News from the Universe:
NASA Telescope Reveals Largest Batch of Earth-Size, Habitable-Zone Planets Around Single Star

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Dr. Nikole Lewis (STScI)
Dr. Robert Hurt (IPAC)
Carolyn Slivinski (STScI)

Facilitator:
Dr. Brandon Lawton (STScI)
Reach

- Potential reach of all social media posts talking about the announcement is over 2.5 billion non-unique users (includes duplicates who may see multiple posts from different sources)
- 99.94% of all 254,038 social media mentions of the announcement came from non-NASA sources
- Press-Conference
  - NASA.gov: 1,031,000 total visitors to TV & Live pages
  - UStream: 318,000 total viewers
  - Facebook Live: 3,360,951 total viewers
- REDDIT AMA:
  - Over 2,800 questions in 90 minutes
  - #10 top Reddit AMA’s of all time on the site
  - Most popular NASA Reddit AMA ever
Additional Resources

**NASA Wavelength List:**
http://nasawavelength.org/list/1668

1. NASA Press-conference: TRAPPIST-1A
2. NASA Website: Exoplanet Exploration – TRAPPIST-1A
3. NASA Website: Spitzer Space Telescope - TRAPPIST-1
4. TRAPPIST-1 FAQ for Informal Audiences
5. Reddit Ask-Me-Anything: TRAPPIST-1A
6. Website: TRAPPIST-1A official website
7. Activity: NASA’s Eyes on Exoplanets
8. Activity: Scale Models
   - Sun and Earth
   - TRAPPIST-1A system
9. Activity: Universe Discovery Guides – April, “Discovering Planet Families”
10. Activity: DIY Planet Search
11. Kids News: 20 Years of Exoplanets
TRAPPIST-1 Science Results

Dr. Sean Carey
Manager, Spitzer Science Center

Dr. Nikole Lewis
Assistant Astronomer, STScI
The *Spitzer* Space Telescope:
Launched in 2003
Studying Exoplanets since 2005

Infrared Telescope (3.6 – 160 microns)
Spitzer’s unique orbit is good for studying exoplanets.
Spitzer’s Discovery of 7 Earth-sized Worlds

Gillon et al. (2017)
Planets in the “Habitable” Zone
TRAPPIST-1 in context

Credit: NASA/JPL-Caltech/R. Hurt, T. Pyle (IPAC)
Measuring Masses using Transit Timing Variations

Gillon et al. (2017)
The ‘Earth-like’ Nature of the TRAPPIST-1 Planets

Gillon et al. (2017)
Studying the atmospheres of the TRAPPIST-1 Planets
Transit Spectroscopy with the Hubble Space Telescope

de Wit et al. (2016)
The James Webb Space Telescope (JWST)
Visualizing the Worlds Of TRAPPIST-1

Dr. Robert Hurt
Visualization Scientist, Caltech/IPAC

Illustration credit: NASA/JPL-Caltech/R. Hurt, T. Pyle (IPAC)
The plot underlying the whole result

Gillon et al. (2017)
Figure 1 | The TRAPPIST-1 system as seen by Spitzer. a and b. Spitzer photometric measurements (dark points) resulting from the nearly-continuous observation of the star from 19 September to 10 October 2016. The ground-based measurements (binned per 5 min for clarity) gathered during the Spitzer gaps are shown as light grey points. The position of the transits of the planets are shown as coloured diamonds. c. Period-folded photometric measurements obtained by Spitzer near transits of planets TRAPPIST-1b-h corrected for the measured TTVs. Coloured dots show the unbinned measurements, whereas the open circle depict binned measurements for visual clarity. The best-fit transit models are shown as coloured lines. 16-11-5-2-3-2-1 transits were observed by Spitzer and combined to produce...
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<th>Planet Mass (M_earth)</th>
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### Trappist 1 System Properties

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### Solar System Properties

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### Trappist-1 Star Properties

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<th>Distance (ly)</th>
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**Closest approach between planet X and neighbors (in thousandths of AU and Earth-moon distance)**

