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The interpretation of broadband data from radio pulsars

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Profiles from radio pulsars typically show a strong dependence on observing frequency. This depends both on the intrinsic radio emission mechanism, as well as the interaction of the radio waves with the interstellar medium (ISM) that lies between the pulsars and our detectors on Earth, due mostly to the effects of dispersion and scattering. The aim of our project is to study how to best extract information on pulsar profiles and the ISM, using the wide frequency bands that are typical of radio telescopes today. We make use of radio pulsar emission models to simulate pulse profiles. Basic radio pulsar geometry is used, assuming that pulsar emission comes from a set of open magnetic-field lines above the neutron star's surface, with high frequencies emitted in regions closer to the neutron star and low frequencies from high altitudes further up the field lines. Depending on the line-of-sight cut and the radio frequency of observation, which are both chosen for each simulation, the generated profile may comprise of overlapping components that are approximated to first order as Gaussians. With this information we simulate pulse profiles representing data from telescopes observing at various centre frequency bands, covering bands from 30 MHz up to 1.7 GHz, and with a variety of corresponding bandwidths for each pulsar beam model. The results show that intrinsic profile evolution with frequency can be interpreted as an additional component to the dispersion measure (DM), the frequency dependent delay of the radio emission normally associated with dispersion in the ISM. In addition, this DM correction will be frequency dependent, unlike the ISM induced DM. We discuss the systematics introduced to pulsar data due to this effect.

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