

# Phenomena of Natural Dark Skies

2<sup>nd</sup> International Symposium for Dark-sky Parks and  
2<sup>nd</sup> International Dark-sky Camp

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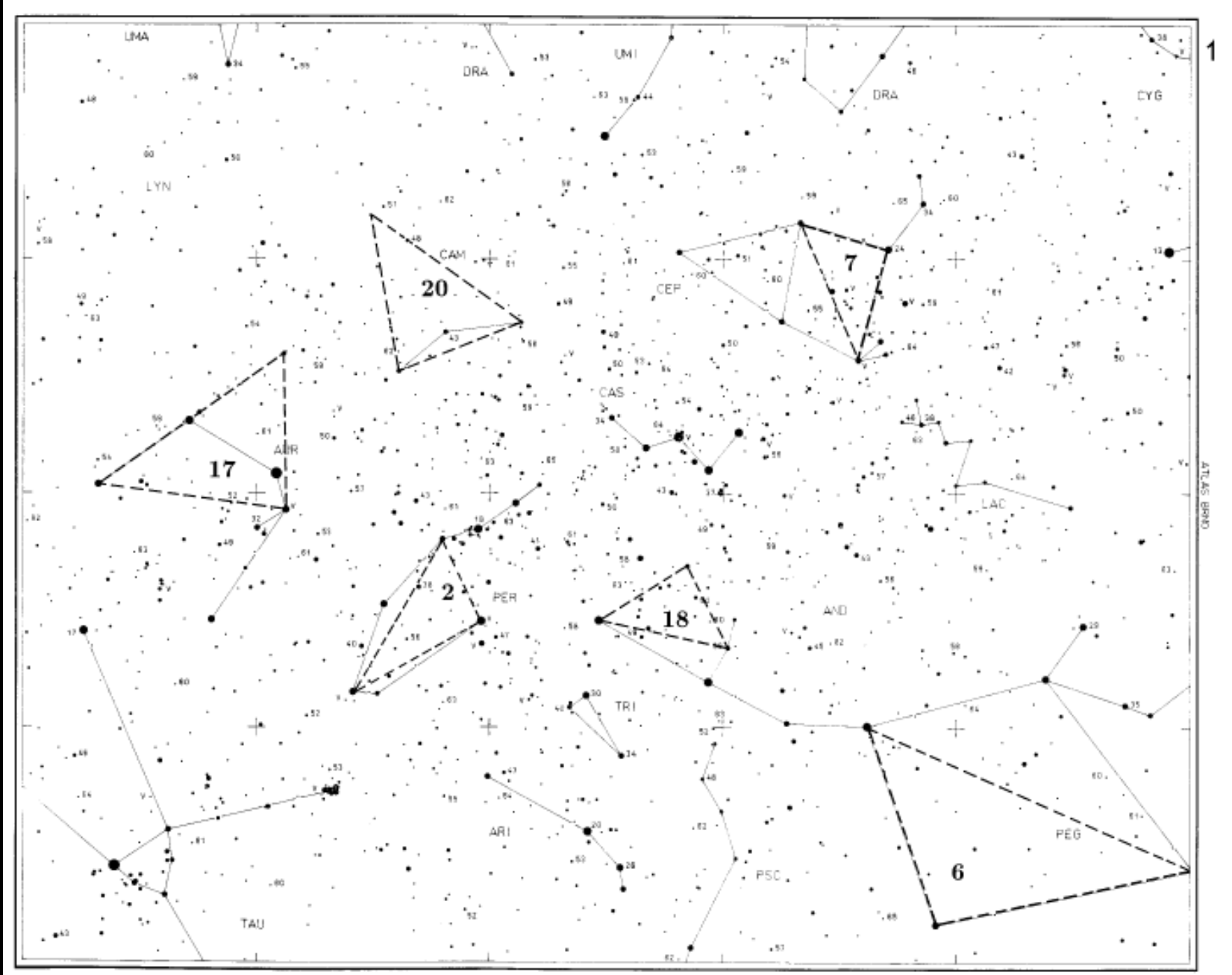
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# Naked Eye Stellar Limiting Magnitude

