

The 2017 Eclipse Megamovie

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Pasachoff, Larisza Krista, Mark Bender, Matt Penn et al., plus
Google*

The opportunity, 21 August 2017



Outline

- The Megamovie(s)
 - The Google connection
 - The corona - Megamovie
 - The mountains on the Moon – Gigamovie?
- Outsourcing Einstein
 - A bit of history
 - A Kilomovie?

Google help

The Eclipse Megamovie project will receive important help from Google, including

- A website for participants to register and upload images.
- Access to raw data for scientists for a set period of time
- Testing infrastructure to verify heavy loads
- Monitoring services to identify system stresses, reliability support on day of eclipse
- Awareness opportunities, portion of outreach materials

Google will *not* provide

- Coalignment and image processing software
- Astrometric calibration software
- Image stitching software

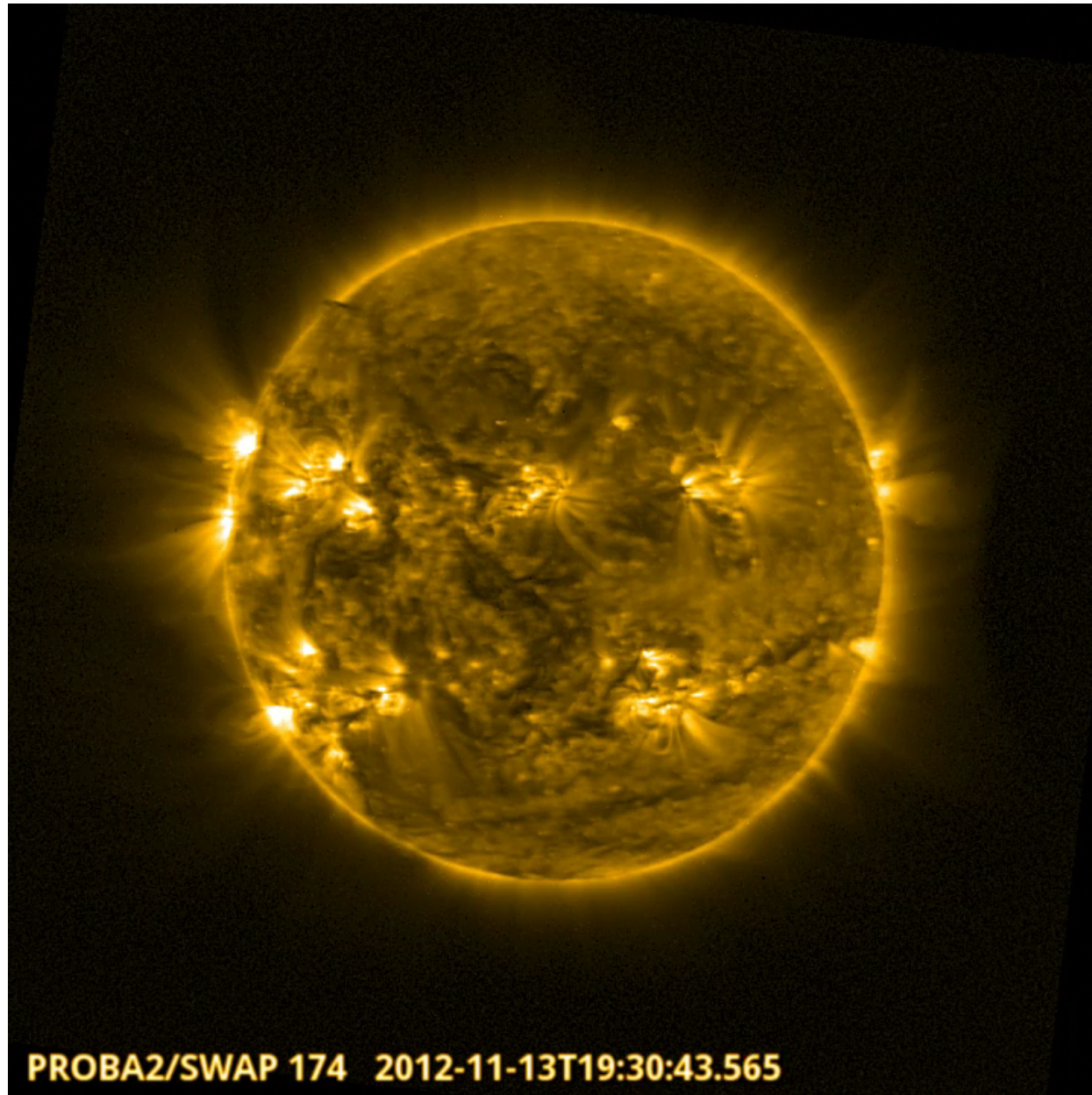
What is a Megamovie?

- Many photographers can record this eclipse because of its great conditions.
- The Megamovie will stitch together everybody's images to make movies of varying quality.
- We may be able to make use of smartphone cameras.
- This eclipse could also see a first-ever pixel confirmation of the Eddington experiment in the 1919 eclipse.

