Astrophotography

Conservation of Energy and Photographic Tools

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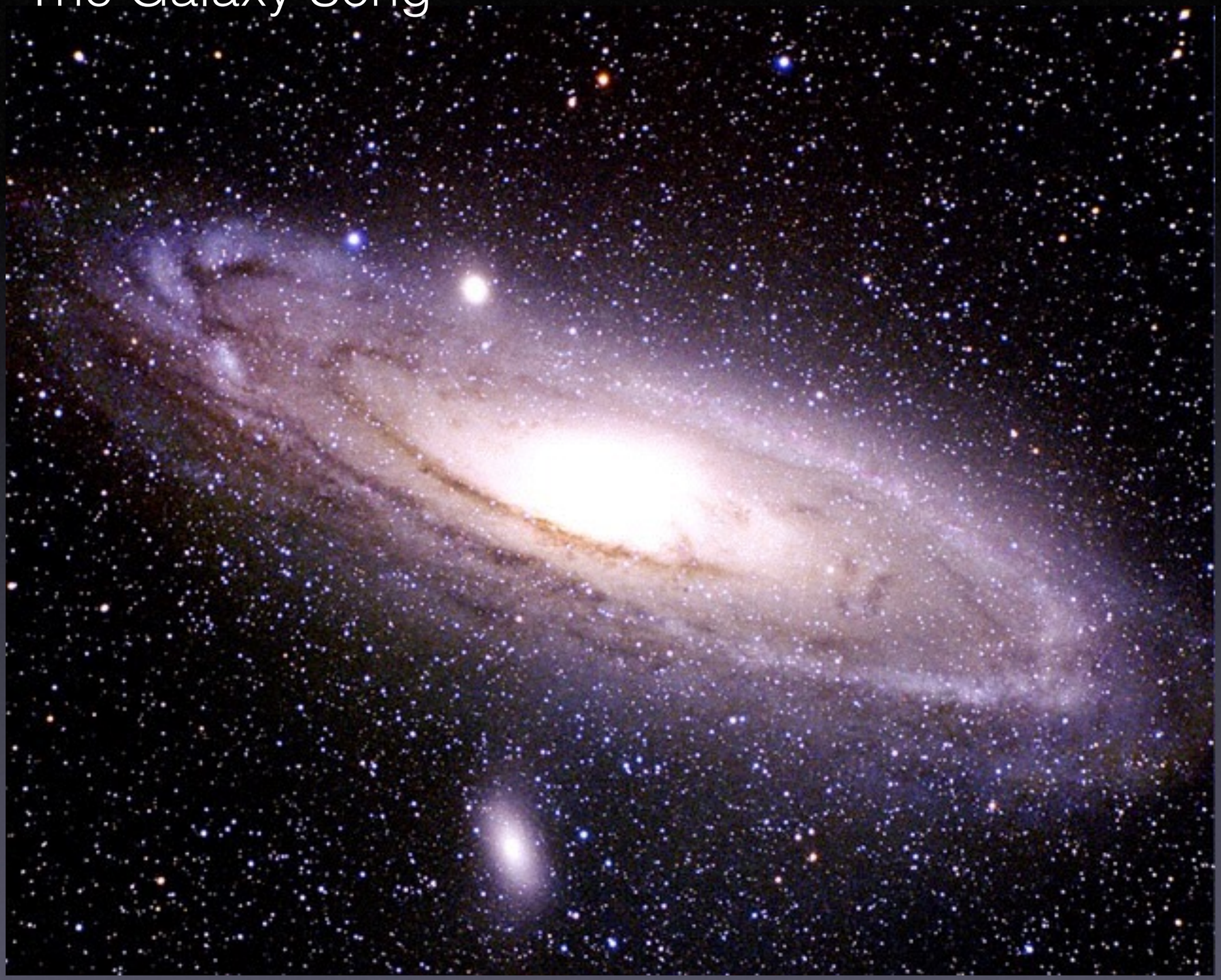
A few details . . .

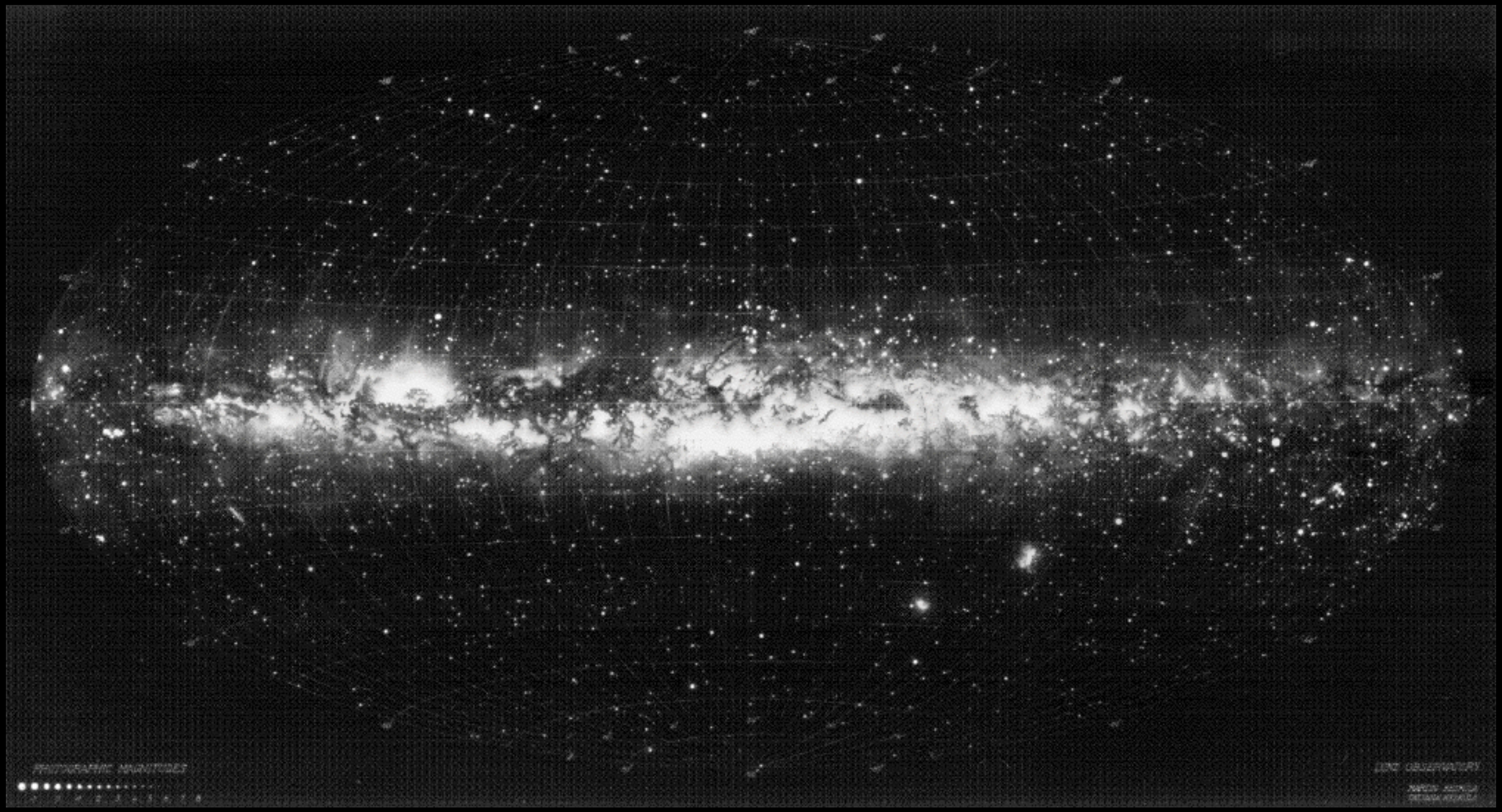
- We live on a **planet** (Earth) . . .
- That goes ‘round a **star** (Sun) . . .
- that’s part of a **galaxy** . . .
- that’s within a single **universe**.

