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Scientists from Germany and the United States have unveiled the results of a newly-completed, state of the art simulation of the evolution of galaxies.

TNG50 is the most detailed large-scale cosmological simulation yet. It allows researchers to study in detail how galaxies form, and how they have evolved since shortly after the Big Bang. For the first time, it reveals that the geometry of the cosmic gas flows around galaxies determines galaxies' structures, and vice versa. The researchers publish their results in two papers in the journal Monthly Notices of the Royal Astronomical Society.

Astronomers running cosmological simulations face a fundamental trade-off: with finite computing power, typical simulations so far have been either very detailed or have spanned a large volume of virtual space, but have so far not been able to do both. Detailed simulations with limited volumes can model no more than a few galaxies, making statistical deductions difficult. Large-volume simulations, in turn, typically lack the details necessary to reproduce many of the small-scale properties we observe in our own Universe, reducing their predictive power.

The TNG50 simulation, which has just been published, manages to avoid this trade-off. For the first time, it combines the idea of a large-scale cosmological simulation - a Universe in a box - with the computational resolution of "zoom" simulations, at a level of detail that had previously only been possible for studies of individual galaxies.
In a simulated cube of space that is more than 230 million light-years across, TNG50 can discern physical phenomena that occur on scales one million times smaller, tracing the simultaneous evolution of thousands of galaxies over 13.8 billion years of cosmic history. It does so with more than 20 billion particles representing dark (invisible) matter, stars, cosmic gas, magnetic fields, and supermassive black holes. The calculation itself required 16,000 cores on the Hazel Hen supercomputer in Stuttgart, working together, 24/7, for more than a year - the equivalent of fifteen thousand years on a single processor, making it one of the most demanding astrophysical computations to date.

The first scientific results from TNG50 are published by a team led by Dr Annalisa Pillepich (Max Planck Institute for Astronomy, Heidelberg) and Dr Dylan Nelson (Max Planck Institute for Astrophysics, Garching) and reveal unforeseen physical phenomena. According to Nelson: "Numerical experiments of this kind are particularly successful when you get out more than you put in. In our simulation, we see phenomena that had not been programmed explicitly into the simulation code. These phenomena emerge in a natural fashion, from the complex interplay of the basic physical ingredients of our model universe."

TNG50 features two prominent examples for this kind of emergent behaviour. The first concerns the formation of "disc" galaxies like our own Milky Way. Using the simulation as a time machine to rewind the evolution of cosmic structure, researchers have seen how the well-ordered, rapidly rotating disc galaxies (which are common in our nearby Universe) emerge from chaotic, disorganised, and highly turbulent clouds of gas at earlier epochs.

As the gas settles down, newborn stars are typically found on more and more circular orbits, eventually forming large spiral galaxies - galactic carousels. Annalisa Pillepich explains: "In practice, TNG50 shows that our own Milky Way galaxy with its thin disc is at the height of galaxy fashion: over the past 10 billion years, at least those galaxies that are still forming new stars have become more and more disc-like, and their chaotic internal motions have decreased considerably. The Universe was much messier when it was just a few billion years old!"

As these galaxies flatten out, researchers found another emergent phenomenon, involving the high-speed outflows and winds of gas flowing out of galaxies. This launched as a result of the explosions of massive stars (supernovae) and activity from supermassive black holes found at the heart of galaxies. Galactic gaseous outflows are initially also chaotic and flow away in all directions, but over time, they begin to become more focused along a path of least resistance.

In the late universe, flows out of galaxies take the form of two cones, emerging in opposite directions - like two ice cream cones placed tip to tip, with the galaxy swirling at the centre. These flows of material slow down as they attempt to leave the gravitational well of the galaxy's halo of invisible - or dark - matter, and can eventually stall and fall back, forming a galactic fountain of recycled gas. This process redistributes gas from the centre of a galaxy to its outskirts, further accelerating the transformation of the galaxy itself into a thin disc: galactic structure shapes galactic fountains, and vice versa.