The Solar Corona

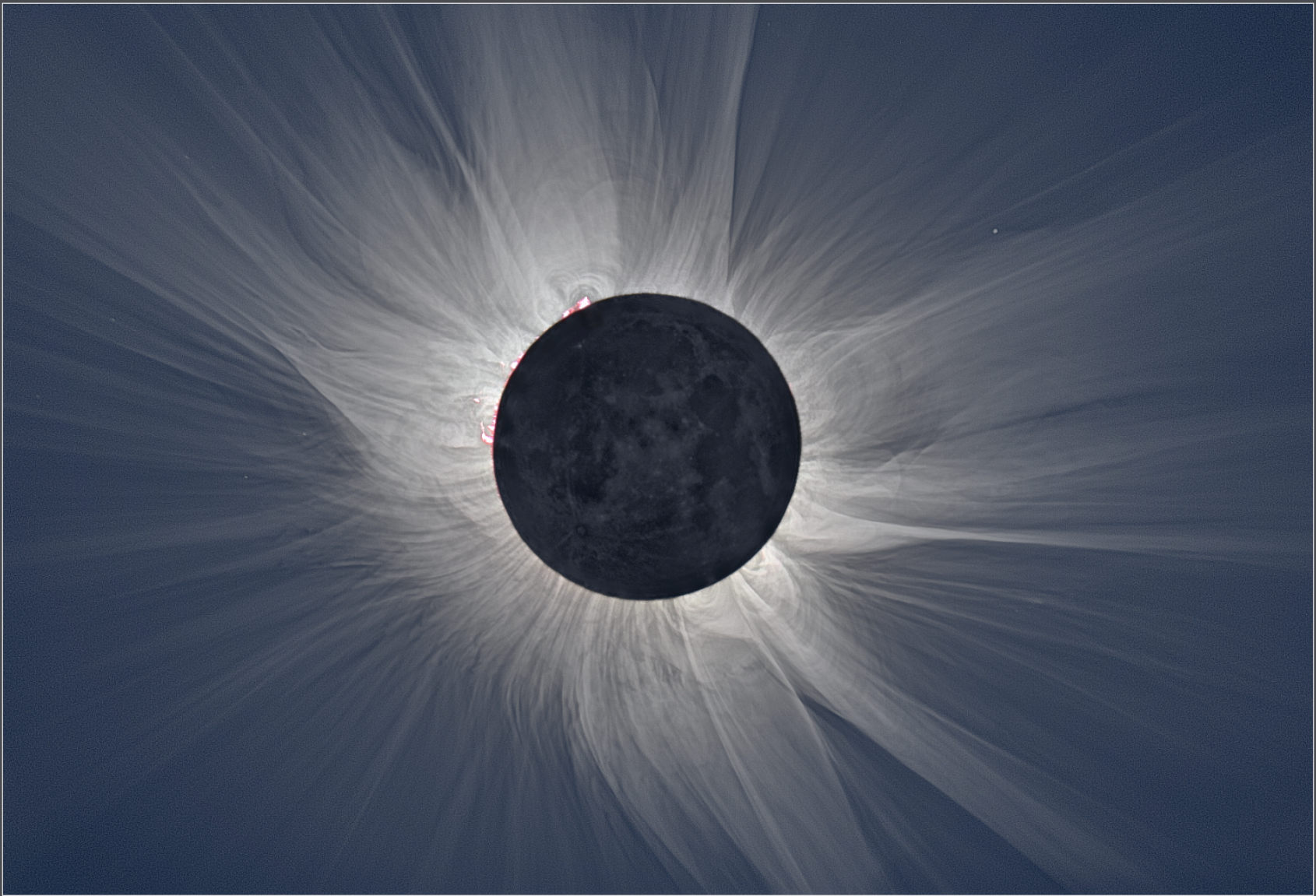
- This astronomical object is about as bright as the full Moon, shining from scattered sunlight.
- It cannot be observed without a *coronagraph* – or, in a total eclipse.
- In an eclipse, one can see the whole corona, right down to the chromosphere.

