Thermal inertia of binary near-Earth asteroids

B. Rozitis[1], E. C. Brown[2], S. F. Green[1], S. C. Lowry[3], A. Fitzsimmons[4], A. Rozek[3], C. Snodgrass[1], P. Weissman[5], and T. Zegmott[3]

[1] School of Physical Sciences, The Open University, Milton Keynes, MK46 5BE, UK
[2] Department of Physics, University of Oxford, Clarendon Laboratory, Parks Road. Oxford OX1 3PU, UK
[3] School of Physical Sciences, University of Kent, Canterbury, CT2 7NH, UK
[4] School of Mathematics and Physics, Queens University Belfast, University Road Belfast, BT7 1NN, UK
[5] Planetary Science Institute, 1700 East Fort Lowell, Suite 106, Tucson, AZ 85719-2395, USA.

`contact e-mail:` *simon.green@open.ac.uk*

Binary asteroids represent ~15% of the NEA population. Most primary bodies in NEA binaries have low bulk density (~1-2 g cm^{-3}), high macro-porosity (~40-60 %), rapid rotation (P~2-4 h) and 'spinning-top' shapes, with secondary orbit characteristics consistent with models of formation through YORP-induced mass loss. Delbo et al. [Icarus 212, 138-148, 2011] used a distribution of 12 NEATM beaming parameters of 8 binary NEAs to infer a mean thermal inertia of 480±70 in SI units (J m^{-2} K^{-1} $s^{-0.5}$) more than double the mean value of 200±40 inferred in equivalent work for solitary NEAs [Delbo et al. Icarus 190, 236-249, 2007] and suggest that binary NEAs preferentially have large regolith grains on their surfaces. However, our previous work involving full thermophysical modelling for 3 binary NEAs, i.e. (1862) Apollo [Rozitis et al. AA 555, A20, 2013], (175706) 1996 FG3 [Wolters et al. MNRAS 418, 1246-1257, 2011], and (276049) 2002 CE26 [Rozitis et al. MNRAS 477, 1782-1802, 2018], found a much lower mean thermal inertia of ~140. To resolve this apparent discrepancy, we determined the thermal inertia of an additional 4 binary NEAs ((3671) Dionysus, (66391) 1999 KW4, (153491) 2001 SN263, and (185851) 2000 DP107) using thermal-infrared observations from NEOWISE, Spitzer and VLT VISIR, a thermophysical model (ATPM: Rozitis & Green, MNRAS 415, 2042-2062, 2011) and previously published shape models and pole orientations. For these 7 binary NEAs we find an average thermal inertia of 150±50. This is at the lower end of the average of 385±225 determined for 12 solitary NEAs using thermophysical modelling [Delbo et al. Asteroids IV, University of Arizona Press, 107-128, 2015], and is significantly less than the value for binaries of 480±70 derived using NEATM analysis. Our results imply that fine-grained regolith is preferentially kept during the formation of binary asteroids by YORP spin-up.