



UNISTELLAR



Unistellar: The Largest Network of Backyard Astronomers

Franck Marchis

SETI Institute/Unistellar; fmarchis@seti.org

Tom Esposito^{1,2,3}, Ryan Lambert¹, Paul Dalba^{1,4}, Joé Asencio², Guillaume
Blaclard², Dan Peluso^{1,2}, Laurene Sgro¹, Ariel Graykowski¹
>900 Unistellar citizen scientists

¹SETI Institute; ² Unistellar; ³ UC Berkeley, ⁴ UCSC, ⁵ USQ, ⁶ AMTA

Useful
for Science



Cool
Consumer
Product

Educative
Device



UNISTELLAR's Enhanced Vision Telescope

"eVscope" Specs

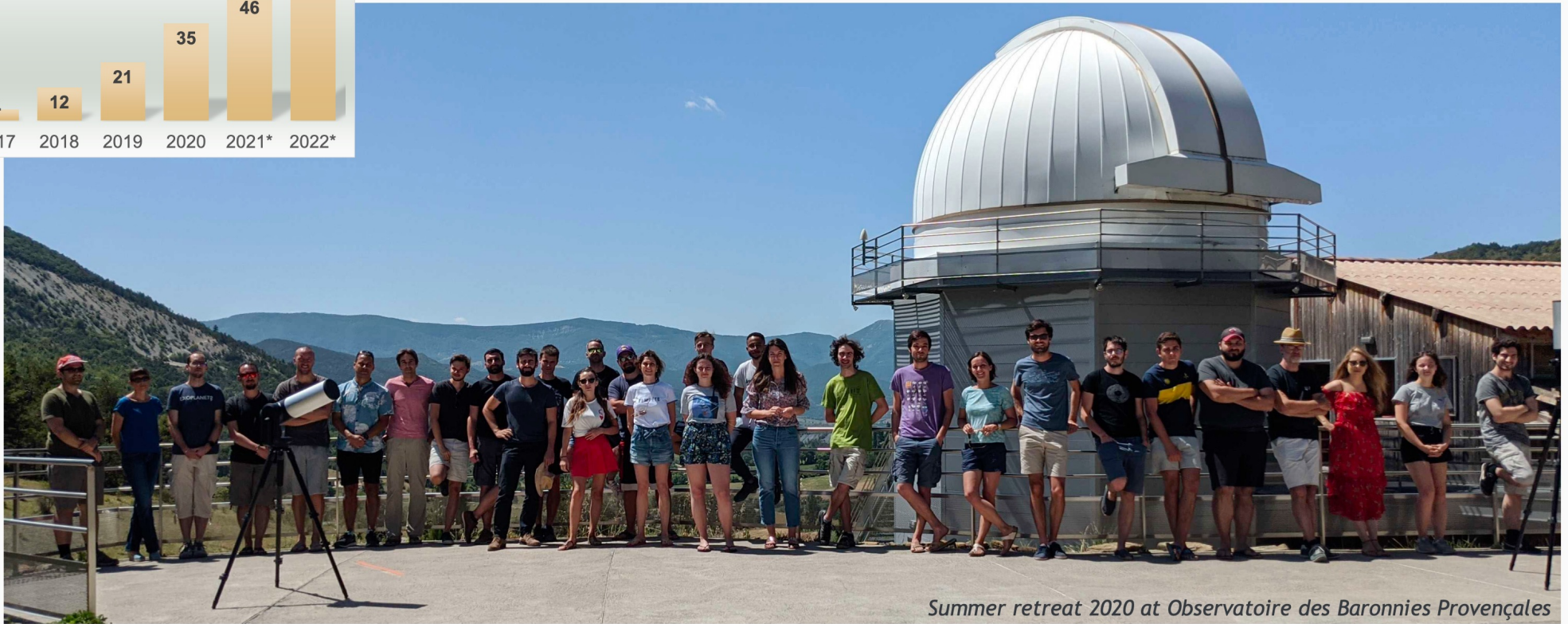
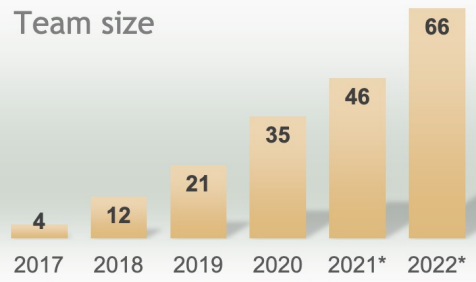
- **4.5 inch aperture**
- **CMOS RGB sensor (Sony IMX224), 400-900 nm**
- **37' x 28' FOV; 1.7 "/pixel**
- **Alt-Az mount**
- **Controlled from smartphone or tablet app**
- **Autonomous field detection**
- **Portable (10 hr battery, 15.4 lbs incl. tripod)**
- **On-board computer & GPS**

Images uploaded to Unistellar cloud storage via WiFi

SETI cloud pipeline processes data into light curves and fits models in 10 min – 2 hr per data set



Team size



Summer retreat 2020 at Observatoire des Baronnies Provençales

Unistellar-SETI

Astronomers in our San Francisco Office

Dr. Tom Esposito

*Space Principal
Transit researcher
March 2021*



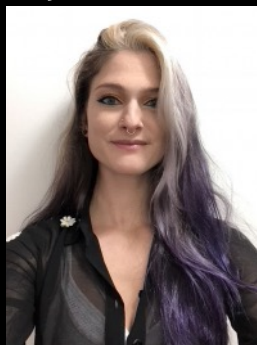
Dr. Ryan Lambert

*Planetary Defense researcher
March 2022*



Dr. Lauren Sgro

*Citizen Science researcher
May 2022*



Dr. Paul Dalba

*Occultation researcher
March 2022*



Dr. Ariel Graylowski

*Comet Lead Researcher
June 2022*



New SETI/Unistellar Office



THE ENHANCED VISION



THE ENHANCED VISION



Outreach – More than a telescope...

Weekly Challenges

APR 19
DEEP-SKY DISCOVERIES BY WOMEN
#UnistellarChallenge

APR 26
GEMINI CONSTELLATION
#UnistellarChallenge

APR 12
A COSMIC VALENTINE'S DAY TOUR
#UnistellarChallenge

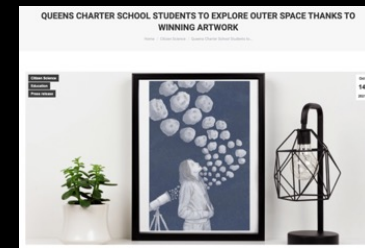
challenge of the Week: A Cosmic Valentine's Day Tour
By: 19 February 12, 2021
Unistellar Citizen Astronomers are invited to participate in this week's quest to observe celestial objects in the Gemini constellation! Quick facts about the Gemini constellation: In Latin, Gemini literally means "twins." In Greek and Roman mythology, Zeus placed the twin brothers Castor and Pollux in the sky the twins after their clash with Atlas.

Cultural & Entertainment events

Unistellar Panel
**By All, For All :
Citizen Science to reveal Cosmos**
SXSW

Unistellar at SXSW 2021: Watch the "By All, for All: Citizen Science to Reveal Cosmos" panel
Citizen Science - By: 20 March 2021

Partnerships with Science groups



Social Media videos

Transit 101: Become an Exoplanet Hunter with your eVscope
YouTube - Unistellar 5 days ago

Launch of Lucy, NASA's First Mission to the Trojan Asteroids
YouTube - Unistellar 1 week ago

SETI Live: Getting Ready for Lucy's Launch!
YouTube - Unistellar 1 week ago

Aster terminal
Workshop
Stargazing night with the world's most powerful telescope



WORLDWIDE COMMUNITY

A world map with a dark blue background. Numerous yellow star-shaped markers are scattered across the map, representing the locations of eVscope users. The markers are most densely clustered in North America (USA and Canada) and Europe. Other significant clusters are visible in East Asia (China and South Korea), Australia, and New Zealand. The map also shows the outlines of major countries and oceans, with some labels like 'North Atlantic Ocean', 'South Atlantic Ocean', and 'Indian Ocean'.

~7,000 eVscope users around the world
>500 joined science campaigns
and in Slack workspace

Who Are Our Citizen Astronomers (so far)

Amateur Astronomers



Schools



Urban Families

VIP



Techies



Scientists



Outdoor Lovers

SCIENTIFIC PARTNERSHIPS



MOU

?ETI
INSTITUTE

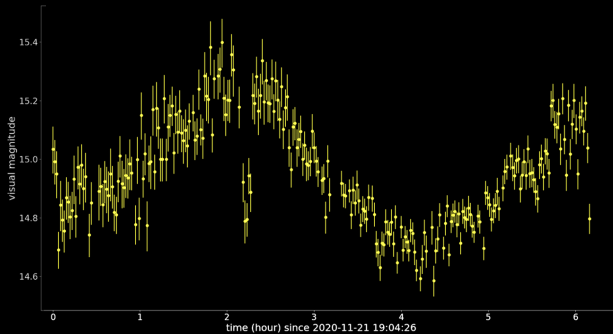


Charles University

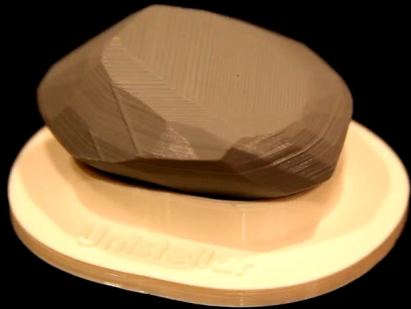
Three main scientific campaigns for citizen scientists

Planetary Defense

Orbits & Shapes of Near-Earth Asteroids

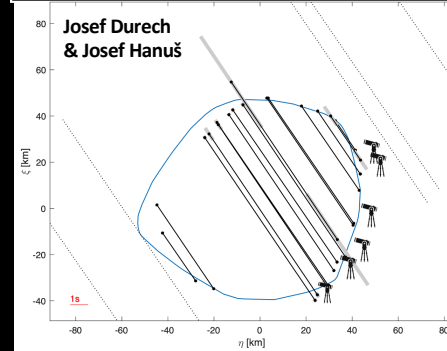
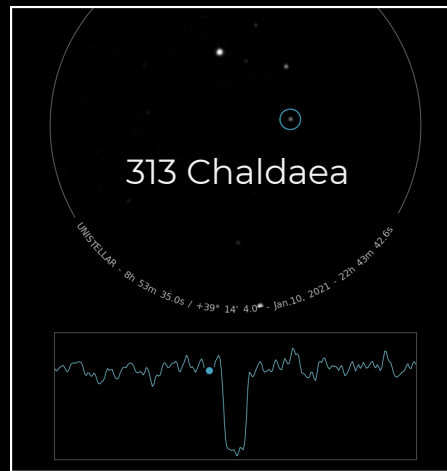


Asteroid 159402 1999AP10



Asteroid Occultations

Shapes of Asteroids



Exoplanet Transits

Planet Timing & Confirmation

April 6, 2021 - Christchurch, NZ

TESS candidate
TOI 1019.01

Actual
eVscope
light curve!

