Project 2 Proposal

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1 Introduction

Near-Earth objects (NEOs) are any small extraterrestrial bodies, mainly comets and asteroids, whose orbit around the Sun brings them gravitationally close to Earth. Recently, the NEO comet NEOWISE, can be seen visibly in the night sky as it passed close to Earth on its orbit, and will not do so again for almost another 70,000 years. There are hundreds of thousands of NEOs, and while they are interesting objects for scientific observation and study, they also sometimes pose a risk. Since the discovery of NEOs, scientists have realized the danger a collision with potentially hazardous asteroids (PHAs) could present, such as the Cretaceous–Paleogene extinction event, and have launched initiatives to discover and monitor them more closely. In space, hundreds of thousands of kilometers is a hairline margin. The Jet Propulsion Laboratory's Center for NEO Studies (CNEOS) was created from NASA's Planetary Defense Coordination Office to assess the trajectories of these comets and asteroids, and encourage ideas about methods to deflect them. We use a dataset from CNEOS to research the attributes of asteroids (size, shape, orbit), and make inferences on potential NEOs in the solar system, and those possibly around other Sun-like stars.

2 Background

We utilized data from the Small-Body Database (SBDB) organized by the Jet Propulsion Laboratory, a national research facility operated by the California Institute of Technology. Our dataset contains characteristics about both near-earth and potentially hazardous asteroids, which help us understand their formation and evolution, possibly around similar type stars as well. There are approximately 990,040 rows and 25 columns.

The following are common fields used to describe Solar System bodies that we may use for analysis:

- i: measure of inclination, or how far above or below object is from the ecliptic plane (in degrees)
- e: eccentricity is a measure of how much an elliptical orbit deviates from a circular orbit (unitless)
- a: the semi-major axis in Astronomical Units (AU), or the distance to object from the Sun

- q: perihelion distance in Astronomical Units (AU), the distance when the object is closest to the Sun in its orbit
- Q: aphelion distance in Astronomical Units (AU), the distance when the object is farthest to the Sun in its orbit
- H: absolute magnitude, or how bright the object is from a designated distance
- Diameter of the object if known (in kilometers)

We use the pandas package to filter and group the data to see spatially where clusters of the asteroids reside, and what kinds of asteroids are most prominent. We will also show what it means for a NEO to be potentially hazardous. We will compare the results with various academic papers to see what kinds of trends exist for known asteroids and discuss what factors are still unknown.

References

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[2] Joseph R. Masiero, Patrice Smith, Lean D. Teodoro, A. K. Mainzer, R. M. Cutri, T. Grav and E. L. Wright. Physical Properties of 299 NEOs Manually Recovered in Over Five Years of NEOWISE Survey Data, 2020; arXiv:2003.14406.

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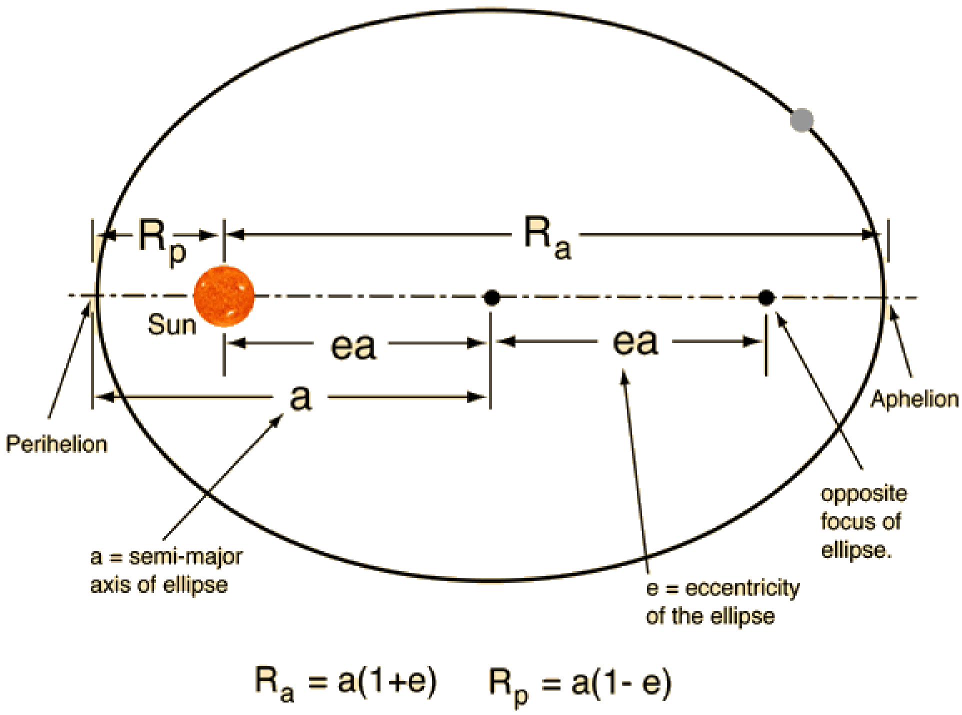

