Title: THz radioastronomy: from the inhomogeneity of Cosmic Background Radiation to the first images of black holes: what will come next?

General description

The application of sub-THz millimeter wave technologies in astronomy resulted in many fascinating findings such as the anisotropy of cosmic microwave background radiation or even the first images of the black hole event horizon. Referring to the recent findings, despite their ubiquity and large mass of black holes, these objects are relatively small in size meaning even the best telescopes up to date can't take images of them — at least when working alone. Therefore, to capture the first-ever image of a Black Hole, the Event Horizon Telescope (EHT) applied a method known as "very long baseline interferometry" (VLBI) to yoke multiple telescopes together into a single virtual observatory the size of the planet. Moreover, despite that presented findings can be treated as quantum leaps, there are expectations that they only mark the beginning of the understanding of the nature of spacetime and gravity.

Students task description

Give an overview of existing THz detection techniques required for state-of-the-art observations.
Estimate the radiation intensities of cosmic objects and summarize the challenges for the sensitivity of THz (sub-THz) measurement equipment.

Literature:

de Bernardis, P., Ade, P., Bock, J. *et al.* A flat Universe from high-resolution maps of the cosmic microwave background radiation. *Nature* **404**, 955–959 (2000). https://doi.org/10.1038/35010035

https://eventhorizontelescope.org/science

Geoffrey C. Bower, Focus on First Sgr A* Results from the Event Horizon Telescope, The Astrophysical Journal Letters https://iopscience.iop.org/journal/2041-8205/page/Focus_on_First_Sgr_A_Results

Gurvits, L.I., Paragi, Z., Casasola, V. et al. THEZA: TeraHertz Exploration and Zooming-in for Astrophysics. Exp Astron 51, 559–594 (2021). https://doi.org/10.1007/s10686-021-09714-y.