Name of research institute or organization:

# I. Physikalisches Institut, Universität zu Köln

Title of project:

KOSMA - Kölner Observatorium für Submm-Astronomie

Project leader and team:

Prof. Dr. Jürgen Stutzki, project leader
Dr. M. Miller, station manager
Dr. C. Kramer, Dr. S. Jeyakumar, Dr. B. Mookerjea, M. Brüll, H. Jakob

Project description:

**The large scale distribution, physical and chemical conditions of the interstellar matter**

The central topic is the spectrally resolved observation of the global distribution of the interstallar matter in the Milky Way and nearby external galaxies, using the important mm-, submm-lines of CO (and its isotopomers), and atomic carbon ([CI] 492 and 809 GHz. These observations have been carried out with the KOSMA 3m-telescope. Two SIS receivers were used, a dual channel receiver operating at 230 GHz and 350 GHz (the transitions CO(3-2) and CO(2-1) can be observed simultaneously), and the new dual frequency array receiver SMART which allowed a series of successful observations of both [CI]-lines simultaneously.
Observations were done in the star forming regions W3, S140, S106, Orion BN/KL, NGC2068, NGC2023, NGC2024, Cepheus B, and other sources, in the Cygnus X region, in several dark clouds, in the galactic plane near l=45° (galactic ring survey), in galactic cirrus clouds, intermediate-velocity clouds (IVCs), and high-velocity clouds (HVCs) (Project of university of Bonn), and at the positions of 250 IRAS point sources (project of our guest observer Prof. Wu, university of Beijing).

**The KOSMA Galactic Ring observations**

We nearly finished the observations of the first selected field in the Galactic Molecular Ring. It is layed at l=45° ,…, 46°, b=-0.1°,…,+0.2° galactic coordinates at the outer part of the ring. We are able to compare the transitions CO(J=3-2), CO(J=2-1), $^{13}$CO(J=2-1) and $^{13}$CO(1-0) (from the Boston University survey). Analysing the structure of the different maps, we see the influence of star formation on the structure of the whole cloud. This winter we started the observations of a second field containing a cloud at the inner part of the ring.

**The Photon Dominated Region W3 Main**

Our observations of W3 Main are covering a region of 360" x 220" (4.2 pc x 2.6 pc). We observed the two [CI] fine structure lines and in the CO(4-3) (7-6) rotational lines with the SMART@KOSMA receiver (Sub-Millimeter Array Reveiver for Two Frequencies) on the Gornergrat. The observations were done in Dual-Beam-Switch mode with a 6' chop throw in azimuth. Additional larger scale observations at low-J CO transitions (see Table 2) were done in On-The-Fly mode with the dual channel 230/345 GHz SIS receiver.

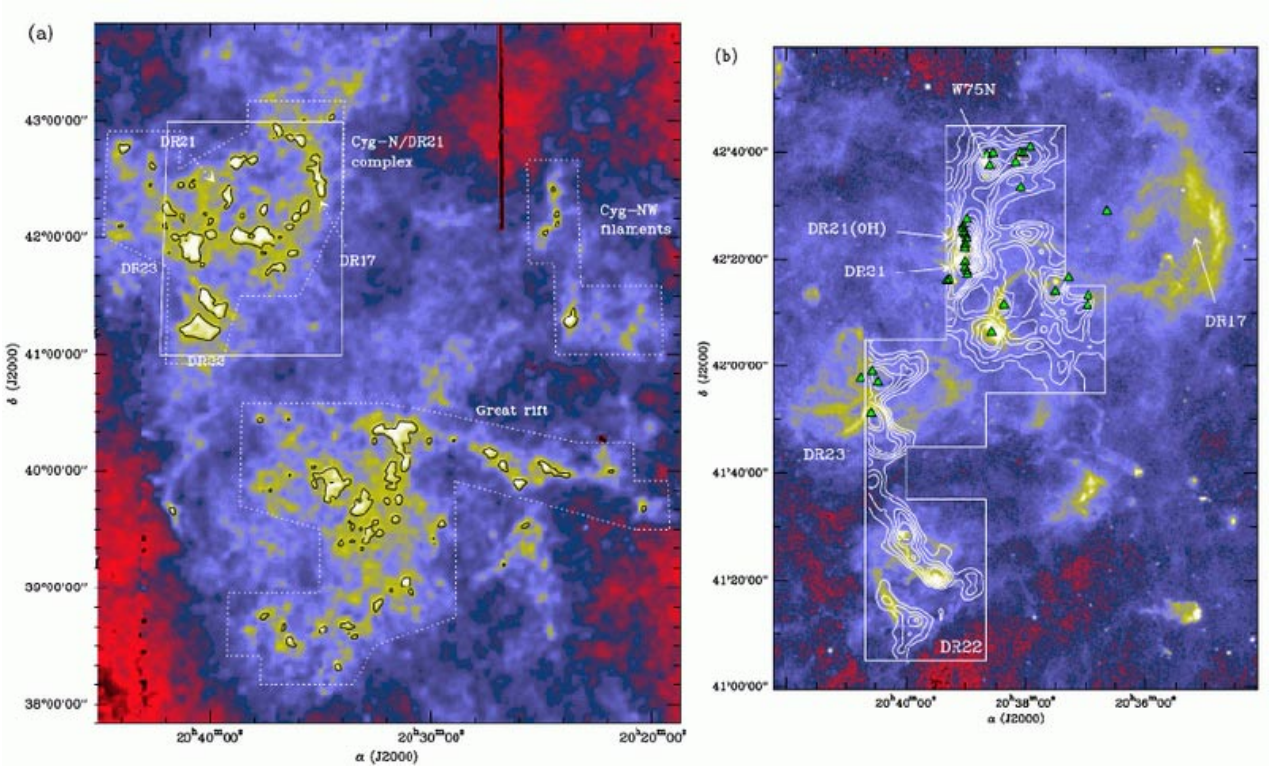
| Species | Transition | Frequency[GHz] | Points | Beamwidth [“] |
|---|---|---|---|---|
| $^{13}$CO | J = 3 → 2 | 330.588 | 1091 | 85 |
| CO | J = 3 → 2 | 345.796 | 1091 | 85 |
| CO | J = 4 → 3 | 461.041 | 192 | 57 |
| CO | J = 7 → 6 | 806.652* | 192 | 42 |
| $C^0$ | $^3P_1$ → $^3P_0$ | 492.1607* | 192 | 55 |
| $C^0$ | $^3P_2$ → $^3P_1$ | 809.3420* | 192 | 42 |

