Occultations as a tool for creation and validation of asteroid models

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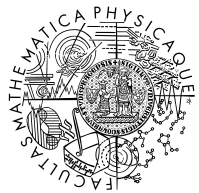

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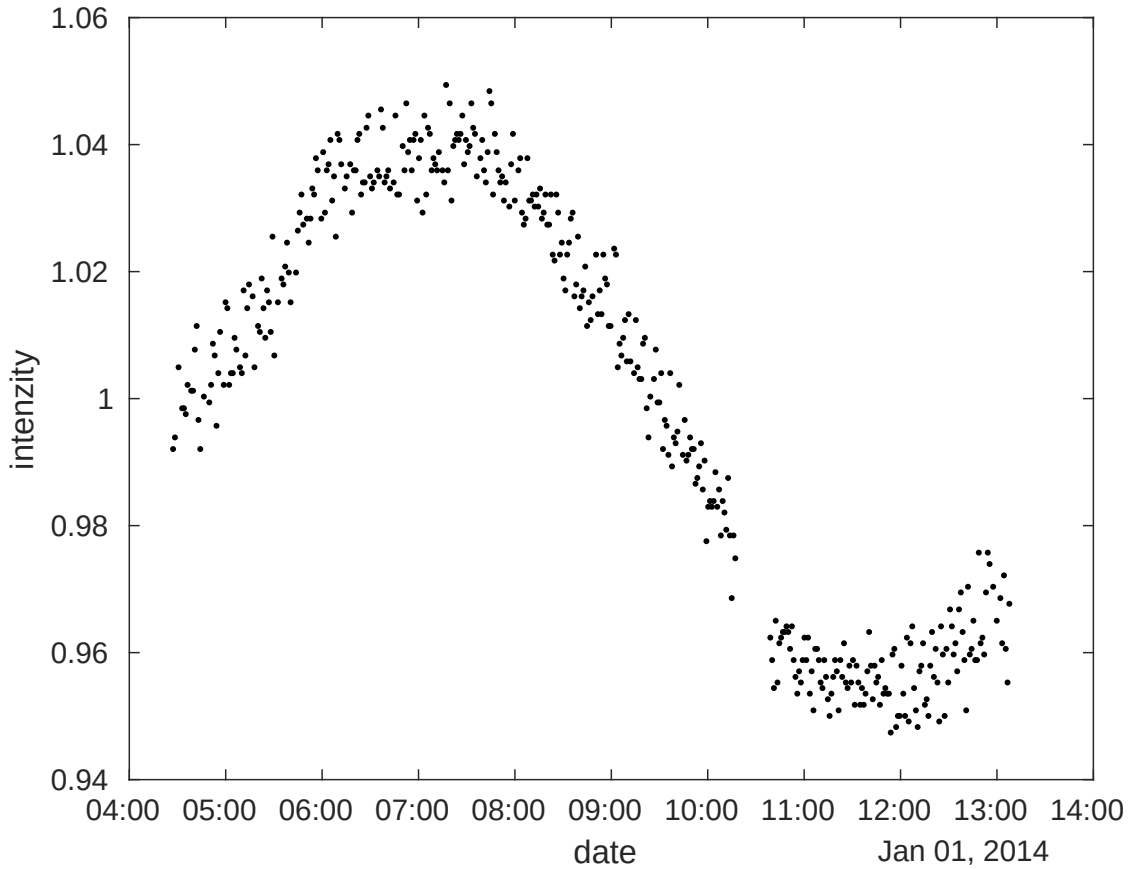
Asteroids and their shapes

- Most numerous group in Solar system
- Their size makes them hard to observe
- Most asteroids only lightcurves

