

**Astronomy 100**  
**Section 2– MWF 1200-1300**  
**100 Greg Hall**



**Leslie Looney**  
**Phone: 217-244-3615**  
**Email: lwl @ uiuc . edu**  
**Office: Astro Building #218**  
**Office Hours:**  
**MTF 10:30-11:30 a.m. or by**  
**appointment**

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**How to View/Print Lectures**



1. Use Adobe PDF viewer (acrobat).  
Download from  
<http://www.adobe.com/products/acrobat/readstep2.html>

2. View in Microsoft Office-- Powerpoint

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**Step to step**



- Download from the web. In Internet Explorer right click on pdf, “save target as”.

For Acrobat

- click “file” then “print”
- brings up print menu, choose correct printer, then click properties
- MOST printers have an option for number of “pages per sheet”.
- Best option is 2 pages per sheet with landscape orientation

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**Step to step**



- Download from the web. In Internet Explorer right click on powerpoint, “save target as”.

For Microsoft Powerpoint

- Just like Acrobat in the print menu
- Or click file, print, then at the bottom of the print menu, choose “print handouts”, then choose 2 slides per page

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# Observing



You must do at least one of the following. If you do more, then you can drop up to 2 HW grades.

1. Nighttime Observing project.  
<http://www.astro.uiuc.edu/classes/obs.shtml>
2. Solar Observing Project.  
<http://www.astro.uiuc.edu/classes/obs.shtml>
3. Planetarium Observing Project.  
<http://www.astro.uiuc.edu/classes/planetarium/>

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# Outline



- Seasons– revisited– it's all about the tilt
- Phases of the Moon– revisited– it's all about the position
- Lunar Eclipses
- Solar Eclipses
- Dance of the Planets

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# Fun with Seasons



<http://www.astro.uiuc.edu/projects/data/Seasons/seasons.html>

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# Phases of the Moon



- Phases of the Moon are caused by the relative positions of the Earth, Moon, and Sun.
- The Moon does not give off any light of its own. The light we see is reflected sunlight. It reflects only about 10% of the light.

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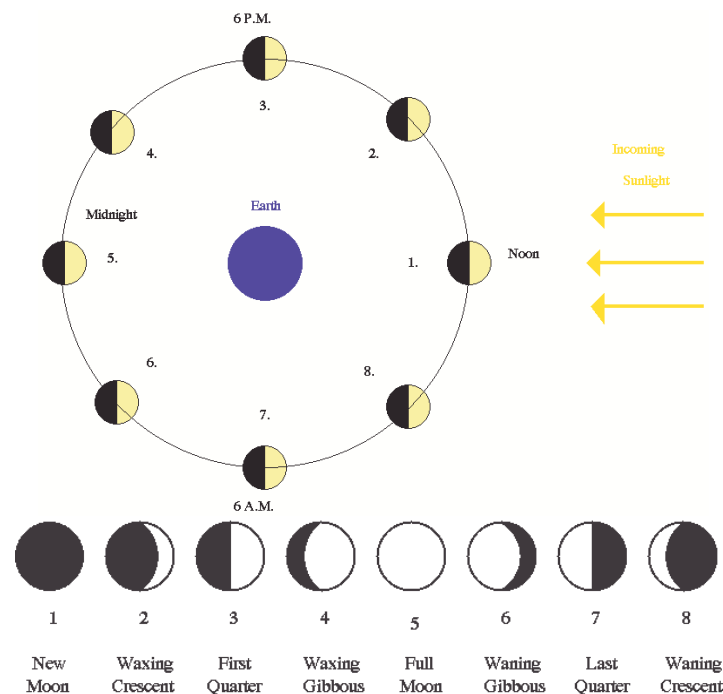
# Moon Phase Demo



<http://www.astro.uiuc.edu/projects/data/MoonPhases/index.html>

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## Dark Side of the Moon?



Is there really a dark side of the Moon?

NO! It is better called the Far Side of the Moon.

As we will learn again later, the Moon rotates once every orbit.

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## Current Phase?



At end of class, I requested we think about the current phase of the moon?



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# Lunar Eclipses



A lunar eclipse is when the Moon enters the Earth's Shadow. The Earth's shadow has nothing to do with the Moon's phases, but it can cause beautiful lunar eclipses.



[http://antwrp.gsfc.nasa.gov/apod/image/0007/nzeclipse\\_munford\\_big.jpg](http://antwrp.gsfc.nasa.gov/apod/image/0007/nzeclipse_munford_big.jpg)

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# When can a Lunar Eclipses Occur?



