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Why is it dark at night?

Week 51

Because the Sun does not shine at night, of course! Or, more precisely, because sunlight does not reach the side of the Earth that is facing away from the Sun. This answer is not sufficient for astronomers. Just like being in a large forest, where in every direction and in our entire field of vision we can see trees that are either somewhat closer or further away, in a Universe that is infinite and filled evenly with stars or galaxies, we would have to see a star in every direction, sooner or later. The night sky should actually gleam as brightly as the surface of the Sun.



The Earth's night sky

In 1826 the German doctor and astronomer Heinrich Wilhelm Olbers encountered this problem, which has come to be known as Olbers' paradox. Various proposals for solving the paradox have been discussed since then. It could be suggested, for example, that opaque gas or dust clouds between the stars prevent the propagation of light. However, these clouds would absorb the radiation, heat up in the process and, after a time, start to radiate – they therefore do not provide an explanation for the nocturnal darkness.

The observable cosmos: not infinitely large, not an infinite number of stars

Our current model of the Universe provides one solution. The Universe was formed a finite period of time ago and it is expanding and developing. The age of the Universe multiplied by the speed of light defines the boundary of observable space. The light from objects that are beyond this boundary cannot have reached us yet. Added to this is the fact that the expansion of the Universe lengthens the wavelength of the radiation and thus depletes its energy. (See the astronomy question from week 10:

Where is the coldest point in the Universe?) Thus the further away the region, the less radiation energy reaches us. The cosmic background radiation that was formed several hundred thousand years after the Big Bang lit up the Universe brightly in the beginning. Over time its wavelength has shifted from the visible range to the microwave range and thus the human eye can no longer perceive it.

If you stand before your front door in the evening and realise that the night sky is dark then, sharp as a razor, you can come to the conclusion that, "Aah, the Universe is expanding!"

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