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# MPIfR cryoPAF: First results of our technology developments

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## Extended Abstract

Embedded into the "Low Frequency Gravitational Wave Astronomy and Gravitational Physics in Space“, a joint project of CAS and MPG, we started together with our colleagues from NAOC a long-term development project on cryogenic PAF systems back in 2018. The electronics division of the Max-Planck-Institute for Radio-Astronomy took this collaboration as a starting point to invest massively in the development of phased array feed receiver systems.

To lay the foundation stone for future PAF developments at the institute, we established an initial phase of research, design-, and feasibility-studies. This phase now is producing first results and is also slowly transitioning into a phase of an actual receiver design – with the target to produce a first generation cryogenic PAF for the Effelsberg 100m telescope. Here we will present some of the developments and results of this initial project phase.

Beside the classical developments on receiver components (e.g. analog signal processing chain, or LNAs) and system engineering (e.g. layout of the front- and back-end, cooling, window options), a lot of effort was put into the simulation of a PAF system as a whole. This now allows to optimize the design parameters of a PAF system for a dedicated science case. Therefore a full noise simulation including LNA, matching, antenna, and array geometry is available. Beside optimization tasks like maximizing the field-of-view, we can test scenarios like the ability to deal with blind elements, telescope surface inaccuracies, or simulated RFI sources.

As a PAF can be seen to large extend as a software based receiver system at which only algorithms give access to its unique capabilities, we ramped up personnel and development activities for digital signal processing. One of the highlights achieved during the last years are the software algorithms for beam-forming and RFI mitigation. These have already been tested on sky using the warm PAF available at Effelsberg [1] and are now being used for routine PAF observations like FRB search. These results underline the hope to operate large radio-astronomical facilities like the 100m telescope also in future within highly RFI polluted regions like central Europe.

## References

[1] A. P. Chippendale et al., "Testing a modified ASKAP Mark II phased array feed on the 64 m Parkes radio telescope," 2016 International Conference on Electromagnetics in Advanced Applications (ICEAA), Cairns, QLD, 2016, pp. 909-912, doi: 10.1109/ICEAA.2016.7731550.