Scout: short-arc orbit analysis and hazard assessment for newly discovered asteroids

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The International Astronomical Union
Minor Planet Center

The nerve center of asteroid detection in the Solar System

OBSERVERS PUBLIC IAWN

- Processing (Info)

The NEO Confirmation Page

Please ensure you are familiar with the notes at the bottom of this page.

You are reminded that a cross-reference of designations that have appeared here previously is available elsewhere.

Problems? Comments?

Get ephemerides | Reset form

See this list in R.A. order

Select object(s) from the current list of objects needing confirmation (NEO prob, class, discovery date, rough current position and magnitude given):

○ All objects with V = -30 to 30, with Decl. between -90 ° and +90 °, with an NEO probability of 0 % to 100 %

◉ or just the objects selected below: Deselect All | Select All

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☐ XHBA675 100 1 [2016 Apr. 18.4 UT.   R.A. = 17 13.7, Decl. = +23 42, V = 20.3] Updated Apr. 18.51 UT [1 nighter]
☐ SWB001  100 1 [2016 Apr. 18.3 UT.   R.A. = 15 17.6, Decl. = +05 00, V = 20.0] Updated Apr. 18.56 UT * [1 nighter]
☐ XHBA5BD  99 2 [2016 Apr. 18.2 UT.   R.A. = 14 23.4, Decl. = +33 11, V = 20.4] Updated Apr. 18.36 UT [1 nighter]
☐ XHBA5B1  96 2 [2016 Apr. 18.2 UT.   R.A. = 14 40.7, Decl. = +30 28, V = 20.9] Updated Apr. 18.36 UT [1 nighter]
☐ P10uT0H 100 1 [2016 Apr. 17.5 UT.   R.A. = 15 17.9, Decl. = +04 55, V = 20.5] Added Apr. 17.84 UT * [1 nighter]
☐ P10uT08  46 3 [2016 Apr. 17.5 UT.   R.A. = 15 14.4, Decl. = +18 53, V = 21.2] Updated Apr. 18.56 UT
☐ P10uSZd 100 1 [2016 Apr. 17.5 UT.   R.A. = 15 34.6, Decl. = +17 37, V = 21.7] Added Apr. 17.83 UT * [1 nighter]
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2008 TC_3

~5 m asteroid

Discovered by R. Kowalski, Catalina Sky Survey, ~ 20 hours before impact

Soon recognized as an impactor

Almost 900 optical observations

Nubian desert, Sudan

Jenniskens et al. 2009

2014 AA

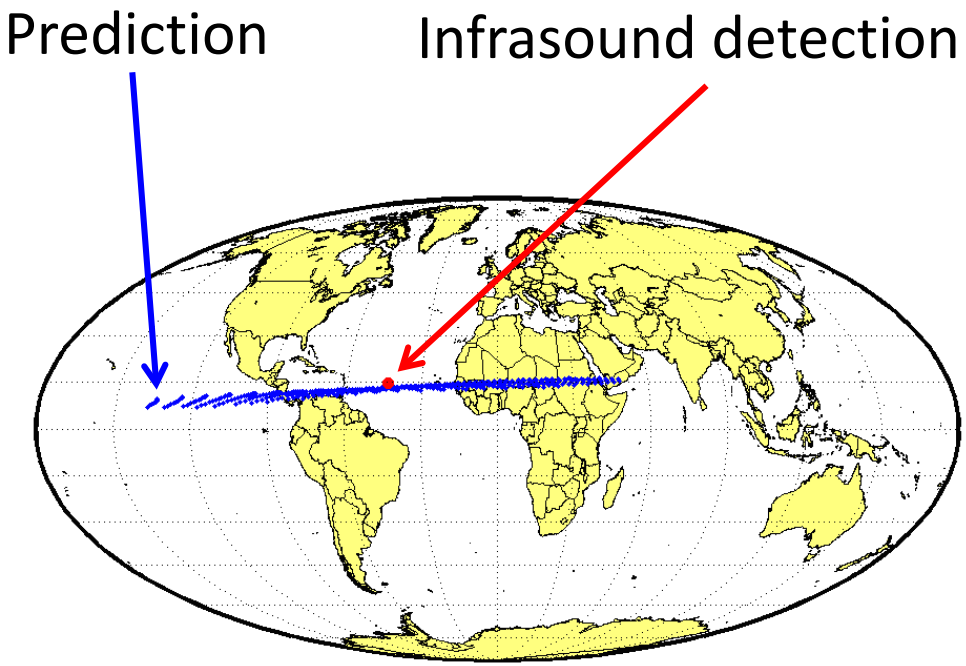
Officially announced by the MPC after the impact

