

Soul of High Mass Star Formation

March 16-20, 2015

Puerto Varas, Chile

“Sociology”

- Many young people
- All 10 minute talks given by graduate students
- Excellent posters
- Growing importance of surveys
- New “actors” on the scene: filaments, hubs, fibers, central molecular zone, the Brick, the conveyor belt mode...

Jets and Outflows

- From jets to explosions to equatorial winds(?)
- Explosions: BN/KL, DR21, 05506
- Jet activity => Accretion activity?
- Ionized jet (fast and compact) base of molecular outflow (slow and extended)
- Not clear that more massive outflows less collimated than low mass outflows
- IRAS 17233-3606: Single from Multiple?
- Correlations suggest same mechanism for young stars of all masses

Why is this important?

- It would be interesting to conclude that star formation has the same basic characteristics for all stellar masses (similar efforts at the other end of the mass function in very low mass stars and brown dwarfs).

Intermediate mass stars

- Must study intermediate mass stars as a bridge between solar and massive stars: faster and more massive jets than in solar protostars

Methanol masers

- Class I (collision excited) and Class II (radiation excited)
- Class II only in regions of high mass star formation.
- Periodic methanol masers (probe something at the AU scale). Massive binary systems?
- Water masers valuable tracers of long term kinematics of structures (W75N).

Disks

- Several IR and radio tracers.
- OK for up to B stars
- Keplerian rotation?
- NGC 7538 IRS1: two disks?
- AFGL 4176 and IRAS 16547-4247

Chemistry

- Need sensitivity *and* high angular resolution.
- Study evolution of molecular gas.
- Large chemical differences in regions separated just a few arcsec.
- ALMA is an awesome machine for chemistry, but ammonia is having a renaissance with the JVLA capability of doing very high, (14,14)!, inversion transitions.

Large Scale Structure

- A paradigm change: from clouds, clumps and cores (spherical) to filaments and hubs (linear geometry).
- Converging flows: star-forming region is not isolated from the rest of the ISM but could be feeding from the rest of the filament.
- Different evolutionary states in the same filament (CMZ, “Nessie”).
- ALMA extremely powerful to image substructure.

Central Molecular Zone

- A lot of hot, dense and turbulent molecular gas in a small ($R=200$ pc) around the galactic center.
- From the Brick to Sgr B2: an evolutionary sequence by conveyor belt mode?
- A different mode of star formation?
Starbursts?
- Many unsettled issues.

The Forces at Play

- Gravity
- Magnetic fields
- Turbulence
- Rotation
- Radiation pressure

Somehow, we are still trying to understand the relative roles of these forces,

Surveys

- They have also been here (think of Messier or Lynds) but they have become increasingly important in the last few decades.
- Herschel, MALT90, ATLASGAL, SASSy, HOPS, THOR, MMB, CORNISH,...
- Powerful tools of research but let's hope studies of individual sources keep being important.

The future of massive star formation looks bright

- With ALMA and other powerful telescopes we may finally come to a more satisfying understanding of massive star formation.
- Let's end by thanking the SOC (chaired by Mardones and Garay), the LOC (chaired by Mardones and Chavarría) and all speakers and participants for a most enjoyable meeting that refreshed us all with new ideas and possible projects.
- See you in Manchester 2018!