



# Amateur Photometric Monitoring of Comets

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# We are all aware of what amateurs can do...

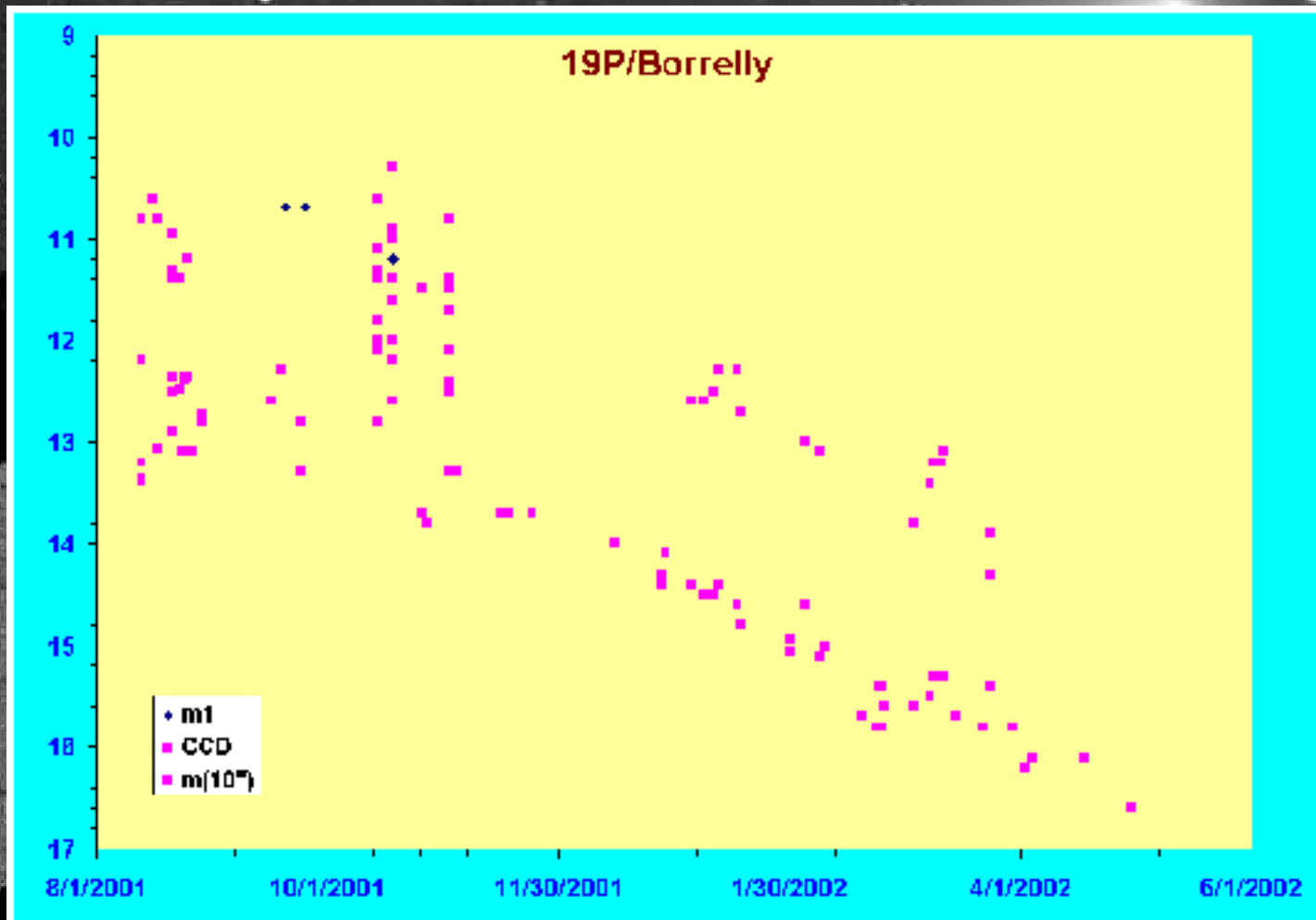
- Many amateurs are now equipped with good CCDs and telescopes of 30-40 cm diameter, under computer control.
- Initially used mainly for astrometry and “pretty pictures”.



- Amateur astronomers take large quantities of astrometry, but the associated photometry has mainly been “thrown away”.
- Photometry has been a “come as you are party”
  - Any aperture
  - Any method
  - Any filter (or no filter)
  - The photometry is virtually unusable.



# A typical example: 19P/Borrelly



©2002 T7 2004 02 11 19:24 LX200 12" F5 MX716 4x6x60 sec 2.5 arc sec/pxel each frame 167x127

J. Lacruz, J87 La Cañada

# The “Observadores\_cometas” group

- More than 80 members and collaborators in 8 countries on 3 continents.
- Mainly Spanish language (but includes a number of English, Italian and Portuguese speakers).
- A large percentage are active observers
- About two thirds of the active members use CCD with telescopes from 20-40 cm.
- Regularly observe comets as faint as  $R=18$ .

# Standardise what can be controlled

- **Standard aperture for photometry**
  - 10 arcseconds – compatible with the normal pixel size of amateur CCDs.
- **Treat unfiltered data as R and reduce using a common reference catalogue**
  - USNO A2.0 is closest to “Landolt” R and has reasonable photometric errors.
- **Sky subtract with the median of the frame.**
- **Use a common reduction routine**
  - Initially “Astrometrica”, but now using a routine “FOCAS” written by a group member for this project.