~5 m asteroid

Discovered by R. Kowalski, Catalina Sky Survey, ~ 20 hours before impact

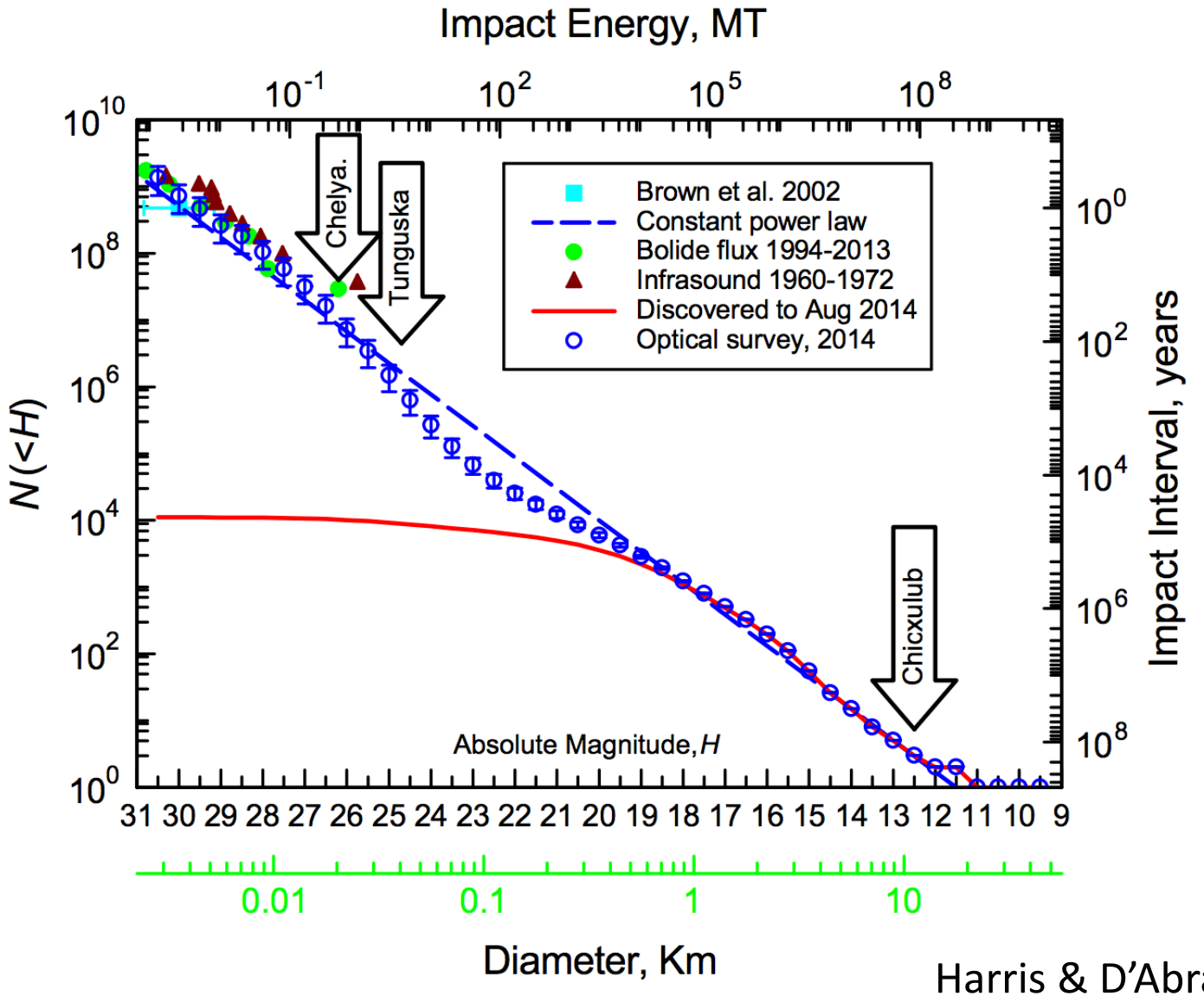
Not recognized as an impactor

Only 7 observations over 70 min



Chesley et al. 2015

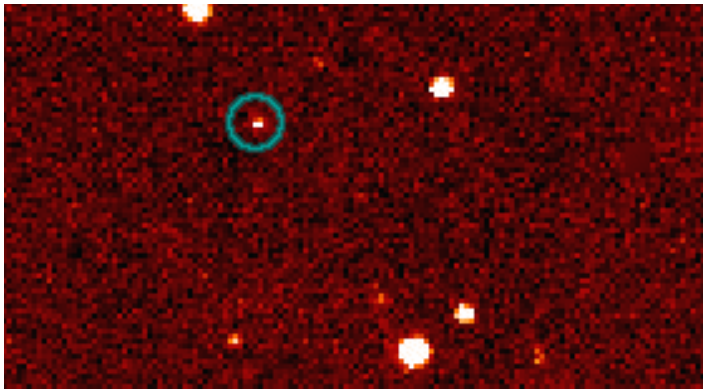
How often?



