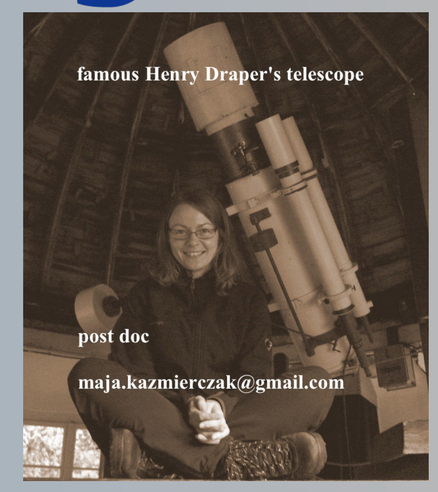
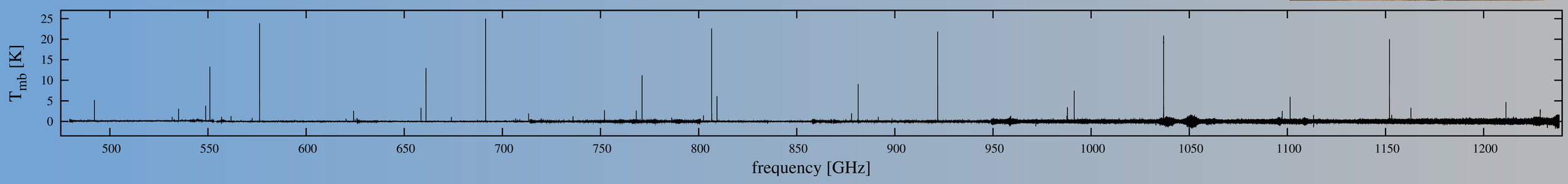
The HIFI spectral survey of massive star-forming region AFGL 2591

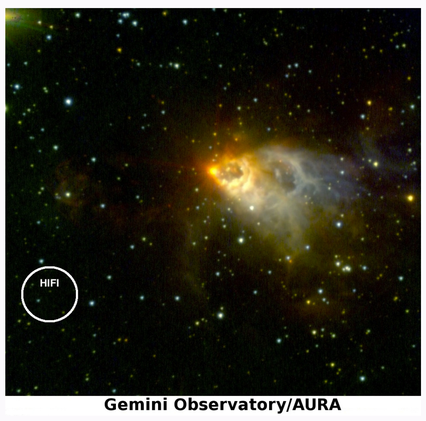
Maja Kaźmierczak[1], Floris van der Tak[1,2], Frank Helmich[1,2], Luis Chavarría[3], Kuo-Song Wang[4] and Cecilia Ceccarelli[5]

[1] SRON Netherlands Institute for Space Research, Landleven 12, 9747 AD Groningen, The Netherlands; [2] Kapteyn Astronomical Institute, University of Groningen, PO Box 800, 9700 AV, Groningen, The Netherlands; [3] Centro de Astrobiología (CSIC-INTA), Laboratorio de Astrofísica Molecular, Carretera de Ajalvir, Km 4. Torrejón de Ardoz, 28850 Madrid, Spain; [4] Leiden Observatory, Leiden University, PO Box 9513, 2300 RA, Leiden, The Netherlands; [5] UJF-Grenoble 1/CNRS-INSU, Institut de Planétologie et d'Astrophysique de Grenoble (IPAG) UMR 5274, Grenoble, France





1. AFGL 2591



- AFGL 2591 – high mass protostellar object with a bipolar outflow (van der Tak et al. 1999)
- located in the Cygnus X region (l, b)=78.°9, 0.°71
- relatively isolated massive star-forming region
- distance = 3 kpc (Rygl et al. 2012)