Star: TIC 341420329 ; Planet: TOI 1019.01; Rp/R*: 0.142; Star Temp (K): 7550
Transit duration (h): 4.7; Max transit depth (%): 2.4
Observation: 06 April 2021; Christchurch, New Zealand; Observer: Dr John W Pickering

Created by citizen scientist
John W. Pickering

ASTEROID OCCULTATIONS

Summary in Numbers

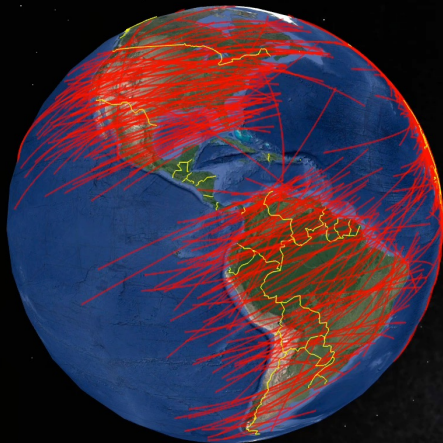
PREDICTIONS

- 10 worldwide areas
- 6 events per week

Choose your continent to find out if an occultation will happen near your location!

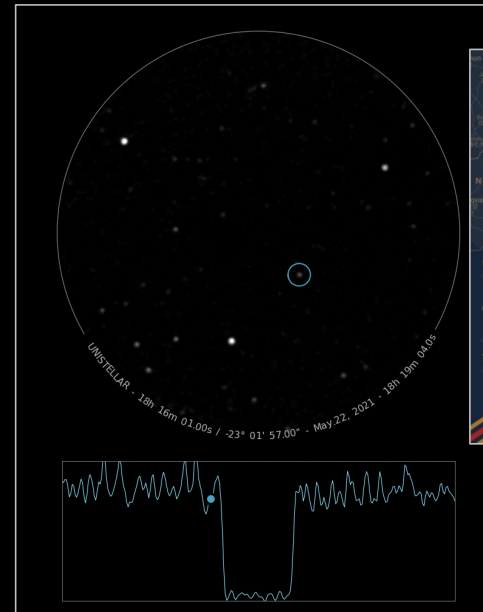
Select your location

- ✓ Choose your location
- Western Europe
- Eastern Europe
- North America
- South America
- Africa
- Middle East
- East Asia
- South Asia
- Japan
- Oceania



RESULTS from 2020-01 to 2021-10

353 asteroid occultations
167 citizen astronomers
+70 positive detections



Shadow path of 3925 (Tret'yakov)
on 2021-07-21



ASTEROID OCCULTATIONS

Shadow hunters: a Space-focused adventure!

Goals:

- Shapes & Sizes of Trojan & Main-belt Asteroids
- Find Moons & Rings around Asteroids

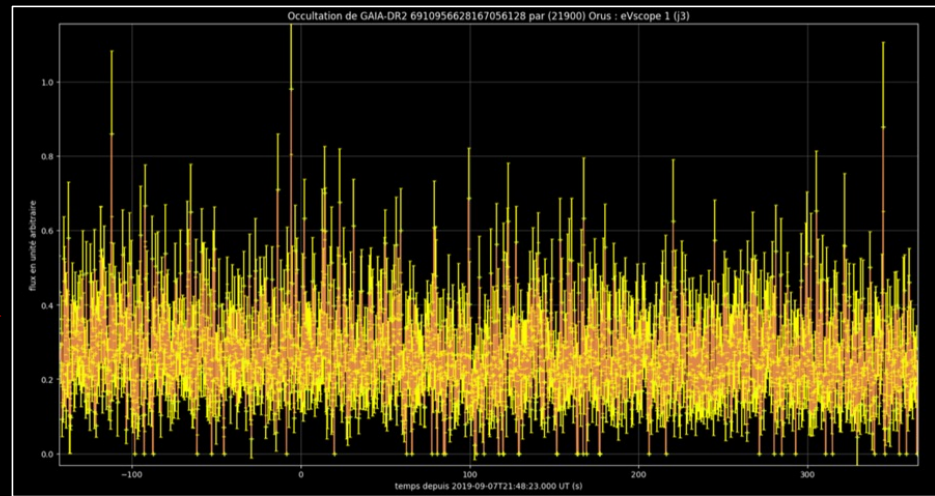
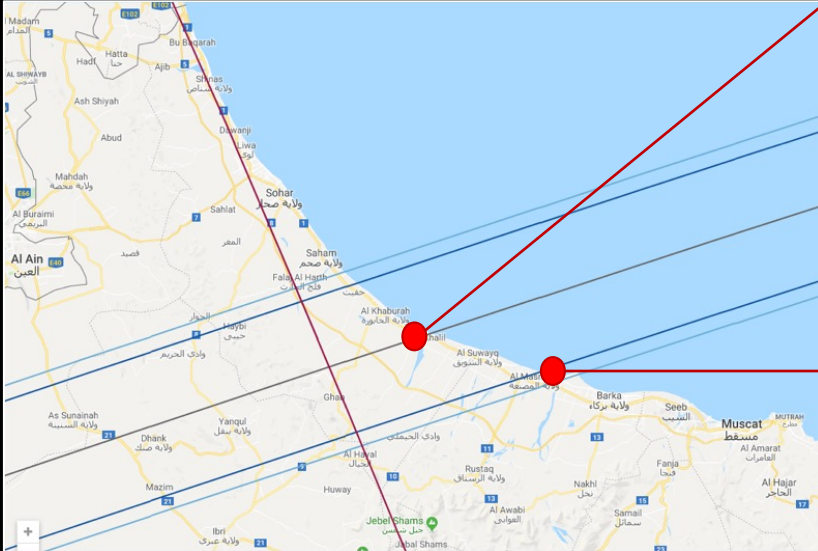


