The Hitch-Hiker's Handbook to Exploring the Solar System

- or -

How I learned to stop panicking and love the prospect of near-earth-asteroids

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Team FREDNET

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Asteroid (1999 JM8)

- Dia. 3.5 km (~ 2 miles)
- Min. Miss: 22 LD

Near Earth Objects (NEOs)

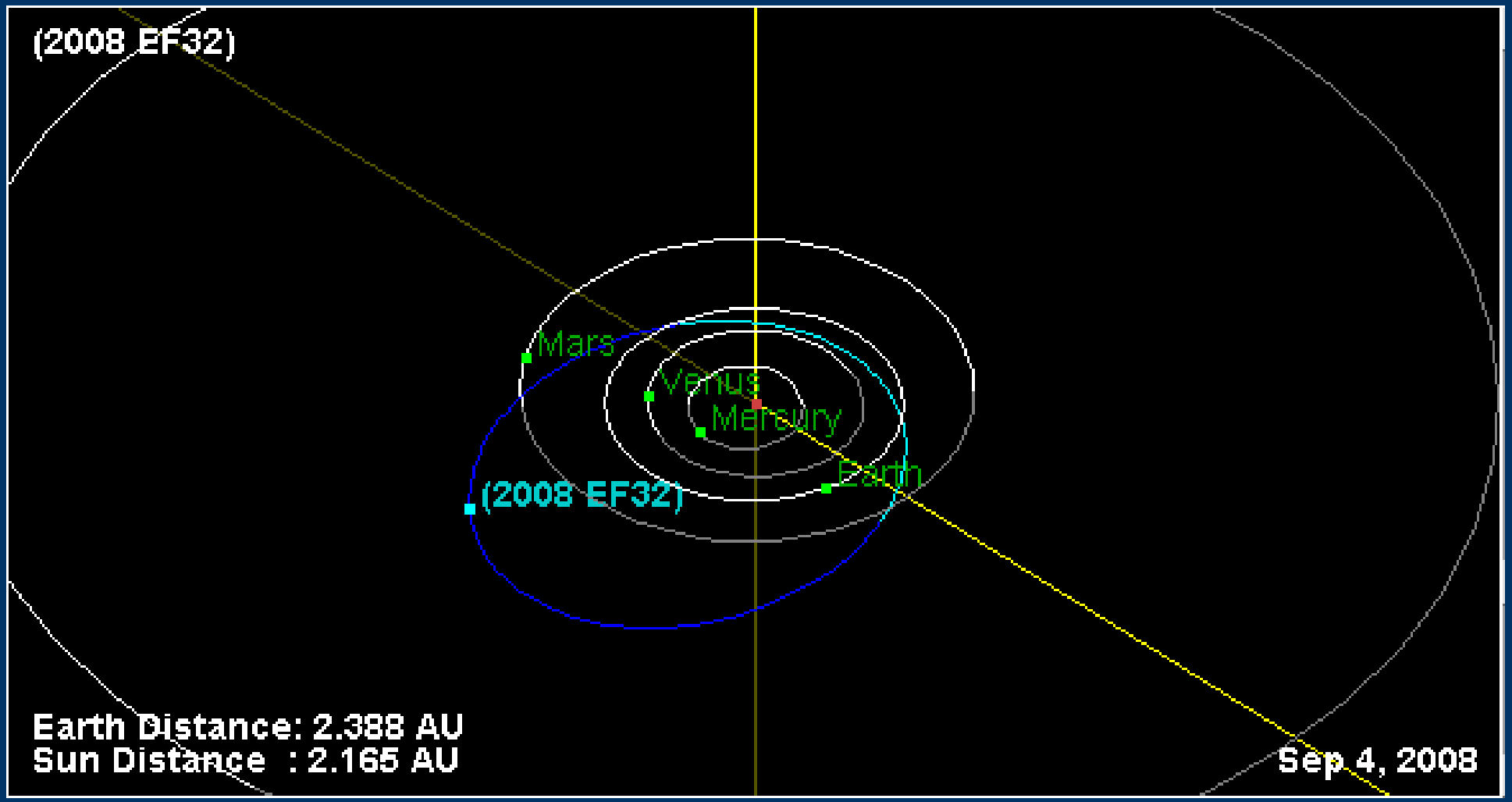
- Dozens Annually
- Small Size ... (< 1 km)
  - Many less than 20 m diameter
- Minimum distance < 1 LD
- Acceptable Relative Velocity
- Interesting Orbital Path

