Science at Recent Solar Eclipses

For Patrick and
Joanne Poitevin's
2014 Solar Eclipse
Conference

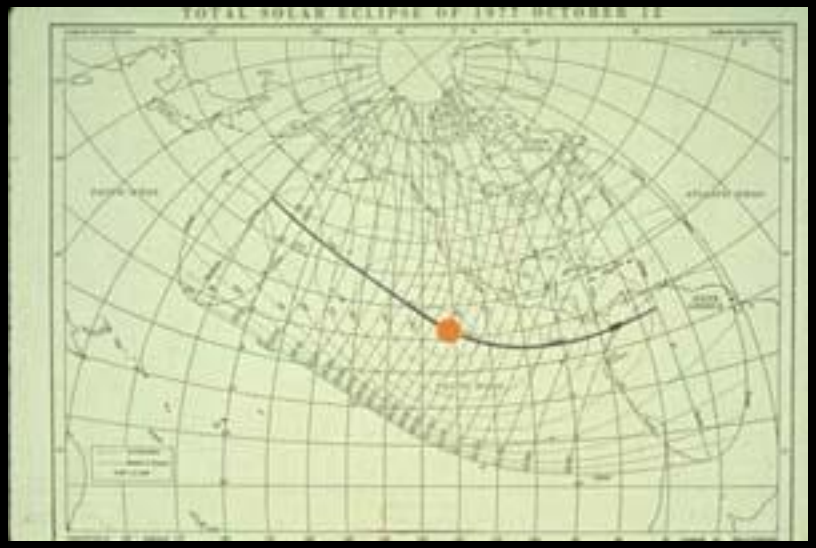
Jay M. Pasachoff

Science at Recent Solar Eclipses

For Patrick and Joanne Poitevin's 2014 Solar Eclipse Conference

The October 23, 2014, partial solar eclipse imaged as part of the conference from Sac Peak (Jay M. Pasachoff and Austin Shea '15)

1977 eclipse in the Pacific



1977 eclipse in the Pacific: the youngest viewers of eclipses:
Deborah Pasachoff, age 5 months
Eloise Pasachoff, age 2 years 7 months




Lily [Pasachoff] Kezsbom at Kids Klub, Pasadena
October 23, 2014

3 classes of 18 at Kids Klub, Pasadena, 2014

International Astronomical Union

Working Group on Solar Eclipses/Program Group on Public Education at Solar Eclipses

Search

Home | Reference Materials | Previous Eclipses | Upcoming Eclipses

Working Group on Solar Eclipses

Reference Materials

- Eclipse Map Sites
  - 2014: October 23 Partial Eclipse in Western US/Canada, Pacific, and Siberia
    - Jubier's Clickable Map
    - Espenak's EclipseWise Page
    - Sky and Telescope Posting
  - 2015: March 20 Total Eclipse in Arctic, including Svalbard and Faroes; Partial Throughout Europe
  - 2016: March 9 Total Eclipse in Indonesia
  - 2016: September 1 Annular Eclipse in Africa
  - 2017: August 21 Total Eclipse in the U.S.
  - Jay Anderson's Weather Statistics for Future Eclipses
- Eclipse Web Sites
- Eye Safety & Solar Filters

International Astronomical Union
Union Astronomique Internationale

Working Group on Solar Eclipses of Division II

and

Program Group on Public Education on the Occasions of Solar Eclipses of Commission 46 on Education and Development

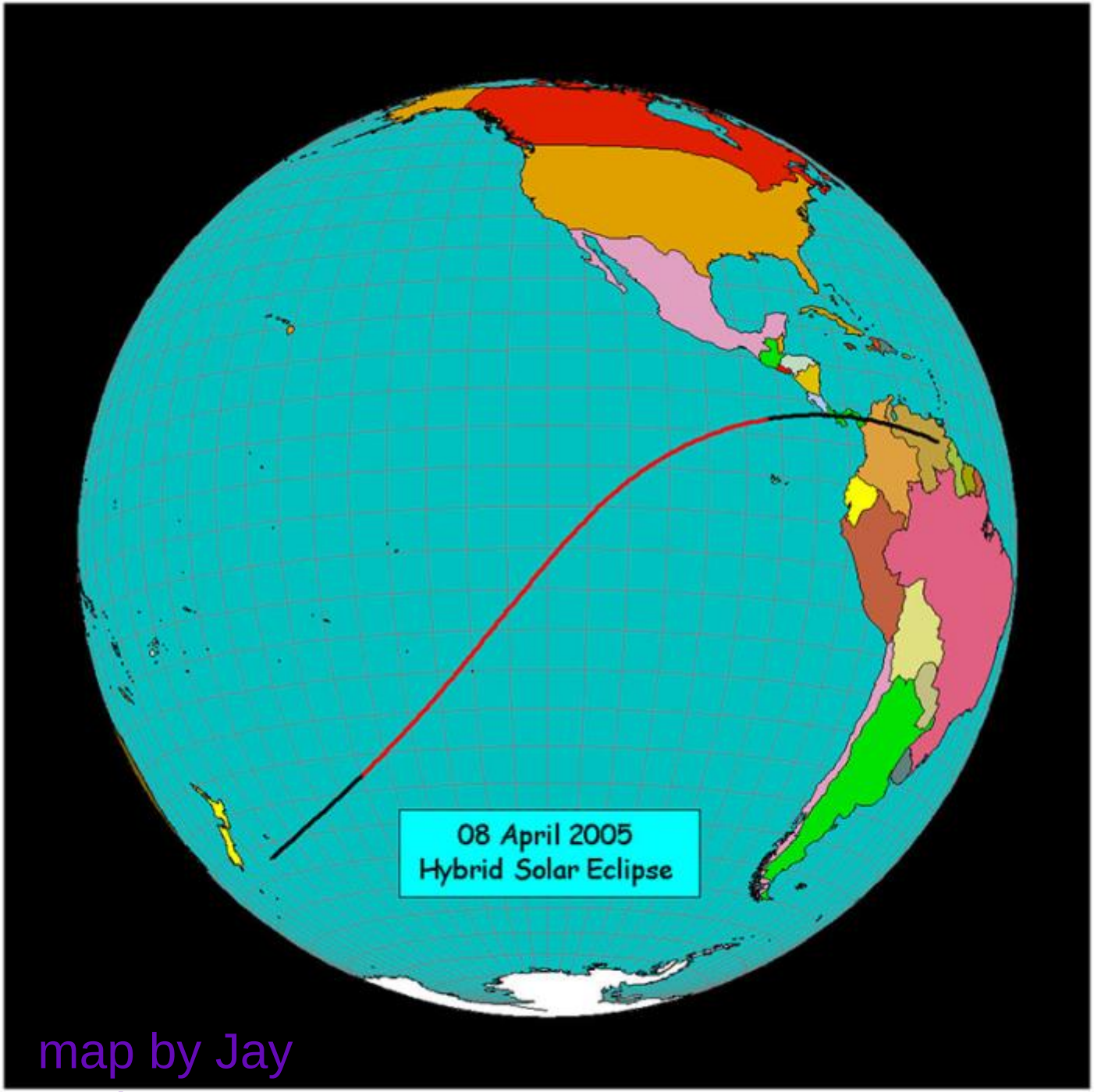
IAU Working Group on Eclipses Members

http://www.eclipses.info/

Eclipse Web Sites

- Fred Espenak's Eclipsewise Website
- Fred Espenak's World Atlas of Solar Eclipse Paths
- Fred Espenak's Solar Eclipses
- Fred Espenak's Lunar Eclipses
- Fred Espenak's NASA Eclipse Resources
- Xavier Jubier's *Google Maps* Eclipse Maps
- Xavier Jubier's Interactive maps for upcoming solar eclipses
- Xavier Jubier's *Google Earth* KMZ files for eclipse tracks
- Xavier Jubier's 5MCSE "Five Millennium (–1999 to +3000) Canon of Solar Eclipses"
  Using the 5MCSE link will get you to any eclipse type
- For TSE 2017 it will generate an URL such as
  http://xjubier.free.fr/en/site_pages/solar_eclipses/xSE_GoogleMap3.php?Ecl=+20170821&Acc=2&Umb=1&Lmt=1&Mag=1
- &Lmt=x (x set to 1 or 0) will display or not the penumbral limits, maximum on horizon and rise/set curves
  &Mag=x (x set to 1 or 0) will display or not the equal magnitude curves
  &Max=x (x set to 1 or 0) will display or not the maximum eclipse curves
- Michael Zeiler: eclipse-maps.com
- Glenn Schneider's site
- The Cosmic Mirror: Daniel Fischer looks into the Universe
- Arnold Barmettler: Interactive Eclipse Maps 1900-2100
- Eclipse Chasers (Bill Kramer), with list of statistics
- Jay M. Pasachoff: Williams College Solar Eclipse Expeditions
- Miloslav Druckmüller: Eclipse Photography
- Stanford Solar Center
- Eclipse statistics and other links (Sheridan Williams)
- spaceweather.com
- Solar Monitor

http://www.eclipses.info/



map by Jay Anderson

image by
Jay Pasachoff
and
Dava Sobel

from the
Galápagos Legend
arranged by Jen Winter

Miloslav Druckmüller, Shelby Kimmel, Jay Pasachoff, Vojtech Rusin

based on images from the Galápagos Legend and the World Discoverer

From the journal *Solar Physics*

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and

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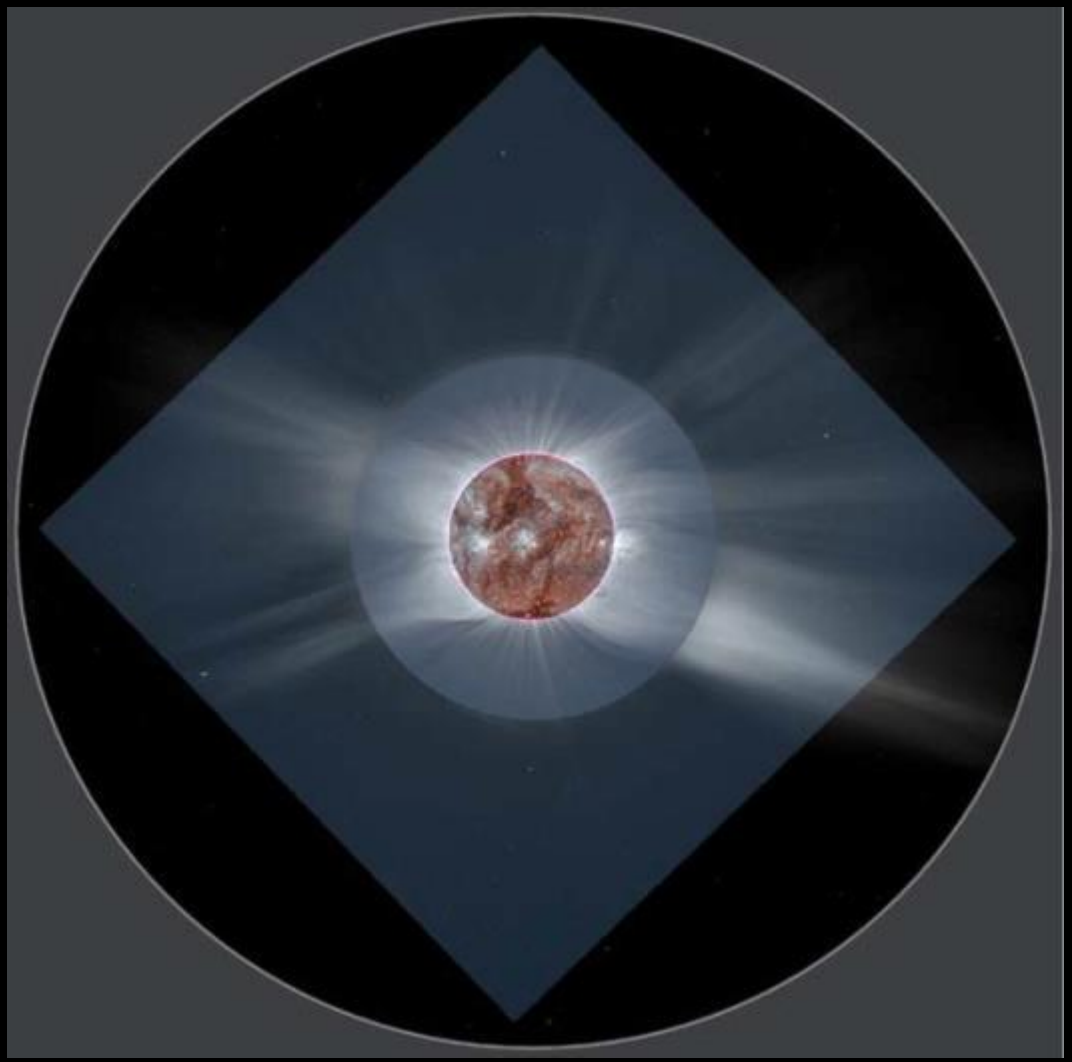
(Received 13 March 2006; accepted 11 September 2006; Published online 15 November 2006)

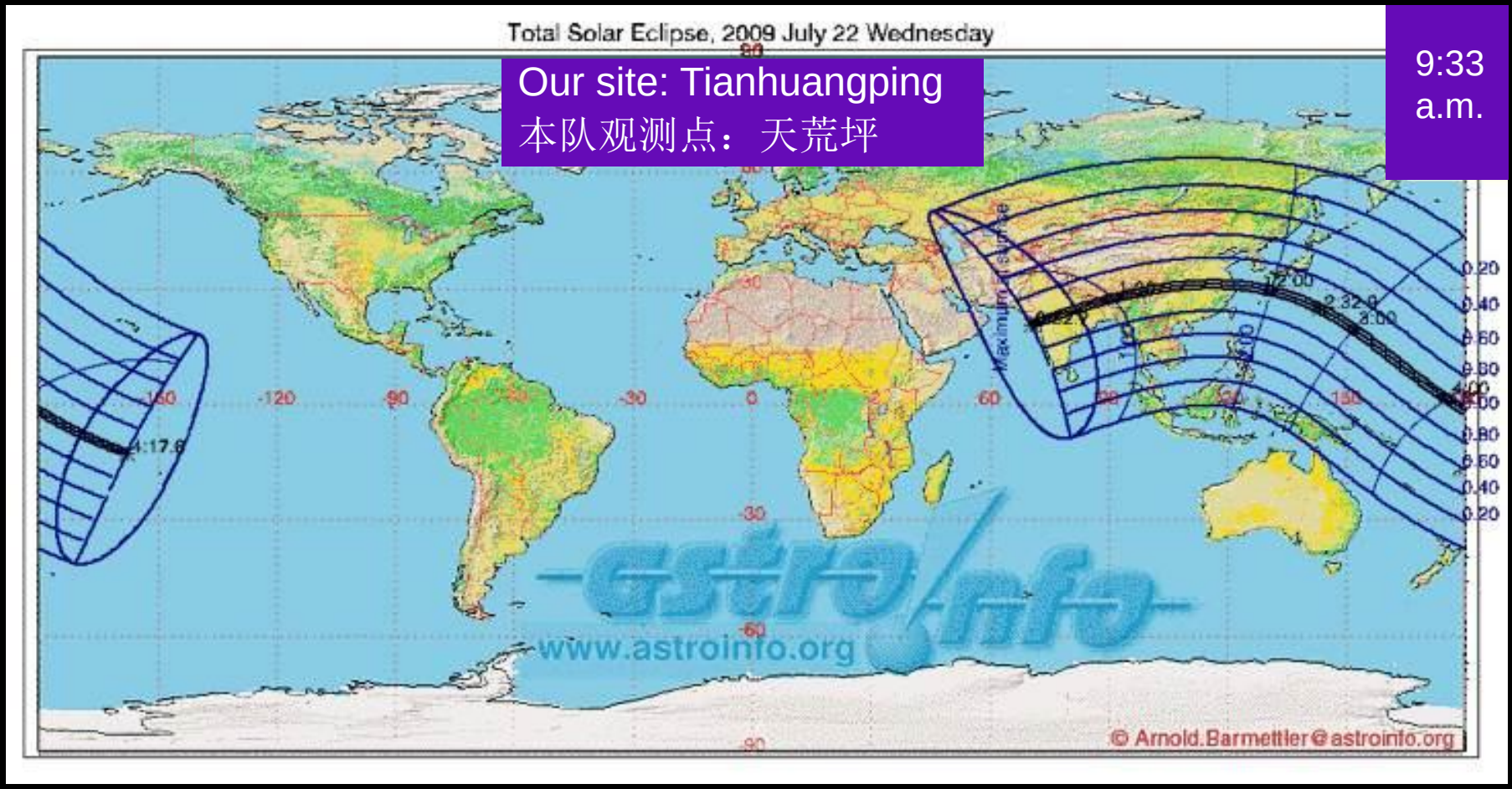
Abstract. The hybrid solar eclipse of April 8, 2005, provided a good opportunity to observe the white-light solar corona, even though the eclipse lasted just 30 seconds and could be seen only from ships in the Pacific Ocean. During the eclipse, we detected a unique 'cloud' of particles in the white-

composite by Miloslav Druckmüller of
40 images by the authors:
Pasachoff/Kimmel/Rusin



Wednesday, 22 July 2009

2009年7月22日 星期三



participants from Williams College: (2009年 威廉姆斯大学科考队成员)

Jay Pasachoff

Bryce Babcock

Katie DuPré ‘10

Sara Dwyer ‘11

Caroline (Yung Hsien Ng) Tam ‘11

Rachel Wagner-Kaiser ‘10 (Keck Northeast Astron. Consortium Summer Fellow)

Adam (Jianjun) Wang

Paul Rosenthal

Charles (Huajie) Cao ‘09 (now Princeton University)

collaborators from China:

Yihua Yan, Beijing Solar Observatory

Jin Zhu, Beijing Planetarium

Lin Lan, Hangzhou High School

with assistance from the Committee for Research and Exploration
of the National Geographic Society, and the Rob Spring ‘75 Fund

