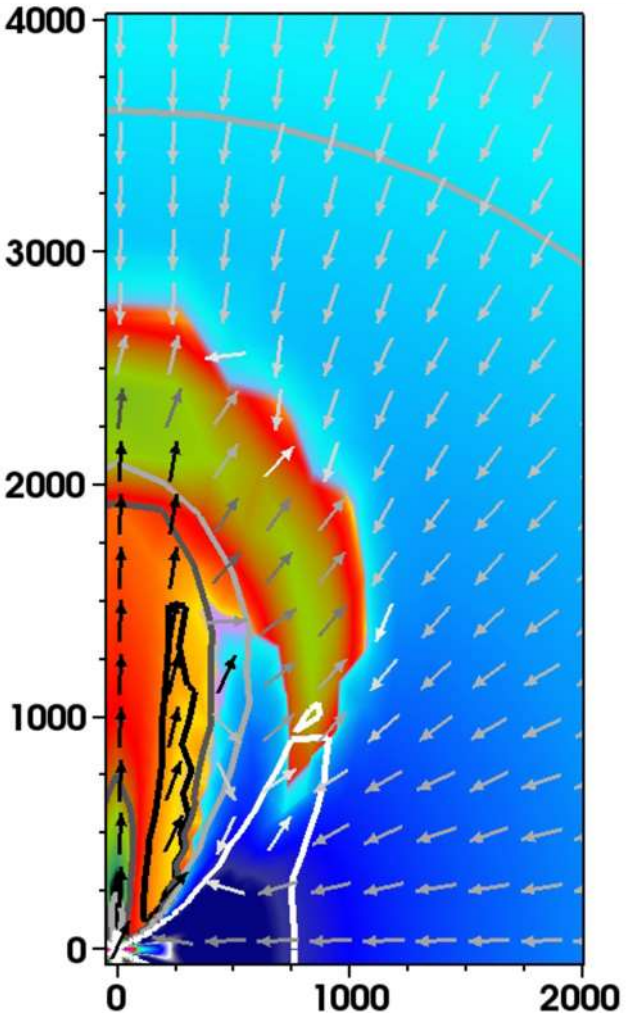
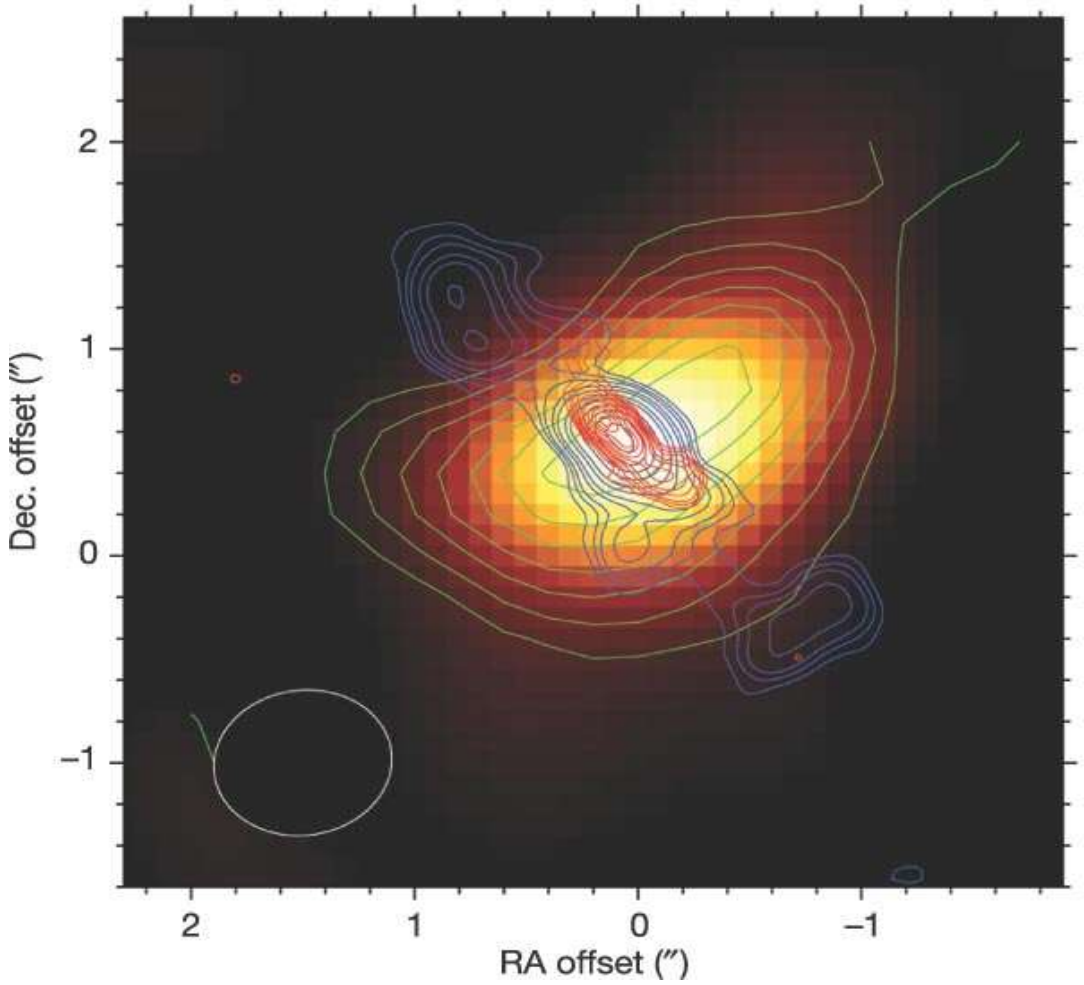


Kuiper et al (2015)



Cep A2 (Patel et al. 2005)

e-MERLIN

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- 6 x 25 m + 1 x 76 m dishes
- 200 km baselines
- 40 mas resolution at 5-7 GHz
- Legacy Survey Programme on Feedback in Massive Star Formation
- Examine jets and winds as a function of age