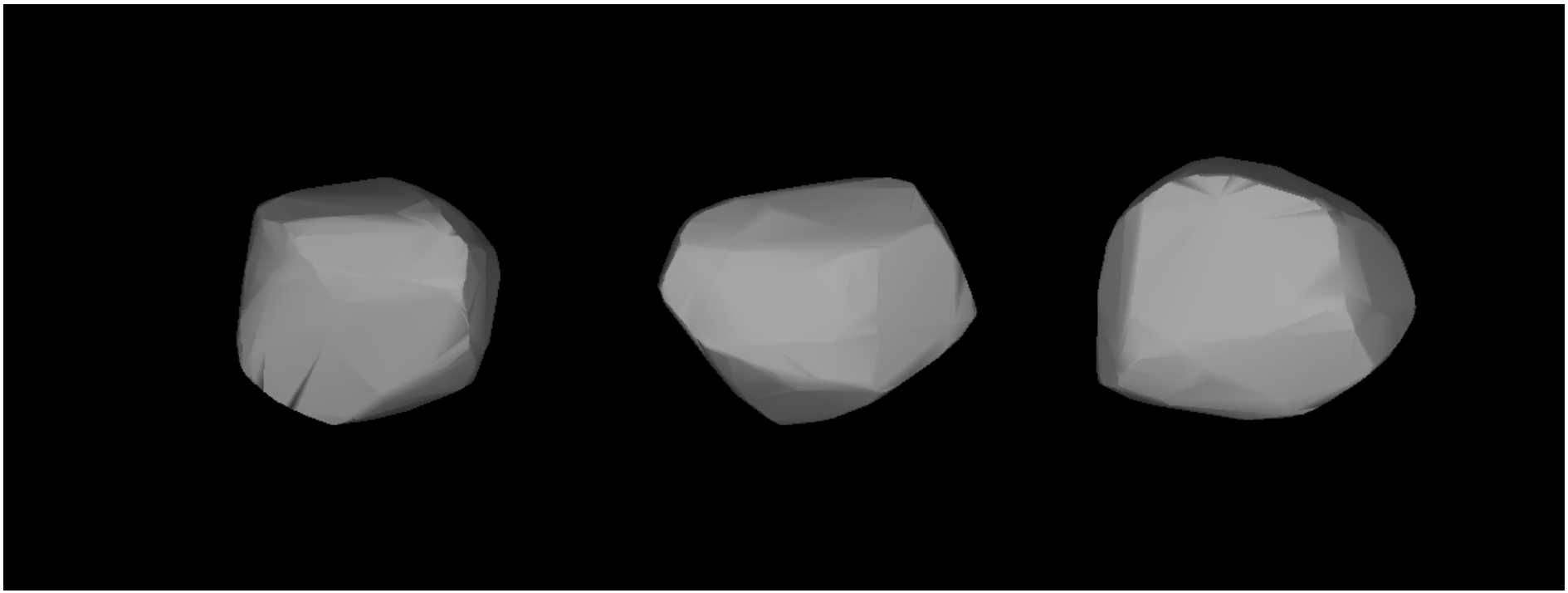


Models from light curves

- The most common way of creating models of asteroids.
- Determine period, position of pole and shape
- Needed lots of light curves
- Often ambiguous in pole
- Mostly convex shapes
- Uncertainty in size

