Physical structure of the molecular envelope of the high-mass star-forming region AFGL2591

Matthijs van der Wiel*, Floris van der Tak, Marco Spaans
(Kapteyn Astronomical Institute/SRON Netherlands Institute for Space Research, Groningen, NL)
& JCMT Spectral Legacy Survey team & Herschel/CHESS KP team

Overview figure showing substructure in AFGL2591's envelope at various scales

Colorscale background: 850 micron continuum
White contours: integrated line intensity per molecular transition

Physical structure of the molecular envelope of the high-mass star-forming region AFGL2591

Matthijs van der Wiel*, Floris van der Tak, Marco Spaans
(Kapteyn Astronomical Institute/SRON Netherlands Institute for Space Research, Groningen, NL)
& JCMT Spectral Legacy Survey team & Herschel/CHESS KP team

JCMT Spectral Legacy Survey
Spectral imaging survey of five objects, using HARP-B instrument at 15-m James Clerk Maxwell Telescope:
1. Orion Bar: photo-dissociation region
2. NGC1333 IRAS4: low-mass star-forming region
3. IRAS20126: intermediate-mass star-forming core
4. AFGL2591: high-mass star-forming region
5. W49: active star-forming region/starburst analog

• spectral coverage: 330-373 GHz (mainly >360 GHz for IRAS20126)
• spectral resolution: 0.8 km/s
• instantaneous mapping: 2x2 arcminute fields
• one unbiased survey:
  spatial & spectral information, many molecular lines
in AFGL2591: 35 molecular transitions with extent beyond beam size

details AFGL2591
• relatively isolated core forming a 16 M\(_{\odot}\) star
• distance ±1 kpc: JCMT traces 10\(^4\)–10\(^5\) AU scales
• spatial resolution: 15000 AU

results
• anisotropic morphology of molecular envelope
• large-scale envelope tilted w.r.t. small-scale envelope
• warm (E\(_{\text{up}}\)=200K) CH\(_3\)OH: two separate peaks
• spherical envelope model is too optically thick:
  • is the envelope flattened?
  • does it have outflow cavities?
  • is the envelope clumpy?

Herschel/HIFI
• unbiased spectral survey 490-1200 GHz in Herschel/HIFI "CHESS" Key Program
• data processing in progress...

goals using spectral lines already identified
• higher-J transitions of CO, \(^{13}\)CO, C\(^{17}\)O, C\(^{18}\)O, HCO\(^+\), HCN, HNC, CS, H\(_2\)CO, SO
  → probe high-temperature conditions
• simple molecules only seen at high frequencies, e.g. H\(_2\)O, HCl, CH, NO, C, C\(^+\)
  → constrain chemical balance

• overview figure showing substructure in AFGL2591’s envelope at various scales

* contact: wiel@astro.rug.nl

goals using spectral lines already identified
• higher-J transitions of CO, \(^{13}\)CO, C\(^{17}\)O, C\(^{18}\)O, HCO\(^+\), HCN, HNC, CS, H\(_2\)CO, SO
  → probe high-temperature conditions
• simple molecules only seen at high frequencies, e.g. H\(_2\)O, HCl, CH, NO, C, C\(^+\)
  → constrain chemical balance

• overview figure showing substructure in AFGL2591’s envelope at various scales

* contact: wiel@astro.rug.nl