THE UNIVERSITY OF ARIZONA

Education & Public Outreach
March 2025, Part 2b

PLANETARY SCIENCE INSTITUTE EST. 1972

VATICAN OBSERVATORY

Some Pictures:

I continue to be busy with Family Science Nights, as well as a teacher workshop. I co-presented, with Sanlyn Buxner, at a workshop on March 29 for elementary teachers, mostly pre-K to 5. This is a program in collaboration with the Pima County School Superintendent's Office. Here are some pictures.

Constellation Transformation

Constellation Transformation

Star Wheel/Planispheres

Neverending Bearhunt

Constellation Viewers

Constellation Classification

Astronomy in the News

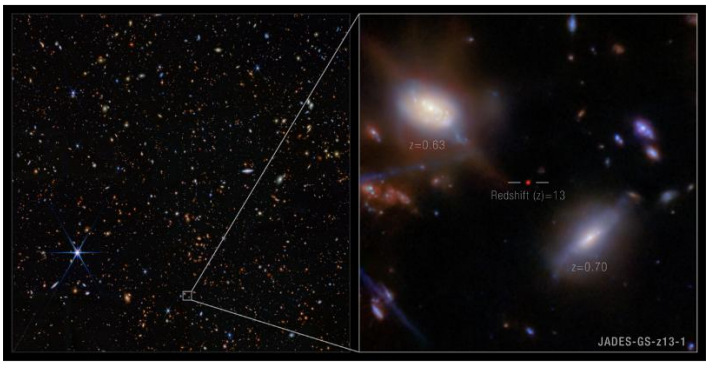
2024 YR4 Update:

The chances of 2024 YR4 hitting the Earth are now down to less than 1 in 100,000 (0.001%). This is down from a maximum of over 3%. However, it still has about a 2% chance of hitting the Moon in 2032 (nominal distancer of 4,000 km from the surface of the Moon). Ground based telescopes have taken spectra and have determined that the asteroid is similar to S-type asteroids (stoney) and JWST has determined a reflectance of about 20% with an estimated diameter of about 60 meters (200 feet) this is about the size of the asteroid that created Meteor Crater (which was much more massive asteroid as it was an iron asteroid) or was responsible for the Tunguska Event in Russian in 1908. The link below is to an animation of the orbital uncertainty of the position of 2024 YR4 as more and more observations were made. As I have said before almost all of the uncertainty of the location of the asteroid in it orbit.

https://neo.ssa.esa.int/-/latest-news

JWST, Early Galaxy:

Astronomers using the Webb telescope have confirmed the distance JADES-GS-z13-0, a galaxy they are seeing 330 million years after the Big Bang. This is almost as early as another galaxy that was reported a few months ago, JADES-GS-z14-0 (seen 300 million years after the Big Bang). The older research emphasized the age of JADES-GS-z14-0, while the observations of JADES-GS-z13-0 emphasize the galaxy in the context of the early Universe and when such galaxies should first be seen during what is called the Era of Reionization following the Dark Ages, when the Universe became transparent to ultraviolet light. In other words, the hydrogen emission from these galaxies was not expected to be seen prior to about a billion years after the Big Bang.



"The incredibly distant galaxy JADES-GS-z13-1, observed just 330 million years after the big bang, was initially discovered with deep imaging from NASA's James Webb Space Telescope's NIRCam (Near-Infrared Camera). Now, an international team of astronomers definitively has identified powerful hydrogen emission from this galaxy at an unexpectedly early period in the universe's history. JADES-GS-z-13 has a redshift (z) of 13, which is an indication of its age and distance."

