Mapping the Invisible Universe

29th August - 2nd September 2022, Lorentz Center@Oort

Scientific description and aims

The 2020s will revolutionise the sub-mm astronomy, with new technologies and multiple single-dish telescopes becoming operational. These will enable wide-field spectroscopic surveys in (sub)-mm regime, which is impractical with current facilities.
This workshop brought together experts on instrumentation, and observational and theoretical astrophysics to discuss the prospects for extragalactic spectroscopic surveys in the sub-mm. Specifically, we covered both 5- to 10-m class telescopes that will become operational within this decade (e.g., FYST), as well as potential 50-m class ones (e.g., AtLAST).

Tangible outcome
We have created a joint knowledge database (e.g., common simulation outputs for simulated observation). We plan to share the results with the wider astrophysics community by submitting a Perspectives article (in prep.) and a Meeting Report (subm.) to *Nature Astronomy*.

Scientific breakthrough
We identified potential parameters for a set of "pathfinder" (~5 years into the future) and "full-scale" survey spectrometers. We explored the main questions and requirements of different scientific approaches: blind galaxy surveys, line-intensity mapping, and the Sunayev-Zeldovich effect.

"**Aha" moments**
We identified two unanticipated challenges – the detector readout system and data processing. For a large-format integrated field spectrometer on a 50-m telescope, we estimate the cost to be >$500M. The readout will also require a significant amount of power (5-10 MW). On the data side, a wide-field survey with a 50-m dish will deliver several PBs of raw data per year. The scale of this issue is similar to, e.g., the LOFAR surveys, opening potential data-processing and data-science synergies. .

Organisation/Format
The workshop consisted of a series of short talks (12-20 mins), plenary discussions and working in splinter groups. The short talks were concentrated into Day 1 and morning of Days 2 and 3; the bulk of the time was devoted to working in splinter groups and discussion sessions.
We had a total of 51 participants: 43 in-person and 8 online. 50% of participants were postdoctoral researchers or PhD students; 35% of the participants were female.

Other comments
We appreciated the coronavirus precautions taken by the Lorentz Center – free masks and self-tests for the participants. Additionally, we offered the participants the option to send us posters in advance and have them printed in Leiden: this got quite an enthusiastic response from international participants.

Matus Rybak (Delft, the Netherlands)
Akira Endo (Delft, the Netherlands)
Claudia Lagos (Perth, Australia)
Frank Bertoldi (Bonn, Germany)
Caitlin M. Casey (Austin, Texas, USA)