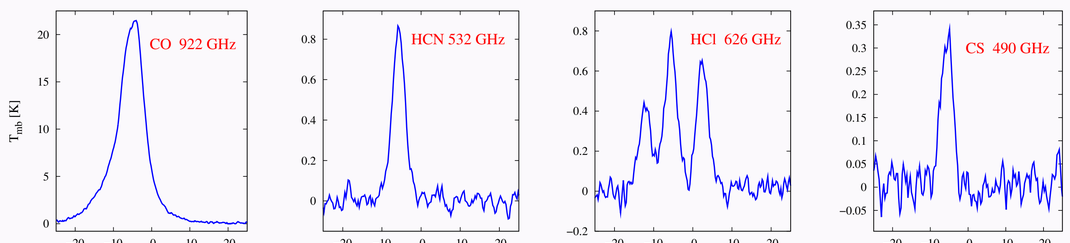
2. Spectral survey

- CHESS – Chemical HErschel Surveys of Star forming regions (Ceccarelli et al. 2010) - Herschel Guaranteed Time Key Programme
- Herschel/HIFI (480 – 1900 GHz)
- 268 lines were found of 32 species

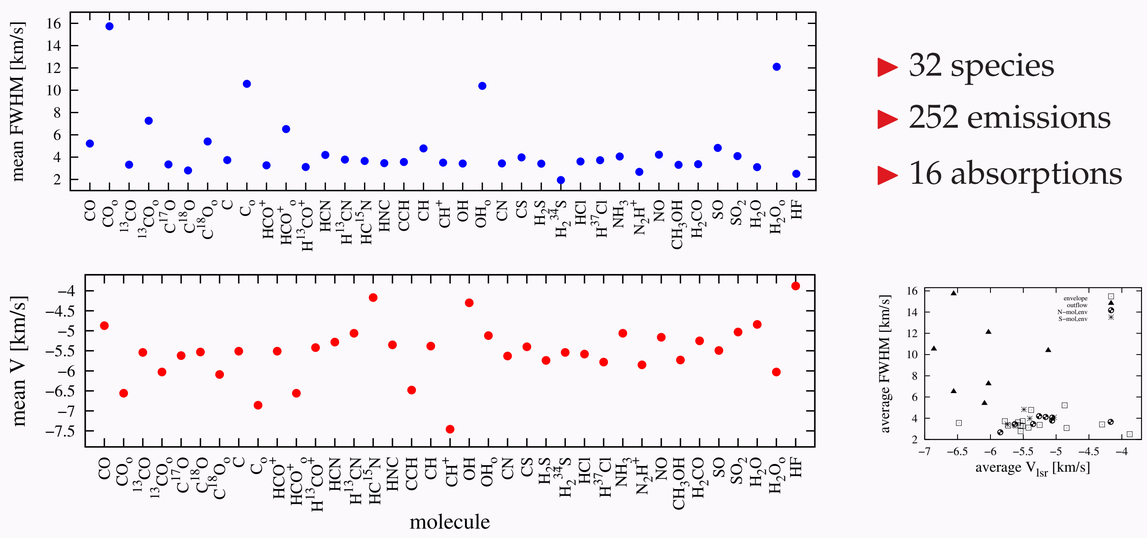
Line profiles:

- most lines are narrow: dominated by protostellar envelope
- some lines are broader: contribution from outflow

