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Imaging Spectral-Line Deep Fields in the SKA-Era: insights from DINGO

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Neutral hydrogen (HI) plays a crucial role in galaxy evolution, by both driving and regulating star formation. Thus, it is essential to carry out large HI surveys to determine how gas content varies as a function of environment and other parameters to improve our knowledge of galaxy evolution. The Deep Investigation of Neutral Gas Origins (DINGO) survey [1] on the Australian SKA Pathfinder Array (ASKAP) [2] plans to do this by surveying cosmologically representative volumes from redshift zero to ∼0.4. To achieve the required sensitivity in its deepest fields, DINGO will observe up to 2,500 hours per field, likely spread over multiple years. However, the resultant data volumes are too large to store the raw visibilities for the full survey length. As such, the default approach is to subsequently average daily images together to form the final deep images.

The insights from other deep spectral line surveys such as the COSMOS HI Large Extragalactic Survey (CHILES) [3] underline that this imaging method imposes severe limitations on any re-processing to improve final image quality. In particular, small systematic errors, that may be unnoticeable in the daily images, would `bake-in' when forming the deep image, and thus they will have a significant impact on the final data products. Therefore, long-term storage of compressed visibilities is required for deep imaging and post-survey re-processing of the accumulated data.

To meet this need, we are actively developing an alternative data processing pipeline, in which we store the daily datasets as gridded data [4]. These grids are sparse, so can be stored efficiently. Gridding the data in this manner forms a product that is of the same scale as the image and applies to correct kernels, whilst maintaining the ability to flag, reweight or even recalibrate the data. Thus this approach addresses the greatest risk in the current strategy. We report on our progress in commissioning a standard gridded visibility pipeline and any improvements in the current processing approaches that will be required in the future.

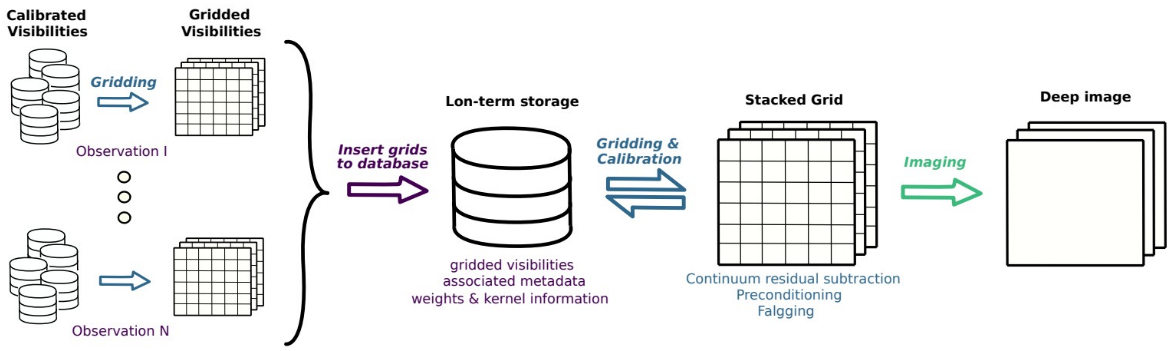

Fig 1.: *Deep imaging pipeline: Raw observed data is discarded after the gridding step and only sparse grids and associated metadata are stored in a dedicated database. After the preconditioning is applied the daily grids are stacked together. Further calibration of the stacked and daily grids can be applied. The deep image is formed via deconvolution*.

References

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