

Splinter meeting to discuss the 2011 AG5x situation Vienna, 10 Feb 2014

Asteroid 2011 AG5x currently shows a 1/5 chance of flying through a keyhole in 2023 which will bring it on a direct collision course with the Earth in 2040. The Committee of Peaceful Uses of Outer Space (COPUOS) has to be briefed on this event. A small expert group shall produce a concise analysis of the situation, list possible mitigation options, and advice COPUOS on how to proceed.

Background information

The Mt. Lemmon Sky Survey discovered Asteroid 2011 AG5x on 08 Jan 2011. Initial computations placed the object on the top of the 'risk list' of both the European NEODyS system and the JPL Sentry system. The impact probability was first computed to be 1/625, based on observations from discovery to about Sep 2011. Initial proposals by R. Schweikart (Association of Space Explorers) to study possible impact missions were followed up on a very low scale. In April 2012, new 'pre-discovery' observations were found in images obtained by the Pan-STARRS telescope (08 Nov 2010). These images increased the impact probability to 1/500.

2011 AG5x will fly by the Earth in a distance of about 1.4 Mio km on 03 Feb 2023. During this flyby it has a chance of flying through a so-called 'keyhole' – a certain distance range of about +/-150 km where it would be deflected such that it will impact the Earth in 2040.

In a workshop held at the Goddard Space Flight Center on 29 May 2012, a number of experts came together and discussed the matter. Studies were prepared by the European NEOSShield project (company Deimos/Spain) and JPL to analyze the situation. The conclusion was that deflection mission possibilities would be available even after the keyhole passage. A deflection before the keyhole passage would, however, require much less energy and might be preferred. The next observational slot for this asteroid would only be in Sep 2013. It was decided to wait until then for further action. The assumption was that the impact risk could be retired after these observations.

Now (in Feb 2014) the latest computations show an increase in the impact risk to 1/5 (20 %). This is considered high enough to bring this up to COPUOS. This splinter meeting has the task to discuss the matter and prepare ideas to be presented to COPUOS with a recommendation for future action.

Physical properties

Even in Nov 2013 the asteroid only barely became brighter than 24 mag, meaning that no physical property observations were possible so far. The absolute magnitude was determined from the initial observations to be 21.8 mag, resulting in an estimated size of 140 m.

Orbital properties

An orbit plot is shown in Figure 1, with the positions of the planets and the asteroid given for 10 Feb 2014.

