

First results of an unbiased millimeter spectral survey of the solar-type Protostar IRAS 16293-2422

Emmanuel Caux¹, Aurore Bacmann², Alain Castets², Stephanie
Cazaux³, Cecilia Ceccarelli⁴, Claudia Comito⁵, Frank Helmich⁶,
Claudine Kahane⁴, Alain Klotz¹, Bérengère Parise⁵, Peter Schilke⁵,
Alexander Tielens⁷, Ewine van Dishoeck⁸, Valentine Wakelam⁹,
Adam Walters¹.

¹CESR, CNRS-UPS, BP 4346, F-31028 Toulouse Cedex 04, France
email:caux@cesr.fr

²Observatoire Aquitain des Sciences de l'Univers, BP 89, F-33270 Floirac

³INAF, Osservatorio Astronomico di Arcetri, Largo Enrico Fermi 5, I-50125 Firenze, Italy

⁴Laboratoire d'Astrophysique, Observatoire de Grenoble - BP 53, F-38041 Grenoble cedex 09,
France

⁵Max Planck-Institut für Radioastronomie, Auf dem Hügel 69, 53121 Bonn, Germany

⁶Space Research Organization of the Netherlands, PO Box 800, 9700 AV Groningen, The
Netherlands

⁷Kapteyn Astronomical Institute, Rijks Universiteit Groningen, 9700 AV Groningen, The
Netherlands

⁸Leiden Observatory, PO Box 9513, 2300 RA Leiden, The Netherlands

⁹The Ohio State University, Department of Physics, 191 W. Woodruff Ave. Columbus, OH
43210-1106 USA

Abstract.

Unbiased line surveys are a unique way of determining the molecular content of astrophysical objects. They allow a complete study of the chemistry in and around molecular sources. Among all class 0 protostars observed to date, IRAS16293-2422 (IRAS16293) has the richest and brightest line spectrum. In particular this low mass protostar is the first one where several complex molecules have been observed (Cazaux et al. 2003) but also many deuterated molecules including D₂CO (Ceccarelli et al. 1998) and doubly and triply deuterated methanol (Parise et al. 2002, Parise et al. 2004). It has been shown recently (Ceccarelli et al. 2000, Shoier et al. 2002) that the structure of the collapsing envelope around this low-mass protostar has a inner hot corino where the temperature exceeds 100 K, and a colder outer envelope. Due to its high temperature and density which excite many transitions not visible from cooler regions, this hot core is responsible for the richness of the IRAS16293 spectrum. Another reason for this richness comes from the molecular diversity of the source itself, due both to the release by the elevated temperature of molecules trapped in icy mantles, and to gas phase chemical reactions which can proceed faster at high density. Also the high temperatures open many chemical pathways which, because they are endothermic, are closed at lower temperatures.

We present the first results of this millimetre unbiased spectral line survey performed with the IRAM-30m and JCMT radiotelescopes. When completed this survey will cover most of the frequency band attainable with the 30m (between 80 and 280 GHz) and with the JCMT in the 350 GHz band (328-366 GHz), i.e. about 205 GHz in total. A first very rough analysis shows the presence of many lines originating from various molecules including complex and deuterated molecules. The density of lines is about 20/GHz at 3 σ , at any observed frequency. This survey will build a complete census of the molecular content of this object, and will allow a detailed modelling of the chemistry governing its hot core and envelope. The molecular composition of

IRAS16293 will be compared to what is already known for massive hot-core regions putting stringent constraints on chemical models.

Keywords. ISM: abundances – ISM: molecules – Stars: formation –ISM:
