NEA POPULATION AND CURRENT SURVEY STATUS

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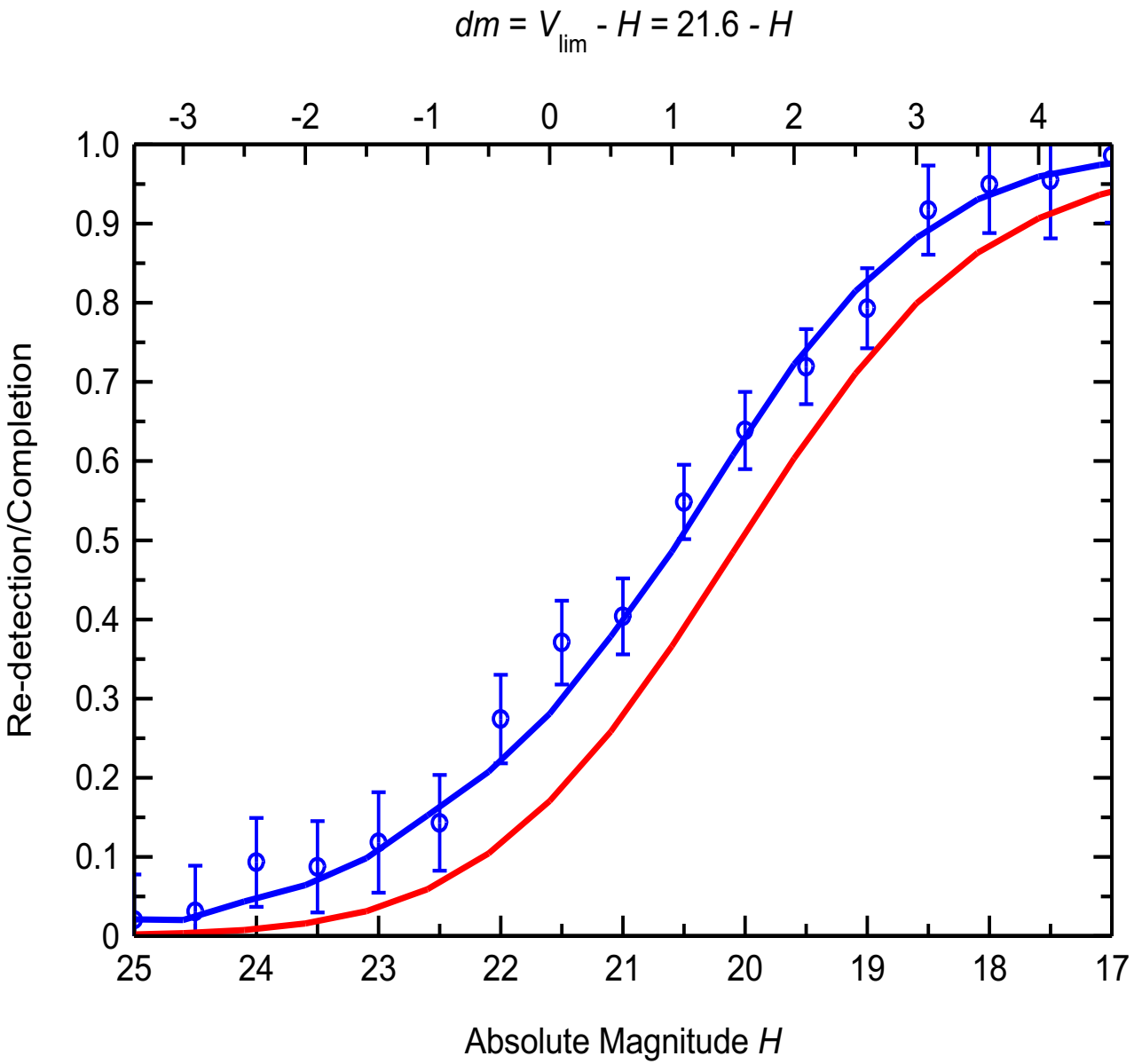
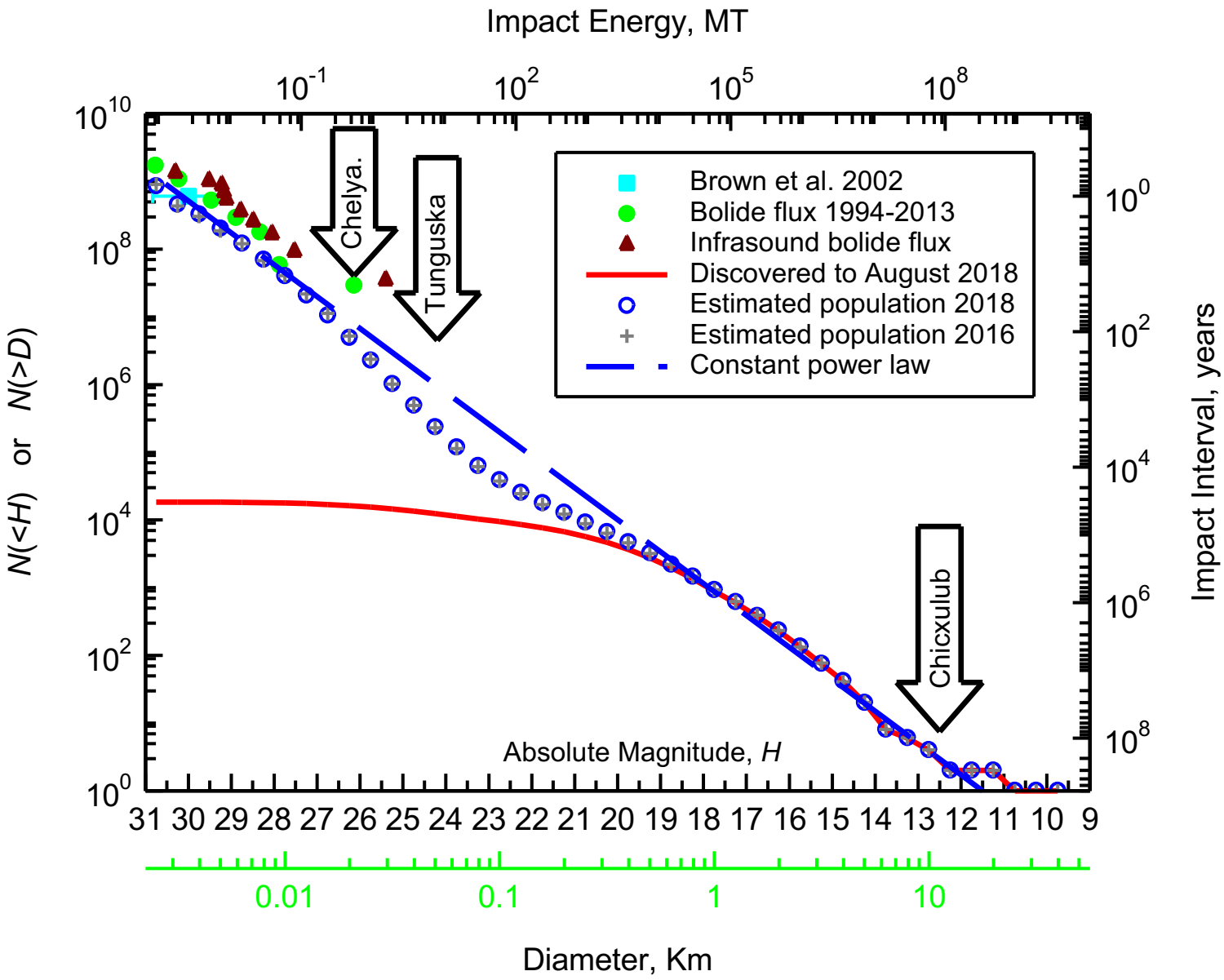
Estimation of Survey Completion



