

# Prediction of Occultations by TNOs (and Centaurs)

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# Introduction I

- TNO/KBO region beyond Neptune is populated by  $\approx 10^5$  Objects with diameter  $D > 100$  km (Jewitt, Luu, Trujillio, AJ 115, 2125,1998).
- Kuiper Belt Objects (KBOs/TNOs) are of special interest for our understanding of the solar system and his formation.
- They are studied intensively by (professional) solar system scientists.
- In-situ observations are very unlikely within the next two decades (Pluto Express !?).

## Introduction II

- Physical data like diameter calculated indirectly from H value (problem: in general albedo=4% assumed).
- Only for a couple of known objects more reliable data derived from combining thermal and photometrical observations.
- Such observations need large telescopes because  $R \approx 22 - 23$  mag.

## **Introduction III**

With exception of Chiron, Pluto and Charon no occultation by KBOs or Centaurs have ever been observed

# Motivation

- Occultation observations could provide us with physical data like diameter, shape, albedo and possible satellites.
- But : "Classical" prediction very difficult. Large uncertainties (discussed later).  
=> the successful prediction/observation of a TNO occultation is a big challenge to calculators and observers ...

## Some statistics

About 800 KBOs listed at the MPC (Aug.04):

- 385 @ >1Opp, (50000) Quaoar (11Opp)
- More than 50% short arc: < 150d

Orbital revolution times  $\approx 10^2 - 10^3$  years  $\Rightarrow$  even for Quaoar no full revolution covered.

# Uncertainties

- The formal ephemeris uncertainty is rather large because of the short observational arc.
- Even small errors on the sky plane imply rather big shifts/errors on the Earth because of the large geocentral distance of the KBO.

Eg: to achieve a ground track accuracy of about 100 km on Earth, the ephemeris of a TNO ( $a = 45$  AU) must have an accuracy of a few mas !!

# Strategies

- "Ordinary" predictions give only hints about possible events. Without last-minute astrometry the uncertainty on Earth is rather large (not to say "a guess"). Problem: larger telescopes are needed for astrometry updates.
- For a given density number of TNOs you should have  $n$  occ/timeunit up to a certain limiting magnitude. Monitor (a subset of) these stars permanently with a tricky setup of telescopes (to be able to separate the occultations by TNOs) => e.g. TAOS project.
- Other techniques => see F.Roques talk

