Growing Heliophysics Citizen Science Strategically: Strategic Working Group

HPAC

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June 17, 2024

Agenda

- Background:
  - Strategy
  - Needs
  - Portfolio Overview
- Where Are We Now?
  - Eclipse Highlight
- Solar Max Campaign

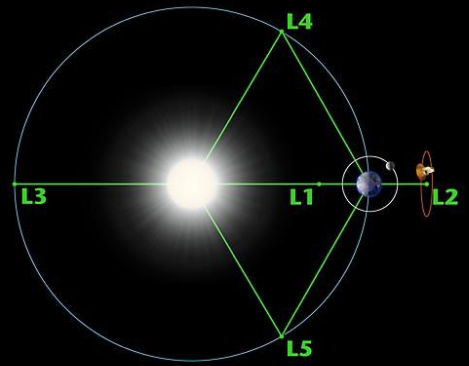
SunSketcher

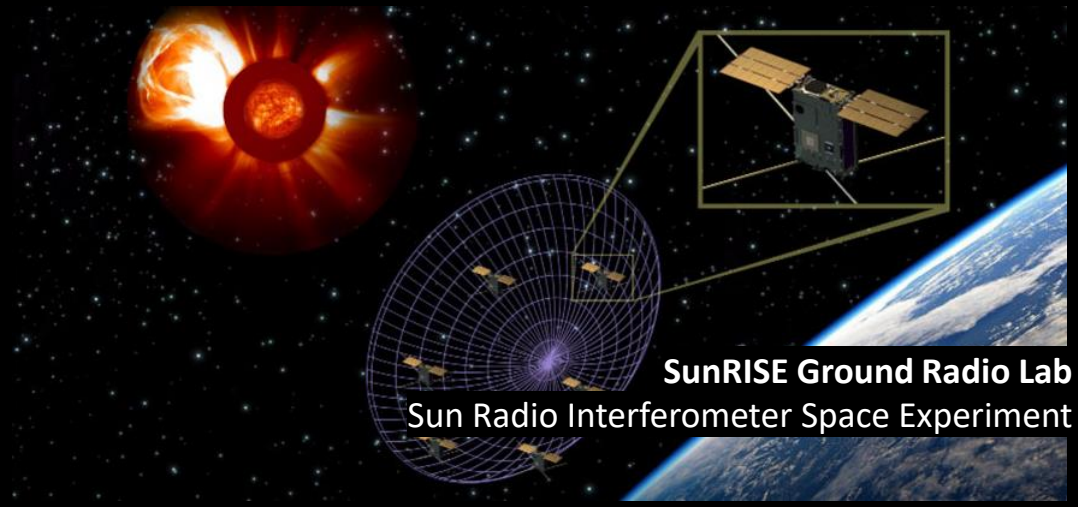
HELIOPHYSICS BIG YEAR KEEPS GETTING BIGGER

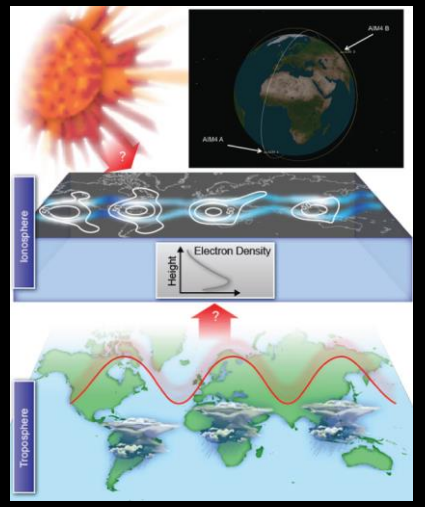
- 6 Citizen Science projects launched in 2023-2024
  - *More than 36,000 volunteers participated in Eclipse Citizen science*
  - *TBs of data like photos, millions of QSO contacts (ham radio) audio, and notes on paper!*
  - *Calibration and science in process*
- Continued observations and campaigns of solar maximum superstorms
- Maintaining community connection & building a stewardship feedback cycle with partners

NEW OPPORTUNITIES

- Citizen science in ROSES24: Check out Seed Funding F.9 CSSFP (due 11/24) and H-Citizen Science Investigations (B.21)
- Also check out citizen science opportunities with missions
- HBY Solar Max campaign







HELIOPHYSICS
BIG YEAR

HELIOPHYSICS
BIG YEAR

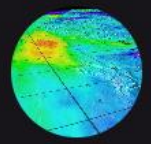
HPD CITIZEN SCIENCE IS PART OF A WIDER SMD EFFORT

Join NASA researchers and discover the secrets of the universe, search for life elsewhere, and protect and improve life on Earth and in space.

Multiple Languages
11 projects in 18 languages

Publications
More than 500 NASA citizen scientists co-authored publications

Meet the People
Who participates, why they do it and what they've discovered



Researcher Resources
Resources to help you collaborate with volunteers

Citizen Science

Through the projects below, sometimes called "citizen science" or "participatory science" projects, volunteers and amateurs have helped make thousands of important scientific discoveries. These 32 projects are open to everyone around the world (no citizenship required).

Citizen Science Resources

For Researchers

- Citizen Science Open Science and Data Management Plan Template
- Citizen Science Policy Document
- ROSES Funding for Citizen Science
- NSPIRES
- Putting DEIA Ideas into Action in NASA Citizen Science Projects
- Federal Citizen Science Page
- NASA ESDS Citizen Science Data Working Group White Paper
- Heliophysics Citizen Science Strategic Working Group
- Do NASA Science LIVE
- CitizenScience.gov Resource Library

For Everyone

- NASA Citizen Science Resources for Learners
- Sciencing with NASA Facebook Group
- NASA Citizen Scientists Named as Co-Authors on Refereed Publications
- SMD Citizen Science Flyer
- Get Involved with NASA
- Citizen Science Association
- Presentations from CitSciCon 2021

NASA HELIOPHYSICS CITIZEN SCIENCE STRATEGY (2020)

Vision

- Leverage public participation in Heliophysics to help drive innovation and diversity in science, society, and education

Mission

- Build a robust, dynamic, and engaging Heliophysics citizen science portfolio that fuses natural phenomena, mission opportunities, and the power of people's diverse viewpoints to fuel collective innovation

Stay tuned for updates:
https://science.nasa.gov/heliophysics/programs/citizen-science

1. Grow
- Broaden the reach and scope of Heliophysics and the vitality of the field through CS

2. Execute
- Create and regularly update a robust citizen science portfolio

3. Innovate
- Discover new aspects of Heliophysics - including those that impact life, society, and the process of doing science

4. Communicate
- Internal & external communication to foster support for & engagement with citizen science

5. Optimize
- Best practices, methodologies, data integrity, and technology infrastructures

6. Partner
- Foster mutually beneficial engagement with partners & stakeholders

HELIOPHYSICS BIG YEAR

HELIO CITSCI STRATEGIC PLAN PROGRESS

BIG THANKS TO THE TEAM!

