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Relativistic Astrophysics with ALMA

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The Atacama Large Millimetre/Sub-millimetre Array, ALMA, is the leading instrument for observations in the frequency range from 35 to 950 GHz. It is an aperture-synthesis array consisting of 66 antennas of 12 and 7m diameter equipped with sensitive receivers located at 5000m altitude on the Chajnantor Plateau in Northern Chile. ALMA is just entering its third observing cycle and is producing transformational science in many areas of astronomy. I will review ALMA's current and potential contributions to relativistic astrophysics, including the estimation of magnetic fields in accretion disks and the derivation of physical parameters in jets. ALMA is currently being upgraded to act as a phased array, in which the signals from 50 of its antennas are combined to give the equivalent of a single dish with a diameter of 84m. This will allow it to be used as an element of a very sensitive global Very Long Baseline array with a resolution of 10's of microarcsec at 230 and 345 GHz. Imaging of the event horizon shadows around the black holes in the Galactic Centre and M87 will become possible for the first time, leading to stringent tests of General Relativity. The jet launching zone in nearby radio galaxies such as M87 and Centaurus A will be resolved and imaged. Phased ALMA alone will enable complementary tests of General Relativity by finding and timing millisecond pulsars orbiting the Galactic Centre black hole.

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