DUst around NEarby Stars (DUNES): description of the project and results

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DUNES
DUst around NEarby Stars

“Cold Disks around Nearby Stars. A Search for Edgeworth-Kuiper Belt Analogues”

• ‘Open Time Key Programme’ de Herschel with the aim of detecting and study cold, dusty discs -analogues to the Edgeworth-Kuiper Belt (EKB) in the Solar System- around solar-type stars in our neighbourhood.

• Tools: PACS photometry at 70, 100 y 160 µm
SPIRE photometry at 250, 350, 500 µm
The detection of **IR excesses** around PMS and MS stars was one of the main discoveries made by IRAS (1983).

- **Debris discs**: dusty discs replenished by collisions between large bodies (planetesimals).
- **Second generation discs**: the primordial gas has disappeared almost totally.
- Debris discs provide information on the presence of *planetesimals* and *planets*.
- Relevant contributions from ISO (1995-1998) and mainly Spitzer (2003-2009) and ground based facilities.
Sample and observing strategy

**Sample:** 133 FGK stars:
- Distance < 20 pc.
- Stars with known planets (d < 25 pc).
- Debris discs detected by Spitzer (d < 25 pc).

+ 106 stars shared with OTKP DEBRIS.

**Volume limited sample**

**Strategy:** integrate as long as necessary to reach the *photospheric* flux at 100 µm, with the only limitation of the background confusion.

*Note that we aim to detect a few mJy above photospheres with fluxes of the same order and both in the Herschel detection limits.*

- \( F_\star (100 \, \mu m) \gtrsim 4 \, mJy. \)
- An analogue to the EKB at 10 pc, 100 µm: \( \sim 7 – 10 \, mJy. \)
## Summary of results

<table>
<thead>
<tr>
<th>Category</th>
<th>F</th>
<th>G</th>
<th>K</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observed</td>
<td>27</td>
<td>52</td>
<td>54</td>
<td>133</td>
</tr>
<tr>
<td>No excess</td>
<td>16</td>
<td>37</td>
<td>42</td>
<td>95 (71%)</td>
</tr>
<tr>
<td>Excess (new)</td>
<td>9 (2)</td>
<td>12 (3)</td>
<td>10 (5)</td>
<td>31 (10)</td>
</tr>
<tr>
<td>Affected by field contamination</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>Resolved (new)</td>
<td>5 (4)</td>
<td>6 (4)</td>
<td>5 (5)</td>
<td>16 (13)</td>
</tr>
</tbody>
</table>
Cold discs: a DUNES discovery

Some stars show excesses only at 160 µm.

This implies cold dusty discs: $T_{\text{dust}} \sim 20 - 25 \text{ K } (<30 \text{ K})$ and faint $L_{\text{dust}}/L_* \sim 10^{-6}$.

These discs cannot be explained within the paradigm of any known scenario.
Summary and conclusions

• ~ 30% of debris discs: remarkable increase with respect to previous statistics, new discs mainly around K-type stars.

• Flux levels similar to that of the EKB reached.

• A large number of resolved discs (5 x previous number).

• Contribution to stellar physics: the observation for the first time of the chromospheric temperature minimum in a star other than the Sun (α Cen A, Liseau et al. 2013)

• Peculiar classes of debris discs: excess only at 160 μm (Eiroa et al. 2011, Krivov et al. 2013), steep SEDs (Ertel et al. 2012)

DUNES goals accomplished: survey paper (Eiroa et al. 2013) submitted, analysis of the observations and interpretation of the results in progress.