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ROSES & SALMON now contain multiple Small, Medium, & Large opportunities, for example:
S: CSSFP, 2nd crop of seed funding & EPSCoR AI/ML partnering
M: H-CSI, as well as through any suitable call such as SpWx Centers of Excellence, H-ARD, others
L: Helio SMEX AO contains large incentive opportunity

Strong balanced growth of small, medium, & large opportunities

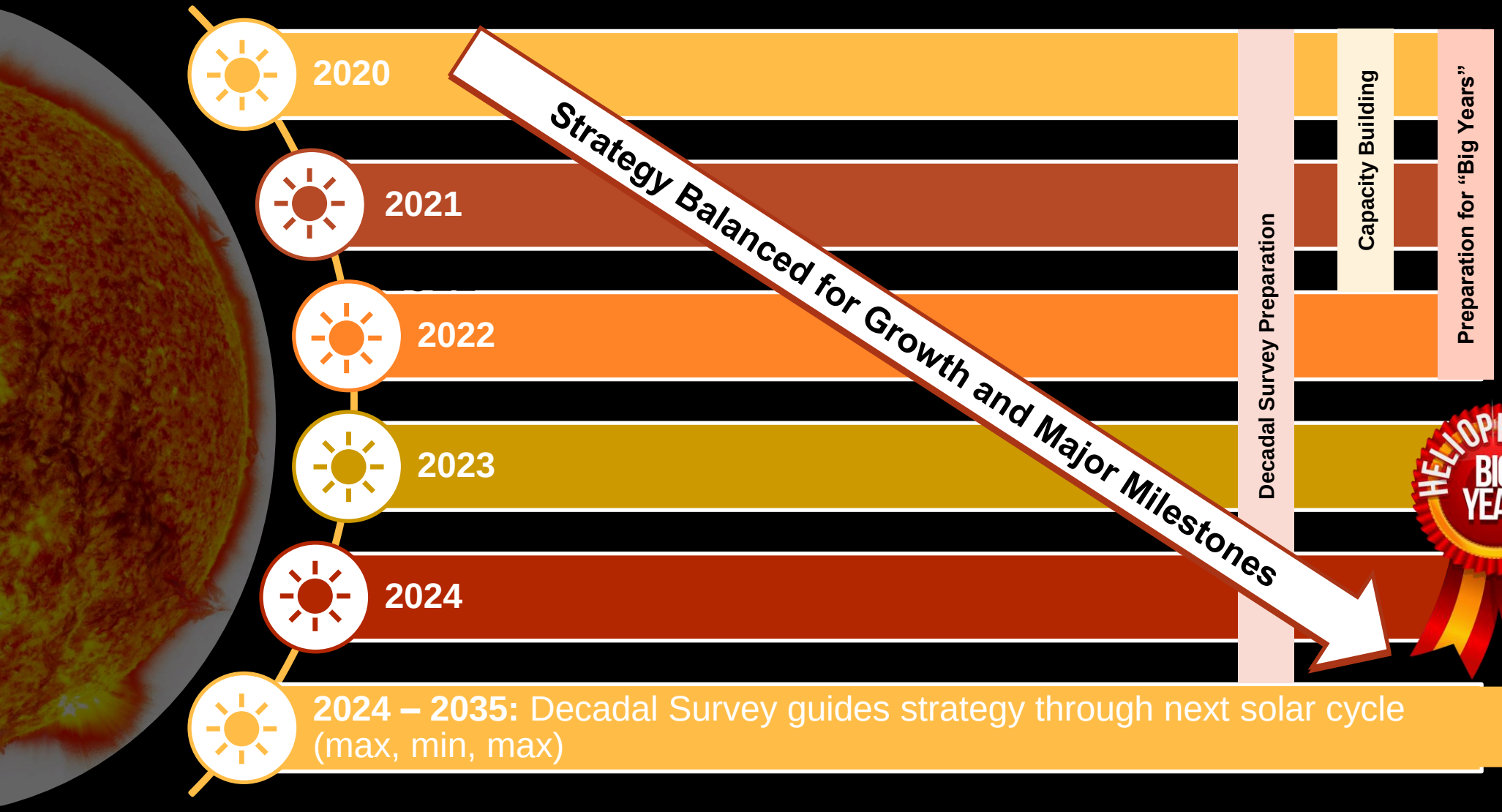
Presidential Innovation Fellow joined HPD, & HPD broadening the HBY beyond CitSci

Communication includes new interns, website content, briefings, conferences & more

"Citizen science is open science" coordination with NASA's TOPS initiative and new data policy SPD-41a