https://webbtelescope.org/contents/news-releases/2025/news-2025-116.html

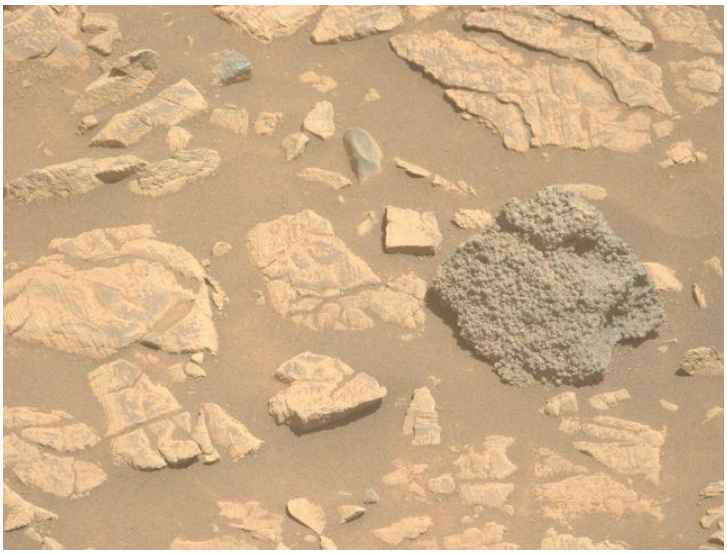
https://www.sciencealert.com/galaxy-caught-turning-on-lights-at-cosmic-dawn-stunning-astronomers

Another Strange Mars Rock:

In the last Newsletter, we reported on an unusual rock that was found by the Mars Rover Curiosity (after the Rover ran over it and cracked it open). Now, it appears that Mars Rover Perseverance has also found an unusual rock. It is the only one of its kind that has been seen and, because it is sitting on the surface, it is like to have come from some other location. It either rolled there from a nearby hill or is ejecta from an unknown impact crater. The rock (seen on the right) is made up of hundreds of dark, round spheres stuck together. No rock like this has ever been seen on Mars.

https://www.sciencealert.com/extremely-weird-rock-found-on-mars-looks-like-nothing-else-around-it

https://www.livescience.com/space/mars/nasa-rover-spots-hundreds-of-spider-eggs-on-mars-and-scientists-have-no-idea-how-they-got-there



"There were no other rocks like St. Pauls Bay in the surrounding area. (NASA/JPL-Caltech/ASU)"

Exoplanet Update:

As of April 1, 2025 (last update), there are 7,442 confirmed extra-solar planets (26 since February 26, my last update) orbiting 5,104 stars (16 more), with 1,038 star systems (3 more) having more than one exoplanet orbiting them. In addition, there are 2,377 candidate (unconfirmed) exoplanets (2 more) orbiting 2,080 stars (6 more), with 139 stars (1 less) having more than one exoplanet orbiting them. Most of these candidate exoplanets are likely to be real but need to be confirmed by more detailed ground-based observations or other techniques. There are 724 star systems with exoplanets orbiting one of the stars and there are 31 star systems with 39 exoplanets orbiting both stars in the binary system. Three star systems have three exoplanets orbiting both stars.

Barnard's Star:

Since its discovery by Edward Barnard over 100 years ago, astronomers have been trying to detect exoplanets orbiting it (several false "discoveries" have been made and disproved). The star is a red dwarf that is 0.2 times the diameter of the Sun and about 0.16 times the mass of the Sun. At a distance of 5.98 light-years, it is the fourth-closest star to us after the three stars in the Alpha Centauri system. It has the highest proper motion (apparent motion relative to the Sun) of 10.3 arcseconds, meaning that moves the diameter of the Moon in 180 years relative to distant stars. Finally, late last year an exoplanet was discovered and confirmed and more recently, three more have been detected, bringing the total to four exoplanets. They are all smaller than the Earth, 0.2 to 0.35 times the mass of the Earth, and orbit from about 0.019 to 0.038 AU (1/10 the distance of Mercury from the Sun) from the star with orbital periods from 2.34 to 6.74 days. They are too close to be in the habitable zone. The detections were made using the radial velocity method, so the masses are minimum masses, but are likely to be close to these numbers. The second article has some nice graphics as well as a nice animation of the radial velocity method to exoplanet detection.

https://earthsky.org/space/mini-earth-exoplanets-barnards-star-red-dwarfs

https://www.sciencealert.com/4-rocky-worlds-found-orbiting-earths-closest-single-star-and-theyre-tiny

Speedy Exoplanet?:

In 2011, astronomers discovered two co-orbiting objects using the microlensing method as the two objects crossed in front of a more distant star. From this detection, the astronomers came up with two possible models, a closer free-floating exoplanet and an orbiting moon, or a more distant dwarf star orbited by a super-Neptune exoplanet. The observations favored the more distant star, orbiting close to the center of our galaxy at an estimated distance of 24,000 light-years from us. Based on these observations the research paper discussed in the link below discusses the discovery of a pair of objects in about the right location to support the distant star and exoplanet model. If so, the star is moving at a speed in excess of 1.9 million kilometers per hour (1.2 million miles per hour). However, more observations are needed to confirm this result.