Initial Results

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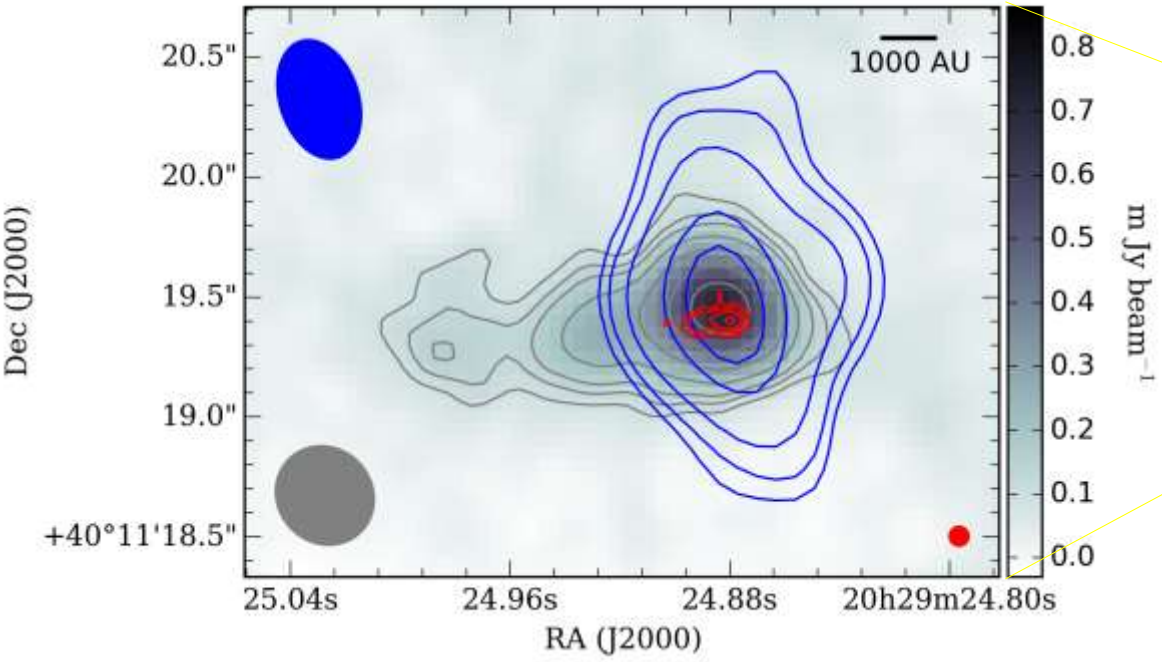
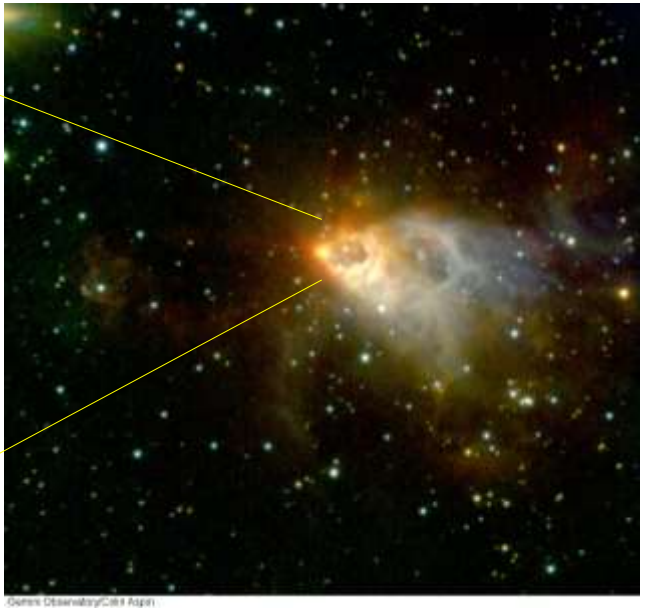
- Highest resolution cm-wave view of a high-mass protostellar jet to date
- Test driving and collimation mechanisms