New partnerships: CoECI EPSCoR

CITIZEN SCIENCE 5 YEAR PLAN OVERVIEW



Milestones

Annular Eclipse
10/14/23

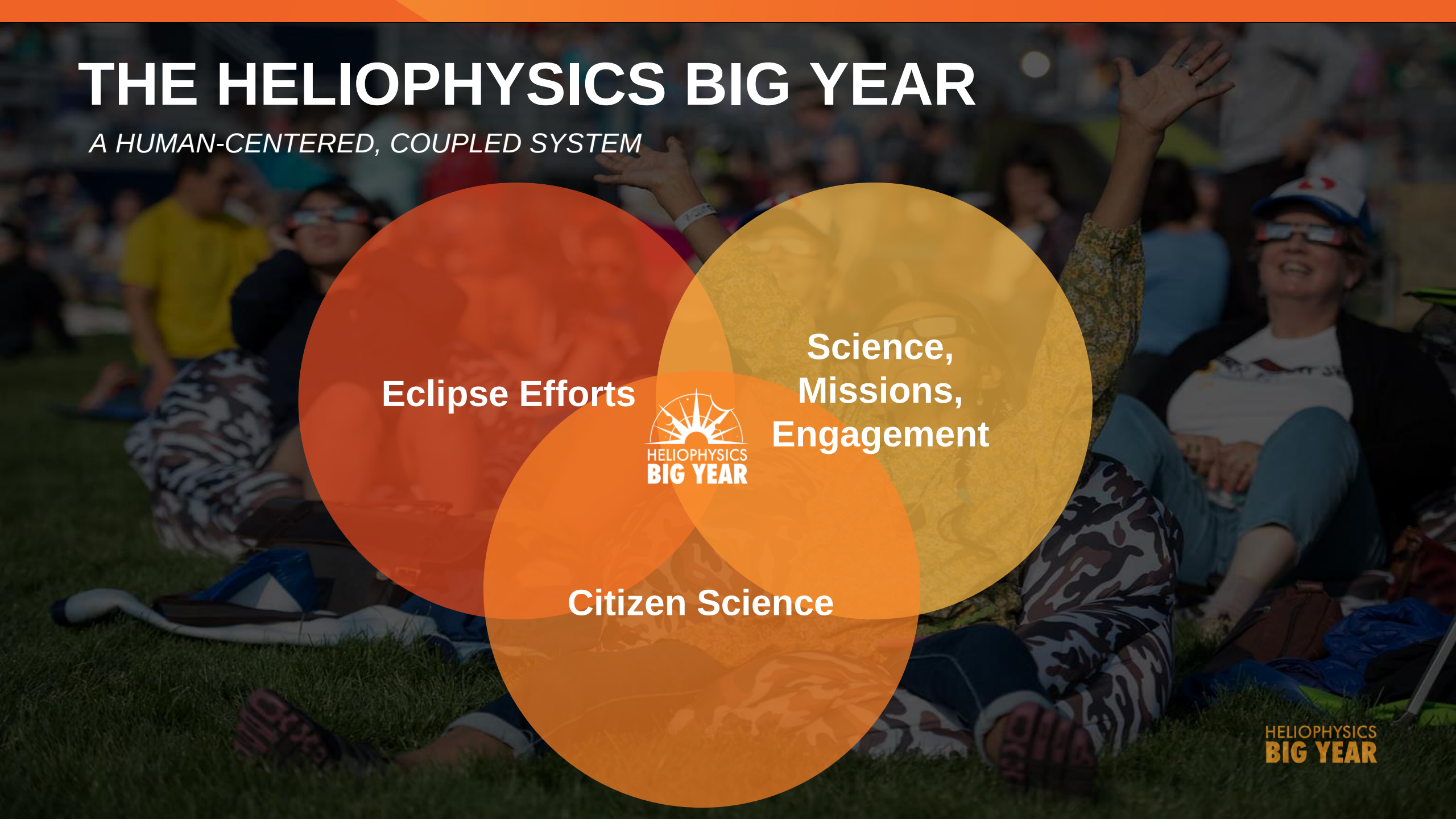
Solar Max
Approx. 2023-2028

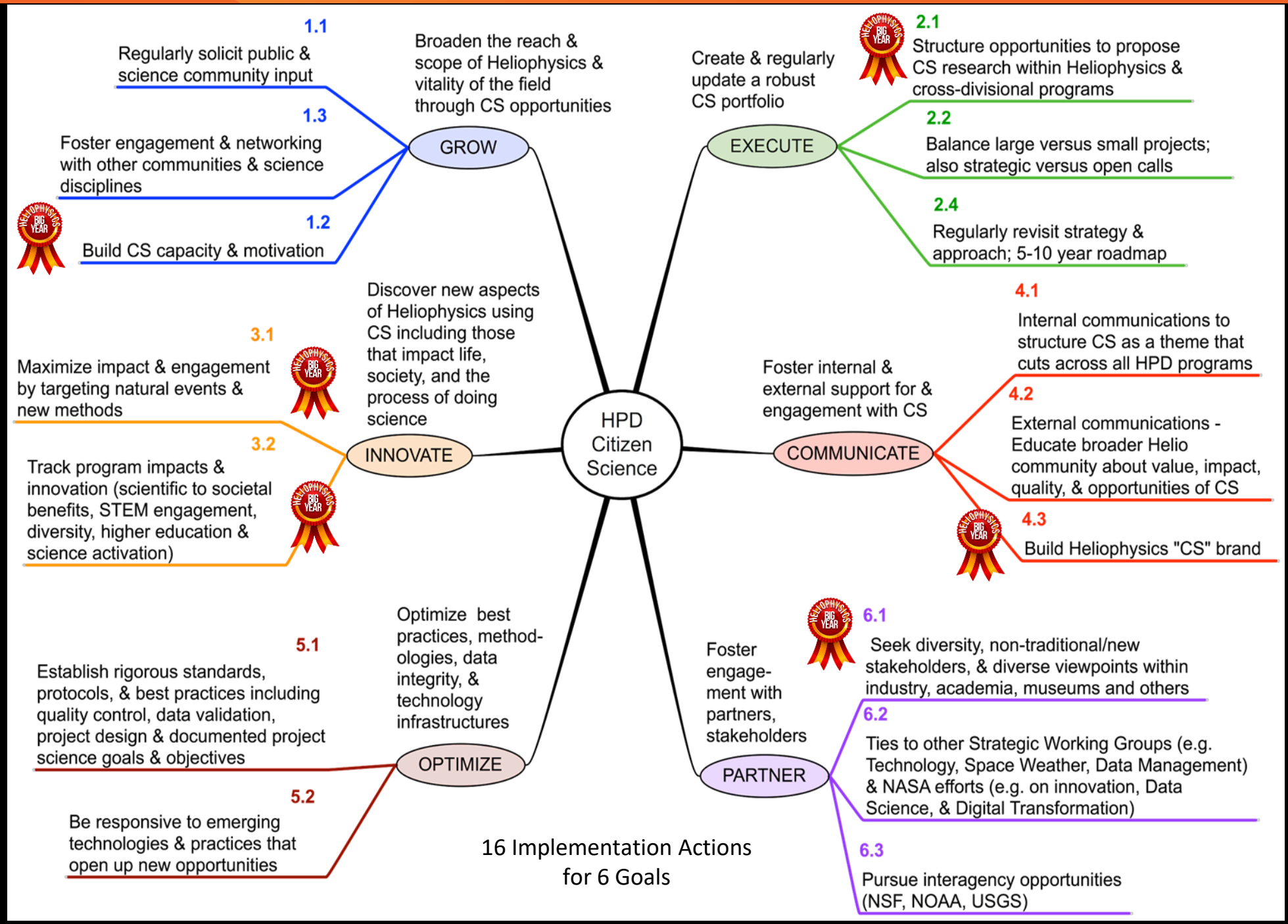
Total Solar Eclipse
04/08/24

HELIOPHYSICS BIG YEAR

THE HELIOPHYSICS BIG YEAR

A HUMAN-CENTERED, COUPLED SYSTEM





16 Implementation Actions for 6 Goals

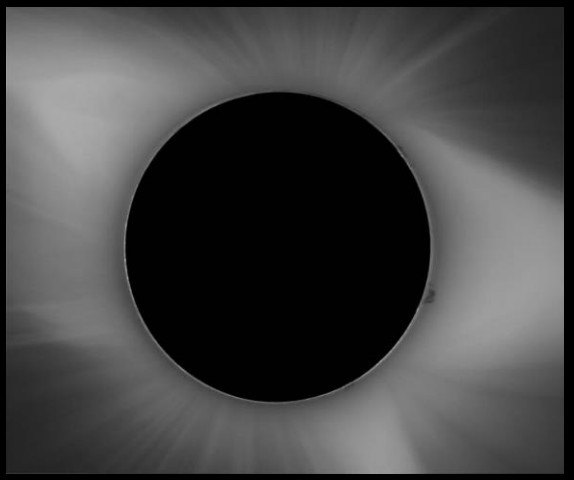
INNOVATION REQUEST – HELIOPHYSICS BIG YEAR

Background:
In 2017, millions in the US were captivated by the first total solar eclipse of the millennium. Lessons learned:

- Magnitude and sharp peak of the interest – what's next
- Need for early planning for programs, coordination with schools, science communication, and informal education.

New Opportunities in 2023-2024:

- Design an experience with two solar eclipses during solar maximum to convert a generation to Heliophysics Science
- Use citizen science as a gateway to our missions and science.
- Use the concept of a "Big Year" to tie the three major Heliophysics events together and encourage the maximization of participation in a coordinated incentivized branded campaign.
- Achieve a broader vision for Heliophysics by utilizing these natural opportunities coinciding with the rise of citizen science within SMD.