Harris & D'Abramo, 2015

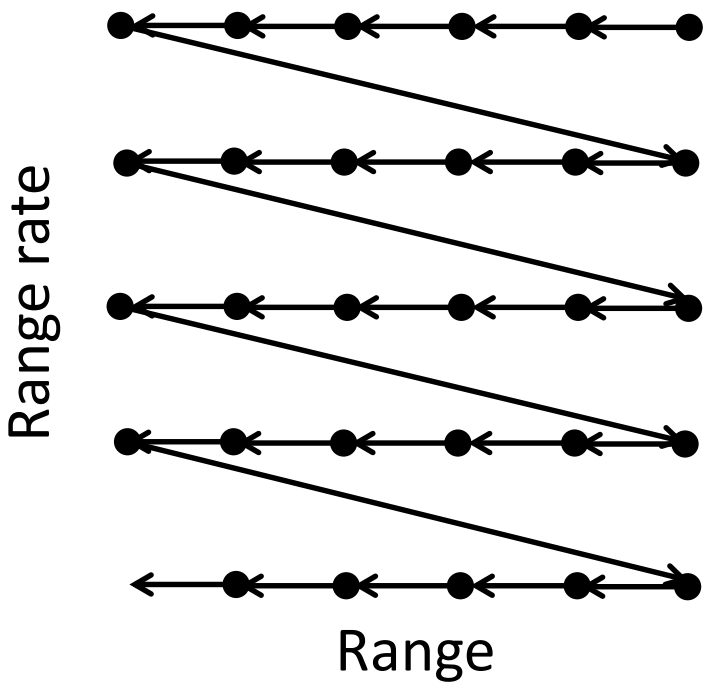
Systematic ranging

Short observation arcs → degeneracies in orbit determination

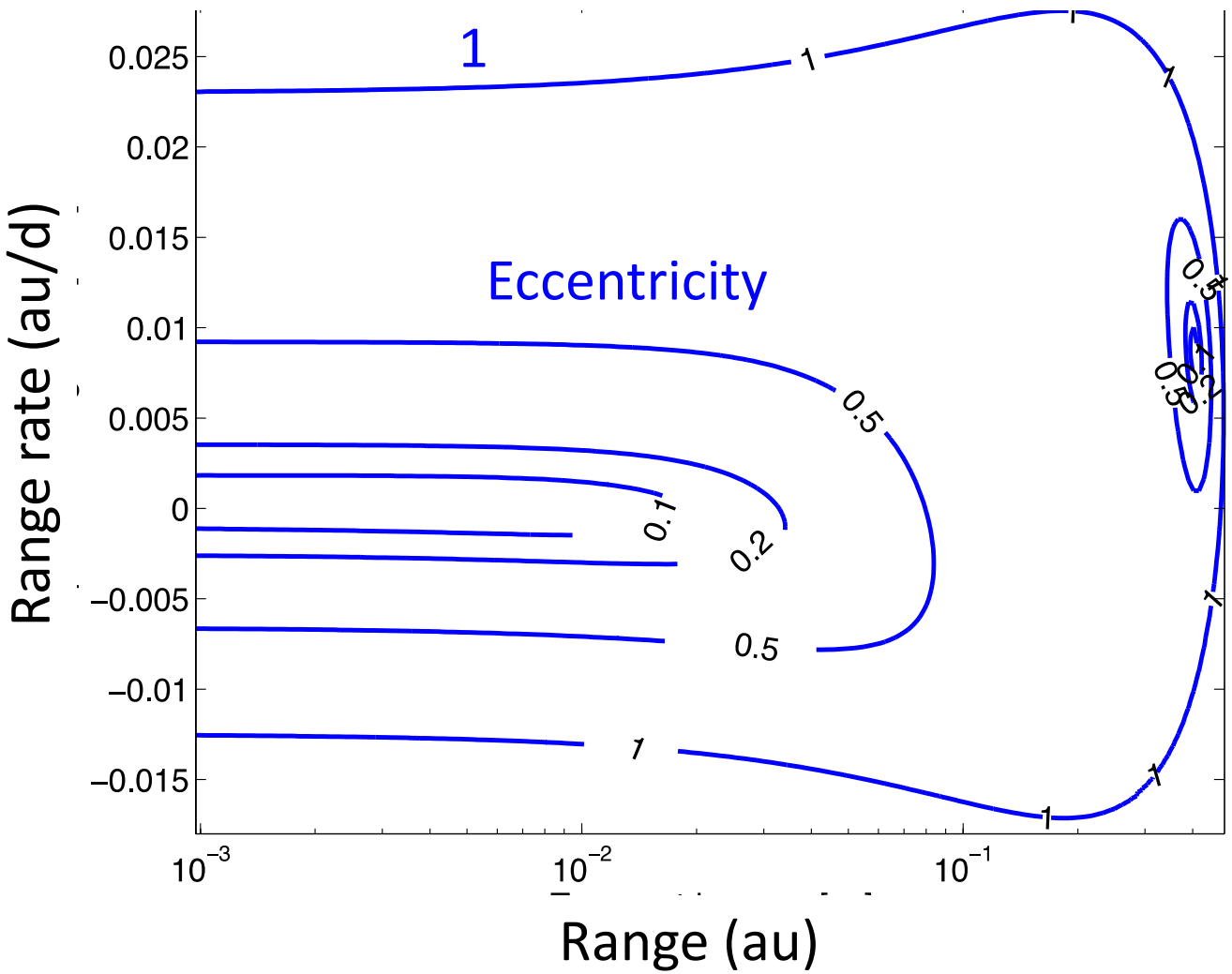


Angular position and motion

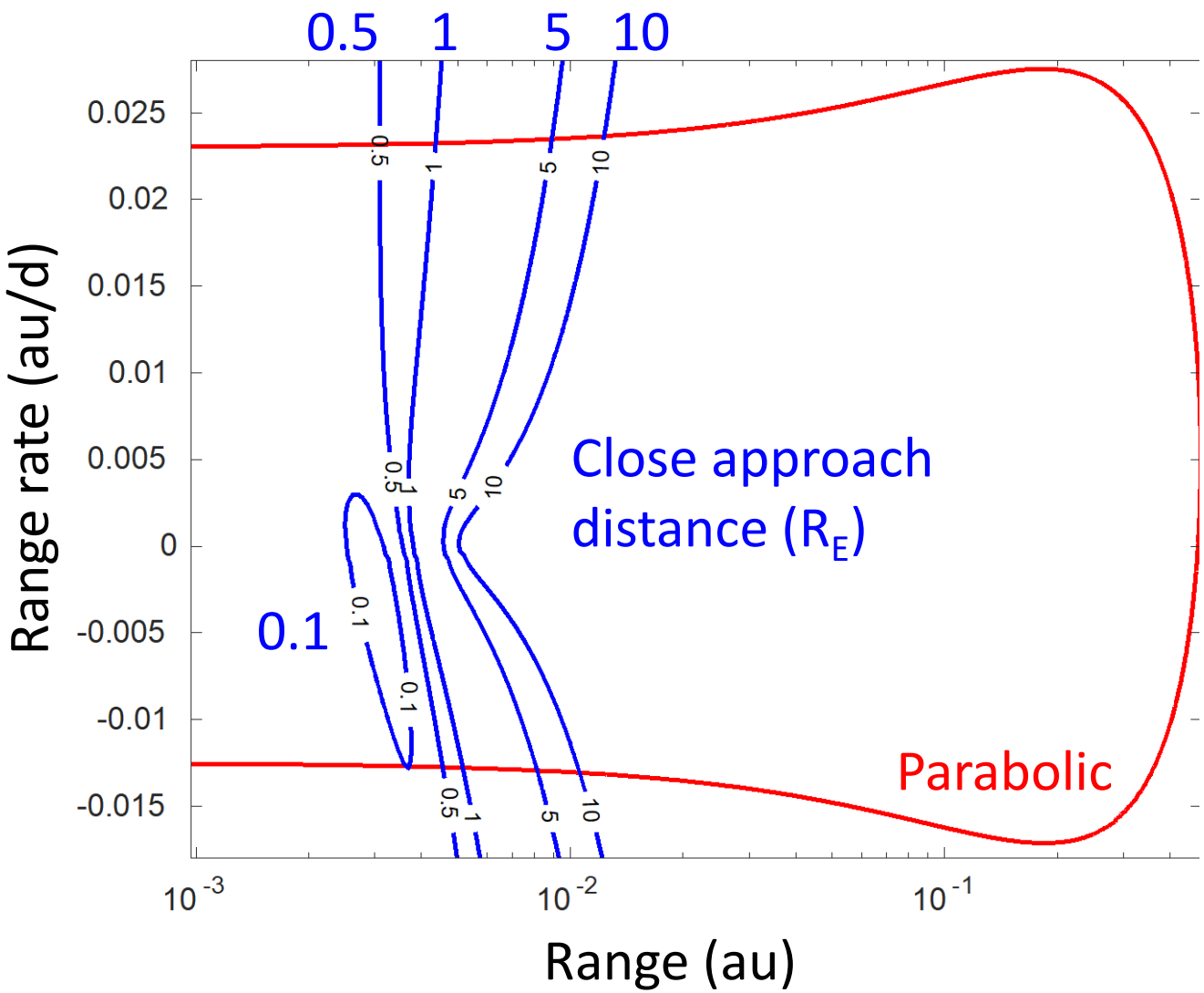
Range & range rate grid
Best-fit orbit at each node