https://earthsky.org/space/speediest-exoplanet-system-red-dwarf-super-neptune-milky-way/

Stars and Galaxies:

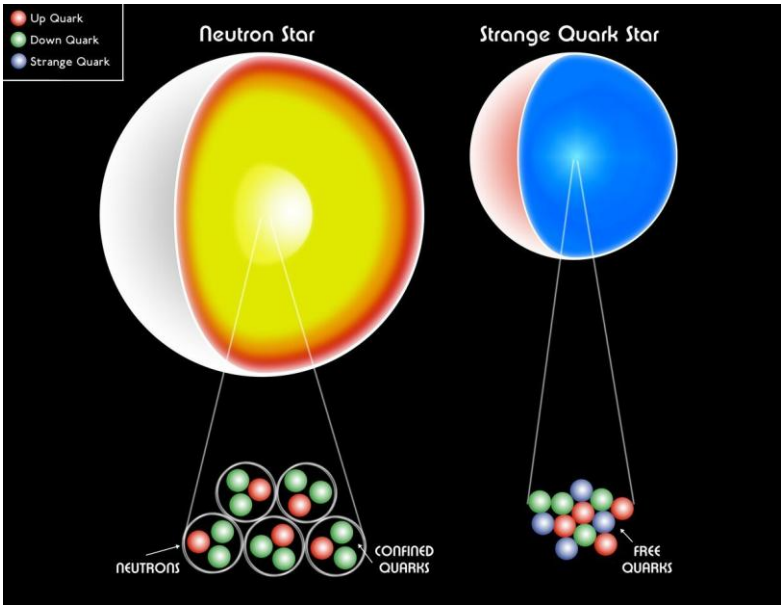
Alpha Centauri in Our Neighborhood:

The research paper referenced in the two online articles below have modeled the loss of material from the outer reaches of the Alpha Centauri triple star system and how much of this material may now be within the outer reaches of our Solar System. Specifically, they model objects larger than about 100 meters. While not discussed in the links below, I am assuming that these are objects that are just passing through the Oort cloud and generally have velocities too high to be captured by the Sun. They estimate that there may be as many as a million objects in the Oort cloud that originated from the Alpha Centauri system. This is actually a small number as the Oort cloud is estimated to have a trillion objects larger than a kilometer. Also, the outer extent of the Oort cloud is estimated to be about 50,000 AU to 100,000 AU or even 200,000 AU. This upper limit is considered to be to outer limit of the gravitational influence of the Sun relative to the influence of the rest of the Milky Way galaxy. For comparison, Alpha Centauri is 267,000 AU from us, which means that our mutual Oort clouds overlap!

https://www.livescience.com/space/astronomy/1-million-interstellar-objects-each-larger-than-the-statue-of-liberty-may-lurk-in-the-outer-solar-system

https://www.sciencealert.com/alpha-centauri-particles-already-lurk-in-our-solar-system-study-suggests

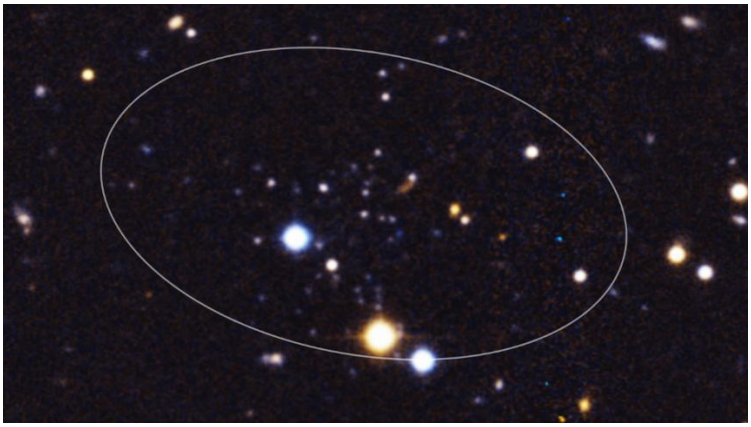
Strange "Star":