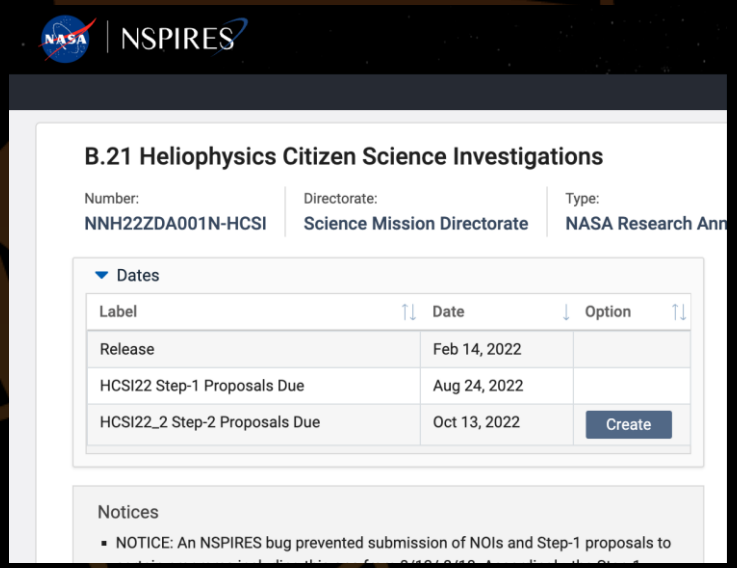
2 Eclipses + Solar Maximum

What is a "Big Year"? A big year is a birding term for maximizing a birder's number of species.

HELIOPHYSICS CITIZEN SCIENCE IS GROWING

AN OPPORTUNITY TO REACH A GENERATION FOR HELIOPHYSICS

ROSES B.21



Citizen Science Incentive for Helio SMEX AO & Included Options in DYNAMIC and Vigil AO

A growing & thriving community

- New CSSFP & H-CSi selections
- ~10 citsci whitepapers submitted to the Decadal Survey

https://science.nasa.gov/heliophysics/programs/citizen-science

HELIOPHYSICS ROSES CITIZEN SCIENCE FUNDING OPPORTUNITIES

F.9 Citizen Science Seed Funding Program (CSSFP)

- Cross-Divisional ROSES Program, offered annually
- Award duration **up to one year only**
- Aims to incubate citizen science projects as they are being conceived or during critical transitions, or when the project changes scientific direction. CSSFP awards require relatively short proposals to encourage new proposers; the S/T/M section has a limit of 6 pages.
- Roughly $80k per award, with ~$700k available for Heliophysics

B.21 Heliophysics Citizen Science Investigations (H-CSI)

- Began in ROSES 2022 and has been offered annually (Inclusion Plan Pilot starting in ROSES 2023)
- Solicits medium-scale citizen science investigations, which are mature enough to produce science results and achieve proposed project goals within a **maximum 3-year period of performance**. Investigations previously funded through CSSFP or a similar program are welcome to submit proposals to H-CSI, though previous seed funding is not a requirement.
- Expected annual funding ~$120-160K per investigation, with ~$700k available in FY24

HELIOPHYSICS BIG YEAR

CITIZEN SCIENCE IN MISSIONS

Highest impact opportunity
Currently organic growth and heterogeneous approach
Need for support and assessment

2024 EZIE-MAG ECLIPSE MEASUREMENT CAMPAIGN

- 25 EZIE-Mag kits were deployed across the path of totality giving the public a unique opportunity to see and participate in eclipse science.
- 650 more kits will be sent to middle and high schools across the US coinciding with the EZIE launch in FY2025

EZIE-Mag Workshop at Navajo Grant School in Arizona
June 3 – 5, 2024

- EZIE project manager and team at “maker space” held at Little Singer Community School in 2023.
- Over 100 registrants for this workshop so far, including teachers, students, mission team, and NASA scientists.

HELIOPHYSICS
BIG YEAR

THE HELIO BIG YEAR FEATURES CORONAL IMAGING PROJECTS WITH A VARIETY OF TECHNOLOGY

	Eclipse MegaMovie	SunSketcher™	 Citizen CATE	Dynamic Eclipse Broadcast Initiative
PROGRAM	**H-CSI, Foundation**	**HITS**	**H-CSI, NSF**	**H-CSI**
WHO	Individuals		Teams	
WHAT	Tracking coronal & disk features	Tracking the size of the Sun	Tracking coronal features	Tracking coronal & disk features
HOW	Camera plus tracking mount	Smartphones	Telescopes and training (provided)	
WHERE	On/off the path	On the path of totality		Anywhere, anytime!

AND PARTICIPATORY PROJECTS LOOKING AT OTHER ECLIPSE EFFECTS LIKE SOUND, WAVES, AND WEATHER

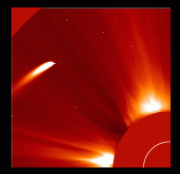
PROGRAM	SciAct, foundation	SciAct, ESD, other agencies	R2O2R, NSF	CSSFP; SunRISE Comm/Outreach	SciAct
WHO	Teams or individuals				College Student Teams
WHAT	Record sound changes	Record temperature and clouds	Festival of Eclipse Ionospheric Science – ham radio & Personal Space Weather Station projects	Monitor the Sun, upper atmosphere & Jupiter for radio wave changes	Instrumented weather and tech platform balloon launches
HOW	AudioMoth simple recording device (B/VI co-designed) or form submission	App, school-ready activities		Field a radio astronomy antenna	Balloon
WHERE	On or very close to totality	Anywhere! Anytime!			On the path of totality

HELIO BIG YEAR HAS NON-ECLIPSE PROJECTS YOU CAN DO THROUGHOUT THE YEAR (OUTDOORS)

EXOPLANET WATCH

PROGRAM	SciAct, NSF	SciAc	CSSFP	EZIE; Comm/Outreach
WHO	Individuals			Individuals/ HS Teams
WHAT	Tracking aurora	Observe Transiting Exoplanets	Photographing sprites above thunderstorms	Measuring changes in the Earth's magnetic field due to space weather
HOW	Use your eyes, take a smartphone or camera pic	Your own or a remotely operated telescope	Camera	Easy to build magnetometer (beta test now)
WHERE	Anywhere! Anytime! (though some locations are better than others)			

& PROJECTS YOU CAN DO ANYTIME THROUGHOUT THE HBY USING A COMPUTER (INDOORS)



Solar Patrol (GAVRT)

PROGRAM	CSSFP, HARP	HPD	CSSFP	ROSES	CSSFP; Eclipse
WHO	Individuals				
WHAT	Tracking waves heard by satellites	Finding new sun-grazing comets	Finding exoplanets, spotting Solar Active Regions as the Sun rotates	Spotting Solar Active Regions as the Sun rotates	Tracking solar features from radio maps observed by Owens Valley Radio Telescope
HOW	🎧🔊 Listening to Space	☄ Be the first to search the ✨ data	📻🔊	Find these projects online on the Zooniverse	
WHERE	Anywhere! Anytime!				