1. Only in Summer when the Moon is behind the Earth.
2. Every Full Moon when the Earth's Shadow intersects the Moon.
3. Only when the Sun, Earth, and Moon is in a straight line– Full Moon when the Moon intersects the Ecliptic.

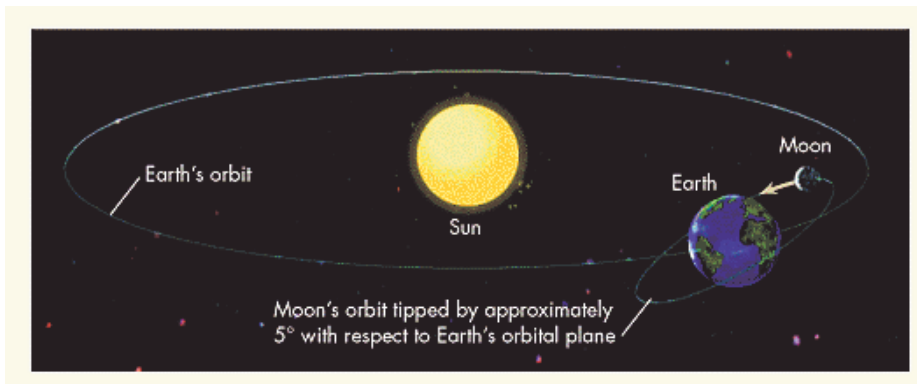
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# The Moon's Orbit is Tilted



Moon's orbit is tilted by about 5 degrees with respect to the Earth's Plane.



<http://www.ociw.edu/~mhamuy/moon.html>

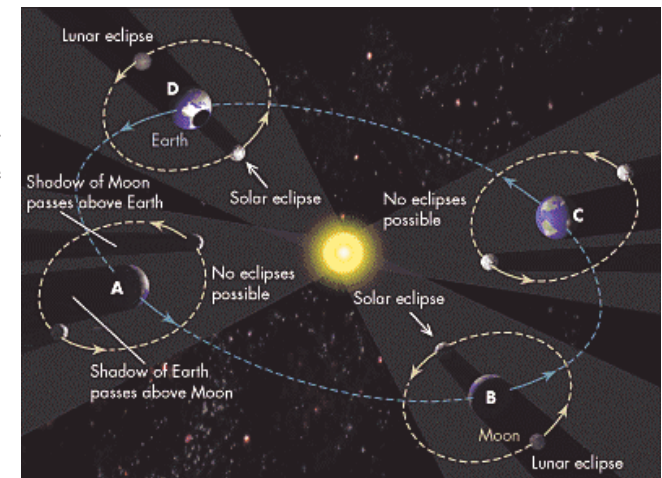
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# Eclipse Seasons



Nodes are the two points in each orbit at which the Moon crosses the Earth's orbital plane. For lunar or solar eclipses to occur the nodes must be aligned with the Earth and the Sun. Hence, eclipses can occur only twice per year and these epochs are called eclipse seasons.

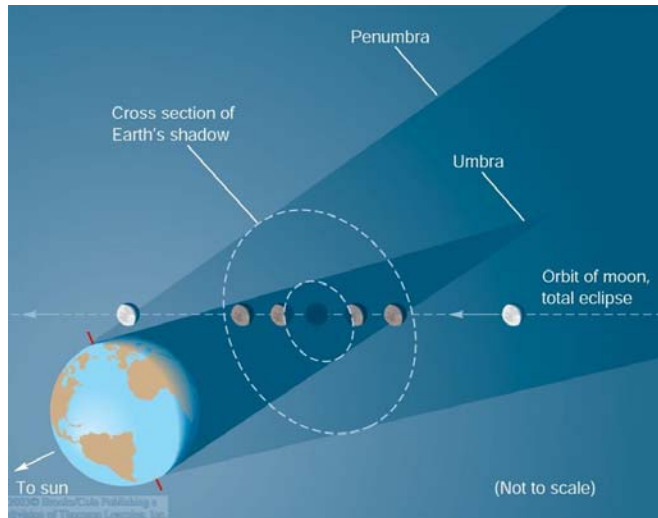


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<http://www.ociw.edu/~mhamuy/moon.html>

# Total Lunar Eclipse



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# Total Lunar Eclipse— Time Lapse



- Occurs when the Moon passes through Earth's umbra completely.