Magnetic Fields via Masers

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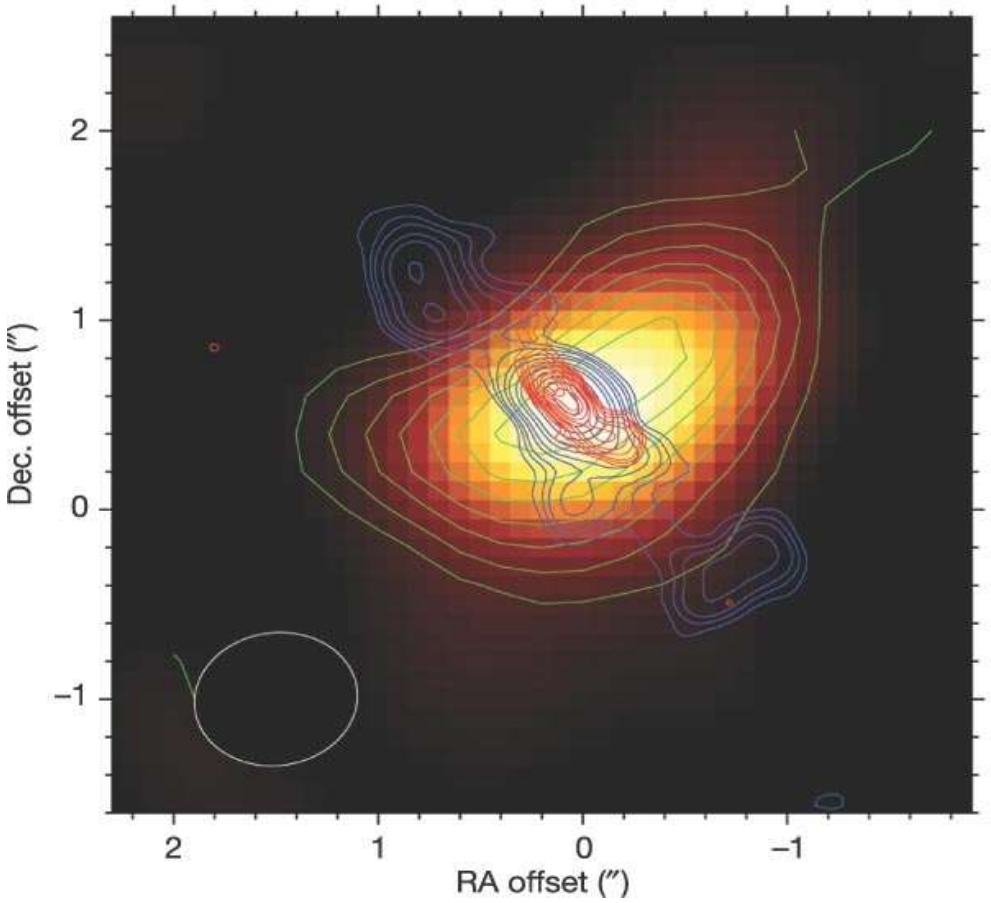
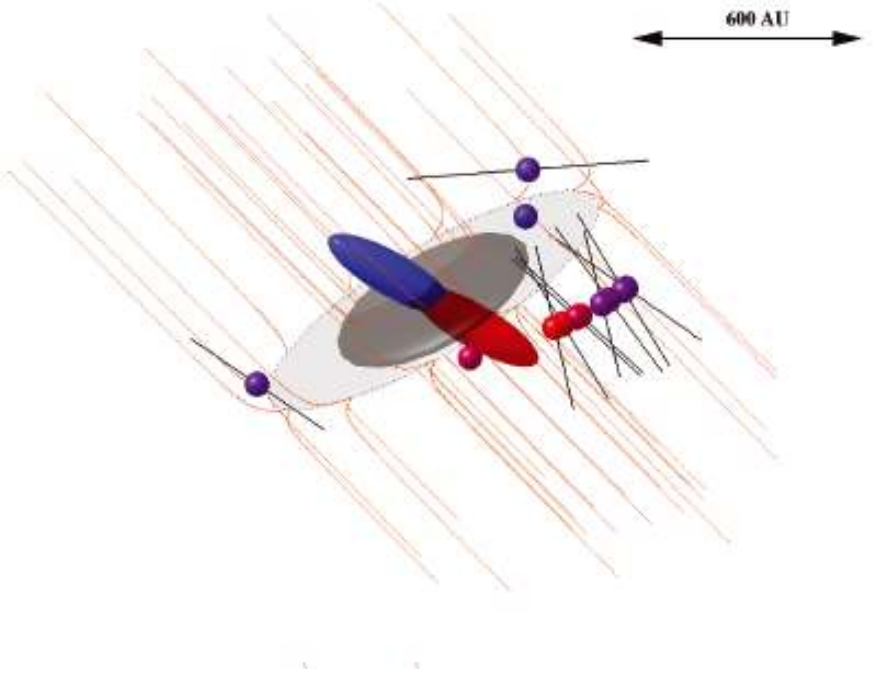


Cep A2 (Patel et al. 2005)

Jet speed ~ 500 kms^{-1} from proper motions



Methanol maser polarization giving 3D B field

(Vlemmings et al. 2010)

Spectral Index Maps

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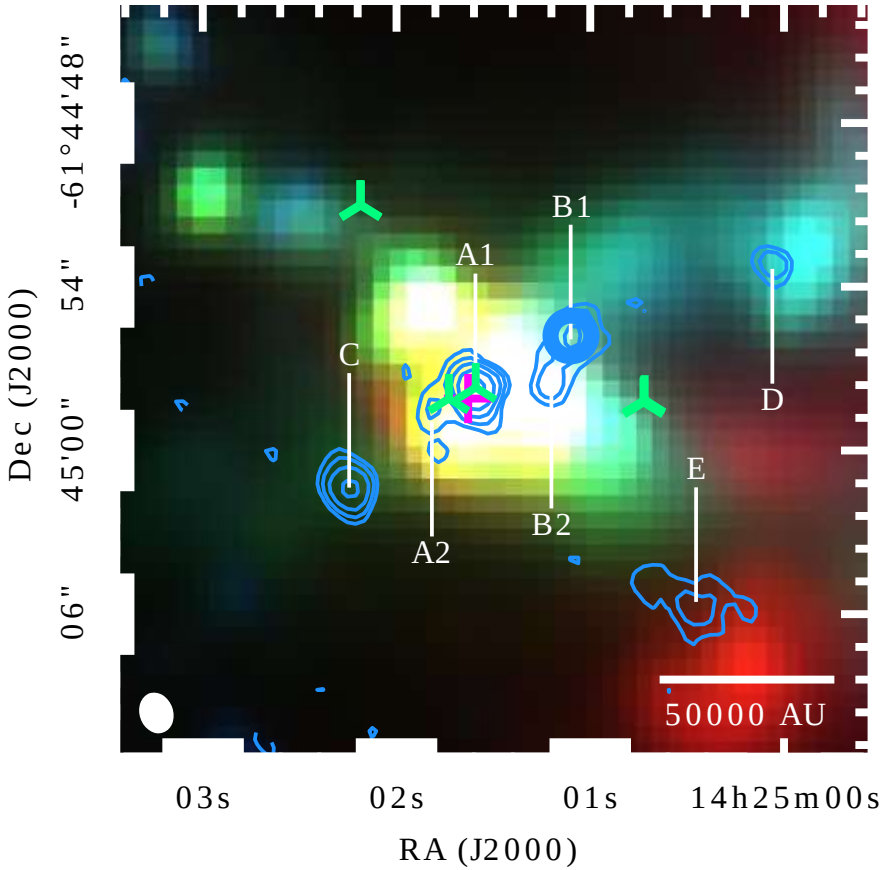