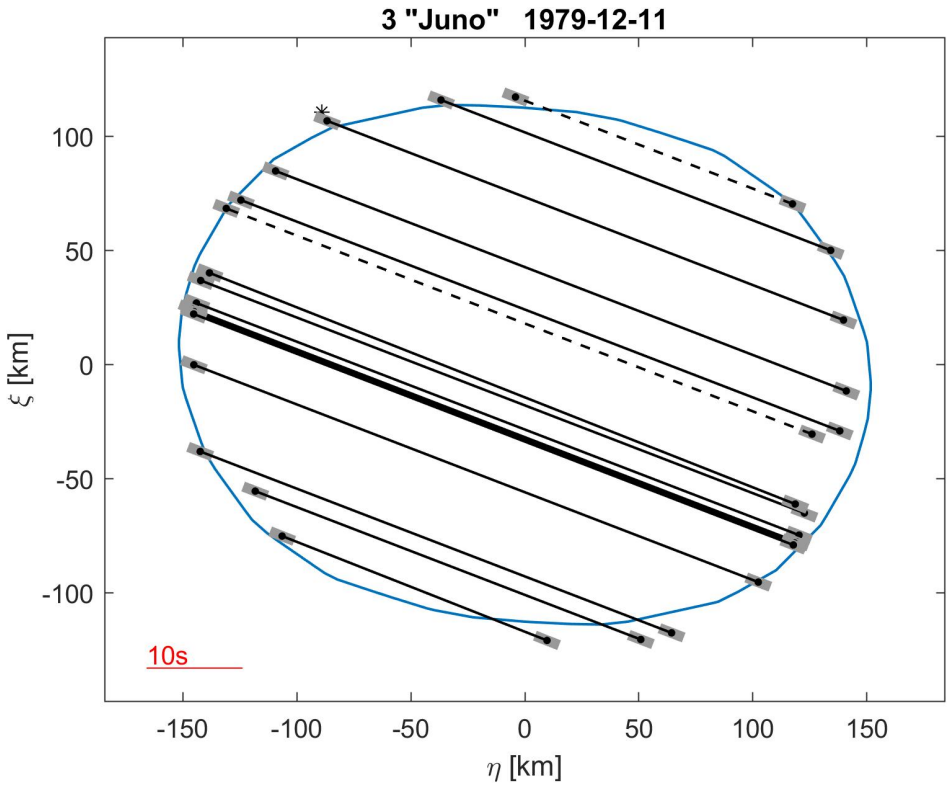
Models from light curves

- DAMIT (Database of Asteroid Models from Inversion Techniques) (Durech a kol., 2010)



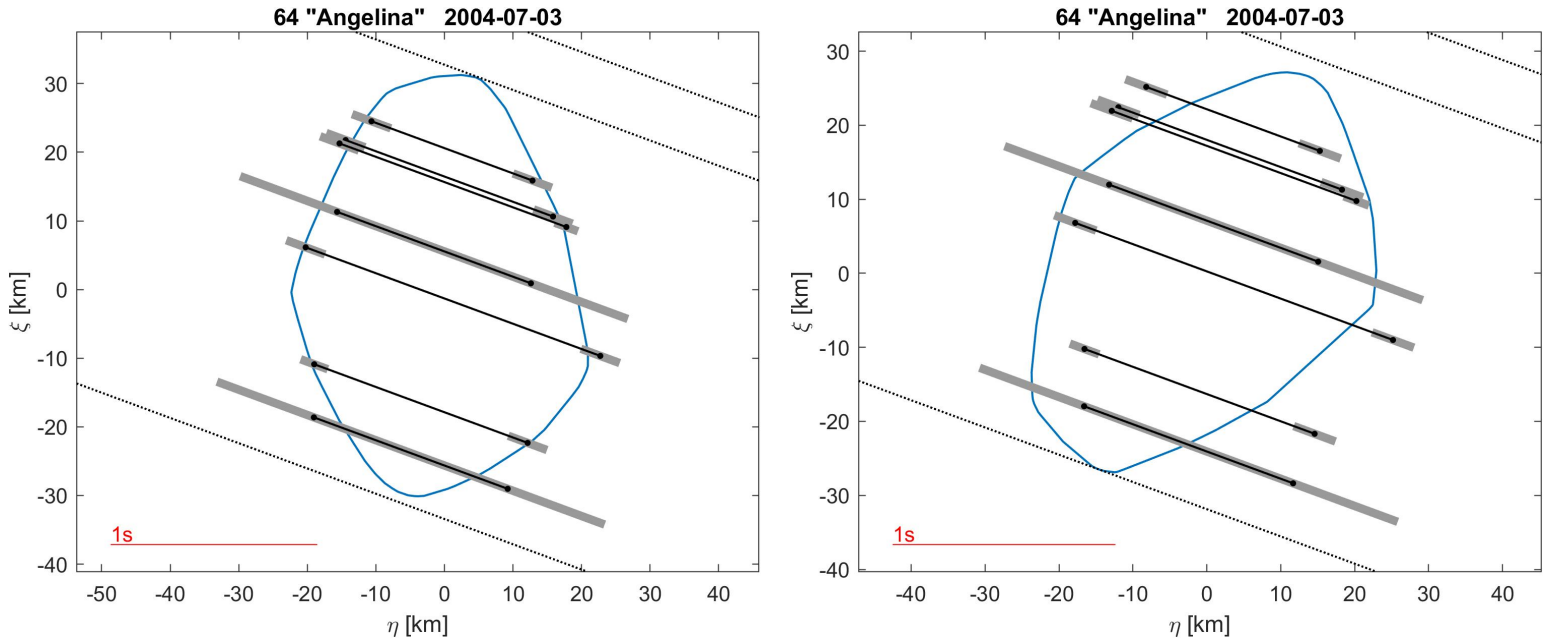
Improvement of models

- Fit model to occultation
- Free parameters are size and position
- Determine dimensions
- Use only occultations with 3 or more observers