Recent Past and Near Future NEOs

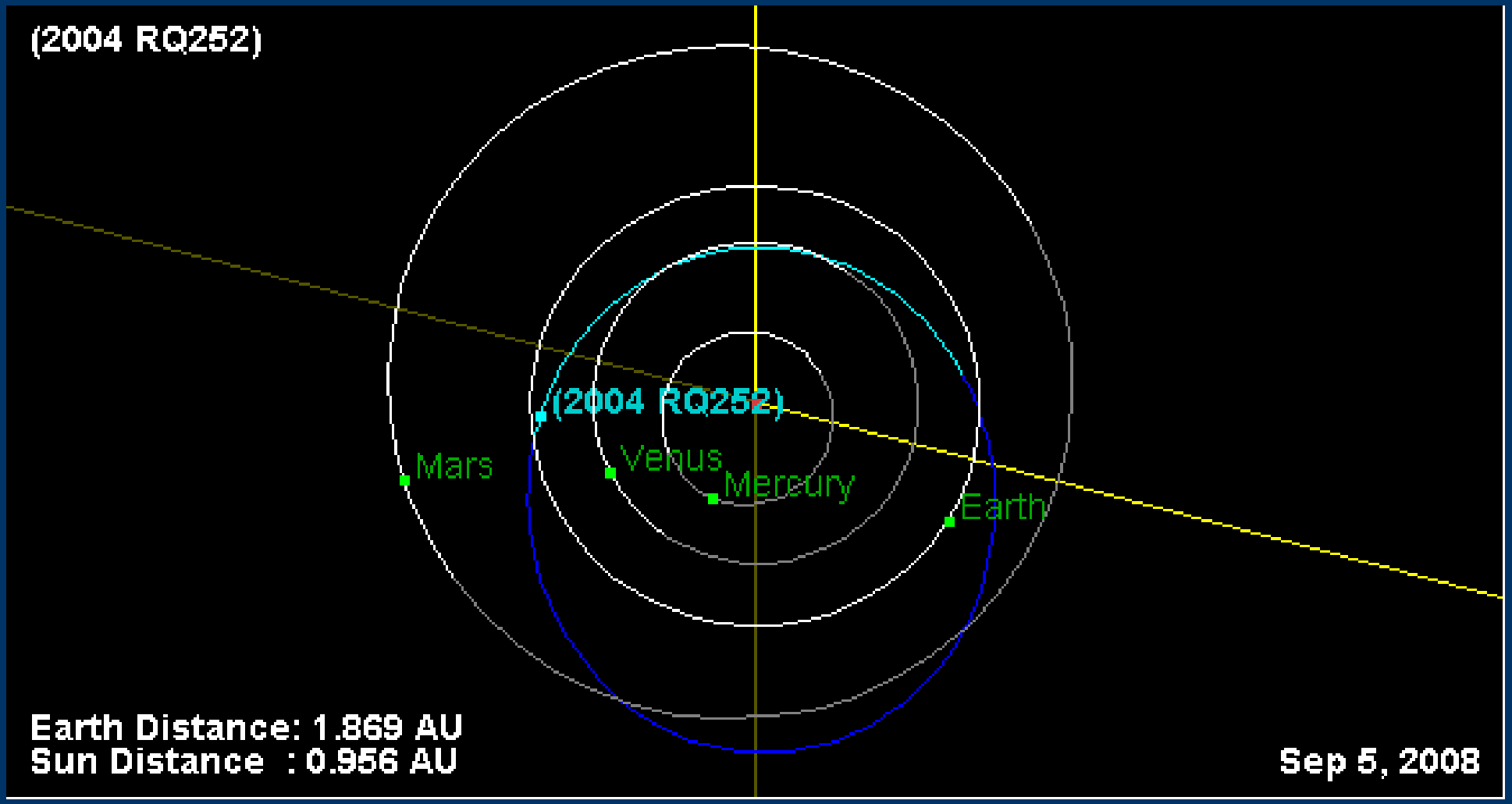
Object	Close Approach Date	Min. Miss Distance (LD)	Relative V (km/s)
(2008 EF32)	2008-Mar-10	0.1	13.56
(2008 EM68)	2008-Mar-10	0.1	17.65
(2004 RQ252)	2012-Apr-13	0.1	10.86
(2008 JD33)	2008-May-11	0.1	7.36
(2008 EJ68)	2008-Mar-14	0.2	18.37
(2007 UN12)	2007-Oct-17	0.2	3.73
(2007 RS1)	2007-Sep-05	0.2	12.15
(2005 WN3)	2005-Nov-26	0.2	19.31