Eclipses from space



PROBA2/SWAP 174 2012-11-13T19:30:43.565

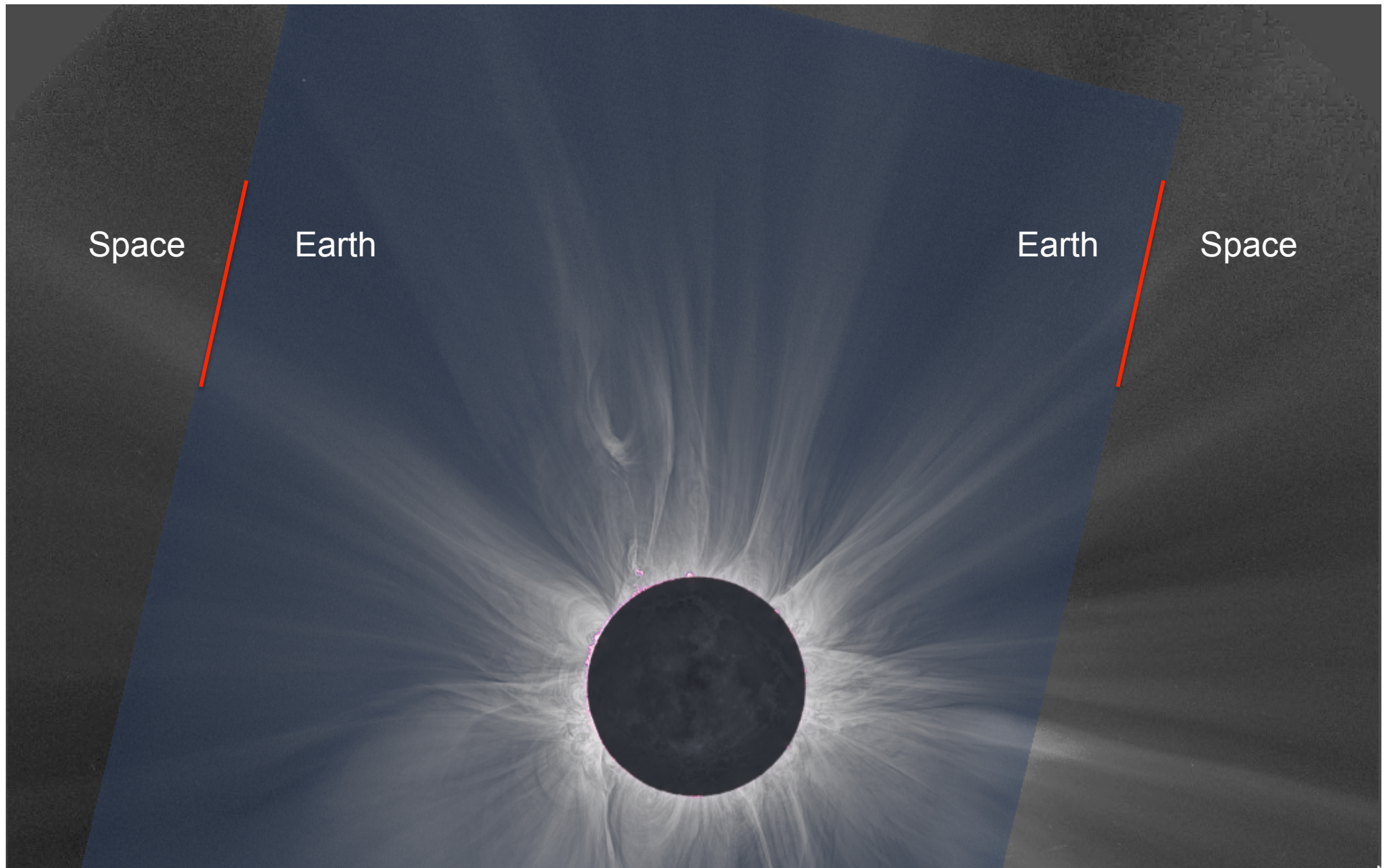
Eclipses from Earth



Total Solar Eclipse 2015

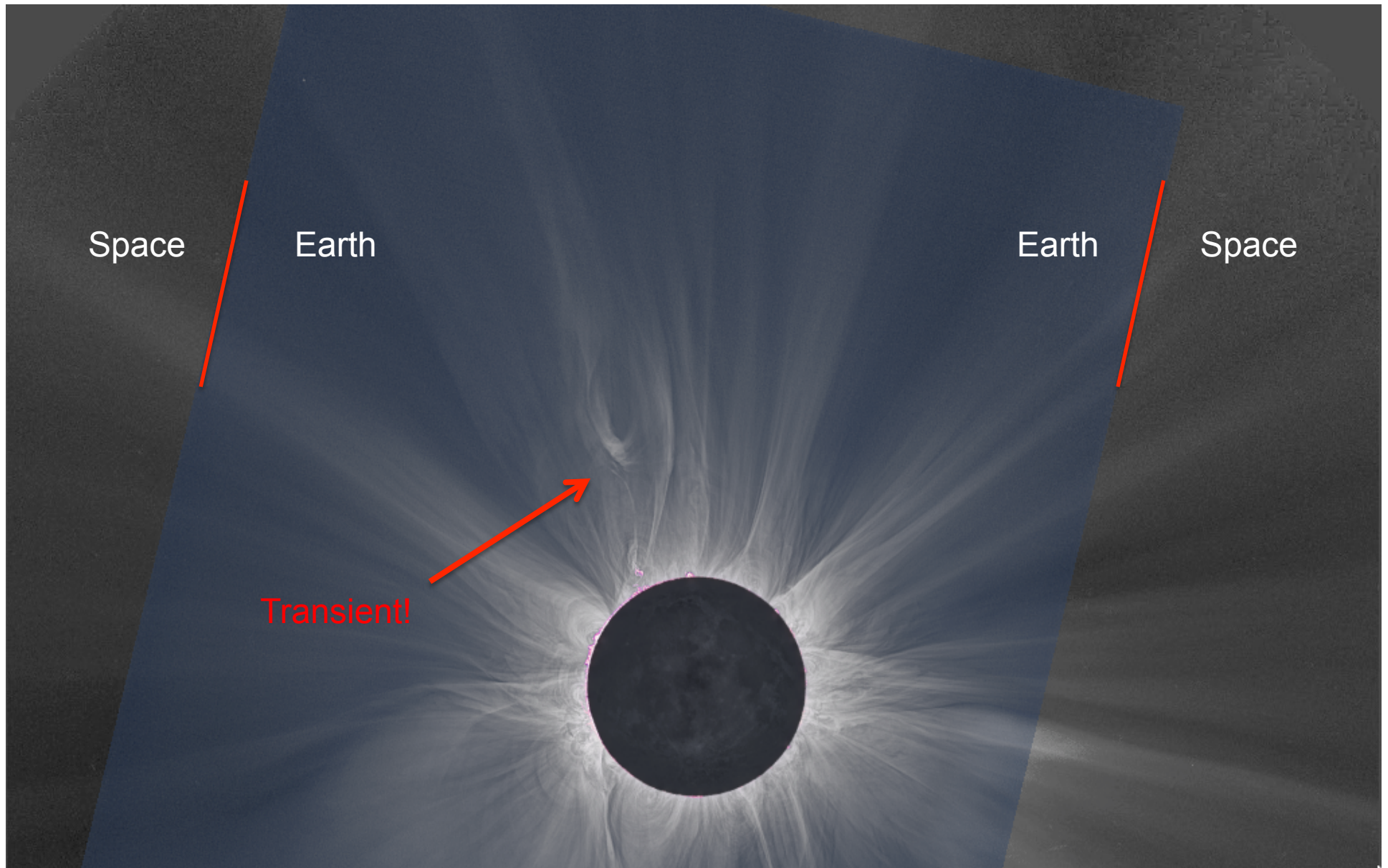
© 2015 Miloslav Druckmüller, Shadia Habbal, Peter Aniol, Pavel Štarha

