<u>Ahad's constant</u> derives from an astro-mathematical construction by **Abdul Ahad** (1968-) in his astronomical paper, *The Music of the Night Sky*, published c. July 2004.
The constant has been provisionally assigned the symbol, $m_{Ahad,}$ and is calculable from the following algorithm, whose input parameters are stellar magnitudes in the v-band part of the electromagnetic spectrum:

$$m_{Ahad} = -2.5 \log \sum_{i=1}^{\infty} 10^{-0.4 m_i}$$

where m_i is the apparent visual magnitude of the *i*th star

For an observer located anywhere within the Solar System - excluding the contribution of light from the Sun (Solar constant) - provisional integrations using stellar magnitude data sourced from astronomical catalogs places an approximation for this constant in the range:

$$-6.0 \leqslant m_{Ahad} \leqslant -7.0$$

having a mid-point value of -6.5 magnitudes as a consensus within the astronomical community. This is the total integrated brightness of the night sky that we visually experience from Earth.

Excerpt from "*The Music of the Night Sky*"

Abdul Ahad wrote (March 2004):

"On exceptionally clear, breezy transparent nights when the atmosphere is more turbulent than usual, the stars are seen to shine down from all across the sky with a more pronounced twinkling effect. To serious astronomers, this added scintillation of starlight is an unwanted element of noise in their instruments, causing images inside the telescope to become hazy and more turbulent. To the more 'artistically oriented' observer, however, the stars shining under turbulent skies could actually be perceived as more appealing to one's senses... each one displaying its own unique, almost musical rhythm of flickering light and shimmering colours due to the Earth's unsteady atmosphere.

Now imagine if we could somehow record and analyse the pitch, quality and tone of each individual note of this "music" of the cosmic night sky... How loud would it sound in total, and would it have a distinctive tune!?

If we could aggregate light from each individual star visible to the naked eye across the entire sky down to, say magnitude 6 (including the faint banding of the Milky Way), what would the total integrated brightness of the night sky be? What are the predominant colours of stars in the solar neighbourhood? Is it true that most of the stars visible in the night sky are reddish in colour and not pure white?

Further, imagine a scene where one is located inside the glass cockpit of an imaginary starship sailing the black interstellar void some half way between the Sun (Sol) and Alpha Centauri with a full 360-degree sky view. From this vantage point (2.2 light years away) our Sun will be seen to shine at star-like magnitude of around -1.2 in one part of the sky, and Alpha Centauri will be shining a touch brighter at magnitude -1.7 in the opposite part of the sky, with the Milky Way banding virtually all around. What a splendid view that would make! No sunshine, just eternal night!

But just how bright would the sky appear when seen from such a dream (or nightmare!) location? To answer this and all of the above questions it would be necessary to estimate the aggregate brightness of all the stars in the entire night sky (including the faint glow of the Milky Way)."

Mathematical properties and scientific use

$$m_{Ahad} = -2.5 \log \sum_{i=1}^{\infty} 10^{-0.4\, m_i}$$

The terminating approximation of the above algorithm for Ahad's constant yields a value of the net amount of natural sky light that an observer would visually experience from any desired location in the universe. It thus has real world, universal applicability for modelling the local environment at any given point in space-time. The number itself is not a true 'constant' of course; its value would differ, at least infinitesimally, depending on where and when one makes the measurements. Hence, some astronomers prefer to call this phenomenon 'Ahad's magnitude' (see note 2 at the foot of this article).
In mathematical terms, this constant has the properties of being a *real* and an *irrational* number, that is *computable*, though it is both *transcendental* and *asymptotic*.
Once determined in magnitude terms via the given algorithm, the value of Ahad's constant can then be expressed in a variety of other luminous flux measures, such as watts per square meter, or however else one desires. For example, in the vicinity of the Solar System and in local interstellar space, it is of the order of ~ $1/300^{th}$ of a Full Moon's worth of light.

In observational astronomy, the algorithm enables one to compute the net contribution of stellar light that would illuminate objects beyond the luminous dominion of the Sun. For example, in the area of telescopic and CCD programs hunting to detect dwarf planetary bodies residing within the Oort cloud, the value of Ahad's constant would be a measure of the amount of incident light from the surrounding cosmos illuminating such objects that are too far out from the Sun for its flux to have the greatest, or close to overwhelming, contribution to their total surface lighting.