Source: NASA/JPL

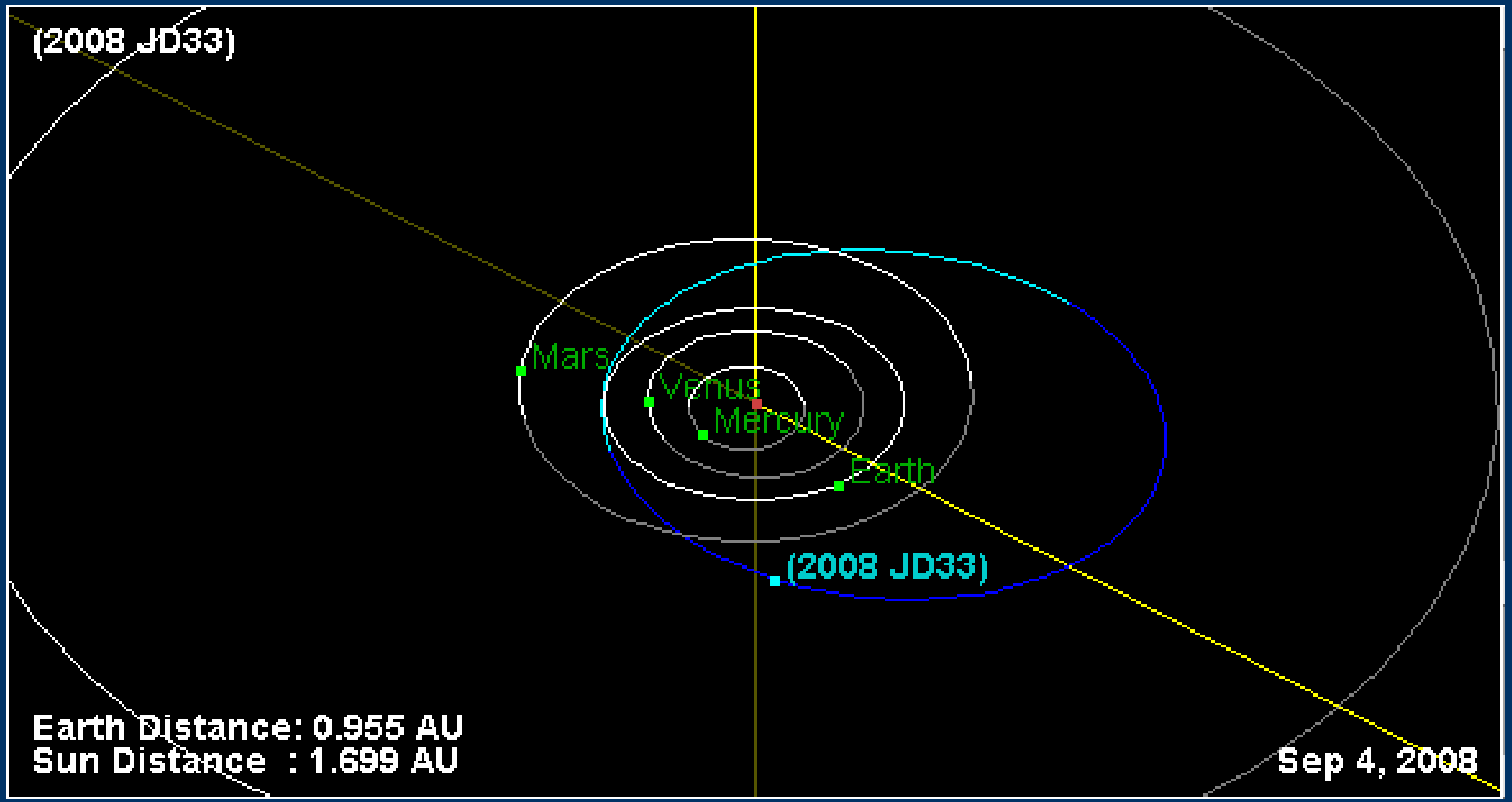
Asteroid (2008 EF32)