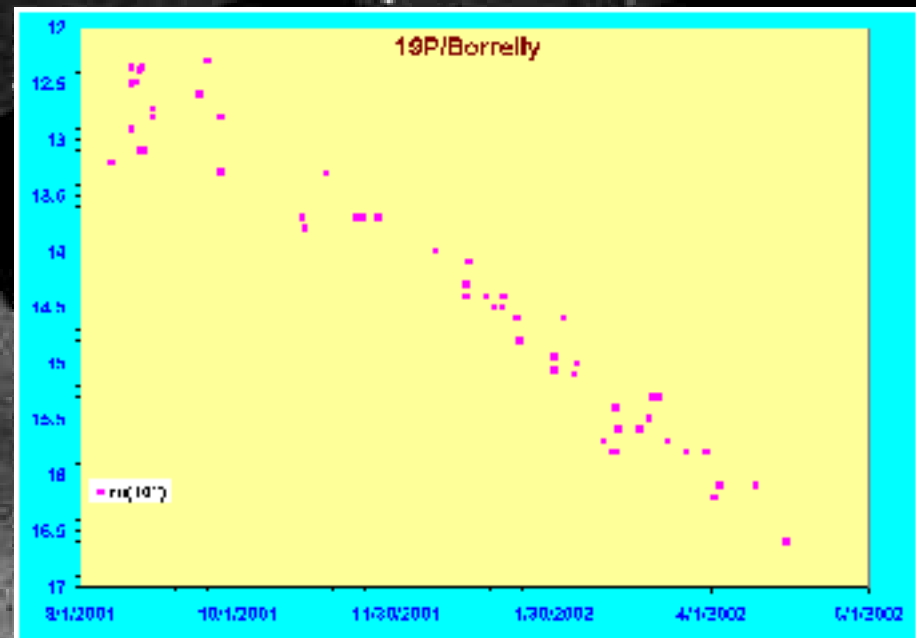
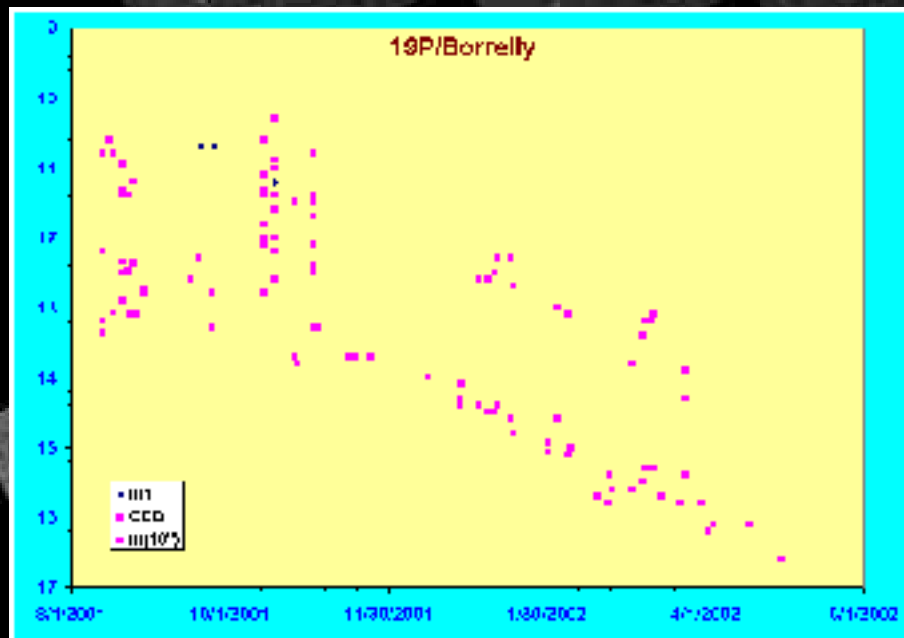
- **The FOCAS routine gives multiaperture photometry**
  - 10, 20, 30, 40 & 60 arcseconds
  - For very bright, nearby comets, 150 & 300 arcseconds may be used.
  - We define a “coma index”  $m_{ap} = a.r^b$
  - For an  $r^{-1}$  coma law we expect  $b = -2.5$
  - The observed average coma index is  $-2.5!$
  - This allows reduction to a standard physical aperture (generally 10 000 or 25 000km, depending on the distance of the comet).

Early attempt at standardisation...

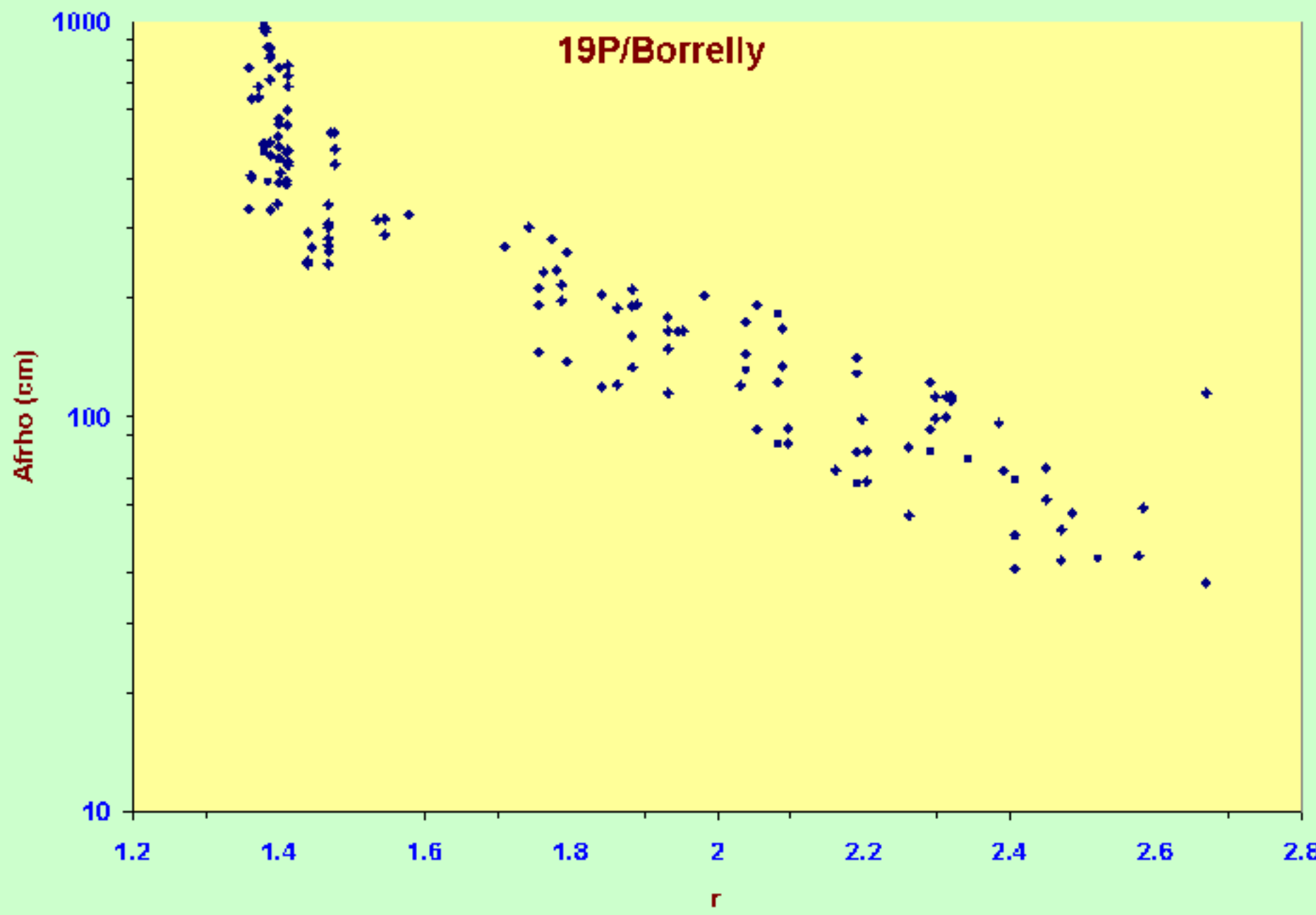
Only applying standard aperture and band.