Pasachoff, Jay M.,Vojtech Rušin, Metod Saniga,

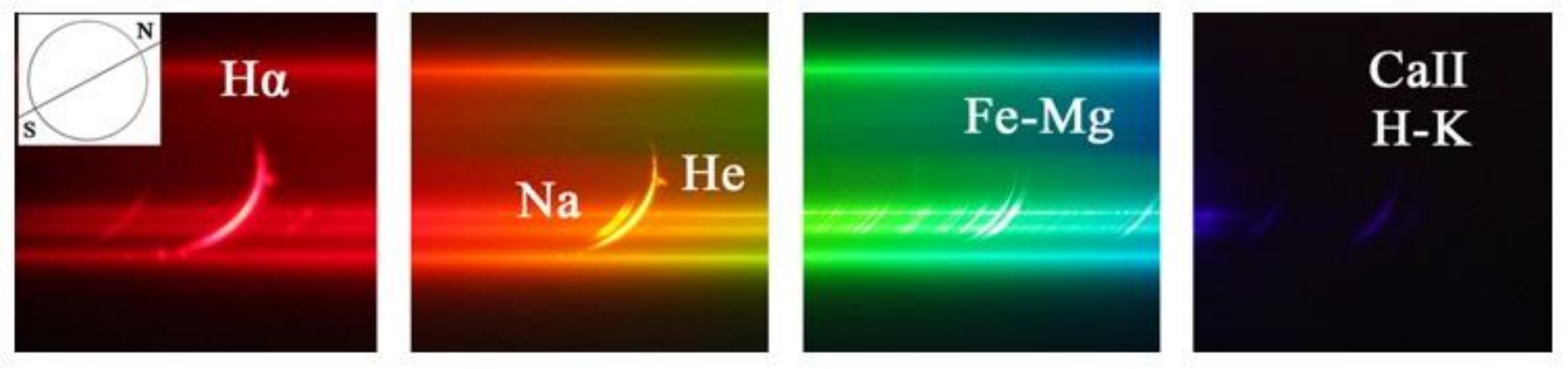
Hana Druckmüllerová, and Bryce A. Babcock, 2011,

"Structure and Dynamics of the 22 July 2009 Eclipse White-Light Corona,"

Astrophys. J. **742**, 29-42.

with assistance from the Committee for Research and Exploration of the National Geographic Society, and the Rob Spring ‘75 Fund

site photos by Edw. Ginsberg

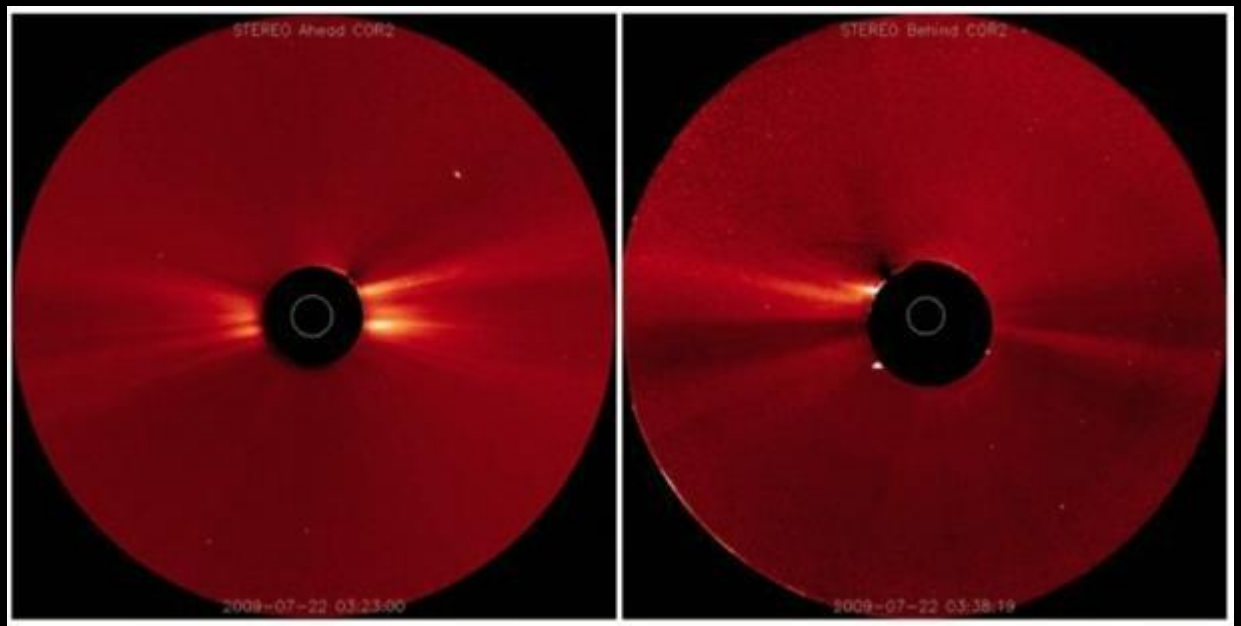


Spectra by Aris Voulgaris and John Seiradakis, Aristotle University of Thessaloniki

Voulgaris, Aristeidis, Tilemachos M. Athanasiadis, John H. Seiradakis, and Jay M. Pasachoff, 2010, "A Comparison of the Red and Green Coronal Line Intensities at the 29 March 2006 and the 1 August 2008 Total Solar Eclipses: Considerations of the Temperature of the Solar Corona," *Solar Physics* **264**, #1, 45-55. DOI 10.1007/s11207-010-9575-7

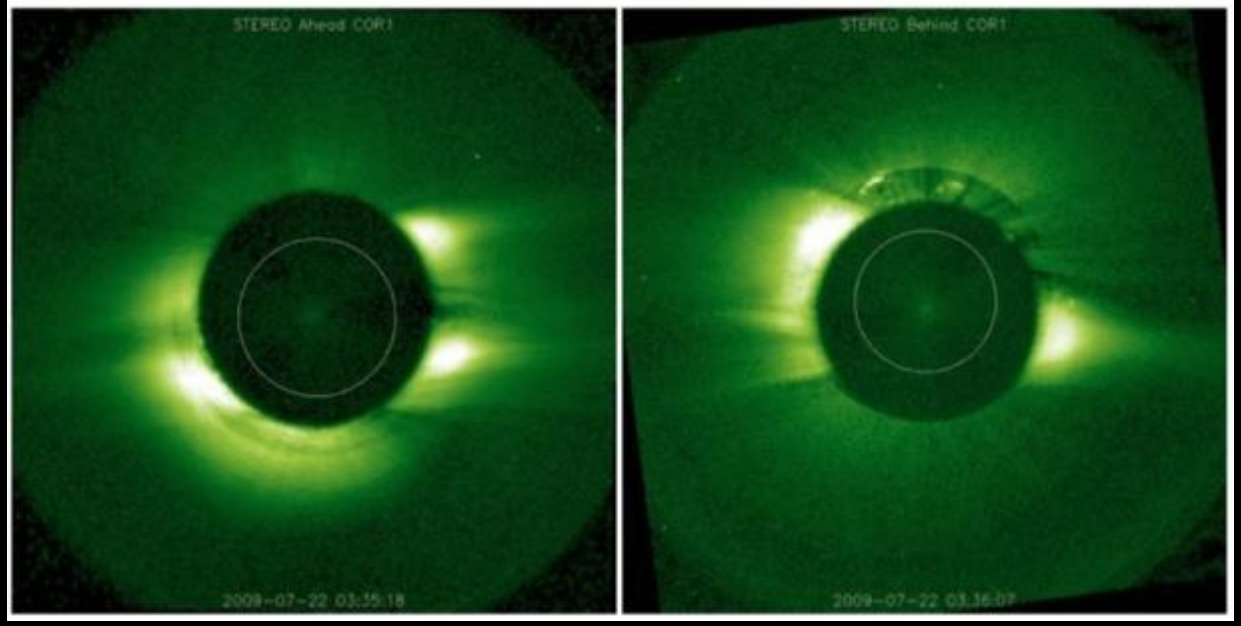
http://arxiv.org/pdf/0911.0325

STEREO A
COR2
03:37:30



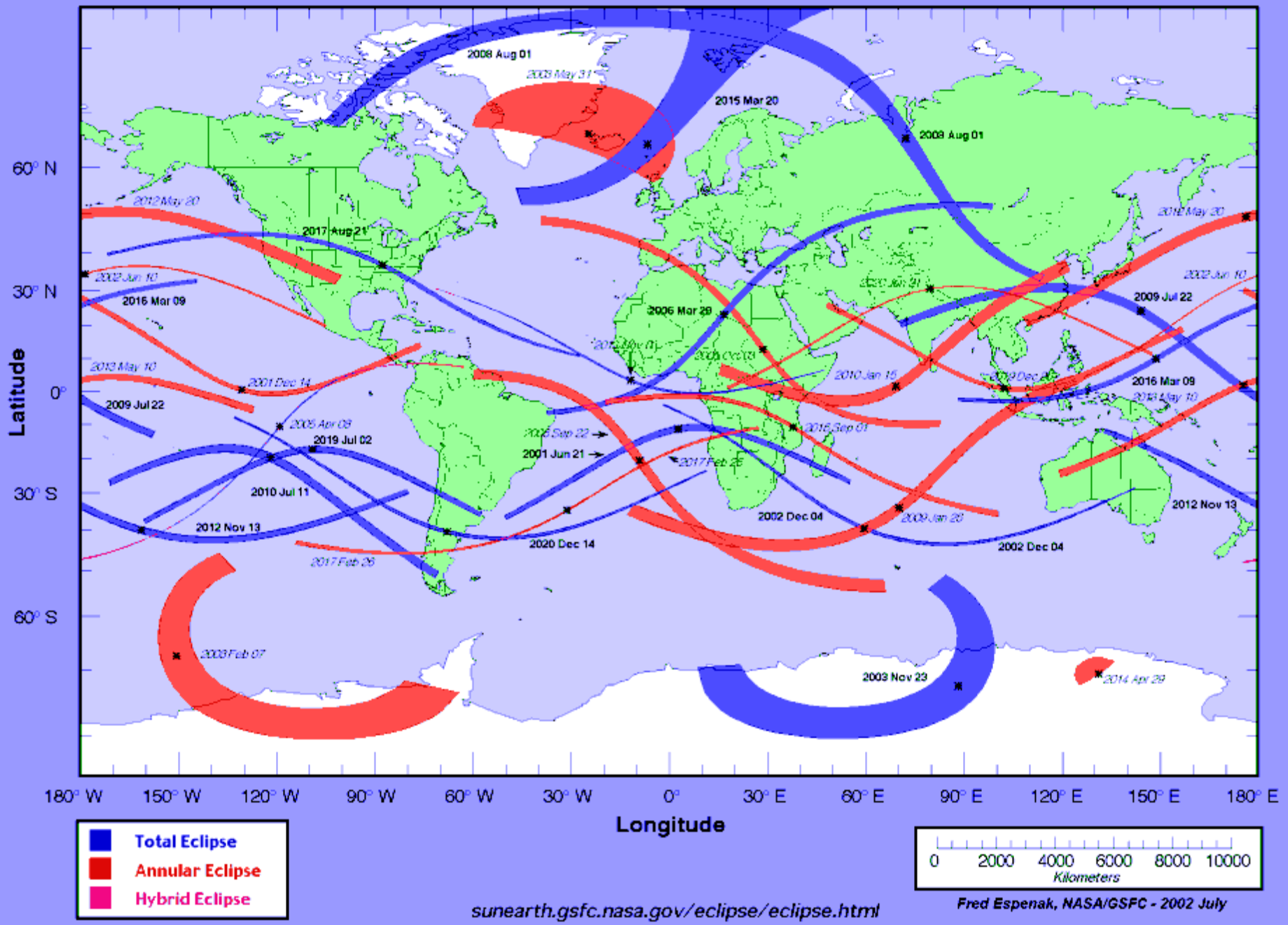
STEREO B
COR2
03:38:19

STEREO A
COR1
03:35:18



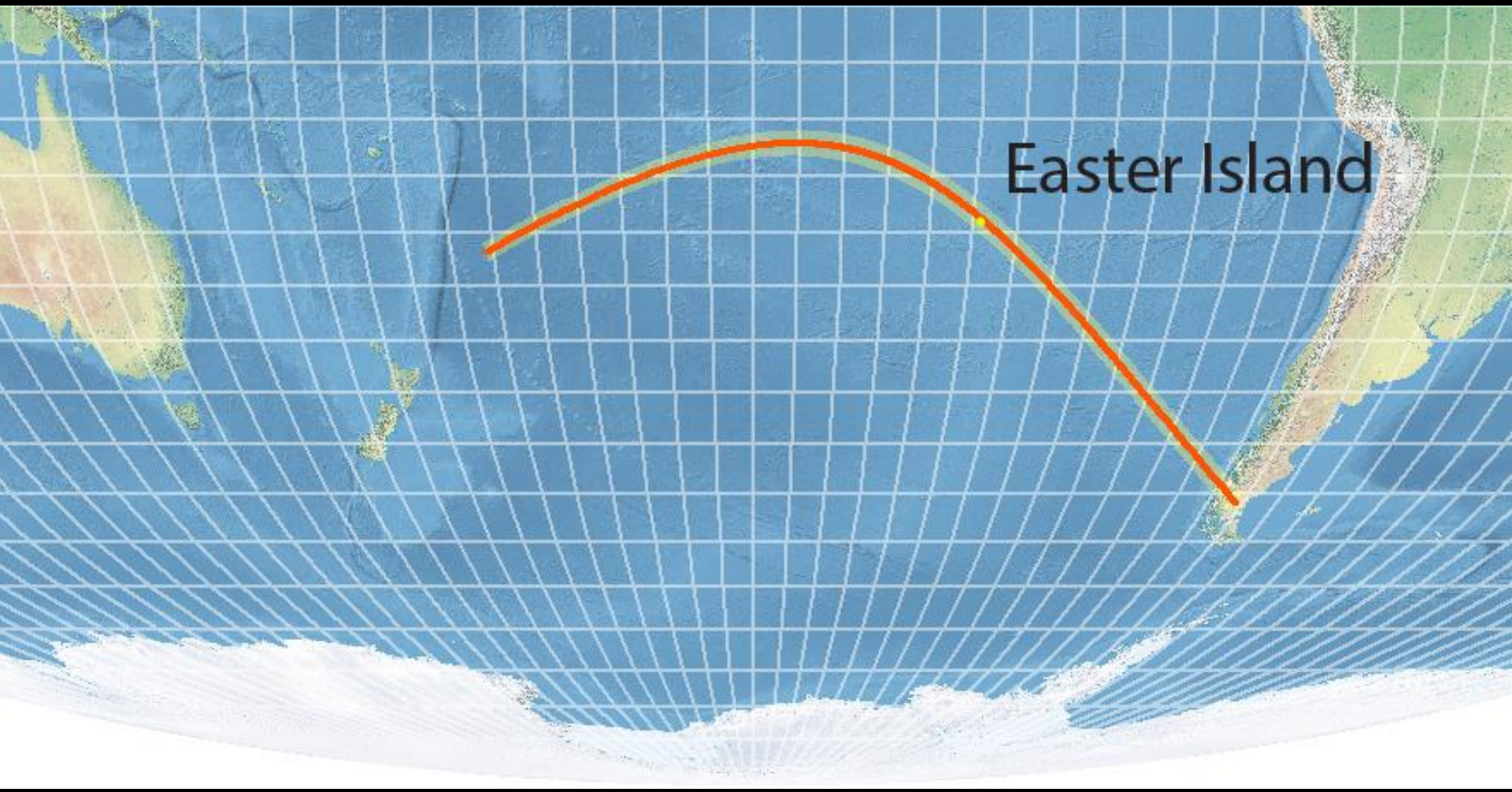
STEREO B
COR1
03:36:07

Total and Annular Solar Eclipse Paths: 2001 — 2020 日全食、日环食轨迹



sunearth.gsfc.nasa.gov/eclipse/eclipse.html

Fred Espenak, NASA/GSFC - 2002 July



Map by Michael Zeiler, eclipse-maps.com

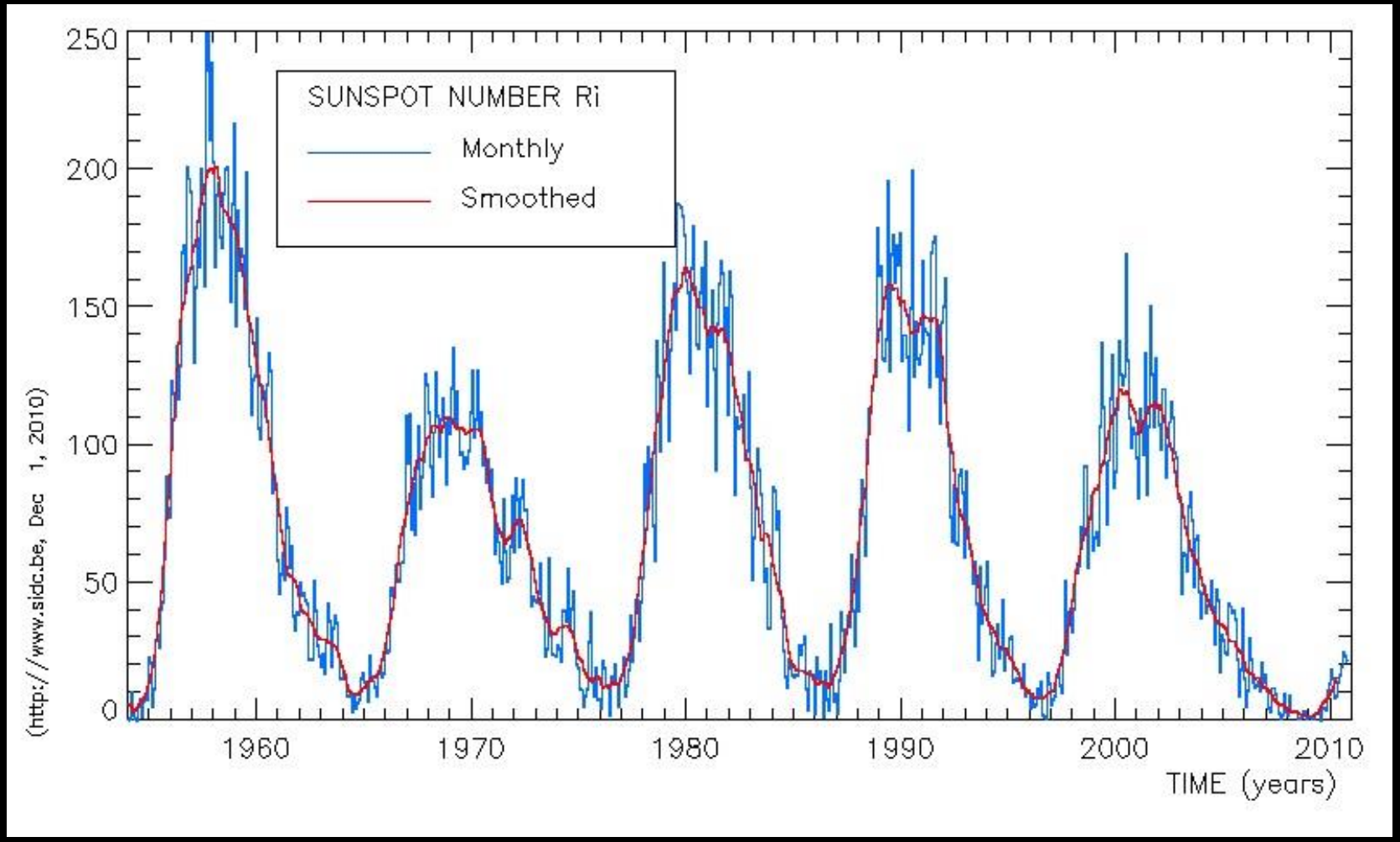
Daily Sun: 09 Jul 10

A region of high magnetic activity is emerging at the circled location.
Credit: SOHO/MDI