The team of scientists creating TNG50 (based at Max-Planck-Institutes in Garching and Heidelberg, Harvard University, MIT, and the Center for Computational Astrophysics (CCA)) will eventually release all simulation data to the astronomy community at large, as well as to the public. This will allow astronomers all over the world to make their own discoveries in the TNG50 universe - and possibly find additional examples of emergent cosmic phenomena, of order emerging from chaos.

Source: Spaceref.com
2. NASA Opens Previously Unopened Apollo Sample Ahead of Artemis Missions

NASA scientists opened an untouched rock and soil sample from the Moon returned to Earth on Apollo 17, marking the first time in more than 40 years a pristine sample of rock and regolith from the Apollo era has been opened. It sets the stage for scientists to practice techniques to study future samples collected on Artemis missions.

The sample, opened Nov. 5, in the Lunar Curation Laboratory at the agency’s Johnson Space Center in Houston, was collected on the Moon by Apollo 17 astronauts Gene Cernan and Jack Schmitt, who drove a 4-centimeter-wide tube into the surface of the Moon to collect it and another sample scheduled to be opened in January. The sample was opened as part of NASA’s Apollo Next-Generation Sample Analysis (ANGSA) initiative, which is leveraging advanced technologies to study Apollo samples using new tools that were not available when the samples were originally returned to Earth.

“We are able to make measurements today that were just not possible during the years of the Apollo program,” said Dr. Sarah Noble, ANGSA program scientist at NASA Headquarters in Washington. “The analysis of these samples will maximize the science return from Apollo, as well as enable a new generation of scientists and curators to refine their techniques and help prepare future explorers for lunar missions anticipated in the 2020s and beyond.”

Since the Apollo era, all samples that were returned to Earth have been carefully stored in the laboratory to preserve them for future generations. Most samples have been well studied, and many are the subject of ongoing research. However, NASA also made the decision to keep some samples completely untouched as an investment in the future, allowing them to be analyzed with more advanced technologies as they are developed. These include samples that remained sealed in their original containers, as well as some stored under special conditions, all intended to be opened and analyzed with more advanced analytical technologies than were available during Apollo.

The unopened Apollo samples were collected on Apollo 15, 16 and 17 missions. Two of those samples, 73002 and 73001, both collected on Apollo 17, will be studied as part of ANGSA. Advances in techniques such as non-destructive 3D imaging, mass spectrometry and ultra-high resolution microtomy will allow for a coordinated study of these samples at an unprecedented scale.

Samples 73002 and 73001 are part of a two-foot long “drive tube” of regolith (rock and soil) that collected from a landslide deposit near Lara Crater at the Apollo 17 site. The samples preserve the vertical layering within the lunar soil, information about landslides on airless bodies like the Moon, and a record of the volatiles trapped within lunar regolith, perhaps even those escaping from the Moon along the Lee-Lincoln Scarp, a fault at the Apollo 17 site.
“Opening these samples now will enable new scientific discoveries about the Moon and will allow a new generation of scientists to refine their techniques to better study future samples returned by Artemis astronauts,” said Francis McCubbin, NASA’s astromaterials curator at Johnson. “Our scientific technologies have vastly improved in the past 50 years and scientists have an opportunity to analyze these samples in ways not previously possible.”

Two Samples, Two Processes

Sample 73002, which has remained unopened but not sealed under vacuum since being brought to Earth, was the first sample to be extruded from its container Nov. 5. Sample processors at Johnson will spend the next several months processing the sample and distributing parts of it to the ANGSA science teams for analysis.

To aid in opening the sample, researchers have used X-ray Computer Tomography (XCT) done at the University of Texas Austin to record a high-resolution 3D image of the regolith within the tube. The imaging aids the processors as they develop strategies to remove the sample for dissection and distribution to research teams, as well as helping scientists understand the sample’s structure before opening the container. It will also protect fragile soil components from damage during opening and processing, and provides detailed images of individual grains and smaller samples known as rocklets.

After X-ray scanning, the samples are removed from their tube using specialized tools inside a glovebox filled with ultrapure dry Nitrogen, and are then subdivided into one-quarter inch segments to allow scientists to understand the variation observed along the length of the core. This is the first time NASA has processed a drive tube like this in over 25 years, and curation scientists have been hard at work over the past few months rehearsing the process.