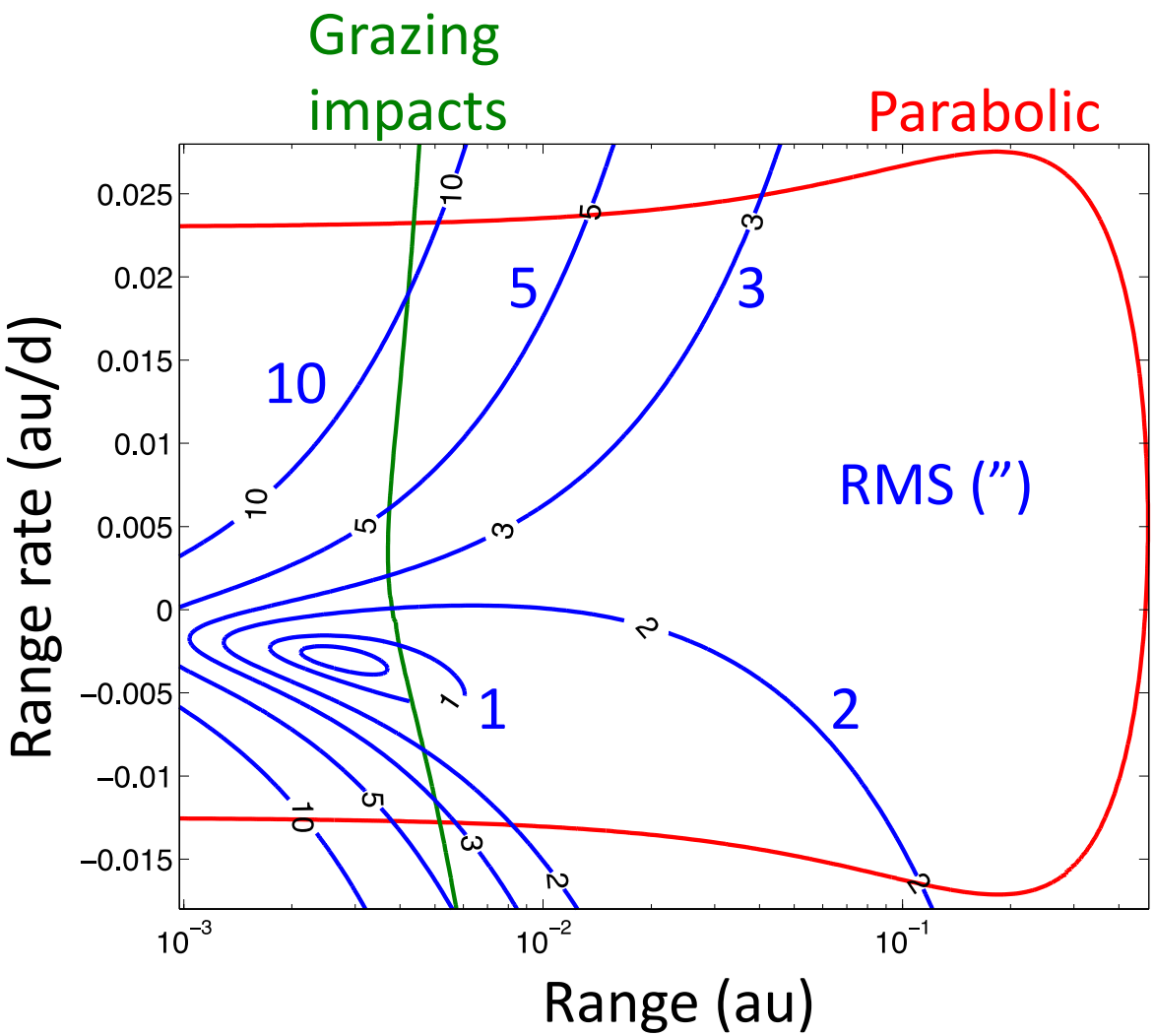
Systematic ranging



Systematic ranging



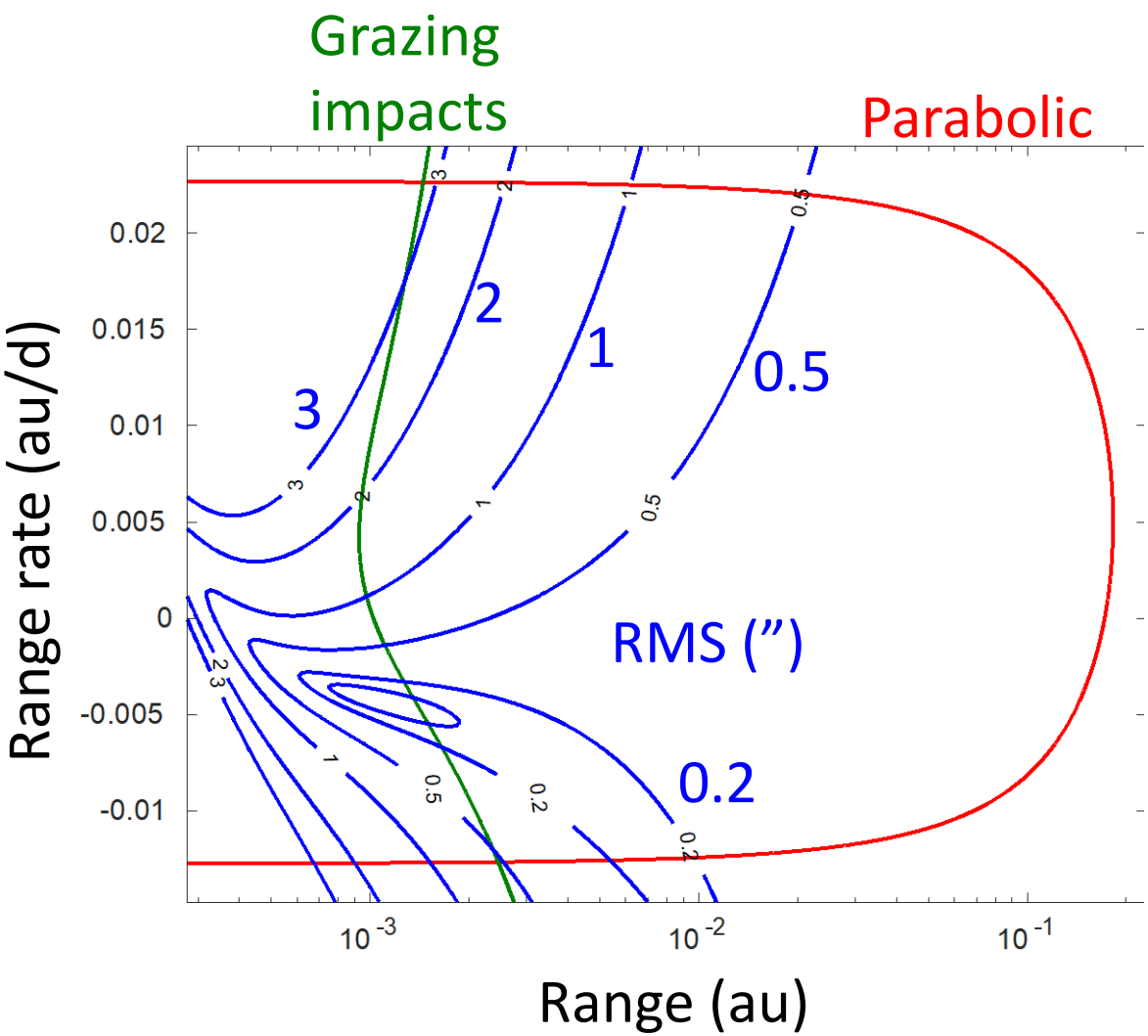
Distribution on the phase space?