Eclipses from Earth



Druckmüller

Eclipses from Earth



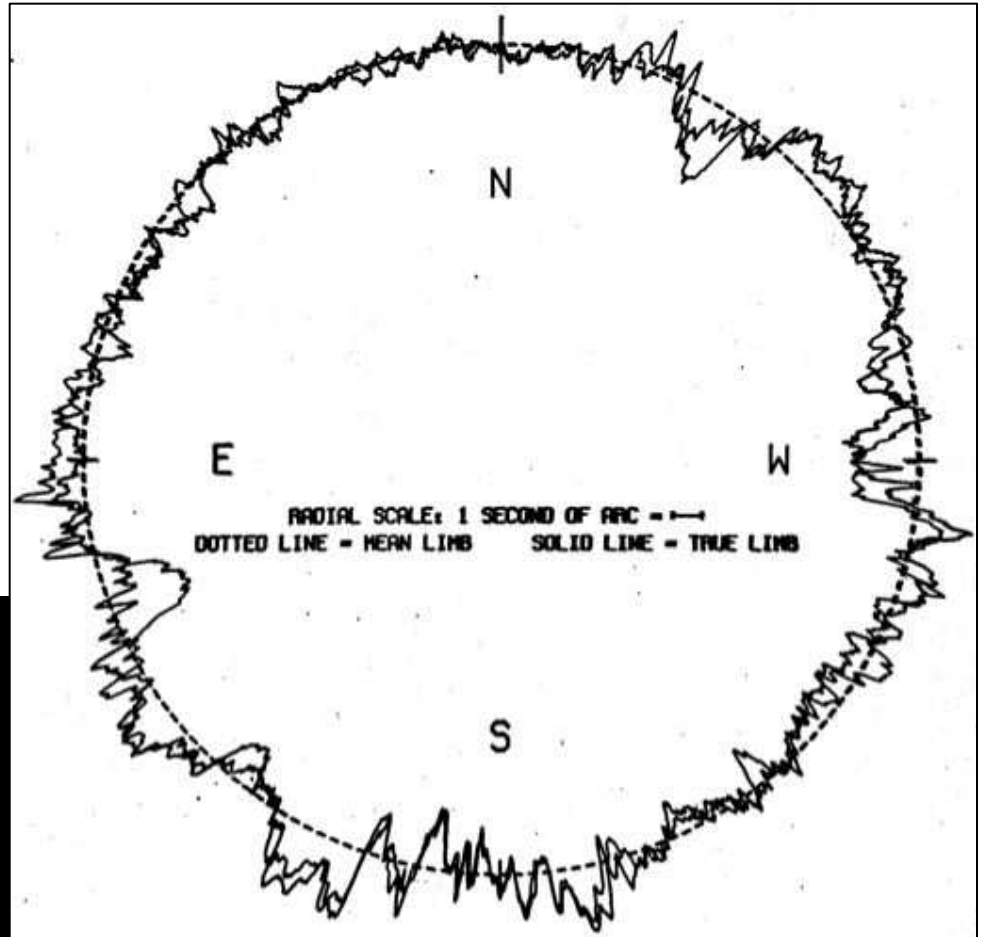
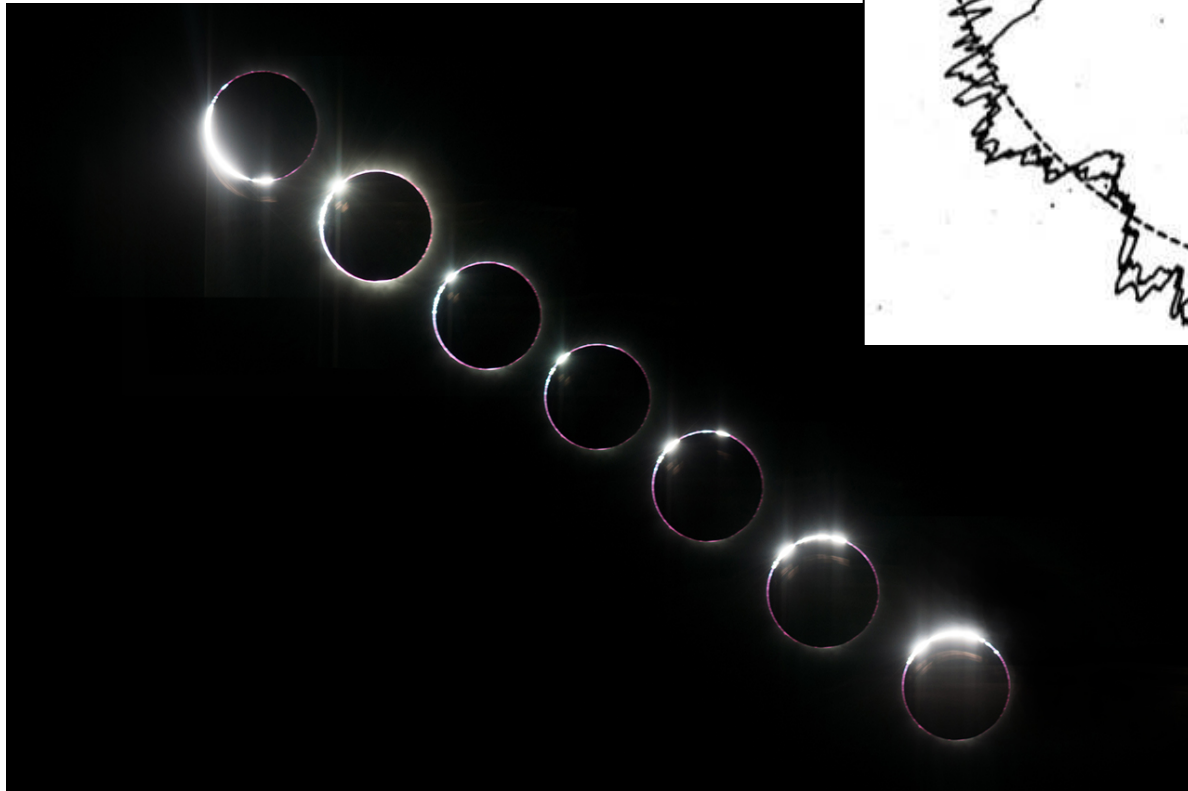
I. The true corona in time

- At eclipse one can see right down to the photosphere.
- During the 2017 eclipse, we can imagine an hour-plus datacube (i.e., a long movie).
- No such data currently exist.
- We expect to observe interesting dynamics and hope for a coronal mass ejection (CME).

II. Lunar topography

- Mountains on the Moon create the “diamond ring” effect.
- Smartphone cameras are good enough to capture “diamond rings” (Baily’s Beads).
- The lunar topography will evolve cross-track and along the track.
- Smartphone metadata give 0.001” resolution.

Mapping lunar mountains with a smartphone Megamovie



2013 images from an airplane above the Atlantic

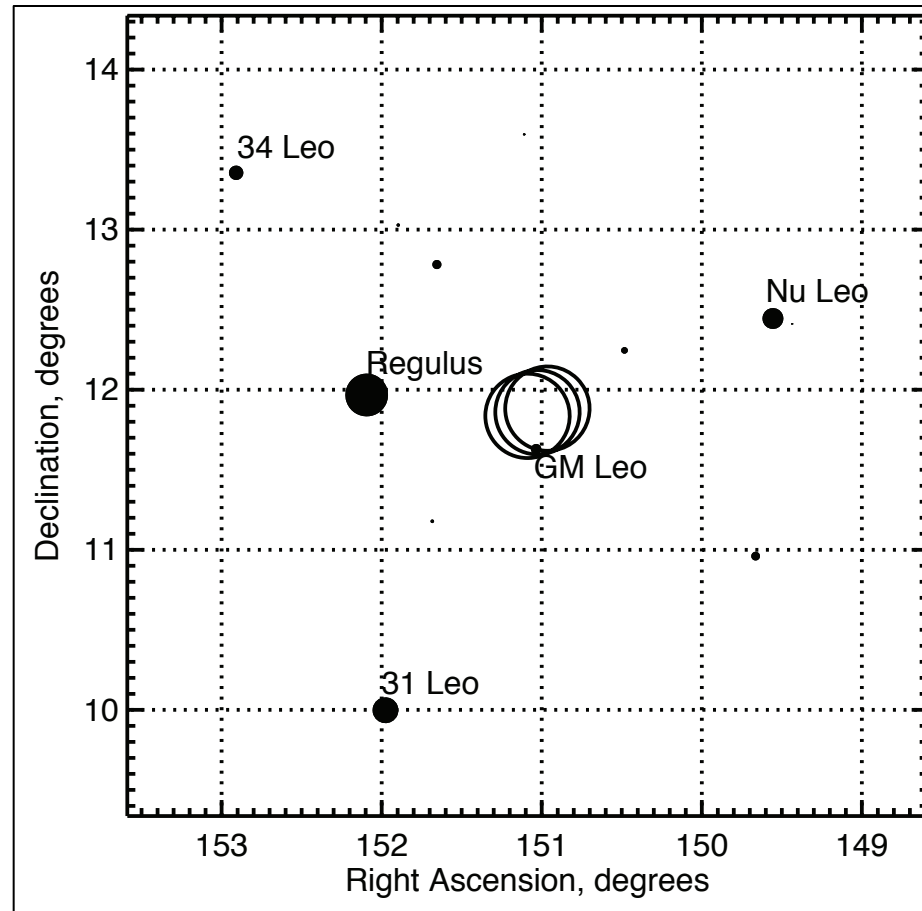
An App for Baily's Beads

- Smartphone cameras can record the Beads in raw format with metadata (GPS required).
- An app to enable this to happen needs to be *developed and motivated*.
- Stitching into movies can happen near real time?
- New and valuable information on lunar topography may result.