Sunspot number: 11
What is the sunspot number?
Updated 08 July 2010

Spotless Days
Current Stretch: 0 days
2010 total: 35 days (18%)
2009 total: 260 days (71%)
Since 2004: 803 days
Typical Solar Min: 486 days

- spaceweather.com


SUNSPOT NUMBER Ri
Monthly
Smoothed
250
200
150
100
50
0
1960
1970
1980
1990
2000
2010
TIME (years)
(http://www.sidc.be, Dec 1, 2010)

Tahai

July 10

Easter Island Eclipse Expedition

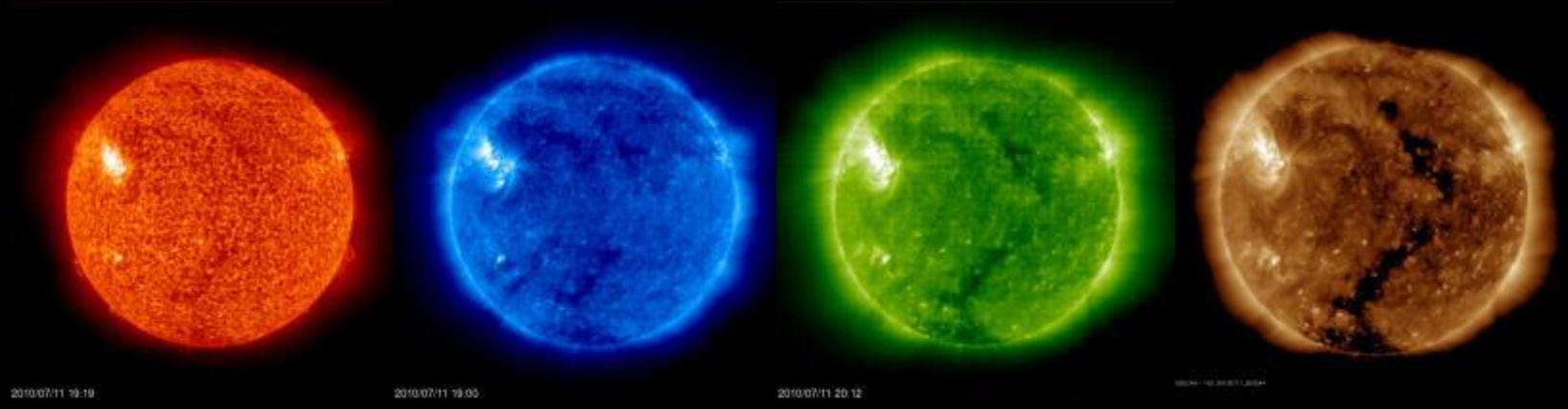
Williams College

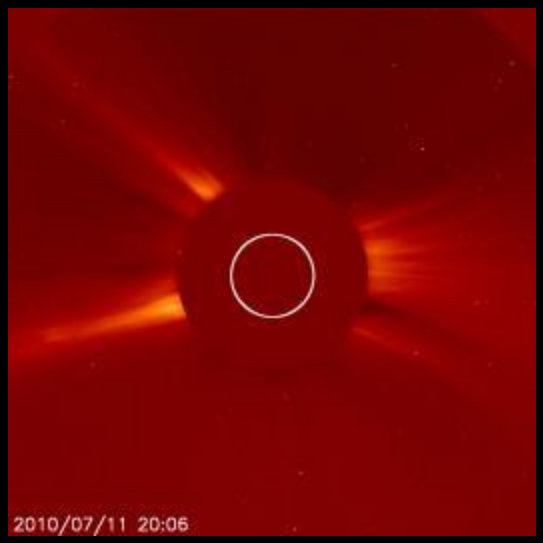
July 11, 2010

Expedition Images: Jay M. Pasachoff, Muzhou Lu, and Craig Malamut; Cover Design: Craig Malamut

Totality! 4 min 45 sec

NASA Images


2010/07/11 19:19
2010/07/11 19:03
2010/07/11 20:12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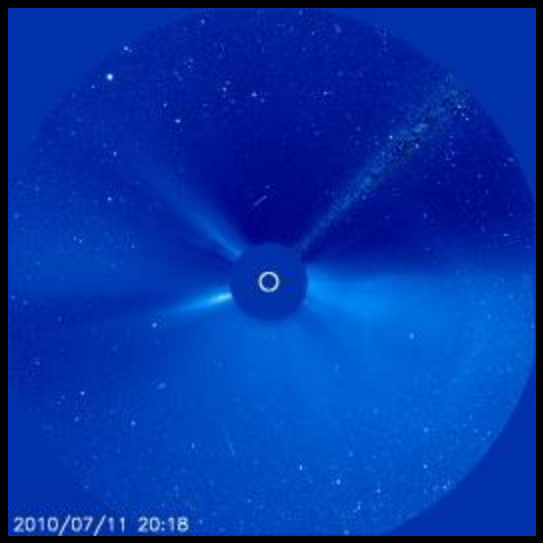
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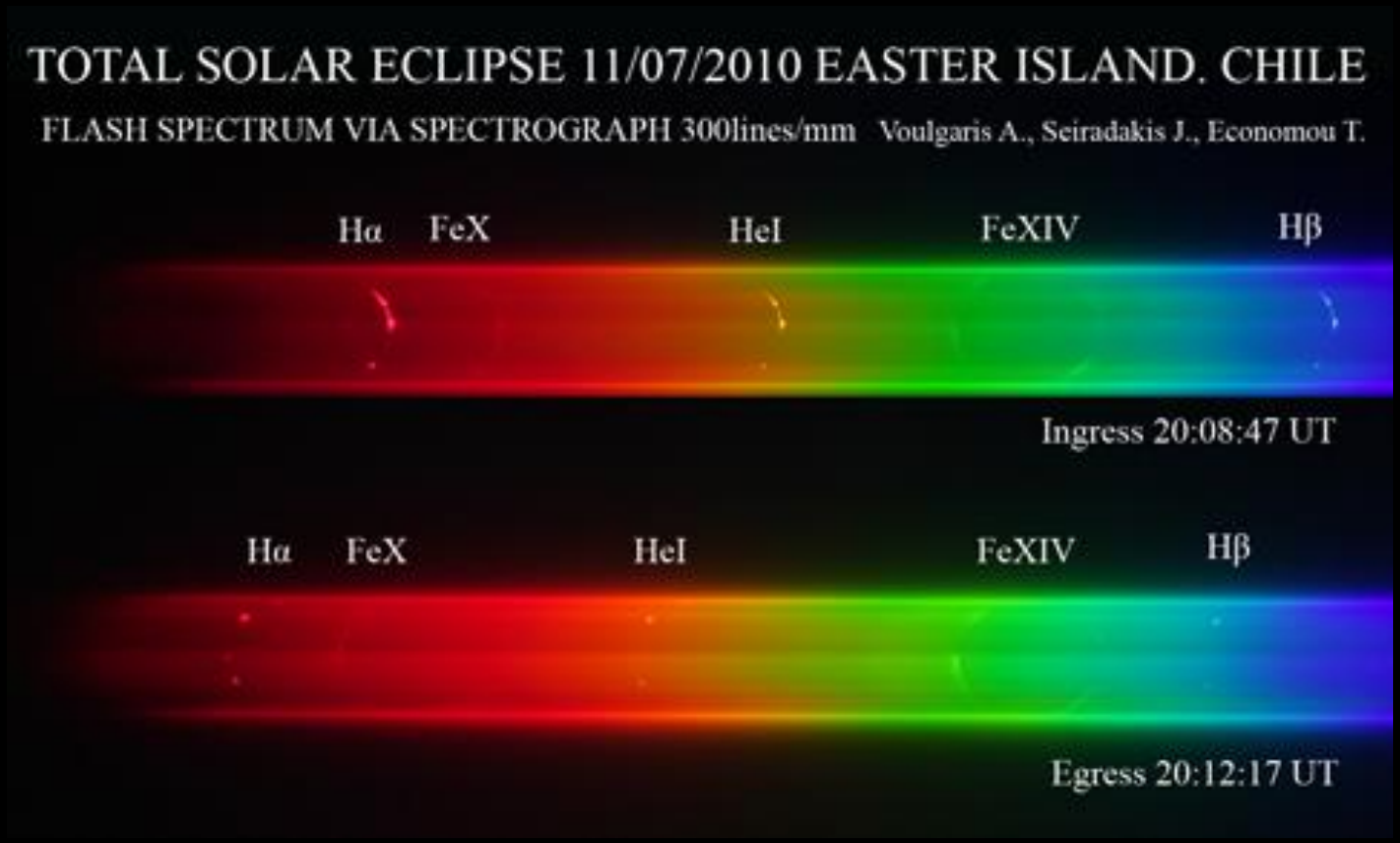
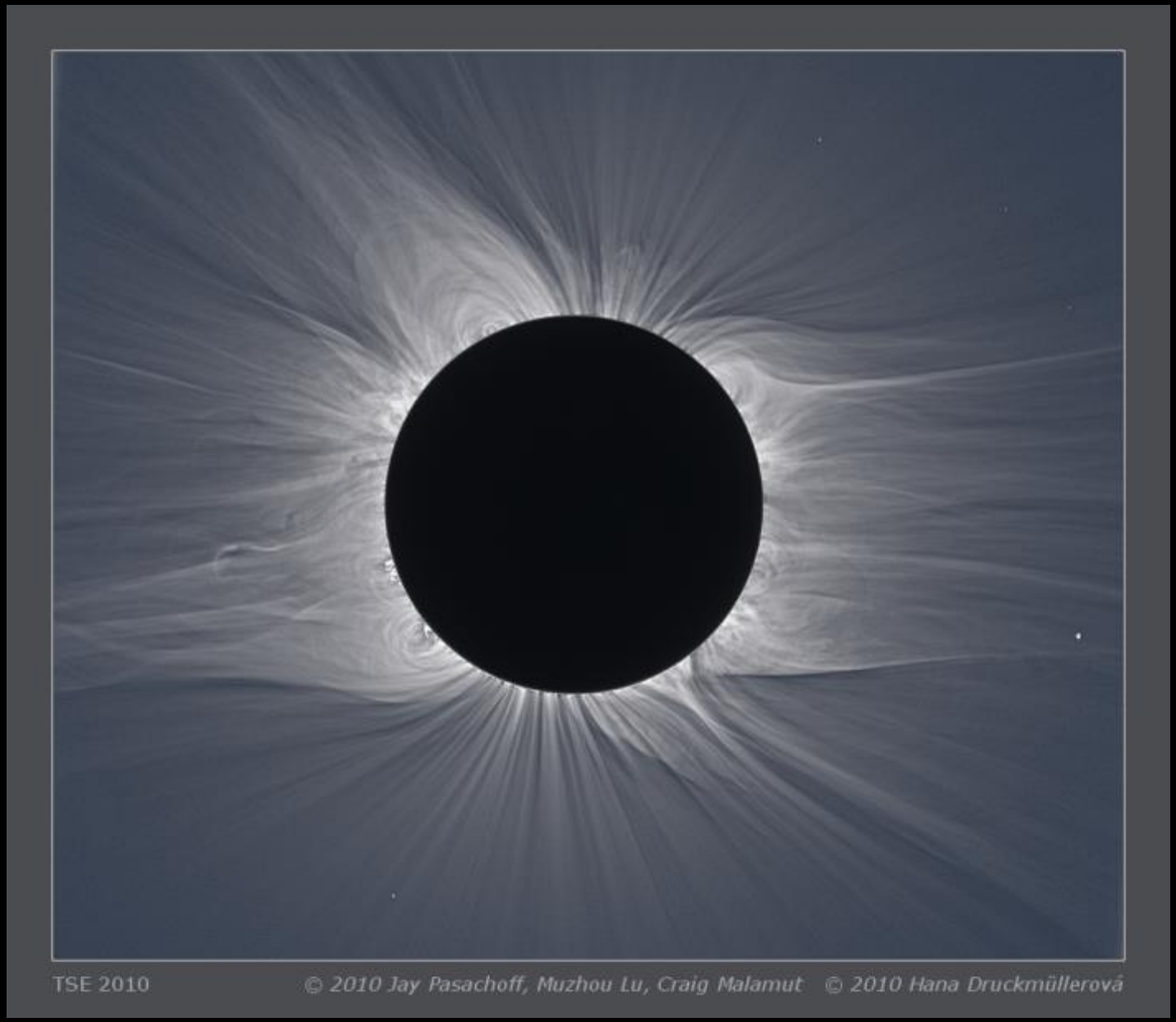
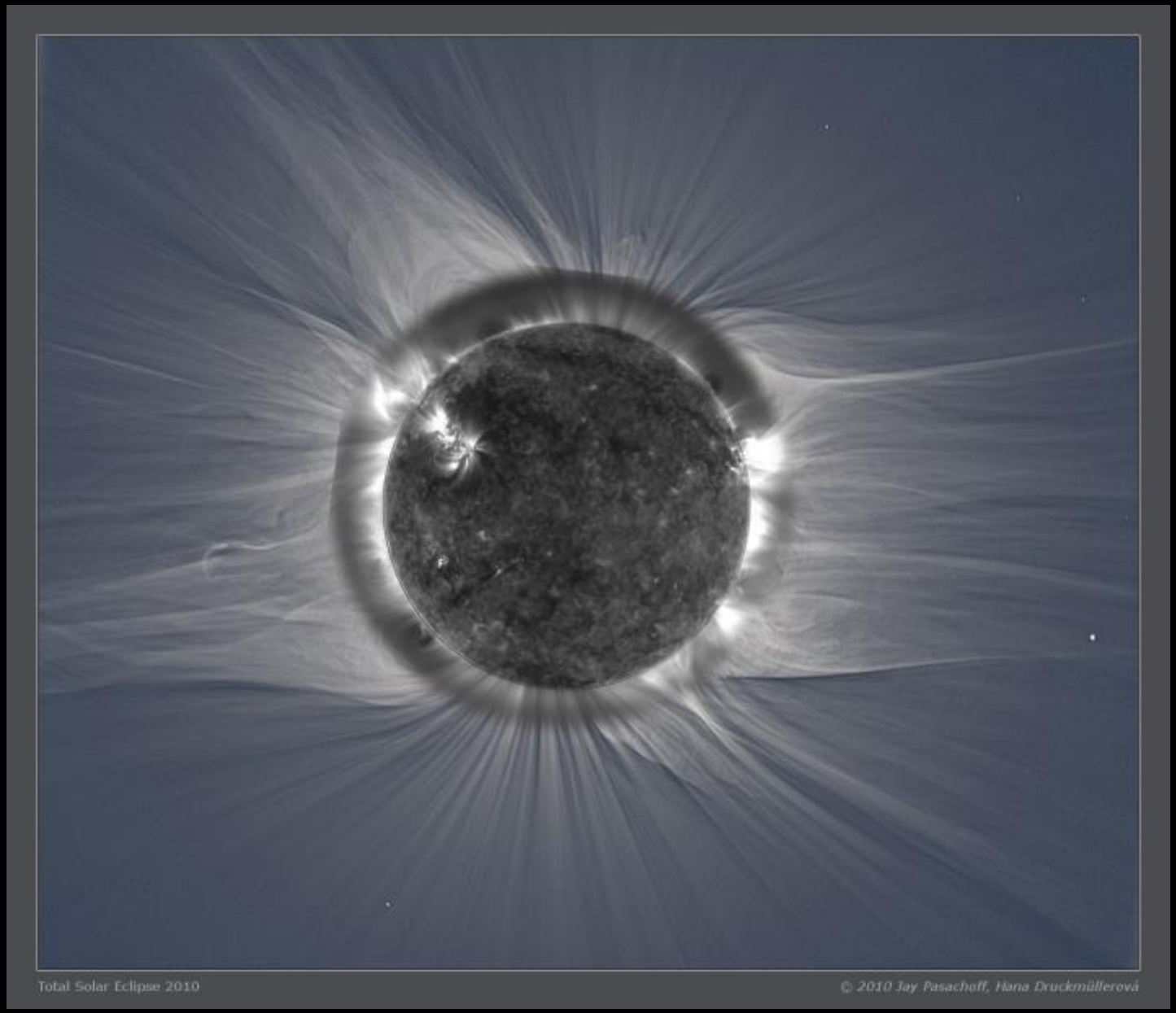


- Stronger coronal green line (Fe XIV) relative to the coronal red line (Fe X)
  - Indication that the corona is heating up again
- Voulgaris, Aris, Paul Gaintatzis, John H. Seiradakis, Jay M. Pasachoff, and Thanasis E. Economou, 2012, "Spectroscopic Coronal Observations during the Total Solar Eclipse of 11 July 2010," *Solar Physics* **278** (1), 187-202; DOI: 10.1007/s11207-012-9929-4.