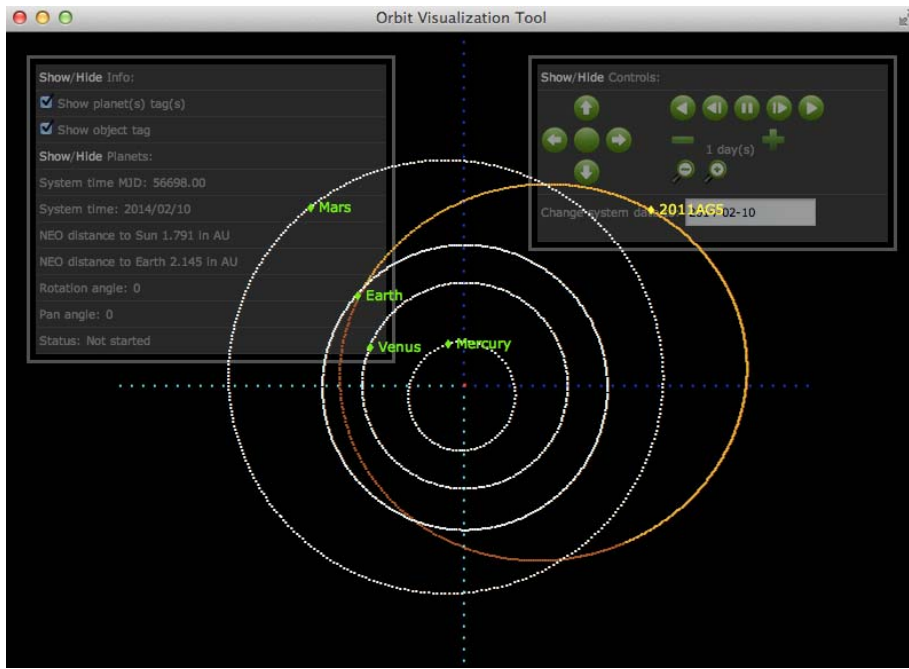


Figure 1: Orbit plot for 2011 AG5x. The planetary positions are for 10 Feb 2014.

The situation during the flyby on 03 Feb 2023 is shown in Figure 2. The image shows on the x-axis the distance to the Earth + 1.4 Mio km; the y-axis shows the flyby distance to the Earth during a subsequent return. The bar indicates the current (Feb 2014) uncertainty of the flyby. As can be seen, about 1/5 of the uncertainty results in distances where the asteroid would be deflected such that the flyby distance in 2040 would be less than 1 Earth radius.

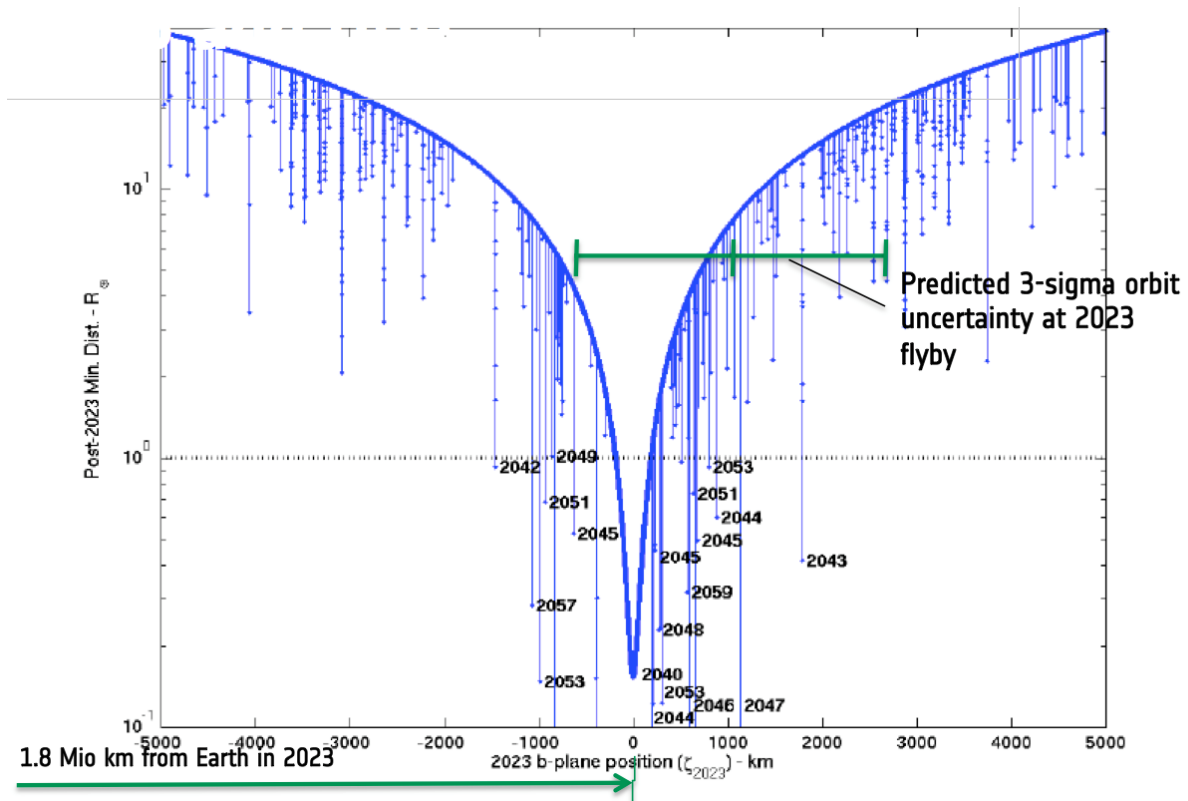


Figure 2: Keyhole map for the 2023 flyby.