- **A measure of the faintest stars visible with the naked eye.**
- **At the darkest places, 8.0 – 8.4 is achievable. Why is 6.5 the universally adopted value?! - no dark sky for 99.99% of astronomers!!**
- **The most widely and systematically used method – IMO method for determination of visual naked eye limiting magnitude for meteor observers.**
  - Predetermined areas with stellar photometry down to magnitude 7.50; the observer counts the stars in an area; the faintest star is determined by the star count.
  - 30 areas in the sky.
  - “Problem”! Limiting magnitude tables go 'only' down to magnitude 7.50, not enough for observations under pristine skies... → most meteor observers do not observe under really good skies...

# Naked Eye Stellar Limiting Magnitude



# Bortle dark sky scale

- Made by veteran observer John E. Bortle and published in the February 2001 issue of Sky & Telescope.
- Uses various criteria to estimate sky quality:
  - Naked eye stellar limiting magnitude
  - Naked eye visibility of the Milky way, Gegenschein and the zodiacal band
  - Naked eye visibility of the brightest deep-sky objects
  - Telescopic visual stellar limiting magnitude (30 cm and 50 cm)

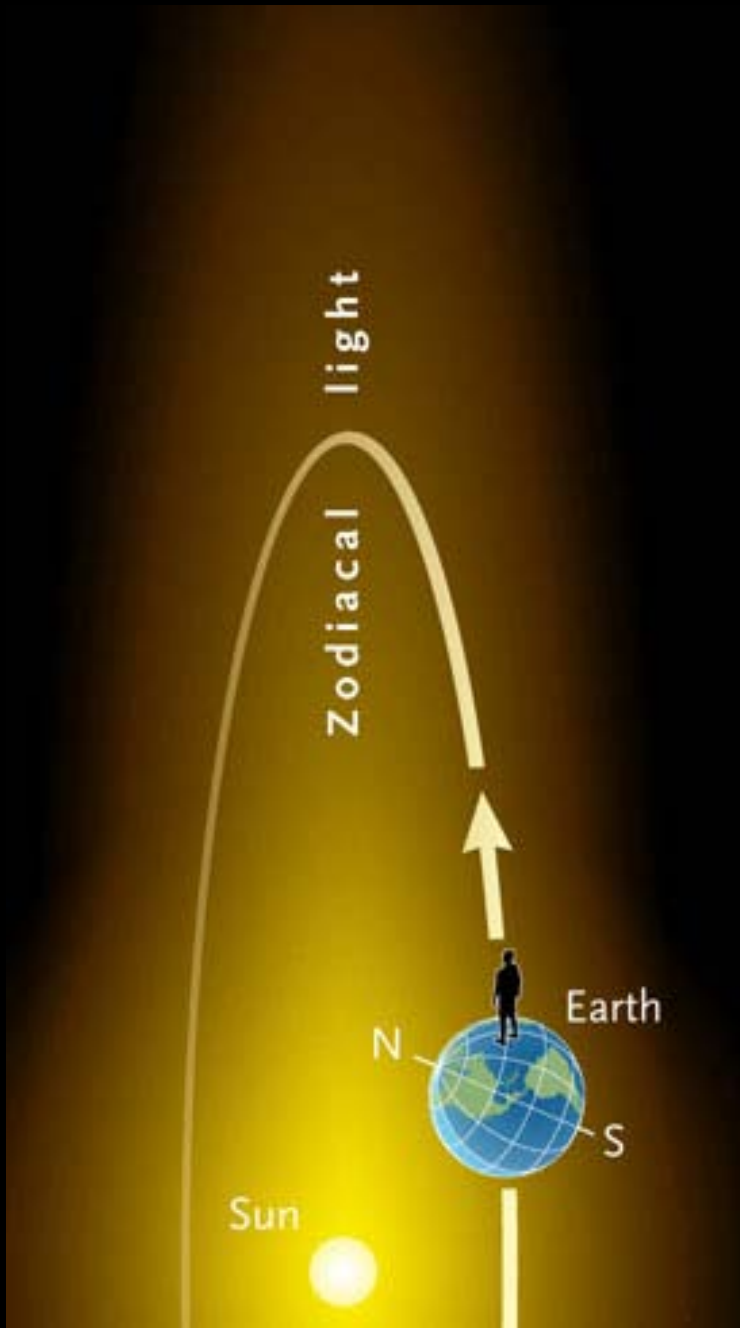
# Bortle dark sky scale

<b>Class</b>	<b>Title</b>	<b>NELM</b>	<b>Description</b>
1	Excellent dark-sky site	7.6 - 8.0	Zodiacal light, gegenschein, zodiacal band visible; M33 direct vision naked-eye object; Scorpius and Sagittarius regions of the Milky Way cast obvious shadows on the ground; Airglow is readily visible; Jupiter and Venus affect dark adaptation; surroundings basically invisible.
