RadioAstron Observations
of Pulsars and Interstellar Scattering

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We describe RadioAstron observations directed to understand interstellar scattering by studies of pulsars. The RadioAstron project is an international collaborative mission involving a free-flying satellite, Spektr-R, carrying a 10-m space radio telescope on an elliptical orbit around the Earth. This space telescope performs radio astronomical observations, using very long baseline interferometry (VLBI) techniques in conjunction with ground-based VLBI networks. The orbit of Spektr-R evolves with time. It has an apogee between 280,000 and 350,000 km, a perigee between 7,000 and 80,000 km, a period of 8 to 9 days, and an initial inclination of 51°. RadioAstron operates at the standard radio astronomical wavelengths of 1.19 to 1.63 cm (K-band), 6.2 cm (C-band), 18 cm (L-band), and 92 cm (P-band).

As compact radio emitters, pulsars display a variety of observables useful for inferring properties of the material responsible for interstellar scattering. In particular, scattering in the interstellar plasma convolves the time series of electric field emitted at the pulsar with a impulse-response function. This impulse-response function changes over a lateral scale at the observer plane, typically over a scale of an Earth diameter. This variation can be sampled directly only by observations with telescopes separated by this scale, as for example by the space radio telescope aboard Spektr-R and an Earth telescope.

We present results of space-Earth VLBI observations of pulsar B0950+08 and the Vela pulsar, at P- and L-band. Individual pulses of both are detected on space-Earth baselines. Pulsar B0950+08 lies within the Local Bubble and is weakly scattered. Its scattering shows similarities to that of intra-day variable extragalactic sources. The Vela pulsar is strongly scattered, by its enclosing supernova remnant. We discuss observations, results, and their interpretation in terms of interstellar scattering for both pulsars.