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A Solar Imaging Pipeline for MeerKAT

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Most radio astronomers consider the Sun a nuisance, being considered one of the biggest sources of RFI in MeerKAT observations. The MeerKAT radio telescope is a precursor radio interferometer for the Square Kilometre Array (SKA) mid frequency telescope, that is located in the arid Karoo region of the Northern Cape Province, in South Africa (at 21 degrees East, 30 degrees South) (Jonas and MeerKAT Team, 2016). It will be the most sensitive decimetre-wavelength radio interferometer array in the world before the SKA1-mid. MeerKAT is an interferometer composed of 64 antennas with 13.5 m of diameter and the maximum baseline within antennas is 8 km (Abbate, 2021). MeerKAT operates in UHF band (580-1015 MHz) as well as L-band (856-1712 MHz), with S-band (1.75 - 3.5 GHz) currently being commissioned and Solar interference is likely to be stronger in UHF band (Jonas and MeerKAT Team, 2016). The Sun is such a strong source of radio emission (Hey, 1973) that solar fringes can readily be seen on individual baselines of the MeerKAT telescope, and the solar disk has even been successfully imaged when the telescope was pointing almost 90 degrees away from it. Aside from observations where the Sun is very close to the optical axis of the telescope, the observing conditions that lead to the most prominent solar interference are not thoroughly understood and this is one of the solutions that can be obtained through this project.

The goal of this project is to build an automated pipeline that is able, through MeerKAT observations, to determine the location of the Sun in relation to the antenna orientations and the celestial coordinates of the targets, Image the Sun, characterise the strength of the solar contamination and remove the Sun from the observations.
These results will be used to influence the scheduling strategies of MeerKAT and SKA-MID. A natural by-product of this work will be many images and movies that resolve the solar disk and its complexes of sunspots.

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