A few other details . . .

- If our galaxy has about 100,000,000,000 stars, and our universe has about 100,000,000,000 galaxies, we've got about 10,000,000,000,000,000,000,000 possible places to live. (10^{22} stars)
- There are a few good questions to ask at this point:
  - How do we know that?
  - Where does all this stuff come from?
  - Where does it all go? And how?

The Galaxy Song





A map of the entire sky surrounding us.

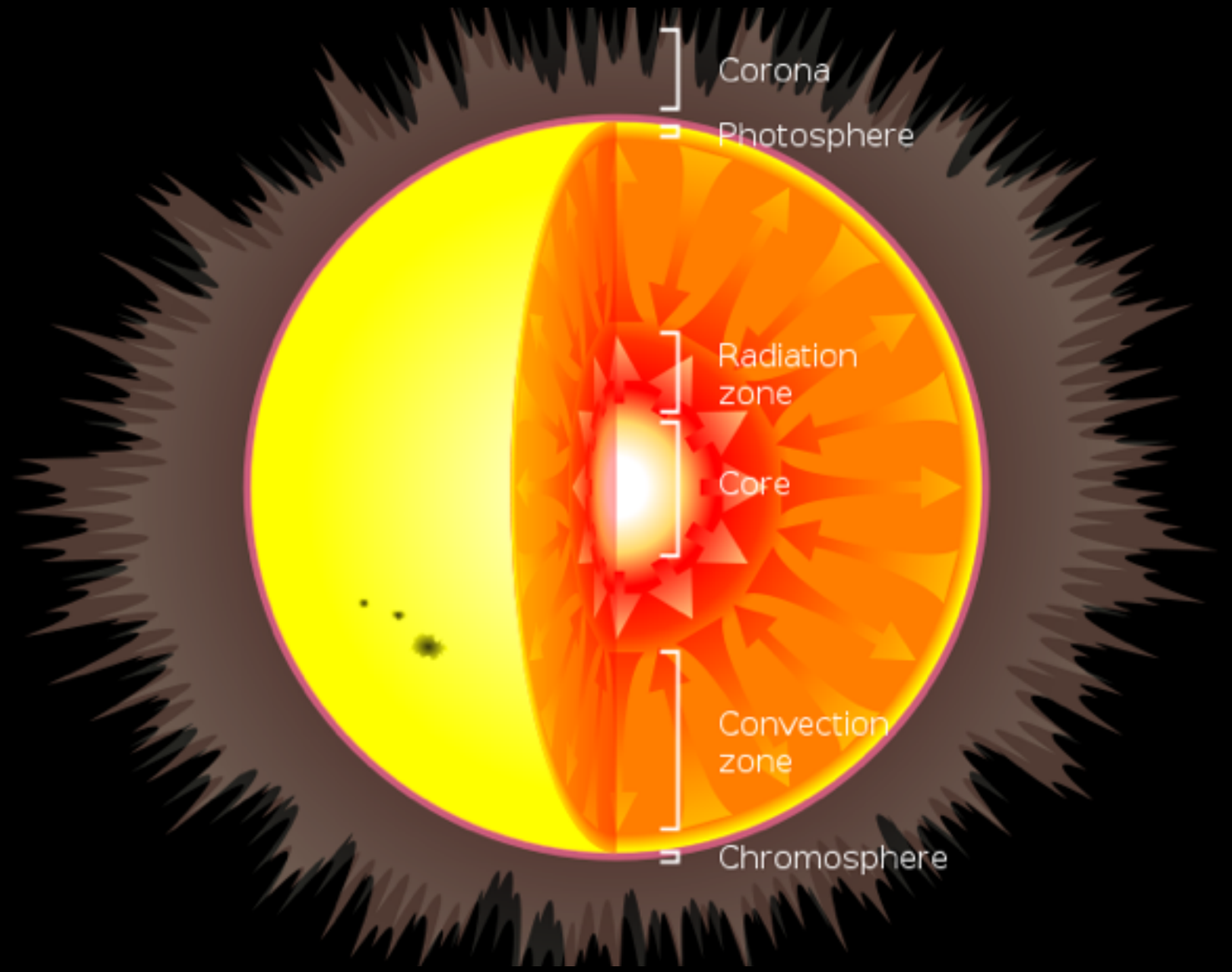
Just how big is space?