ASTEROID OCCULTATIONS

Shape of Asteroids



Prediction path by M. Buie (SWRI)



Europa Occultation

A few days ago in Namibia

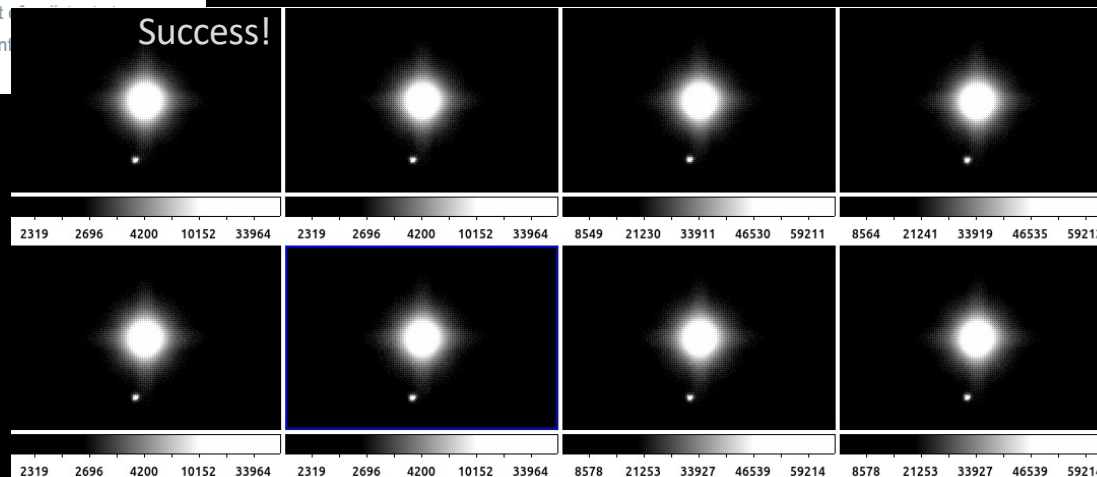
SCIENCE & EXPLORATION

Jupiter's moon Europa to obscure distant star

07/06/2022 3913 VIEWS 105 LIKES

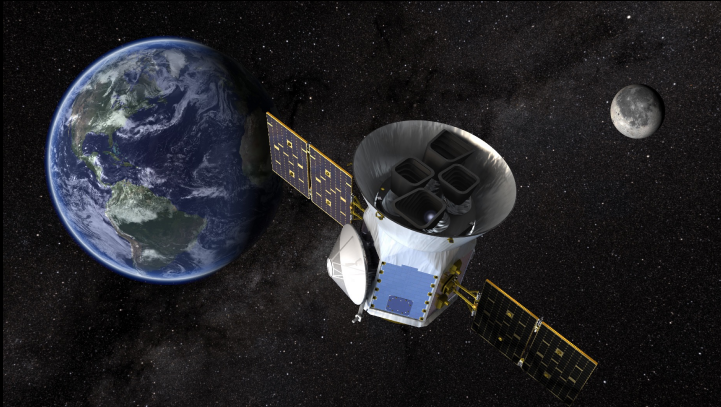
ESA / Science & Exploration / Space Science / Gaia

On 19 June 2022, Jupiter's intriguing moon Europa will pass in front of a star, making that star appear to disappear for at least a minute. This event can be seen with any size of telescope from certain parts of Africa.



EXOPLANET TRANSITS

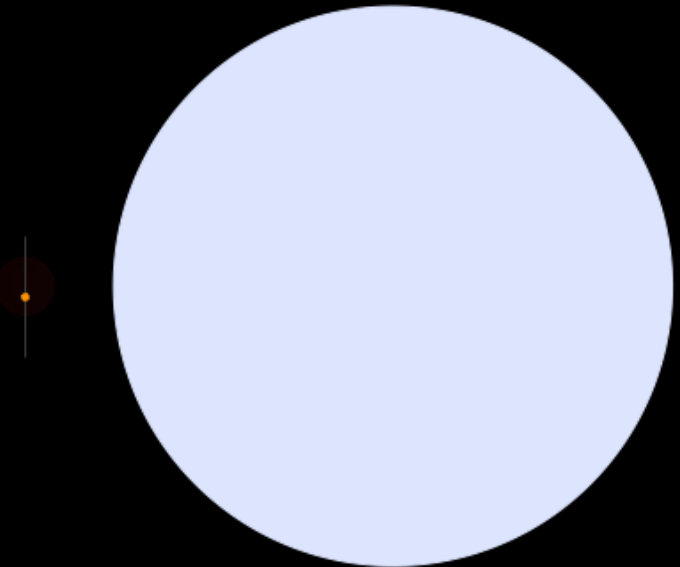
Planet Timing & Confirmation



Goals: Help NASA TESS!

