

IAU WORKING GROUP ON ECLIPSES TRIENNIAL REPORT FOR

March 2022-March 2024 Inter-Division C-E WG Solar Eclipses — Functional

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We report on the professional, educational and outreach aspects of the activities of the IAU Working Group on Solar Eclipses of Divisions C (Education, Outreach, and Heritage) and E (Sun and Heliosphere) over the last triennium and with plans for the next triennium.

CHAIR Jay Pasachoff (USA, former Chair, died), Zhongquan Qu (China, Chair)  
MEMBERS Irida Kim (Russia), Jagdev Singh (India), Vojtech Rusin (Slovakia), Yoichiro Hanaoka (Japan), Beatriz Garcia (Argentina), Patricio Rojo (Chile), Xavier Jubier (France), Fred Espenak (USA), Jay Anderson (Canada), Glenn Schneider (USA), Michael Gill (UK), Michael Zeiler (USA), Bill Kramer (USA);  
ASSOCIATES: Michael Kentrianakis (USA), Ralph Chou (Canada), Terry Cuttle (Australia)

THE TRIENNIAL REPORT (2022-2024)

1. INTRODUCTION

Web sites: [www.eclipses.info](http://www.eclipses.info), and for specific expeditions:  
[www.totalsolareclipse.net](http://www.totalsolareclipse.net).

The triennium between March 2022 and March 2024 had one hybrid solar eclipse in Australia/Indonesia/East Timor on 20 April 2023; and an annular eclipse on 14 October 2023. It also included respectively two partial eclipses on 30 April 2022 and 25 October 2022.

Our Working Group includes members from Argentina, Canada, Chile, China, France, India, Japan, Russia, Slovakia, UK and USA.

The Working Group on Solar Eclipses has as its task the coordination of the eclipse frontier research, guiding the amateurs to scientific observations, doing the solar eclipse observation efforts, particularly making liaisons with customs and other officials of countries through which the path of totality passes, and providing educational information about progresses made from the eclipse observations, the safe observation of eclipses for the wide areas of the Earth in which total, annular or partial eclipses are visible.

Two of our members, Espenak and Anderson, keep producing widely used Technical Publications with eclipse paths and detailed information, available as hard copies or online, linked through [www.eclipses.info](http://www.eclipses.info) or via <http://EclipseWise.com>, a successor to the "NASA Eclipse Site". Gill runs the Solar Eclipse Mailing List, now at [SEML@groups.io](mailto:SEML@groups.io); daily summaries are available: <https://groups.io/g/SEML>. Anderson at <http://eclipsophile.com> has cloudiness statistics and other weather-related information. Jubier produces zoomable, clickable maps customizable for each eclipse; the forthcoming few are linked at our website at <http://eclipses.info>. Kramer at <http://eclipse-chasers-com> keeps a log of statistics of individual eclipse observers, and is newly partnering with Andreas Mueller for an archive of historical eclipse papers.

## 2. REPORT OF ACTIVITIES

In 2022, only two partial solar eclipses took place. They were respectively partial eclipses on 2022 April 30 with an eclipse magnitude of only 0.6389(according to NASA) and October 25 with an eclipse magnitude of 0.8611(according to NASA again). One of our members Costantino Sigismondi organized special events as well at St. Maria degli Angeli meridian line I.C.R.A. Network - Eclissi solare parziale - 25 Ottobre 2022 (icranet.org) and online (for the lunar eclipse, occurred at noon time for Europe). Our member Vojtech Rusin conducted the amateurs to observe in Slovakia, and some beautiful photographs were taken; Dr. Singh, another group member, guided their activities at Indian Institute of Astrophysics, Bangalore. Arrangements were made for the public to come and view the event. Groups of astronomers and the news media publicized the event so that the public can take a view of the partial eclipse with safety measures in India. Terry Cuttle has contributed to the service. He worked with the Astronomical Society of Australia to produce an eclipse website to provide comprehensive public information on 20 April 2023 Australian total solar eclipse, the four more total solar eclipses in Australia in the next 15 years and provide safe viewing advice. He also provided information, evidence and advice to authorities and organizations to assist them to provide the best safe viewing advice to the Australian public and correct information.