3. Spectra

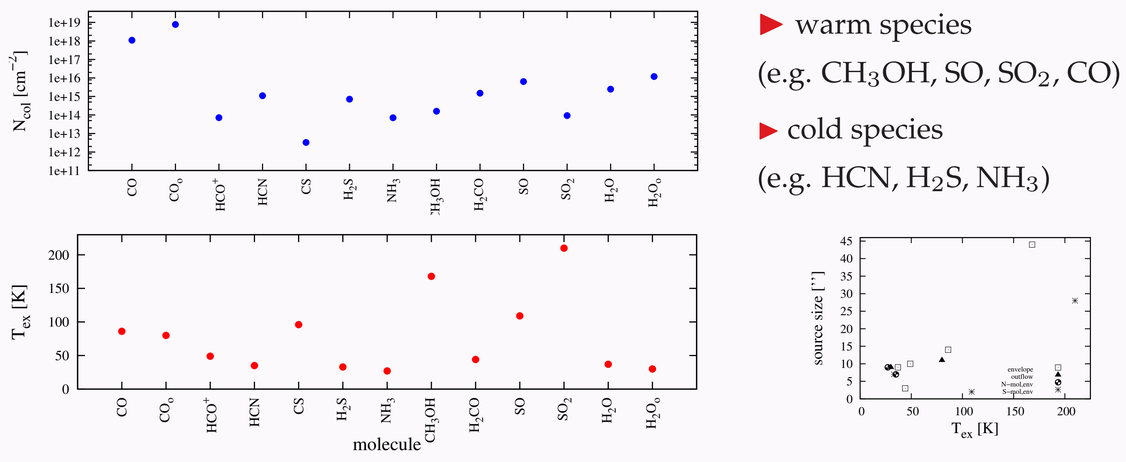


4. Observed parameters



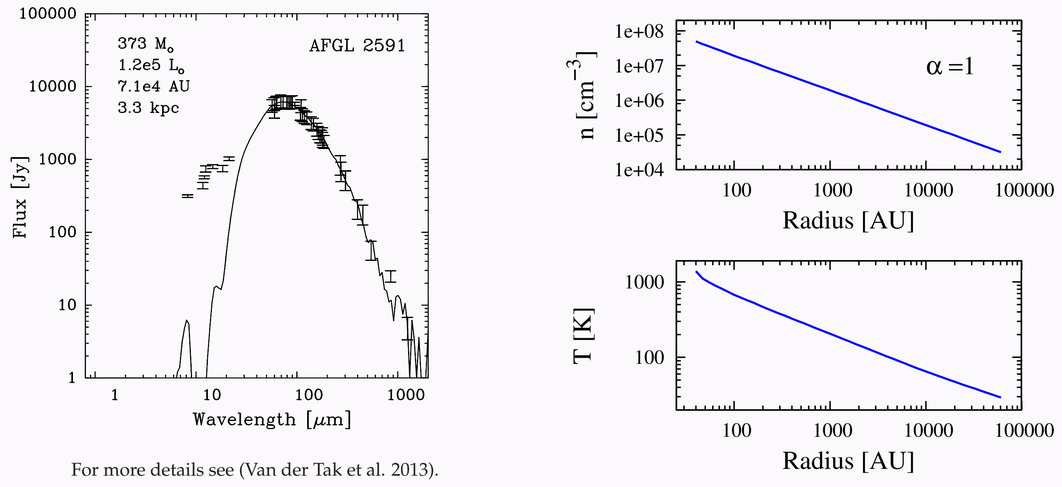
- 32 species
- 252 emissions
- 16 absorptions

5. Column densities & temperatures



- warm species (e.g. CH_3OH, SO, SO_2, CO)
- cold species (e.g. HCN, H_2S, NH_3)

6. Physical model



For more details see (Van der Tak et al. 2013).

7. Abundances

Abundances were estimated using Ratran (Hogerheijde & van der Tak 2000).

- Some molecules are evenly distributed through the envelope: [N_2H^+]=5e-10, [NO]=2e-8, [CN]=8e-11, [CO]=3e-5 and [HCO^+]=9e-9.
- HNC, HCN and its isotopologues are more abundant in the inner envelope, when T > 230 K ([HCN]=1e-5, [HNC]=3e-7). This temperature was predicted by the chemical models in which most of the atomic oxygen is driven into water. As a result atomic C and N abundances are higher, thus HCN abundance is increased as well at T > 230 K (Boonman et al. 2001).
- NH_3 is concentrated in the inner part of the envelope (3e-7), when T > 100 K, i.e., where water ice evaporates; van der Tak et al. 2006).