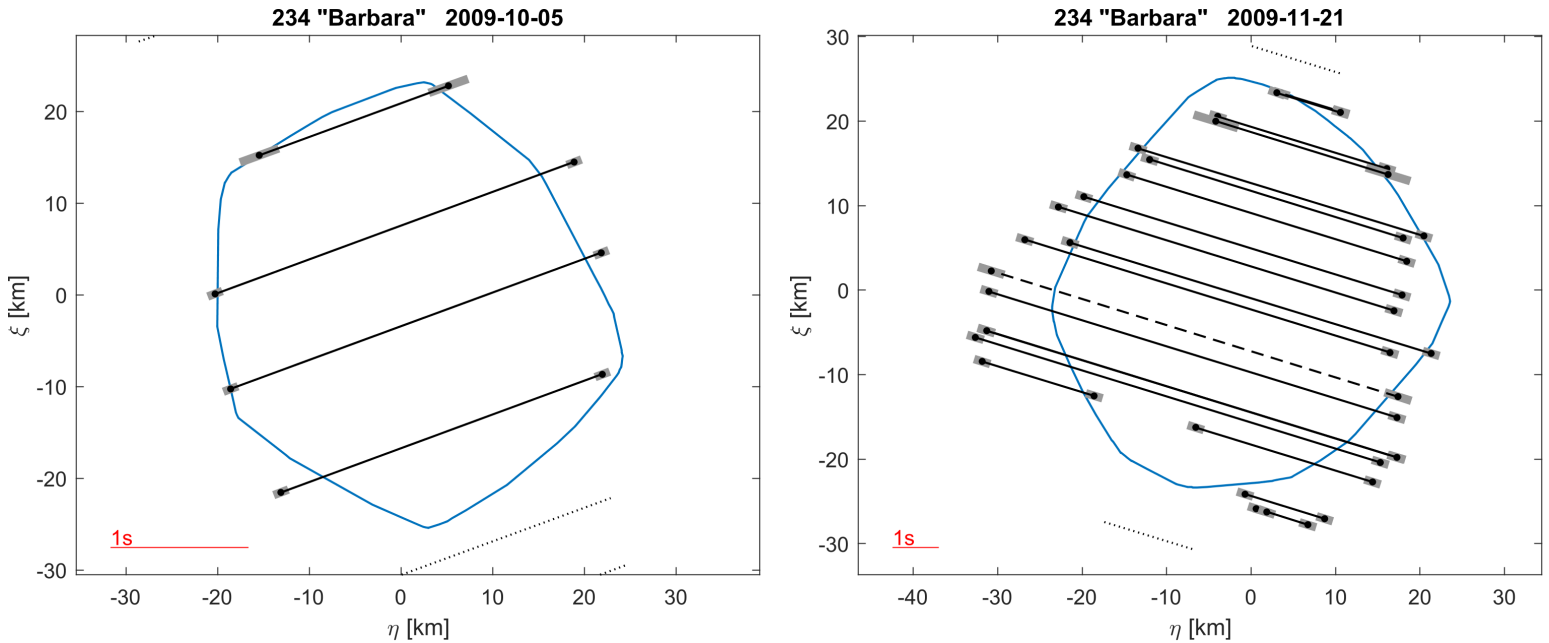
Improvement of models

- Solve pole ambiguity
- Needed occultation with the right rotation of asteroid



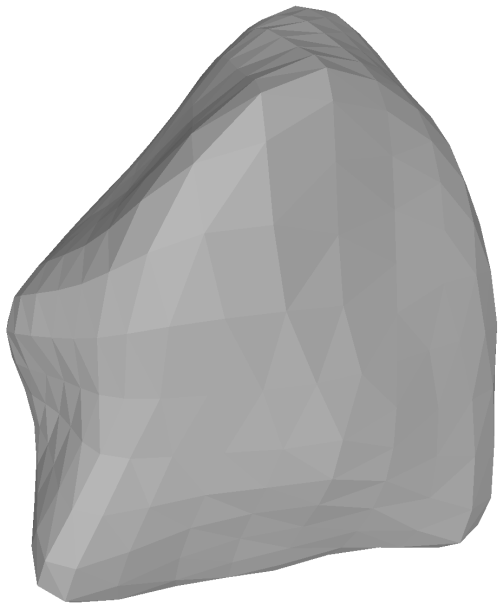
Improvement of models

- Models can be disproved
- Obvious non-convex shape



Using occultations

- Create new model
- Period, pole and intial elipsoid from old model
- Using ADAM with both light curves and occultations