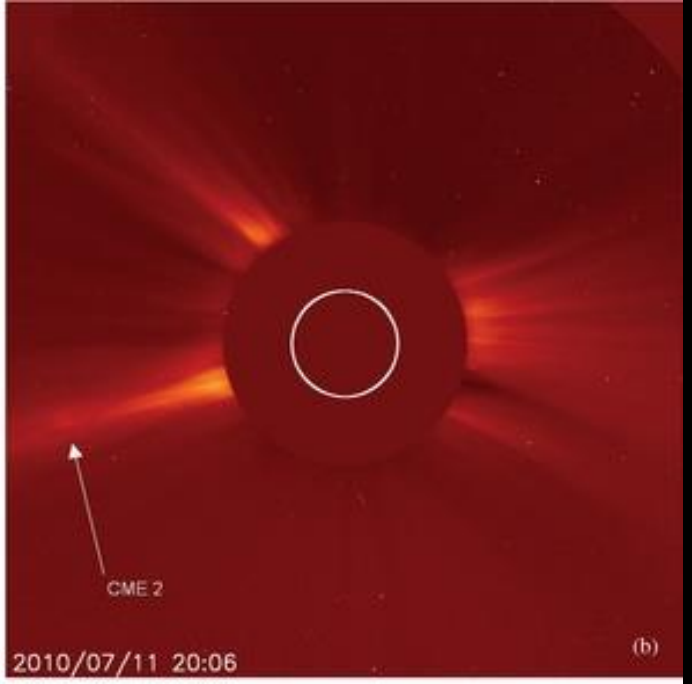
http://lasco-www.nrl.navy.mil/daily_mpg/2010_07/100711_c2.mpg



Disk and annulus: SDO processed by Alec Engell for Leon Golub/CfA

200-mm lens equiv.

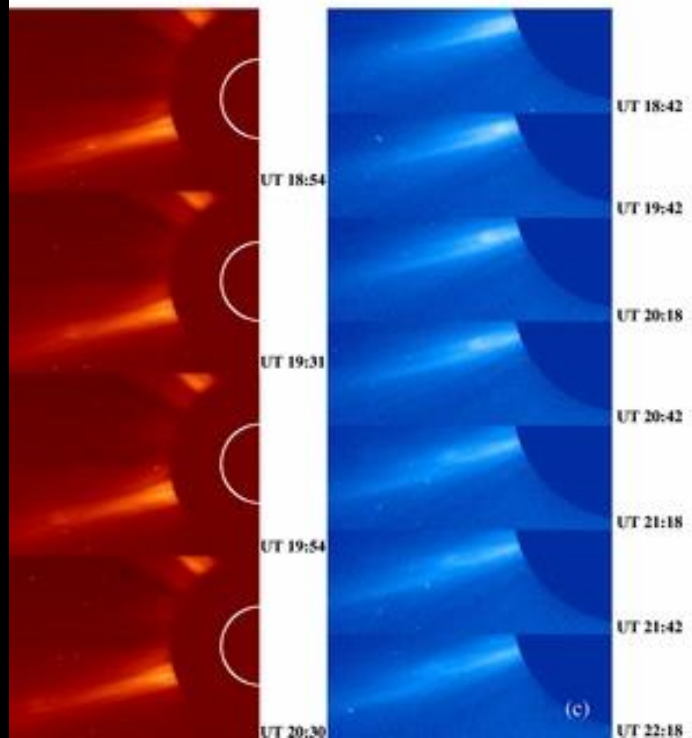
(Druck-müller, Dietzel, Habbal Rusin)

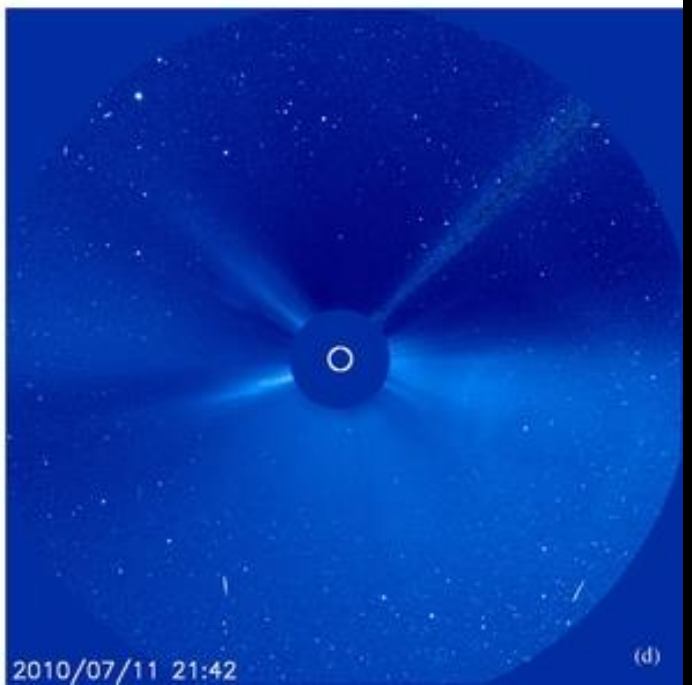


C2/SOHO

(courtesy of LASCO Consortium/ NRL/NASA/ ESA)

CME on C2 and C3





C3/SOHO

(courtesy of LASCO Consortium/ NRL/NASA/ ESA)

November 14, 2012: Australia

Expedition Members:

Jay Pasachoff
Naomi Pasachoff
Bryce Babcock
Phyllis Babcock
Rob Lucas
Helen Robinson
Aram Friedman
Ron Dantowitz
Nicholas Weber
Alec Engell
Ainslie Brennan
Muzhou Lu ‘13
Amy Steele ‘08
Michael Kentrianakis

Sterling’s group:

Aphonse Sterling
(NASA MSFC)
Hakeem Oluseyi
(Florida Tech)
Roderick Gray
(Alabama A&M)

Group from Slovakia:

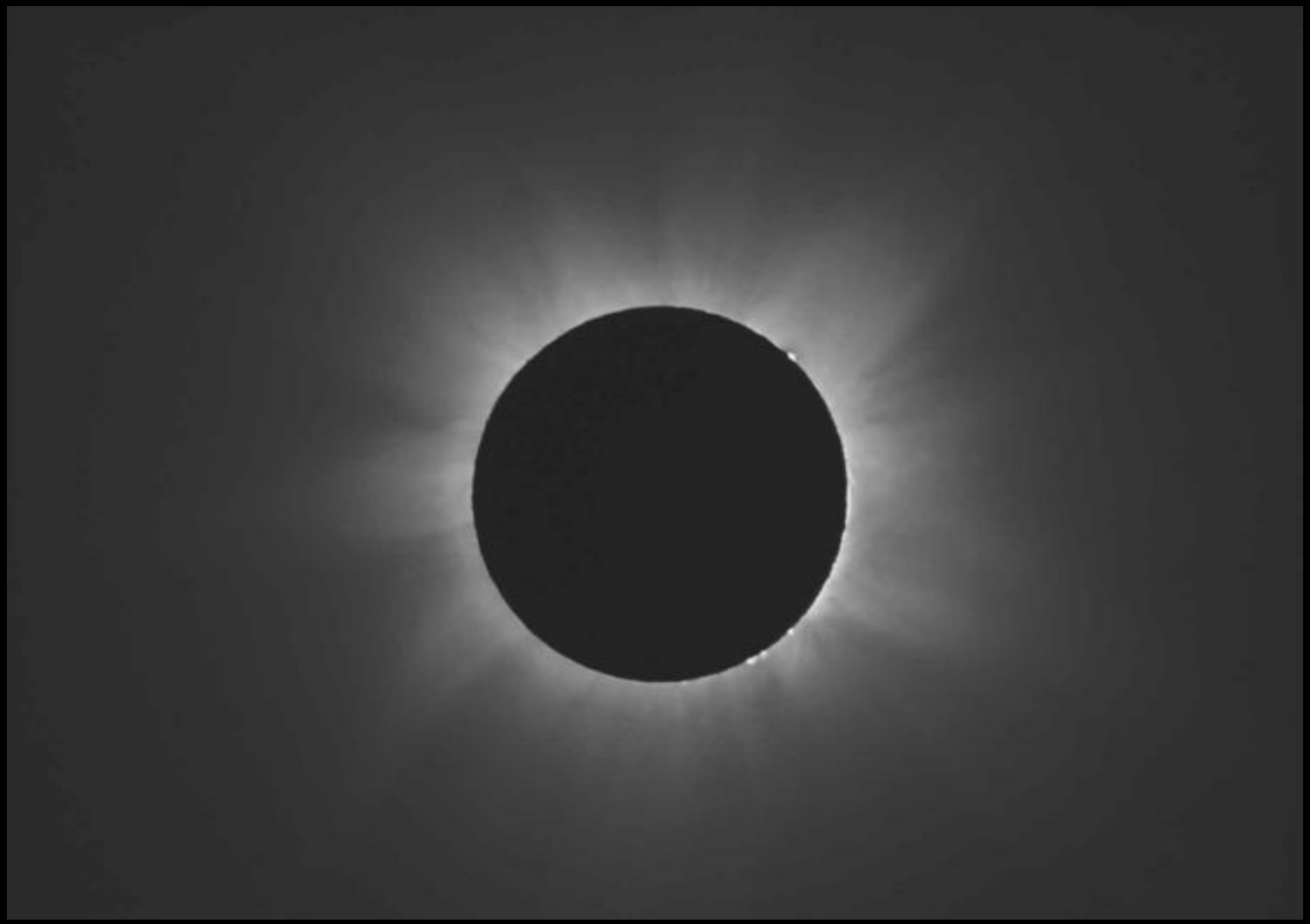
Vojtech Rusin
Metod Saniga
Metod Saniga
Pavel Rapavy

Also:

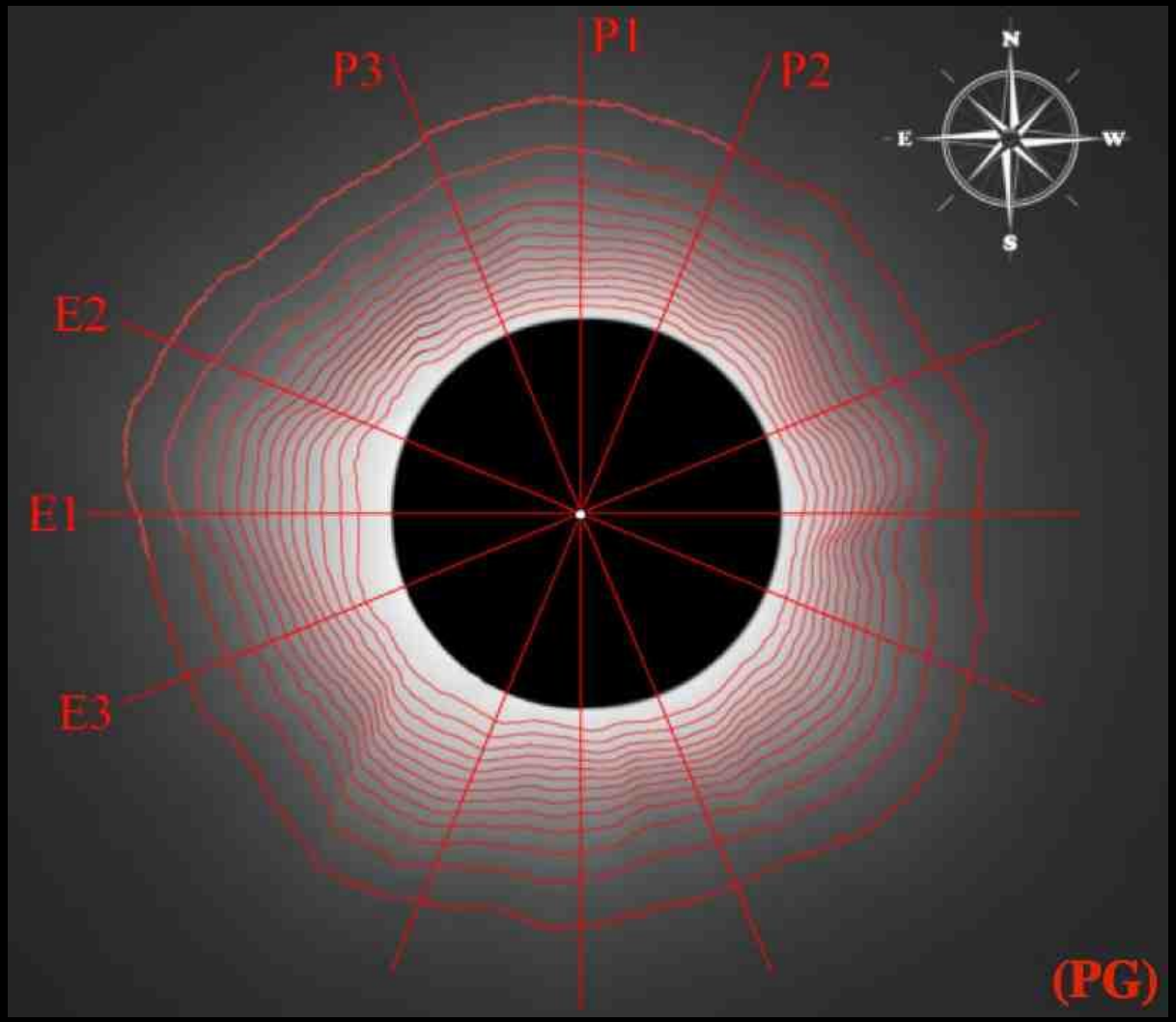
Paul Rosenthal
Elaine Hantman
Rob Wittenmyer ‘98 (UNSW)
Gretchen Wittenmyer
ElijahWittenmyer (age 3)
Isaac Wittenmyer (age 9 months)
Eliana Wittenmyer (age months)
Edw. Ginsburg (U Mass Boston)
Mike Durst
(Columbia Basin College)

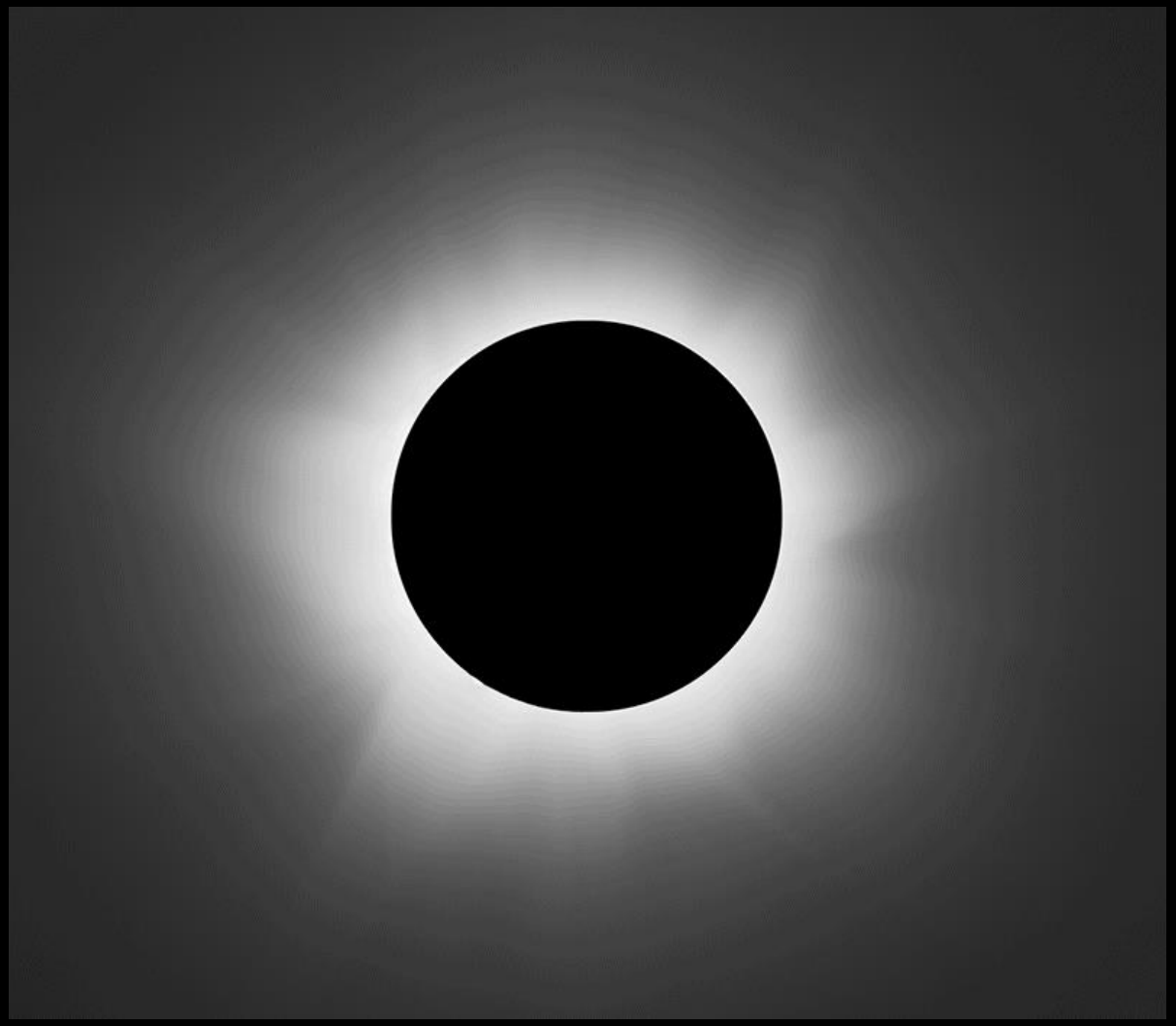
Bill Youngs (Eastern Wash. U)
Dave Rust (JHUAPL)
Gail Rust
Sean Harlan Higgins
Lawrence Cram (ANU)
Barbara Cram
Sharon Gray
Jeff Hall

Takahashi Fsq 106mm f=530
red epic 5k (“imax” camera)