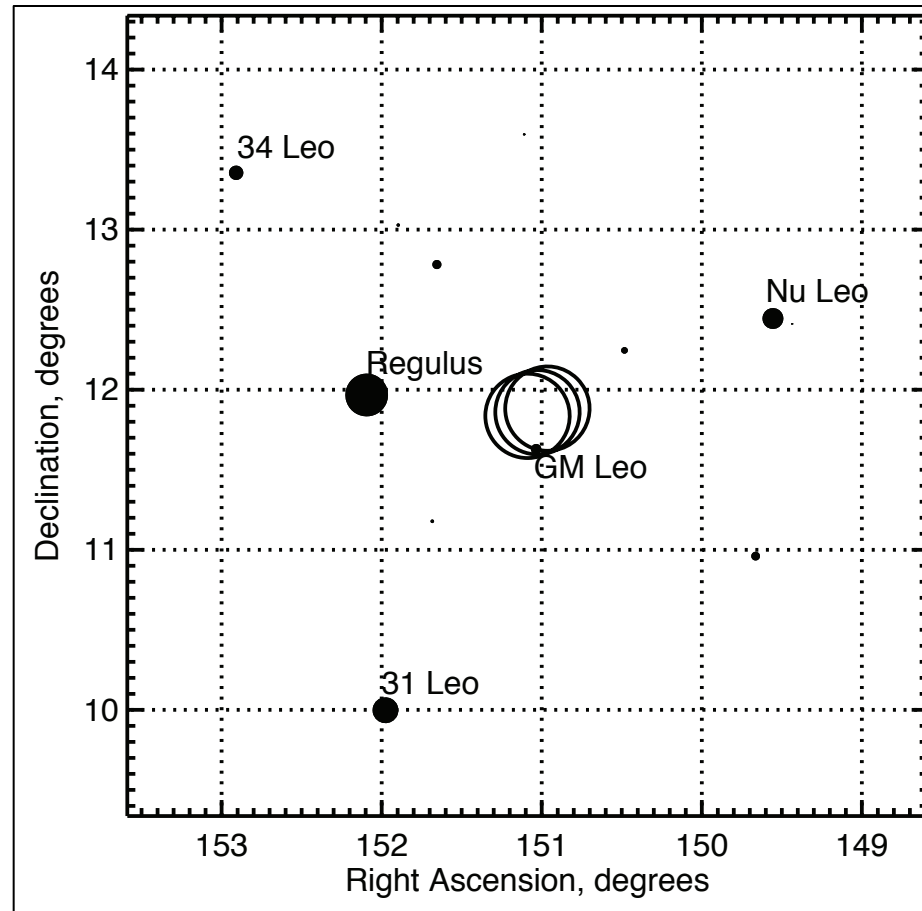
III. Outsourcing Einstein

- The celebrated confirmation of Einstein's prediction has a long and interesting history.
- There has never been pixel-based observation of this effect, to my knowledge.
- There are lots of wonderful CCD/CMOS cameras in peoples' hands right now.

The star field in 2017



The star field in 2017



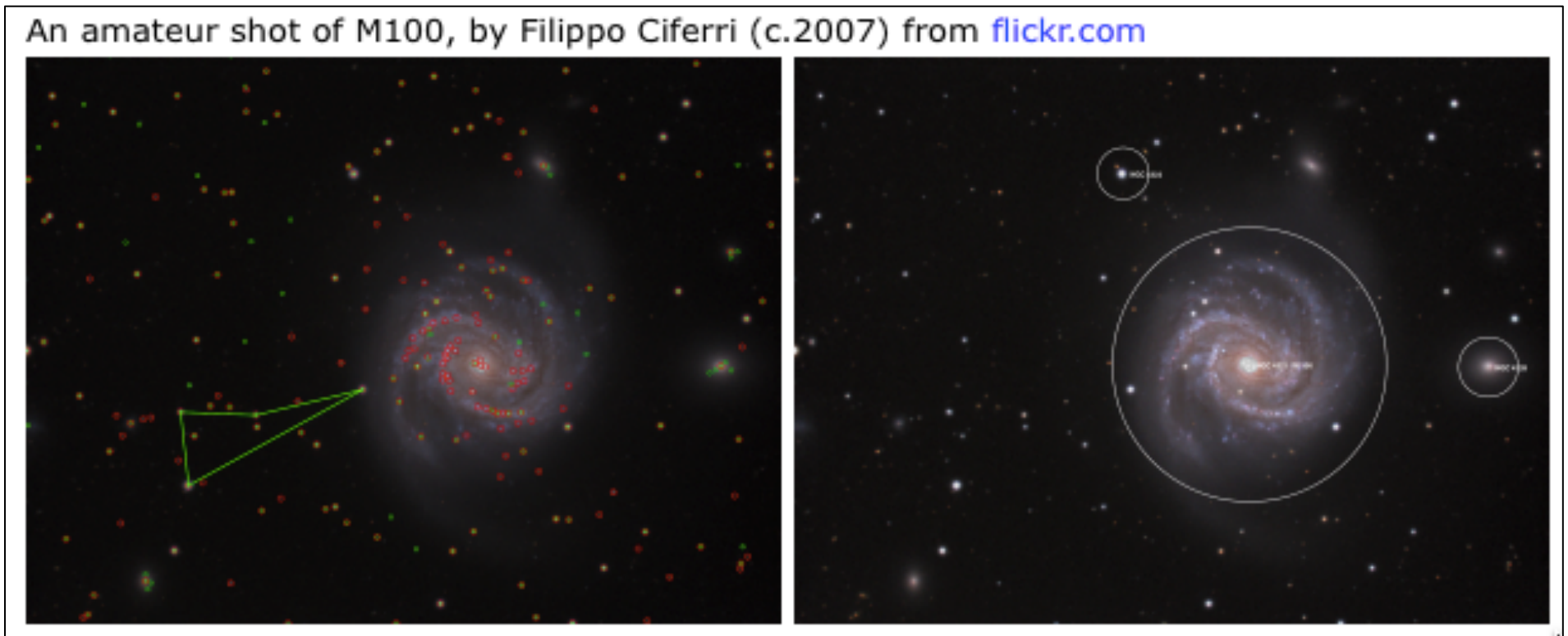
Can one measure the deflection simply by comparing Regulus and the Moon?