Before

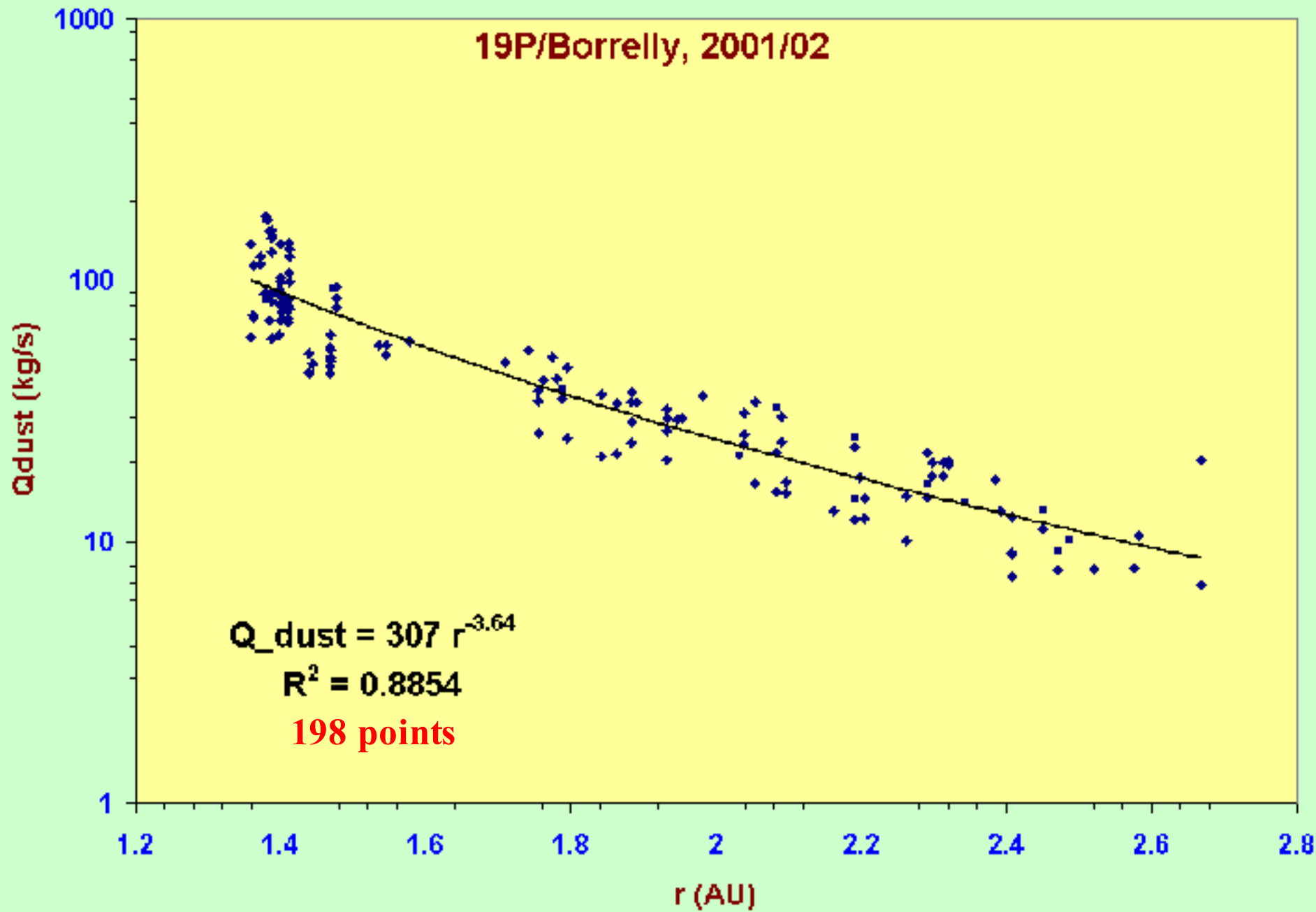
After



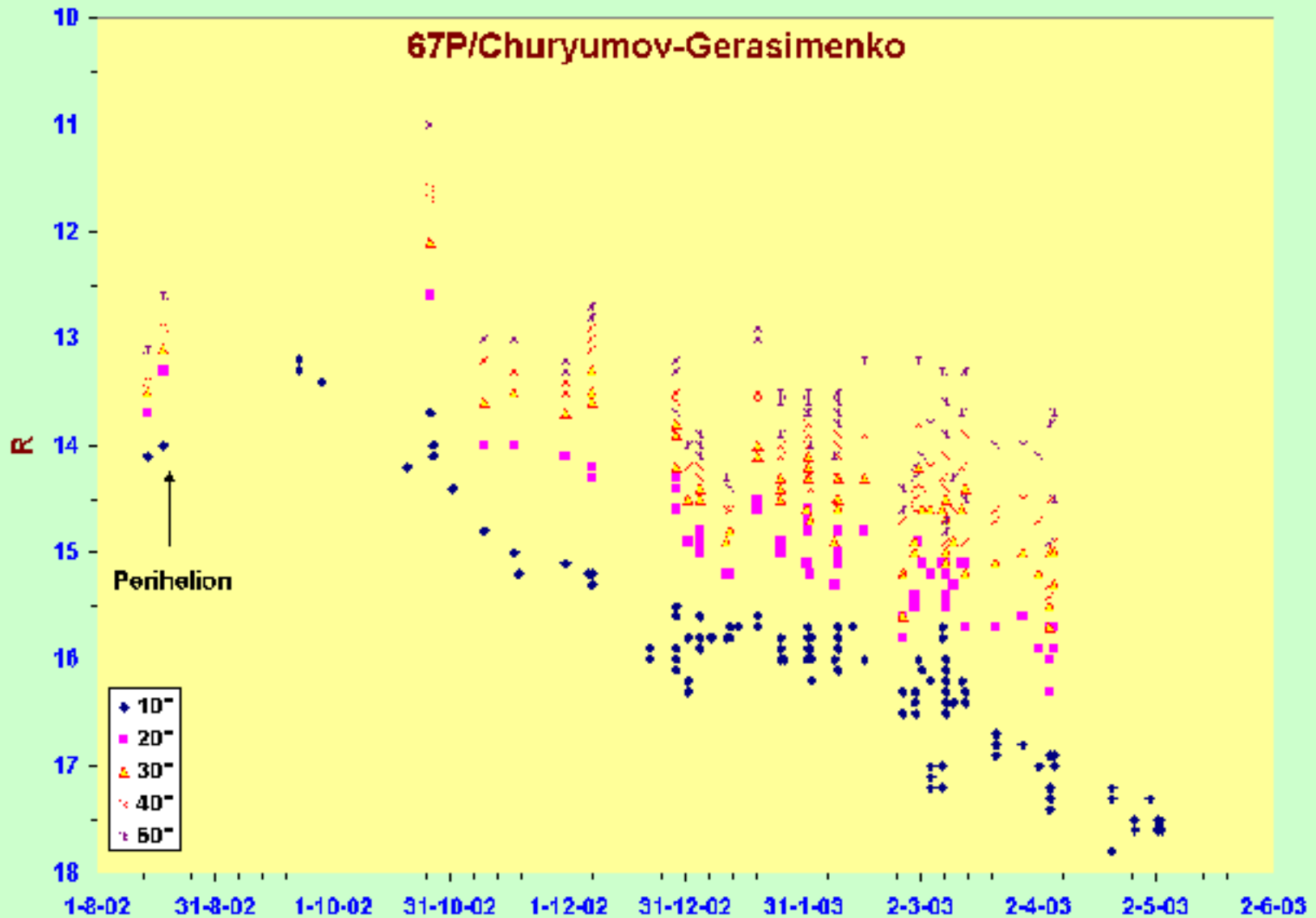