- Look up . . .
- Imagine a pencil tip . . .
- Held out at arm's length:


Hubble Deep Field
HST WFPC2
ST ScI OPO January 15, 1996 R. WIlliams and the HDF Team (ST ScI) and NASA

Things you probably know

- Stars are hot
- To be hot, there must be a source of energy
- Hot things produce light (in all forms)



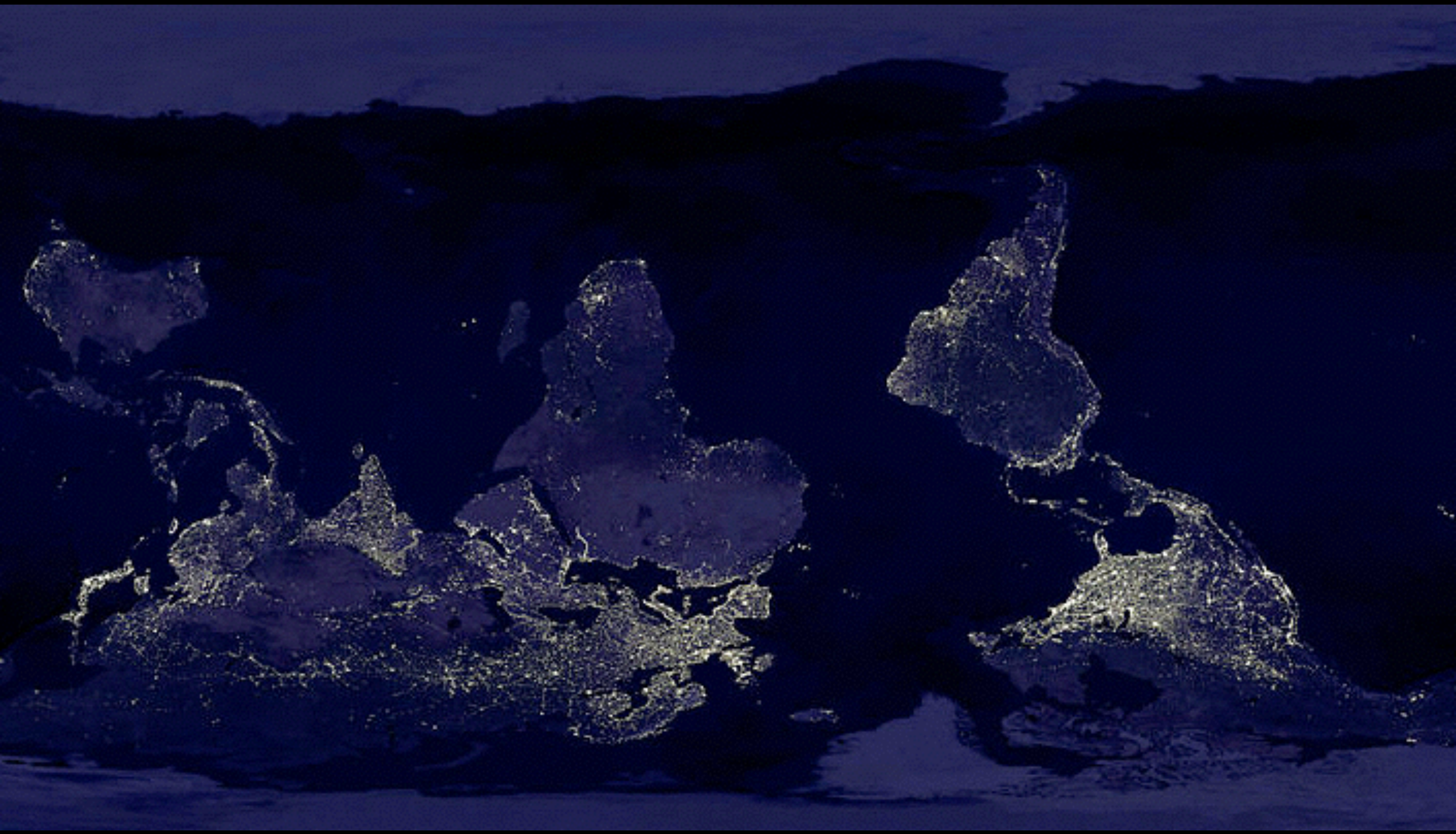
Energy in a Star:
Where does this come from? How does it get here?

