Radio Astronomical Interferometry at the Chajnantor Observatory

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Abstract

A number of research activities relevant for the scientific purposes of the astronomical projects at the Chajnantor Observatory are presented. Support for the instrument upgrade for polarization observations and execution of the CBI polarization campaign schedule for CMB observations, contributed to the scientific results in which an 11.7σ detection of CMB polarization from EE angular power spectrum was reported, along with the confirmation of the 180^o phase offset between the TT and EE peaks, as expected from the density/velocity relation of the photon-baryon fluid in the early universe.

A method for the estimation of receiver-based instrumental polarization with application to radio-interferometers is shown. The use of early CBI polarization observations as the input for the method showed consistent results and good stability of the solutions over long periods of time. Given that the unknowns of the system are added in the model, the method is susceptible to overestimation of the solution in the presence of outliers. A technique that isolate the outliers, solves the system in a clean manner and then calculates the outlying values, gave good and consistent results. With the help of this method we have learnt that in certain periods, complete receivers or some receiver/channel pairs shouldn't be considered for further polarization analysis.

The design and complete commissioning of the CBI2 antennas is presented. Numerical methods and techniques to correct for individual antenna pointing errors and main beam asymmetries are proposed and applied. Final results of the commissioning stage showed average pointing errors of about $1'$ and round beams. The validation of the performance of CBI2 antennas is done by using mosaic observations of IC443 supernova remnant, and comparison of the derived maps

with CBI1 observations and maps from other telescopes at lower frequencies. The morphological features seen in CBI1 and CBI2 maps agree with the ones from observations at lower frequencies, which is only possible if the remnant is well detected by the instrument in both configurations (CBI1 and CBI2).