# 19P/Borrelly

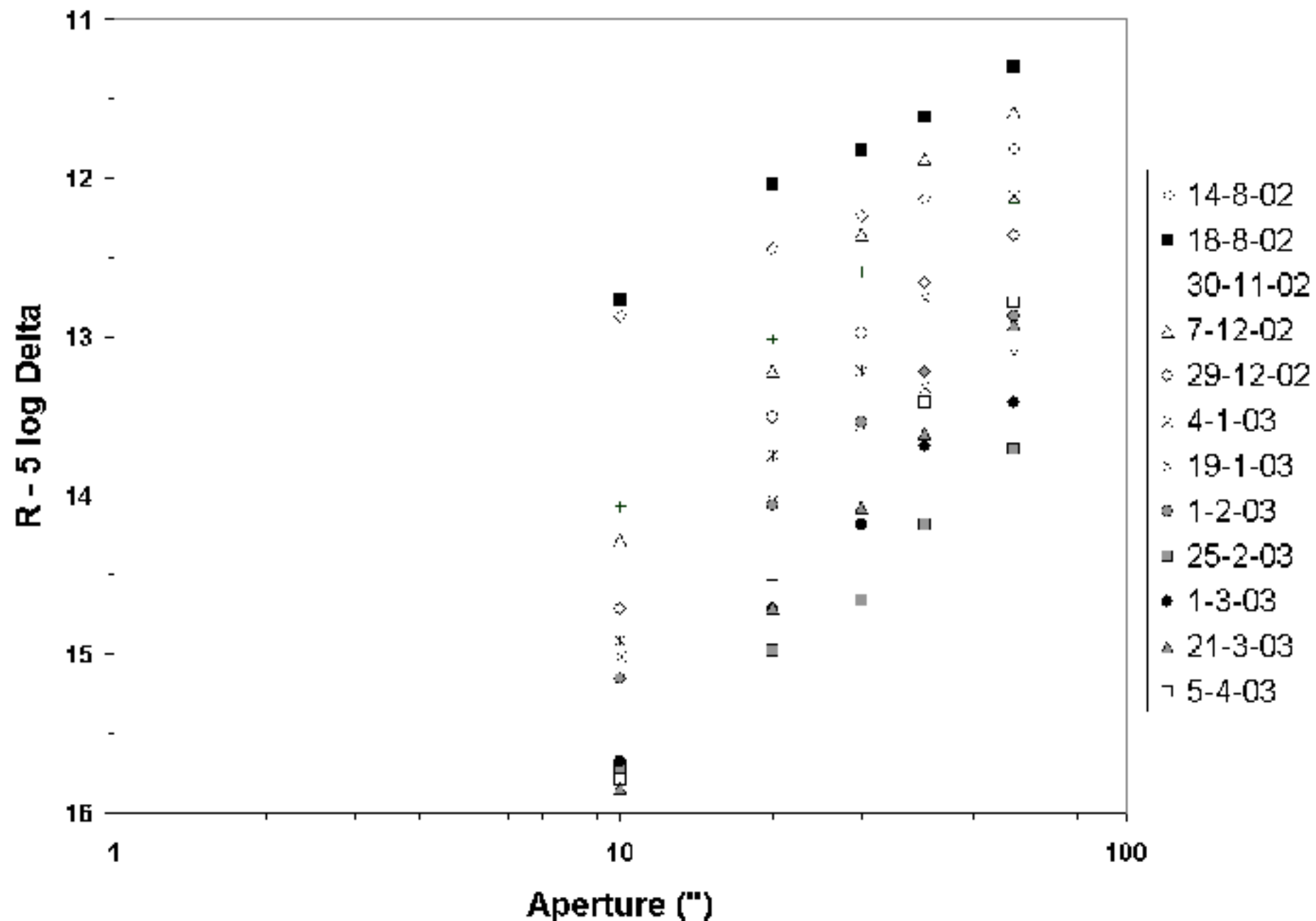


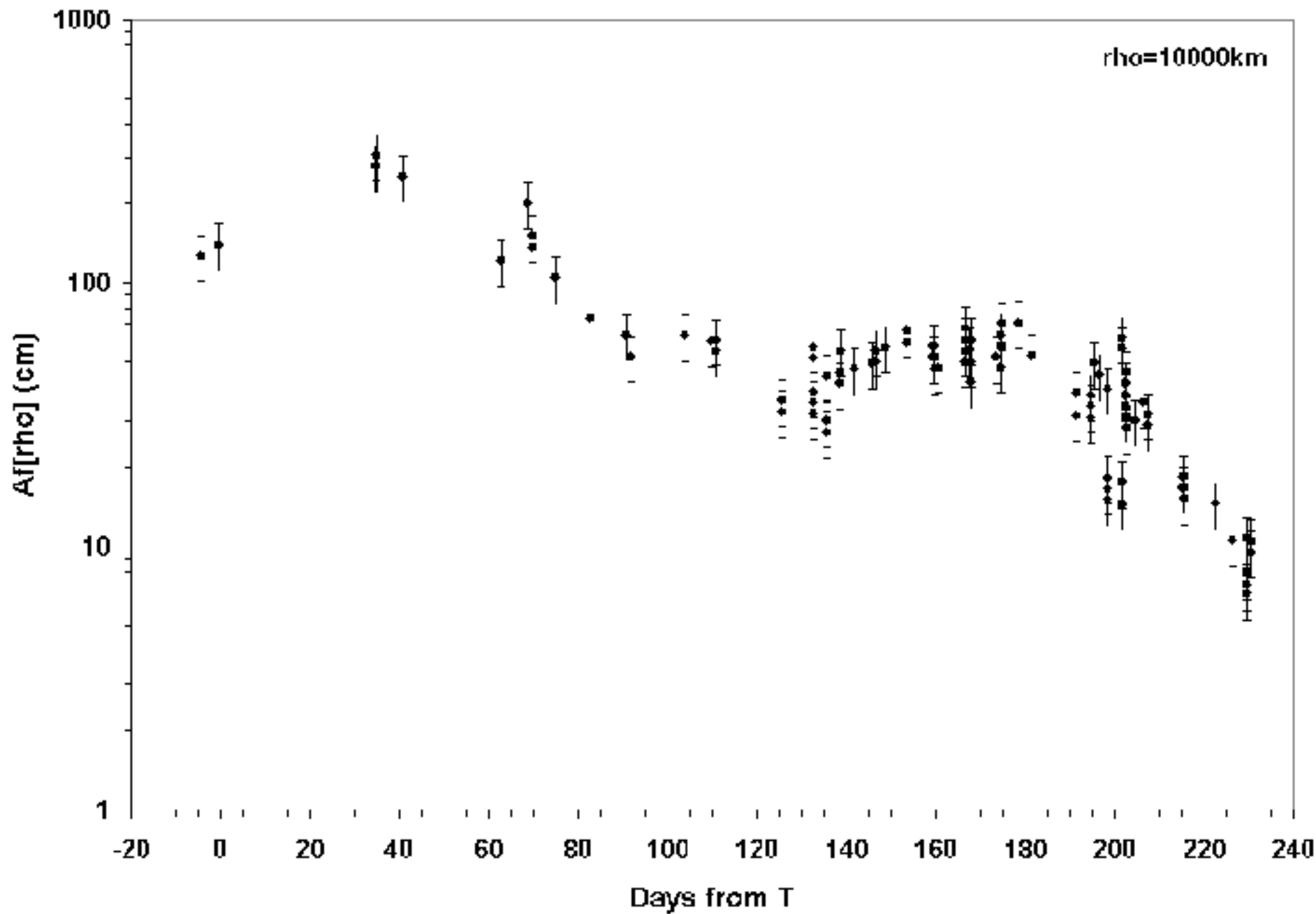