2014 AA

Linear approach
~100 % impact
probability

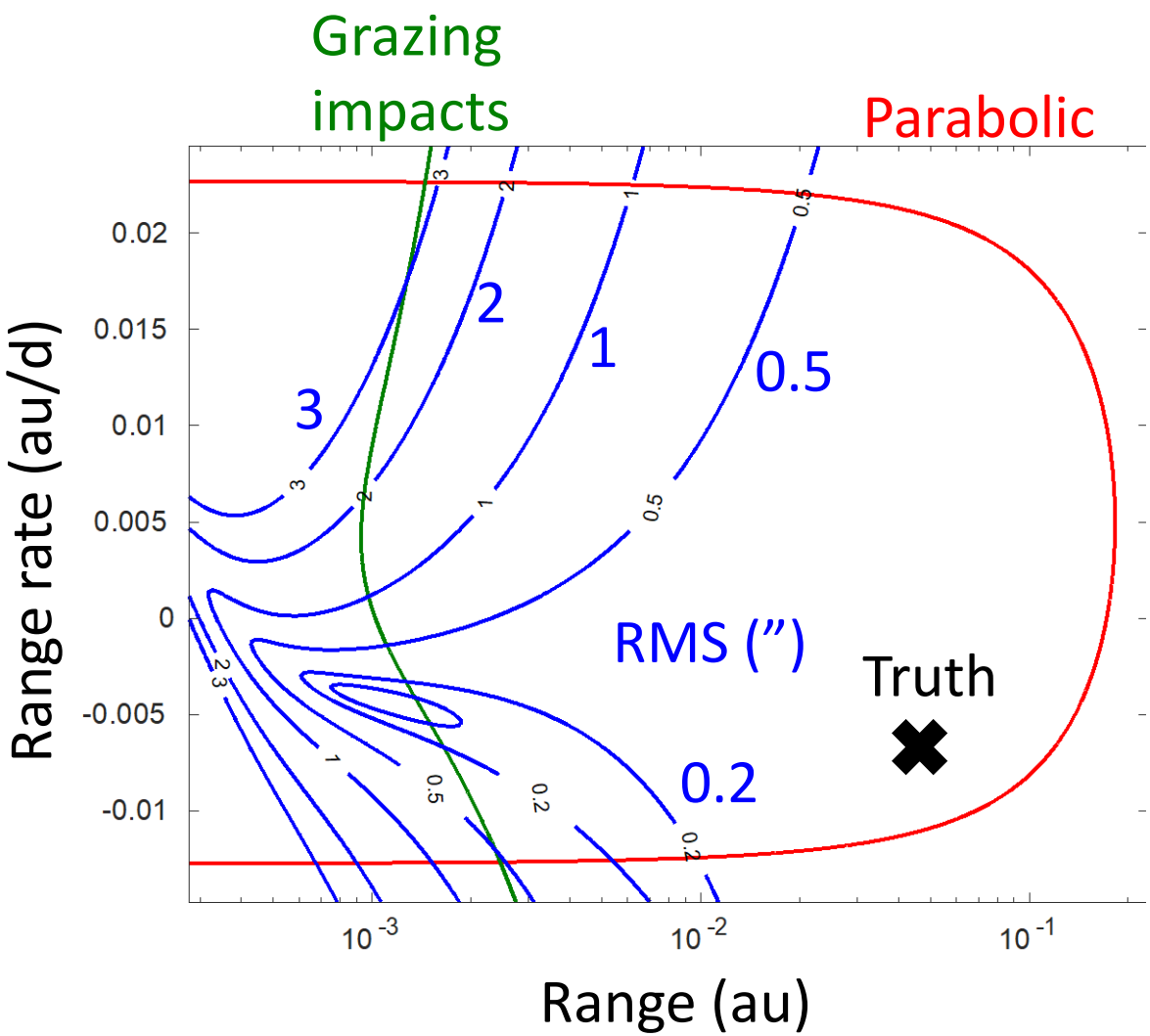
Distribution on the phase space?