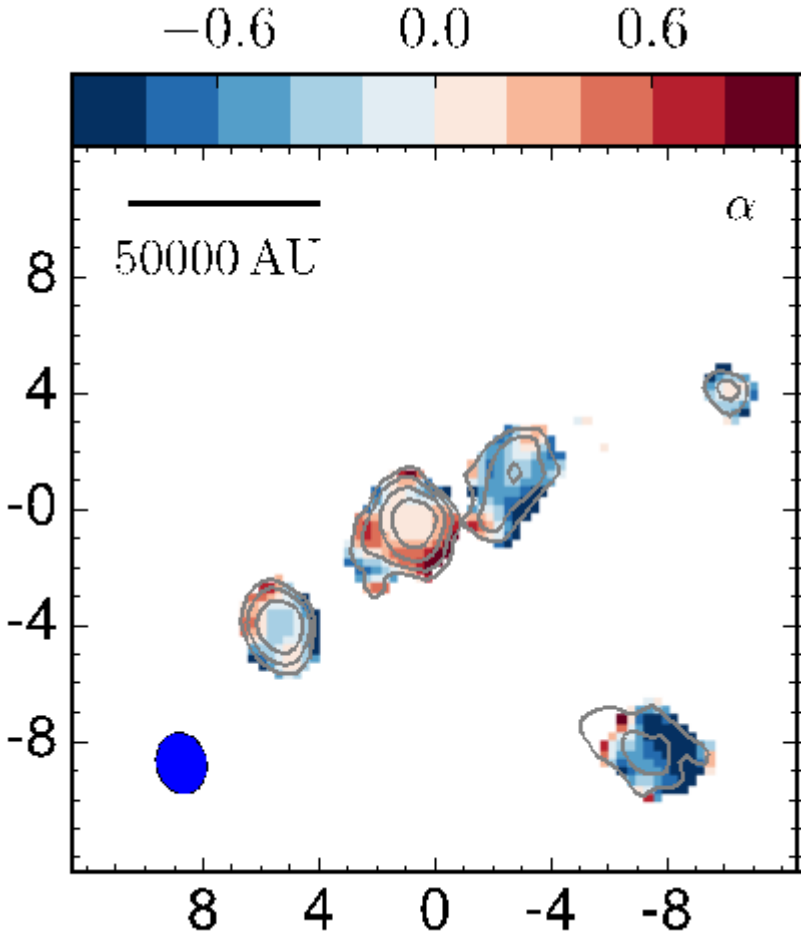

Purser et al. (2016)

Polarization

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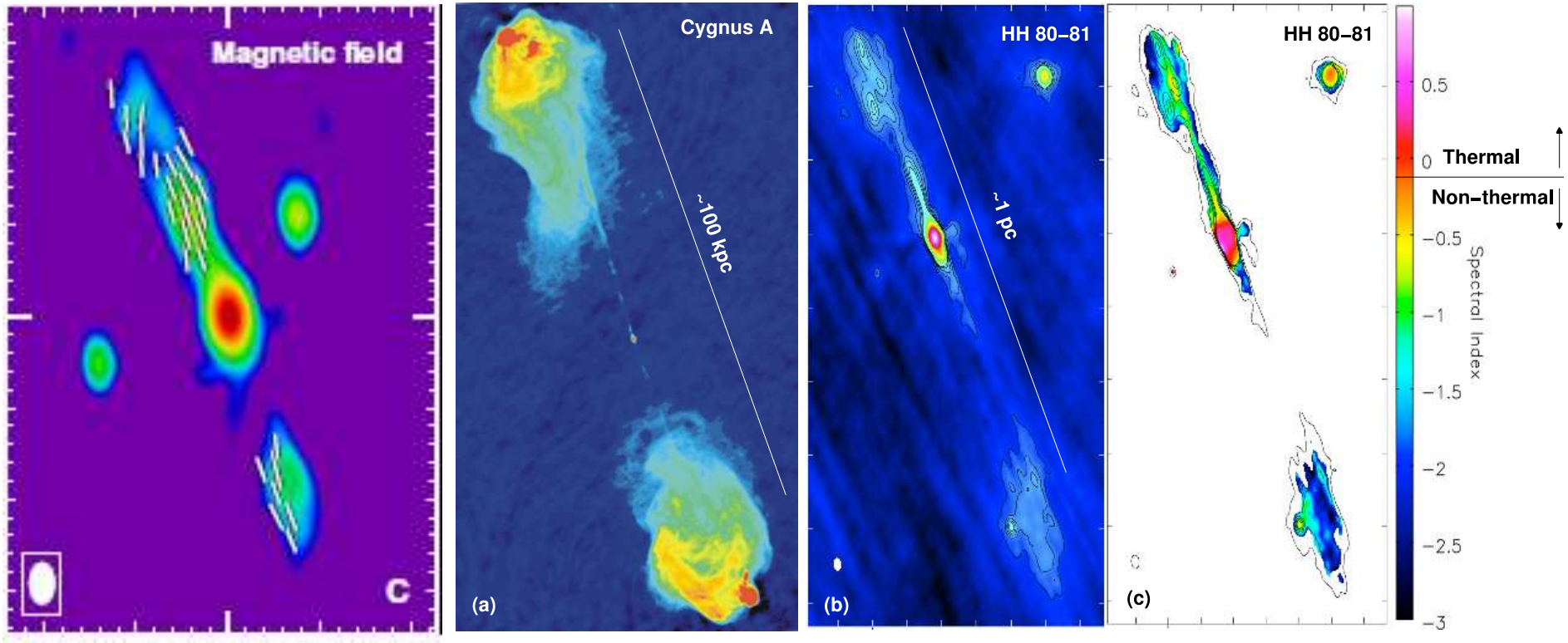

HH80-81 (Carrasco-Gonzalez et al. 2010; 2013)

