The birth of a telescope 30 times larger than Earth

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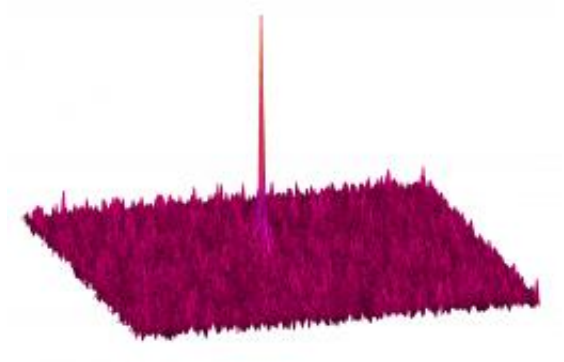
Artist's impression of Spektr-R, the 10-meter space-borne antenna of the RadioAstron project. Credit: Lavochkin Association

(PhysOrg.com) -- On 15 November 2011, the Effelsberg 100-meter radio telescope, together with three Russian and one Ukrainian telescope, took part in the first interferometric observations with the orbiting 10-meter antenna Spektr-R of the Russian RadioAstron project. The observations were made at a wavelength of 18 centimeters, targeting the distant, bright, and very compact quasar 0212+735. Interferometric signals have been successfully detected by the RadioAstron team between Spektr-R and the ground antennas, setting a new world record for the size of a radio interferometer and opening a new era in interferometric studies of cosmic radio emission.

The technique of very long baseline interferometry, which has already set a number of world records in astronomy, now enters an entirely new era signaled by a successful detection of interferometric signals ("fringes") made in observations performed with the 10-meter space-borne antenna Spektr-R of the RadioAstron project, three 32-meter antennas of the Russian QUASAR Network, the Ukrainian 70-meter antenna in Evpatoria, and the German 100-meter radio telescope in Effelsberg. The detection was made on 15 November 2011, with observations performed at a wavelength of 18 centimeters and targeting bright and extremely compact radio emission from the distant quasar 0212+735.



First interferometric signal ("fringe") between Spektr-R and the Effelsberg 100m radio telescope. Credit: Astro Space Center of Lebedev Physical Institute, Russian Academy of Sciences

"These fascinating results confirm our expectations that we will be able to probe with RadioAstron the conditions in the innermost regions of quasars with unprecedented detail", says Anton Zensus, director at the Max-Planck-Institut für Radioastronomie in Bonn and head of the institute's "Very Long Baseline Interferometry" (VLBI) research group. "The weak signals from such systems require the coordinated use of the

most sensitive radio telescopes available such as the 100-m dish in Effelsberg."

In order to perform these observations, data from the space antenna of RadioAstron were recorded on-board and sent to the satellite tracking antenna in Puschino, Russia. These data have been subsequently combined with recordings made at ground-based radio telescopes participating in RadioAstron observations. This is done at a special RadioAstron correlator facility in Moscow. The RadioAstron correlator performs searches for correlations (or interferometric fringes) between the signals recorded at two or more antennas. Using these correlations, images of distant cosmic objects can be reconstructed at a resolution that would have been achieved with a telescope as large as the largest distance between the antennas participating in observations.

The satellite was about 100,000 km away from Earth during the observations of the quasar 0212+735. Planned observations with SpectR will extend out to 360,000 kilometers from the Earth, thus creating a telescope which is effectively 30 times larger than the size of our planet. This kind of telescope will achieve a resolution as fine as 1/100,000 of a second of arc. This resolution is sufficient for measuring the size of a one cent coin on the surface of Moon and reaches within a factor of two of the scale of the event horizon in the supermassive black hole in the center of our Galaxy.

"The RadioAstron team is very excited to get the first interferometric signals", says RadioAstron scientist Yuri Kovalev from Astro Space Center in Moscow. "This achievement confirms a successful operation of the extremely complex system and is a milestone that allows us to move forward to an extensive science program involving radio telescopes located throughout the world."

This exciting new capability promises to help tackling some of the most

puzzling problems in astrophysics, including the origin of the most energetic particles in the Universe and the nature of supermassive black holes.

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