Figure 1: A visual representation of perihelion and aphelion distance for an object in solar orbit. Both are functions of the semi-major axis and eccentricity. These common characteristics are usually more constrained than size or composition because they can more easily be observed/calculated. (Taken from http://hyperphysics.phy-astr.gsu.edu/hbase/kepler.html)

results

full_name	a	e	i	node	Peri	q	Q	per_y	data_arc	condition_code	n_obs_used	n_del_obs_used	n_dop_obs_used	H	diameter	extent	albedo	rot_per	GM	BV	UB	IR	spec_B	spec_T
'Oumuamua (A/2017 U1)	-1.27234500742808	1.201133796102370	122.7417062847290	24.59690955523240	241.8105360304900	0.2559115812959120			80		207			22.08				7.937						
(1927 LA)	3.344071475534310	0.3336182654401850	17.63149800359950	191.7174238363290	341.10951009	2.228428150358550	4.459714800710060	6.11535297505408	34	8	3			11.0										
(1935 UZ)	2.15751129807725	0.2512900717446140	4.757745004376930	134.5184679431190	281.1885944073110	1.615350129193600	2.699672466960900	3.16911369505468	4	9	3													
(1937 CK)	2.320183991729070	0.1374228209905290	6.548047229815480	273.8719464702850	130.2699689086080	2.001337762368600	2.639030221089550	3.53420584906365	31	7	3													
(1939 RR)	2.9046747	0.2536844	13.13929	322.99733	64.83753	2.1678040	3.6415454	4.95056142039699	27		3			12.0										
(1942 RH)	2.257215529562660	0.1453236994892060	4.223979696597430	205.8577464486060	134.5323898134170	1.929188618262130	2.585242440863190	3.39131199963765	10	9	4			13.8										
(1960 SB1)	3.008002289914820	0.5308469322101570	10.4106280434907	201.2248163319800	218.6315135877750	1.411213502232410	4.604791077597240	5.21705537046857	4	9	6			17.222										
(1979 MW5)	3.188524902735170	0.297586294423568	9.393654454063780	124.456997523028	161.0505076533200	2.239663592252950	4.137386213217400	5.69367825781582	5	9	3			16.05										
(1979 XB)	2.228139446564490	0.7084572219505030	24.73433191482800	86.05548731492980	75.57980383566120	0.6495979641330820	3.806680928995900	3.32599623542165	4	9	18			18.6										
(1981 EG6)	2.906377618262230	0.2989181959012170	6.546141321217870	295.9426708276060	194.977288025385	2.037608464003610	3.775146772520850	4.95491561807045	38	8	5			17.267										
(1981 EN35)	2.380254360475430	0.2113372345003600	11.56722648318460	196.9507438249490	12.35113202318250	1.87721798652513	2.883290734425730	3.67234315648241	14114	0	127			17.3										
(1981 EO47)	2.595755343685970	0.2485673362220240	4.513849039545390	165.6835797532960	138.9253368783270	1.950535352421860	3.24097533495007	4.18219075225249	30	8	6			15.0										
(1982 YA)	3.648792355329230	0.6910730595704560	35.11945980006100	268.9686221689390	144.3864556990840	1.127210258594570	6.170374452063890	6.96998632890481	12766	0	72			18.1										
(1983 LC)	2.601034380379270	0.7150273157625690	1.562866914923280	159.7032964183870	184.8525336843720	0.7412237491705240	4.460845011588010	4.19495533719587	7852	0	67			19.3										
(1983 QC)	2.591031874791200	0.4345254985109070	7.250290618312810	162.3982335299410	191.0617901457000	1.465162457739900	3.71690129184249	4.17078051370078	12535	0	40			18.1										
(1984 QL1)	3.294906455853890	0.4999418774269300	4.822687064800660	236.9725730016340	98.47908180987710	1.647644736368180	4.942168175339590	5.98098669280471	12722	0	149			15.6										