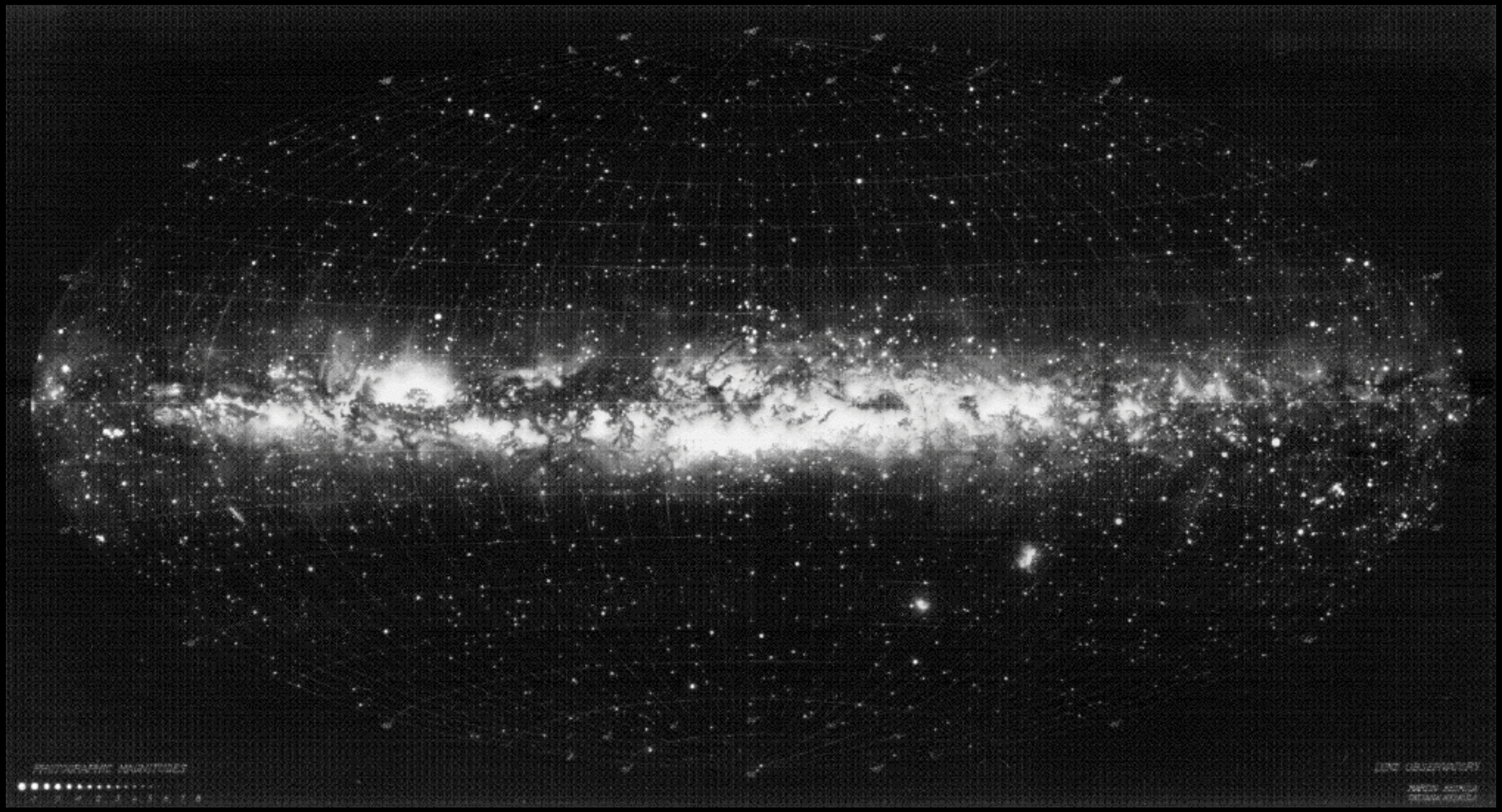
www.spacetelescope.org

https://www.spacetelescope.org/videos/heic1017b/

Things you probably know

- We produce light at night
- Producing light requires energy
- That energy is wasted and changes the contrast of the night sky

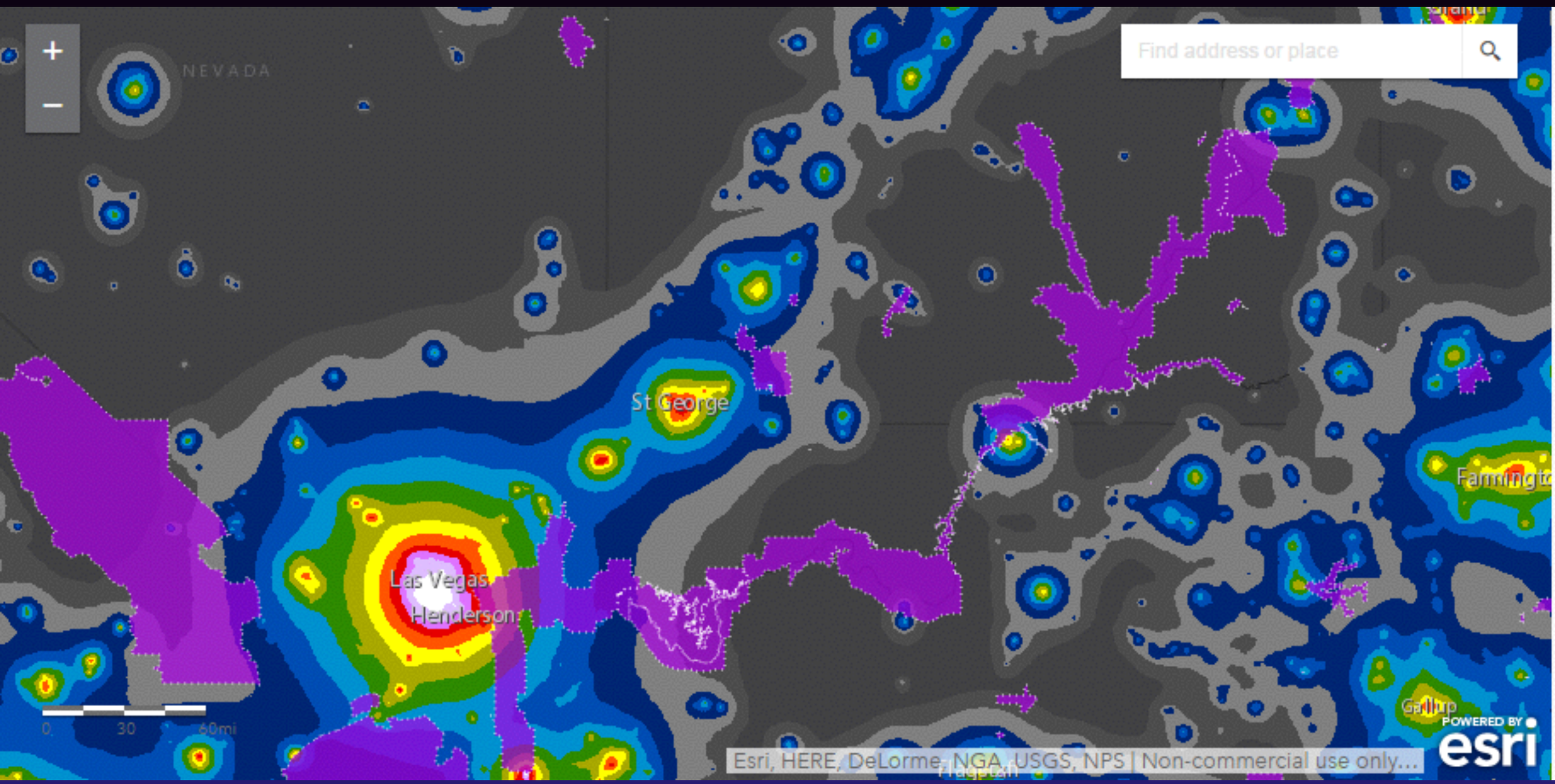




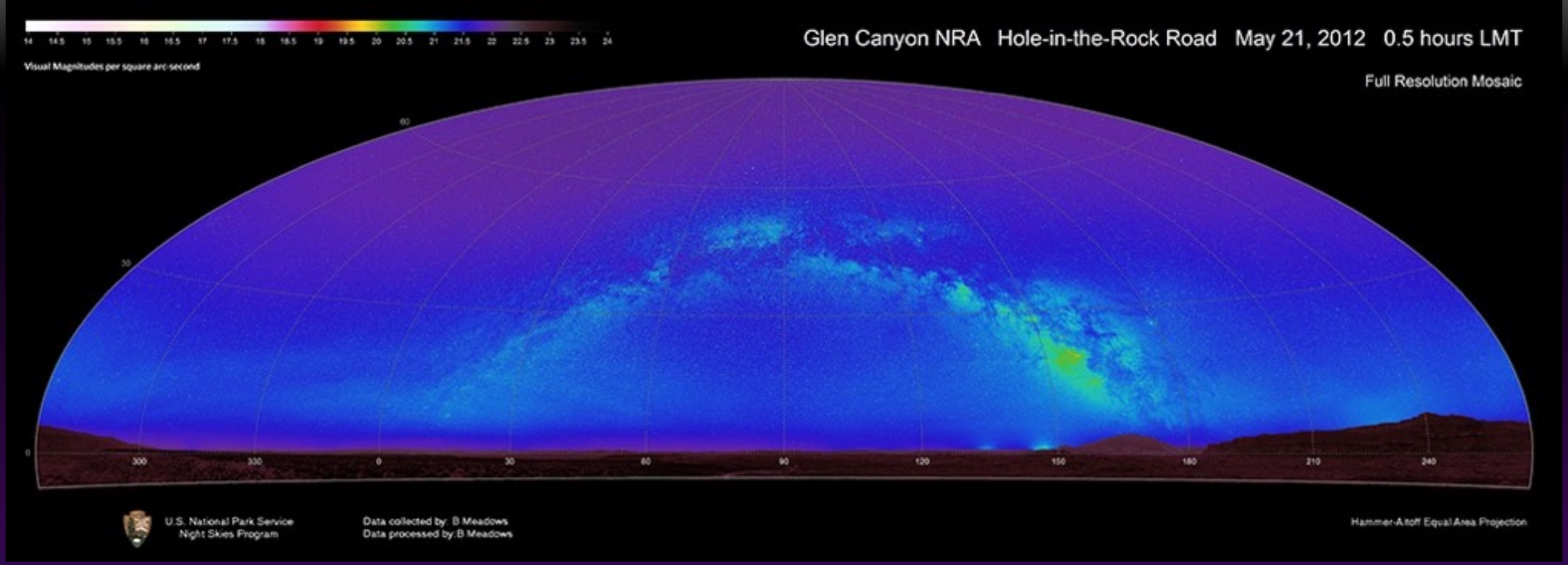
Remember this?
What permits/prevents us from seeing all these stars?

