The Dynamic Eclipse Broadcast (DEB) Initiative:
A network of volunteer citizen scientists observing the Sun

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What is the DEB Initiative:

- Network of volunteer citizen science telescope-observing teams
  - Teams come from a wide variety of backgrounds
  - Includes secondary student groups, university students, amateur astronomers, & people who have no previous observing experience but want to get involved
- Teams currently located all across North America, including the USA, Canada, and Mexico
  - Want to expand the network across the globe

Equipment:

- Mount: iOptron Skyhunter EQ/AZ
- Telescope: Askar FMA 180 Pro
- Camera: Neptune-M Player 1 Camera
- Solar Filter: 60mm Solar Filter, Rainbow Symphony, Black Polymer
- Adapter: ZWO M42 to M48 Extender (16.5mm), ZWO T2-M48-16.5
- Extension Tube Kit: SVBONY, SKU: F9190A
- Laptop: Dell Inspiron 15 3520, 16GB RAM, 1TB SSD
Total cost of equipment is approximately €1600 ($1800 USD)

Figure 1: Equipment setup by Team 72, University of Washington, USA

Communication Plan:

- Team Leaders: Primary point of contact for each telescope-observing team. They attend virtual project-wide meetings and coordinate practice sessions with their volunteers.
- Regional Team Coordinators: Experienced members of the core project team who work with a dedicated group of observing teams. They assist with technical challenges, help teams troubleshoot during practice events, and provide overall astronomical observing advice as needed.
- Project Team Coordinator: This individual serves as the focal point for communications sent out to all teams. They coordinate team placement during eclipses and provide administrative support to help recruit and organize new teams.
- Virtual Office Hours: One or more core project members hold office hours on a weekly basis using a Discord server. Teams can ask any questions they have, get one-on-one assistance with troubleshooting, etc.

Training Events:

- For the 2024 Total Solar Eclipse, almost all training was done using various online tools.
  - A series of online training videos walked teams through each step of the observing process, including unboxing their equipment, telescope setup and alignment, and image collection.
  - Additional training was done over Discord to provide individualized assistance to teams from either the Regional Team Coordinators or during Virtual Office Hours.
  - Network-wide practice sessions were held multiple times before the Total Solar Eclipse to ensure teams were both comfortable and proficient operating their equipment and capturing data during simulated eclipse viewing events.
- For the 2027 Total Solar Eclipse, the project is hoping to offer several in-person training events for new teams who would appreciate the hands-on assistance to get ready for solar viewing.
  - The virtual and online trainings will still be available for all teams as well as individualized support as needed.

Lower Coronal Observations (Solar Eclipses):
08 April 2024, North American Total Solar Eclipse

- 82 observing teams both in and out of path of totality (Fig. 2)
  - 37 teams successfully collected totality data (many others were clouded out)
  - 16 teams were out of the path of totality, collected photospheric data
- Two types of images collected:
  - 1000x1000 pixel, 15 sec, .ser images every minute during partial phases (Fig. 3)
    - Provided near-live feeds (debra.physics.siu.edu)
    - Allowed for rotational alignment across teams
  - Continuous capture of a 4-exposure sequence (0.4, 4, 40, & 400 ms) during totality – 3096x2078 pixel, .fits images
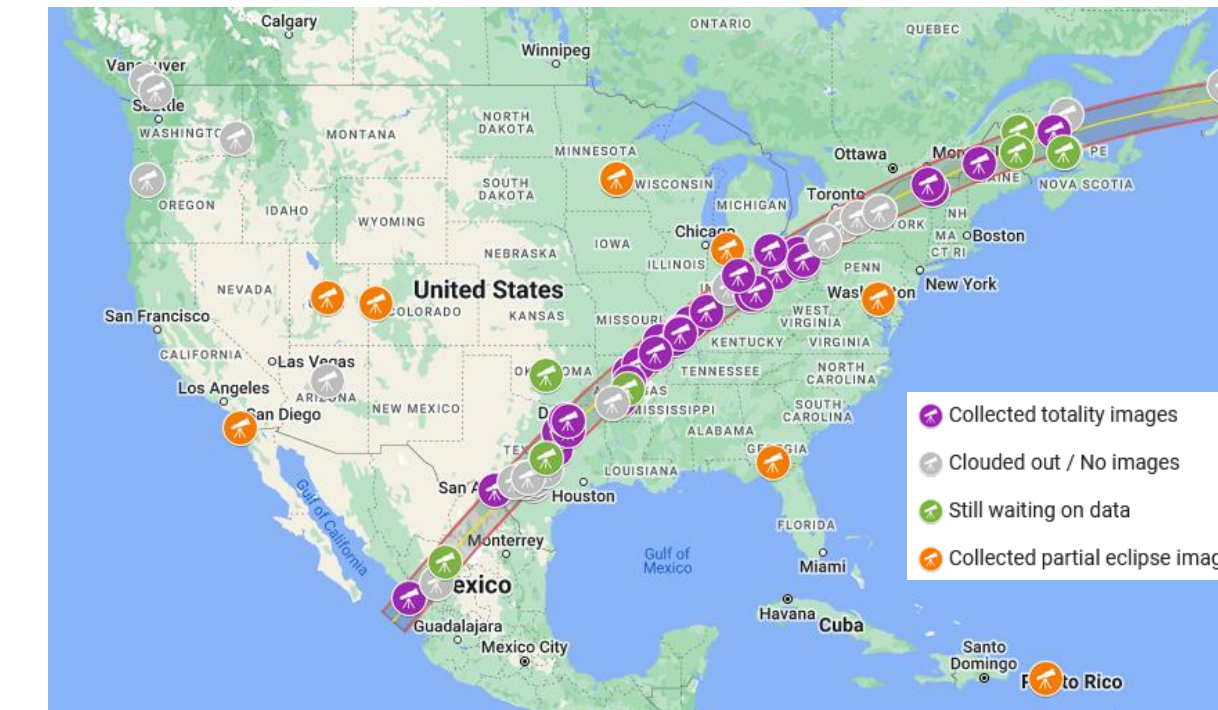
Preliminary Results:
- Currently processing over 468 GB of data
- Time sequences of data show changes in the corona occurring during the eclipse event. (Fig. 4)