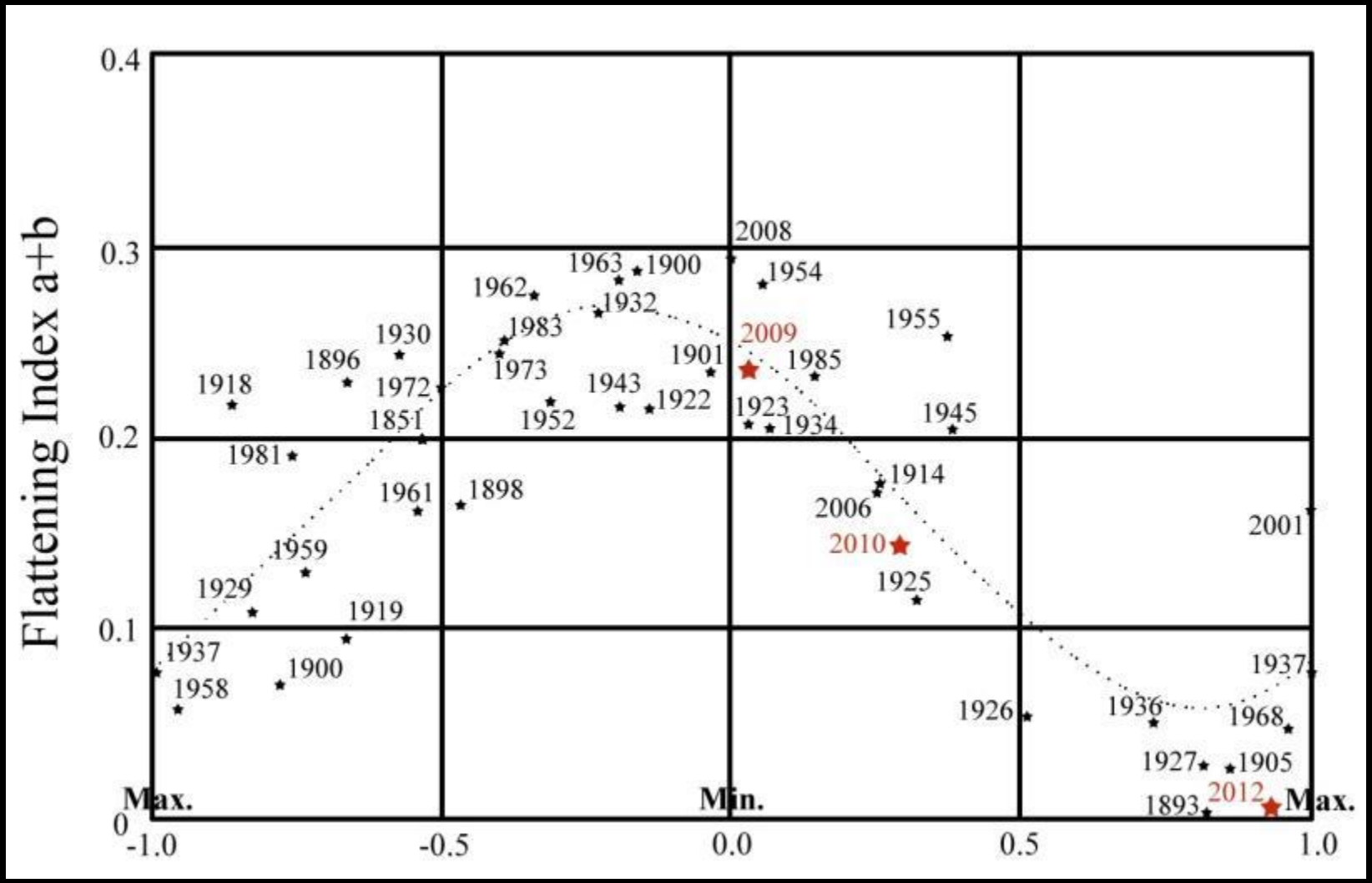


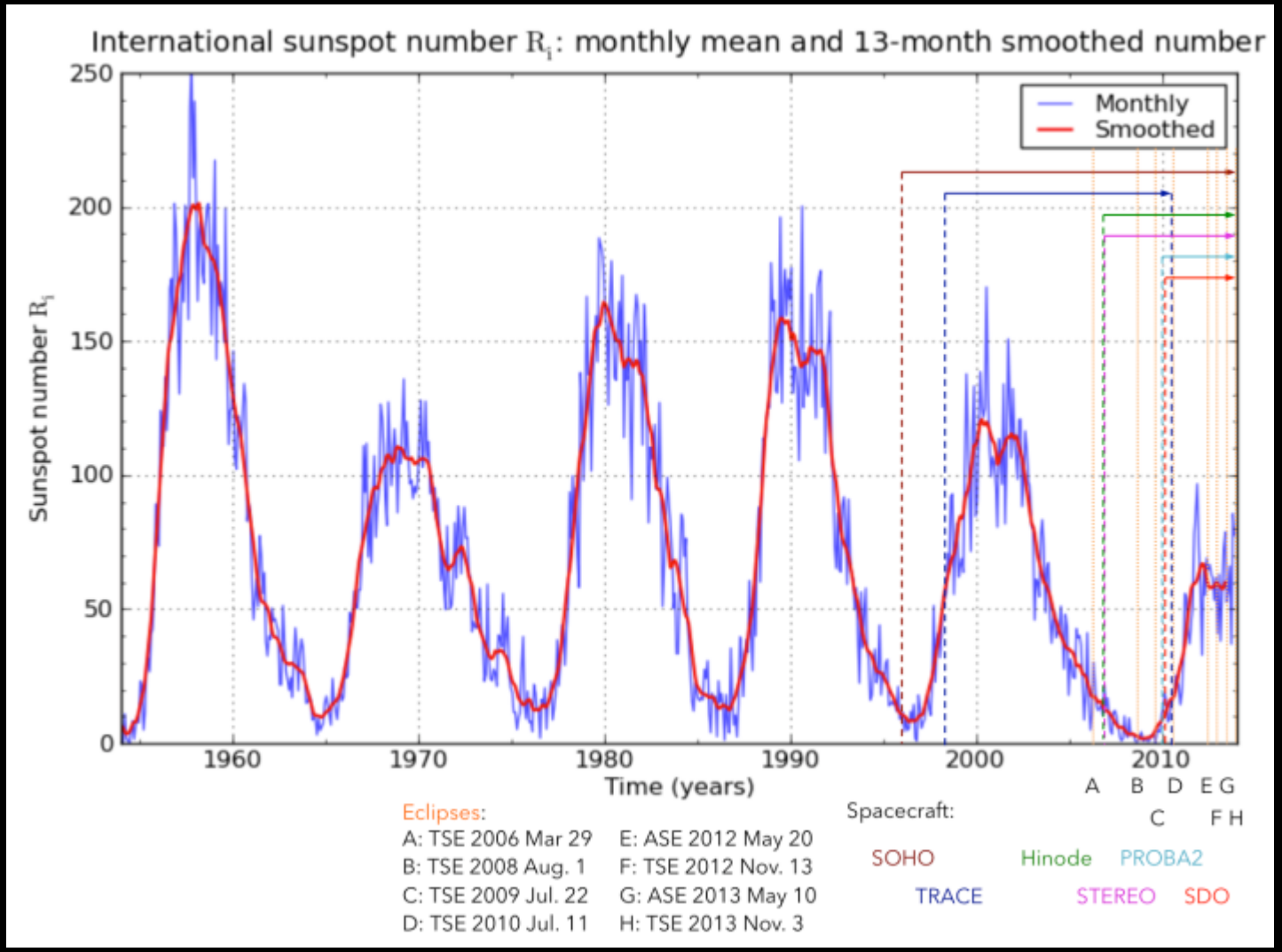
coronal isophotes





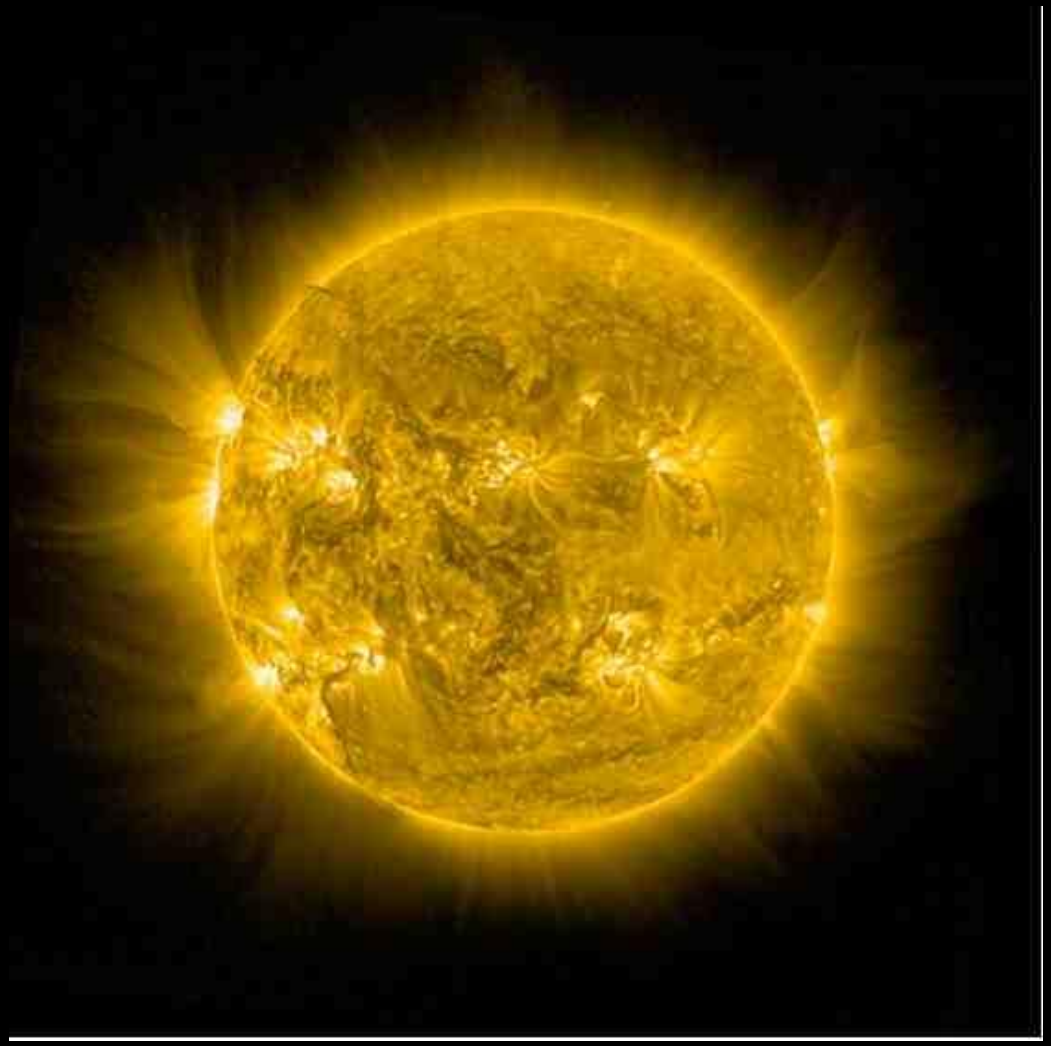
Ludendorff flattening coefficient



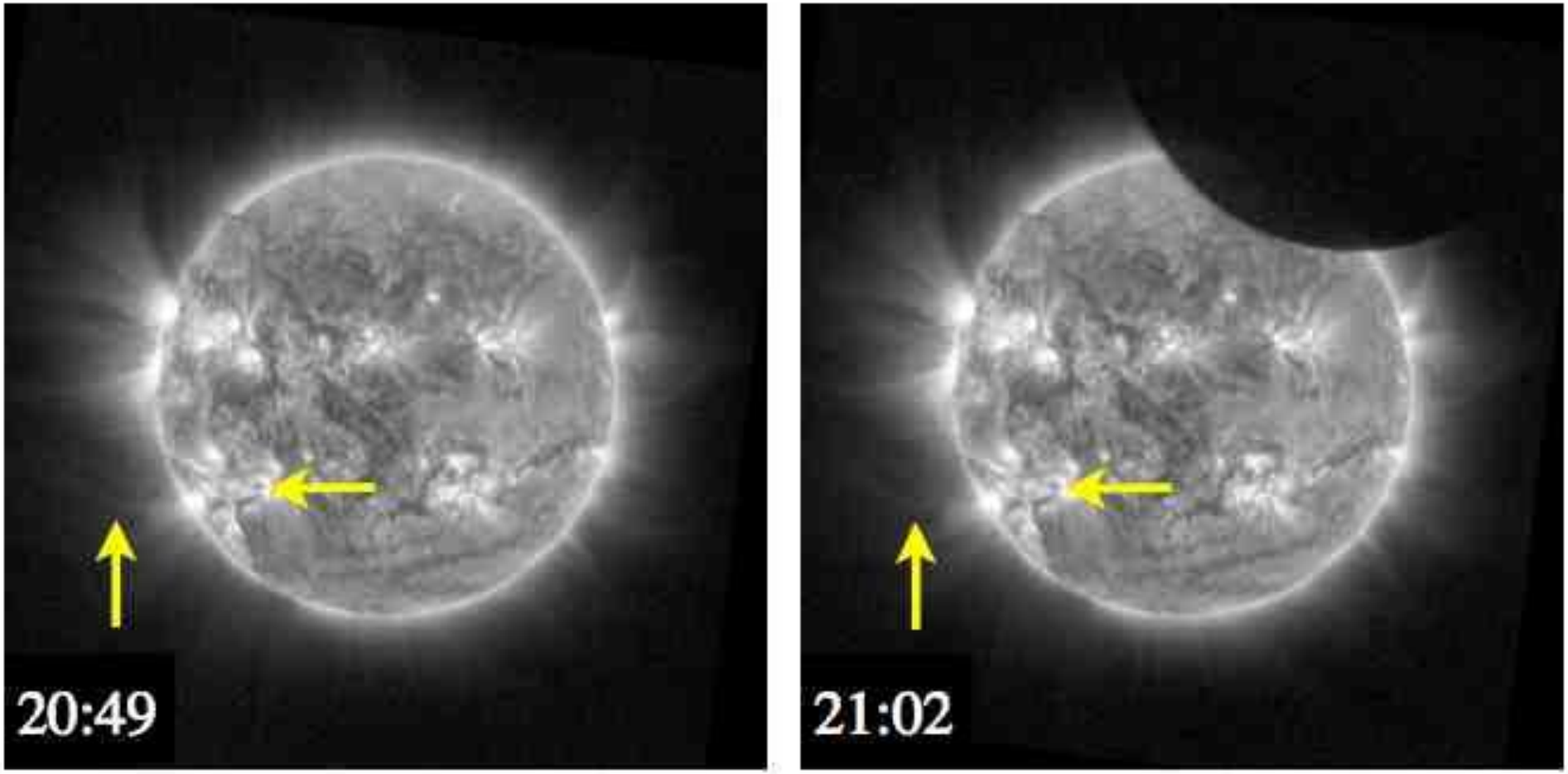


SIDC, Royal Observatory of Belgium, modified with spacecraft

A composite of fifty 10-s SWAP images (174 Å) acquired during a 60-minute window surrounding the eclipse observation

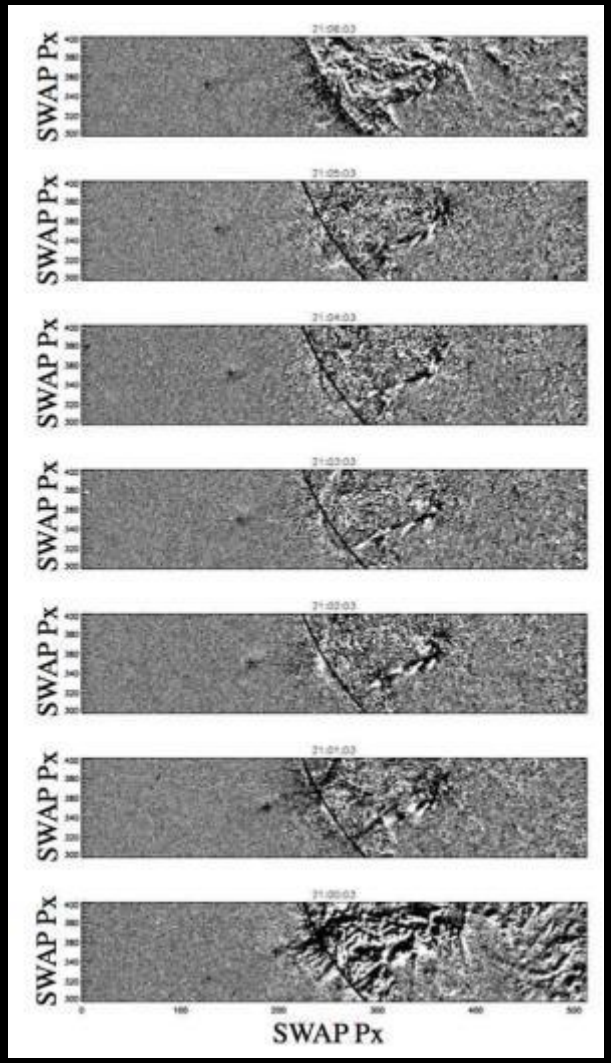


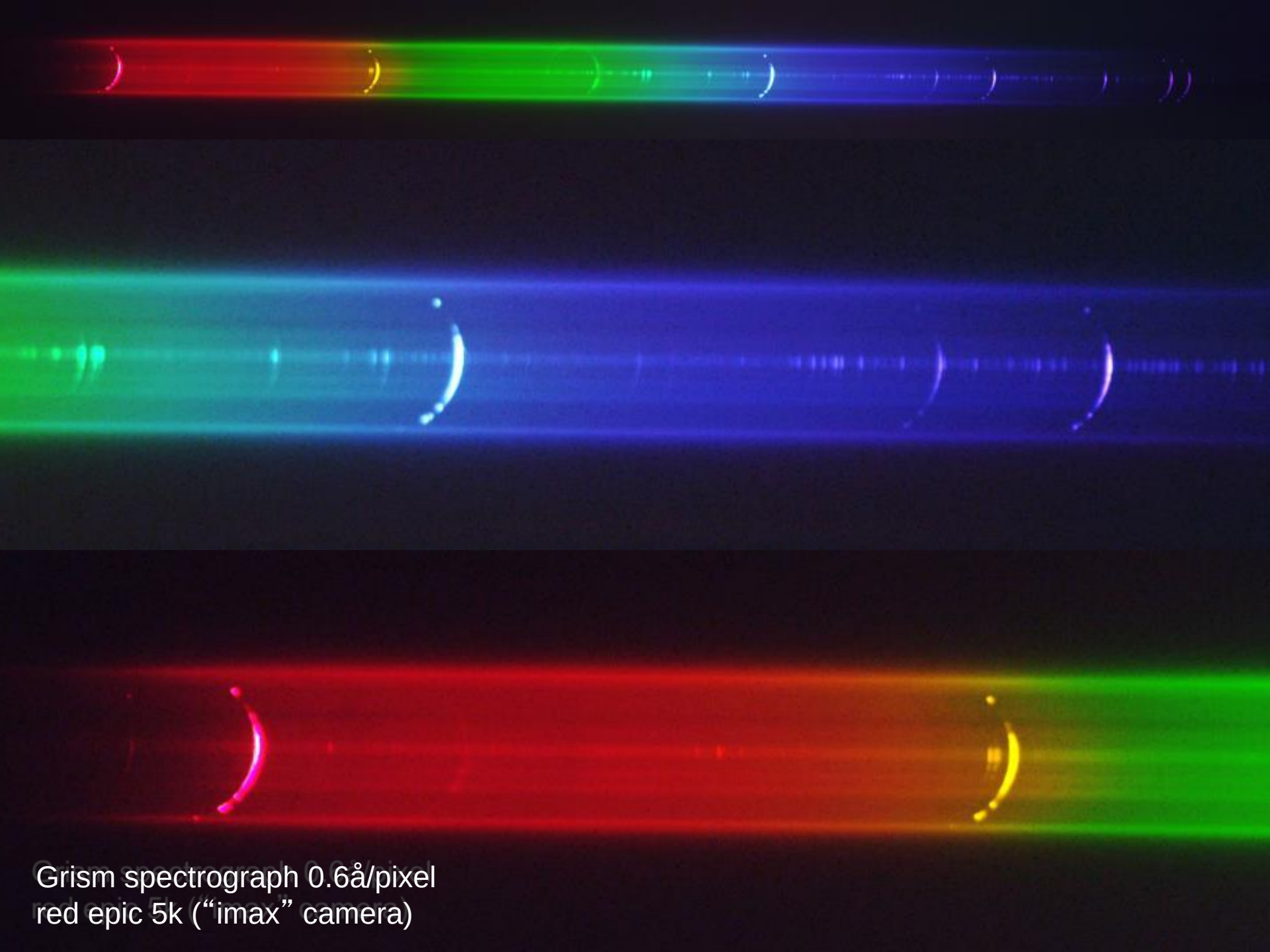
PROBA2/SWAP Consortium/Royal Observatory Belgium



