



The ngEHT Analysis Challenges: Key Science, Traceability, and Algorithm Development for the Next-Generation EHT

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The Next-Generation Event Horizon Telescope (ngEHT, [1]) will be a transformative enhancement of the Event Horizon Telescope (EHT). The EHT is the very long baseline interferometry (VLBI) array which has imaged the supermassive black holes in the center of M87 (M87*, [2]) and in our Galactic Center (Sgr A*, [3]). The ngEHT will deploy ~ 10 antennas at new sites, and will significantly upgrade hardware at existing sites. These developments will result in an array that is capable of reconstructing high-resolution and high-fidelity movies of both EHT main targets and other AGN, at frequencies of 86, 230, and 345 GHz. The data will not only grow in volume and increase in quality, but they will also provide new opportunities to extract information from the frequency and time domains. Algorithmic development for the extraction of scientific information from the rich ngEHT datasets will thus be essential.

To foster this algorithmic development, we are organizing the ngEHT Analysis Challenges [4]. For each Challenge, we generate synthetic ngEHT datasets that are made available for anyone to analyze, with the aim of maximizing the science output. Analysis typically consists of image and movie reconstructions, model fitting, and/or black hole and accretion parameter estimation. Submitted results are then compared qualitatively and quantitatively across participants and methods.

For each Challenge, the ground-truth source models and observational setup are selected to focus on specific ngEHT science cases. Challenge 1 and 2 focused on image and movie reconstructions of Sgr A* and M87*, and they have demonstrated the ngEHT's ability to image the rapid variability of Sgr A* and the extended jet emission of M87* under realistic observing conditions. Challenge 3 focuses on polarization reconstructions, and Challenge 4 will focus on black hole parameter estimation. The Analysis Challenges have led to significant development of several imaging algorithms, have refined the ngEHT key science goals, and have brought together global expertise in theoretical source modeling, (synthetic) observations and calibration, and source reconstruction and science extraction techniques.

References

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