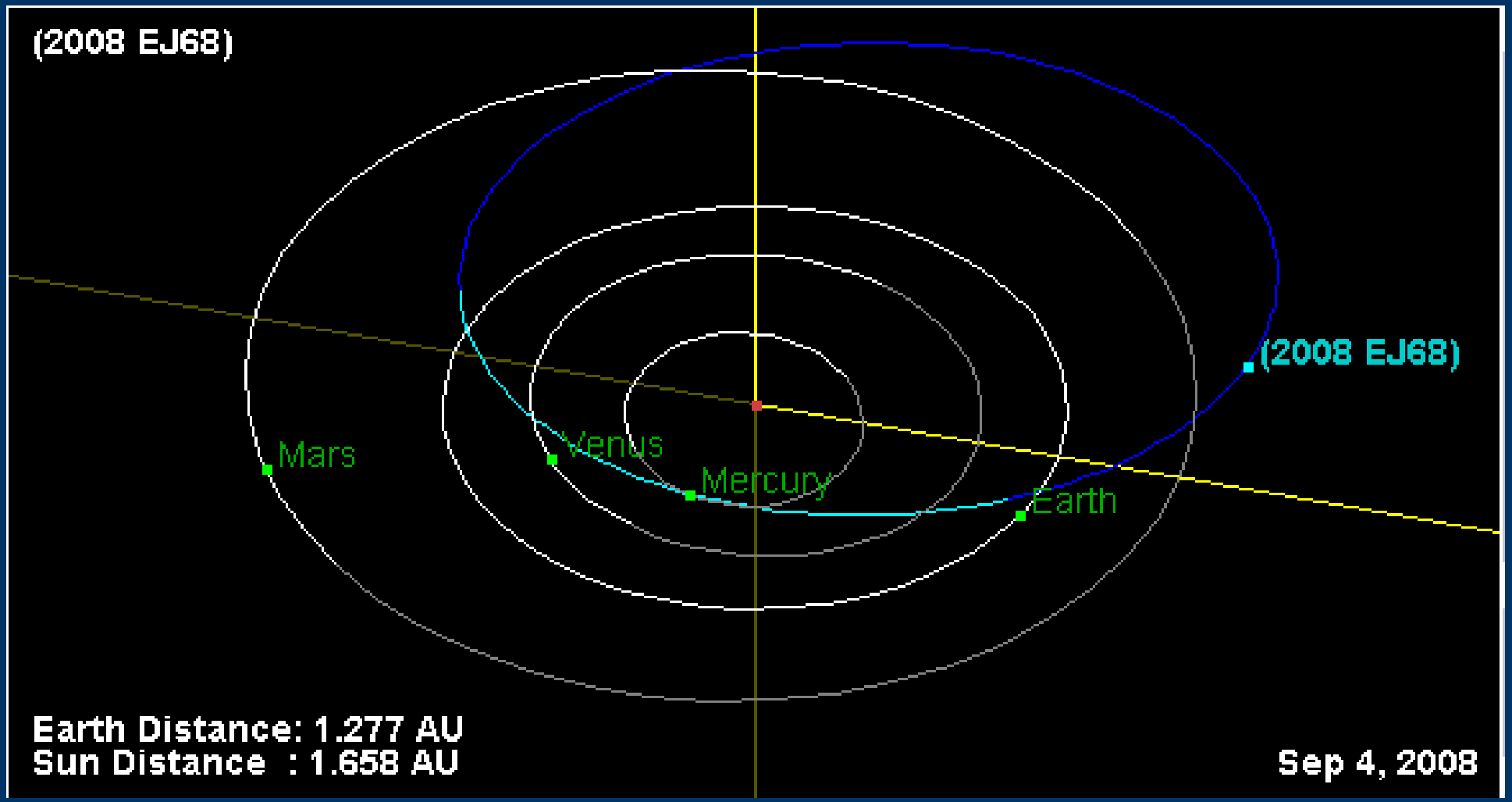
Asteroid (2004 RQ252)