Figure 2: DEB Team Placement for the 2024 Total Solar Eclipse

Figure 3: Partial Eclipse Image collected by Team 64, Junior Texas Astronomical Society, USA.
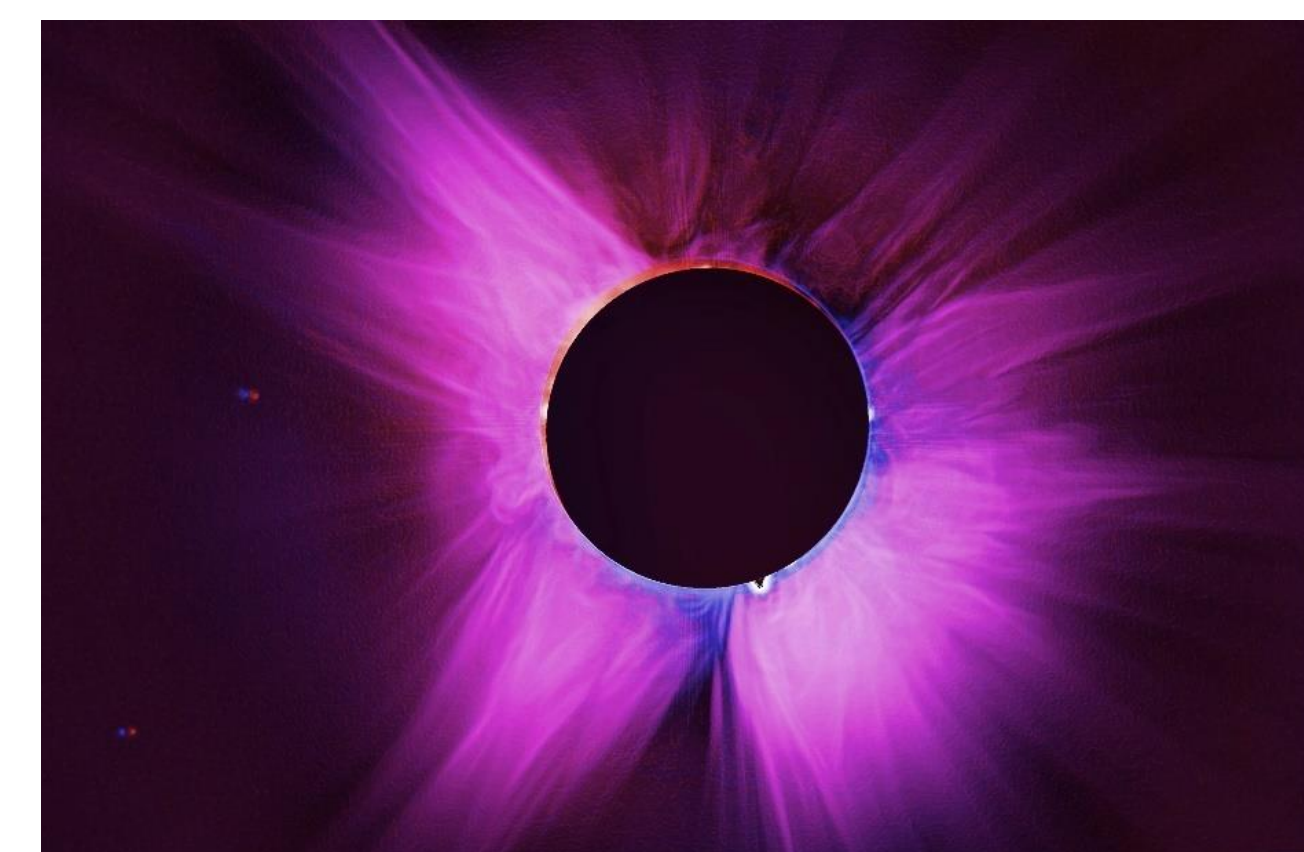