“I grew up on the stories of Apollo, they inspired me to pursue a career in space and now I have an opportunity to contribute to the studies that are enabling the next missions to the Moon,” said Charis Krysher, the lunar sample processor who will be opening sample 73002. “To be the one to open a sample that hasn’t been opened since it was collected on the moon is such an honor and heavy responsibility, we’re touching history.”

Sample 73001, which will be opened in early 2020, was sealed on the Moon in a special core sample vacuum container and then placed within another vacuum container and sealed on Earth. That sample will be opened once scientists have fine-tuned plans for capturing the gases from the Moon collected in the container along with the sample itself. Once removed, it will be processed in a glovebox and shared with scientific teams selected for the ANGSA research.

Artemis Generation

Exploration of the Moon by astronauts in the Artemis program will be enabled by using the resources of the Moon, including water ice that can be used to make rocket fuel or oxygen to breathe. Studying these unopened samples may allow scientists to gain insight into the origin of the lunar polar ice deposits, as well as other potential resources for future exploration. They will also gain a better understanding of how well Apollo tools worked, which will help with tool designs for future lunar missions.

“The findings from these samples will provide NASA new insights into the Moon, including the history of impacts on the lunar surface, how landslides occur on the lunar surface, and how the Moon’s crust has evolved over time,” said Charles Shearer, science co-lead for ANGSA. “This research will help NASA better understand how volatile reservoirs develop, evolve and interact on the Moon and other planetary bodies.”

During the preliminary examination of these unopened Apollo samples, multiple generations of scientists, engineers, and curators will work together to study the samples. Team members who have long NASA
experience, some of whom were part of the original teams to first study Apollo samples, will work with younger team members in a true collaboration between past and present generations of lunar explorers. Schmitt, the lone geologist among the Apollo astronauts and lunar module pilot of Apollo 17, which collected sample 73002, is also actively involved in the science team.

“This provides an essential link between the first generation lunar explorers from Apollo and future generations who will explore the Moon and beyond starting with Artemis,” said Shearer.

Since these samples were collected, NASA has continued to study Earth’s nearest neighbor through missions like the Lunar Reconnaissance Orbiter and now has an incredible amount of data about the lunar surface, environment and composition. Under Artemis, the agency will send a suite of new science instruments and technology demonstrations to study the Moon ahead of landing astronauts on the lunar surface by 2024, and establishing a sustained presence by 2028. The agency will build on its past to leverage its Artemis experience to prepare for the next giant leap — sending astronauts to Mars.

Source: NASA
3. The Alchemy of Merging Neutron Stars

For the first time, astronomers have identified a chemical element that was freshly formed by the merging of two neutron stars. The underlying mechanism, called the r-process—also known as rapid neutron capture—is considered to be the origin of large quantities of elements heavier than iron.

This discovery sheds new light on the mystery of the environments in which this r-process takes place. The team of astronomers, also including scientists of FAIR and GSI, has now unequivocally demonstrated that the fusion of two neutron stars creates the conditions for this process and acts as a reactor in which new elements are bred.

The origin of heavy elements such as gold, lead and uranium has not yet been fully clarified. The lightest elements—hydrogen and helium—were already formed in significant quantities with the Big Bang. Nuclear fusion in the cores of stars is also a well-established source of atoms in the mass range from helium to iron.

For the production of heavier atoms, scientists suspect a process that attaches free neutrons to already existing building blocks. The fast variant of this mechanism is the so-called r-process (r stands for rapid) or fast neutron capture. At present, research is being carried out to determine which objects might be sites where this reaction takes place. Possible candidates so far are a rare type of supernova explosions and the merging of dense stellar remnants like binary neutron stars.

Large amounts of strontium form within less than a second

An international group of astronomers with substantial participation of Camilla Juul Hansen from the Max Planck Institute for Astronomy (MPIA) in Heidelberg has now discovered the signature of the element strontium, which was formed by the r-process during an explosive fusion of two neutron stars. With on average 88 nucleons, of which 38 are protons, it is heavier than iron.
Professor Almudena Arcones and Privatdozent Andreas Bauswein were also involved in the publication in the scientific journal Nature. In addition to their activities in the research department for theoretical physics at FAIR and GSI, they are also active at the Technical University of Darmstadt and at the University of Heidelberg, both partner universities of FAIR and GSI. They provided valuable estimates for the publication. The process and characteristics of the r-process are among the important research questions to be investigated at the future FAIR accelerator facility currently under construction in Darmstadt.

