Subaru/Gemini MIR Observations of Warm Debris Disks

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Outline

• Introduction: Debris Disks
• AKARI/IRC 18 μm Survey of Warm Debris Disks
• Subaru/Gemini Follow-up Observations
• Summary and Future Prospects
Debris Disk = Extrasolar Zodiacal Light

- **Debris Disk**
  - Dust Disks around MS stars
  - More than 100 samples

- **Infrared Excess**
  - Thermal emission from circumstellar heated by central star
  - Infrared excess over photospheric emission
  - 1st sample – Vega with IR Excess at $\lambda > 25\mu$m by IRAS (Aumann+ 84)
  - Possible connection with planets
Warm Debris Disks

- Main stream after IRAS
  - Far-infrared observations that can trace low-temperature dust (~100K)
  - Outer region of debris disk (~100AU)
  - Kuiper-belt analog
- More interesting thing (for me) is …
  - Situation in planet forming region
  - Traced by “Warm Debris Disk” at ~1-10AU from star (Asteroid analog)
  - MIR excess emission from warm dust
- AKARI, Spitzer
  - MIR observations with high sensitivity
  - Studies of warm debris disks have begun in earnest

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**AKARI MIR All-Sky Survey**

- **AKARI**: a Japanese IR satellite (surveyor)
  - IRC: Near-Mid-IR & FIS: Far-IR
  - All-sky survey with higher sensitivity and spatial resolution than IRAS
  - MIR IRC survey (9 & 18 μm) is useful for warm debris disk search

- Warm debris disk survey by comparing AKARI, 2MASS and Tycho-2 Spc catalog

<table>
<thead>
<tr>
<th>Band</th>
<th>S9W</th>
<th>L18W</th>
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<tbody>
<tr>
<td>Wavelength</td>
<td>6-12 micron</td>
<td>14-26 micron</td>
</tr>
<tr>
<td>Sensitivity</td>
<td>50 mJy</td>
<td>120 mJy</td>
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<tr>
<td>Resolution</td>
<td>9.4”</td>
<td></td>
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</tbody>
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BG: AKARI IRC MIR All-Sky Survey (Ishihara+ 2010, submitted to A&A)
AKARI-identified Debris

- Red: AKARI-discovered
- Yellow: 1st confirmation after IRAS (Oudmaijer+ 92)
Follow-up Observations

- Observations from space
  - Limited spatial resolution of observation from space
  - Suspicious of contamination/mis-identification
- Ground-based follow-up observations
  - Higher spatial resolution
  - Confirmation of excess emission
- High spectral resolution/multiple bands
  - Hints for properties (dust temperature and species)
- Availability of MIR capability in both of Northern and Southern Hemisphere
  - AKARI candidates distribute in all sky
  - Subaru/COMICS + Gemini-S/T-ReCS
HD106797 by Gemini/T-ReCS

- A-type dwarf star
  - 18μm excess by AKARI
- Gemini/T-ReCS
  - Si2-6 and Qa
  - Excess at λ>11μm
  - Dust T~200K
- Feature Shape
  - Crystalline silicate?
  - Not sub-μm amorphous (ISM-like) silicate
HD165014 by Subaru/COMICS

- **A-type dwarf star**
  - 9&18μm excess by AKARI

- **Subaru/COMICS**
  - 8.8, 11.7, 18.8μm
  - Large Excess at λ>8μm
  - Dust T>200K (500K?)
  - $L_{\text{dust}}/L_{\text{star}} \sim 5\times 10^{-3}$
    - Comparable to b Pic

- **Dust Feature by Spitzer**
  - Crystalline silicate
HD165014 by Subaru/COMICS

- A-type dwarf star
  - 9\&18\textmu m excess by AKARI

- Subaru/COMICS
  - 8.8, 11.7, 18.8\textmu m
  - Large Excess at \(\lambda>8\textmu m\)
  - Dust \(T>200K\) (500K?)
  - \(L_{dust}/L_{star} \sim 5\times10^{-3}\)
    - Comparable to \(\beta\) Pic

- Dust Feature by Spitzer
  - Crystalline silicate
Summary

- AKARI identified 24 warm debris disk candidates
- 6 candidates confirmed by Subaru/Gemini follow-up observations so far
- Crystalline silicate towards 2 candidates
  - Dust evolution during planetesimal formation?
Future Prospects

- MIR follow-up observations of 18 candidates
- MIR spectroscopy for dust property examination
- Coronagraph observations for direct detection of disks (HiCIAO/NICI)

- Availability of MIR capability in N/S hemisphere
  - important for follow-up observations of sources discovered by all-sky survey (AKARI/WISE/Planck)