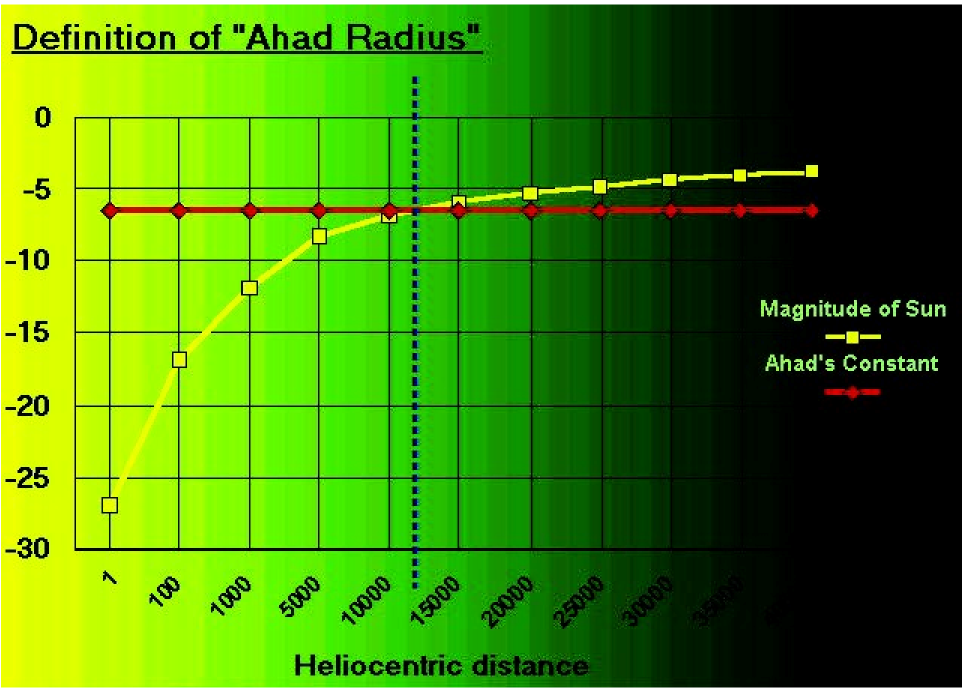
In the fields of deep-sky astronomical scrutiny, such as the observation of dark nebulae in far-off locales within the Milky Way galaxy, which have no intrinsic luminosity of their own, Ahad's constant enables one to compute the total flux contribution to their illumination from stars and other sources of incandescent light in their surrounding 3D neighborhoods. The observed surface brightness, contrasted against the theoretical surface brightness predicted by Ahad's algorithm of such molecular clouds, would then hint at core-nested unseen protostellar sources, warranting further multispectral investigations.

Ahad Radius and Ahad's Sphere of the Sun

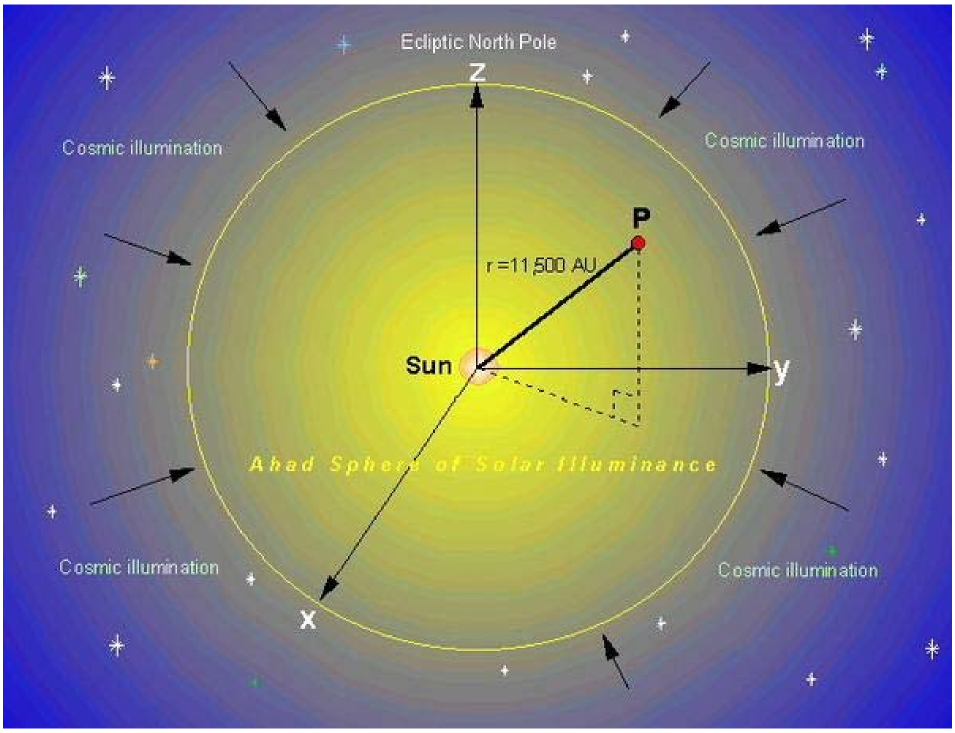
The apparent visual magnitude, m, of a star whose absolute magnitude is M, as seen from a distance of d light-years is given by:-

$m = M - [5 - 5 * \log_{10}(d / 3.2616)]$

Using the above formula the fall off in apparent magnitude of the Sun with increasing distance can be charted, thus:



At a distance of circa 11,500 astronomical units (0.18 light-year) going radially outward from the Solar System in any chosen direction, the Sun's apparent light output matches Ahad's constant.
It is thus possible to draw an imaginary sphere around the Sun of such a radius, within which the Sun would remain the most supreme source of light, relative to the universe's total background illumination:



The outer edge of such a sphere, in principle, defines an edge of the Sun's monopoly of light and heat provision to our Solar System and nearby interstellar space; an effective end of its light dominion.

References

1. How bright is the sky beyond our Solar System? A. Ahad, letter in *Journl Brit.Astron.Assoc. Vol. 115, No. 5*, p. 297
2. *The Sky this Week* - David Oesper, October 23, 2008
3. *Cambridge Encyclopaedia of Stars* by James B. Kaler (Cambridge University Press, 2006), table on p. 50
4. *Scientist quantifies the darkness of outer space,* Emdad Rahman, The Mathaba News Network, February 1, 2007