DARK SKIES for April 2021:

T/F	Apr.	1/2	9:04 p.m.	12:41 a.m.
F/S	Apr.	2/3	9:06 p.m.	1:53 a.m.
S/S	Apr.	3/4	9:07 p.m.	2:55 a.m.
S/M	Apr.	4/5	9:08 p.m.	3:46 a.m.
M/T	Apr.	5/6	9:10 p.m.	4:28 a.m.
T/W	**Apr.**	**6/7**	**9:11 p.m.**	**4:53 a.m.**
W/T	**Apr.**	**7/8**	**9:13 p.m.**	**4:50 a.m.**
T/F	**Apr.**	**8/9**	**9:14 p.m.**	**4:48 a.m.**
F/S	**Apr.**	**9/10**	**9:16 p.m.**	**4:46 a.m.**
S/S	**Apr.**	**10/11**	**9:17 p.m.**	**4:44 a.m.**
S/M	**Apr.**	**11/12**	**9:19 p.m.**	**4:42 a.m.**
M/T	**Apr.**	**12/13**	**9:20 p.m.**	**4:40 a.m.**
T/W	Apr.	13/14	9:24 p.m.	4:38 a.m.
W/T	Apr.	14/15	10:25 p.m.	4:36 a.m.
T/F	Apr.	15/16	11:27 p.m.	4:34 a.m.
F/S	Apr.	16/17	12:26 a.m.	4:32 a.m.
S/S	Apr.	17/18	1:23 a.m.	4:30 a.m.
S/M	Apr.	18/19	2:14 a.m.	4:28 a.m.
M/T	Apr.	19/20	2:59 a.m.	4:26 a.m.
T/W	Apr.	20/21	3:37 a.m.	4:24 a.m.
W/T	Apr.	21/22	4:10 a.m.	4:22 a.m.
T/F	Apr.	22/23	none	
F/S	Apr.	23/24	none	
S/S	Apr.	24/25	none	
S/M	Apr.	25/26	none	
M/T	Apr.	26/27	none	
T/W	Apr.	27/28	none	
W/T	Apr.	28/29	9:47 p.m.	10:19 p.m.
T/F	Apr.	29/30	9:48 p.m.	11:37 p.m.
F/S	Apr.	30/1	9:50 p.m.	12:45 a.m.

Times listed are for Dodgeville, Wisconsin when
(1) Moon is below the horizon
(2) Sun is > 18° below the horizon
(astronomical twilight)

Please minimize your use of outdoor lighting during these times to give everyone the best possible view of the night sky.

Time Travel

conducted by David Oesper

Continued from last month...

Hunting for Comets and Planets*

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(Received 1991 November 4)

Radio-waves, unlike light waves, may be refracted by inhomogeneities of the interstellar plasma to such an extent as to smear out lens interference effects completely. The only hopeful aspect of the situation is the fact that radio-telescopes routinely achieve far higher signal-to-noise ratios than optical telescopes. Because of the superior sensitivity of radio detectors, Peterson & Falk estimate that a distant quasar source will show detectable lens interference effects with high probability, if as much as one part per million of the total mass of the universe happens to be in the form of loose planets, small black holes or other dark objects of planetary mass. So far as I know, no radio-astronomers are rushing to find out whether our universe is infested with such a high abundance of interstellar vermin.

A typical comet has a mass about 10^{-12} times the mass of the Earth. Its Schwarzschild radius is about 10^{-14} m, 10 000 times smaller than an atom. Therefore, we all said until recently, gravitational lensing by comets is utterly negligible. The lensing effect would be lost in the comet's shadow. This conclusion is still correct so far as occultation of visible starlight is concerned. But Andrew Gould, another young colleague of mine at Princeton, pointed out a few days ago that gravitational lens interference effects by objects of cometary mass might be detectable in the gamma-ray bursts that are now being observed at a rate of about one per day by the Gamma-Ray Observatory in orbit (Gould 1991). The Gamma-Ray Observatory is now called the Compton Observatory in honour of Arthur Compton, who discovered the process of electron-photon scattering that the observatory uses to detect gamma-rays. The Schwarzschild radius of a large comet, with a physical diameter of 5 or 10 km, lies conveniently in the range of wavelengths observed by the Compton Observatory. If we imagine both the gamma-ray source and the comet to be at cosmological distances, the size of the lens is of the order of 10^4 km, well outside the area obstructed by the body of the comet. Gould then finds, in agreement with the calculation of Peterson & Falk, that the probability of observing lens interference in each gamma-ray burst is roughly equal to the fraction of the mass of the universe contained in the lensing objects. The interference effect would be manifested as a series of equally-spaced maxima and minima in the observed spectrum of the gamma-rays.

The origin of the gamma-ray bursts is one of the great unsolved problems of astronomy. Five years ago, Bohdan Paczynski argued on the basis of fragmentary evidence that they must be at cosmological distances (Paczynski 1986b). Now that the Compton Observatory is in orbit, we have at least some reliable information about the distribution of the sources in the sky and about their spectra and luminosities. The evidence, still preliminary, seems to indicate that Paczynski was right. If they are in fact at cosmological distances, they must be events of extreme violence, surpassing supernovae and quasars in the instantaneous intensity of their radiation. They are perhaps giving us a glimpse of a new universe, as revolutionary as the new universe revealed by the primitive radio-telescopes of Martin Ryle and Bernard Lovell 40 yrs ago.

* The text of the Milne Lecture, delivered 1991 October 24.

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To be concluded next month...