HELIOPHYSICS
BIG YEAR

AN OPPORTUNITY TO REACH A GENERATION FOR HELIOPHYSICS

How can we support members of the public who want to explore Heliophysics and ***do Heliophysics participatory science****?*

HELIOPHYSICS BIG YEAR

ACTION, ENTHUSIASM, RESULTS: MORE THAN 36,000 VOLUNTEERS PARTICIPATED IN ECLIPSE CITIZEN SCIENCE

52 M ham radio contacts!

Festival of Eclipse Ionospheric Science “QSO contest”

Eclipse Soundscapes reached **over 900** people in training programs and distributed hundreds of AudioMoth devices

32,000 phones uploaded data through Sunsketcher

80 teams in DEB

100+ ‘gold-star’ Eclipse MegaMovie participants and uploaded **1,097 GB** of data

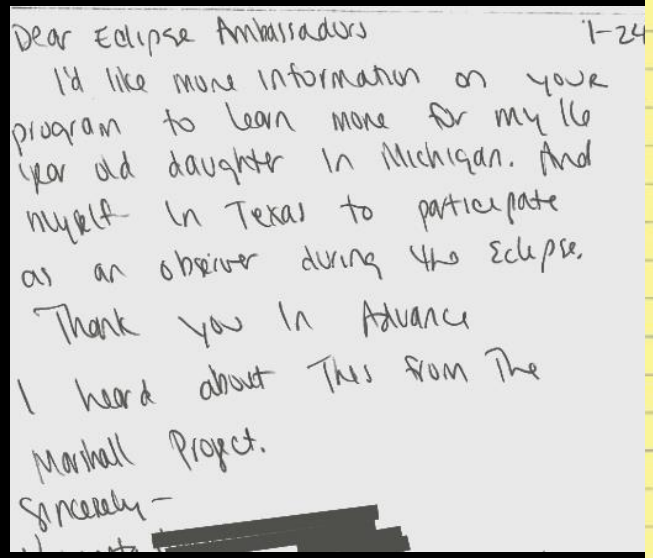
Stats from **35** Citizen CATE teams

379 applications, **225+** participants
50% women team leads & state coordinators
75% women regional coordinators
2 teams with Indigenous participants
Many Latinx participants (esp. TX!)
10 student lead trainers
>50% teams with student participation
2 US Air Force Academy teams (supporting/participating)
>90% full or partial success at eclipse observations

HELIOPHYSICS
BIG YEAR

BROADENING PARTICIPATION

How might we design inclusive and equitable experiences that ***feed the American Public's joy and curiosity*** *in service of science?*



Dear Eclipse Ambassadors 1-24

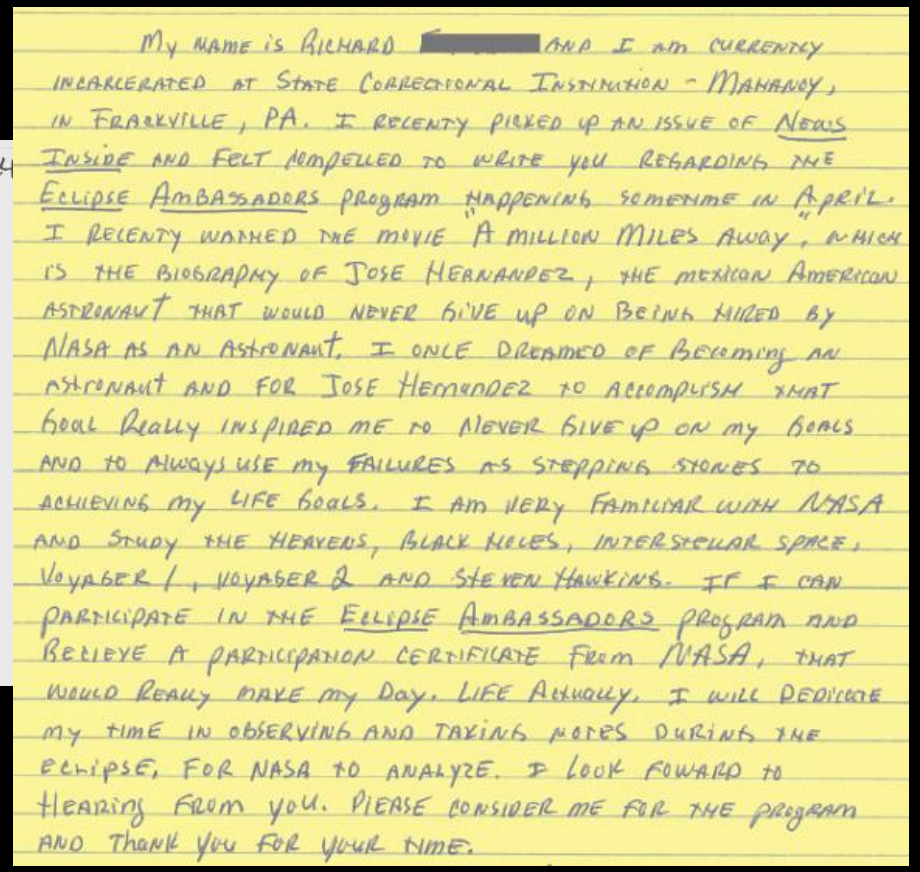
I'd like more information on your program to learn more for my 16 year old daughter in Michigan. And myself in Texas to participate as an observer during the Eclipse.

Thank you in Advance

I heard about This from The Marshall Project.

Sincerely-

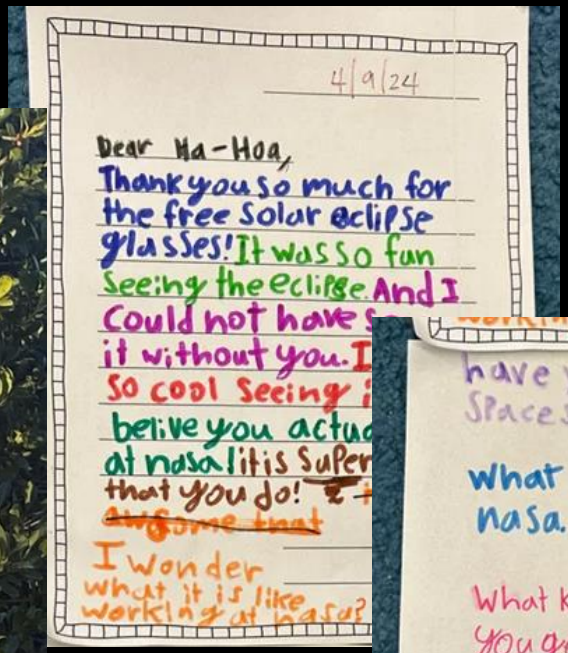
[redacted]