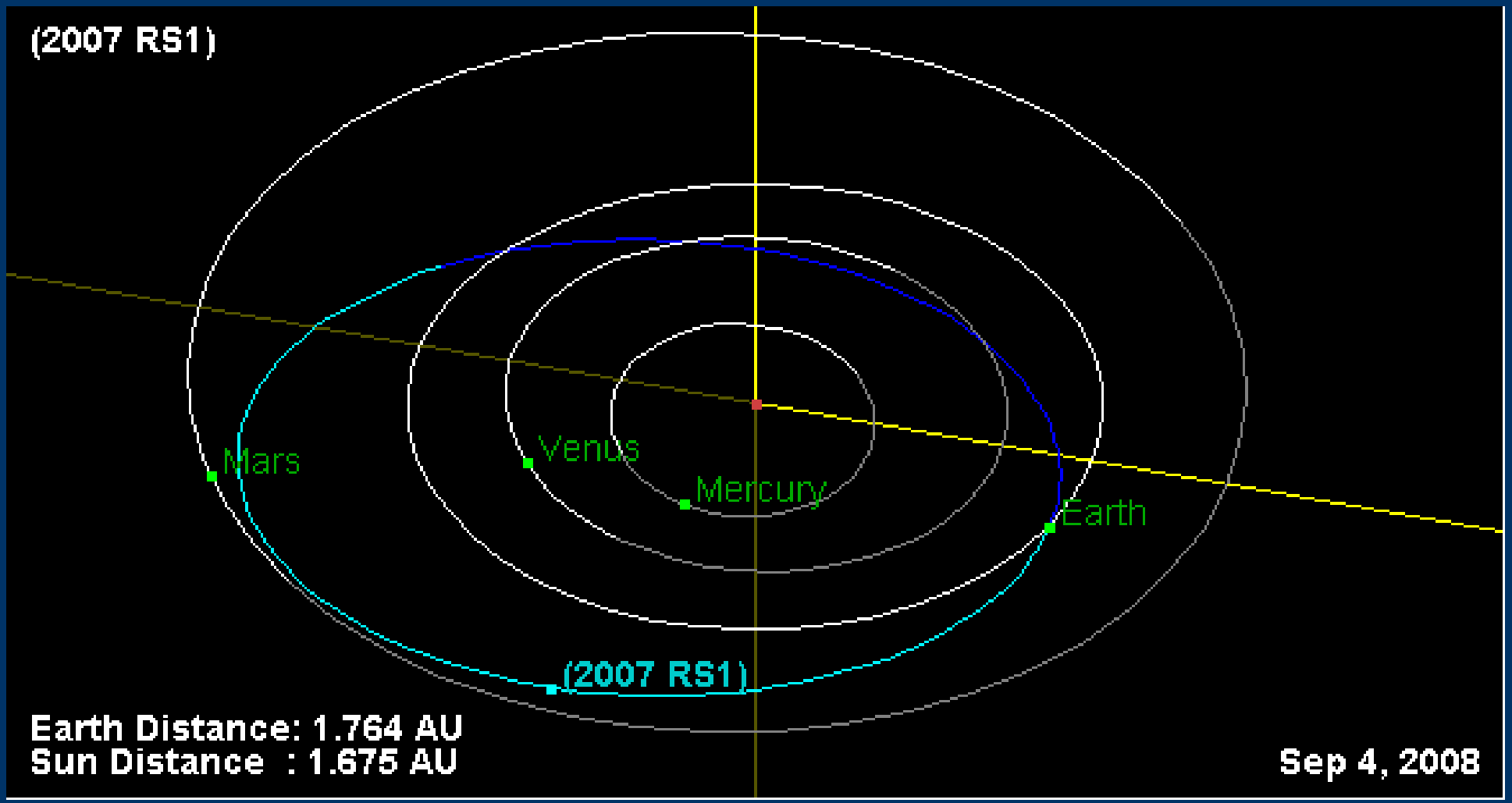
Asteroid (2008 JD33)