2015 VD105

Linear approach
50% impact
probability

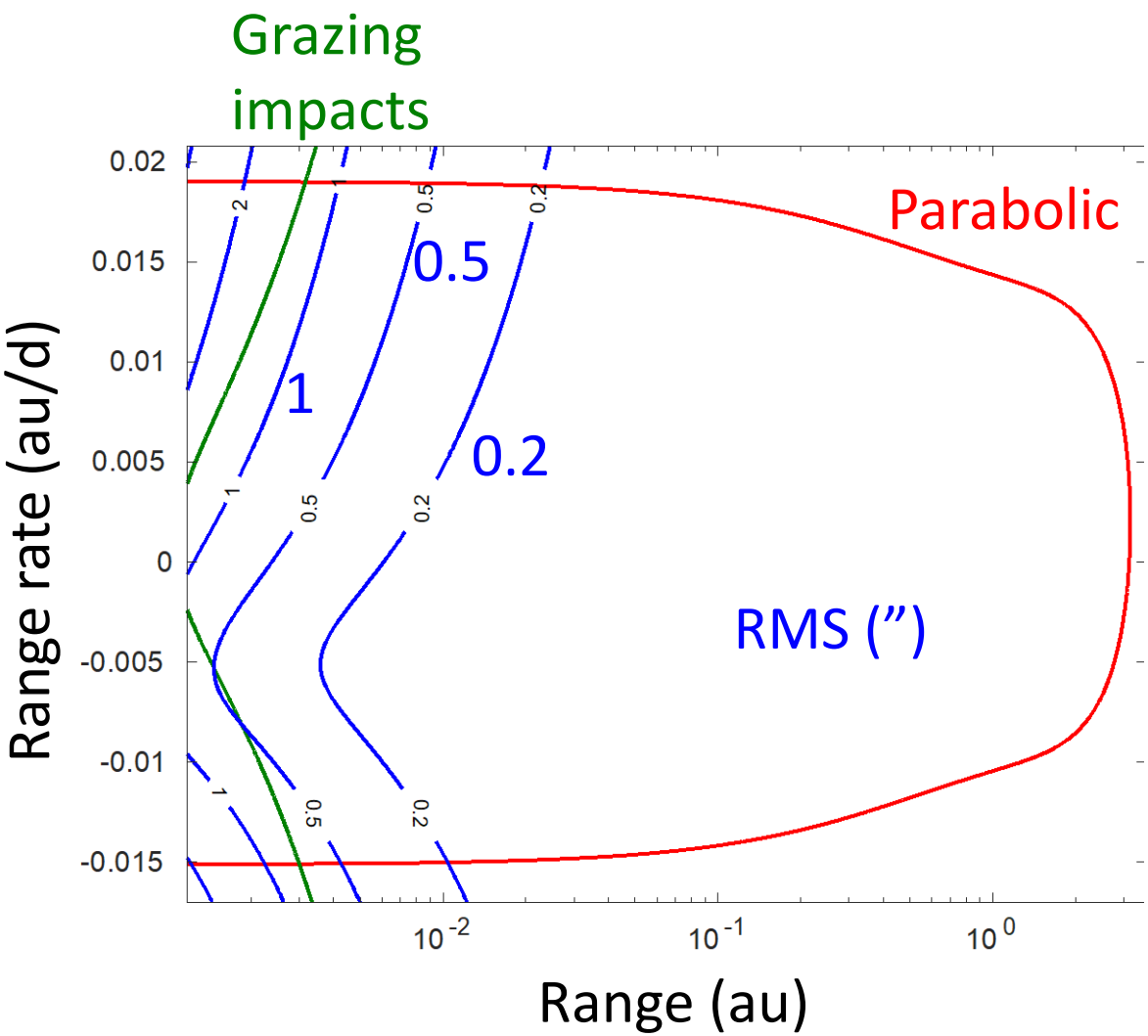
Distribution on the phase space?



2015 VD105

Linear approach
50% impact
probability

Distribution on the phase space?



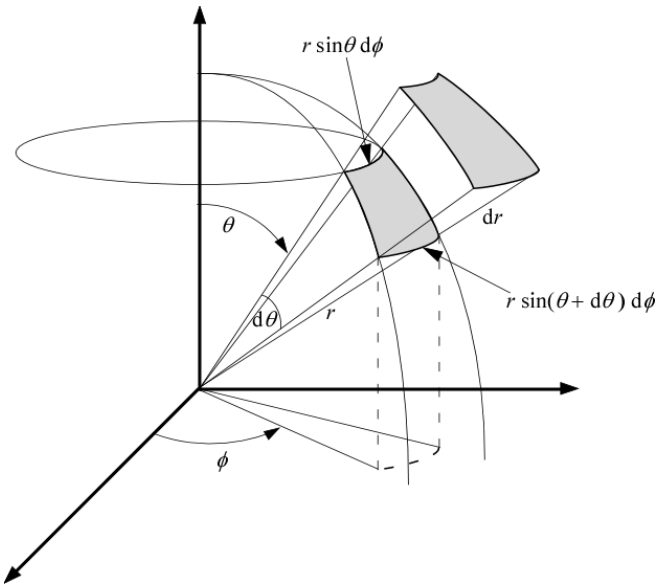
Bayesian approach:

$f_{post} \propto f_{prior} \times \exp(-0.5\chi^2)$

Prior distribution

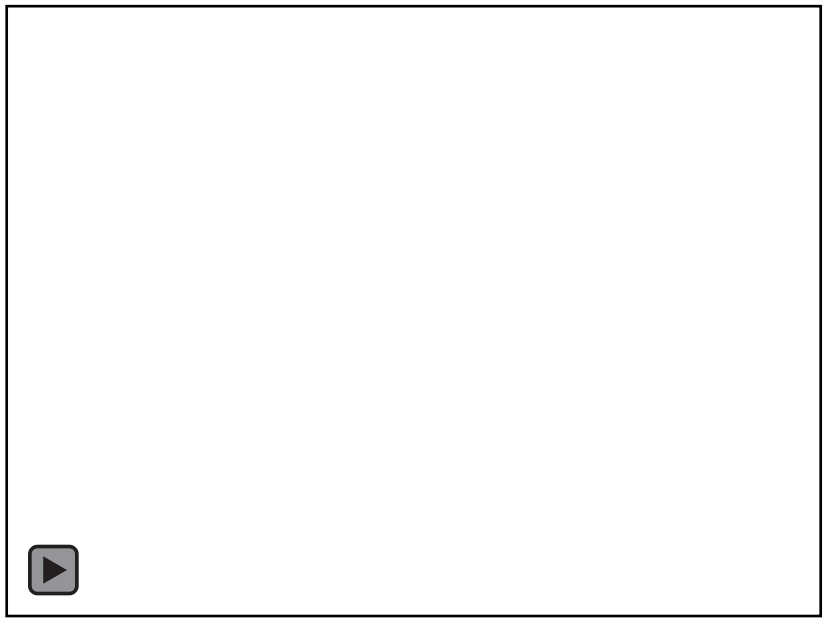
- Geometry:

$f_{prior} \propto dV/dr \propto r^2$



- Asteroid population model:

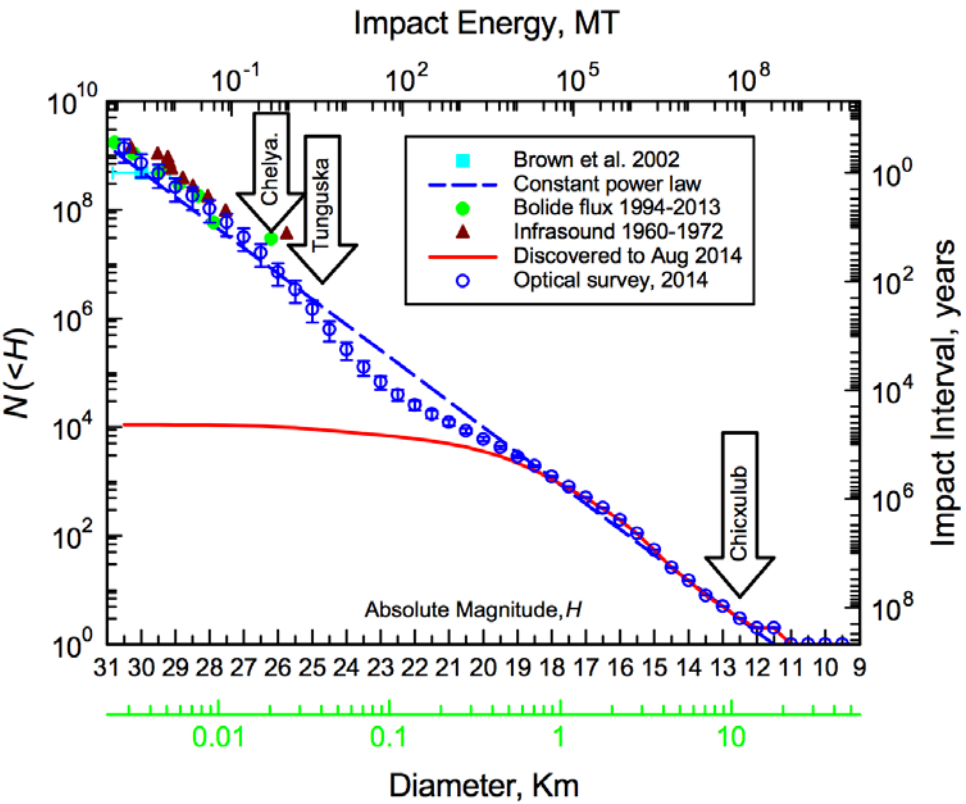
$f_{prior} \propto f(a,e,I,H)$



Granvik et al. 2016

$f_{prior} \propto r^2 \times f(a,e,I,H)$

Frequency size distribution



For NEOs:

$N(<H) \propto 10^{\eta H}$ $\qquad$ $f(H) \propto r^{-5\eta}$

$$f_{prior} \propto r^{2} \times r^{-5\eta}$$

$\eta = 0.35$ Bottke et al. 2002

$\eta = 0.47$ Harris & D'abramo 2015

$$r^{-0.35} < f_{prior} < r^{0.25}$$

Uniform f_{prior}

2008 TC_3 & 2014 AA

Object	Number of observations	Arc length	Impact probability
2008 TC_3	4	43 min	4%
2008 TC_3	7	99 min	100%
2014 AA	3	28 min	3%
2014 AA	7	69 min	100%

Clear distinction between interesting objects and less remarkable ones.

Scout: Short-Arc Orbit Analysis and Hazard Assessment for NEOCP objects

This page provides trajectory analysis and hazard assessment for recently detected objects on the Minor Planet Center's Near-Earth Object Confirmation Page (NEOCP).
Objects on these pages are unconfirmed; their designations are user-assigned and unofficial.
These objects could be real asteroids, but they cannot be officially designated until they are confirmed by additional observations.
In fact, it is very possible that some of these "objects" are not real, but rather observing artifacts.
If the Minor Planet Center receives enough confirming observations to make sure that an object is a real asteroid, the object is given an official designation and disapperars from the NEOCP and this page.
Objects that remain unconfirmed are eventually removed from the NEOCP and also disappear from this page.

The Scout system continually monitors the objects on the NEOCP, and for each provides the following orbital, ephemeris, and hazard assessment information:

- The number of observations and the length of the observed arc;
- The RMS of the weighted residuals for the best fitting orbit;
- Coarse indicators of absolute magnitude H, MOID, close approach distance, asymptotic velocity relative to Earth (when defined). Note that these quantities can be extremely uncertain for short arcs;
- Current ephemeris information as of 2016-04-26 20:51 UTC: Coarse RA, DEC, V-band magnitude, solar elongation, plane-of-sky (POS) rate of motion, 1-sigma POS uncertainty, POS uncertainty tomorrow;
- Scores between 0 and 100 for PHA, NEO orbit, geocentric orbit, cometary orbit (Tisserand parameter $T_J < 3$), and Interior-Earth orbit;
- A rating to categorize the chances of an impact on Earth: 0: Negligible, 1: Small, 2: Modest, 3: Moderate, 4: Elevated. The rating is not defined for arcs shorter than 20 minutes or with less than three observations.

Because of the generally short observation arcs and the uncertain quality of the astrometry, the reported impact ratings and scores are meant to identify interesting objects rather than provide a rigorous probability assessment.

Note that the table is sortable by clicking on the appropriate column header.

This website is about unconfirmed objects and all information should therefore be treated as confidential.