Please note that I am a planetary geologist, not a particle physicist. When a star between 10 and 25 solar masses can no longer fuse elements, it goes through a red supergiant phase and eventually explodes as a supernova. The remnant of this event is a neutron star with a diameter of about 20 kilometers and a mass of about 1.4 to 2.2 times that of the Sun. Further collapse is limited what is called neutron degeneracy pressure. Less massive stars (which avoid the supernova phase) are limited in size (about the diameter of the Earth) by electron degeneracy pressure, a white dwarf. More massive stars will become black holes. It is theorized that more massive neutron stars may have cores made up of quark matter (neutrons and protons are made up of quarks) with crusts of neutron matter. Quark matter is stable only under very high temperatures and pressures. However, one "flavor" of quarks is the strange quark which is theorized to be more stable at lower temperatures and pressures and may be more stable at the surface of a strange quark star. How do strange quark stars form from neutron stars? Either the collapse of the neutron crust (under its own pressure) or the collision between two neutron stars. The collapse of the crust would cause a gamma ray burst similar to what the authors of this paper have observed in GRB 240529A. Also, the remnant appears to have a diameter that is about 10 kilometers (6 or 7 miles), which is too small to be a neutron star, but just right for what is expected of a strange quark star. Other observations at X-ray wavelengths are consistent with the formation of the strange quark star.

https://www.universetoday.com/171006/did-astronomers-just-witness-the-formation-of-a-strange-star/

Smallest Galaxy:

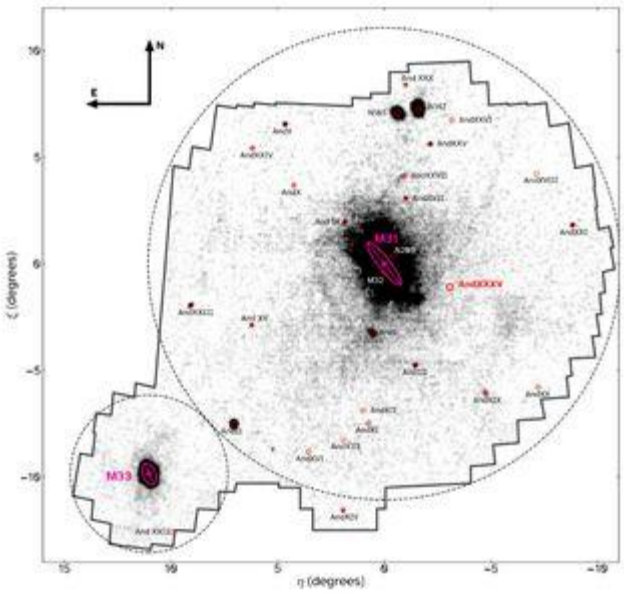


"The newfound galaxy, Andromeda XXXV, is seen within the white ellipse. (Image credit: CFHT/MegaCam/PAndAS [Principal investigator: Alan McConnachie; Image processing: Marcos Arias])"

It is likely that this is a continuation of the observations of the Andromeda Galaxy that we have reported on over the last few Newsletters. We have talked about the satellite galaxies of the Milky Way that include the Large and Small Magellanic Clouds. There are over 60 known dwarf satellite galaxies of the Milky Way. The Andromeda Galaxy also has many satellite galaxies. One site gives the number at over 100. Recently, HST discovered what appears to be the smallest known dwarf satellite galaxy, Andromeda XXXV with a total diameter of only about 300 light-years. Two mysteries have yet to be solved. How have these small galaxies survived since their formation more than 10 billion years ago, and how, while most star formation stopped 10

billion years ago in the Milky Way Galaxy, star formation in many of Andromeda's satellite galaxies lasted until a few billion years ago?

https://www.space.com/the-universe/scientists-discover-smallest-galaxy-ever-seen-its-like-having-a-perfectly-functional-human-being-thats-the-size-of-a-grain-of-rice



A map showing the Andromeda galaxy and its satellites. The newly discovered Andromeda XXXV companion galaxy is highlighted in bold red text. (Image credit: M. Arias et al. Astrophys. J. Lett. [2025])