# 19P/Borrelly, 2001/02



# 67P/Churyumov-Gerasimenko





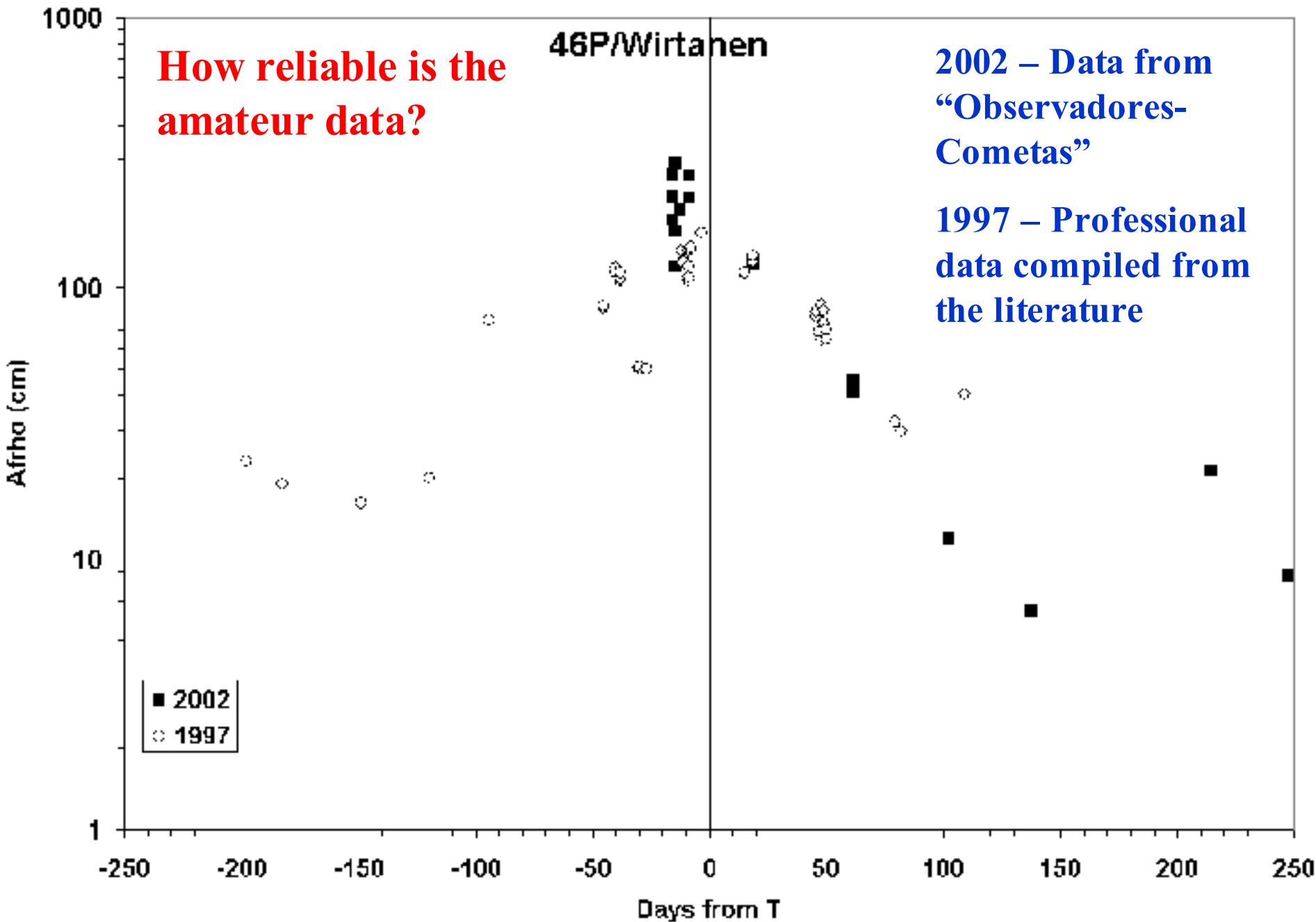