Light pollution and visible sky before and after power outage.
See darksky.org (International Dark Skies Association)

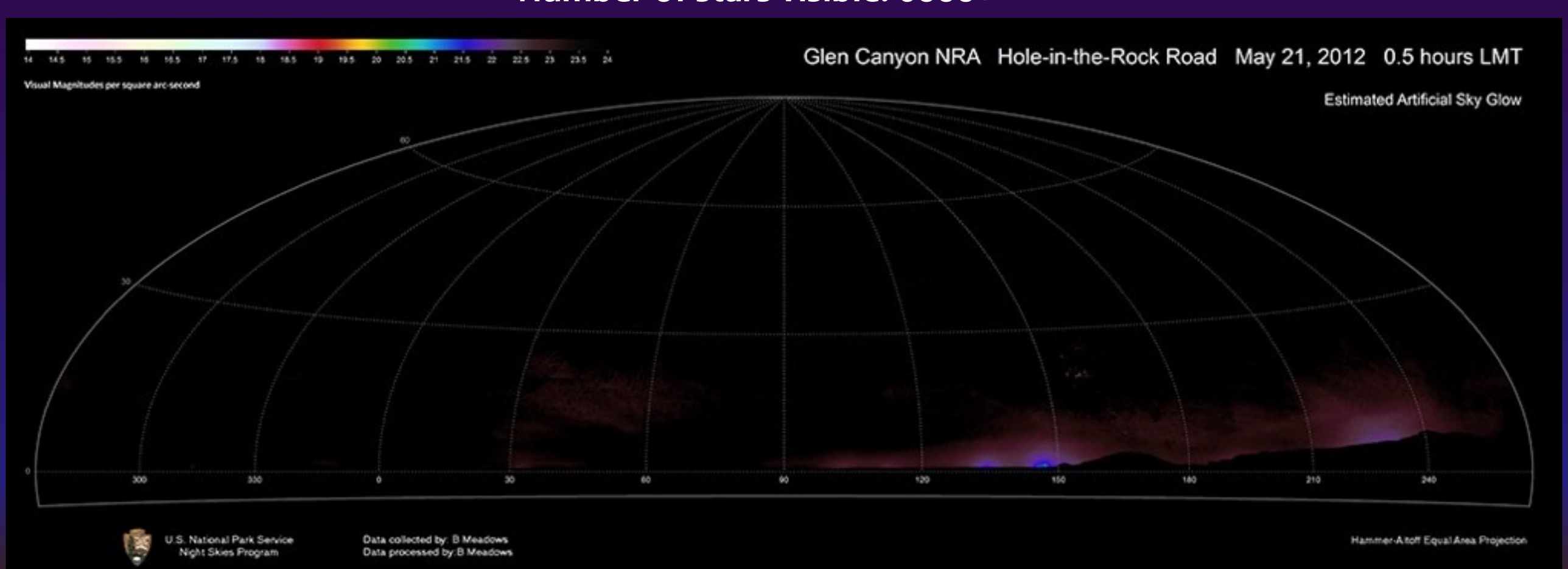
Dark Skies in Southern Utah

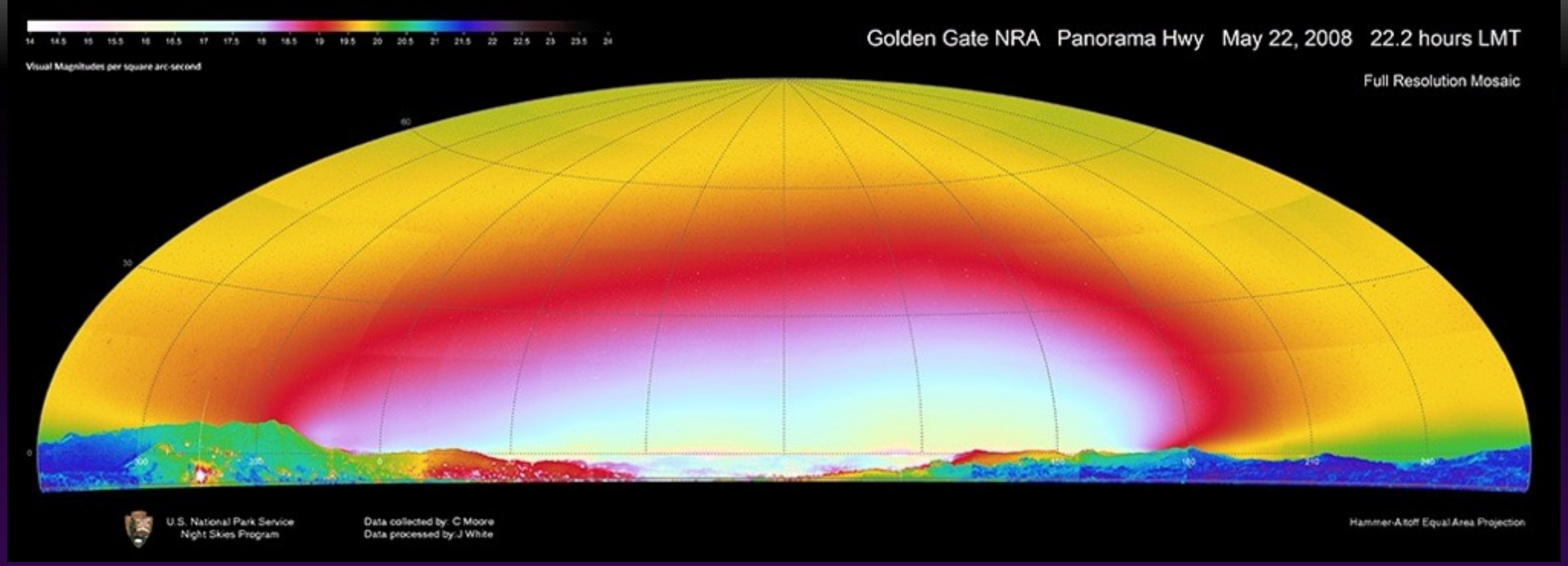


New World Atlas of Artificial Night Sky Brightness (6/16)