New models

- Use occultation again to verify new model
- Better but not perfect fit
- Another well observered occultation could help

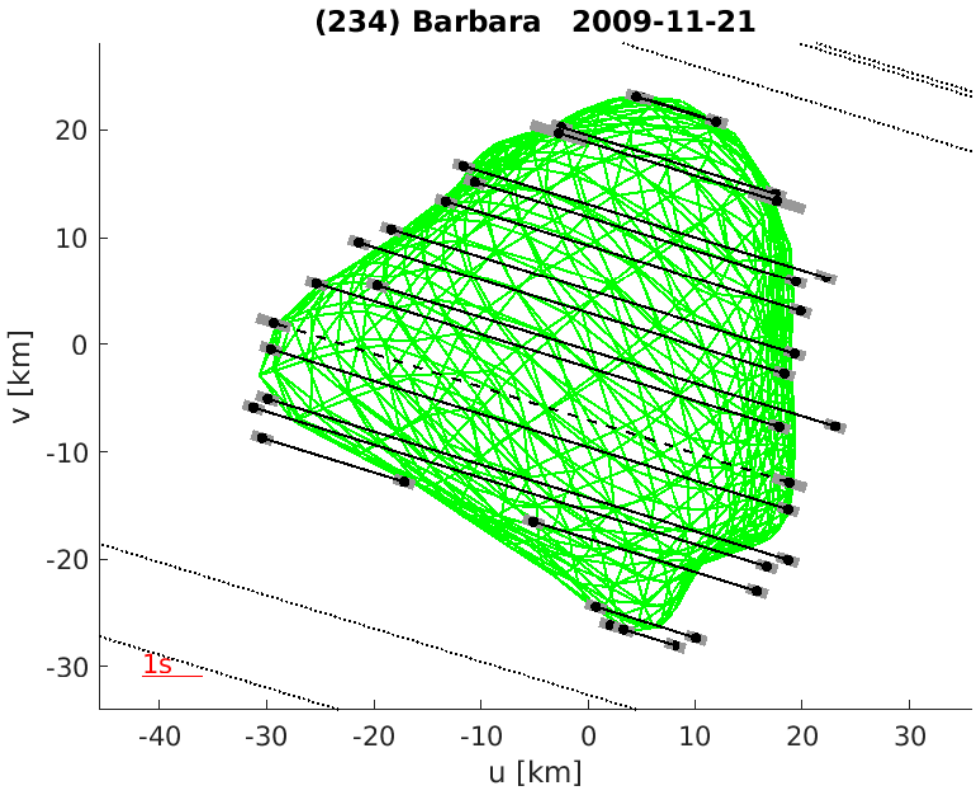
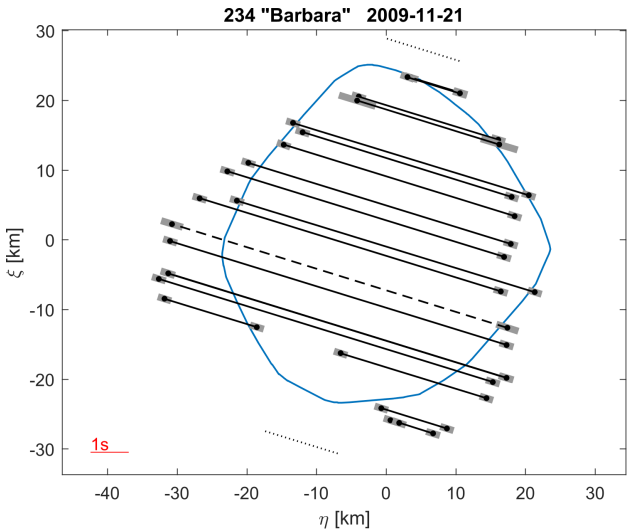
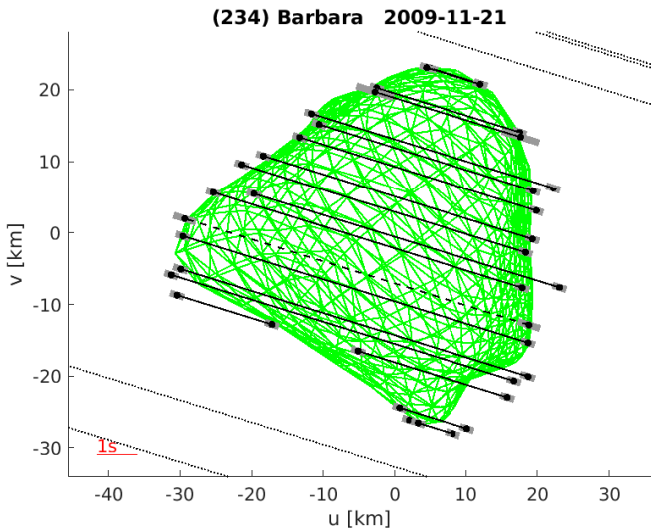
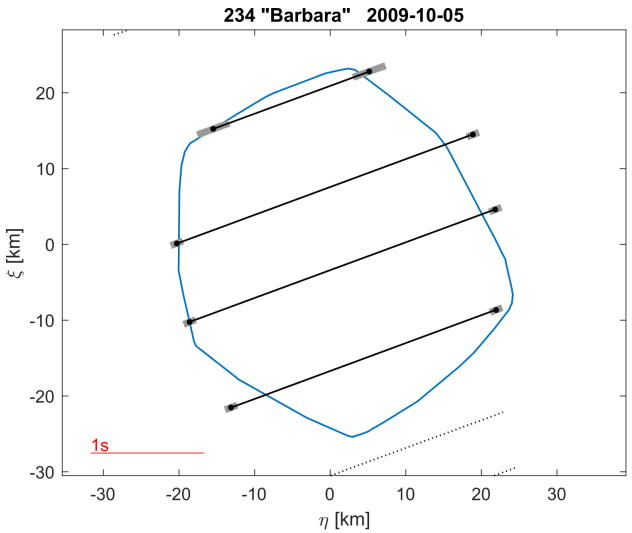