The lines are computer simulation models of re-detection ratio (blue) and completion (red), in units of relative *H* magnitude (top scale). The plot symbols are actual survey redetection ratios for 2016-2018, as a function of *H* (bottom scale). After sliding the scales to best fit the observed re-detections, the completion curve can be taken as survey completion vs. *H*.

Current estimate of NEA population



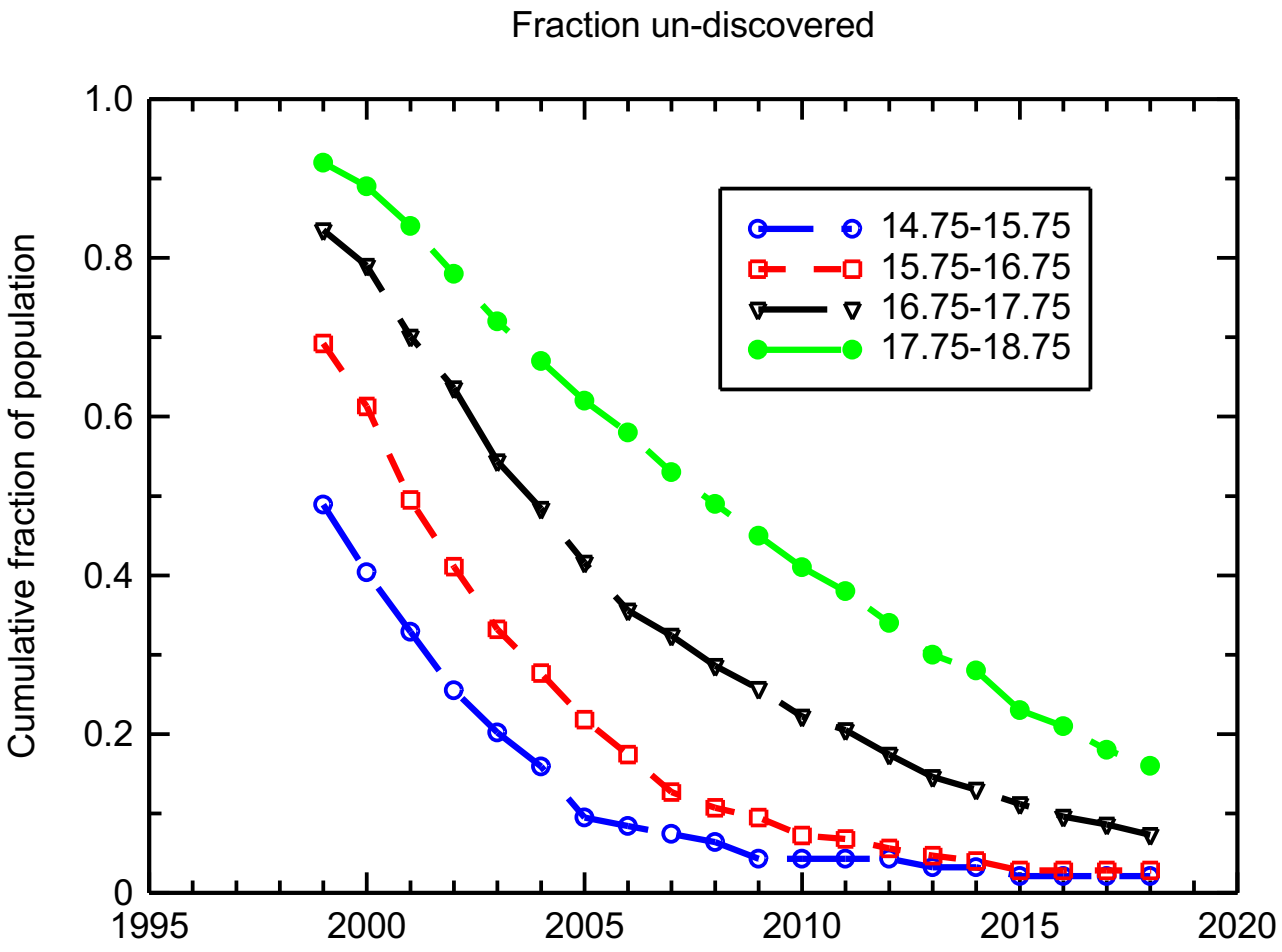
The latest estimate of population, based on re-detections from July, 2016 to July 2018, is satisfyingly boring, differing from the previous 2-year estimate by less than the plot symbol sizes.