The explosive merger produced a raging expansion shell moving with 20% to 30% of the speed of light. It consists of newly formed matter, of which strontium alone amounts to about five Earth masses (1 Earth mass $= 6 \times 10^{24}$ kg). Thus, for the first time, the researchers provide clear evidence that such a collision provides the conditions for the r-process in which heavy elements form. Besides, this is the first empirical confirmation that neutron stars consist of neutrons.

The r-process is truly rapid. Per second, more than $10^{22}$ neutrons flow through an area of one square centimetre. The beta decay transforms some of the accumulated neutrons into protons, emitting one electron and one antineutrino each. The special aspect about this mechanism is that the neutrons combine to form large compounds faster than the newly formed conglomerates break up again. In this way, even heavy elements can grow from individual neutrons within less than a second.

**Merging neutron stars produce gravitational waves**

Using the Very Large Telescope (VLT) of the European Southern Observatory (ESO), scientists obtained spectra following the spectacular discovery of the gravitational wave signal GW170817 in August 2017. In addition to a gamma-ray burst, the kilonova AT2017gfo, an afterglow in visible light due to radioactive processes, which faded within a few days after an initial sharp increase in brightness, occurred at the same location. The first analysis of the spectra in 2017 by another group of researchers did not yield a clear result about the composition of the reaction products.

Dr. Hansen and her colleagues based their re-evaluation on creating synthetic spectra and modeling the observed spectra, which were recorded over four days at intervals of one day each. The spectra indicate an object with an initial temperature of about 3700 K (approx. 3400 °C), which faded and cooled in the following days. The brightness deficits at wavelengths of 350 and 850 nm are conspicuous. These are like fingerprints of the element that absorbs light at these parts of the spectrum.

Taking into account the blue shift of these absorption lines caused by the Doppler effect the expansion following the merger event produces, the research group calculated spectra of a large number of atoms using three increasingly complex methods. Since these methods all yielded consistent results, the final conclusion is robust. It turned out that only strontium generated by the r-process is able to explain the positions and strength of the absorption features in the spectra.

**Progress in the understanding of the nucleosynthesis of heavy elements**

"The results of this work are an important step in deciphering the nucleosynthesis of heavy elements and their cosmic sources," Hansen concludes. "This was only possible by combining the new discipline of gravitational wave astronomy with precise spectroscopy of electromagnetic radiation. These new methods give hope for further ground-breaking insights into the nature of the r-process."

**Explore further**

First identification of a heavy element born from neutron star collision

Source: Phys.org

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The Night Sky

Friday, Nov. 8

• High above the gibbous Moon, pointing down at it, is the eastern edge of the Great Square of Pegasus. Continue down below the Moon and there’s Diphda (Beta Ceti).

• This week, wintry Orion is clearing the eastern horizon by about 9 p.m. (depending on how far east or west you live in your time zone).

High above Orion shines orange Aldebaran. Above Aldebaran is the little Pleiades cluster, the size of your fingertip at arm’s length.

And far left of Aldebaran and the Pleiades is bright Capella.

• The transit of Mercury is coming up in three days! Plan your observing now. See Monday below.

Saturday, Nov. 9

• In early evening, look high above the Moon for the Great Square of Pegasus through the moonlight. It’s standing on one corner. The line from its top star through its bottom star points to the Moon.

• Happy 85th birthday, Carl Sagan (November 9, 1934 – December 20, 1996). If only.

Sunday, Nov. 10

• Sometime around 8 or 9 p.m., depending on where you live, zero-magnitude Capella will have risen exactly as high in the northeast as zero-magnitude Vega has sunk in the west-northwest. How accurately can you time this event? Astrolabe not required... but it might help.