Mm-wave studies of discs

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- We are starting to resolve the accretion discs themselves via dust continuum and molecular line emission with the Atacama Large Millimetre Array (ALMA)
- 54 x 12m dishes + 12 x 7m dishes on baselines up to 16 km
- 80 – 700 GHz giving resolution up to 10 milliarcseconds

Bipolar Outflow

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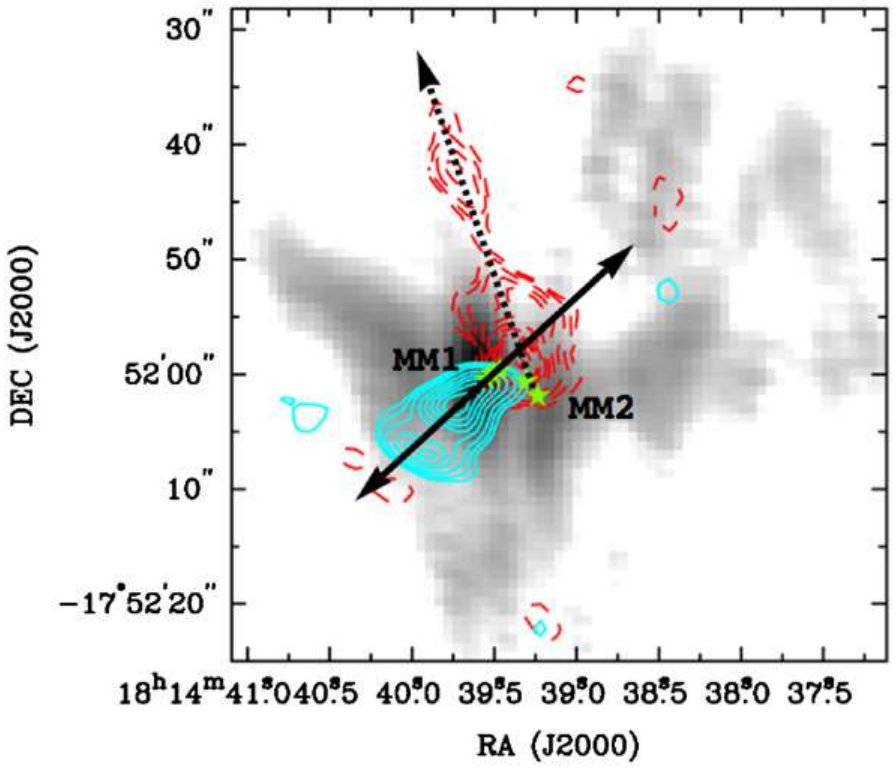
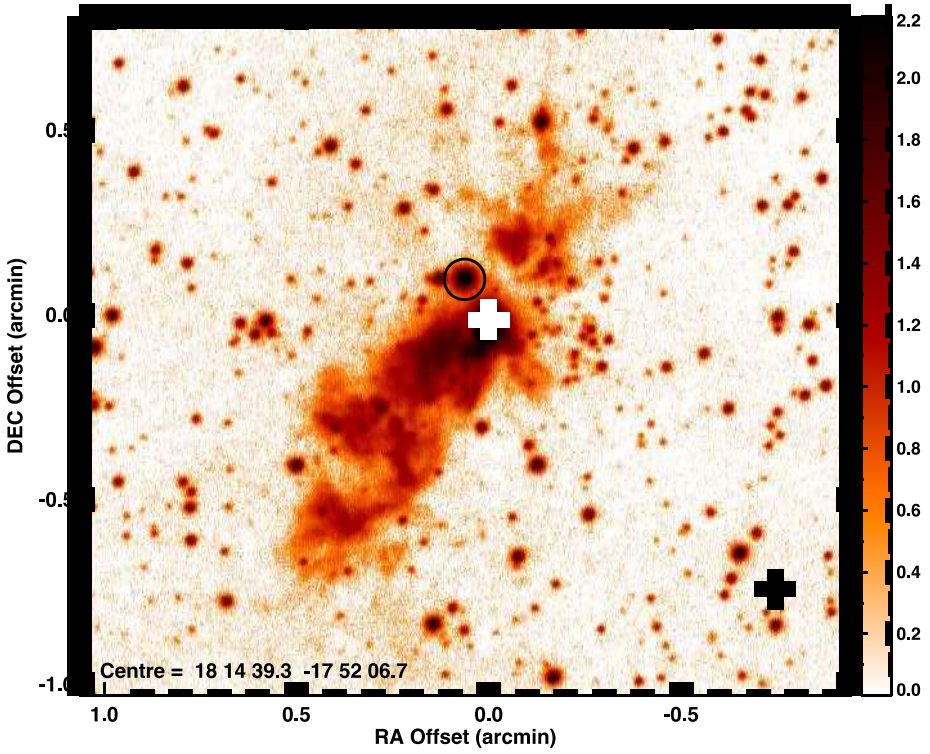