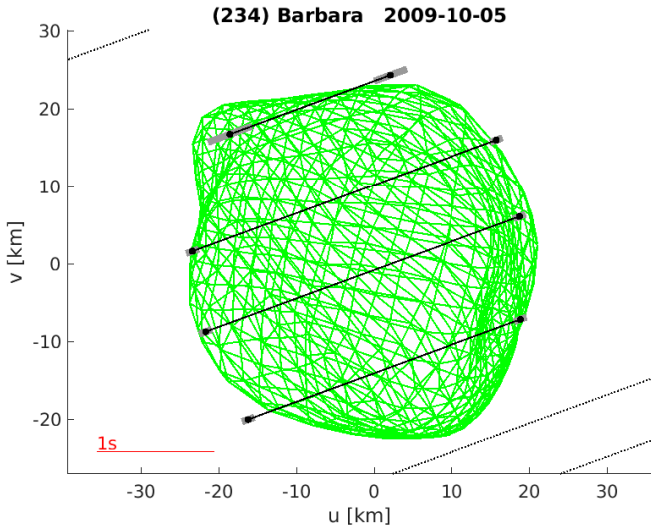
Figure: Projection of occultation and new model of 234 Barbara.

New models


234 "Barbara" 2009-11-21
ξ [km]
η [km]
1s


(234) Barbara 2009-11-21
v [km]
u [km]
1s


234 "Barbara" 2009-10-05
ξ [km]
η [km]
1s


(234) Barbara 2009-10-05
v [km]
u [km]
1s

Future models

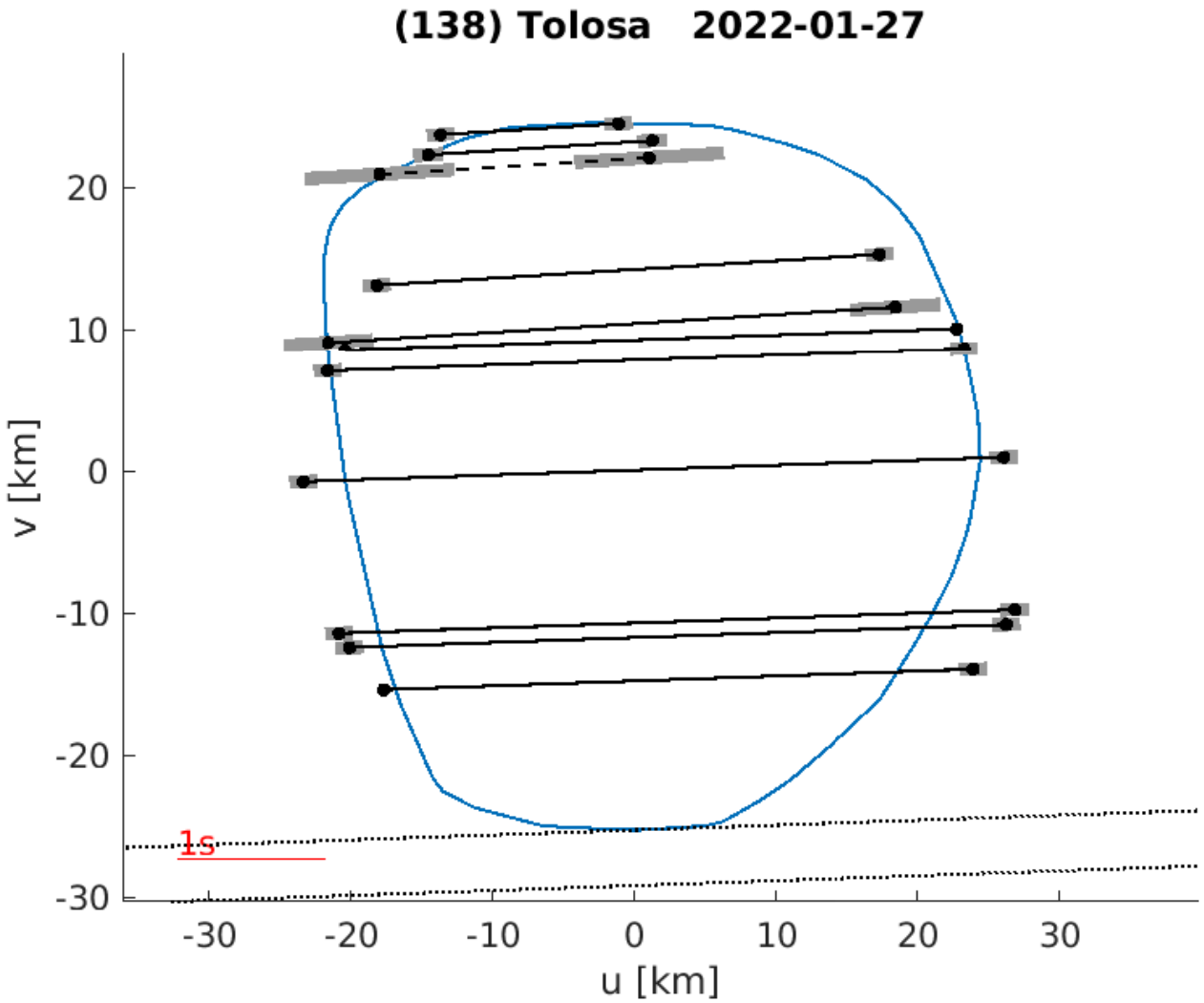


Figure: Projection of occultation by 138 Tolosa and its model.

Future model

- No model (in DAMIT, Marciniak et al. (2023), A&A, in press)
- Few light curves
- Densely observed occultation

