Level of the Project: Honours

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Title: Searching for Life in Extraordinary Places with MeerKAT and BLUSE

Description:
Searching stars, planets, and the cosmos in general to look for signs of technologically advanced beings is a computational, technical, and scientific challenge but one that could provide an answer to one of humanity's oldest questions. In the search for radio emission from complex life, we must navigate a large parameter space (the cosmic haystack) with axes addressing time, location, frequency, and duty cycle. We have a digital recording system on the back of the MeerKAT telescope in South Africa which gets a copy of the digital, calibrated voltages from each antenna during standard observations. We do not control the telescope but instead get a copy of the digital data and the Breakthrough Listen User Supplied Equipment (BL USE) adjusts autonomously and in real time to process and search for narrow-band drifting signals potentially associated with extra-solar planets.

Using a mix of existing and curated Python libraries and software, the goal of this student project is to help continue to improve and automated methods for sorting through the data, and to build better filters to reduce the number of files containing only locally-generated radio signals (radio frequency interference). This means sifting through collected data and searching for unique signals isolated towards the targets of interest. BL USE is relatively new and not a lot of the data has been reviewed for technosignatures. You will be diving into the data as we collect thousands of files each hour of operation. You will learn to work with a series of file formats for radio astronomy data from the raw to the processed products. The project will rely heavily on Python and other tools deemed fit to carry out these tasks, to look at the data and visualize the information.

References
[1] Czech et al. In prep (request a copy of the paper)
[2] Enriquez et al. (2017) https://iopscience.iop.org/article/10.3847/1538-4357/aa8d1b [3] Jian-Kang et al (2022) https://arxiv.org/pdf/2208.02511.pdf
There is a paper describing a post processing and filtering method under development that can be used as a guide: https://www.overleaf.com/read/xjmxbfkfknwt#3137bf
[3] Tremblay et al. (2025) https://ui.adsabs.harvard.edu/abs/2025AJ....169..122T/abstract
Code References & Tutorials:

https://github.com/UCBerkeleySETI/blimpy
https://github.com/lacker/seticore
https://blimpy.readthedocs.io/en/latest/
https://notebook.community/UCBerkeleySETI/breakthrough/GBT/filterbank_tutorial/Filterbank%20Tutorial %20(public)
https://github.com/Chenoachem/COSMIC_Stuff/blob/main/COSMIC_STAMP_Play.ipynb
https://github.com/lucyjsteffes?tab=repositories
https://github.com/NMStiegler/COSMIC_stamp_tutorial STAMP Tutorial