NEA population and completion

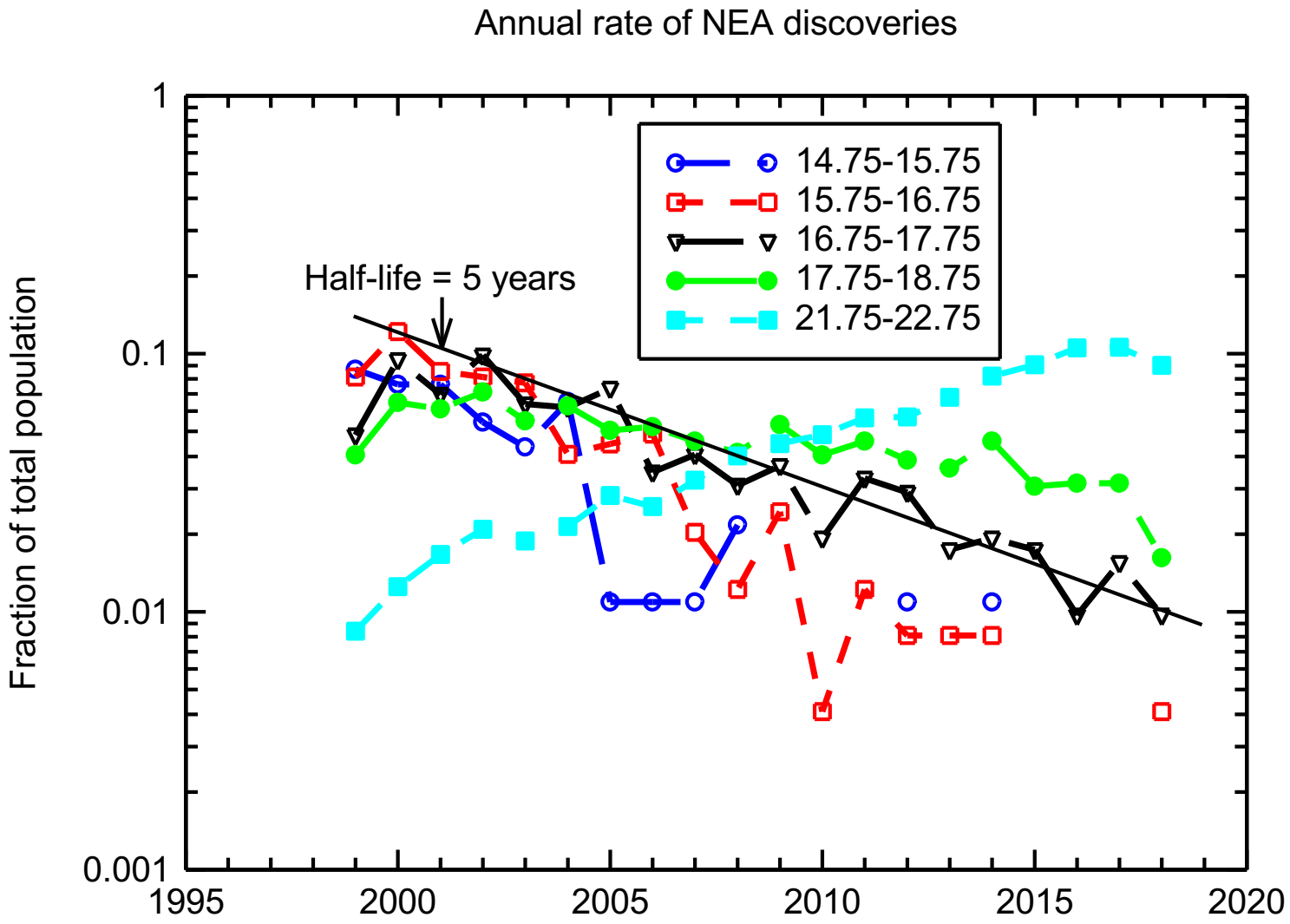
- 2018 estimate of $N(H<17.75)$ (D > 1 km) is 942, compared to the 2016 estimate of 934.
- The number discovered was 872 in 2016, or 93.4% complete. In 2018, the number discovered was 890, or 94.5% complete
- The estimate of number of yet undiscovered NEAs H < 17.75 is 52 as of July 2018, compared to 62 in 2016.
- At H < 22.0 (D > 140 m), the current (2018) completion is estimated to be 37.6%, compared to 33.6% in 2016.

Survey completion of very large NEAs

Even at the high level of completion of surveys at $D > 1$ km, a substantial fraction (maybe even most) of the remaining risk lies in that small number of yet undiscovered large NEAs. What do we estimate is the largest remaining NEA? How long will it take ground-based surveys to find the very last NEA of $D > 1$ km? This plot shows the estimated fraction of population in selected large size ranges that remain un-discovered.