**Angular size of neighboring planets at closest approach relative to size of Moon in Earth sky**

**Relative strength of tides induced by neighboring planets scaled by (R1^2 * M2) / r^3**
PLANET HOP FROM TRAPPIST-1e

VOTED BEST "HAB ZONE" VACATION WITHIN 15 PARSECS OF EARTH
Video fly-arounds of each planet at:

http://www.spitzer.caltech.edu/video-audio/1642
https://www.youtube.com/watch?v=f37W81C38lw
Animated, annotated version available at:
http://www.spitzer.caltech.edu/video-audio/1639
https://www.youtube.com/watch?v=oQtsuA8ZPfY
Trappist-1 Planet Color Scheme

Colorblind Equivalents
On the Spitzer site we have released:

- Images
- Videos (b-roll and annotated/narrated)
- Planet surface maps and starfield backdrop image

http://www.spitzer.caltech.edu/trappist-1

On the JPL site you can also find:

- Exoplanet Travel Poster
- VR tour of TRAPPIST-1d surface
- Additional videos

https://exoplanets.nasa.gov/trappist1/

On the ESO site you can also find:

- Even more videos and graphics

http://www.eso.org/public/news/eso1706
Strategies for Engaging Audiences

Carolyn Slivinski
STScI
Overview

- Engage your visitors in conversation
- Hands-on activities – STEAM, STEM
- Related exhibits or activities
- Relevance
Engage in Conversation

- Invite a guest speaker to talk to visitors
  - On site (look to local universities if you have no scientists on staff; local astronomy clubs)
  - Online (Skype, etc.)

- Have a floor educator engage in conversation with visitors

- Post official News Release in your facility – “Breaking News!”

- Post local press (online or newspaper articles)
Hands-On Activities...
STEAM Activities

- Can be based on scientific data, or

- Can be left completely to the imagination!
STEAM Activities

- Invite public to **draw** their own exoplanets
  - Share with other visitors by displaying on a monitor, Science on a Sphere, corkboard, clothesline, etc.
  - Submit drawings online to NASA’s Transiting Exoplanet Survey Satellite mission to fly on TESS (deadline Nov. 20, 2017 – space permitting)
  - Create “Travel posters” to convey what it would be like on the surface of your exoplanet (see Kepler posters)

From TESS coloring book
STEAM Activities

- Invite public to **create** their own exoplanets
  - Clay, recycling materials, papier-mâché, cardboard cutouts...
  - Use crayons, chalk, stickers, glitter (if you dare!), magazine collages...
  - Mixed Media: 2D representation of an exoplanet system, with 3D models of star, planets, etc.
  - Share with other visitors by displaying on shelf (3D models), Science on a Sphere, other monitor, corkboard, clothesline (2D models), etc.

- Invite public to **write about** their own exoplanets
  - Share with other visitors by displaying on magnet board, corkboard, display clothesline, etc.
STEM Activities

- Eyes on Exoplanets - [http://eyes.jpl.nasa.gov/eyes-on-exoplanets.html](http://eyes.jpl.nasa.gov/eyes-on-exoplanets.html)
  - on kiosks
  - on laptops
  - on tablets
STEM Activities

TRAPPIST-1 SYSTEM,
FEB. 21, 2017
STEM Activities

TRAPPIST-1 SYSTEM,
FEB. 22, 2017
STEM Activities

- Size + Scale activities...
  - Our Solar System, and
  - the TRAPPIST system
  - By themselves...
  - and compared to each other!

STEM Activities

- Size + Scale activities...

STEM Activities

- Size + Scale activities...

Set up in larger spaces

Mercury

Set up in smaller spaces
Related exhibits

- ViewSpace (if you have it):
  play new TRAPPIST-1 show
- Any space-themed exhibit or display

Relevance

- Current events: Relate to coming total solar eclipse Aug. 21, 2017 (the Moon transits our Sun)
- Understand the science that has come from studying eclipses and transits

Credit: NASA/SDO
Questions?
If you have activity ideas you’d like to share with this community, please send them to Jeff Nee at the Museum Alliance:

Jeffrey.Nee@jpl.nasa.gov;
we can post some of them at a later date!
To ensure we meet the needs of the education community (you!), NASA’s UoL is committed to performing regular evaluations, to determine the effectiveness of Professional Learning opportunities like the Science Briefings.

If you prefer not to participate in the evaluation process, you can opt out by contacting Kay Ferrari <kay.a.ferrari@jpl.nasa.gov>.

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