* Simultaneous observation

Table: KOSMA observational parameters

**Cygnus X**

Cygnus X is one the most active, nearby Giant Molecular Cloud (GMC) complex with ongoing high-mass star formation. In order to investigate the relationship between the global GMC complex structure and the star formation activity, we draw the global view of the high-density regions of Cygnus X based on a complete $^{13}$CO(3-2)/(2-1) survey with KOSMA. We also started large scale [CI] 1-0 and 2-1 observations of selected regions in Cygnus X during the winter period 2002/2003.




Left panel: Extinction map derived from 2MASS data for the Cygnus X region. The dotted polygon boxes correspond to a total area of ~ 8 square degrees to be mapped in $^{13}$CO with KOSMA. Right panel: Close-up view of the Cyg-North/DR21 complex. The image displays the MSX 8.3 μm emission. The white contour map shows the total integrated intensity in $^{13}$CO(3-2) already imaged with KOSMA. The triangles display 33 compact millimeter sources which are high-mass protostar candidates.

**Galactic Cirrus clouds, IVCS, and HVCs**

For this ongoing project of the Radio Astronomical Institute of the University of Bonn we made observations of $^{12}$CO(3-2),(2-1) and the [CI] transitions at 492Ghz and 809 GHz in the Draco nebula. Several excellent submm-weather periods allowed to map 4 extented parts of the cloud in the [CI](1-0)-line. This was the first time that the lower [CI] transition was observed in galactic cirrus clouds.

Key words:

Interstellar matter, ISM, PDR, millimeter, submillimeter wave telescope, SIS reciever, array reciever

Internet data bases:

http://www.ph1.uni-koeln.de/gg

Collaborating partners/networks:

Astronomisches Institut der Universität Bonn, MPI für Radioastronomie Bonn, Universität Bern, Institut für angewandte Physik, Center of Astrophysics, Boston, USA, Observertoire de Bordeaux

Scientific publications and public outreach 2002 (KOSMA relevant only):

**Refereed journal articles**

Ossenkopf, V. and Mac Low, M.-M., Turbulent velocity structure in molecular clouds A&A **390**, 307, 2002.

Ossenkopf, V., Molecular line emission from turbulent clouds, A&A, **391**, 295, 2002.

Schneider, N., Simon, R., Kramer, C., Stutzki, J. and Bontemps, S., A multiwavelength study of the S106 region. I. Structure and dynamics of the molecular gas , A&A, **384**, 225, 2002.

**Conference papers**

Kramer, C., Alves, J., and Lada C., The Physical Structure of a Prestellar Core in IC 5146, The Origins of Stars and Planets: The VLT View. Proceedings of the ESO Workshop held in Garching, Germany, 24-27 April 2001, **45**., 45, 2002.

Address:

1. Physikalisches Institut
Universität zu Köln
Zülpicher Str. 77
D-50937 Köln

Contacts:

Jürgen Stutzki (observatory director)
Tel.: +49 221 470 3494
Fax: +49 221 470 5162
e-mail: stutzki@ph1.uni-koeln.de

Martin Miller (station manager)
Tel.: +49 221 470 3558
Fax: +49 221 470 5162
e-mail: miller@ph1.uni-koeln.de

URL: http://www.ph1.uni-koeln