PROBA2/SWAP Consortium/Royal Observatory Belgium,
Dan Seaton ‘01

SWAP running-difference images

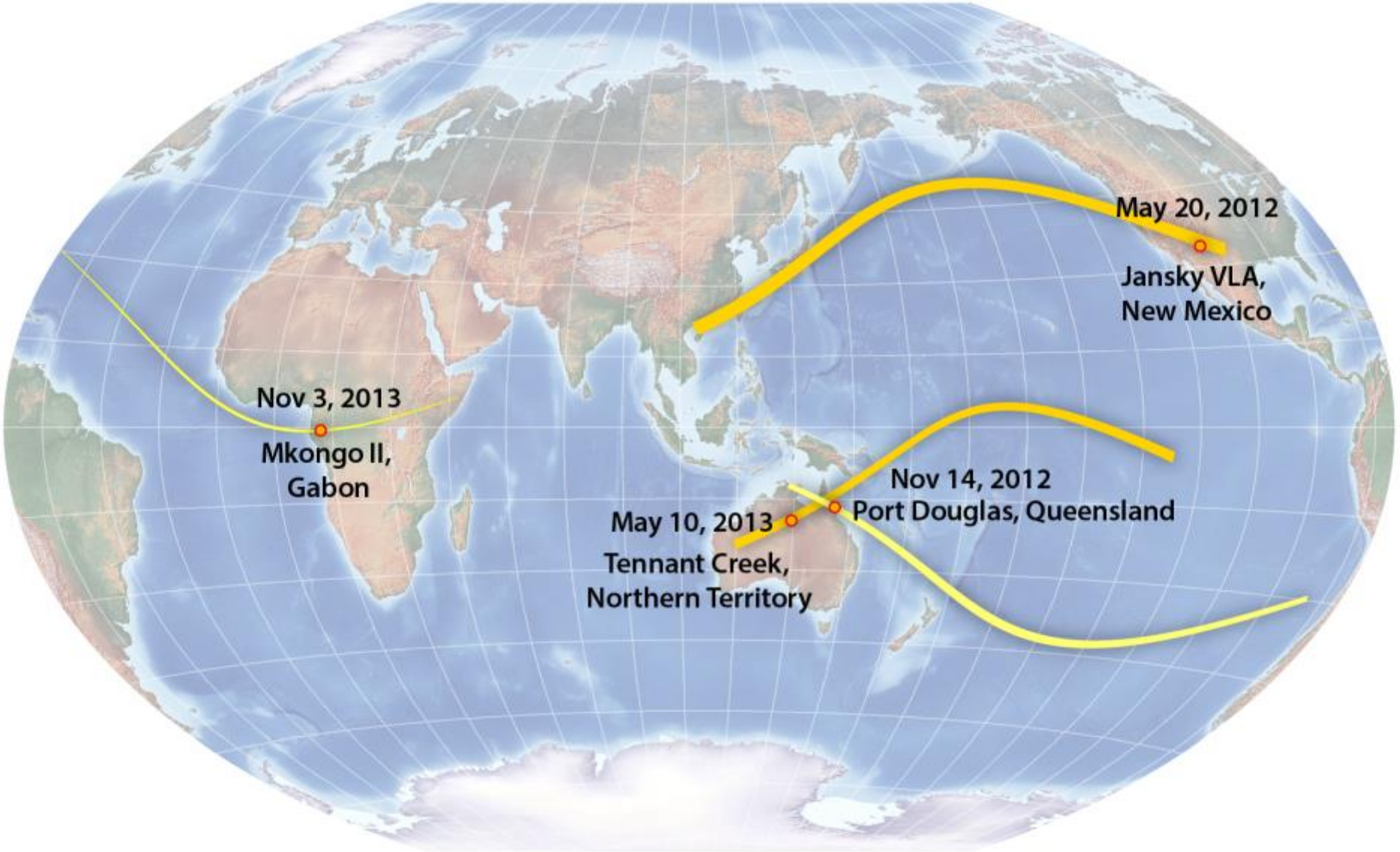




Grism spectrograph 0.6å/pixel
red epic 5k (“imax” camera)

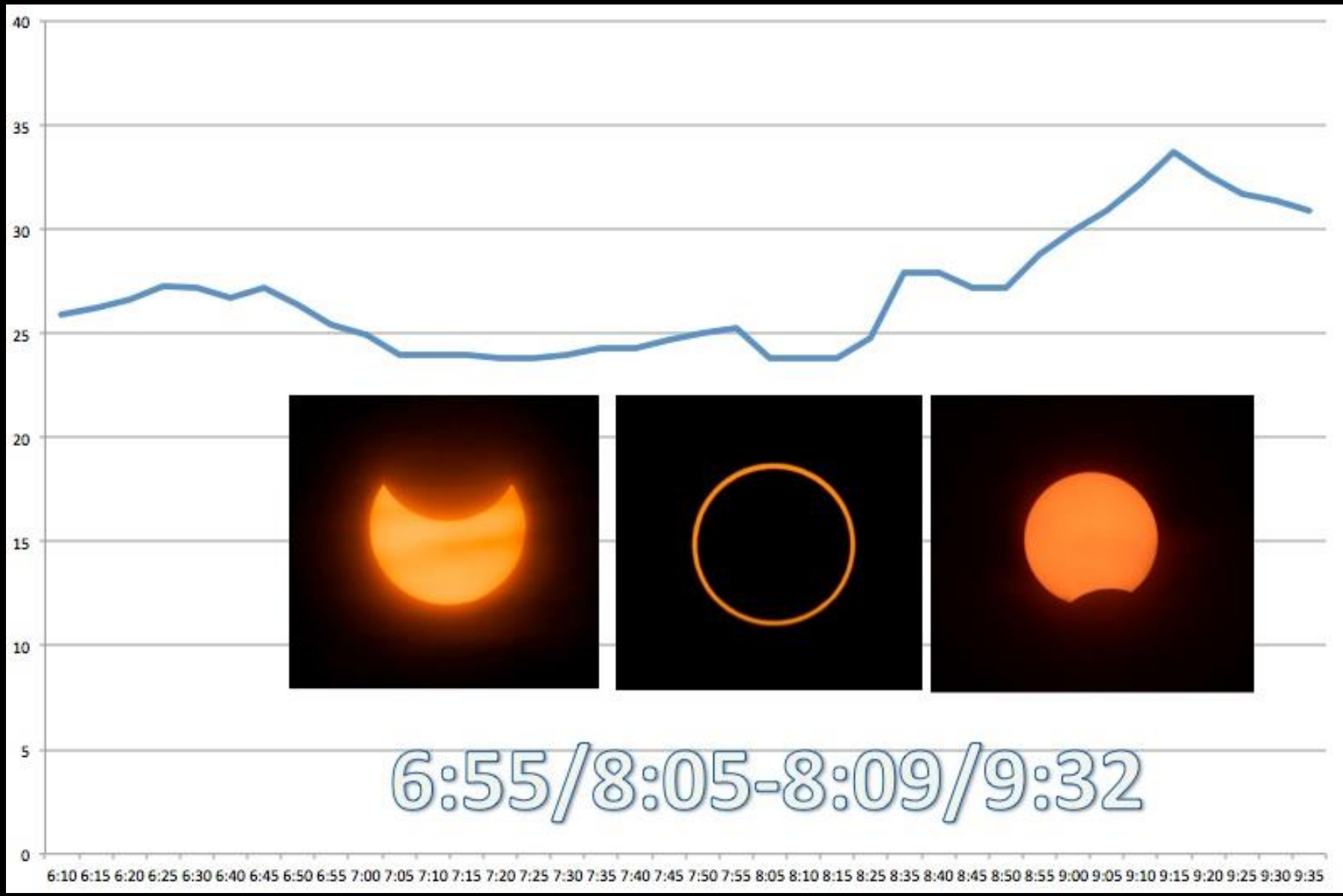
scientific paper about the 2012 eclipse dynamics

- Pasachoff, J. M., V. Rusin, M. Saniga, B. A. Babcock, M. Lu, A. B. Davis, R. Dantowitz, P. Gaintatzis, A. Voulgaris, D. B. Seaton, and K. Shiota, 2014/2015, "Structure and Dynamics of the 13/14 November 2012 White-Light Corona," *Astrophysical Journal*, in press.

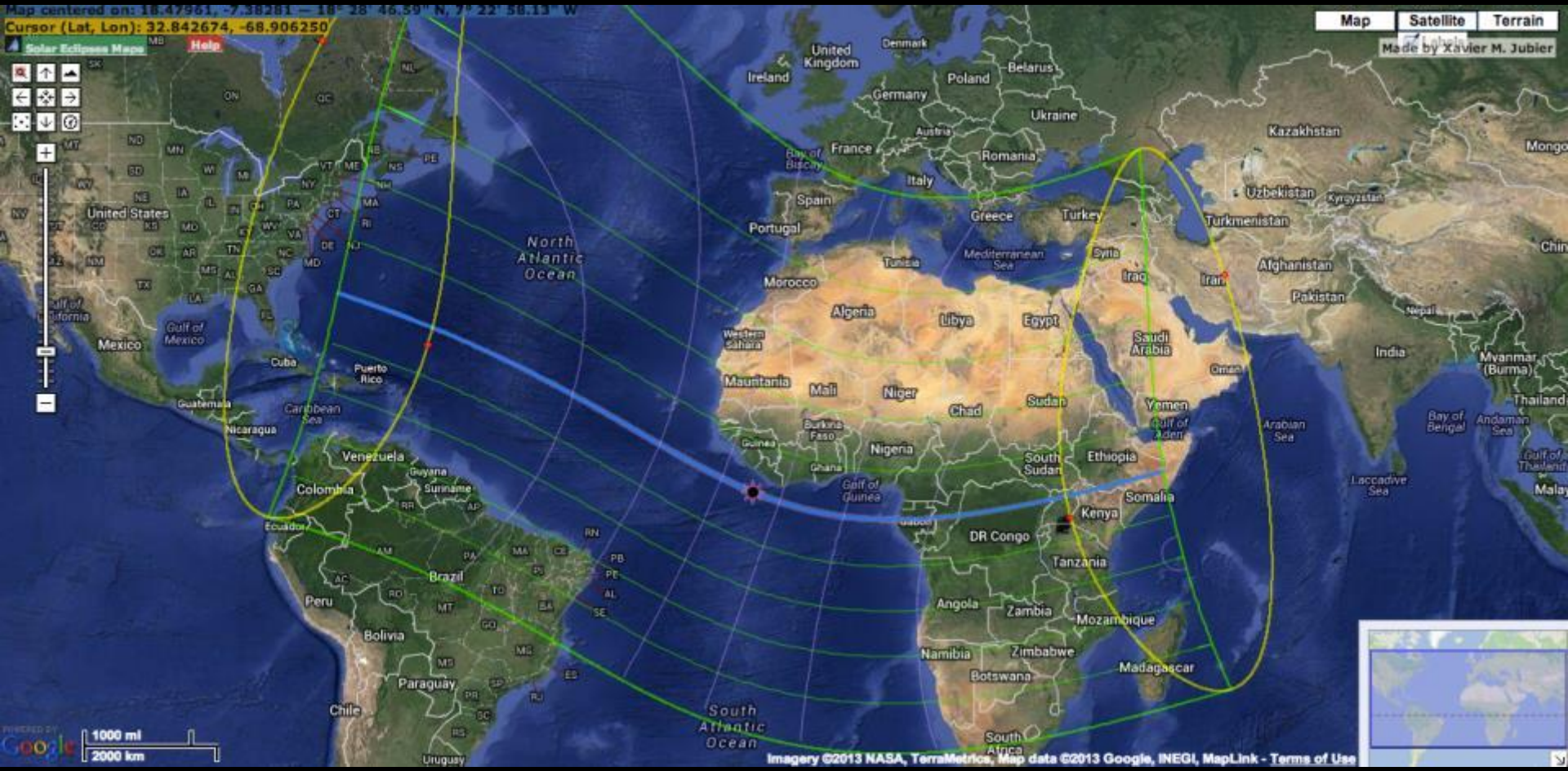


Michael Zeiler, eclipse-maps.com

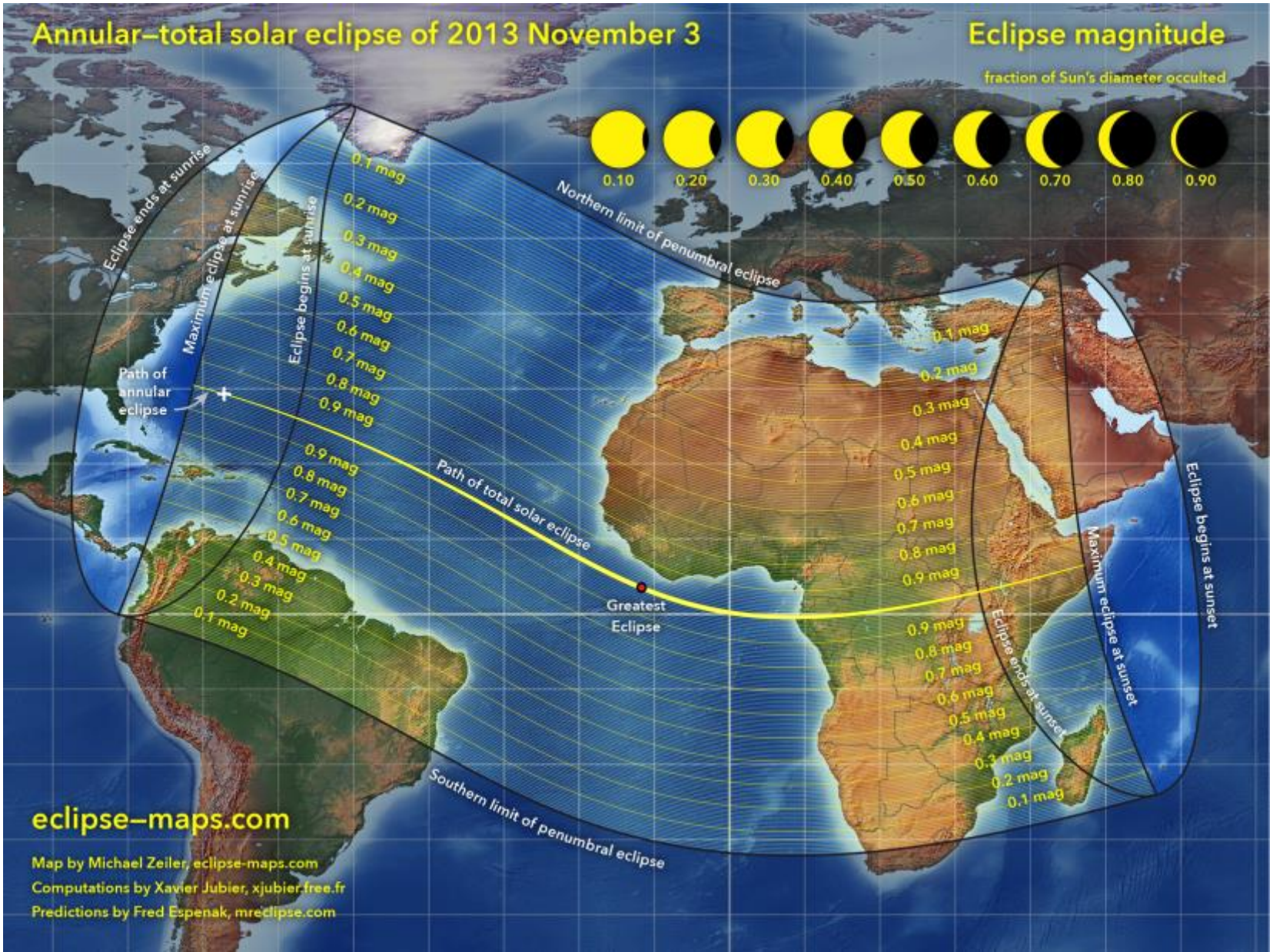

ASE May 10, 2013 – Tennant Creek, Northern Territory
Taken with a Nikon D600 FX and a 400-mm Nikkor lens with a Thousand Oaks Optical filter from a site 70 km north of Tennant Creek, Northern Territories, Australia. Many more in the series are also available.
© 2013 Jay Pasachoff (solarcorona.com), composited by Muzhou Lu


Air Temperature (˚C)
40
35
30
25
20
15
10
5
0
6:10 6:15 6:20 6:25 6:30 6:40 6:45 6:50 6:55 7:00 7:05 7:10 7:15 7:20 7:25 7:30 7:35 7:40 7:45 7:50 7:55 8:05 8:10 8:15 8:25 8:35 8:40 8:45 8:50 8:55 9:00 9:05 9:10 9:15 9:20 9:25 9:30 9:35
6:55/8:05-8:09/9:32
Time (Local)