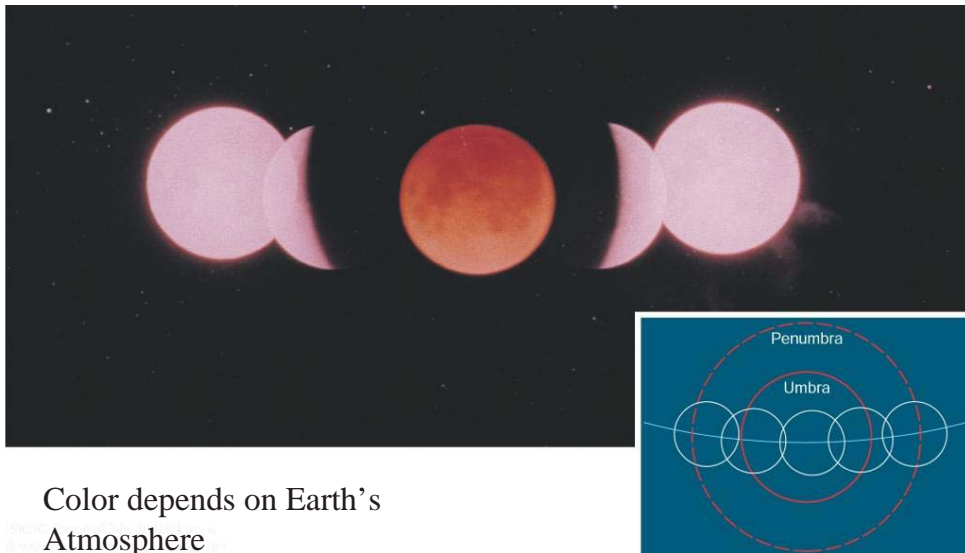
- Occur roughly twice a year, and last for about an hour or two.
- Can be seen by anyone experiencing night during the lunar eclipse.

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<http://www.mreclipse.com/LEphoto/TLE20001/T00sequence1w.JPG>

# Eclipsed

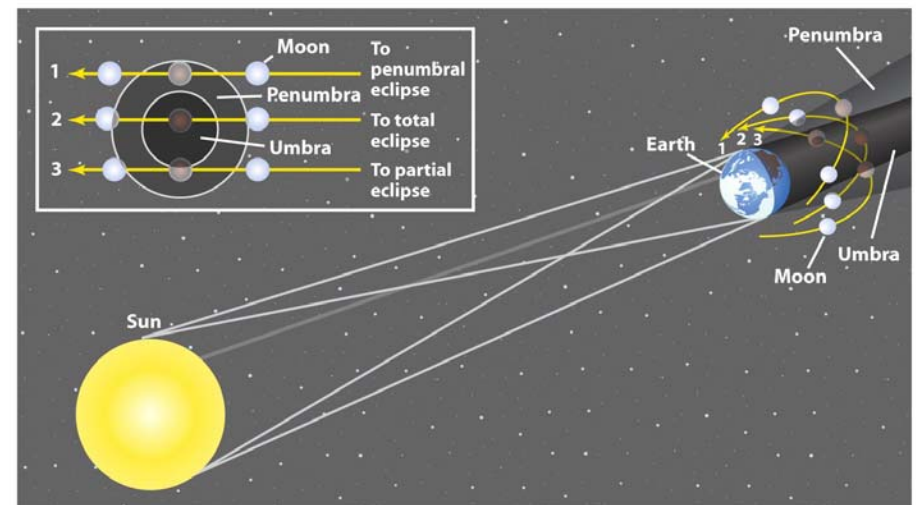


Color depends on Earth's Atmosphere

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# 3 Types of Lunar Eclipses



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# Solar Eclipses



- Occur when the Moon casts a shadow on the Earth.
- Only possible because the Moon and Sun are approximately the same size as seen from Earth, around  $\frac{1}{2}$  a degree.
- Occur roughly twice a year, and last only a matter of minutes.
- Viewable only in a very small band of area across the Earth (about 270 km in width).



Erding, Germany 1999

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# Digitally Added Picture



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[http://antwrp.gsfc.nasa.gov/apod/image/9909/corona99\\_espanek.jpg](http://antwrp.gsfc.nasa.gov/apod/image/9909/corona99_espanek.jpg)

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# An Eclipse Movie



<http://www.saxton.org/eclipse/eclipse.mov>

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# Diamond Ring



© 2001 by F. Espenak, [www.MrEclipse.com](http://www.MrEclipse.com)

<http://antwrp.gsfc.nasa.gov/apod/ap010621.html>

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# Annular Eclipse



There is a small difference (a few percent) in the size of the Moon, due to a slightly elliptical orbit. When the Moon is at its farthest, a total eclipse is not possible. An annular eclipse is seen more often than total eclipses.