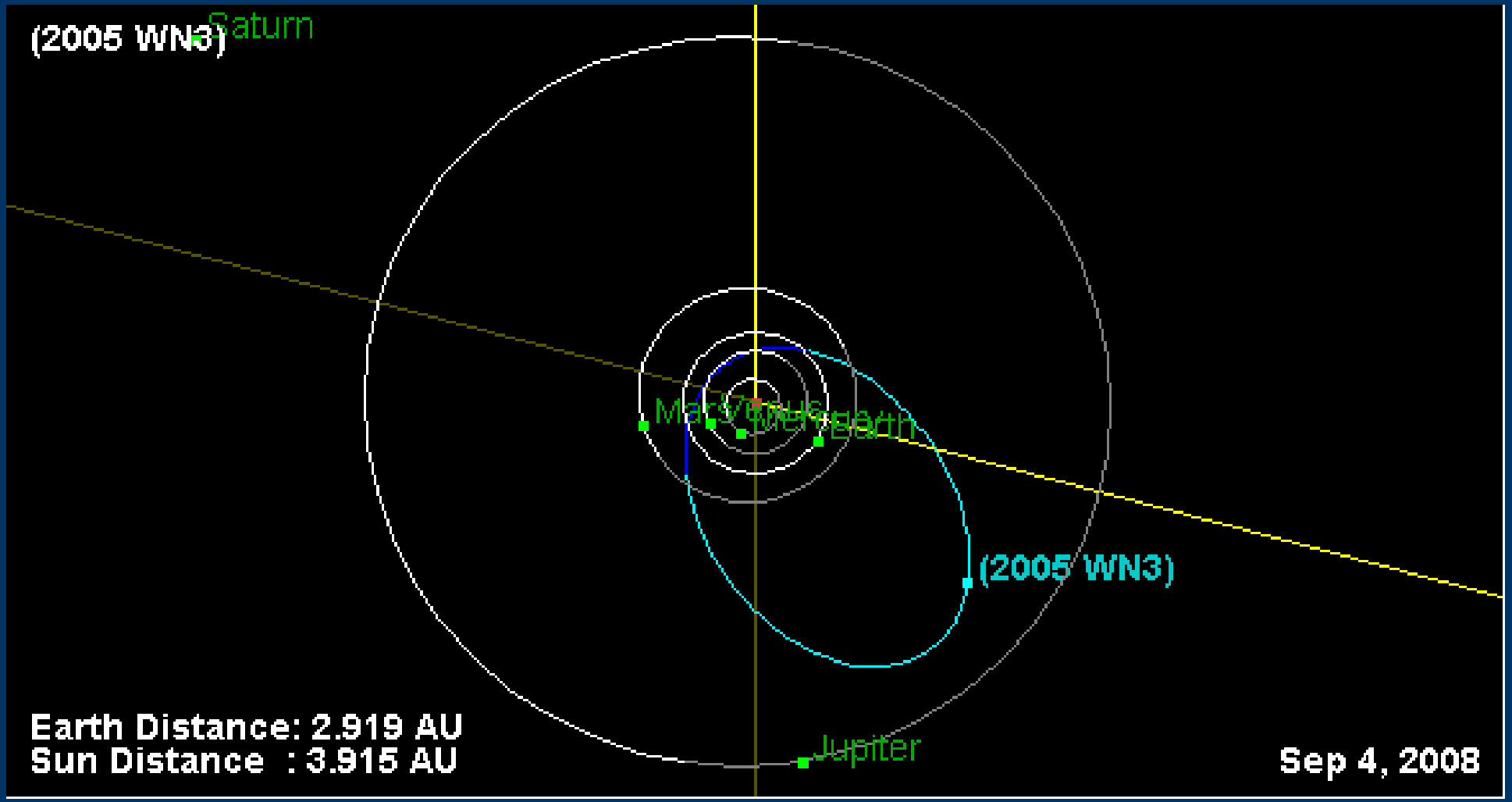
Asteroid (2008 EJ68)



