Luminance and Brightness Data for the Full Moon Near Perigee on January 11th, 2009

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Measurements of the moon's luminance L near the full moon of Jan. 11th, 2009, 3:29 UT were performed with an absolutely calibrated industrial standard photometer and gave, on the average over the lunar disk, record values in the range of $L = 4900...5400\ \mathrm{cd/m^2}$ (candela per square meter). These values were determined under excellent sky conditions from three sites near Dortmund, and south of Heidelberg, all in Germany. The measurements were reduced to unit clear air mass, i.e. to a moon fictitiously positioned in the zenith and observed from a sea-level position. [1] Contributing to the extremely high luminance values were two effects:

a) the earth was only one week past its perihelion position, so the intensity of the sun's illuminance in the earth-moon system was 3.3% above the average value on Jan. 11th

b) the recent full moon hardly escaped the earth's penumbral shadow, its phase angle (i.e. the angle at the vertex of the earth moon-sun-triangle) reaching almost the smallest possible value of 1.64°. This brings into play a strong "opposition effect", a combination of almost complete filling of any shadows on the lunar soil with some "cat's eye" like retroreflexion. The effect resulted in a increase of more than 25% in the lunar luminance as compared to a " typical" full moon near phase angles of 5°.

The luminance of most normal surfaces is independent from the distance to the observer, so it does not change along the highly eccentric elliptical orbit of the moon for any given solar distance and phase angle. This is of course not true for the luminous intensity or total brightness of the moon, which is directly proportional to the subtended solid angle. So it is clear that

c) the perigee position of the Jan. 11th, 2009, full moon, further increased its total brightness by another 15.4%

After conversion to the astronomers' logarithmic brightness magnitude scale, our data resulted in a peak value of $-(13.23 \pm 0,05)\,\mathrm{m_{vis}}$. This is half a magnitude brighter than the "typical" full moon's brightness in the average earth distance, and translates into a linear effect of more than 50%. According to the combined factors a), b), c) as mentioned above, this hints to an opposition effect of at least (25-30)%, which coincides with other studies. [2]

The following diagrams show our data, taken from January 9th to 12th, 2009, over lunar phase angle on both luminance and brightness scales. The curved lines serve just as a guide for the eye. They cannot be extrapolated to smaller phase angles than 1.5°, because this is, when the moon enters a penumbral eclipse.

[1] N. Hernitschek, E. Schmidt, and M. Vollmer; Appl. Optics **47** (no.34), 62 (2008)

[2] B.J. Buratti, M. Staid, C.M. Pieters et al., Lunar Planet. Sci, **39**, 1471 (2008) www.lpi.usra.edu/meetings/lpsc2008/pdf/1471.pdf