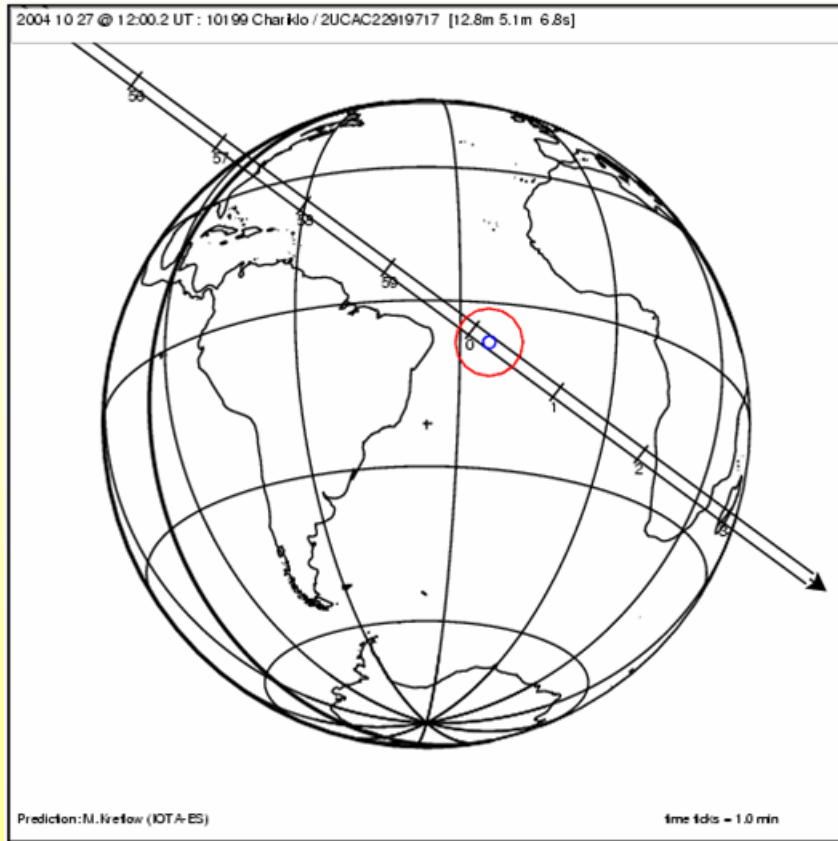


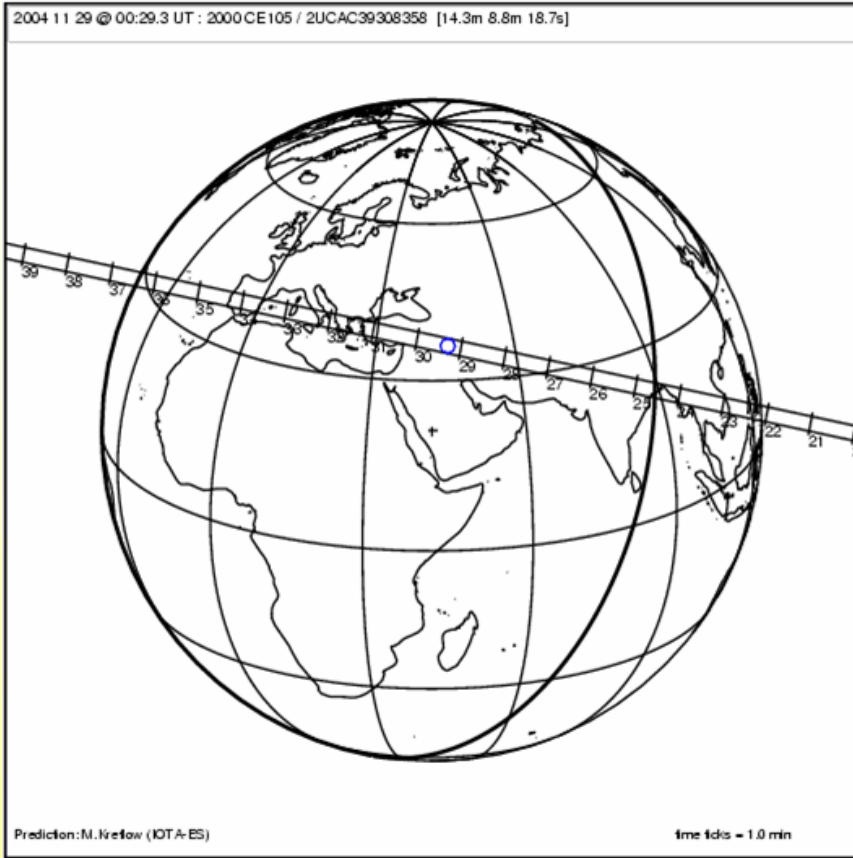
## **(Unsuccessful) attempts in 2004 reported on planoccult**

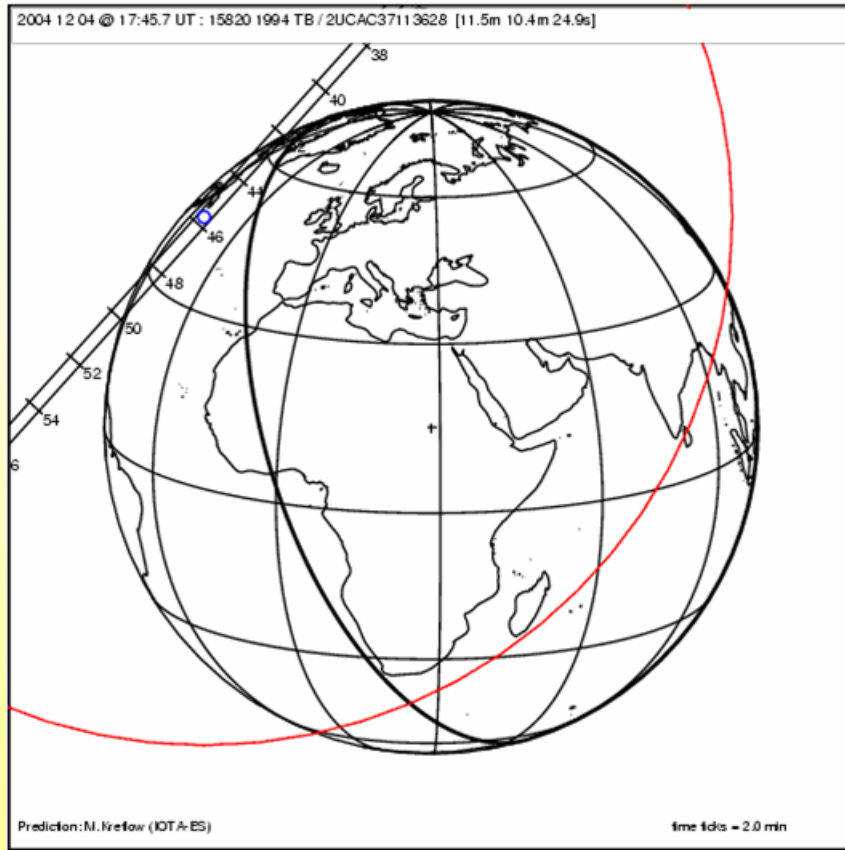
- (55565) 2002 AW197 on January 11 (UK)
- 2001 QD298 on August 9 (DE,IT)