Bipolar flow seen in mm-wave CO lines



Reflected light from blue-shifted lobe in near-IR

Complex Accretion Dynamics

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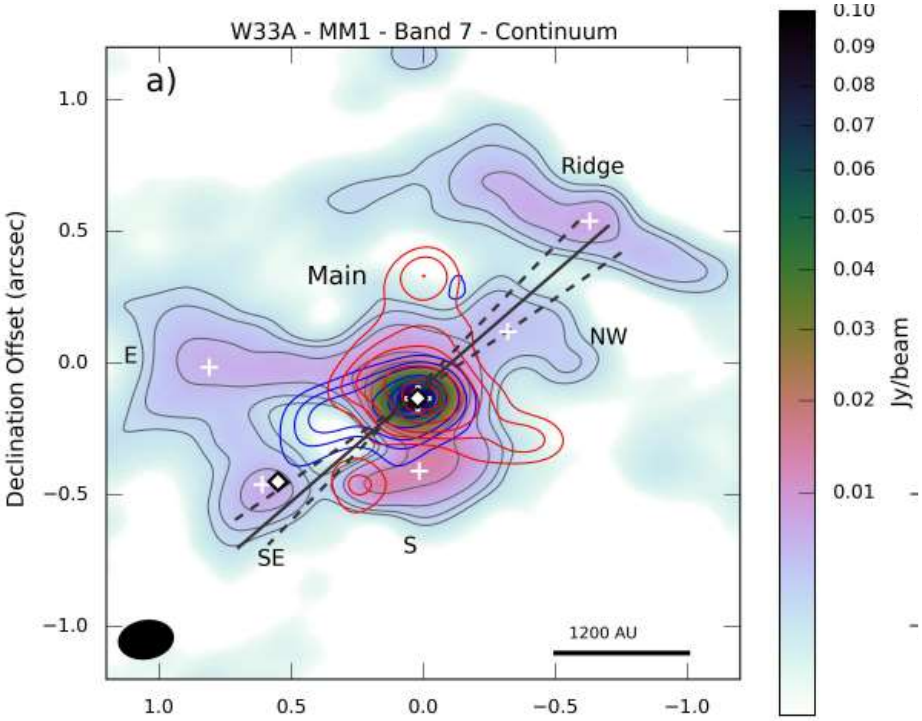
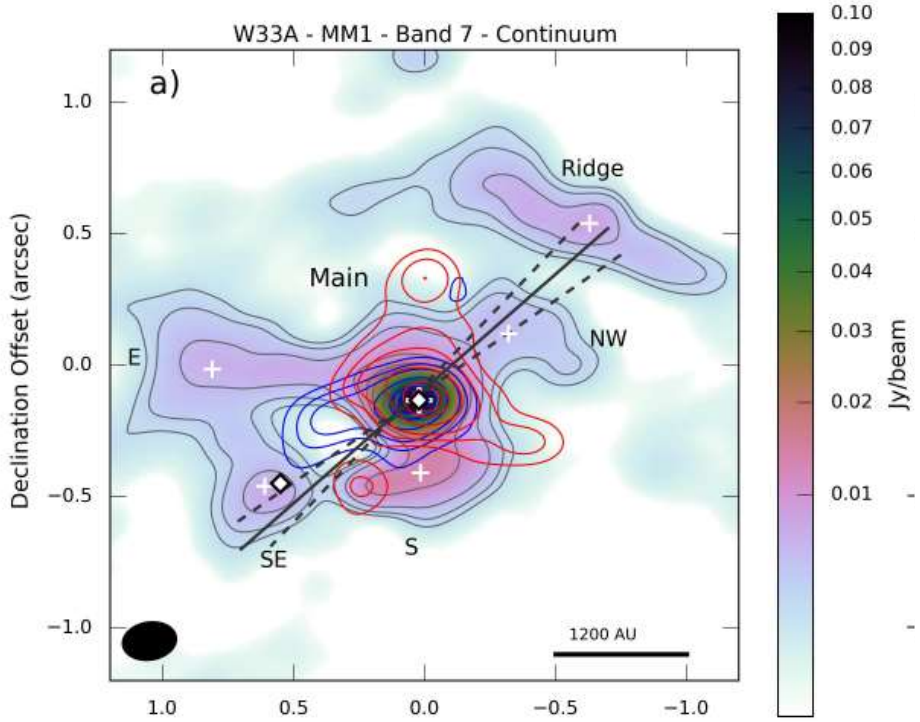
- 



Goonhilly + e-Merlin

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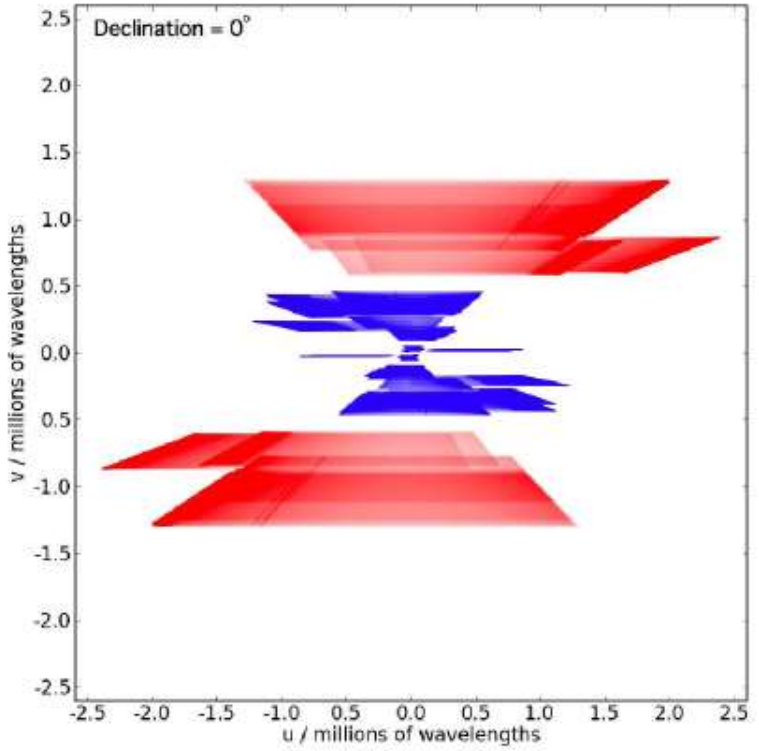
- Add southern dish to give higher resolution and extend usage to equatorial fields for joint ALMA studies



Heywood et al. 2011 arXiv1103.1214

30 m ex-telecomms dishes

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Radio Surveys for UCHII regions

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- The Co-Ordinated Radio ‘N’ Infrared Survey for High-mass star formation or CORNISH survey
- High spatial resolution 5 GHz surveys of the northern and southern Galactic plane using VLA and ATCA
- Targeting ultra-compact H II regions (movie)