2	Typical truly dark site	7.1 - 7.5	Airglow weakly visible near horizon; M33 easily seen with naked eye; highly structured Summer Milky Way; distinctly yellowish zodiacal light bright enough to cast shadows at dusk and dawn; clouds only visible as dark holes; surroundings still only barely visible silhouetted against the sky; many Messier globular clusters still distinct naked-eye objects.
3	Rural sky	6.6 - 7.0	Some light pollution evident at the horizon; clouds illuminated near horizon, dark overhead; Milky Way still appears complex; M15, M4, M5, M22 distinct naked-eye objects; M33 easily visible with averted vision; zodiacal light striking in spring and autumn, color still visible; nearer surroundings vaguely visible.



# Zodiacal light

- Light scattered off dust particles in the ecliptic plane – the Zodiacal cloud
- Zodiacal cloud dust replenished mostly by cascading disintegration of large/giant comets (e.g. - the Taurid meteoroid complex)
- Zodiacal light enhanced through forward scattering of light
- Best visible:
  - vernal equinox, evening sky, at a high angle to the western horizon
  - autumnal equinox, morning sky, at a high angle to the eastern horizon



# Zodiacal light

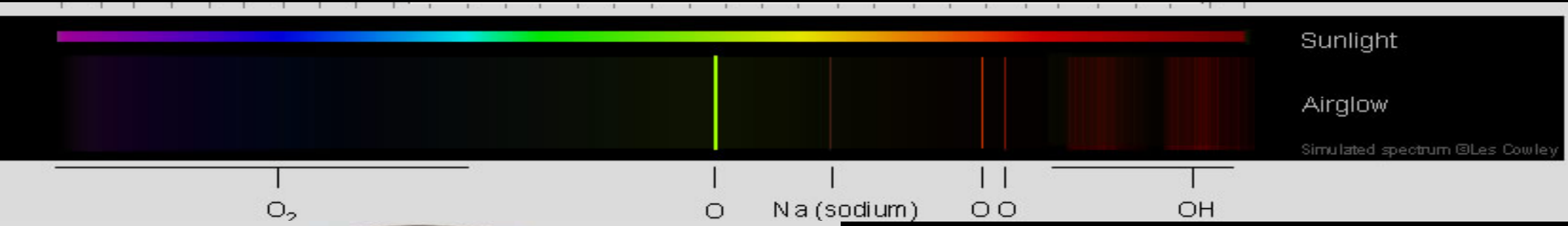




# Gegenschein and Zodiacal band



# Natural airglow



Babak A. Tafreshi



# The Milky Way



# Naked eye visibility of bright deep-sky objects

- Under a pristine dark sky many deep sky objects are visible with the naked eye:
  - Galaxies: M31 – large, spanning over  $3^\circ$ , very bright; M33 – obvious naked eye object, visible with direct vision; M81 – faintly detectable with the naked eye
  - Globular clusters: M13, M15, M5, M3 – obvious naked eye objects; M92, M2, M12, M14 – easily detectable with the naked eye
  - Open clusters: many easily visible – M44, M35, M41, ... partially resolved with the naked eye