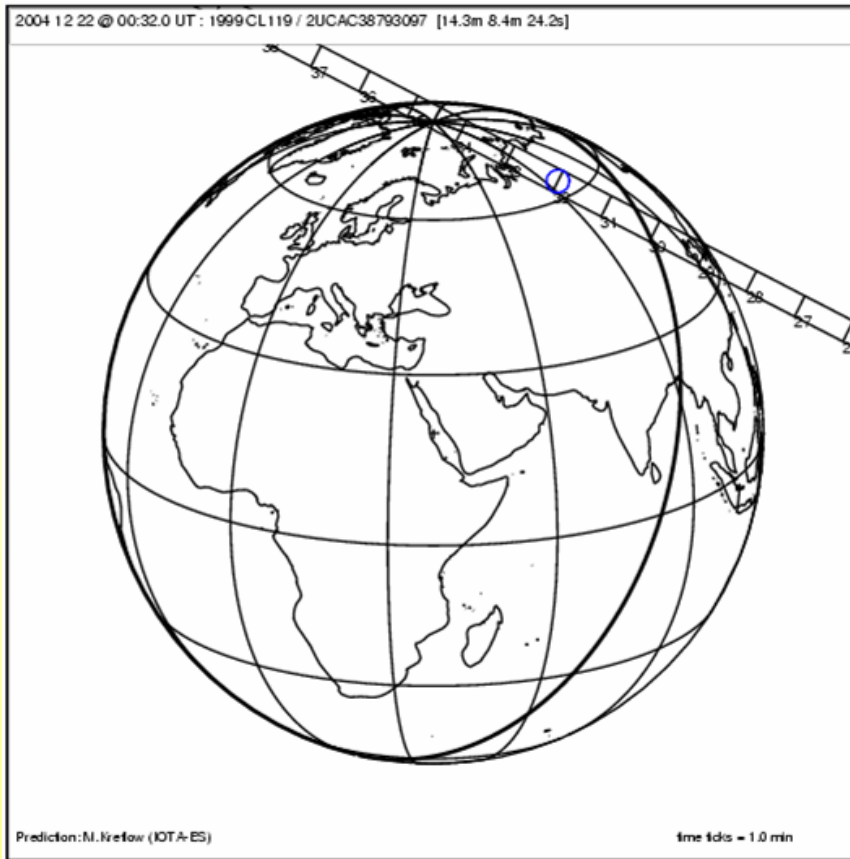
# Outlook

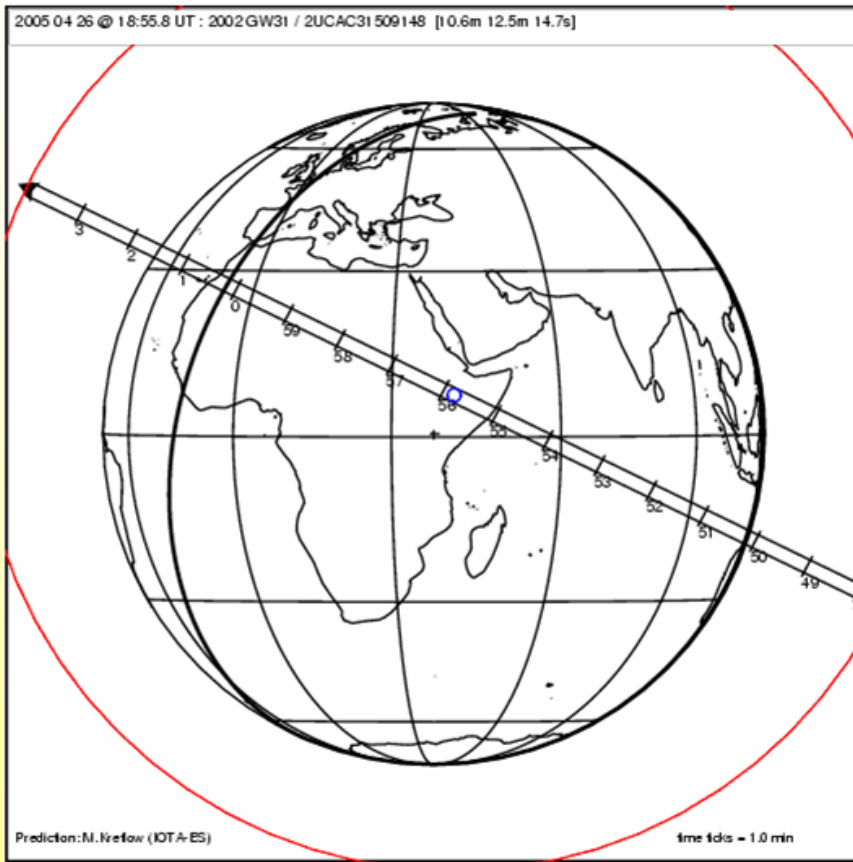
Date	Object	Note
2004 Aug 30	2004 PA44	CEN
2004 Oct 27	(10199) Chariklo	CEN, Namibia
2004 Nov 29	2000 CE105	TNO, 3Opp.
2004 Dec 04	(15820) 1994 TB	TNO, 6Opp.
2004 Dec 22	1999 CL119	TNO, 4Opp.
2005 Apr 26	2002 GW31	TNO, 3Opp.