Many questions

Noting that the deflection change over the full interval will not exceed 0.1 arc sec:

- Does crowdsourcing help at this level?
- Are non-astrographic telescopes useful?
- Do color CCDs work at sub-pixel scales?
- Can we see faint stars ($m_V \sim 9$)?
- Can the Moon enable a basic measurement?
- Will professionals in airplanes win the race?
- Or can a few dozen well-equipped amateurs do the trick, supported by *astrometry.net*?

Astrometry.net



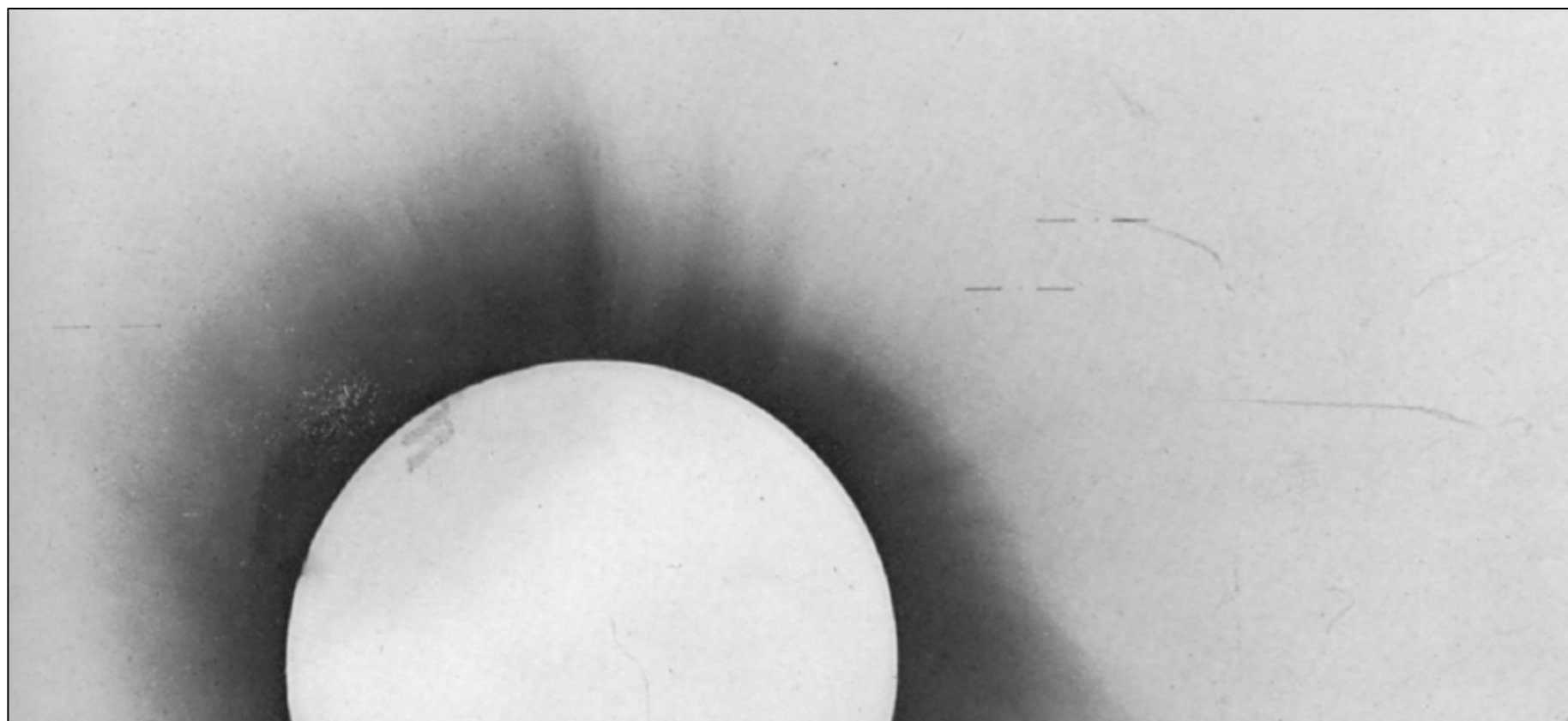
The red-circled stars are stars found in the image;
The green ones are in *astrometry.net*'s master
catalog. Note the Flickr.com source here.

IX. *A Determination of the Deflection of Light by the Sun's Gravitational Field,
from Observations made at the Total Eclipse of May 29, 1919.*

*By Sir F. W. DYSON, F.R.S., Astronomer Royal, Prof. A. S. EDDINGTON, F.R.S.,
and Mr. C. DAVIDSON.*

(Communicated by the Joint Permanent Eclipse Committee.)

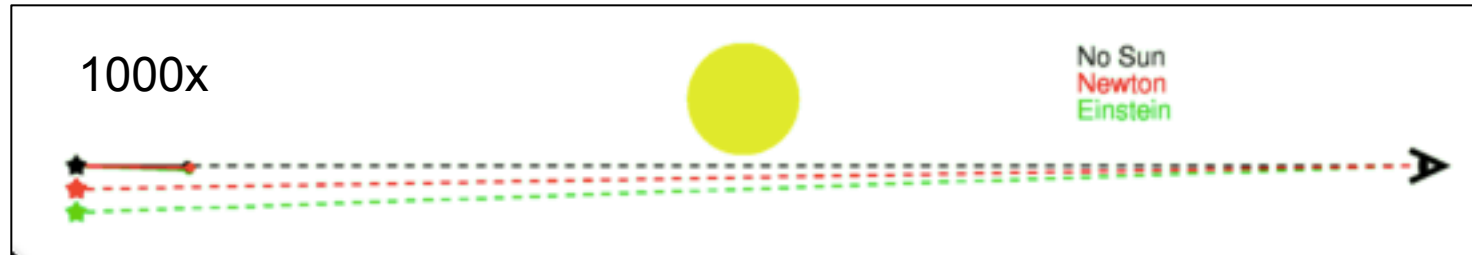
Received October 30,—Read November 6, 1919.



