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Mapping the PAHs and H_2 in ρ Oph A

Kay Justtanont[1], René Liseau[1], and Bengt Larsson[2]

[1]Onsala Space Obseravtory, Chalmers University of Technology,
SE-439 92 Onsala, Sweden
email: kay.justtanont@chalmers.se, rene.liseau@chalmers.se

[2]Stockholm Observatory, AlbaNova University Center,
SE-106 91 Stockholm, Sweden
email: bem@astro.su.se

Abstract. We present an ISOCAM-CVF map of the ρ Oph A region, covering $3' \times 3'$. For each 6 arcsec^2 pixel, we extract the spectrum from 5–15 μm. We determine the fluxes of the main PAH features by fitting Lorentzian profiles to the spectrum. The peaks of the various PAH components correspond well with the known positions of the PDRs in this vicinity. The spectrum in several pixels exhibits strong rotational lines of molecular hydrogen which can be used to derive the physical properties of the cloud. The H_2 emission traces the hot gas of the bipolar CO outflow from VLA1623.

Keywords. Molecular processes, ISM: clouds, ISM: jets and outflows, Stars: formation

1. Introduction

At 120 pc (Lombardi *et al.* 2008), the ρ Oph A is one of the closest active star forming regions. Within this dense core, a couple of B stars ionize the surrounding gas, creating Photo-Dissociation Regions (PDRs). Using the data archive of the ISO mission (Kessler *et al.* 1996), we extracted ISOCAM (Cesarsky *et al.* 1996) CVF data which partly cover the SM1 cloud and the CO outflow from VLA 1623 (Dent *et al.* 1995), we extracted spectra of 32×32 pixels which extend from 5 to 15μm. Each pixel has a size of $6'' \times 6''$, i.e., 8.5×10^{-10} sr.

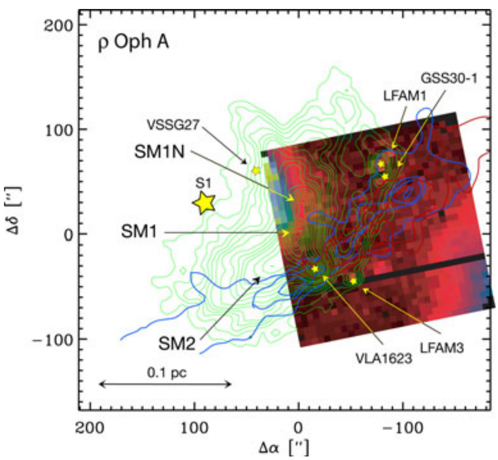

Figure 1. The ISOCAM PAH 6.2 μm map, together with the cold dust map (light contours) and the CO outflow (solid contours). The origin is at $16^h\ 23^m\ 27.5^s$, -24^o 23$'$ 56$''$, J2000.

2. PAH maps

The spectrum in most ISOCAM pixels shows that the emission is dominated by Polycyclic Aromatic Hydrocarbons (PAHs). We derive fluxes of each PAH band by fitting a Lorentzian profile to the continuum subtracted spetrum. Figure 1 shows that the peak emission of the 6.2 μm band arises from the region heated by the star S1, and lies close to the peak of the cold dust emission (Motte *et al.* 1998). Another emission peak comes from the PDR region excited by the star HD 147889 (Abergel *et al.* 1996). Different emission bands of these PAHs have a similar distribution (Figure 2), having two peaks on the north-east and south-west of the map. The region of the CO outflow shows minimum emission from PAHs in all the bands.

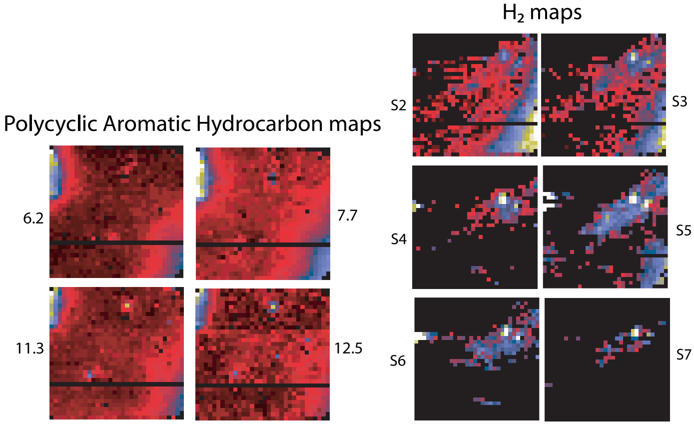

Figure 2. Left : The map of main PAH bands. One peak emission is a region close to the exciting star S1. The emission from the lower right arises from the bight western filament, excited by the star HD 147889. Right : The ISOCAM-CVF H_2 maps showing that the higher transition lines exclusively trace the CO outflow from VLA1623 (see Figure 1).

3. H_2 maps

Several pixels also show strong emission due to rotational transitions of H_2. We fitted the H_2 lines using Gaussian profiles with the width coresponding to the resolution at that wavelength. The maps of the pure H_2 lines show that they trace the CO outflow. The lower transition lines S(2) and S(3) also show strong emission due to the PDR region on the western part of the cloud (see Figure 2), The line S(3) line is serverely affected by deep silicate dust absorption which is present in all pixels. Also the lines S(6) and S(4) are blended with the strong PAHs at 6.2 and 7.7 μm.

From these observations, we derive iteratively the dust extinction, the gas temperature and the column density of the ortho- and para-states of warm H_2, i.e., for the brightest H_2 pixel, $A_v = 10^{\rm mag}$, $T = 1380 \pm 120$ K, o/p $= 0.728 \pm 0.002$. In that pixel, the total H_2 luminosity is 4×10^{-11} $L_\odot$ and the H_2 mass is 3×10^{-3} $M_\odot$ ($\Omega = 8.5 \times 10^{-10}$ sr).

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