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Two H_2O MegaMasers at High Resolution

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The RadioAstron Space-VLBI mission has successfully detected extragalactic H_2O MegaMaser (MM) emission regions at space-Earth baselines ranging between 1.4 and 26.7 Earth Diameters (ED). The results for two galaxies, NGC 3079 and NGC 4258, indicate unexpected and distinctly different masering environments and excitation conditions in these galaxies.

The high-brightness maser components in the H_2O MM NGC 3079 form an arc that is offset from the triple components of the Compact Symmetric radio Object (CSO) at the nuclear center. The maser components in the offset arc-structure appear to result from a shocked region in the nuclear ISM that is also seen in blue-shifted OH and HI absorption components. The cross-correlation spectrum of NGC 3079 on a 2.3 ED space-Earth baseline shows features with a line strength that is significantly lower than obtained on the terrestrial baselines and no detections have been made at any longer baselines. The decrease in strength of the detected features and the absence of further detections at longer baselines would indicate that the maser emission is mostly extended at a 2.3 ED baseline, and appears completely resolved at longer baselines.

The H_2O MM emission regions in NGC 4258 are confined to a nearly edge-on disk of 0.5 pc surrounding the nuclear AGN with a CSO radio structure. The orbiting molecular regions within the disk drift in front of the southern part of the CSO radio continuum and amplify this continuum. The H_2O MM emission of NGC 4258 has been detected with space-Earth baselines up to 26.5 ED, which constitutes a record resolution of 8 micro-arcseconds or a spatial resolution at the galaxy of 60 AU inside the 0.5 pc disk. At shorter space-Earth baselines the spectra show a multi-component profile that resemble those obtained with terrestrial baselines. At longer baselines these components are isolated and regularly spaced because the diffuse emission will be resolved, and only the high brightness and compact components remain unresolved. The mere detection of such compact maser components in NGC 4258 and their regular spacing highlight the special conditions of the masering activity inside the accretion disk. Furthermore, more compact masering regions are a good place to detect organized magnetic fields by means of their polarization properties.