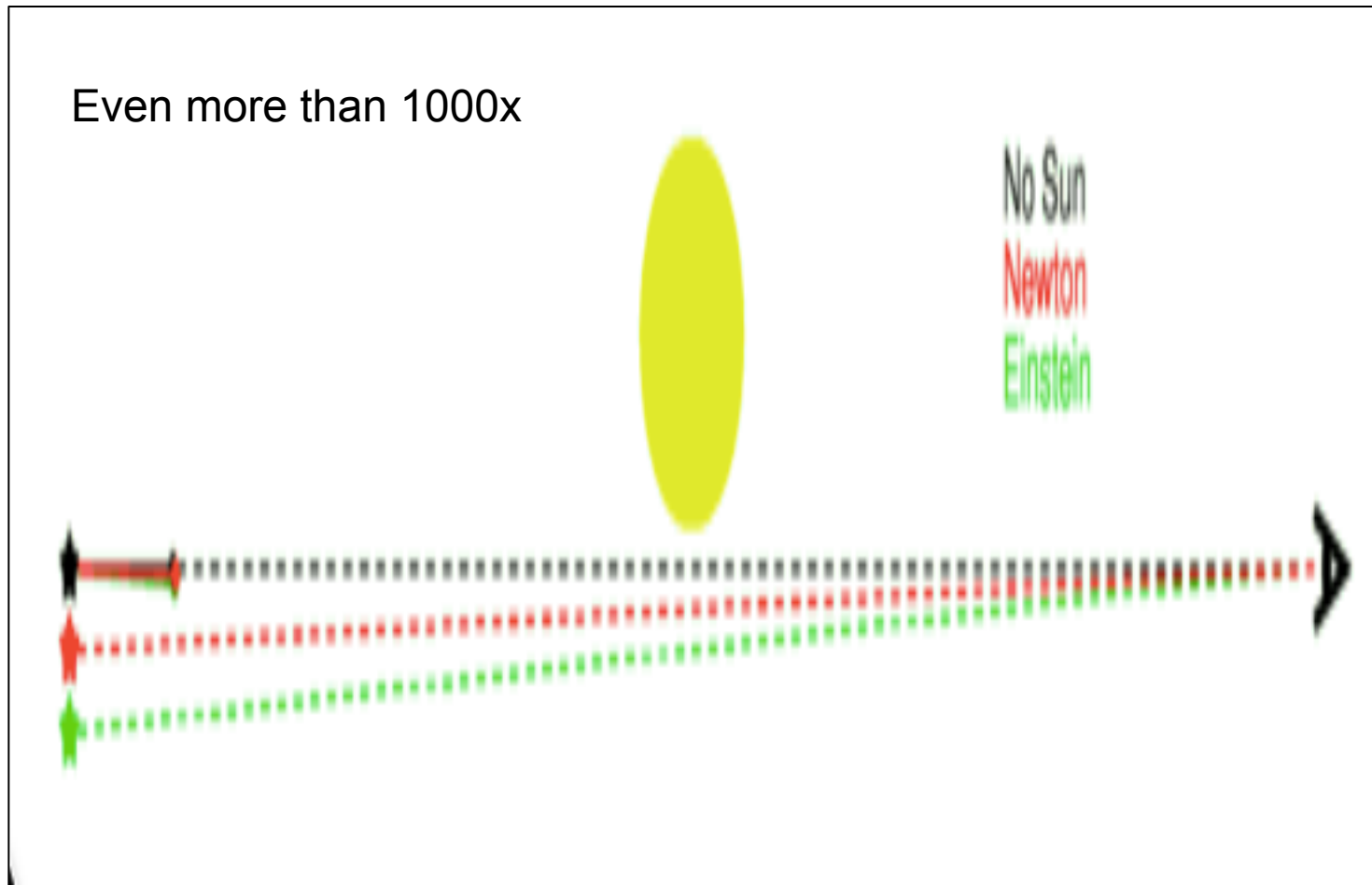
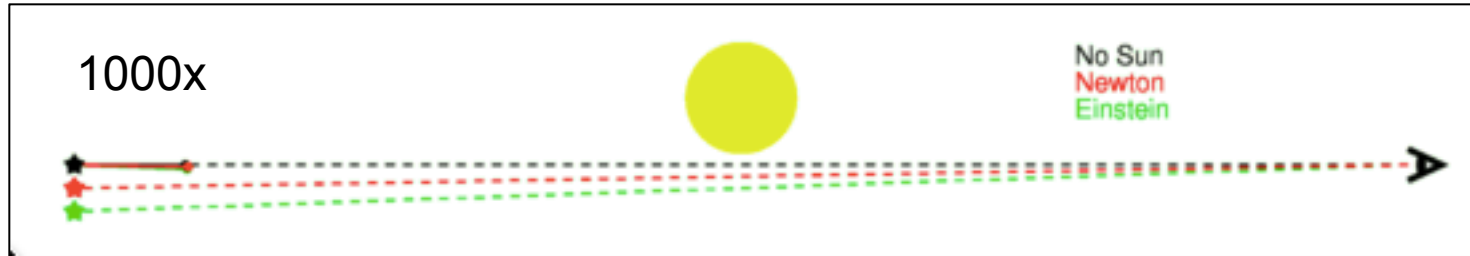
The history in one slide

- An early attempt to confirm Einstein's prediction was aborted by the war, but his 1911 theory had been erroneous! The 1915 theory was OK.
- There were lingering grumbles about Eddington's work, since he liked the theory.
- Pacifism, anti-German WW I sentiment, and antisemitism all played roles in this adventure.
- J. Crelinsten "Einstein's Jury: The Race to Test Relativity" (Princeton, 2006) is a good read.

How big an effect?