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[http://antwrp.gsfc.nasa.gov/apod/image/9808/annulareclipse\\_staiger\\_big.jpg](http://antwrp.gsfc.nasa.gov/apod/image/9808/annulareclipse_staiger_big.jpg)  
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# Apparent Moon Sizes



Perigee

Apogee



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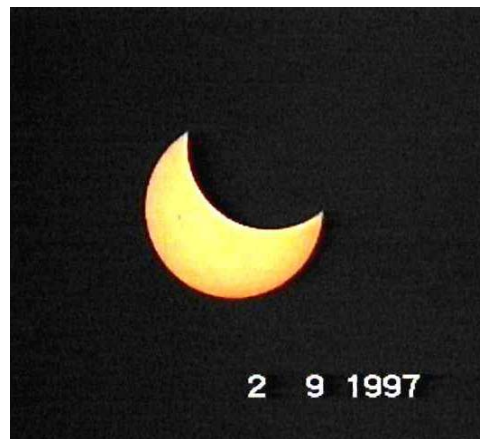
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[http://www.fourmilab.ch/earthview/moon\\_ap\\_per.html](http://www.fourmilab.ch/earthview/moon_ap_per.html)

# Partial Eclipse



Like the Earth's shadow for a lunar eclipse, the Moon's shadow has 2 parts, the umbra and penumbra. If you are in the penumbra, you only see a partial eclipse. Even if people a few miles away see a total eclipse.

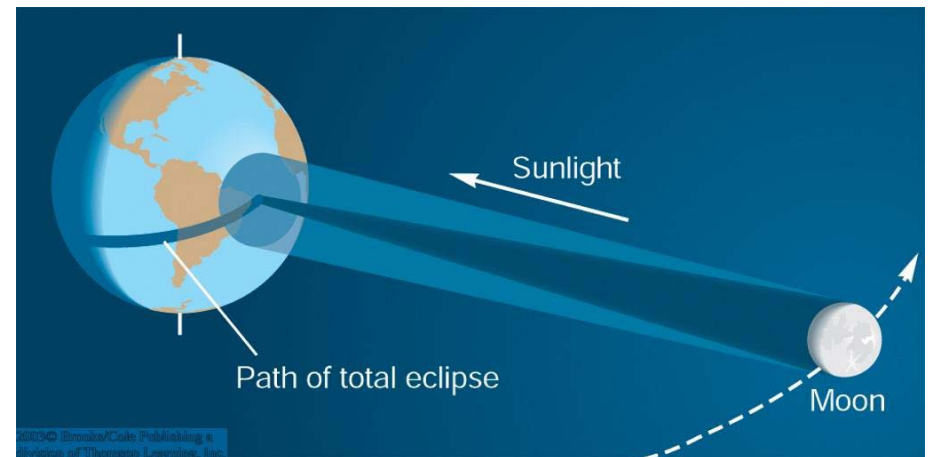


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[http://antwrp.gsfc.nasa.gov/apod/image/9709/soleclipse1\\_staiger\\_big.jpg](http://antwrp.gsfc.nasa.gov/apod/image/9709/soleclipse1_staiger_big.jpg)

# Moon's Shadow



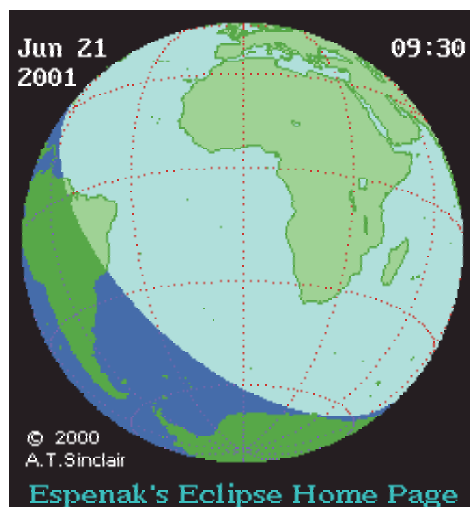
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# Path of the Eclipse



Shadow of the Moon races across globe.