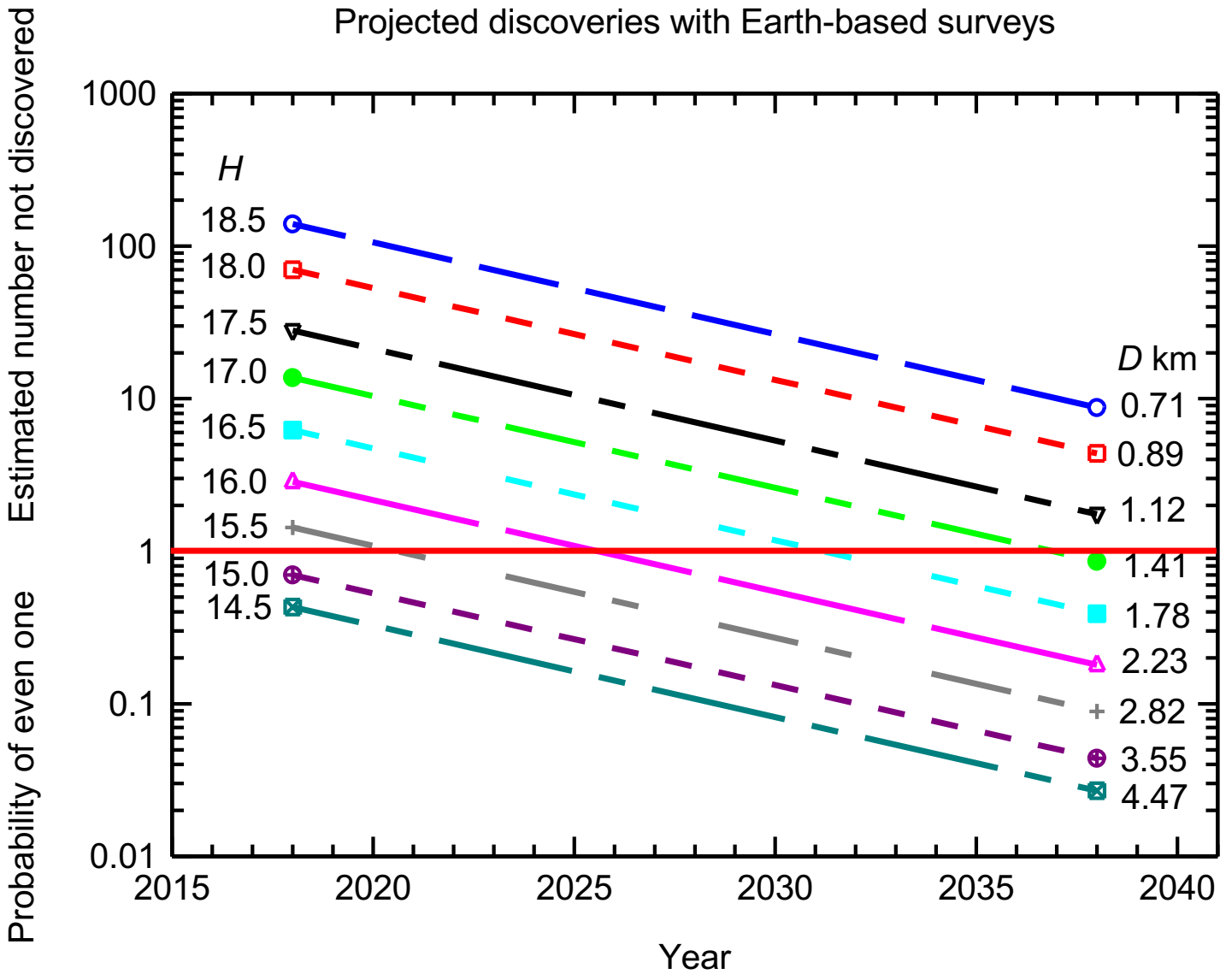


Fractional discovery vs. size

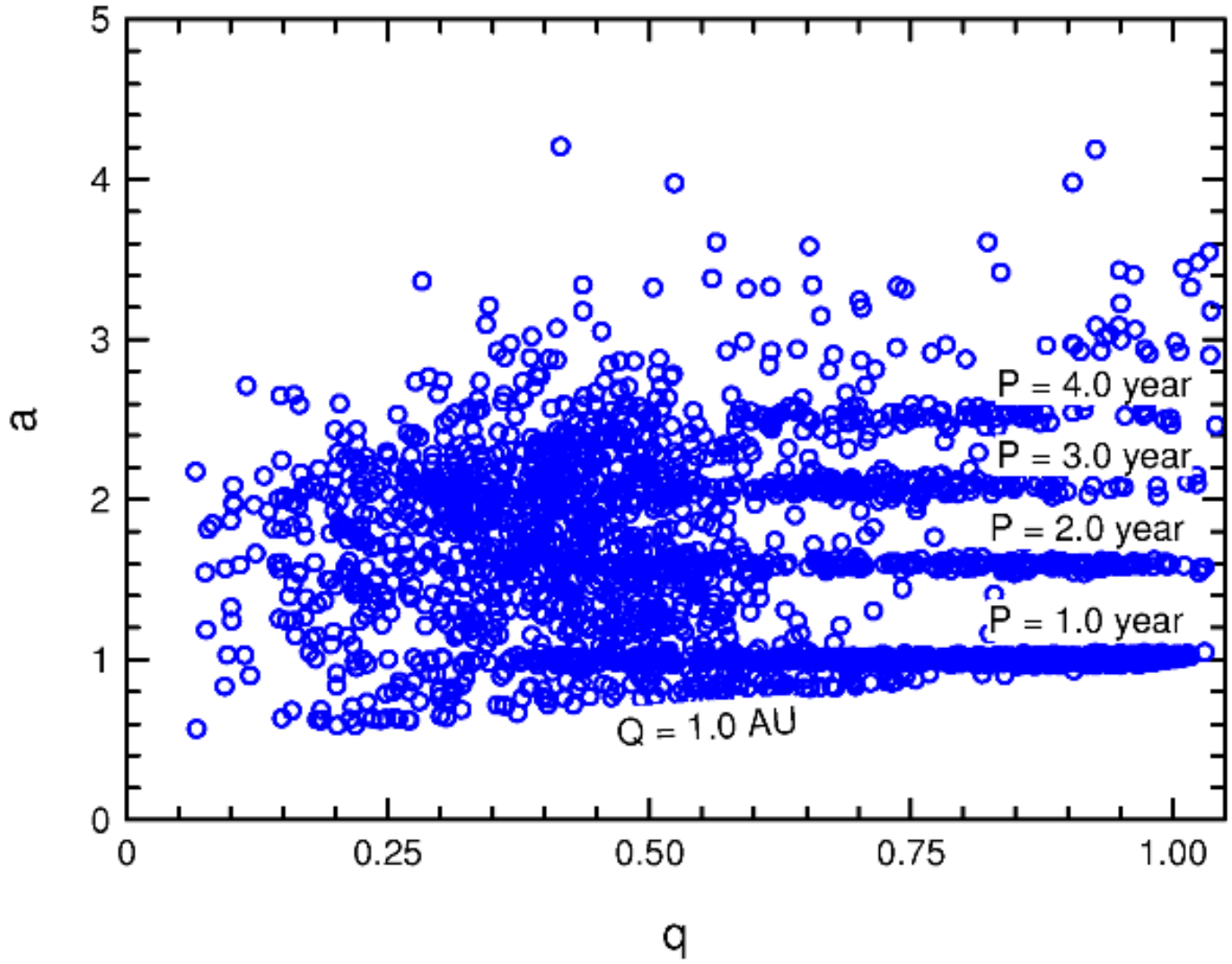


Among smaller sizes (blue curve for ~140 m size objects), rate increases with time as surveys become better. At larger sizes, rate falls off as surveys approach completion, and is nearly independent of size of NEA.

Survey progress assuming 5-year half life



Where are the un-discovered PHAs hiding?



This is a plot of *a* vs *q* of the 2% of simulated PHAs that remained "undetected" in a 20-year simulation. They hide behind the sun on orbits commensurate with the Earth's period.

Further considerations

- PHAs constitute only about 20% of NEAs, so the expected last undiscovered PHA corresponds to about 5 remaining undiscovered NEAs
- Because of the resonant tendency of the last few, they do not come “out of the blue”, but can be discovered looping around from behind the sun years in advance.

Conclusions

- $N(<H)$ is stably determined over entire range, within few % at large end and factor of 2 at smallest sizes. Greatest uncertainty of estimated risk lies in translation to D, uncertain density, strength, etc.
- Completion to $H < 17.75$ ($D > 1$ km) is now ~95%. Ground-based surveys should achieve completion of NEAs to $H < 17.75$ by ~2040, but should achieve completion for PHAs to that size by ~2030.
- Last few undiscovered large NEAs are mostly hiding behind the sun in resonant orbits, thus will not “strike out of the blue”, but instead will move into discoverable regions of sky long before a close approach or impact with the Earth.