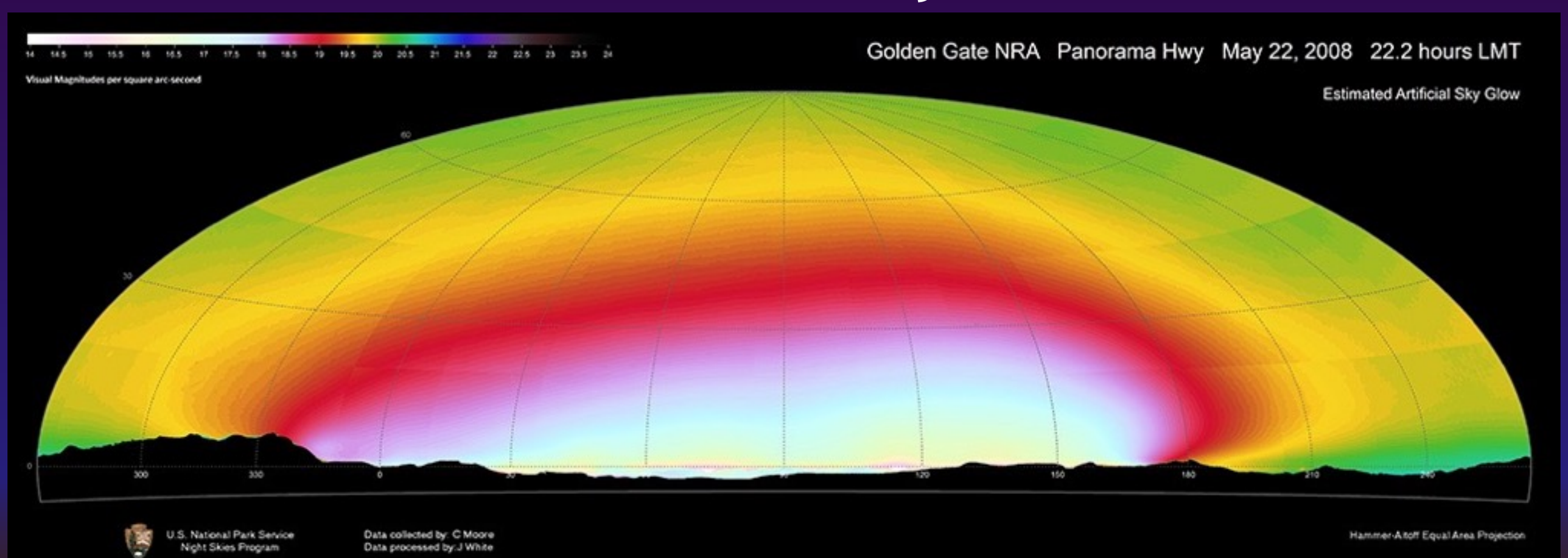


Number of stars visible: 6000+





Number of stars visible: ~500

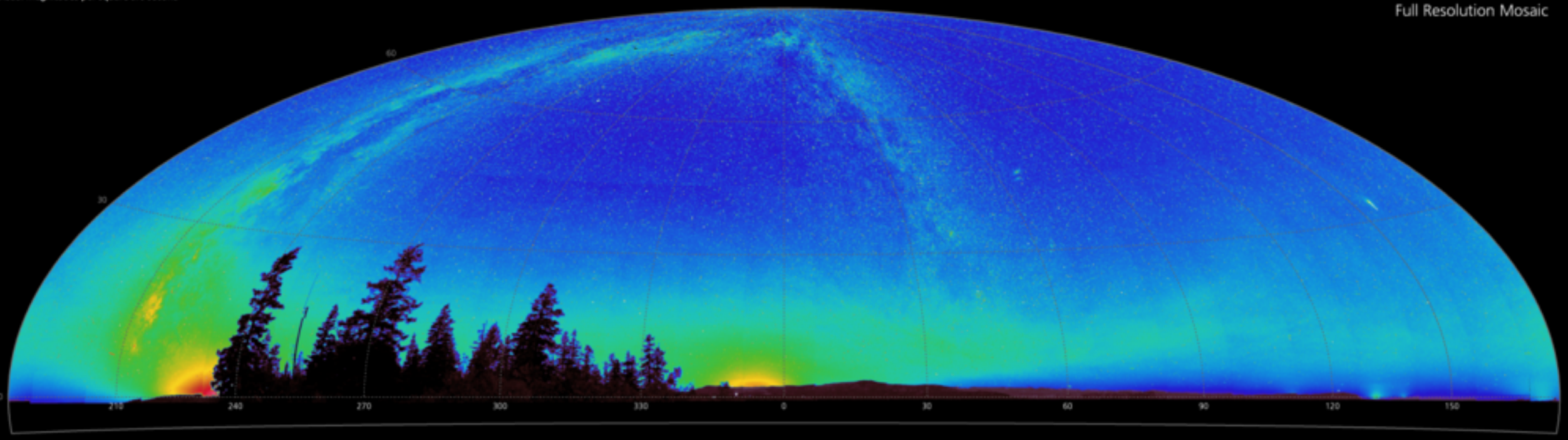


14 14.5 15 15.5 16 16.5 17 17.5 18 18.5 19 19.5 20 20.5 21 21.5 22 22.5 23 23.5 24