Monday, Nov. 11

• Transit of Mercury. Tiny Mercury crosses the face of the Sun today — during morning for North America, midday in South America, and afternoon for Europe and Africa. The transit begins at 7:35 a.m. EST (12:35 UT) and ends at 1:04 p.m. EST (18:04 UT). At mid-transit, 15:20 UT, Mercury will be very close to the center of the Sun’s disk. Of course you’ll need a safe solar filter over the front of your telescope!

Map and details, or see the November Sky & Telescope, page 48. Also: see Citizen Science with the Transit of Mercury.

Cloudy? Watch Gianluci Masi’s live observing session of the transit from the Virtual Observatory, starting at 12:30 UT (7:30 a.m. EST).
• Algol is at its minimum brightness, magnitude 3.4 instead of its usual 2.1, for about two hours centered on 11:46 p.m. EST. In its normal state Algol is equal in brightness to Gamma Andromedae, now above it.

Source:  Sky & Telescope
ISS Sighting Opportunities

For Denver:

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Sighting information for other cities can be found at NASA’s [Satellite Sighting Information](https://www.nasa.gov/)

**NASA-TV Highlights**

*(all times Eastern Daylight Time)*

No Special Programming

Watch NASA TV on the Net by going to the [NASA website.](https://www.nasa.gov/)
Space Calendar

- Nov 08 - Moon Occults Asteroid 21 Lutetia
- Nov 08 - Comet P/2019 T6 (PANSTARRS) Perihelion (2.053 AU)
- Nov 08 - Comet 372P/McNaught At Opposition (3.050 AU)
- Nov 08 - Comet P/2018 P4 (PANSTARRS) Closest Approach To Earth (3.353 AU)
- Nov 08 - Apollo Asteroid 2019 UM12 Near-Earth Flyby (0.003 AU)
- Nov 08 - Apollo Asteroid 2019 UR4 Near-Earth Flyby (0.019 AU)
- Nov 08 - Apollo Asteroid 2019 VM1 Near-Earth Flyby (0.029 AU)
- Nov 08 - Asteroid 17898 Scottsheppard Closest Approach To Earth (1.186 AU)
- Nov 08 - Asteroid 4987 Flamsteed Closest Approach To Earth (1.441 AU)
- Nov 08 - Neptune Trojan 2013 V30 At Opposition (26.625 AU)
- Nov 08 - Neptune Trojan 2014 UU240 At Opposition (29.746 AU)
- Nov 08 - Pluto 144897 (2004 UX10) At Opposition (38.353 AU)
- Nov 08 - 15th Anniversary (2004), Orlando Meteorite Fall (Hit Car, House in Florida)
- Nov 08 - 35th Anniversary (1984), STS-51-A Launch (Space Shuttle Discovery - Anna Lee Fisher, 1st Mother in Space)
- Nov 08 - 50th Anniversary (1969), Azur Launch (Germany's 1st Scientific Satellite)
- Nov 08 - Johannes Rydberg's 165th Birthday (1854)
- Nov 08 - Amor Asteroid 5620 Jasonwheeler Closest Approach To Earth (1.583 AU)
- Nov 08 - Amor Asteroid 1941 Wild Closest Approach To Earth (2.078 AU)
- Nov 10 - 15th Anniversary (2004), Orlando Meteorite Fall (Hit Car, House in Florida)
- Nov 10 - 35th Anniversary (1984), STS-51-A Launch (Space Shuttle Discovery - Anna Lee Fisher, 1st Mother in Space)
- Nov 10 - 50th Anniversary (1969), Azur Launch (Germany's 1st Scientific Satellite)
- Nov 10 - Johannes Rydberg's 165th Birthday (1854)
- Nov 10 - Amor Asteroid 5620 Jasonwheeler Closest Approach To Earth (1.583 AU)
- Nov 10 - Amor Asteroid 1941 Wild Closest Approach To Earth (2.078 AU)
- Nov 11 - Transit of Mercury Across the Sun
- Nov 11 - Starlink 2 (60) Falcon 9 Launch
- Nov 11 - Comet C/2019 K5 (Young) At Opposition (1.664 AU)
- Nov 11 - Comet 173P/Mueller At Opposition (4.227 AU)
- Nov 11 - Comet C/2015 XY1 (Lemmon) At Opposition (7.740 AU)
- Nov 11 - Apollo Asteroid 2019 VN Near-Earth Flyby (0.008 AU)
- Nov 11 - Apollo Asteroid 2019 VX2 Near-Earth Flyby (0.009 AU)
• Nov 11 - [Nov 08] **Apollo Asteroid 2019 VX3** Near-Earth Flyby (0.010 AU)
• Nov 11 - **Apollo Asteroid 2005 WD** Near-Earth Flyby (0.060 AU)
• Nov 11 - **Apollo Asteroid 137052 Tjelvar Closest Approach To Earth** (0.631 AU)
• Nov 11 - **Asteroid 268242 Pebble** Closest Approach To Earth (0.909 AU)
• Nov 11 - **Asteroid 2975 Spahr** Closest Approach To Earth (1.430 AU)
• Nov 11 - **Neptune Trojan 2006 RJ103 At Opposition** (29.196 AU)