On April 20, 2023, a hybrid solar eclipse occurred, passing through Australia, Indonesia, East Timor and Pacific Ocean. Chair Qu led his group to realize the maps of K-corona, F-corona and E-corona, derived from simultaneously recorded filtering images in two bands 659.25-659.55nm and 659.95-660.25nm, performed by twin telescopes. This started a new kind of eclipse observation method. The band 659.25-659.55nm contains neutral iron lines 659.3nm and 659.4nm while the band 659.95-660.25nm includes almost pure continuum. Qu conducted his amateur friends to carry out this scientific observation at Com city of East Timor. Further guidance will be given for those amateurs outside China. Tens of “eclipse glasses” were spread at the observational site for the local people and amateurs. Educational conversations concerning the eclipses were carried out with the amateurs from all over the world.

A cultivation aiming at conducting the students and amateur astronomers to understand and execute the scientific solar eclipse observations was hosted by Qu. It covered two days, Aug.7-8, 2023, at headquarter of Yunnan Observatories, Chinese Academy of Sciences. The history of findings in upper solar atmosphere during total solar eclipses, the instrumentation and the data reduction techniques are conducted and organized. And this kind of cultivation is planned to be expanded out of China to other countries and regions, and to be practiced for the coming 2024 total solar eclipse.

### 3. FUTURE PLANS

During 2024-2027, there will be three total eclipses and three annular eclipses (<https://eclipse.gsfc.nasa.gov/SEdecade/SEdecade2021.html>). Our group members will carry out the professional observations of these eclipses with new methods and techniques. New members will be absorbed into the group if they are qualified. On the other hand, we will continue to expand the domain of scientific training for amateur astronomers in fields of theory, instrumentation as well as observation, to realize the idea ‘science without borders’.

Especially, for the coming April 8, 2024 total eclipse, a meeting ‘Multi-scale Coupling in Space: Solar Eclipse and Beyond’ will be held just after 2024 Apr 8 total solar eclipse, originally organized by University of Texas at Arlington(UTA), and associated by our group. And public outreach speech will be given by our group members in Texas.

### 4. RESOURCES

A new eclipse observational method and technique called spectro-imaging polarimetry was realized in solar eclipse observations and used further in the following eclipses:

❖ Qu, Z.Q. Dun, G.T., Chang, L., Murray, G., Cheng, X.M., Zhang, X.Y., and Deng, L.H., 2017, “Spectro-imaging Polarimetry of the Local Corona during Solar Eclipse”, *Solar Physics*, 292, 37;

The following new eclipse-related items appeared:

- ❖ Michael Zeiler and Michael E. Bakich, 2020, *Atlas of Solar Eclipses: 2020 to 2045* (GreatAmericanEclipse.com)
- ❖ Michael Zeiler with Sky & Telescope, 2020: *eclipse globe, 2001-2100* (GreatAmericanEclipse.com)

The following softbound books are particularly useful for the next triennium:

- ❖ Fred Espenak, 2016, *21st Century Canon of Solar Eclipses* (Astropixels Publishing)
- ❖ Fred Espenak, 2017, *Road Atlas for the Total Solar Eclipse of 2024* (Astropixels Publishing)

Especially useful websites:

- ❖ IAU website linking much eclipse reference material: <http://eclipses.info>
- ❖ [NASA Eclipse Website](#) (formerly from Fred Espenak. now retired)
- ❖ EclipseWise.com from Fred Espenak, with current and past maps
- ❖ GreatAmericanEclipse.com from Michael Zeiler, with maps and materials
- ❖ Eclipse-chasers.com from Bill Kramer, with individuals' logged eclipses
- ❖ <http://xjubier.free.fr/en/> from Xavier Jubier, with current maps

Earlier eclipse-related material

- ❖ Fred Espenak, *Thousand Year Canon of Solar Eclipses 1501 to 2500*, 2014 (ISBN-10: 194 1983006); <http://www.astropixels.com/pubs/>

