

Name of research institute or organization:

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**I. Physikalisches Institut, Universität zu Köln,  
Radioastronomisches Institut, Universität Bonn**

Title of project:

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KOSMA - Kölner Observatorium für Submm-Astronomie

Project leader and team:

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Prof. Dr. Jürgen Stutzki, observatory director

Dr. M. Miller, station manager

Universität zu Köln: H. Jakob, Dr. U. Graf, PD Dr. C. Kramer, Dr. B. Mookerjea, PD Dr. V. Ossenkopf, Dr. M. Röllig.

Universität Bonn: Prof. Dr. F. Bertoldi, Dr. U. Klein, Dr. F. Bensch, P. Müller, J. Pineda, Dr. S. Stanko, T. Westmeier.

Project description:

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

In 2005 KOSMA was in operation for 5 months only. The observations had to be stopped end of March. The Kulmhotel including some rooms of the observatory were refurbished. The works started in April. The observatory was back in operation in mid October. After cleaning all rooms and the telescope and starting up all systems the first astronomical observations after refurbishment was done in November. Two SIS receivers were used, a dual channel receiver operating at 230 GHz and 350 GHz, and the dual frequency array receiver SMART which allowed a series of successful observations of both [CI]-lines simultaneously and the transitions CO(4-3), (7-6), and <sup>13</sup>CO(8-7). [CI](1-0)/(2-1) observations were done in IVC135, IVC140, in the Serpens region, in IC348, W51 IRDC1, CepheusB, and CasA. CO(4-3) was observed in CepheusB, in the DR21 region, in Serpens, and in IC348. In April the array receiver SMART was brought back to the institute in Cologne for upgrading the system to 16 channels (8 pixel in the two frequency ranges 490GHz and 810 GHz). Besides <sup>12/13</sup>CO-1,3-2 transitions we observed with the dual channel receiver N<sub>2</sub>H<sup>+</sup>(3-2) and N<sub>2</sub>D<sup>+</sup>(3-2) in several sources in Cygnus, Perseus, and Taurus and we detected the very weak transition of <sup>13</sup>C<sup>18</sup>O (J=2-1) in W49.

Five major projects were continued during the short observing period in 2005:

1. KOSMA observations of CO in the Cepheus OB3 Giant Molecular Cloud

Observers: M. Masur, B. Mookerjea, C. Kramer (Universität zu Köln)

For a large-scale CO survey we observe the Cepheus Giant Molecular Cloud at 730 pc distance in CO (3-2) and <sup>13</sup>CO (2-1) using the KOSMA 3m submillimeter telescope. We would like to get more knowledge about the structure of the densities and temperatures in the whole Cepheus GMC. That cloud shows bright emission features, which are in regions of ongoing star formation, a quiescent and very broad region and regions with embedded and obscured young stars and objects.

Status: ongoing.

## 2. Low-metallicity translucent clouds

Observers: Jorge L. Pineda, Angela Kuhn, Frank Bensch (Universität Bonn)

We try to understand the physical properties of low-metallicity translucent clouds as examples of low metallicity low UV radiation field photon dominated regions (PDRs). Sources: IVC 210, IVC 140, IVC 135. We used both SIS receivers for our observations. We observed the transitions of  $^{12}\text{CO}(2-1)$ ,  $^{12}\text{CO}(3-2)$ ,  $^{13}\text{CO}(2-1)$ ,  $^{12}\text{CO}(4-3)$ ,  $[\text{CI}] 3\text{P}1-3\text{P}0$ . Status: ongoing.

## 3. High Mass Star Formation in the Cygnus X Region

Observers: N. Schneider, S. Bontemps, (University Bordeaux), R. Simon (Universität zu Köln)

Cygnus X is one of 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  $^{13}\text{CO}(3-2)/(2-1)$  survey with KOSMA. Status: this project has been finished now.

## 4. Supernova remnant: HB21 in $^{12}\text{CO}$ 2-1 & 3-2

Do-Young Byun, Bon-Chul Koo Korea Astronomy and Space Science Institute and Seoul National University in collaboration with Martin Miller, Carsten Kramer (Universität zu Köln).