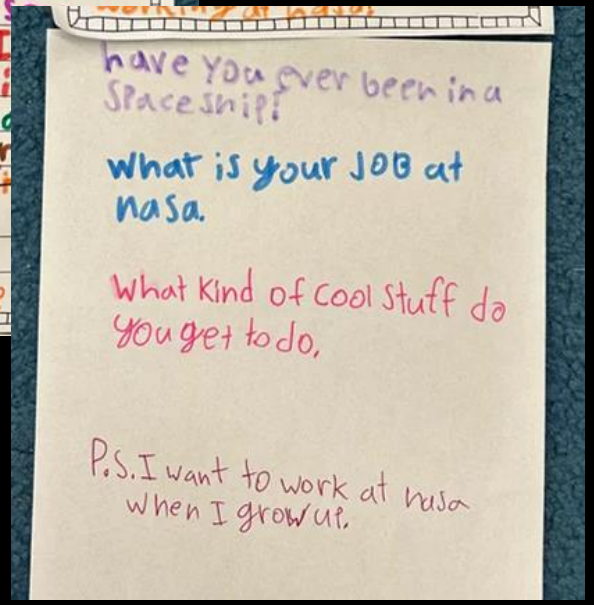


My name is Richard [redacted] and I am currently incarcerated at State Correctional Institution - Mahanoy, in Frackville, PA. I recently picked up an issue of News Inside and felt compelled to write you regarding the Eclipse Ambassadors program happening sometime in April. I recently watched the movie "A Million Miles Away", which is the biography of Jose Hernandez, the Mexican American astronaut that would never give up on being hired by NASA as an astronaut. I once dreamed of becoming an astronaut and for Jose Hernandez to accomplish that goal really inspired me to never give up on my goals and to always use my failures as stepping stones to achieving my life goals. I am very familiar with NASA and study the heavens, black holes, interstellar space, Voyager I, Voyager 2 and Steven Hawking. If I can participate in the Eclipse Ambassadors program and believe a participation certificate from NASA, that would really make my day. Life Actually. I will dedicate my time in observing and taking notes during the eclipse, for NASA to analyze. I look foward to hearing from you. Please consider me for the program and Thank you for your time.

HELIOPHYSICS
BIG YEAR

VISION: LEVERAGE PUBLIC PARTICIPATION IN HELIOPHYSICS TO DRIVE INNOVATION AND DIVERSITY IN SCIENCE, SOCIETY, & EDUCATION

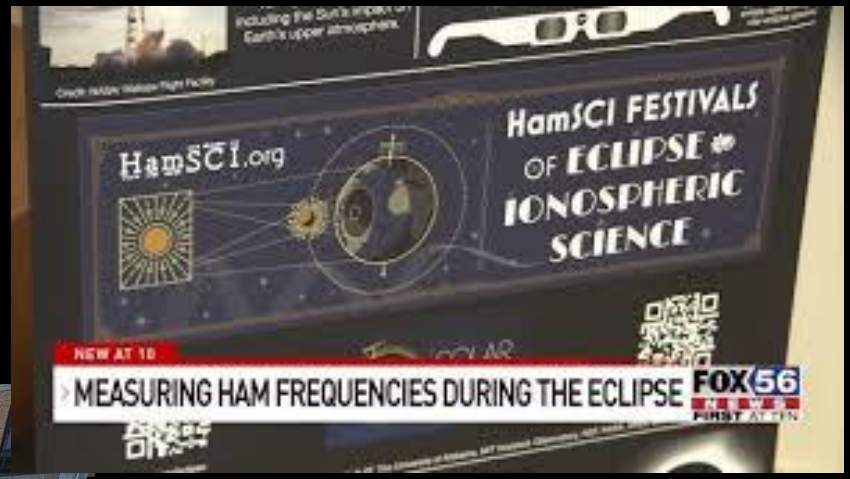




HELIOPHYSICS
BIG YEAR

BUILD A ROBUST, DYNAMIC, AND ENGAGING HELIOPHYSICS CITIZEN SCIENCE PORTFOLIO

Fusing natural phenomena, mission opportunities, & the power of people's diverse viewpoints to fuel collective innovation



MONTHLY THEMES

October 2023: Annular Eclipse

November 2023: Mission Fleet

December 2023: Citizen Science

January 2024: The Sun Touches Everything

February 2024: Fashion

March 2024: Experiencing the Sun

April 2024: Total Solar Eclipse

May 2024: Visual Art

June 2024: Performance Art

July 2024: Physical Health

August 2024: Kids

September 2024: Environment/ Sustainability

October 2024: Solar Cycle/Solar Max

November 2024: Bonus Science

December 2024: Parker's Perihelion

HELIOPHYSICS BIG YEAR

HELIOPHYSICS BIG YEAR

CELEBRATING ECLIPSE SUCCESS & CONTINUING FORWARD MOMENTUM

Continuing Science & Analysis

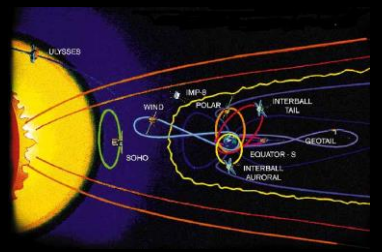
- Eclipse Megamovie Kaggle competition
- Data archiving & commons

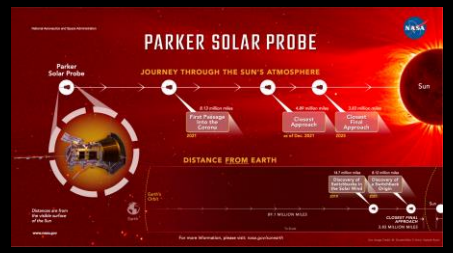
Maintaining Community Connection

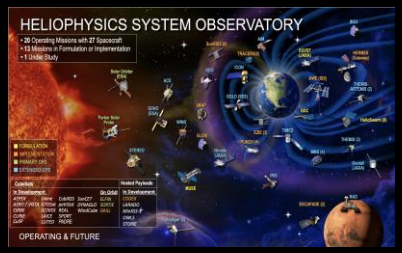
- Building a stewardship feedback cycle
- Amplifying and tying into the HBY themes
- Contests for Art and Code

Rising to HBY Solar Max

- Ongoing Solar Max campaign
- Infusing Helio community & public participation







1957 - 1958

International Geophysical Year IGY 1957-58

Radiation Belts

Sputnik, Explorer I

Plate Tectonics

Established NASA

Nations working together

1958 - 2006

Int'l Solar Terrestrial Physics Program

Heliophysics System Observatory Created (start in mid 1990's)

ANNÉE GÉOPHYSIQUE INTERNATIONALE
1957 1958
INTERNATIONAL GEOPHYSICAL YEAR

2007 - 2008

International Heliophysics Year IHY 2007-8

50-year Anniversary IGY

Spaceweather

Scientific Cooperation

Scientific Capacity Building

2009 - 2023

Parker Solar Probe: Touch the Sun

Solar Dynamics Observatory: Big Data

Solar Orbiter

HSO expanded to 20 operating missions (27 spacecraft), 13 missions in formulation/development

2024 - 2025

Heliophysics Big Year–Solar Max (HBY-SM) Sept 2024-Sept 2025

Citizen Science

Sun-Geospace System Focus

Approach to Solar Max

Solar Superstorm Dynamics

HELIOPHYSICS BIG YEAR

Evolving Plans

HBY– Solar Maximum Sept 2024-Sept 2025

Observations, modeling focused on major new discoveries, key science questions & impacts

Predictions & Reports

NASA Moon2Mars Planetary Space Weather

NOAA SWPC Solar Storm Warnings

Evolving Space Environment

NASA & Int'l Planetary missions

NOAA GOESR, DISCOVR

NASA Heliophysics System Observatory, EZIE

AFOSR DMSP ITM satellites

Int'l scientific satellite data

Scientific Satellites

NSF Ground-based Facilities (radars, all sky cameras, ionosondes, GPS TEC, imagers)

International ground-based facilities (e.g., Canadian REGO, SuperDARN, SuperMAG)

Ground-based observatories

Modeling programs worldwide

Models

Citizen Science

Crowdsourced observations

HBY-SM Hub to identify leverage & highlight worldwide organic efforts.