Cometary H II Regions

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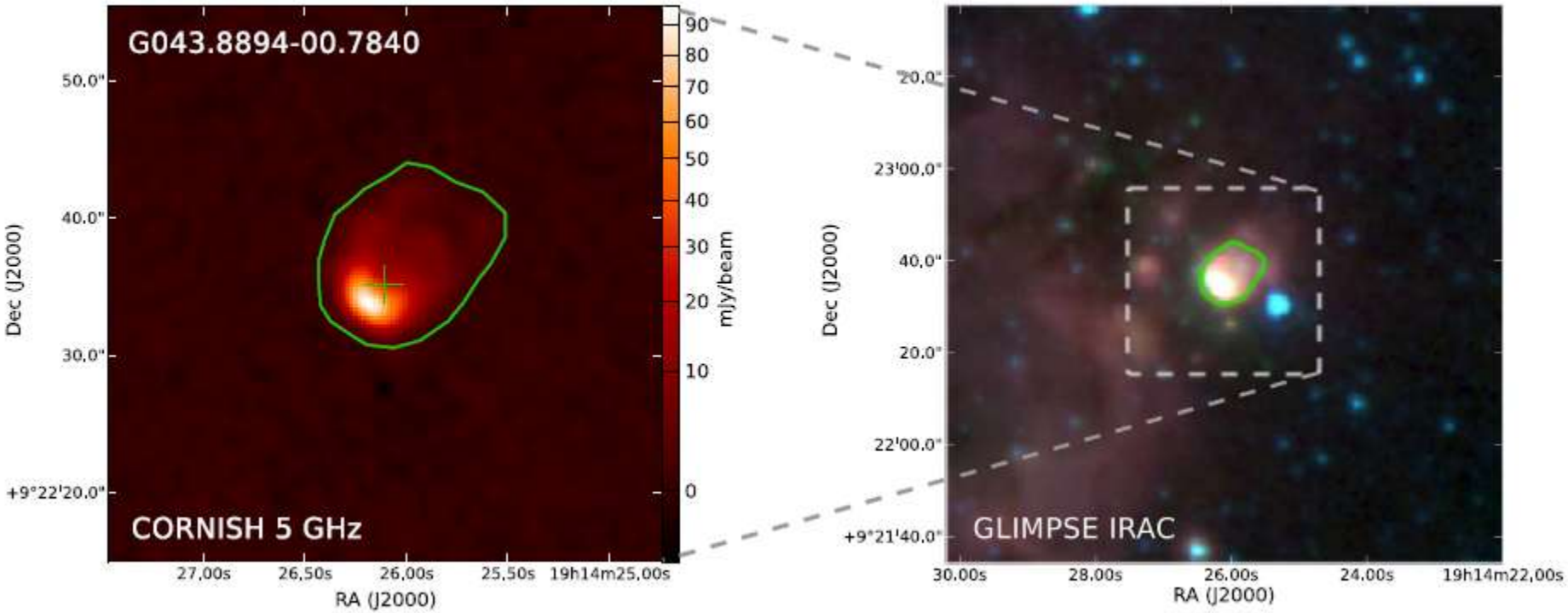

- Cometary ultra-compact H II regions
- Similar morphology in radio and mid-Irr PAH emission

Velocity Structure

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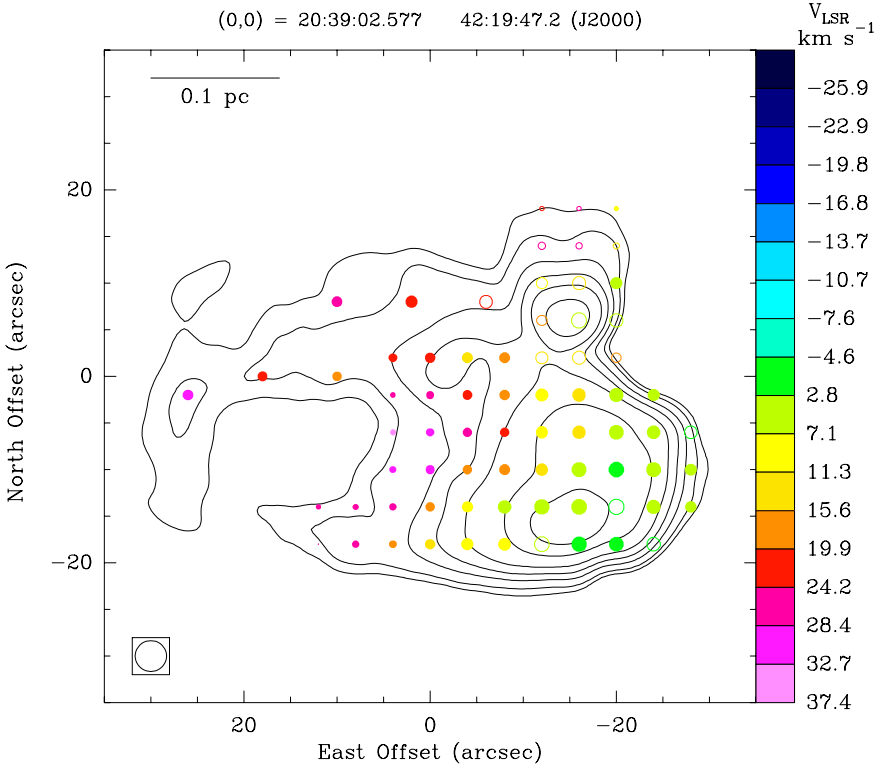
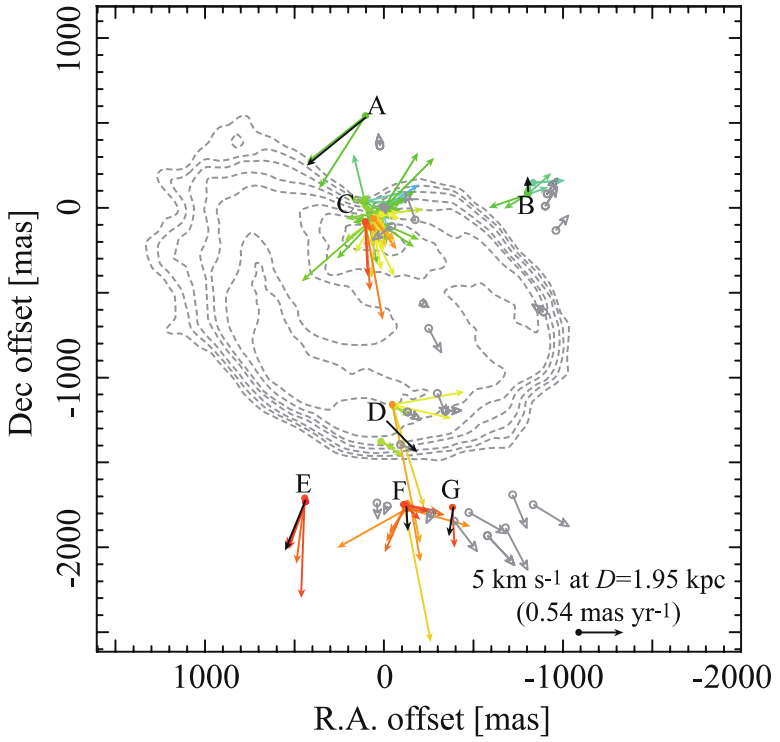
- Use RRLs to map out velocity structure in the ionized gas
- Use VLBI maser proper motions for molecular gas