- Refine transit timing of Jupiter-sized planets for future follow-up
- Help NASA/ESA to confirm newly discovered exoplanet candidates (TESS)
- Transit timing variations & close environment (moons/rings)

Credit: John Pickering (citizen scientist)



Star: TIC 341420329 ; Planet: TOI 1019.01; Rp/R*: 0.142; Star Temp (K): 7550
Transit duration (h): 4.7; Max transit depth (%): 2.4
Observation: 06 April 2021; Christchurch, New Zealand; Observer: Dr John W Pickering

EXOPLANET TRANSITS

Timing & Confirmation

Unistellar Network Exoplanet Results since April 2020

388 Transit Observations

107 Transit Detections

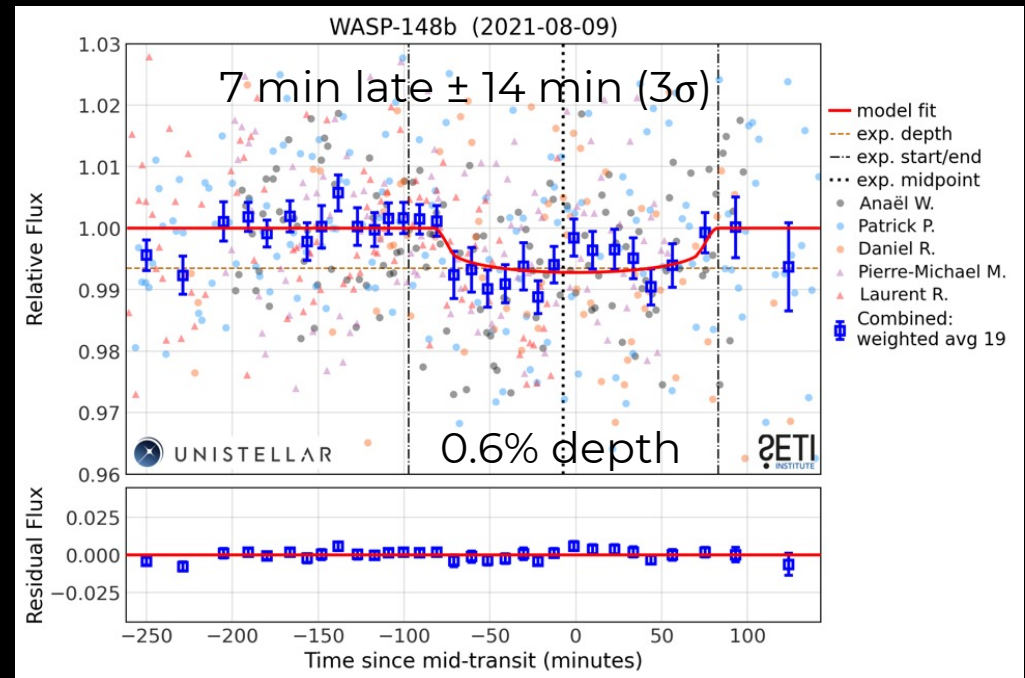
93 Different Citizen Scientists

21 Light curves in public AAVSO Exoplanet Database (obs code UNIS)

18 Countries

as of Today

WASP-148b TTV search with AFA (France)



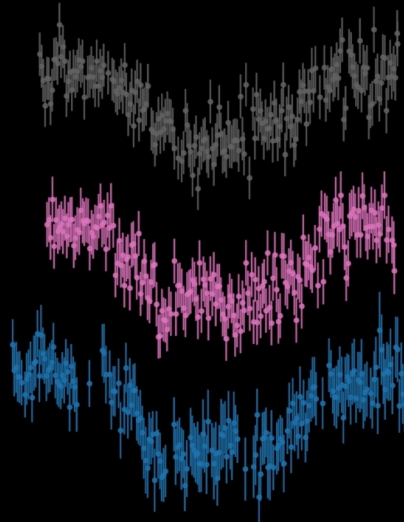
EXOPLANET TRANSITS

Timing & Confirmation

Combining simultaneous observations from multiple eVsopes leads to:

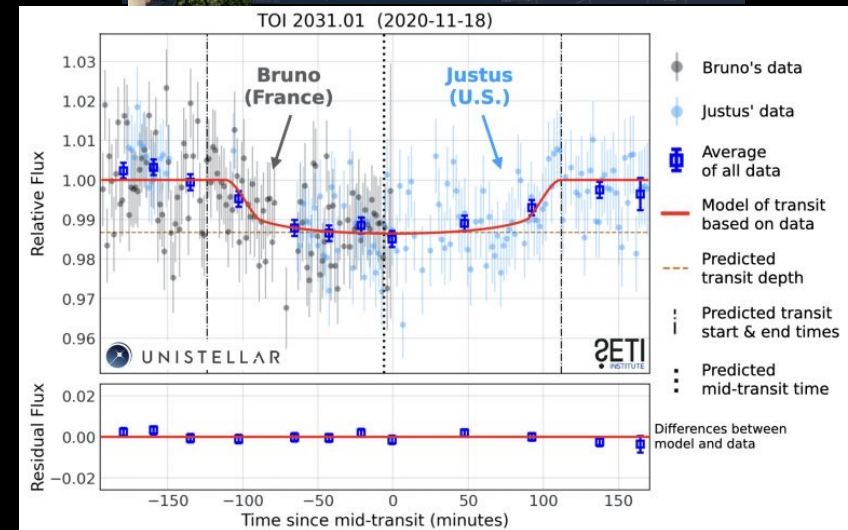
- $\sim N^{1/2}$ improvement in mid-transit time precision
- longer duration detections

Results:
HD 189733b



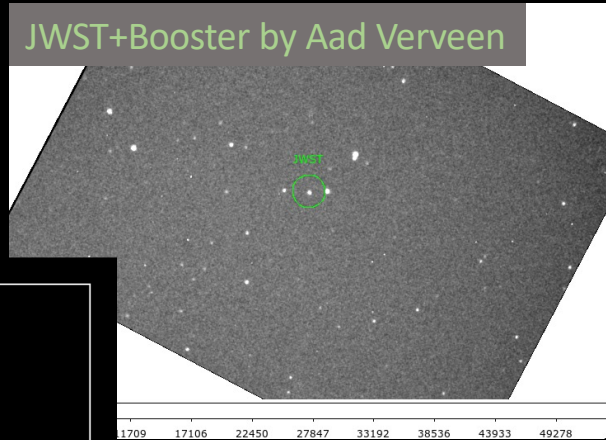
Mid-transit time from joint fit to 3 eVscope observations:
 -1.71 ± 0.68 min (relative to predicted)

Intercontinental Observation

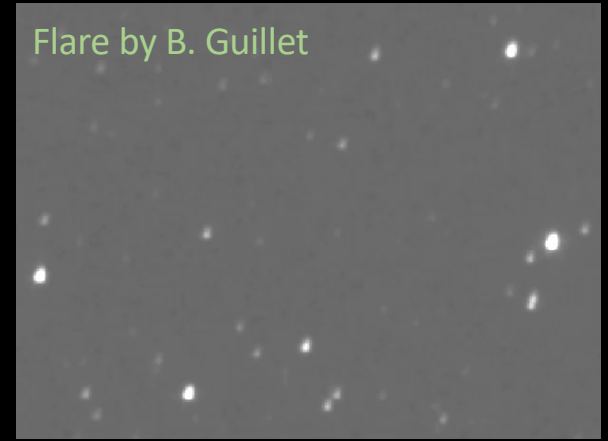


HUMAN MADE OBJECTS: JWST

JWST+Booster by Aad Verveen



Flare by B. Guillet



RESULTS



50

UNISTELLAR
NETWORK
OBSERVERS

139 JWST
OBSERVATIONS

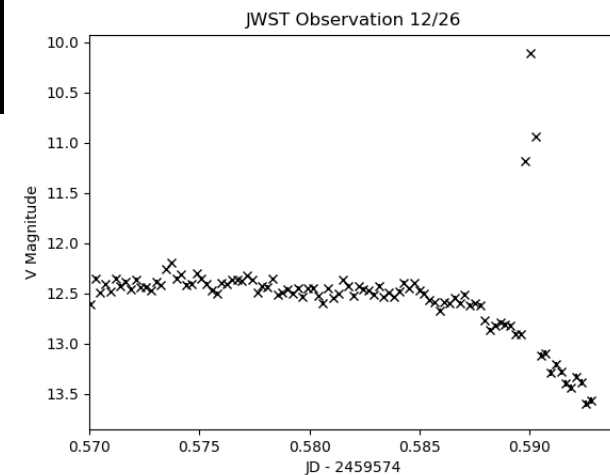
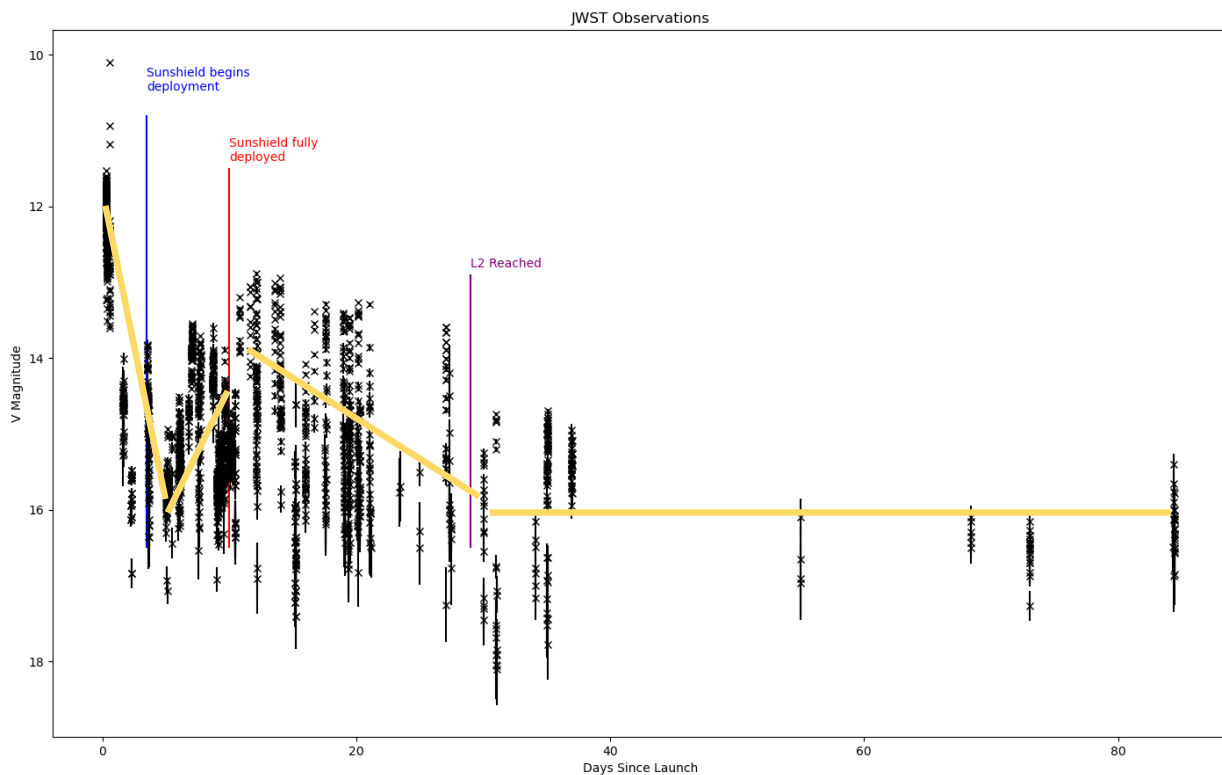
12/25 TO 02/11
47 NIGHTS