2005 May 26	2003 WN188	CEN, arc=234d

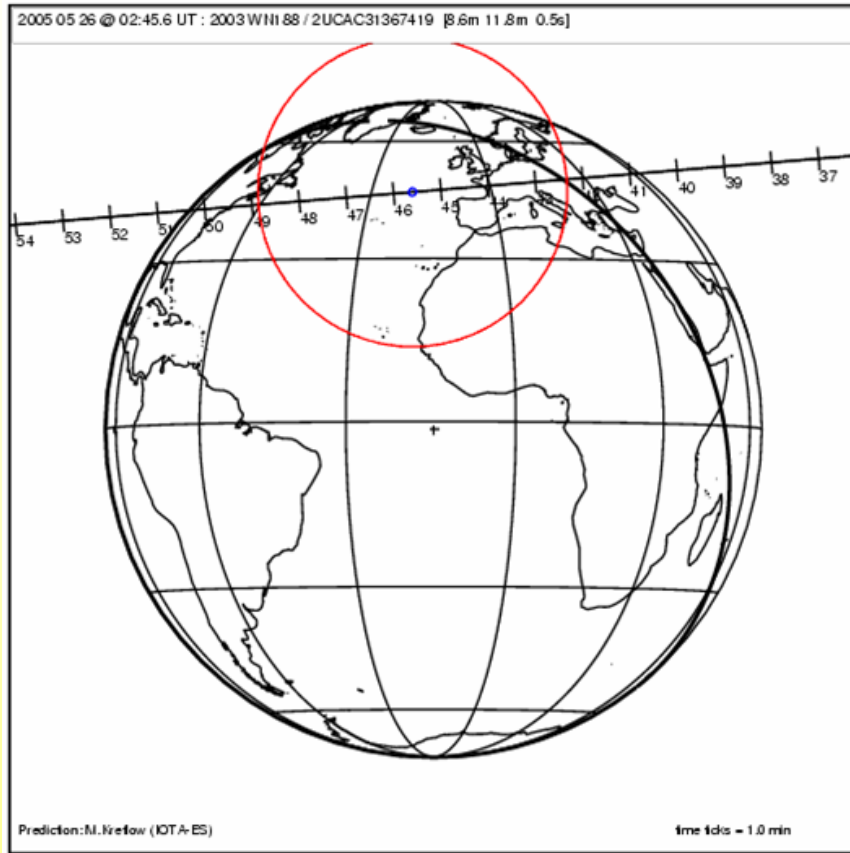














## **Don't give up**

Even the chances are small to catch an occultation by TNOs you should try it, whenever an event is announced.

**Just don't be discouraged when you have a miss  
(but report it!)**