Data Commons

Model Output Commons

Living Open Science Commons

Storm Narratives

Data Subset in AWS "Registry of Open Data"

Information on 2023-2025 storms from worldwide efforts

Exciting New Tools and Visualization Capabilities for HBY-SM

HBY-SM Website (hosted by CCMC)

Layered content from public outeach to Heliophysics researchers

Data products & storm narratives focused on key science questions & impacts

Public-Friendly Data Access Platform

Queries about Heliophysics & Space Weather for both public & interdisciplinary communication

Aim is to eventually use Natural Language Processing

New Model/Data Visualizations (CCMC)

Komodo - 3D model output and boundaries

ISWA historical

Open Space

Auroral images on 3D Surface

Crowdsourcing app to add metadata on UT, location, star map overlay, etc. automatically on auroral photos

Innovative New Citizen Science Data Products

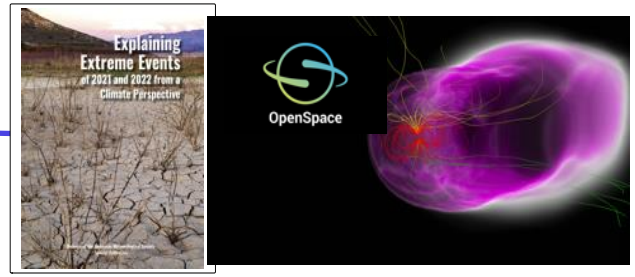
Working toward stitching together photos to create global auroral image

New Tools HDRL

3D Orbit Plotter

Student HelioViewer

Important Public-Facing Campaign Outcomes



Working to Engage Multi-Agency & Int'l Partners

NSF

HELIOPHYSICS NASA

NOAA

COSPAR

IUGG

IAGA International Association of Geomagnetism and Aeronomy

AAS Cross-Project Eclipse Takeaways

Lots of data and good response rates

Calibration, analysis, modeling in progress

Transferrable lessons learned on project execution shareable now

Intentional stewardship and engagement followthrough

A PROJECT WITH A LOT OF "MULTIDISCIPLINARY SECRET SAUCE"

App Code Development and Integration

Eclipse Astronomy and Camera Specifications

Data Upload and Storage

User Experience

Human Subjects / Privacy / Legal

Testing and Publicity


Travis Peden


Starr May


Leah Moss


Hugh Hudson


Nessa Unseld


Greg Arbuckle

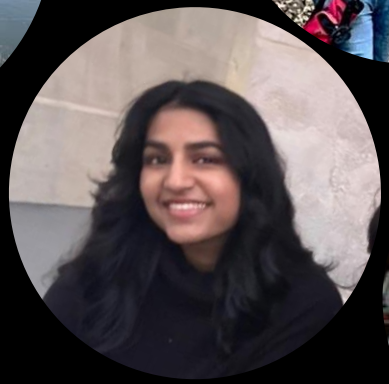
Kelcee Gabbard


Kelly Miller


Andrea Florence


Tameka Ferguson


Tabby Cline


Shikha Sawant


Mark Simpson


Michael Galloway

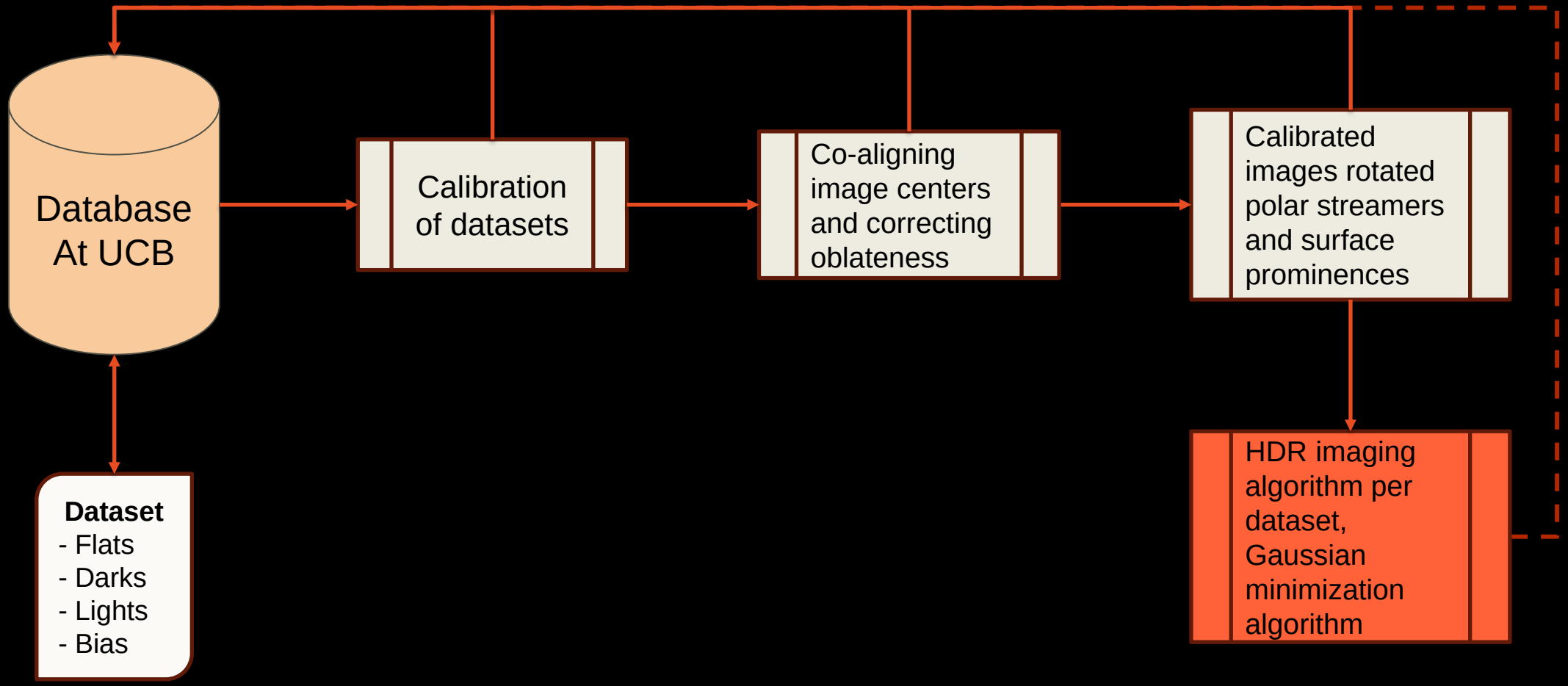
SunSketcher™

HELIOPHYSICS BIG YEAR

(slide courtesy of G. Emslie, 2024 AAS meeting)