DR 21 Immer et al. (2014)



W3(OH) Matsumoto et al. (2011)

Galactic Population Synthesis

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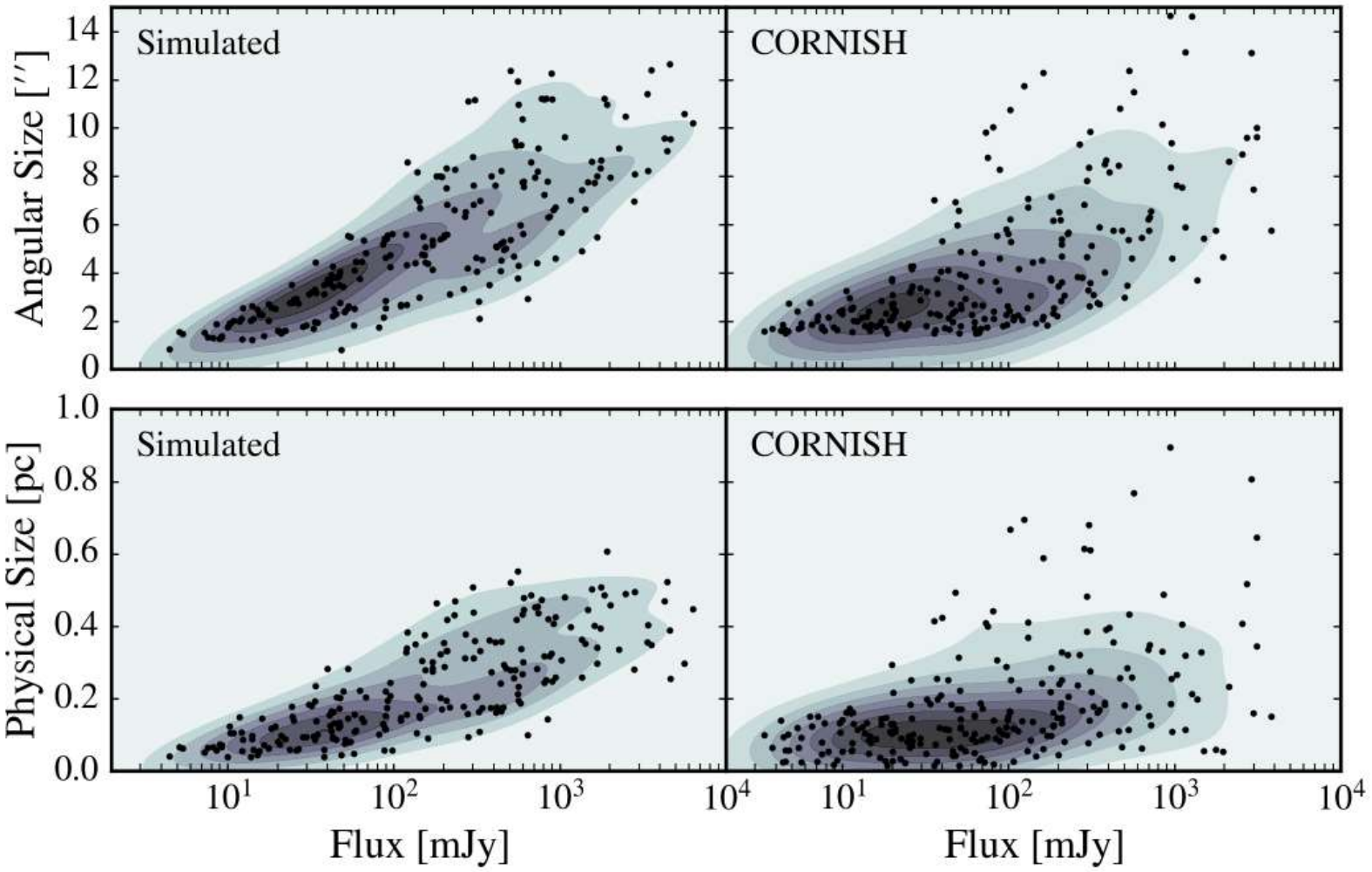
- 

Summary

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- Massive protostars
  - Ionized jets and molecular accretion discs
- Ultra-compact HII regions
  - Feedback and triggering
- Multi-wavelength surveys of the Galactic plane
  - Radio surveys
- Simulations
  - Hydrodynamic
  - Radiative transfer