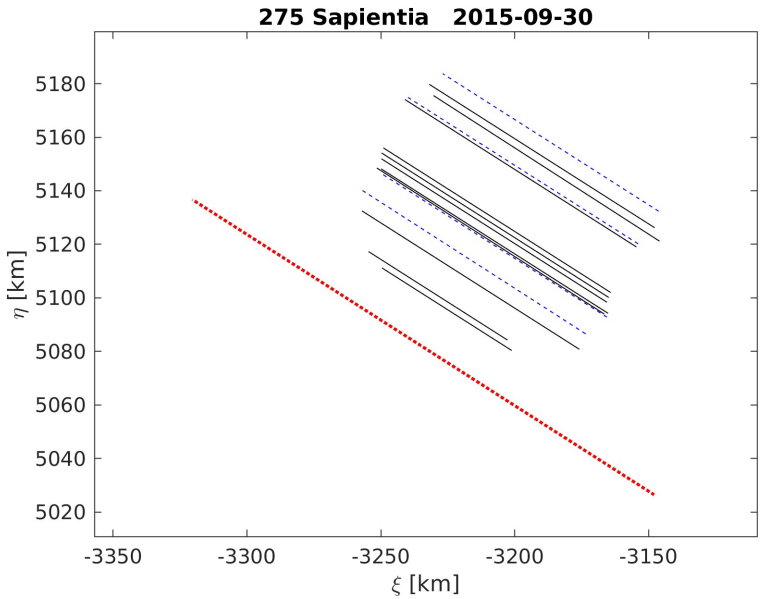
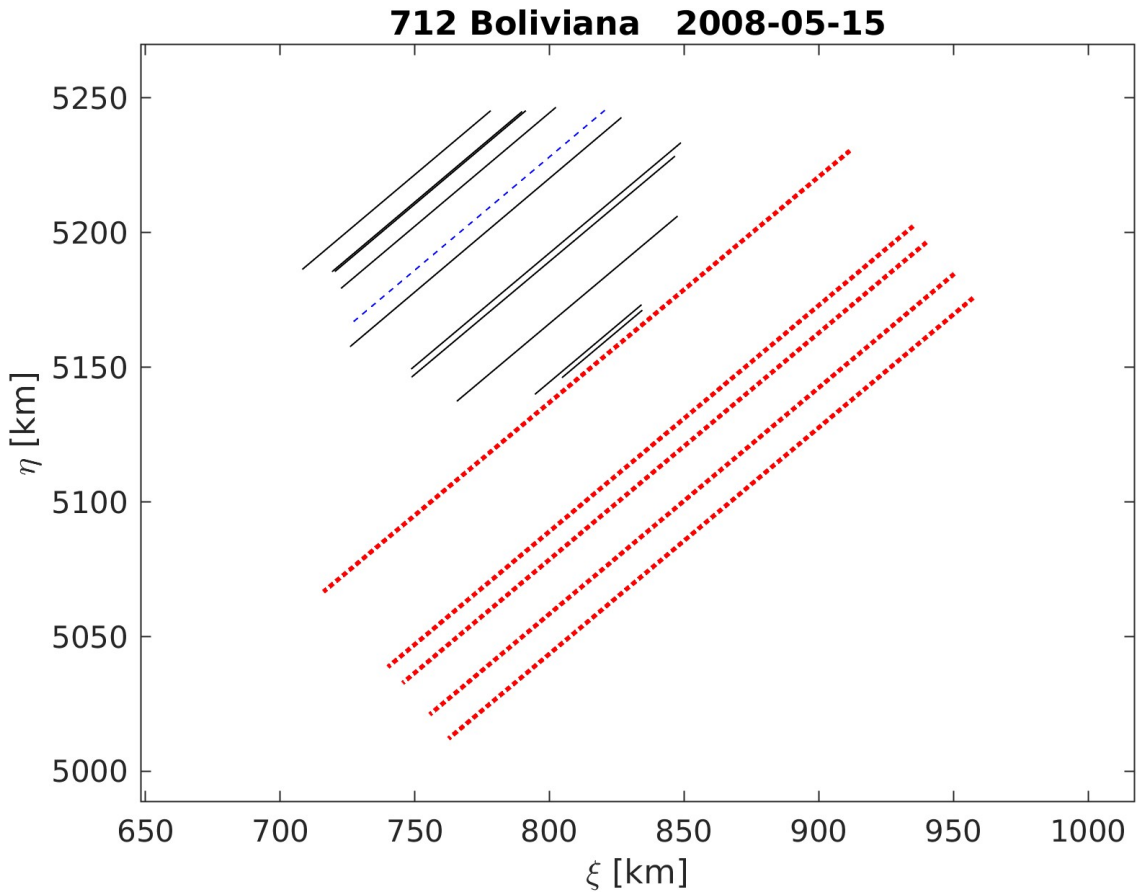


Figure: Occultation by asteroid 275 Sapientia without model.

Future models

- Even fewer light curves



Results

- DAMIT: 16076 models of 10745 asteroids
- At least 3 observer occultations for 274 asteroids
- 516 occultations
- 190 asteroids models correspond with occultation
- 44 had unusefull occultation
- 40 asteroids had noncoresponding model.

Conclusion

- Models from light curves
- Validation with occultations
- New models from both occultations and light curves
- Adding non-convexity and precise dimensions
- Needed enough observers

Durech, J., Sidorin, V. a Kaasalainen, M. (2010). DAMIT: a database of asteroid models. A&A, 513:A46. doi: 10.1051/0004-6361/200912693.