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The RADIOBLOCKS project contribution to the VLBI of the future

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VLBI is a technique used in radio astronomy to achieve the highest angular resolution in astronomy by using multiple radio telescopes hundreds to thousands of kilometres apart to simultaneously observe the same object and deliver processed scientific data after a sequence of complex operations. Radio telescopes usually participate in VLBI networks on a part-time basis, as in EVN, EAVN, GMVA or EHT, or on a full-time basis, as in VLBA. For many years, the networks have used a small number of radio telescopes, which limited the collecting area and the objects studied to bright and compact sources. The participation of ALMA and the advent of the SKA, together with an increased number of radio telescopes around the world and the combination of networks, will provide a higher sensitivity, allowing VLBI to leave its niche and become a mainstream technique in astronomy. In addition, recent technological developments offer new possibilities that will extend the use of VLBI.

RADIOBLOCKS is a European Union-funded project (Horizon Europe research and innovation programme, grant agreement 101093934) that aims to go beyond state-of-the-art technological solutions to increase the sensitivity, field of view and bandwidth of radio astronomy infrastructures. Although these developments address aspects for almost all types of radio telescopes and instruments along the entire data chain, VLBI will benefit from their results and deliverables. This talk will highlight the developments that will have an impact on the VLBI of the future.

RADIOBLOCKS is divided into several interlinked work packages with different objectives. Work package 2 addresses the developments of improved cryogenic LNAs and SiS mixers, among others, which will allow large bandwidths and simultaneous observations at different, largely separated frequencies to study the emission of sources, increase the sensitivity, and are essential for the frequency-phase transfer that allows to extend the coherence time at millimetre and submillimetre wavelengths, which is limited by atmospheric propagations effects. Work Package 3 will develop and demonstrate digital receivers that produce large data streams capable of RFI mitigation, including cryoPAFs and a prototype VLBI backend that will allow broadband and multi-frequency observations. Work Package 4 will be dedicated to the processing of the data produced by the new receiver systems of WP2 and WP3 and it will develop a collection of efficient, high performance signal processing blocks using commercially available hardware accelerator platforms such as FPGAs, tensor core-enabled GPUs for correlations, and an off-the-shelf Ethernet network switches for high-speed data transfer. These developments may allow, for example, faster correlation of multiple phase centers within the same primary beam. Work package 5 is concerned with the implementation of a generic software toolkit to handle the post-processing of the resulting large data streams. This includes fringe fitting, advanced data processing algorithms to handle data with sparse visibility and simulations to extend the EHT tools for cm-VLBI or to study different SKA-VLBI observing scenarios.