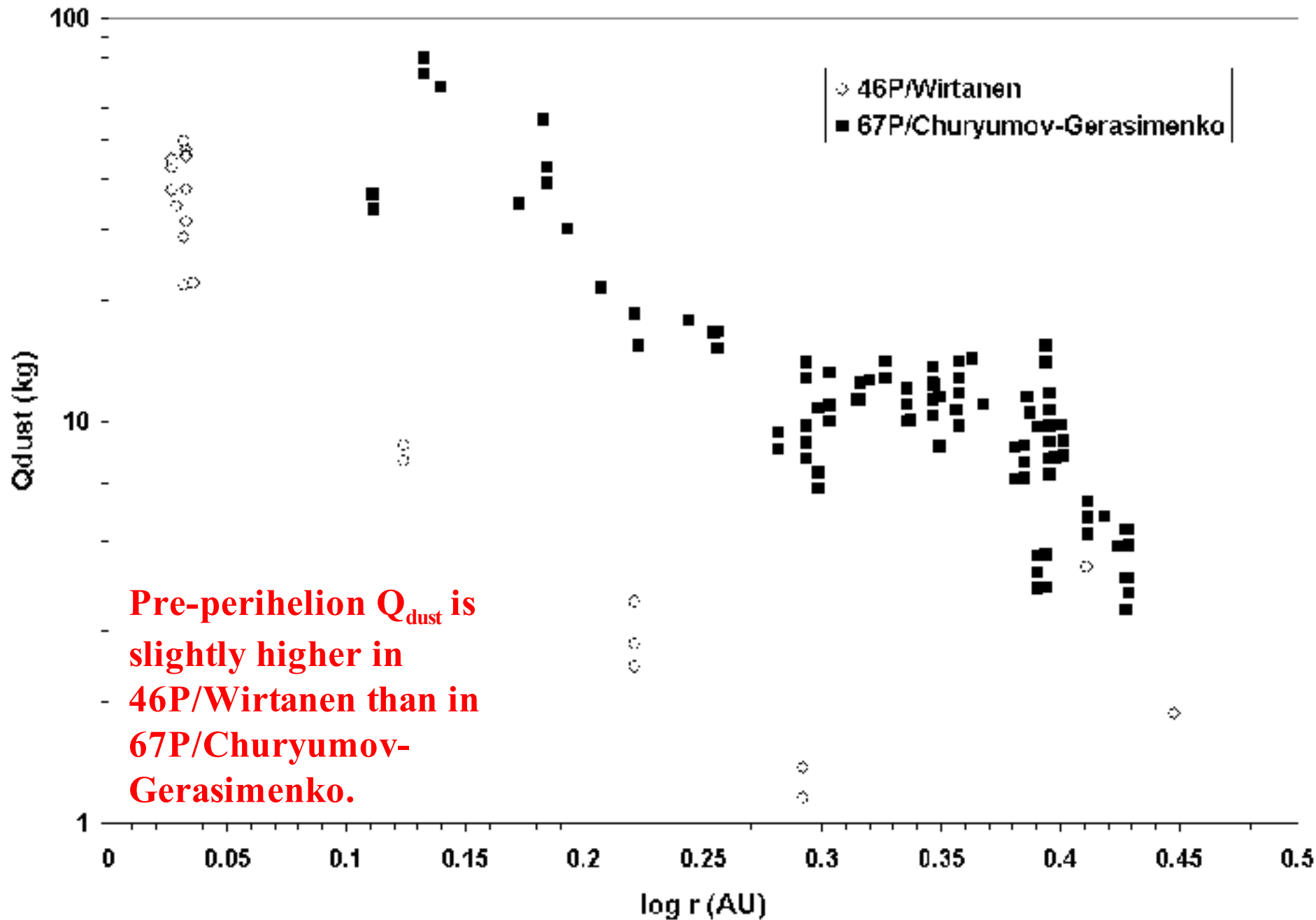
**How reliable is the amateur data?