Mercury Transit 2006

Patrick P. Murphy, Ph.D.
National Radio Astronomy Observatory
(and long-time Amateur Astronomer)
TUNA Presentation 2006.11.07
Re-presentation of a talk given to the Blue Ridge Astronomy Club, Lynchburg, VA, 2006.10.24
Overview

• The Basics — What's happening?
• History of Mercury Transits (inc. my 1973 obs)
• What is this transit good for?
• Observing (some of) the transit from Virginia
  – handouts with "how to", times, more.
• Safety!!!!!
• Questions, comments, etc.
The Basics

• Orbits not perfect
  – Mercury's orbit inclined at 7°
  – Also highly eccentric
    • Sun subtends < 2 degrees at aphelion
    • Sun subtends > 3 degrees at perihelion!
    • Compare to ½ degree from Earth

• Transits infrequent
• On average, only 13 per century
• Occur in May and November
  – due to resonance between orbits
History of Mercury Transits

• 1\textsuperscript{st} known: Nov. 7, 1631 Pierre Gassendi

• 14 Transits in 20\textsuperscript{th} Century
  – including 1973, Author's first!
    • See next slide for log book entry

• 21\textsuperscript{st} Cent.: 2003, 2006, 2016, 2019, 2032...
  – Total of 12 after this upcoming transit.

• Venus: 6\textsuperscript{th} June 2012, then not till 2117.
  – This will be more impressive (weather permitting!)
Sat. 10/11/1973
Me. 2-73
Transit

Mercury: Observed latter half of Transit of Mercury at Eddie Lunnity's observatory (10" Schmidt-Cassegrain) Telescope stopped down to 4", and selected magnitude 3% of light with various filters 7 Camera. Also Projection. Dr. of cam 3 1/4 inches - mercury, Duration 125 days (Miles) 1 min 25 sec after observation (Took me 1 hour) with 60mm (3x Projector) Telescope - we weren't the last - made out 4" of Mercury's 3" absolute limit of Resolution! Took some shots afterwards then deleted.

Eddie Lunnity's 10" Celestron Schmidt (Cassegrain) with Camera & 1 omega 15 13.5 in Observatory on Southern 3 Rock Rd.
Me. 10th Nov. 1973
What is the Transit Good For?

• At one time: determine scale of solar system
  – use parallax and triangulation (see next slide)
• Now: other techniques better (e.g., radar)
• Rare event: not many lifetime opportunities
  – so take advantage of this one!
• Great way to envision size of the Sun!
• Timing is still useful (more later...)
Parallax / Triangulation for a Venus transit
- Principle applies to Mercury Transits also.
- Different locations on Earth observe duration of transit
- Timing used to calculate ingress, egress points
What does it look like?
November 8, 2006: Virginia

Details for Richmond:

- Externel Ingress: 2:12pm
- Sun Altitude at Ingress: 27°
- Internal Ingress: 2:14pm
- Mid Transit: 4:41pm
- Sun Altitude at mid: 4°
- Internal Egress: After sunset

November 8, 2006: Virginia (2)

Details for Charlottesville:

- External Ingress: 2:12:19pm
- Sun Altitude at Ingress: 26°.8
- Internal Ingress: 2:14:12pm
- Position Angle: +141°
- Minimum Separation: 4:40:48pm
- Sun Altitude at mid: 4°.0
- Internal Egress: After sunset

Source: http://home.hetnet.nl/~smvanroode/mercury.html
Orientation, Angles...

- See first handout
- NCP (North Celestial Pole) will be at an Angle
- With Astronomical refractor or reflector, image will be upside down!
The "Black Drop" Effect

- Ingress and Egress
- Seems to "connect" with Sun's edge
- Limb Darkening
- Not Earthbound
- Seen from space too

Source: Schneider, Pasachoff, Golub: AAS New Orleans, 2001
http://nicmosis.as.arizona.edu:8000/POSTERS
How to Observe the Transit

• **CAREFULLY!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!**

• NEVER LOOK DIRECTLY AT THE SUN
  – We know you know this, but it's important!

• NEVER USE AN EYEPiece SUN FILTER!!!

• **Use PROJECTION:** safest way, best magnification

• Telescope no larger than 4" (120mm) diameter
  – stop down larger scopes to 4" (no resolution loss)
  – If you must do direct observation:
    • use a solar filter (objective)
    • Disable or remove those finder scopes!

• Cardboard cutout around scope: shade for image
Web Links: Safety, Equipment...

• List of some vendors of safe solar filters

• Eye Safety during Solar Eclipses (good for transits too)

• A Solar Observing Refresher Course (from S&T)

• Observing the Sun by Projection (also from S&T)

• Avoid "blind date" with the Sun!
  - http://www.transitofvenus.org/safety.htm
What can YOU do?

"Amateurs can make a useful contribution by timing the four contacts at ingress and egress. Observing techniques and equipment are similar to those used for lunar occultations. Since poor seeing often increases the uncertainty in contact timings, an estimate of the possible error associated with each timing should be included. Transit timings and geographic coordinates of the observing site (measured from a topographic map or GPS) should be sent to Dr. John Westfall (johnwestfall@comcast.net), A.L.P.O. Mercury/Venus Transit Section, P.O. Box 2447, Antioch, CA 94531-2447".

Source: NASA Eclipse Home page

http://sunearth.gsfc.nasa.gov/eclipse/OH/transit06.html
Conclusions

- Mercury transits: only 13 per century
- Safety (can't emphasize this enough!)
- Scale of solar system

Questions?

http://www.cv.nrao.edu/~pmurphy/Talks/Mercury-Transit-2006