Visual Magnitudes per square arc-second

Zion N P Lava Point September 26, 2003 20.4 hours LMT

Full Resolution Mosaic



U.S. National Park Service
Night Skies Program

Data collected by: D Duriscoe
Data processed by: D Duriscoe

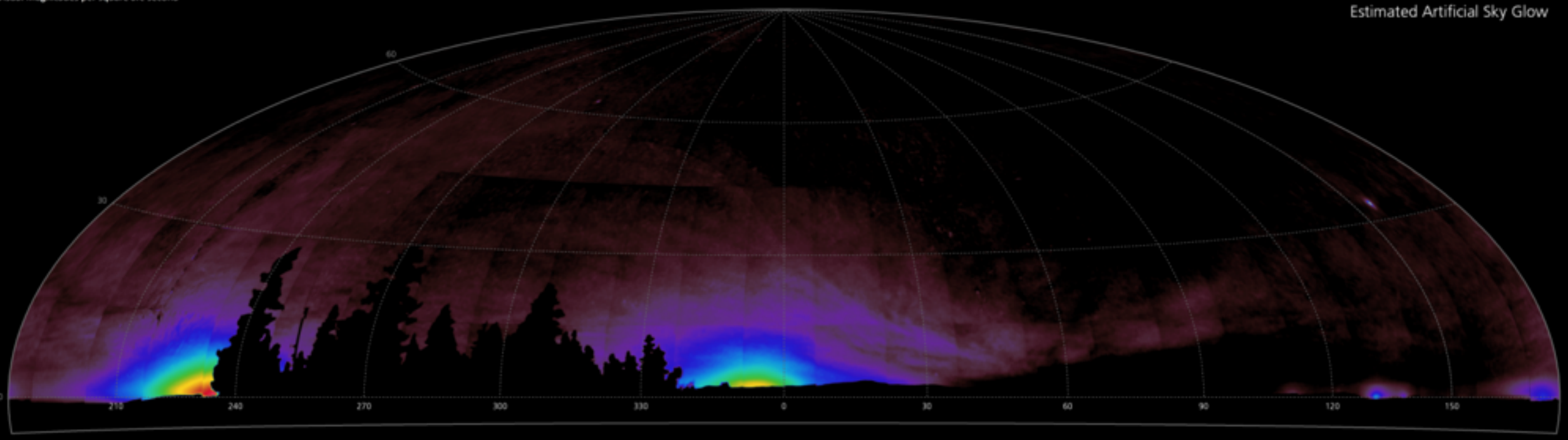
Hammer-Aitoff Equal Area Projection

14 14.5 15 15.5 16 16.5 17 17.5 18 18.5 19 19.5 20 20.5 21 21.5 22 22.5 23 23.5 24

Visual Magnitudes per square arc-second

Zion N P Lava Point September 26, 2003 20.4 hours LMT

Estimated Artificial Sky Glow



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Night Skies Program

Data collected by: D Duriscoe
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Hammer-Aitoff Equal Area Projection

Energy in lighting:
Where does this come from? How does it get here?

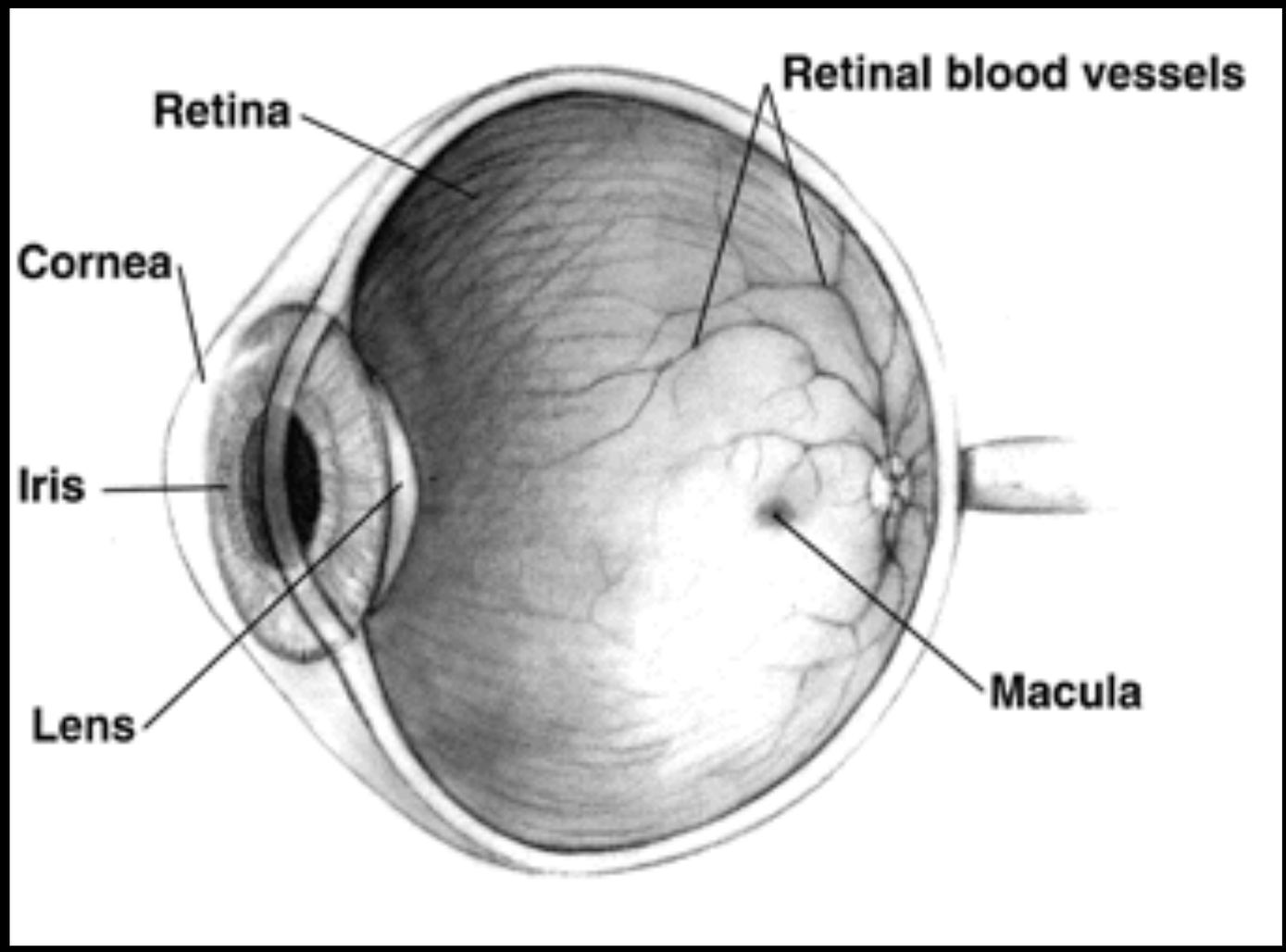
Photo credit: By Staplegunther at the English language Wikipedia, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=8010162