- ❖ Fred Espenak, [Five Millennium Canon of Solar Eclipses: -1999 to +3000](#), 2006 (NASA/TP-2006-214141);
- ❖ Jay M. Pasachoff, [The Complete Idiot's Guide to the Sun](#), Alpha Books, 2003 (ISBN-10: 1592570747).
- ❖ Leon Golub and Jay M. Pasachoff, [The Sun](#), 2017, UK: Reaktion Press; US: U. Chicago Press, 2017 ISBN:978-0-8109-7274-2.
- ❖ Leon Golub and Jay M. Pasachoff, [The Solar Corona](#), 2nd ed., Cambridge University Press, 2010 (ISBN-10: 052188201X).
- ❖ Jay M. Pasachoff and Alex Filippenko, [The Cosmos: Astronomy in the New Millennium](#), 5th ed., Cambridge University Press, 2019.
- ❖ Leon Golub and Jay M. Pasachoff, [Nearest Star: The Surprising Science of Our Sun](#), 2nd edition, Cambridge University Press, 2014 (ISBN-10: 1107672643).
- ❖ Pasachoff, Jay M., 2017, "The Great Solar Eclipse of 2017," *Scientific American*, 317, #2, 54-61, August.
- ❖ Pasachoff, Jay M., 2017, "Heliophysics at Total Solar Eclipses," *Nature Astronomy* 1, article number 0190 (August).  
<https://www.nature.com/articles/s41550-017-0190> <http://rdcu.be/uEuz>
- ❖ Pasachoff, Jay M., 2018, "Science at the Great American Eclipse," *Astronomy & Geophysics (A&G)*, 59 (August), 4.1-4.5.
- ❖ Pasachoff, Jay M., 2019, "Education and Outreach about Science at the 2017 Eclipse," in *The 2017 Total Solar Eclipse*, Astronomical Society of the Pacific Conference Series, Sanlyn Buxner, Linda Shore, and Joe Jensen, eds., pp. 331-336.
- ❖ Peticolas, Laura, Hugh Hudson, Calvin Johnson, Dan Zevin, Vivian White, Juan Carlos Martínez Oliveros, Igor Ruderman, Justin Koh, David Konerding, Mark Bender, Christopher Cable, Brian Kruse, Darlene Yan, Larisza Krista, Braxton Collier, Andrew Fraknoi, Jay M. Pasachoff, Bryan Mendez, Alex Filippenko, Scott McIntosh, and Noelle Filippenko, 2019, "Eclipse Megamovie 2017 Successes and Potential for Future Work," in *The 2017 Total Solar Eclipse*, Astronomical Society of the Pacific Conference Series, Sanlyn Buxner, Linda Shore, and Joe Jensen, eds., pp. 337-352.
- ❖ Hudson, Hugh S., Laura Peticolas, Calvin Johnson, Vivian White, Mark Bender, Braxton Collier, Juan Camilo Guevara Gomez, Justin Koh, David Konerding, Juan Carlos Martínez Oliveros, Scott McIntosh, Brian Kruse, Brian Mendez, Jay Pasachoff, Igor Ruderman, Dan Zevin, 2018, "The Eclipse Megamovie Project," in Scott W. McIntosh, Michael Thompson, Chris G. Tzanis, eds., *Frontiers in Astronomy and Space Sciences: The Great American Eclipse of August 21, 2017 - Connecting Solar and Terrestrial Science*, *Frontiers in Astronomy and Space Sciences*. 5:37. doi: 10.3389/fspas.2018.00037.
- ❖ Pasachoff, Jay M., Christian A. Lockwood, Erin Meadors, Ross Yu, Cielo Perez, Marcos A. Pelozo-Murillo, Daniel B. Seaton, Aris Voulgaris, Ron Dantowitz, Vojtech Rušin, Thanasis Economou, 2018, "Images and Spectra of the 2017 Total Solar Eclipse Corona from our Oregon Site," in Scott W. McIntosh, Michael Thompson, Chris G. Tzanis, eds., *Frontiers in Astronomy and Space Sciences: The*

Great American Eclipse of August 21, 2017 - Connecting Solar and Terrestrial Science, *Frontiers in Astronomy and Space Sciences*. 5:37. doi: 10.3389/fspas.2018.00037.

<https://www.frontiersin.org/articles/10.3389/fspas.2018.00037/full>

❖ Pelozo-Murillo, Marcos A., and Jay M. Pasachoff, 2018, "The longest total occultation of the Sun of the 21st century at Tianhuangping (Zhejiang), China: Air-temperature observations and its theoretical analysis under adverse meteorological conditions," *J. Geophys. Res.: Atmospheres*, 123, DOI: [10.1029/2018JD029253](https://doi.org/10.1029/2018JD029253)

<https://agupubs.onlinelibrary.wiley.com/doi/pdf/10.1029/2018JD029253>

❖ Publications by Shadia Habbal's Solar Wind Sherpas

Note that sometimes ESA's Solar and Heliospheric Observatory (SoHO) sees some additional partial solar eclipses, such as on Jan 13, 2021:

<https://www.nasa.gov/feature/goddard/2021/nasa-sdo-first-lunar-transit-2021-moon-sun>