82
Accession number:20122015026299
Title:High-J CO emission in the Cepheus e protostellar outflow observed with SOFIA/GREAT
Authors:Gómez-Ruiz, A.I. (1); Gusdorf, A. (1); Leurini, S. (1); Codella, C. (3); Güsten, R. (1); Wyrowski, F. (1); Requena-Torres, M.A. (1); Risacher, C. (1); Wampfler, S.F. (4)
Author affiliation:(1) Max-Planck-Institut für Radioastronomie, Auf dem Hügel 69, 53121 Bonn, Germany; (2) LERMA, UMR 8112 du CNRS, Observatoire de Paris, École Normale Supérieure, 24 rue Lhomond, 75231 Paris Cedex 05, France; (3) INAF, Osservatorio Astrofisico di Arcetri, Largo E. Fermi 5, 50125 Firenze, Italy; (4) Institute for Astronomy, ETH Zurich, 8093 Zurich, Switzerland
Corresponding author:Gómez-Ruiz, A.I.(agomez@mpifr-bonn.mpg.de)
Source title:Astronomy and Astrophysics
Abbreviated source title:Astron. Astrophys.
Volume:542
Issue date:2012
Publication year:2012
Article number:L9
Language:English
ISSN:00046361
E-ISSN:14320746
CODEN:AAEJAF
Document type:Journal article (JA)
Publisher:EDP Sciences, 17 Avenue du Hoggar - BP 112, Les Ulis Cedex A, F-91944, France
Abstract:Context. Owing to the high energy required for their excitation, high-J CO transitions are a valuable tool for the study of protostellar jets and outflows. However, high spectral resolution observations of high-J CO lines, which are essential to distinguish the different components in the line profiles, were impossible until the start of operations of the Herschel Space Observatory and the Stratospheric Observatory For Infrared Astronomy (SOFIA). Aims. We present and analyze two spectrally resolved high-J CO lines toward a protostellar outflow. We study the physical conditions, as a function of velocity, traced by such high-energy transitions in bipolar outflows. Methods. We selected the molecular outflow Cep E, driven by an intermediate-mass class 0 protostar. Using the German REceiver for Astronomy at Terahertz frequencies (GREAT) onboard SOFIA, we observed the CO (12-11) and (13-12) transitions (E<inf>u</inf> ∼ 430 and 500 K, respectively) toward one position in the blue lobe of this outflow, that had been known to display high-velocity molecular emission. Results. We detect the outflow emission in both transitions, up to extremely high velocities (∼100 km s⁻¹ with respect to the systemic velocity). We divide the line profiles into three velocity ranges that each have interesting spectral features: standard, intermediate, and extremely high-velocity. One distinct bullet is detected in each of the last two. A large velocity gradient analysis for these three velocity ranges provides constraints on the kinetic temperature and volume density of the emitting gas, &asyum; 100 K and &asyum; 10⁴ cm⁻³, respectively. These results are in agreement with previous ISO observations and are comparable with results obtained by Herschel for similar objects. Conclusions. High-J CO lines are a good tracer of molecular bullets in protostellar outflows. Our

analysis suggests that different physical conditions are at work in the intermediate velocity range compared with the standard and extremely high-velocity gas. © 2012 ESO.
Number of references:22
Main heading:Velocity
Controlled terms:Density of gases - Observatories - Signal receivers
Uncontrolled terms:Infrared: ISM - ISM: individual objects - ISM: jets and out flow - Stars: formation - Submillimeter: isms
Classification code:931.2 Physical Properties of Gases, Liquids and Solids - 931.1 Mechanics - 718 Telephone Systems and Related Technologies; Line Communications - 717 Optical Communication - 716 Telecommunication; Radar, Radio and Television - 657 Space Physics - 443 Meteorology
DOI:10.1051/0004-6361/201218936
Database:Compendex