



SUNRISE, SUNSET...

Logic tells me that daylight on the shortest day should be the same as the darkness on the longest day. However, checking it out I find it's 7hrs 49 mins daylight on 21st Dec and 7hrs 21 mins darkness on 21st June. I realise it's only 28 mins difference, but why?

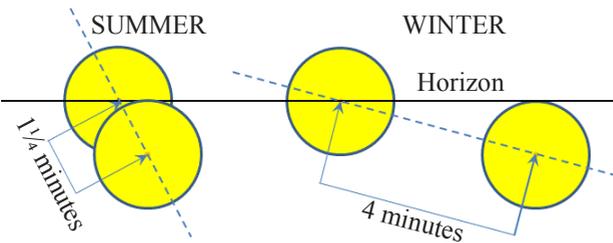
Di Beck

Good question! It took a while to figure it out, but it seems that there are three factors which combine together to cause the discrepancy.

1. According to our clocks, the length of a day is exactly 24 hours. However, this is only an average. The path of the earth around the sun is an ellipse, rather than a circle, which causes the length of the day, measured by the position of the sun in the sky, to vary throughout the year. The difference is only a few minutes, but it provides a discrepancy between the time by the clock and the time by a sundial. It also means that the times of sunrise and sunset are not equally spaced on either side of noon. An article on this subject (*Why don't the times of sunrise and sunset match?*) appeared in *Bosham Life* in July 2010, page 10. It can be downloaded from the website boshamlife.co.uk.

2. Sunrise is defined as the time at which the first of the sun's rays appear above the horizon, and sunset is when the last rays disappear. However, to treat the hours of daylight

and the hours of darkness in the same way, the timings should be based on the time that the middle of the sun's disc is on the horizon, at both sunrise and sunset. Because we define daylight as 'first ray' to 'last ray', we are adding a few minutes to the length of daylight, at each end. More than that, the amount we are adding depends on the season, because the angle at



The time between the centre of the sun's disc and the edge of the sun's disc being on the horizon

which the sun approaches the horizon is much steeper in the summer than it is in the winter. The figure shows that in the summer, sunrise is 1¼ minutes 'early', compared to the time that the middle of the sun crosses the horizon, and sunset is 1¼ minutes 'late'. In winter these discrepancies increase to four minutes at each end.

3. The sun is not where we think it is. An atmospheric effect known as refraction causes the apparent position of the sun to be higher above the horizon than it actually is, so that it appears to rise earlier, and to set later. This effect adds to the length of daylight by about five minutes in the summer and 16 minutes in the winter.

There are thus three factors affecting the timing of sunrise and sunset: 1. the change in the length of the day, measured by the sun, 2. the time between the middle of the solar disc and its edge being on the horizon, and 3. the refraction which moves the image of the sun above the horizon. Each of these causes the length of daylight to be longer, and the length of darkness to be shorter, by a few minutes. The effects are greater in the winter than in the summer, and between them they account for the discrepancy noted in the question.

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