**

**46P/Wirtanen**

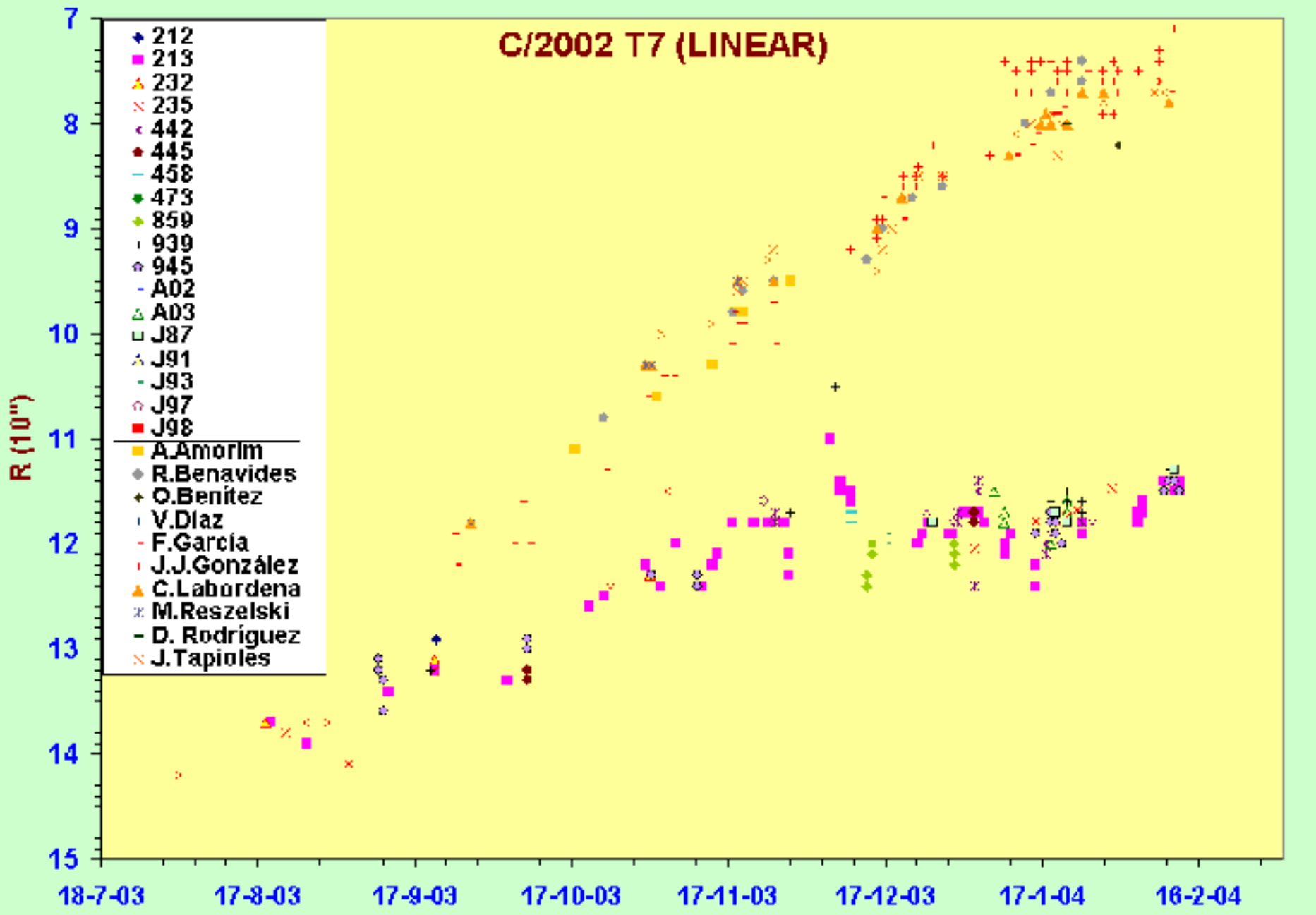
**2002 – Data from “Observadores-Cometas”**