November 3, 2013



ASE/TSE Nov. 3, 2013 – Mkongo II, Gabon




Jay Pasachoff

Allen Davis


Jay Pasachoff

alongside La Lopé National Park, Gabon


Jay Pasachoff

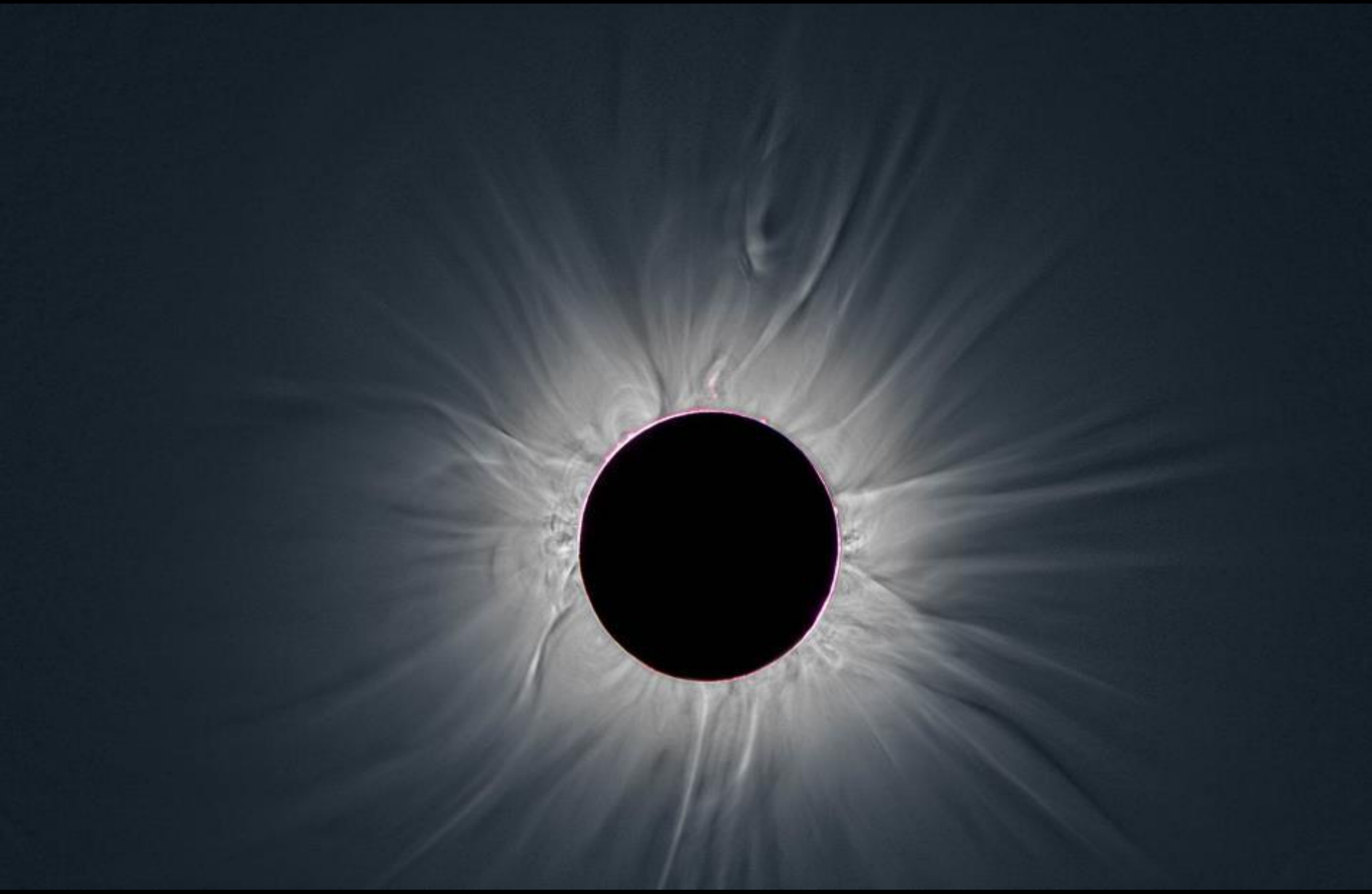
The Williams College Team

- Jay Pasachoff
- Allen Davis ’14
- Zophia Edwards ’05
- Marek Demianski
- Robert Lucas
- Michael Zeiler
- Polly White
- Michael Kentrianakis
- Vojtech Rusin
- Aristeidis Voulgaris
- *with support from the Committee for Research and Exploration of the National Geographic Society*

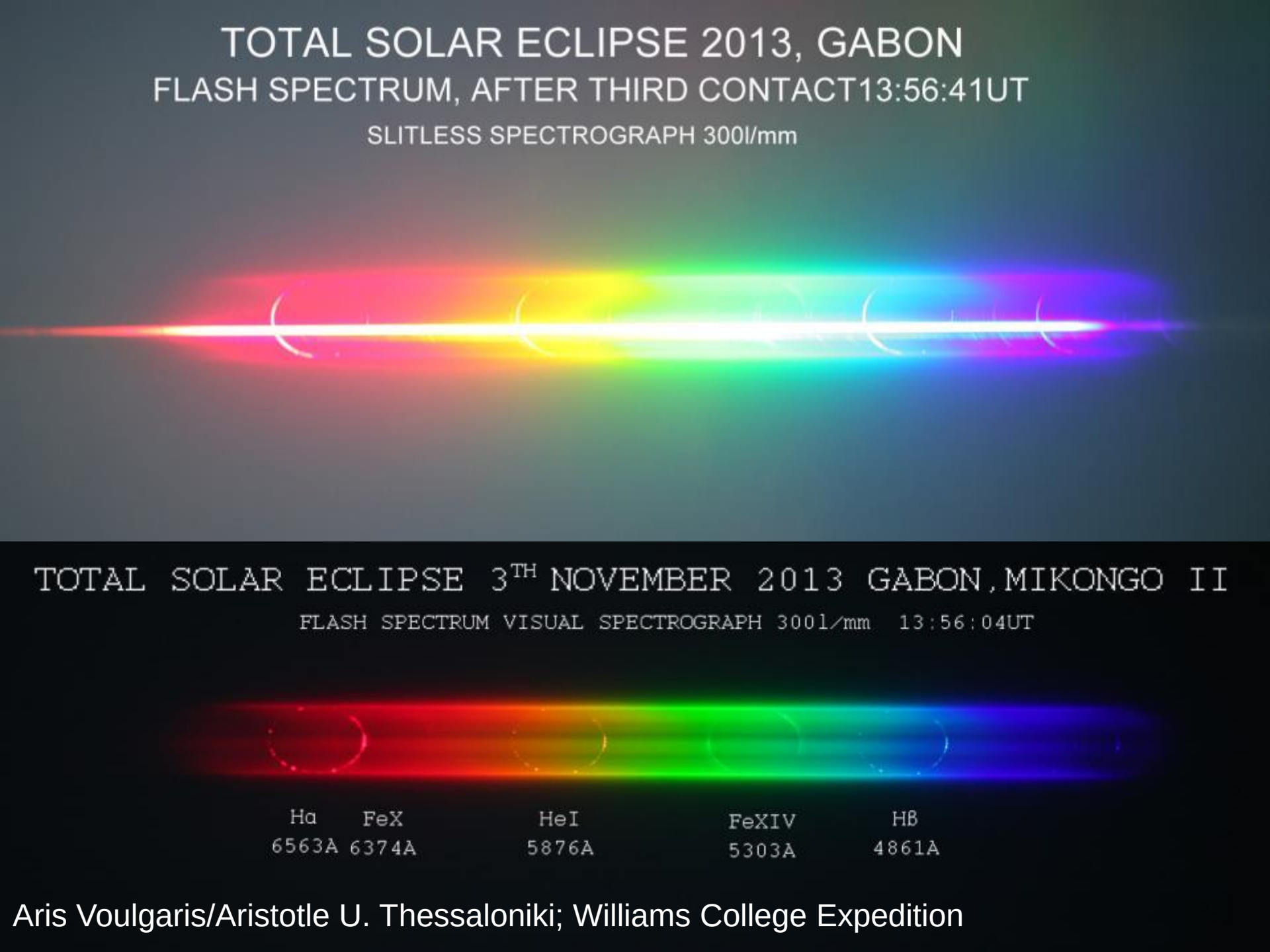
Vojtech Rušin, Zophia Edwards (‘05), Jay Pasachoff, Allen Davis (‘14), Mike Kentrianakis, Aris Voulgaris, Polly White, Michael Zeiler, Marek Demianski, Rob Lucas

Zophia Edwards

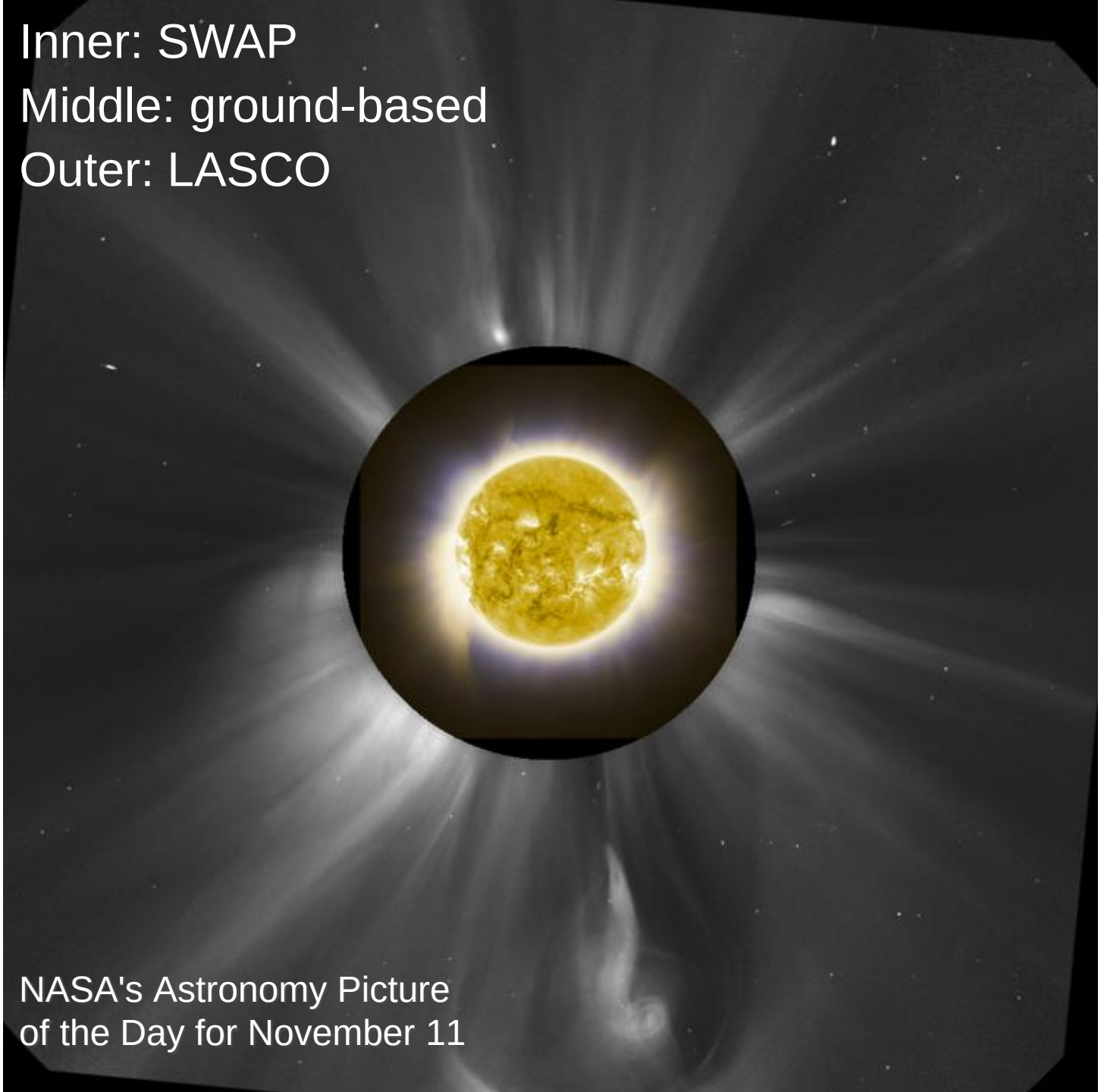
3 November 2013, Gabon



Williams College Eclipse Expedition; combination by Paul Gaintatzis from images by Allen Davis and Jay Pasachoff

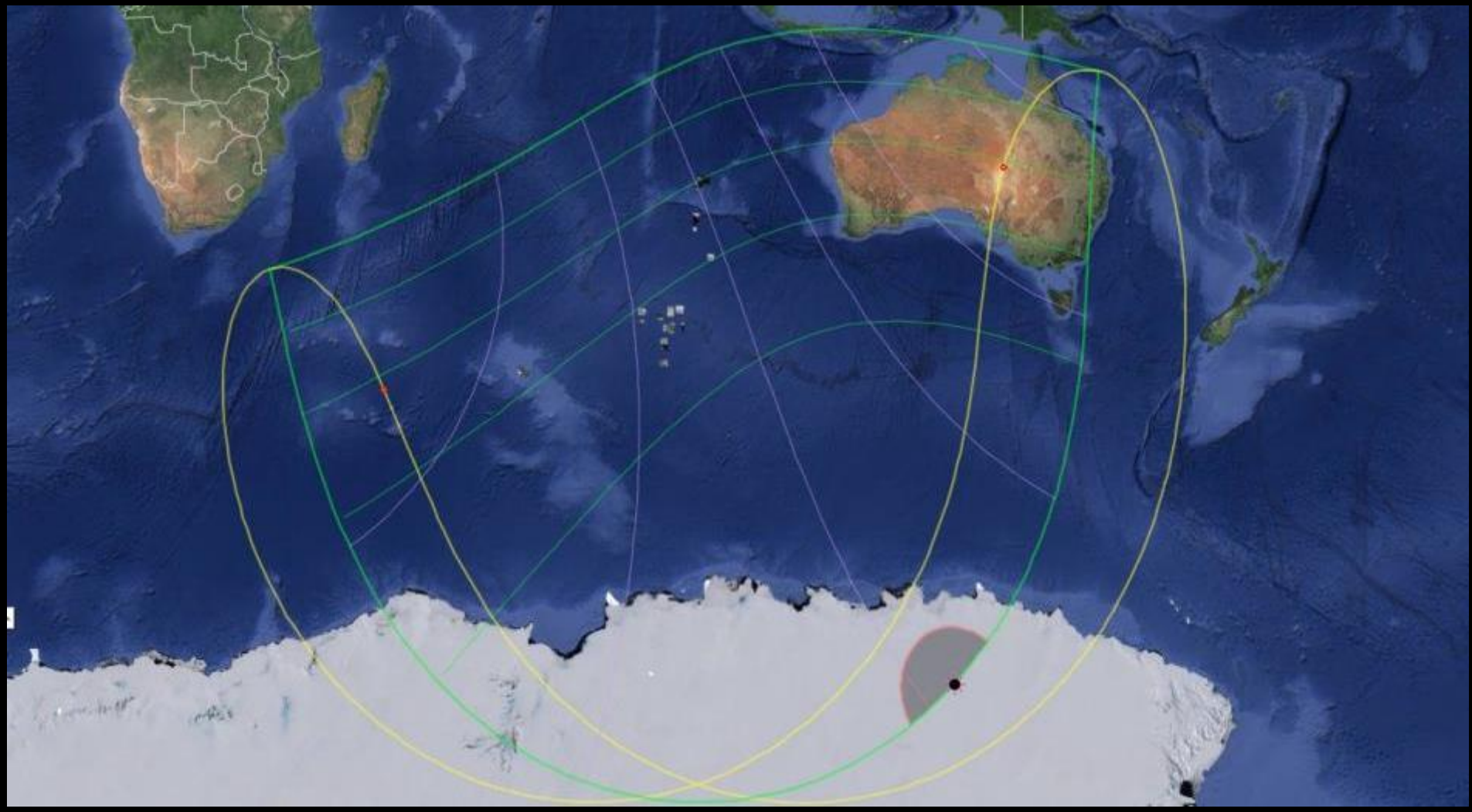


Aris Voulgaris/Aristotle U. Thessaloniki; Williams College Expedition

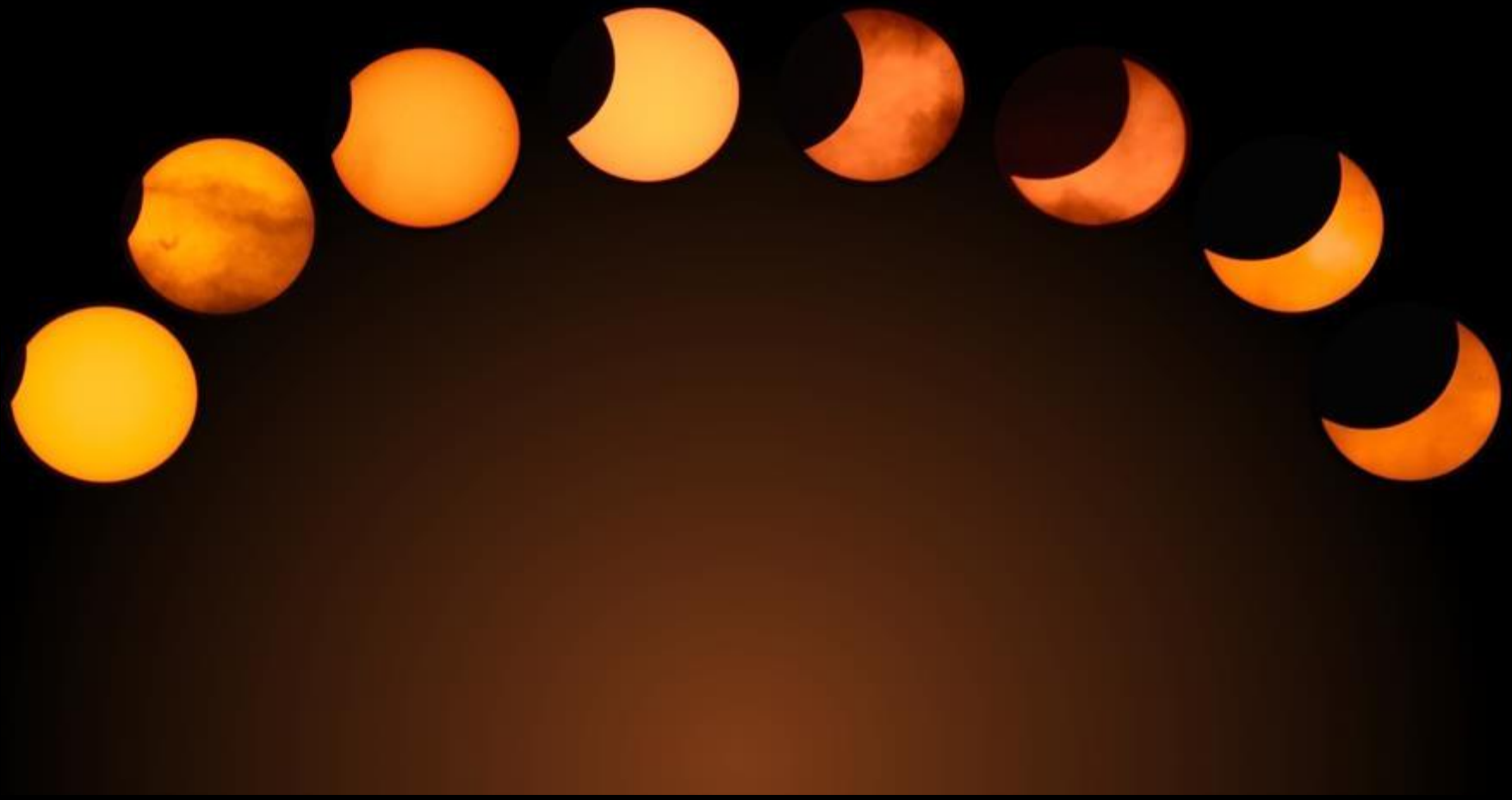

Inner: SWAP
Middle: ground-based
Outer: LASCO
NASA's Astronomy Picture
of the Day for November 11