Figure 4: Color overlay of 10 stacked HDR sets from Team 63 (Talawanda High School, USA) [shown in blue from 19:07UT] and Team 33 (Jackman, Maine, USA) [shown in red from 19:31UT]. Lunar motion is due to the different totality phase, and motion of the corona against the background stars is also seen. Outflows are present in the southern coronal hole as indicated by the predominately blue features, and some of the smaller loops in the inner corona also show changes.
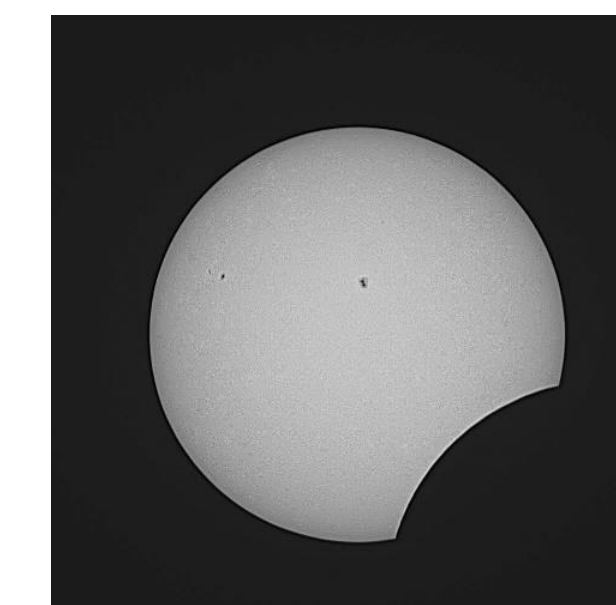
X-class Solar Flare Observing Campaign:

- Daily solar photosphere observations from teams across North America
- Sub-second frame rate, full solar disk imaging in white light
- 15-second image capture on a one-minute cadence
  - Four DEB setups in the telescope network can be used to image the Sun at alternating quarters of a minute starting at 0 s, 15 s, 30 s, and 45 s.
- At this high frame rate, just over 400MB of data is acquired each minute.
  - Data is saved from approximately +/- 1 hour around a GOES (Geostationary Operational Environmental Satellites) detected X-class flare.

Preliminary Results:
- Teams have captured five X-class solar flares so far. (Fig. 5)
- More observations are needed & data is being analyzed.