(1986 JE)	1.830490114667360	0.02849682225325780	20.62365791410560	46.61589890702220	201.0043938122210	1.778326963233340	1.882653266101380	2.47661947714348	33	7	27			18.609										
(1986 NA)	1.932941554517340	0.4020502980109600	9.454580174086430	243.1460825691160	37.58888338170980	1.155801826485880	2.710081282548810	2.68742458754254	10029	1	30			19.8										
(1988 NE)	2.248372276224350	0.4423411157180490	9.637166808123490	251.5183417907630	3.602650686023810	1.253824775009740	3.242919777438950	3.37140195703358	9961	0	98			19.1										
(1988 PF1)	3.008234328399450	0.4470585134744790	4.25701277274636	304.269436825787	46.72065460401960	1.663377561362300	4.353091095436610	5.21765905067778	11495	0	323			16.7										
(1988 RH9)	2.632904501594110	0.3032952562614610	19.17854281982420	153.6993590772550	39.58564549995120	1.834357056071170	3.431451947117050	4.27229135958217	11	9	21			11.063										
(1989 AZ)	1.647604427109200	0.4682069333121280	11.78995761177050	295.4964303980260	111.9931721907340	0.8761846109809170	2.41902424323749	2.11488923989161	6971	0	129	0	1	19.6										
(1989 FR)	3.20293682723145	0.2509843129917230	16.78347165588190	13.84199505969020	170.6850686326090	2.399049928092880	4.006823726370020	5.7323244265832	2	9	6			13.163										
(1990 OK5)	3.1671807	0.0485816	16.48233	149.24058	82.29764	3.0133140	3.3210474	5.63660310718686		0	49			16.4										
(1990 UN)	1.709865162751570	0.5280628858670430	3.684232740279840	8.467996167120710	97.00218625387180	0.8069488304654530	2.612781495037680	2.23589290696832	15	9	22			23.5										
(1991 BA)	2.187712559985850	0.6730255157297490	1.937552515200840	118.8801070986710	70.68682053485540	0.7153261860329260	3.660098933938780	3.23588882727161		9	7			28.6										
(1991 GK)	2.417390449983160	0.4066086997546850	26.06875991293170	21.62814108592960	149.5807054103650	1.434458462316120	3.400322437650210	3.75861987035785	8	9	12			19.902										
(1991 GO)	1.925133070302190	0.6550445428198050	9.55444421556218	24.06090764819370	89.66378341800620	0.6640851583988040	3.186180982205580	2.67115650235415	8788	0	86			20.0										
(1991 JR)	1.405706233823010	0.2609650565290500	10.1443441689445	60.22692493401990	206.9996952548830	1.038866027050150	1.772546440595870	1.66667168946647	11	8	20			23.4										
(1991 RN28)	2.2459528	0.2330746	6.20213	152.94720	205.86183	1.7224782	2.7694274	3.36596156057495		2	35			19.2										
(1991 RY42)	2.966777845281970	0.1737317309844410	10.43606828187260	340.8343199198540	13.44846083555730	2.451354394774850	3.482201295789100	5.11017464823369	10454	0	85			16.4										
(1991 SU3)	2.567553082425470	0.1415250020540140	8.212697974860850	197.3912060826470	238.5768693998040	2.204180127161410	2.930926037689520	4.11421846420773	9725	0	105			16.9										
(1991 TD17)	2.570402582484360	0.1484707764242460	1.794821390812540	248.1421160480280	111.6476630142170	2.188772915340020	2.952032249628700	4.12106937487304	10176	0	111			16.9										
(1991 TE17)	2.326659004491470	0.249197324632289	7.526461125908240	201.9250069604900	112.9535731996240	1.746861805240570	2.906456203742370	3.54901070060184	10183	0	109			17.9										

Figure 2: A small sample portion of initial dataset before adjustments.