UNISTELLAR



Overview lightcurve (still a lot are missing)

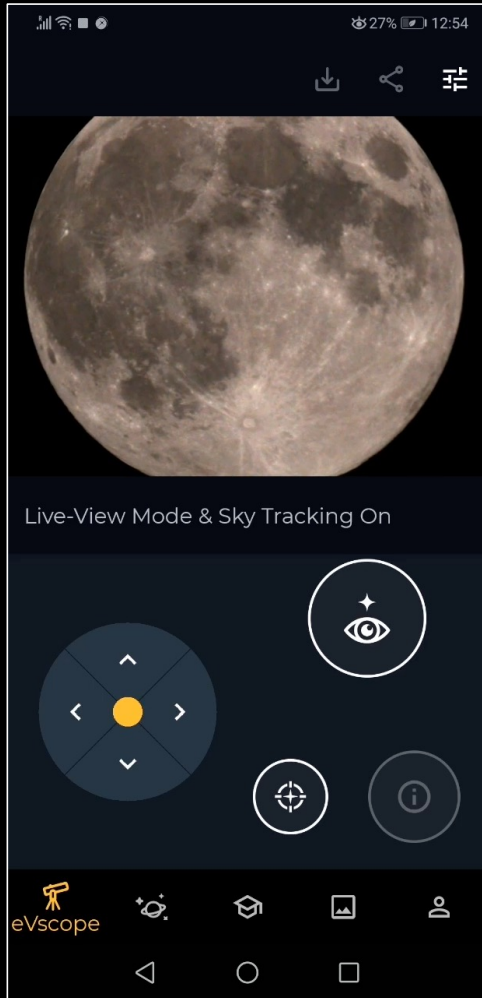


- Almost a continuous observations of JWST on its way to L2
- Booster seen on Dec 25th
- Flare after MCCM on Dec 26
- After deployment
 - 2.5 amplitude lightcurve
 - Detected even at the L2 (now a challenge)