Figure 5: White light X4.5 flare observed on 14 Sep 2024 by DEB site 43 in Brandenburg, KY, USA. Images show detail of the flare region over approximately 10 minutes before (1) and during (2) peak flare activity.
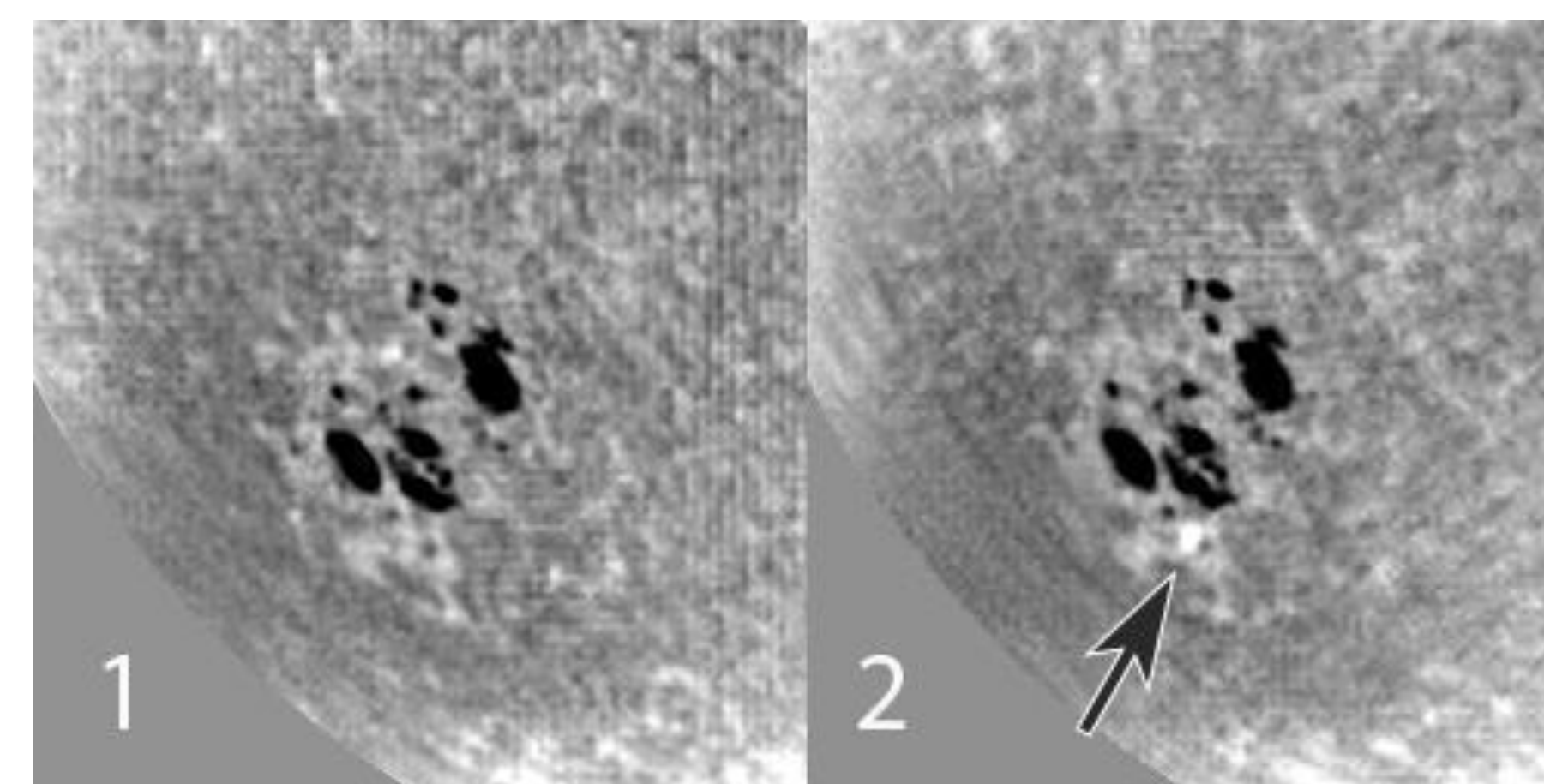
Upcoming Events:
02 Aug 2027, North African Total Solar Eclipse

- A total solar eclipse will cross northern Africa, providing over 2 hours and 20 min of totality along its path (Fig. 6).
- Volunteer network of citizen science teams will be extended across the globe to place telescope-observing teams along this path.
- Collected data will be used to continue the study of lower coronal behaviors that can only be imaged during a solar eclipse.

Figure 6: Path of 2027 Total Solar Eclipse
Image credit: http://xjubier.free.fr/en/site_pages/solar_eclipses

WANTED: Volunteer Observation Teams to join the DEB Initiative Network

- If you or someone you know is planning to be in the path of totality for the 2027 Total Solar Eclipse and is interested in joining our imaging project, email us for details (see Contact Information below).
- All teams use the same telescope setup to ensure images can be compared
- Training sessions will be offered for new teams – some in-person and some virtual
- Network practices give teams a chance to become familiar with the equipment and procedures
- No previous experience is needed, only a passion to get involved
- Great project for secondary schools, universities, and amateur astronomy groups

Conclusions:

- To-date, the DEB Initiative has involved more than 380 volunteers, including secondary students, university students, and interested community members. Teams are currently located in Mexico, the USA, and Canada.
- Coronal and photospheric images were collected during the 2024 Total Solar Eclipse, and that 468 GB of data is being analyzed. Preliminary results are already showing changes in the corona which occurred during the 2-hour eclipse event.
- The network is also engaged in daily solar observations to capture white-light X-class solar flares. Five of these flares have been observed to-date.
- The network is seeking to expand the number of teams involved with the hope of creating a global network, especially focused on North Africa for the 2027 Total Solar Eclipse. Anyone interested in getting involved is encouraged to reach out to the team for more information.

More information at:
https://debinitiative.org

Contact Information:

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