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3.2 mm lightcurve observations of (4) Vesta and (9) Metis with the Australia Telescope Compact Array

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(4) Vesta and (9) Metis are large main-belt asteroids with high albedos. There are strong indications for heterogeneous surfaces for both targets from imaging techniques in the visible and near-IR range, very likely connected to impact structures. Despite that, the thermal spectral energy distributions from mid-IR to the mm-range have, until now, been consistent with a homogeneous regolith-covered surface and the thermal light-curves are dominated by the shape and spin vector properties. With millimetre-observations at 93.0 and 95.5 GHz we tried to characterise the emission properties of the surface material. The coverage of the full rotation period allowed a detailed study of the heterogeneity of the surface. We combined our carefully-calibrated mm-observations with sophisticated thermophysical modelling techniques. In this way it was possible to derive emissivity properties and to disentangle the effects caused by shape, albedo or various thermal properties. The rotationally averaged fluxes are explained very well by our thermophysical model techniques when using an emissivity in the mm-range of about 0.6 for (4) Vesta and about 0.7 for (9) Metis. The mm-lightcurves follow for a large fraction of the rotation period the shape-introduced variations. The rotational phases with clear deviations are connected to structures which are visible in the HST images of (4) Vesta and the Keck AO-images of (9) Metis. The observed lightcurve amplitudes are peak-to-peak $\sim$30% for (4) Vesta and $\sim$25% for (9) Metis, while the shape-related amplitudes are only 5 and 4%, respectively. The emissivities at mm-wavelengths are lower than in the far-IR, confirming that particles with sizes of about 100 μm influence the mm-behaviour. Previously identified bright spots at visible/near-IR wavelength are connected to sharp emissivity drops. The dark Olbers region on (4) Vesta causes an excess in mm-emission on top of the shape intro-

duced light-curve. The thermophysical model predictions match the overall flux levels very well, but cannot reproduce certain lightcurve features due to the lack of information on the grain size distribution. The 3-mm observations are very powerful for the study of surface heterogeneities.