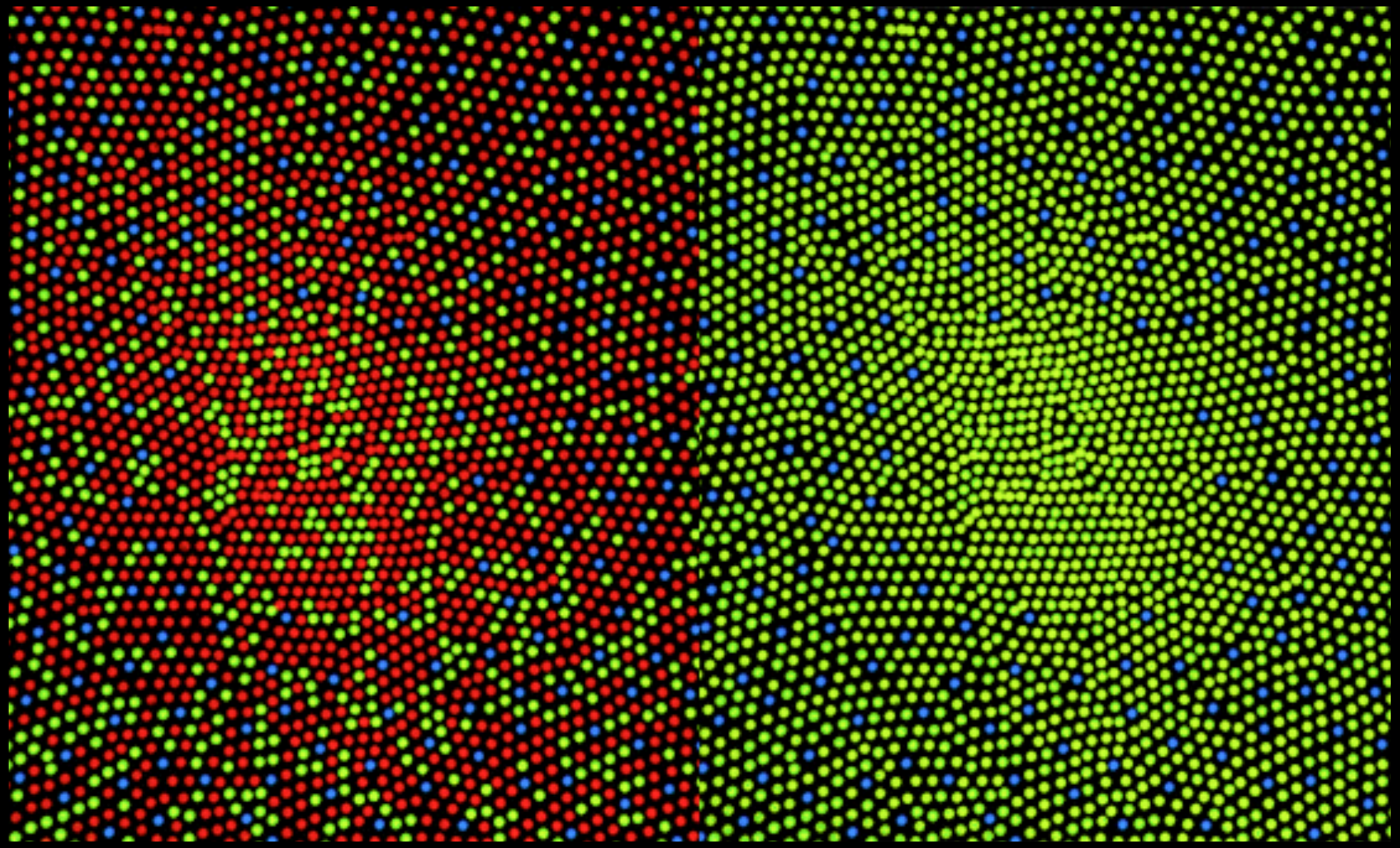
Eyeballs, sunlight, and evolution

- Our eyes as RGB sensors:
  Matches the Sun's spectrum.

- Pupils vs Telescopes:
  Collecting light in a bucket

- Exposure time:
  Why don't you want the eye having long exposures?





map of photoreceptors for full-spectrum human eye vs colorblind human eye

(Mark Fairchild, wikimedia commons)

Milky Way and Light Pollution (Adam Johnston)

Big and Little Dippers, and ??? (Adam Johnston)

Rock Formation and Big Dipper (Adam Johnston)

Milky Way with “Pipe Nebula” (Dan Schroeder)

Milky Way and reflection on lake (Brad Carroll)

How do I see this? How do I make my own pretty pictures?

Your camera, like your eye, is made of of sensors that convert light energy into some kind of signal.

In other words, the energy converted within the core of a distant star is causing a transformation of matter in your eyeball!

Understanding your camera

Typically, a manual setting on a camera allows you to adjust:

- Exposure time: Typically a fraction of a second.
- Aperture, or “f-stop”, describing the size of the opening of lens allowing light through.
- ISO: The sensitivity of the sensor.

How are these things controlled or restricted:
in your eye?
in your phone camera?

Play with your camera!

- Since you can't change the hardware of your eyeball to make it more sensitive, PLAY with your camera, especially:

  - **Exposure time:**
    a few seconds

  - **Aperture size (f-stop):**
    as wide as possible

  - **ISO:**
    It depends.

- <u>Keep in mind:</u>

  - A sturdy tripod!

  - A delay on the shutter

  - Focus on "infinity"
    (This sounds like some kind of ancient wisdom, but it's just photography.)

Note: In some cases, your camera may not have manual adjustments, but might have a special "night" or "star" mode.

1” | f-1.8 | ISO 1600

1” | f-1.8 | ISO 4000
(Good outline of Sagittarius, Mars, and school glow.)

1” | f-1.8 | ISO 4000
(Darker sky with more stars … and clouds.)

1” | f-1.8 | ISO 4000 (What happened?)

Fun tasks:

- Try taking a photo of a dark room. How do you set it up? What do you see?
- “Paint” with a flashlight or moving light source.
- Play with outdoor photography that contrasts foreground (earthly) light with background (stellar) light.
- Try a wide angle view to expose stars and the Milky Way. Watch for tracks of other objects!
- Just generally play!

For more information:

- Resources:
  - http://firstdrafts.net/physicalscience/resources/astronomy/
  - http://firstdrafts.net/physicalscience/astrophotography/
- Directory for images of our astrophotography:
  - https://adamjohnston.smugmug.com/School/AstroWork/
- Questions, etc.: ajohnston@weber.edu