SHAPES AND SPIN-AXIS DIRECTIONS OF MEMBERS OF ASTEROID PAIRS. J. Ďurech[1], P. Pravec[2], P. Fatka[2], P. Scheirich[2], D. Vokrouhlický[1] and J. Hanuš[1], [1]Astronomical Institute, Faculty of Mathematics and Physics, Charles University, V Holešovičkách 2, 180 00 Prague 8, Czech Republic, [2]Astronomical Institute, Academy of Sciences of the Czech Republic, Fričova 1, 25165 Ondřejov, Czech Republic.

Introduction: In [1], we recently published results of our photometric survey of 93 asteroid pairs. Among other results, we derived rotation periods for all primaries and some secondaries and estimated mass ratios of components from their absolute brightness differences. Here we concentrate on those pairs for which we derived also a spin-axis direction and convex shape model of one or both pair members.

Modelling: Shapes and spin states of selected asteroids were reconstructed using the lightcurve inversion method of [2]. To reconstruct these physical parameters uniquely, enough lightcurves covering various observing geometries have to be available, which means observations covering several apparitions. Due to a limited number of lightcurves for most of the studied asteroids, we were able to derive unique models only for 19 asteroids belonging to 17 pairs. In four cases of these, the primaries are binary asteroids and the spin-axis direction was derived from analysis of mutual events assuming that the spin axis is perpendicular to the orbital plane of the secondary [3].

For asteroids (1741) Giclas, (2110) Moore-Sitterly, and (4905) Hiromi, we used also thermal infrared data from the WISE satellite [4, 5] and applied a thermophysical modelling [6, 7] to derive their size, thermal inertia, and surface roughness.

Results: Out of the 17 pairs, 7 are prograde and 10 retrograde, which is not a statistically significant difference. There is an apparent concentration of spin-axis directions to poles of ecliptic, which is similar to concentration of poles of main-belt binaries [8].

For pairs (2110) Moore-Sitterly – (44612) 1999 RP27 and (6070) Rheinland – (54827) Kurpfalz, we have information about spin direction of both components. In both cases they have the same retrograde sense of rotation. For (2110)–(44612), the pole 3σ uncertainty intervals overlap, see Fig. 1. They also have not evolved far apart from each other since the origin of the system and the current configuration is consistent with them being colinear at the time of separation 2 Myr ago. On the contrary, the pole uncertainty intervals for (6070)–(54827) do not overlap and the spin directions were different also at the time of separation 16 kyr ago (according to [9]).

Determining the current spin-axis orientation is important for reconstructing the initial conditions of these systems, which can constrain theoretical models of creation of asteroid pairs. However, to reconstruct initial spins can be impossible in practice for prograde rotators as they are influenced by spin-orbital resonances and their obliquity may chaotically evolve over time, as is the case of (4765) Wasserburg, for example.

Conclusion: Primaries of asteroid pairs are sometimes also binary or triple systems. Reconstructing physical properties of asteroid pairs through photometric observations will help us to unveil a complex picture of how binaries, multiple systems, asteroid pairs, and asteroid clusters are related to each other.

Acknowledgements: This work was supported by grant 17-00774S of the Czech Science Foundation.

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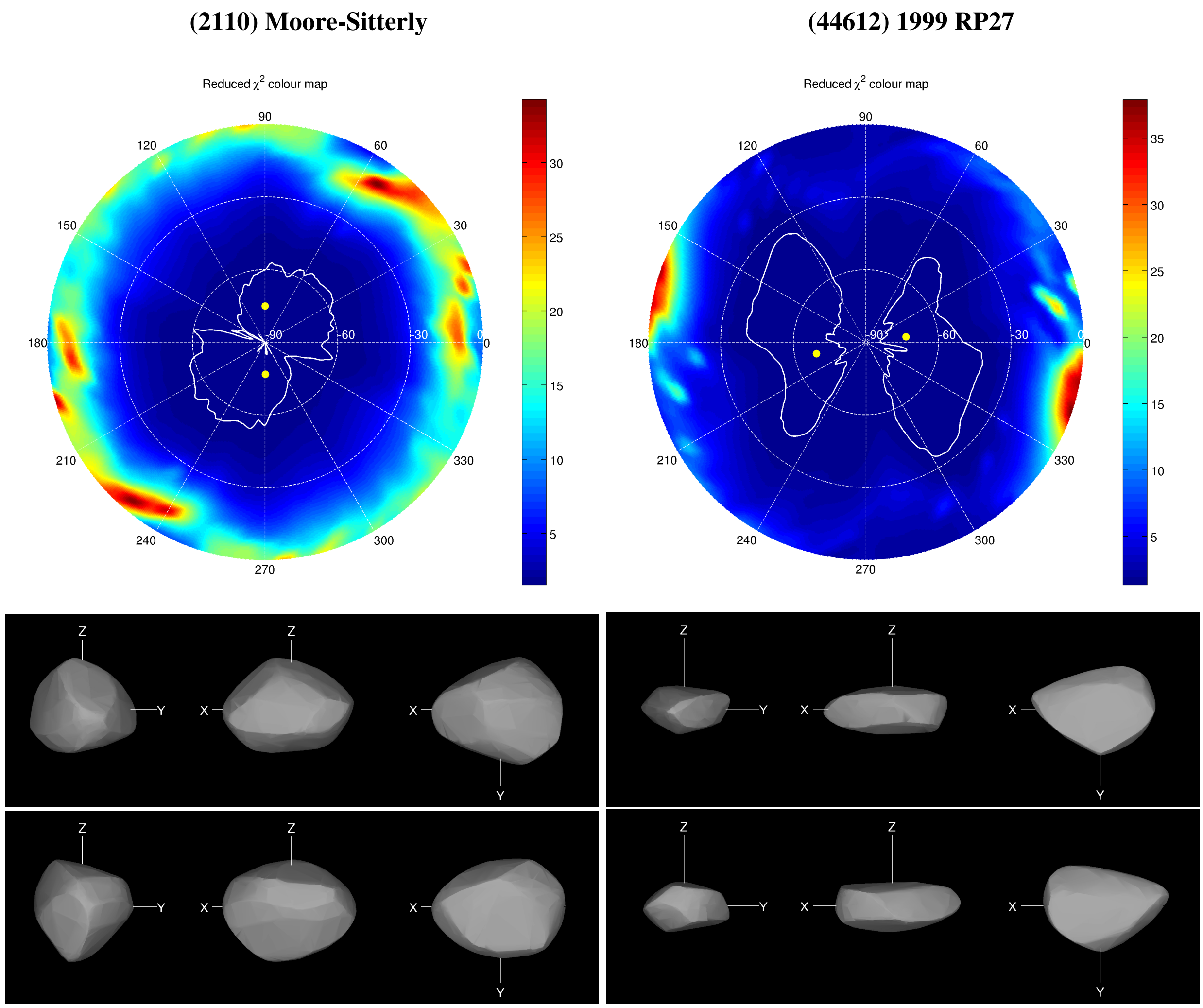

Figure 1: Two nominal spin pole solutions for (2110) Moore-Sitterly (*left*) and (44612) 1999 RP27 (*right*) are shown as yellow dots in ecliptic coordinates polar plot. The 3-σ pole uncertainty areas are shown as white boundaries. In bottom panels, shape models for two pole solutions are shown.