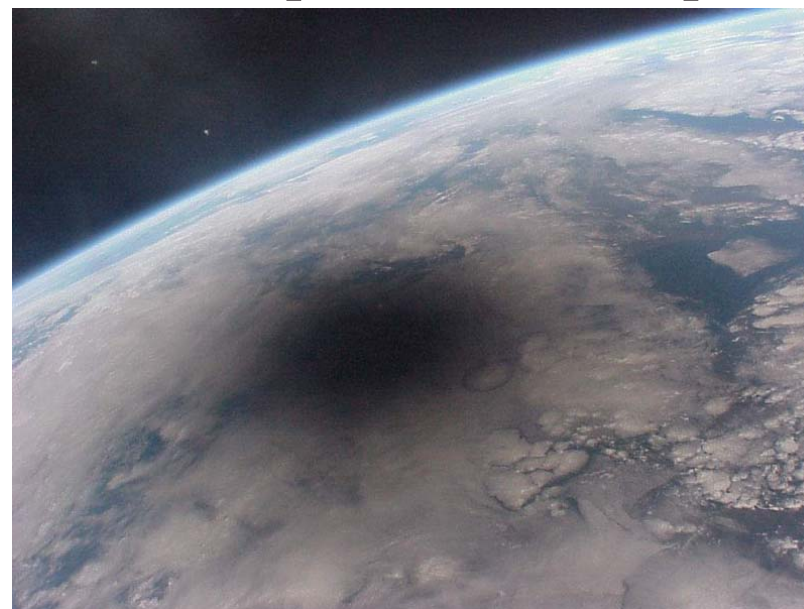


<http://sunearth.gsfc.nasa.gov/eclipse/TSE2001/T01animate.html>

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# Solar Eclipse Seen from Space



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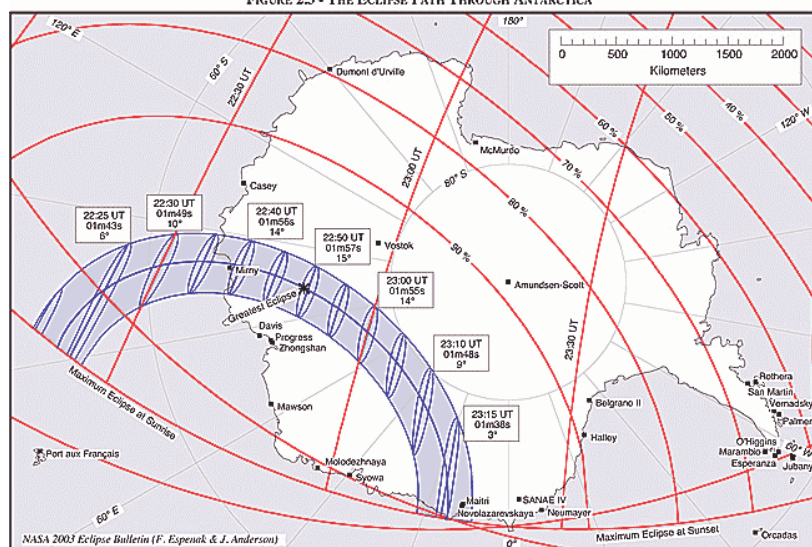
<http://antwrp.gsfc.nasa.gov/apod/ap990830.html>

# Next Eclipse



Total Solar Eclipse of 2003 November 23

FIGURE 2.3 - THE ECLIPSE PATH THROUGH ANTARCTICA



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[http://umbra.nascom.nasa.gov/eclipse/2003/figures/figure\\_2.3.gif](http://umbra.nascom.nasa.gov/eclipse/2003/figures/figure_2.3.gif)

# Eclipses



- Lunar: due to the Moon passing through Earth's shadow.
- Solar: due to the Earth passing through the Moon's shadow.
- Occur roughly every six months due to the inclination of the Moon's orbit around the Earth.

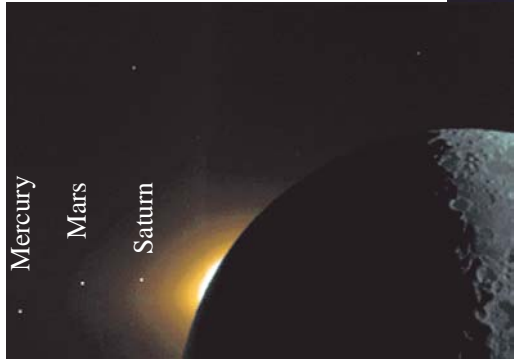
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# Dance of the Planets



Planets also orbit  
near the Ecliptic



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<http://antwrp.gsfc.nasa.gov/apod/ap990325.html>

<http://antwrp.gsfc.nasa.gov/apod/ap001014.html>