The Gas in Protoplanetary Systems (GASPS) Open Time Key Programme will be the first extensive, systematic survey of gas in circumstellar disks over the critical transition from gas-rich protoplanetary disks to gas-poor debris disks.

1- INTRODUCTION

HD 181327 is an F5.6V star located at 60.6pc (Perryman et al. 1997). Its spectral energy distribution shows a Vega-like far-IR excess (Backman & Paresce 1993). HD 181327 was identified as a main sequence debris disk candidate with a L_{dust} = 0.2% (Mannings & Barlow 1998). HD 181327 is a member of the young (~12 Myr) Pictoris moving group (Zuckerman & Song 2004; Mamajek et al. 2004). Schneider et al. (2006), from NICMOS coronographic observations, discovered a ring-like disk of circumstellar debris seen in scattered light (see Figure 1). The ring is inclined by 32 deg from face-on.

2- OBSERVATIONS, DATA ANALYSIS

HD 181327 was observed by the GASPS programme during the Science Demonstration Phase. The data were recalibrated with HIPE, using the processing scripts from the Jan. 2010 Data Processing Workshop. The observations are:

- Point-source chop-nod photometry in the blue channel (70 µm) and in the red channel (160 µm). See Figure 2.
- Line scan spectroscopy targeting [OI] at 63 µm.
- Range scan spectroscopy targeting [CII] at 158 µm and [OI] at 145 µm. Recalibrated spectra extracted from the central spaxel appear in Figure 3.

3- DUST MODELING

We used the GRaTer code (Augereau et al. 1999) to compute a grid of models to reproduce the dust continuum emission of the debris disk of HD 181327. The SED fitting is further constrained by the surface brightness profile of the disk. The procedure assumes a single grain size distribution: n(a) ∝ a^{-α} between a_{min} and a_{max} = 4 µm. The dust is ISM-like, i.e., a mixture of porous particles of astronomical silicates, amorphous carbon and ices. In total, ~340000 models were ran. Results are presented in the box below and in Figure 4, for fits using 27 (left panel) or 7 (right panel) photometric data points, see caption for details.

Results of the SED fitting

\[ a_{min} = 1.44 \text{ µm (resp. 1.13 µm)}; \quad x = -3.71 \text{ (resp. -3.50)} \]

Disk mass: 0.05 M_{earth} (resp. 0.11 M_{earth})
Temperature of a_{min} grains at 88 AU : 82K (resp. 78K)

Flux \pm Stat. Error

<table>
<thead>
<tr>
<th>Gas to Dust ratio</th>
<th>[OI] [145] (W/µm)</th>
<th>[CII] [158] (W/µm)</th>
<th>CO (3-2) (W/µm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>4.5 ± 1.9</td>
<td>2.1 ± 0.9</td>
<td>2.2 ± 1.9</td>
</tr>
<tr>
<td>10</td>
<td>1.1 ± 0.1</td>
<td>1.1 ± 0.1</td>
<td>1.1 ± 0.1</td>
</tr>
<tr>
<td>1</td>
<td>1.2 ± 0.1</td>
<td>1.3 ± 0.1</td>
<td>1.0 ± 0.2</td>
</tr>
<tr>
<td>0.5</td>
<td>1.6 ± 0.2</td>
<td>5.1 ± 0.2</td>
<td>5.1 ± 0.2</td>
</tr>
<tr>
<td>0.01</td>
<td>7.6 ± 0.2</td>
<td>8.6 ± 0.2</td>
<td>1.2 ± 0.2</td>
</tr>
</tbody>
</table>

5- Final Remarks

HD 181327 is easily detected in the continuum by Herschel/PACS at 70 and 160 microns. Fitting of the continuum SED simultaneously with the brightness profile of the debris ring observed by HST provides evidence that grains are large and porous, as expected for debris disks.

Using the density profile inferred from the SED and assuming the gas, if any, in the ring follows the same distribution, we estimated the line fluxes for various Gas-to-Dust ratios in the ring. The current non-detections of OI and CII lines alone do not provide unambiguous upper limits to the gas content. However, the predictions show that coupling with other tracers, in particular with CO lines, offers much better prospects to reach lower limits on the gas content of debris disks.

REFERENCES:

Backmann, D.E., Paresce, F. 1993, Protostars & Planets III