fictitious example – fictitious example – fictitious example – fictitious example – fictitious example

The ground track for the 2040 situation in case of an impact is shown in Figure 3. The nominal flyby position is on the extension of the red line to the right, about 3 Earth radii away from the Earth.



Figure 3: Ground track of 2011 AG5x in 2040.

The splinter meeting should discuss the following points:

- What are the consequences of the impact? What are its uncertainties?
- How and when can the object be deflected? In which direction?
- Who should do it?

A short statement should be written which can be presented to COPUOS on how to proceed.

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2011AG5

Orbital Elements at Epoch
MJD 56000.0000 TDT

Element	Value	1- σ variation	Units
a	1.430703	6.833E-06	AU
e	0.390296	3.735E-06	
i	3.680	3.548E-05	deg
Ω	135.705	8.924E-05	deg
ω	53.490	1.295E-04	deg
M	204.890	1.462E-03	deg

Other useful info

Element	Value	Units
Absolute Magnitude (H)	21.846	mag
Slope parameter (G)	0.150	mag
Perihelion	0.8723	AU
Aphelion	1.9891	AU
Asc. node-Earth separation	-0.00139	AU
Desc. node-Earth separation	0.56583	AU
Earth MOID	0.00033	AU
Orbital period	625.0616	days

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Close approaches of 2011 AG5 until 2075 (from NEODyS)

From 1950 to 2100							
Planet	Date	MJD	Nominal distance (AU)	Min possible distance (AU)	Stretching (AU)	Width (AU)	Close app probability
EARTH	1958/01/26.53708	36229.5	0.0952006	0.0949872	1.448e-3	6.339e-8	1.00e+0
EARTH	1975/06/07.59575	42570.6	0.0939549	0.0894426	1.685e-3	1.405e-7	1.00e+0
EARTH	1987/05/24.62956	46939.6	0.0746478	0.0725943	8.810e-4	1.496e-7	1.00e+0
EARTH	1999/04/13.26482	51281.3	0.1358980	0.1355810	1.156e-4	1.426e-7	1.00e+0
EARTH	2011/02/26.64068	55618.6	0.0956683	0.0956679	9.449e-7	1.056e-7	1.00e+0
EARTH	2023/02/03.36257	59978.4	0.0121999	0.0104662	5.399e-4	6.892e-8	1.00e+0
EARTH	2028/06/11.58864	61933.6	0.1350190	0.1059740	8.678e-3	1.324e-7	1.00e+0
EARTH	2040/02/04.67524	66188.7	0.0044378	0.0000188	2.760e-2	6.992e-8	1.00e+0
EARTH	2045/02/10.45252	68021.5	0.0420990	0.0000358	3.260e+0	7.300e-8	2.01e-2
EARTH	2050/03/06.25602	69871.3	0.1128760	0.0000797	1.551e+0	8.429e-8	3.90e-2
EARTH	2055/04/04.45390	71726.5	0.1412410	0.0001438	3.227e-1	6.357e-8	1.50e-1
EARTH	2060/05/04.56999	73583.6	0.1225180	0.0585856	3.915e-1	1.240e-7	1.52e-1
EARTH	2065/05/29.56687	75434.6	0.0692300	0.0585337	3.617e-1	1.104e-7	1.74e-1
EARTH	2070/06/09.36587	77271.4	0.0792457	0.0584617	1.637e+0	1.074e-7	3.74e-2
EARTH	2075/06/17.73557	79105.7	0.1811180	0.0584757	2.776e+0	1.074e-7	1.42e-2