German Instrumentation Workshops

Bernhard Schulz

6-Dec-2021
Plan for Germany/Europe

- Use the opportunity to change the SOFIA paradigm
  - NASA does senior reviews but that is a normal process
  - No serious alternatives for Infrared/Submm on the 10 year horizon
  - Long term NASA vision makes termination less likely!

- The German/European community can create a complementary 10 year vision for Infrared/Submm astronomy
  - SOFIA is a working observatory
  - Future lighter-than-air observatories are good additional options

- First determine science interests and requirements (July 26-28, 2021)
  - Get German and European Infrared Astronomy together and determine scientific interests

- Second discuss instrumentation and funding (Nov 17-19, 2021)
  - Talk about how to make this science happen
  - New SOFIA instruments, new and planned balloon missions, instrument/detector development, funding opportunities

- Write white paper summary (by end Jan 2022)
  - Reference for proposals to build new instrumentation.
Science Workshop 26-28 Jul 2021

• 231 registered participants
• 3 days @ ~4.5h per day
• typical online attendance 80-90
• 56 Presenters
  • 10 invited speakers
  • 32 Contributed talks
  • 14 Poster presentations
• Summary presentation by Karl Menten
• Main Themes: ISM, PDRs, shocks, star formation, astrochemistry
Science Workshop 26-28 Jul 2021

• **Main Themes:** ISM, PDRs, shocks, star formation, astrochemistry
• 1/3 of presentations extragalactic
• High resolution spectroscopy MIR and FIR
• Trade spectral resolution for sensitivity
  • extra galactic work
  • large scale line mapping
• Polarimetry in FIR
• MIR/FIR broadband photometry
• Specific lines
• Time sampling

**Specific requests:**
• Fine structure lines, HD, CO ladder, oxygen compounds
• large scale mapping of [NII] 122µm / 205µm
• 350µm filter
• NIR capabilities for occultation obs.

<table>
<thead>
<tr>
<th>Session</th>
<th>Talks</th>
<th>Posters</th>
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<tbody>
<tr>
<td>Solar System</td>
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<tr>
<td>Star &amp; Planet Formation</td>
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<td>Interstellar Medium</td>
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<td>Late Stellar Evolution</td>
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<tr>
<td>Nearby Galaxies</td>
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<td>3</td>
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<tr>
<td>High-Redshift Galaxies</td>
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<td>4</td>
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**Instrumental Requirements**

<table>
<thead>
<tr>
<th>Instrument</th>
<th>Requirement</th>
<th>Percentage</th>
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<tbody>
<tr>
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<tr>
<td>Photometer</td>
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<tr>
<td>Heterodyne</td>
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<tr>
<td>R=5000 FIFI</td>
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<tr>
<td>Pol.</td>
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<td>11%</td>
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<tr>
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<td>8%</td>
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<tr>
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<tr>
<td>maps</td>
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<td>59%</td>
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</tbody>
</table>

**Total Science Cases:** 63

Version: 14-Oct-2021

SUG #19, Bernhard Schulz, 06-Dec-2021
Instrument Workshop 17-19 Nov 2021

- 156 registered participants
- 3 days @ ~5h per day
- typical online attendance 50-80
- 31 Presenters
  - 21 invited speakers
  - 6 Contributed talks
  - 2 Poster presentations
- Final discussion
  - Short summaries (Heinz Wilhelm Hübers and Leslie Looney)
  - Including representatives of DLR, DFG, DESY
- Main Themes: Heterodyne- and direct detection systems, balloon platforms, funding opportunities
Instrument Workshop 17-19 Nov 2021

First impressions:

• Balloon options look promising for specific programs
  • Scalable gondola developments
  • Survivability of payload remains a big issue
  • Low flight cadence
  • France has a dedicated balloon budget line

• SOFIA is the only regular platform for at least the next 10 years
  • Roadmap first step is in a 6 months formulation phase now

• Heterodyne HEB mixers, SIS mixers, Schottky diode mixers discussed
  • HEB mixers mature
  • High frequencies still hard to reach because no space missions
  • 100 pixels in focal plane considered very ambitious

Very Preliminary!!!
First impressions:

- Direct Detectors: Kinetic Inductance Detectors (KID), Transition edge detectors (TES), polarimetric Si-bolometers, Cold-electron bolometers
  - Expertise in UK, France, The Netherlands, Germany
- Instrument presentations: upGREAT, FIFI+LS, HERO, Millimetron, HIRES, pHD, SOFIA Chopper, FPI++, ArTeMiS/CoPilot/B-BOP

Heterodyne:

- 100 pixels array hard --> better modular approach
- spectrometer power issue

Direct Detection:

- Many solutions exist, pushing to blue side no easy quick solutions, complex instruments will delay the next instrument
- Funding opportunities in Germany and Europe exist but managers need more awareness of researcher’s needs

Very Preliminary!!!