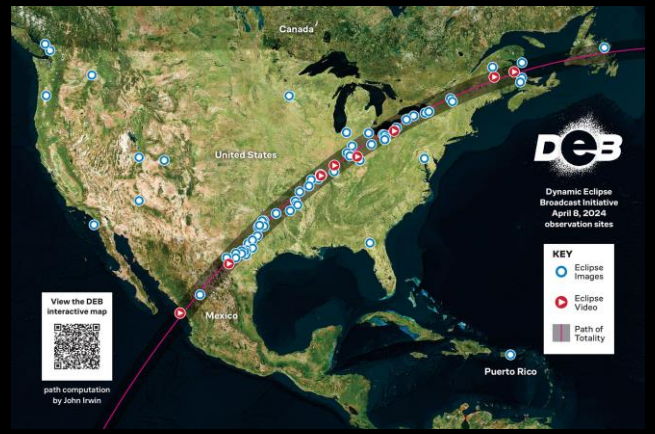
ECLIPSE MEGAMOVIE 2024 PIPELINE

An algorithm was and currently being implemented to analyze the data based in the eclipse megamovie 2017



INVOLVING CITIZEN SCIENTISTS IN HIGHLY TECHNICAL PROJECTS: CHALLENGES AND LESSONS

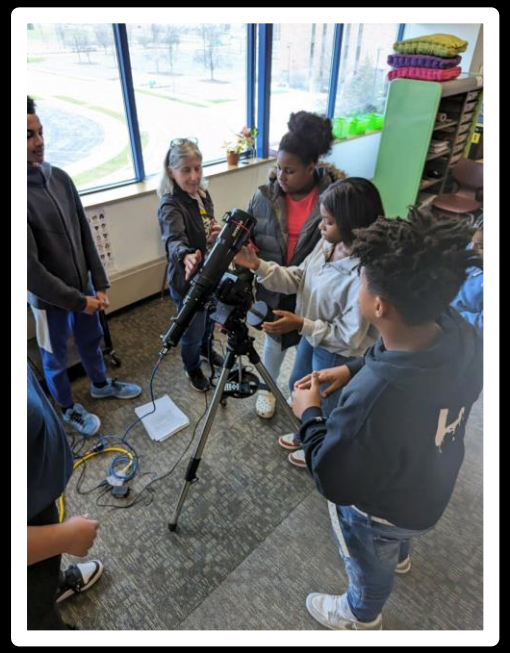
- Obviously: extremely clear, easy instructions
  - Multiple formats (written, video - consistency!)
  - Anticipate methods for *changing* procedures
- Provide hardware, with pre-installed software
  - Beware multiple installations (e.g. Python)
  - Software updates
- “Office Hours” for live troubleshooting – Discord, etc.
- Consider other human needs!
  - Comfort, shade, food, designated outreach person
  - Practice sessions and small, silly competitions

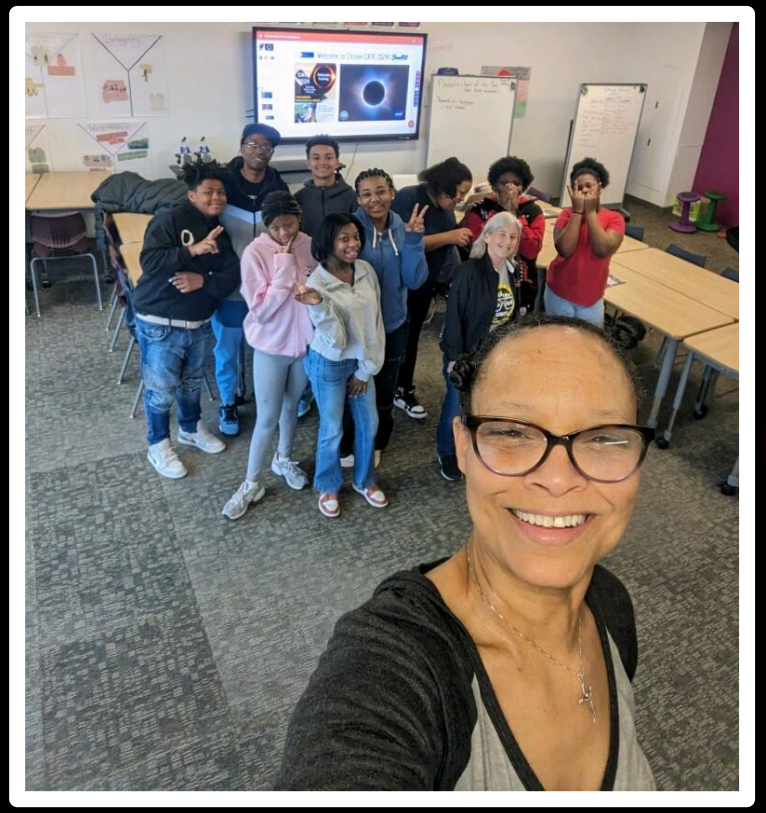


https://debinitiative.org/

PRACTICE, PRACTICE, PRACTICE!

One City Schools student training
with Devalyn Rogers (OCS) and Peggy Hill (SEMO)



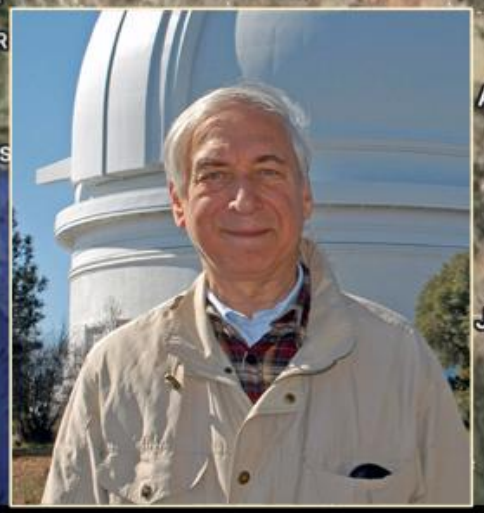


Distribution of Jay M. Pasachoff Solar Eclipse Mini-Grant Awards

Included Participatory Science projects
Seeking more unique cross-Agency collaboration opportunities

Marked are locations of the mini-grant recipients.

Path of Totality



Jay M. Pasachoff (1943–2022)

- Charter member, AAS Solar Eclipse Task Force
- Professor at Williams College (MA) for 50 years
- Veteran of 36 total solar eclipses
- Expert on coronal heating and dynamics
- Prolific author of popular books and articles

WHAT WE HOPE YOU TAKE AWAY

- Citizen science is a strategic underpinning of the Heliophysics Big Year because it **advances the science**
- HBY is an opportunity to develop practices, principles, and approaches that can **improve the equitable design of the public's experience** with NASA
- We need to amplify citizen science as a **human-centered and prototype-driven way** to involve scientists and the public to improve and sustain engagement in NASA Heliophysics

HELIOPHYSICS BIG YEAR

http://go.nasa.gov/HelioBigYear/