We are studying shocked clouds in the supernova remnant HB21. For this, we are combining SRAO 6m  $^{12}\text{CO}$  1-0 maps with KOSMA 2-1 and 3-2 maps. We are planning to supplement these maps with KOSMA observations at selected positions of SiO, HCO<sup>+</sup>, and CS lines. These data sets are complemented with 1420 MHz radio-continuum images from the CGPS/DRAO survey and maps of the X-ray emission detected with ROSAT. Status: ongoing

## 5. $^{13}\text{CO}$ 2-1 and $^{12}\text{CO}$ 3-2 survey of the Serpens molecular cloud

Project of K. Sun, C. Kramer (Universität zu Köln)

Serpens is located in the inner Galaxy, not very far away in the direction toward the Galactic Centre ( $b = 5^\circ$  and  $l = 32^\circ$ ) at a distance of  $259 \pm 37$  pc and contains a deeply embedded, young cluster with large and spatially inhomogeneous cloud extinction, exceeding 50 mag of visual extinction. Earlier observations discovered discrete far infrared sources of relatively low luminosity. It is currently forming a dense cluster of low to intermediate mass stars, which is evident from the existing one of the richest known collection of Class 0 objects, the presence of several molecular outflows, pre-

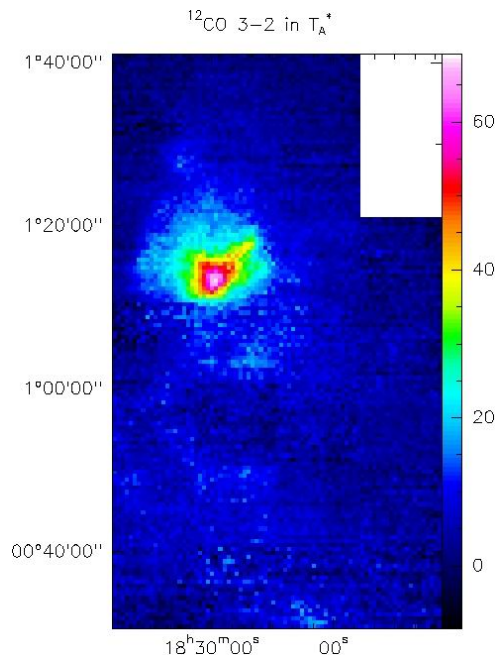


Fig. 1: This Serpens integrated intensity map in the  $^{12}\text{CO}(3-2)$  rotational transition includes all observations up to Dec. 2003.

stellar condensations seen as sub-mm sources, a far-IR source (FIRS1) possibly associated with a non-thermal triple radio continuum source.

Serpens belongs to the complete census of the stellar content of nearby ( $\leq 350$  pc) molecular clouds obtained by the Spitzer legacy project "Cores to Disks". Large-scale  $^{12}\text{CO}$ ,  $^{13}\text{CO}$  1–0 and  $A_v$  maps of the Serpens clouds were recently obtained by the COMPLETE team. The KOSMA survey of Serpens in higher CO transitions traces the warmer and denser gas due to the elevated critical densities and excitation energies ( $\sim 10^5$  cm $^{-3}$  and 33.2K for CO 3–2) relative to the J = 1–0 transition. Moreover,  $^{12}\text{CO}$  is largely optically thick, while  $^{13}\text{CO}$ , being a factor  $\sim 65$  less abundant, is often optically thin, thus tracing column densities.

Status: ongoing

Key words:

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

Internet data bases:

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

<http://www.astro.uni-bonn.de/~webrai/index.php>

Collaborating partners/networks:

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MPI für Radioastronomie Bonn, Institut für angewandte Physik, Universität Bern, ETH Zürich, Center of Astrophysics, Boston, USA, Observatoire de Bordeaux, Astronomy Department Peking University, China.

Scientific publications and public outreach 2005:

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### Refereed journal articles

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Mookerjea, B., Sun, K., Kramer, C., Masur, M., Roellig, M., CI/CO Mapping of IC 348 and Cepheus B using SMART on KOSMA, *Astron. Nachr.*, **326**, 581-582, 2005.

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