**1997 – Professional data compiled from the literature**

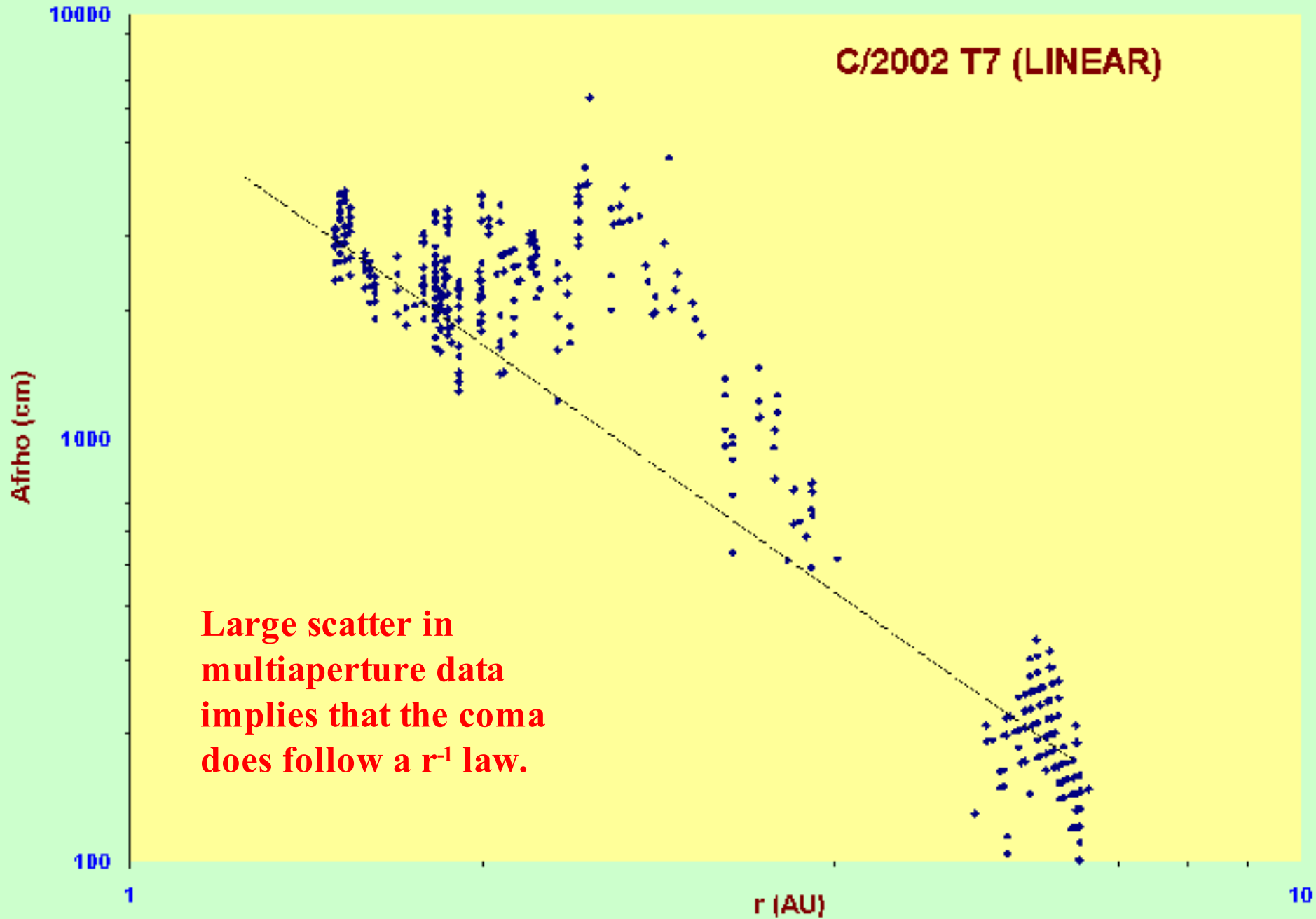




# C/2002 T7 (LINEAR)

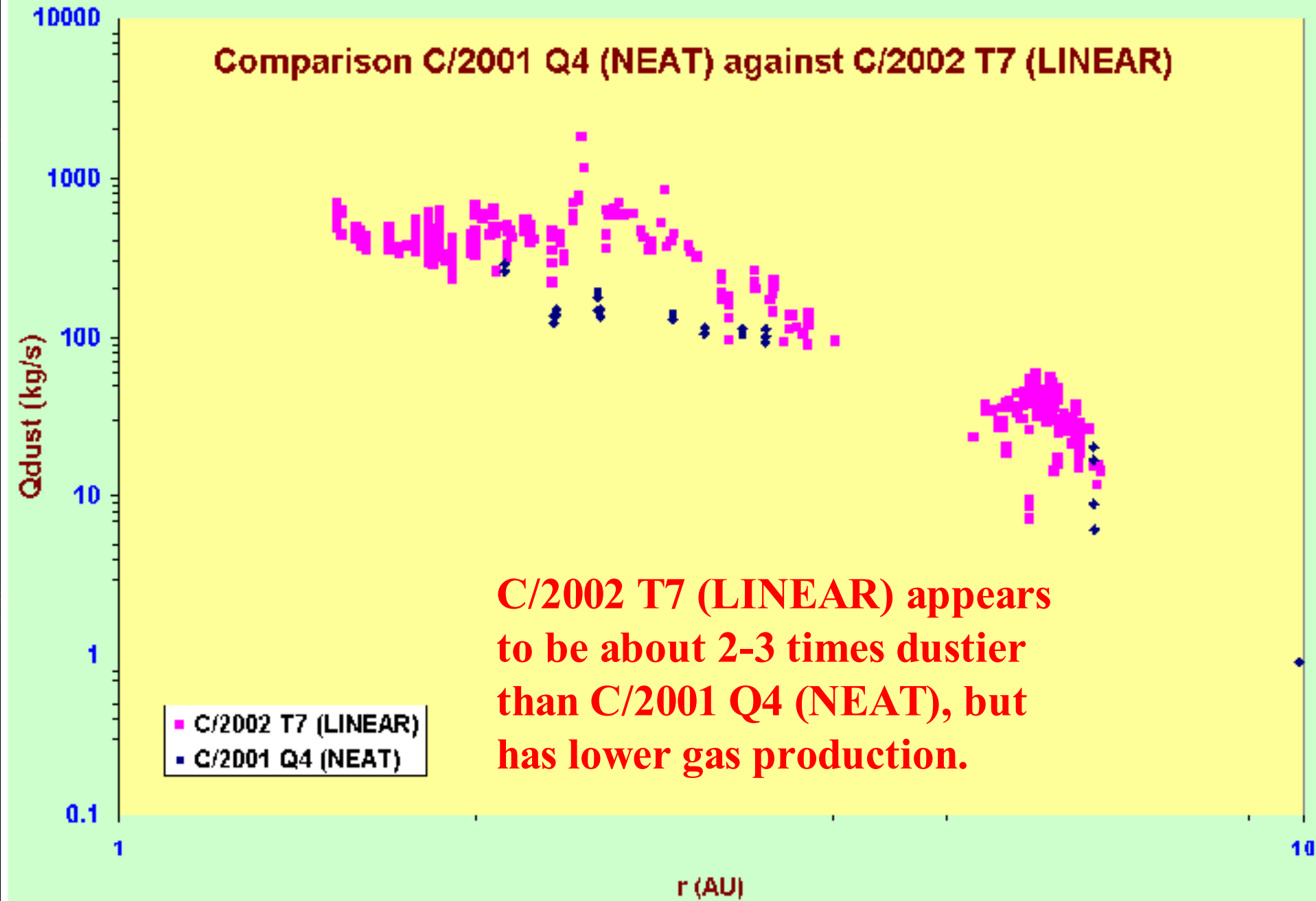


# C/2002 T7 (LINEAR)



**Large scatter in  
multiaperture data  
implies that the coma  
does follow a  $r^{-1}$  law.**

# Comparison C/2001 Q4 (NEAT) against C/2002 T7 (LINEAR)



# Conclusions

- Amateur photometry of 9P/Tempel 1 can be a valuable resource to support the Deep Impact mission because of its high intensity of light curve coverage.
- Carefully standardised amateur data is of a quality little inferior to customised professional photometry.
- Don't just ask the amateurs to take pretty pictures!!!