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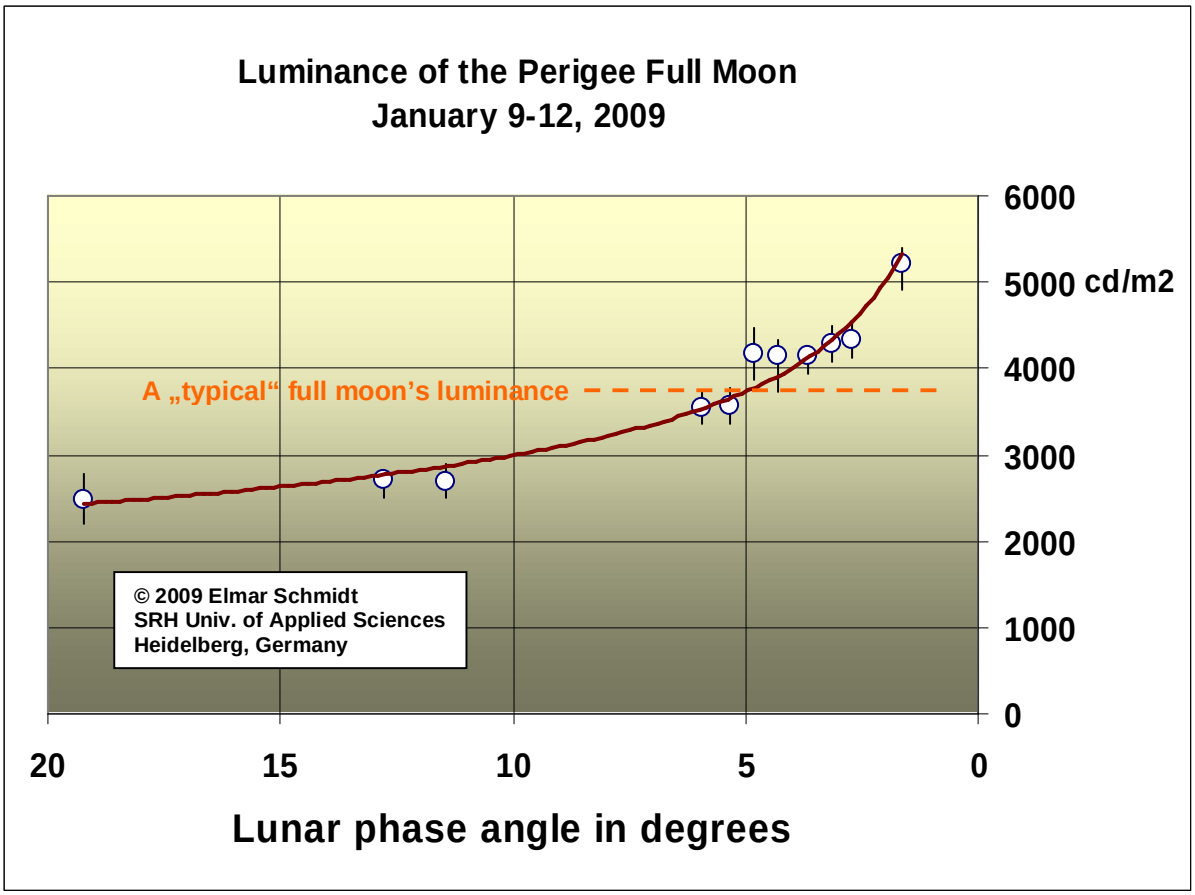
Luminance of the Perigee Full Moon
January 9-12, 2009
6000
5000 cd/m2
4000
3000
2000
1000
0
A „typical“ full moon’s luminance
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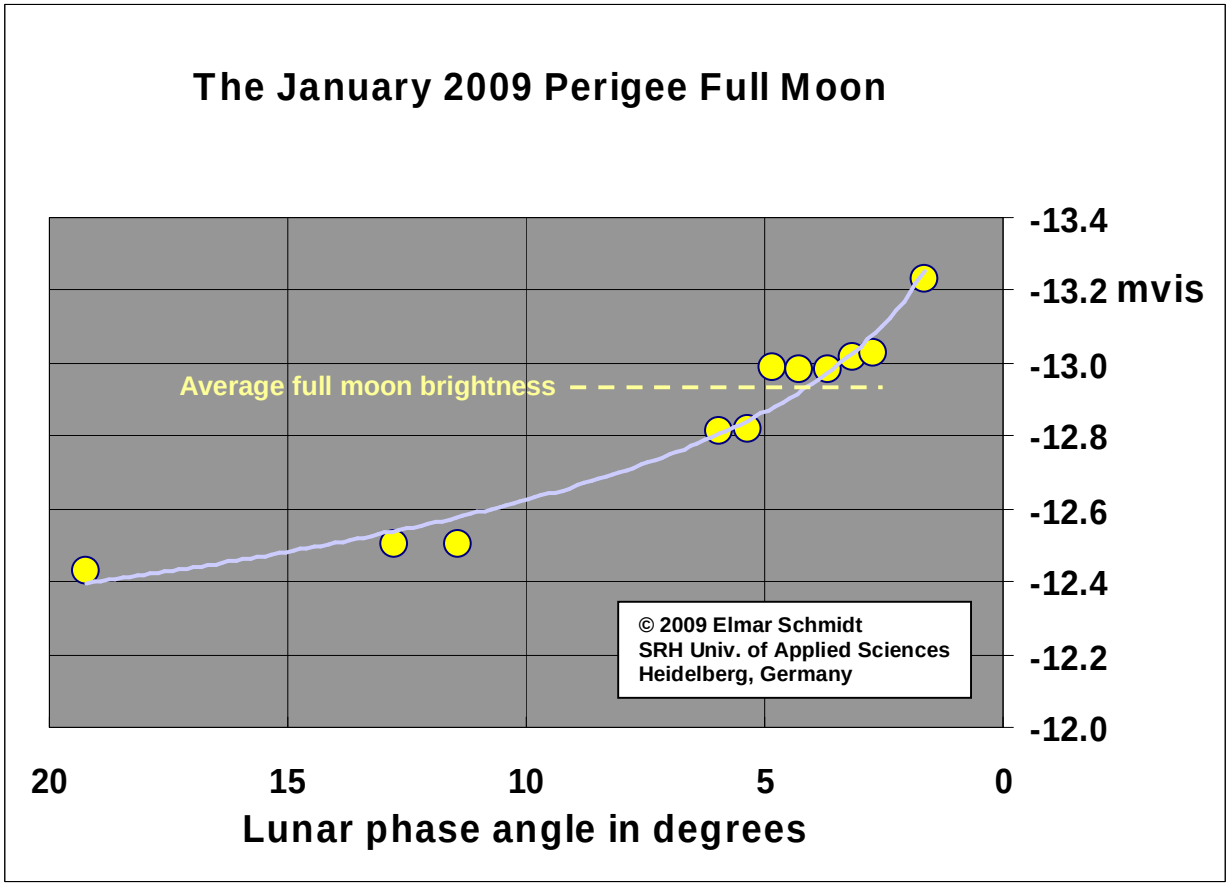
SRH Univ. of Applied Sciences
Heidelberg, Germany
20
15
10
5
0
Lunar phase angle in degrees


The January 2009 Perigee Full Moon
-13.4
-13.2 mvis
-13.0
-12.8
-12.6
-12.4
-12.2
-12.0
Average full moon brightness
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SRH Univ. of Applied Sciences
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20
15
10
5
0
Lunar phase angle in degrees