Asteroid (2007 RS1)



Asteroid (2005 WN3)



Basic Premise

1) Commercial Space Exploration and Development can be achieved using bundled multi-mission modular probe deployments
2) Multiple small probes are bundled and simultaneously launched to geostationary orbit
3) Small probes are deployed from geostationary orbit to intercept an NEO
4) A probe “docks” with an NEO
5) Probe re-launches from NEO at destination

- Other Interesting Possibilities

Problems

- Power Source - Solar Panels
  - Larger panels required as distance from Sol increases
- Landing / Docking
  - Method depends on the particulars of each NEO
    - Electro-Magnetic? Power!
    - Harpoon? Mass!
    - Carbon Fiber Net? Potential Coupling Material Strain?
  - Gravity
- Re-launch
  - Fuel supply must be pre-determined for each destination
- Multiple Probes / NEO ?

Commercial and Scientific Applications

- “Real Time” NEO Tracking
  - a.k.a. “NEO Tag and Release”
- Deep Space Relay Network (DSRN)
  - Act as comm relays for Deep Space Probes
- Asteroid.Net (SAWDISC)
  - Sparse Array of Widely Dispersed Communications
  - Potential applications in Radio Astronomy or DSRN
- Asteroid Mining
  - Potential sponsors among mining corporations
    - BHP Billiton?
    - Freeport McMoran?
    - Others?

Further Research

- Identification of Future Interesting NEOs
- Modularization of Small Probes
  - Feasibility of auto-integrating modules in orbit
- Small Asteroid Docking Systems
- Sophisticated Multi-Mission Planning
- Commercial and Scientific Payload Development
- Funding Sources
  - Research Grants: NASA, ESA, NSF, ...
  - Direct Corporate Funding: BHP, FCX, ...
  - Venture Capital

Summary

- Hitch-Hiking The Solar System Is Plausible
- In-depth, funded research study is required
- Commercial Applications Will Follow
  - (if you build it, they will come)
- Environmental Survivability
  - (not addressed here) is a key requirement

Finally, Two Simple Facts:

1) Space is Big
2) Launches are Expensive

- Implications:
  - Smaller systems cost less to launch
  - Traveling significant distances requires significantly more mass (propellent, power, transmitter, antenna, ...)
    - UNLESS
  - You “Share a Ride” with a Proximate NEO

Contact Information

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