More detail at SPIE Montreal

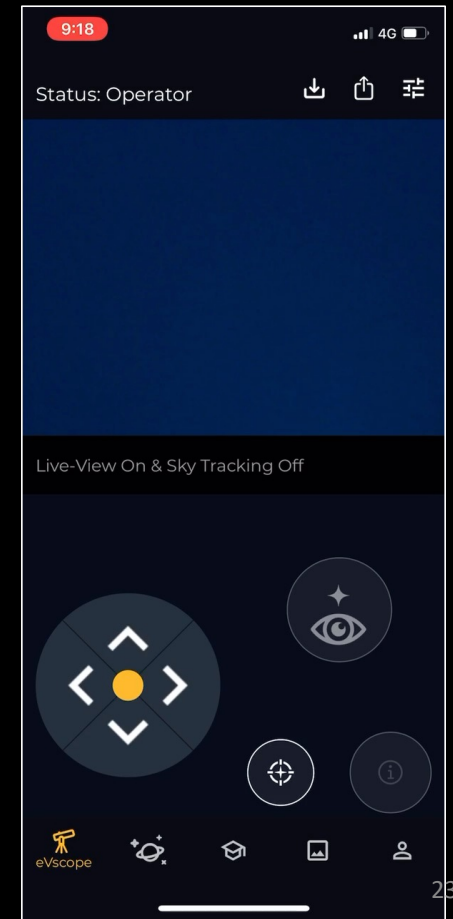
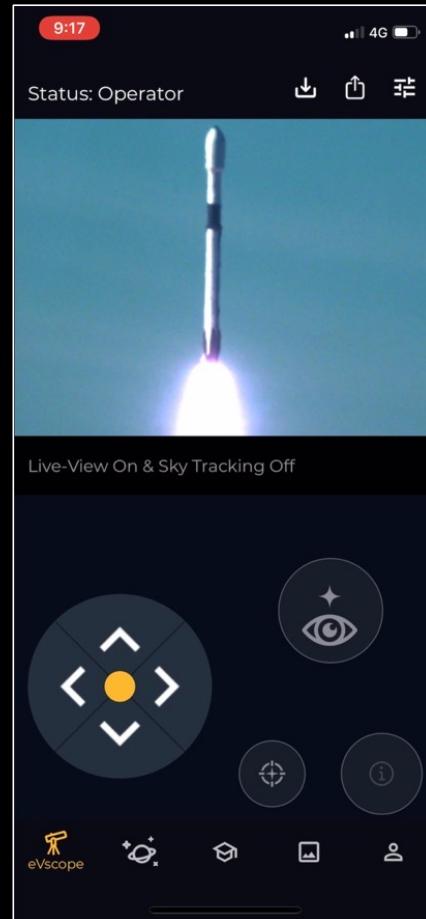
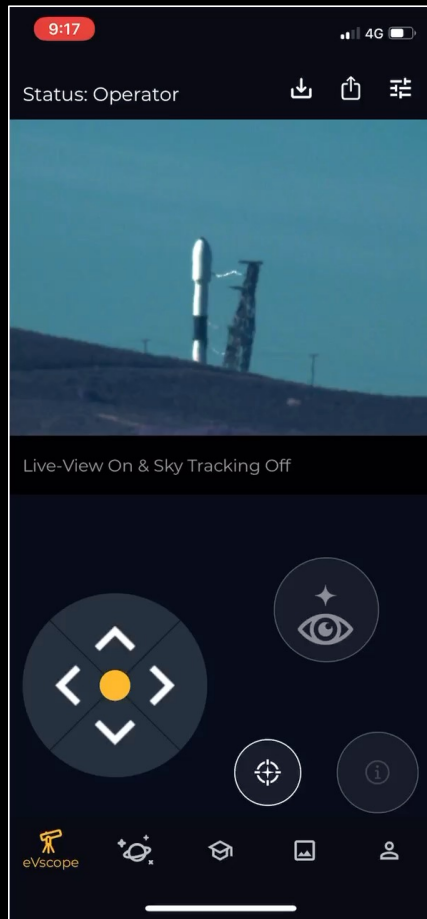
HUMAN MADE OBJECT: ISS

Monitoring of brightness and Orbits



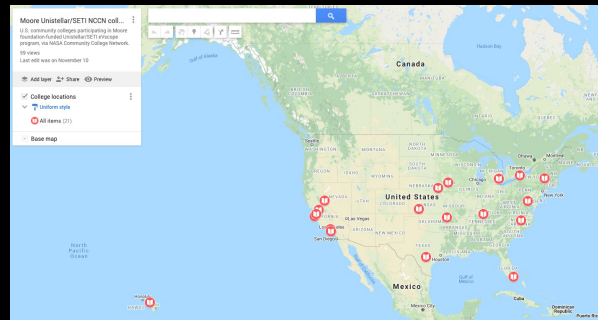
SPACE ROCKET LAUNCH

Falcon 9 launch on Vandenberg Space Launch Complex 4, on November 21 2020, captured 3 miles away



The Future

- **More Education**
 - Chabot, Community Colleges, ...
- **More science campaigns**
 - comet searches, supernova photometry, satellite constellation tracking
- **Easier Science**
- **More translations** (Spanish, Arabic, Portuguese,..)
- **More Partnerships** with Space Agencies and private industries
- **Follow us & Join us!**

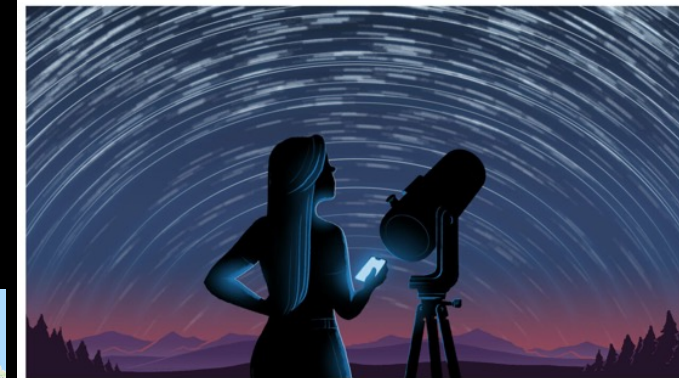


Danielle Futselaar

In year of isolation, this \$3,000 telescope may have changed citizen astronomy forever

Unistellar's smart eScope has made exploring the stars easier than ever before.

By [Bryan Back](#) on June 18, 2021



With the right equipment and enough curiosity, amateur astronomy makes for a safe and stellar pandemic hobby. Credit: Bob Al Green / Stockbyte