Object	# of obs	Arc (h)	RMS	H	Impact rating	MOID (au)	CA distance (LD)	v_∞ (km/s)	RA (hh:mm)	DEC (°)	V	Elongation (°)	Rate ("/min)	Unc (±')	Unc +1 day (±')	PHA	NEO	Geocentric	$T_J < 3$	IEO	Last updated UTC
XD91249	7	3.39	0.75	26.9	0	0.0025	3.2	28	00:34	+03	28.6	28	2.3	200	200	0	100	0	64	0	2016-02-18 10:57
XE9E831	10	5.69	0.81	27.3	0	0.015	7.8	12	12:24	-12	27.3	152	0.4	10	10	0	100	0	7	0	2016-03-12 04:18
XFA96F3	12	2.40	0.65	24.2	0	0.13	ND	20	09:18	-54	23.6	109	1.3	2000	2000	0	100	0	5	0	2016-03-21 15:13
N009fbu	5	6.30	0.61	19.4	1	0.011	ND	31	05:59	+61	20.8	62	2.6	500	500	96	100	0	34	0	2016-03-21 23:32
XFAC29D	15	8.63	0.55	28.2	0	0.002	1.6	21	01:19	+11	35.1	15	0.3	0.5	0.5	0	100	0	0	0	2016-03-28 17:59
Be301LV	10	24.65	0.17	25.1	0	0.16	ND	ND	12:55	-22	23.6	157	0.9	300	300	0	100	0	19	0	2016-03-29 18:29
Be6D1MP	9	23.90	0.84	28.4	0	0.0011	2.4	11	13:16	-20	26.4	164	0.3	10	10	0	100	0	0	0	2016-03-31 02:05
BeKF1N7	9	26.39	0.22	27.1	0	0.083	33	ND	12:57	-17	23.7	156	2.4	1000	1000	0	100	0	2	0	2016-03-31 16:40
Be2z1Lp	9	71.55	0.18	23.2	0	0.017	ND	14	11:36	-12	25.0	141	0.3	60	60	3	100	0	22	0	2016-03-31 16:50
BeEH1K6	9	48.62	0.20	27.2	0	0.089	35	ND	13:02	-12	24.6	161	0.9	90	100	0	100	0	0	0	2016-03-31 17:10
Bdzl1M4	13	95.08	0.18	21.8	0	0.0013	ND	20	11:02	-11	24.6	132	0.5	0.8	0.9	100	100	0	0	0	2016-04-01 03:40
BeU01Ln	12	26.12	0.24	26.2	0	0.029	16	17	12:15	-07	26.2	149	0.6	6	7	0	100	0	0	0	2016-04-01 16:35
BeUc1Ig	14	25.01	0.24	29.3	0	0.0023	1.0	15	11:52	-15	28.2	145	0.4	0.6	0.6	0	100	0	0	0	2016-04-01 16:36
BeEG1JG	8	71.08	0.26	22.9	0	0.39	ND	30	11:15	+18	24.8	125	1.6	100	100	0	77	0	21	0	2016-04-01 16:46
BeMl1KX	8	47.20	0.20	25.7	0	0.047	31	22	11:45	-03	26.7	141	0.3	40	40	0	100	0	20	0	2016-04-02 13:04
BegC1bl	8	24.16	0.31	24.1	0	0.043	ND	15	09:24	+22	23.3	100	3.0	300	300	0	100	0	0	0	2016-04-02 17:19
P10uaJR	6	44.46	0.62	19.1	0	0.23	ND	ND	11:55	-02	23.1	143	0.5	20	20	3	71	0	50	0	2016-04-03 05:37
BeEI1Me	8	121.74	0.23	21.6	0	0.6	ND	ND	12:06	-20	22.9	148	0.5	30	40	0	0	0	78	0	2016-04-03 09:02
XGB1CE8	18	25.47	1.06	29.2	0	0.00029	0.13	22	12:26	-11	28.4	152	0.2	0.04	0.04	0	100	0	0	0	2016-04-03 15:02
P10ufn7	6	45.60	3.22	24.1	0	0.00045	1.4	26	01:45	-00	30.8	16	0.5	40	30	0	100	0	100	0	2016-04-03 15:37
P10uwfb	6	93.70	0.51	21.7	0	0.61	ND	ND	13:32	+12	22.8	152	0.5	20	20	0	0	0	40	0	2016-04-09 08:03
XEA0EAD	58	716.71	0.65	17.9	0	1.8	ND	ND	09:24	+10	23.0	103	1.1	0.02	0.02	0	0	0	100	0	2016-04-10 05:03
P10uOhh	8	25.57	0.18	18.0	0	0.45	ND	ND	13:33	-36	20.3	156	0.9	20	20	0	41	0	35	0	2016-04-15 11:20

2015 VY105

Discovered on 2015 Nov 14 07:50am UTC, Scout alert 45 min later

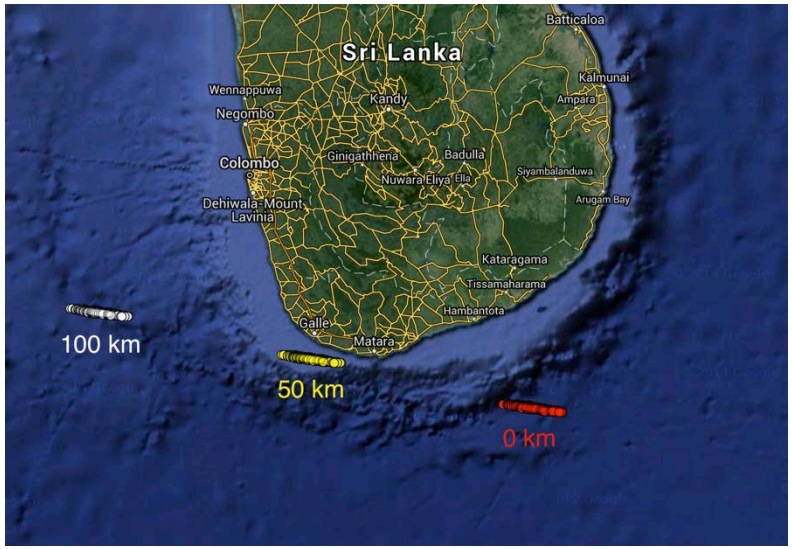
250 km to
450 km of
eight geosats

WT1190F

Artificial object, geocentric orbit detected by Scout
10,000 km × 600,000 km orbit

WT1190F

Impact and airborne observation campaign (Jenniskens et al. 2016)



2015 Nov 13 06:19 UTC

Solar radiation pressure most significant source of uncertainty

Naked eye

Single frame movie camera

Summary

- Early detection of short-term impactors and close approachers
- Few days or less from discovery -> NEOCP
- Orbit determination degeneracies -> Systematic ranging
- Probability distribution on orbit phase space
- Scout automated system, should go live in a few months