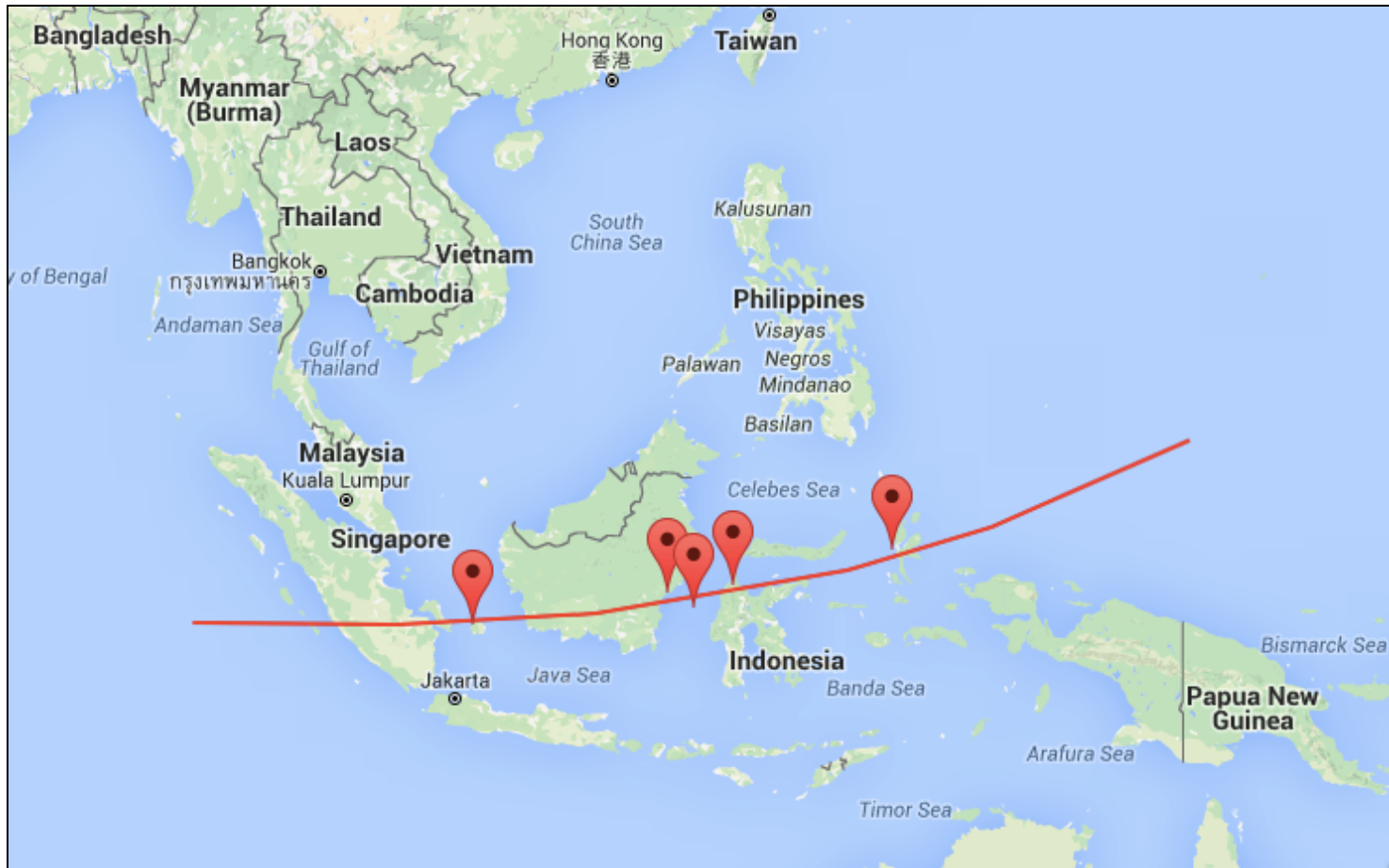
How big an effect?



How will the Megamovies work?

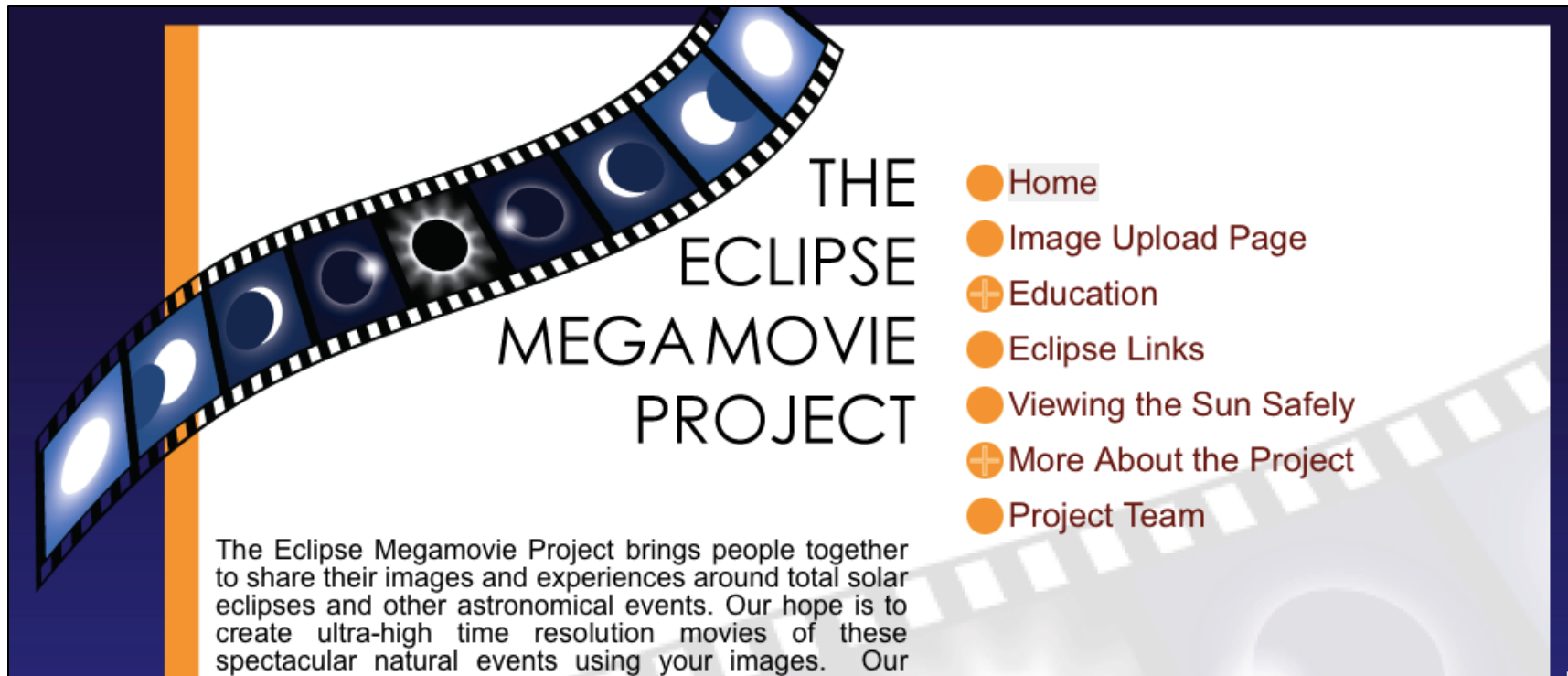
- We persuade many amateur astronomers to contribute their raw images, helped by apps we provide.
- We rely upon Google to deal with the glut.
- We develop software for sorting, stitching, and producing a variety of movies.
 - some can even come from smartphone cameras
 - the best coronal images will be scientifically important
 - the very best (a “datacube” if not a movie) could show the effect of general relativity

Citizen CATE (Matt Penn)



<https://sites.google.com/site/citizencateexperiment/home/eclipse-2016>

Contacts



THE
ECLIPSE
MEGAMOVIE
PROJECT

The Eclipse Megamovie Project brings people together to share their images and experiences around total solar eclipses and other astronomical events. Our hope is to create ultra-high time resolution movies of these spectacular natural events using your images. Our

- Home
- Image Upload Page
- ⊕ Education
- Eclipse Links
- Viewing the Sun Safely
- ⊕ More About the Project
- Project Team

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<http://www.eclipsemegamovie.org>

<https://www.facebook.com/EclipseMegamovie/>

<https://sites.google.com/site/citizencateexperiment/home/eclipse-2016>