Williams College Expedition: Jay Pasachoff, Allen Davis ‘14, Vojtech Rusin, processing by Miloslav Druckmüller

April 29, 2014



April 29, 2014, Albany, Western Australia

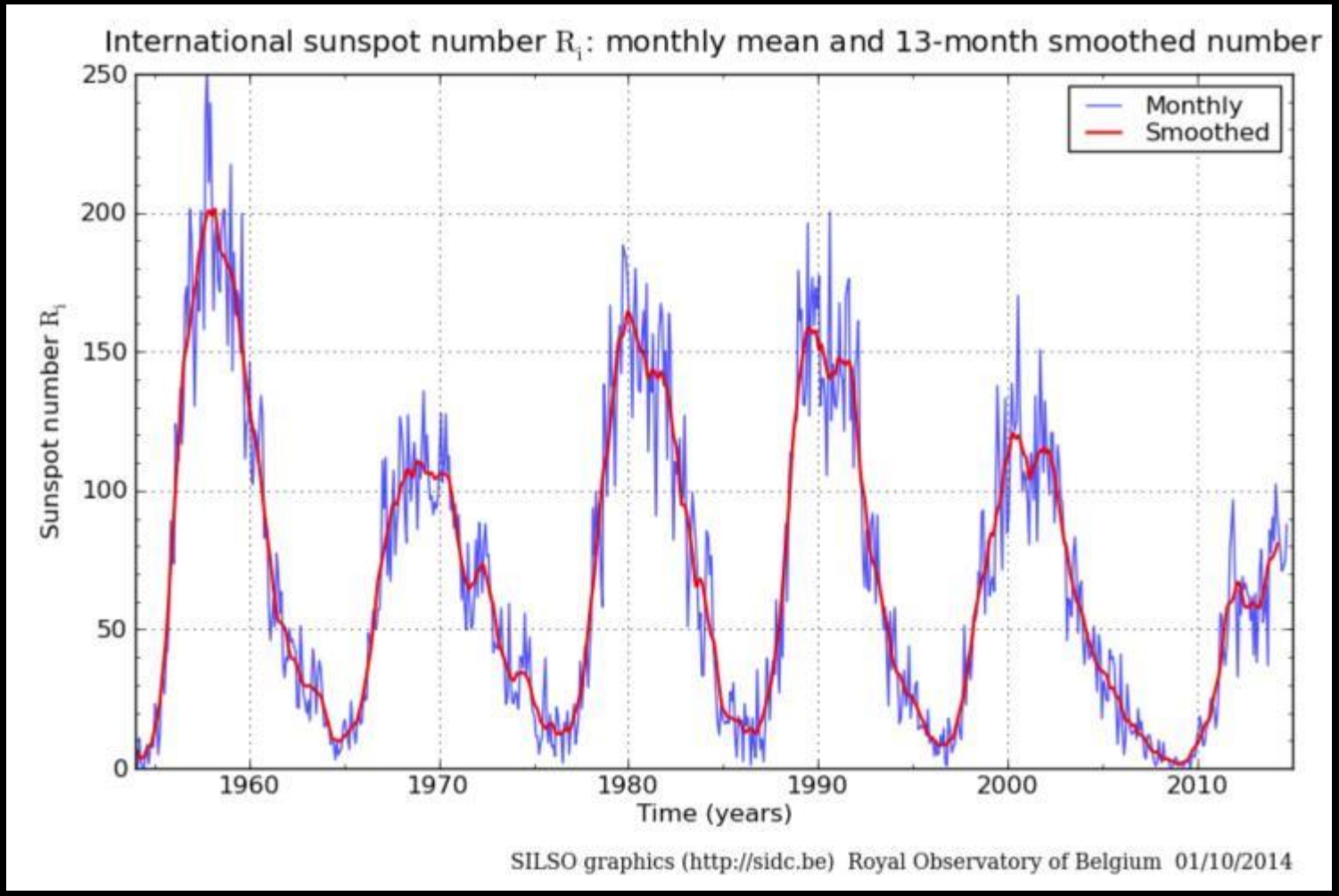


April 29, 2014, Albany, Western Australia

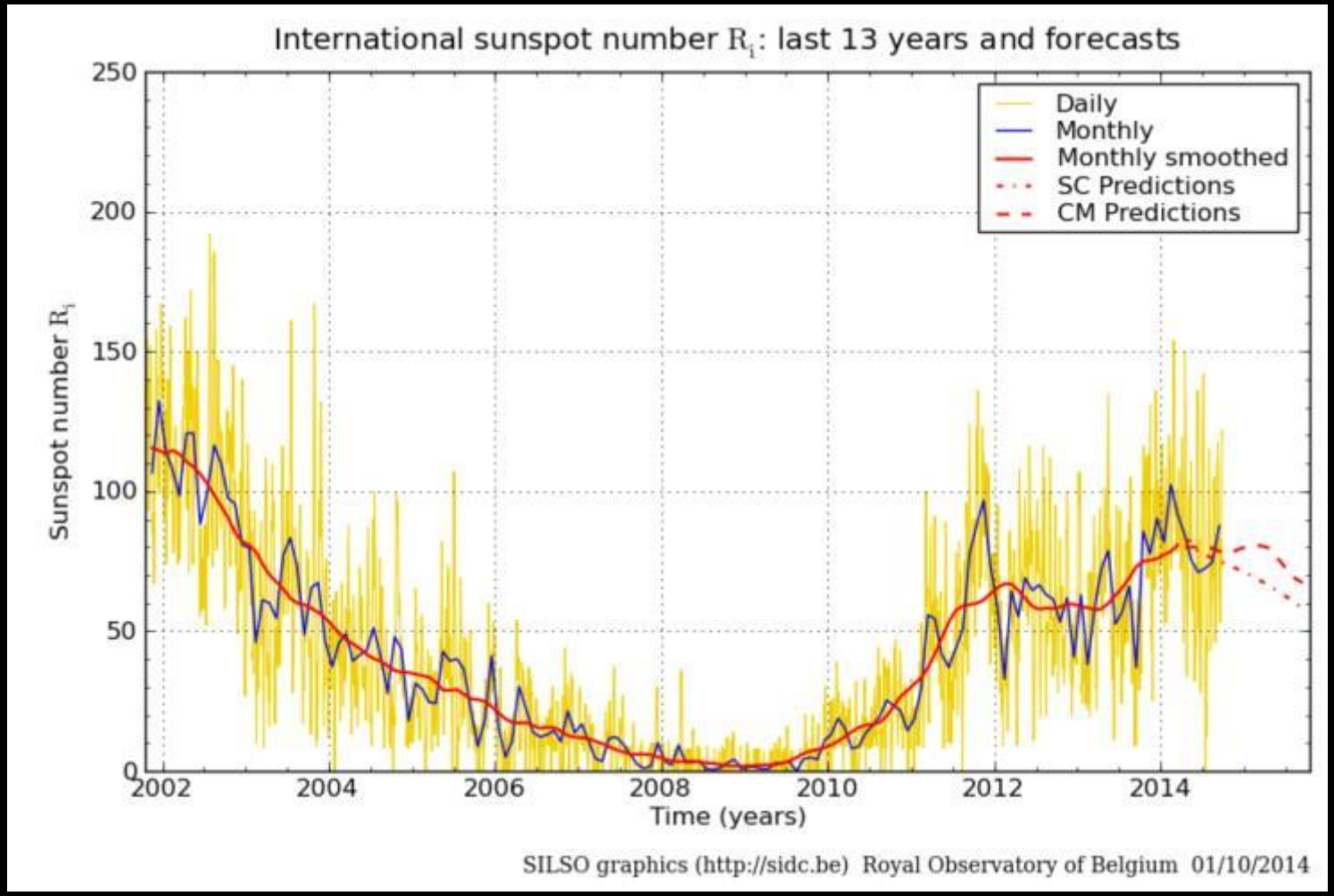
April 29, 2014, Albany, Western Australia

23 October 2014

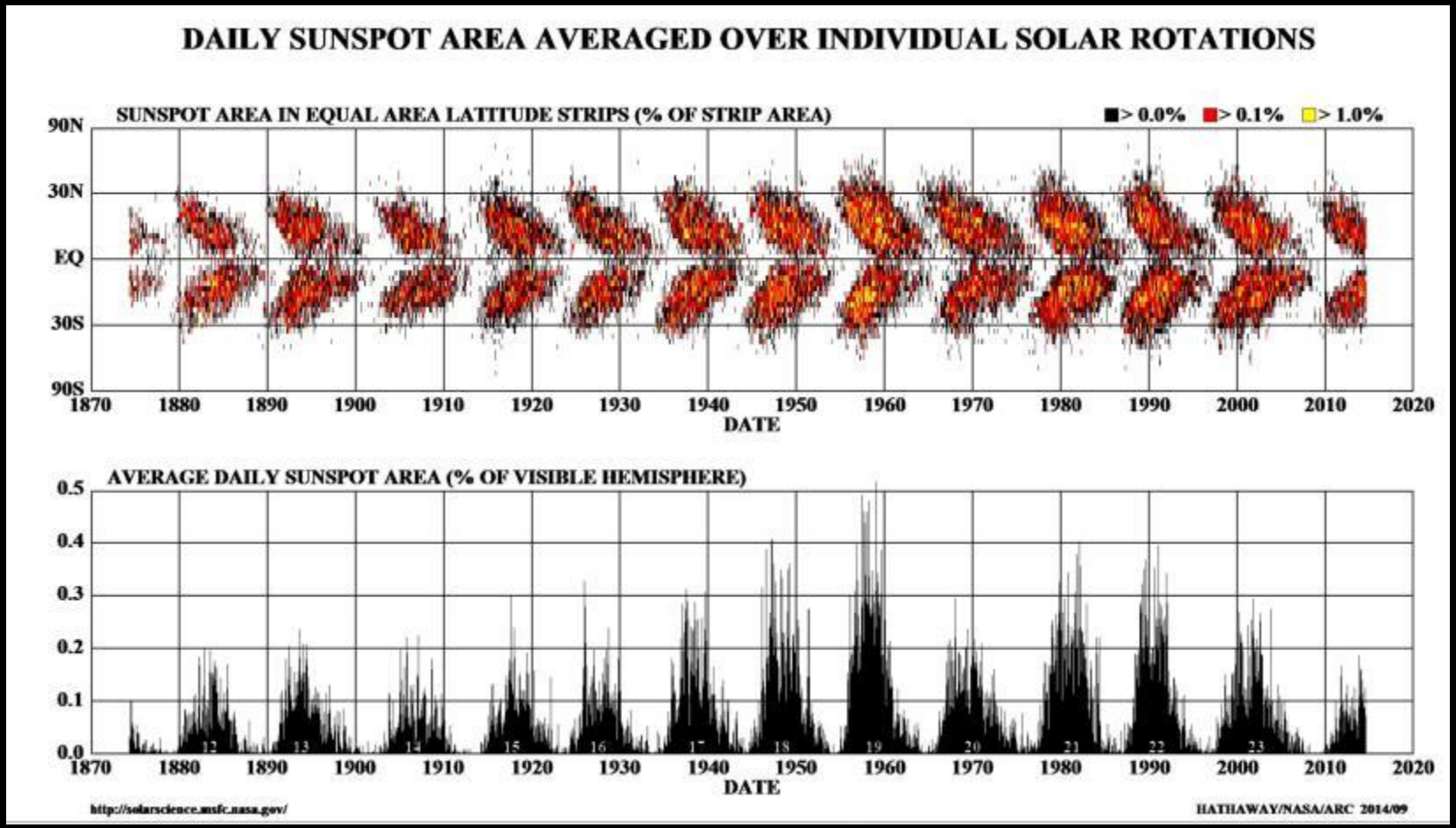
23 October 2014 Google map (Xavier Jubier)



Solar Influences Data Analysis Center, Royal Observatory of Belgium



Solar Influences Data Analysis Center, Royal Observatory of Belgium



NASA's Marshall Space Flight Center/David Hathaway

23 October 2014

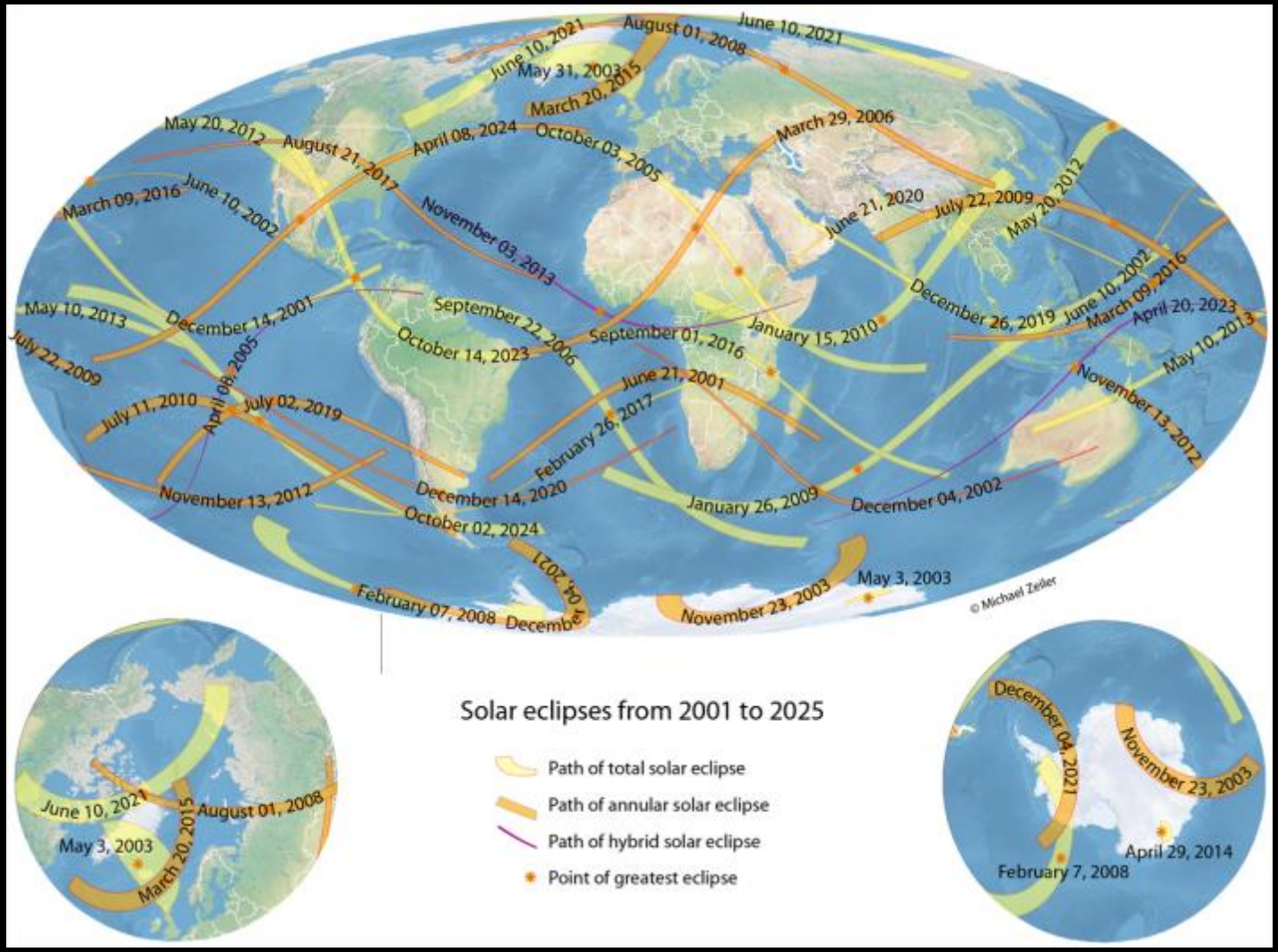
Jay Pasachoff and Austin Shea ‘15

23 October 2014

Phases of the Partial Solar Eclipse on Oct. 23, 2014

Photographs of the partial solar eclipse of October 23, 2014, from the Sacramento Peak Observatory in Sunspot, New Mexico, by Jay Pasachoff and Austin Shea, Williams College. Composited by Muzhou Lu.

Jay Pasachoff and Austin Shea ‘15



Michael Zeiler

Acknowledgments

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Participating in optical observations of the annular eclipse on site at the JVLA were 8 undergraduate students, 6 of them from the just-completed Williams College junior-senior seminar on solar physics, one auditor from the seminar who was a student at neighboring Massachusetts College of Liberal Arts, and the eighth a Keck Northeast Astronomy Consortium Summer Fellow (part of our joint NSF REU program), a junior at Wesleyan. Some of their support came from the NASA Massachusetts Space Grant.

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