Source: [JPL Space Calendar](http://www.jpl.nasa.gov/spacecalendar/)

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From Wind to Data, in No Time Flat: Accelerating Spacecraft and Aircraft Design

NASA is preparing to send astronauts to explore the Moon’s south pole within the next five years as part of the Artemis program. Knowing that time is of the essence, NASA aerospace engineer Nettie Roozeboom thought of an idea that could speed up significantly the design of rockets, lunar landers and other spacecraft to support lunar exploration. By linking in real time two NASA facilities – one for advanced aeronautics testing, the other for powerful analysis of the results – her method could define a new way of doing business in the world of spacecraft and aircraft design. Last month, she showed how it could work during the latest tests of NASA’s new rocket, the Space Launch System, or SLS.

Roozeboom is in the perfect spot to bridge the worlds of testing rocket designs and crunching data.

In the wind tunnels at NASA’s Ames Research Center in California’s Silicon Valley, she helps aerospace designers – whether from NASA, other government agencies or private companies – study their vehicles’ performance by simulating the conditions expected in flight. From an experimental “green” aircraft concept designed by Boeing to reduce both emissions and noise to a launch abort system that would carry astronauts to safety if needed on the launch pad – Roozeboom has helped many designs get on their way.

Down the street at Ames, her neighbors at the NASA Advanced Supercomputing facility, or NAS, work with computer simulations and analyze complex data sets using one of the world’s most powerful supercomputers.

A real-time connection between the two disciplines could become an important tool for many. Traditionally, aerospace design teams carry their data from a wind tunnel test back to their workplace on a stack of hard drives, where it then takes months to analyze. If they realize they missed something, and more data would’ve been valuable, Roozeboom’s facility is in such high demand she won’t have a spot for them to do another test run until 2021—two years from the original test. With NASA’s schedule to land the first astronauts on the lunar surface in 2024, she knew this two-year design cycle wouldn’t fly.
That’s especially critical with all the new traffic she anticipates in the wind tunnels. As the first major step to returning astronauts to the Moon, NASA is working with nine American companies on delivery services to the lunar surface, and Roozeboom expects they’ll all come through her facility.

“The way I see it is: We, NASA, have asked you to do this, so how can we help you get there?” Roozeboom said. “I take it as my responsibility to go create the tools, help them connect to the right talent, and together we can save time.”

**Red Rover, Red Rover, Send the Data Right Over**

In September 2019 at Ames, Roozeboom put her plan to the test with SLS. This rocket will send the Orion spacecraft to the Gateway in lunar orbit, from where the first woman and next man will head to the surface of the Moon aboard a human landing system. The design of SLS is also being tweaked for other missions and types of cargo. For flights that will deliver goods to the Moon, the SLS team needed to test the design for the rocket’s fairing, or nose, specially made to send cargo to deep space. The tests will ensure the rocket will fly safely and protect the cargo inside.

Roozeboom’s job, specifically, is to measure shaking caused by strong and quickly changing pressure from the air a vehicle is pushing through as it travels through the atmosphere to get to space. This tells designers how to build their vehicle to withstand the shaking of a real flight. During her team’s wind-tunnel tests, high-speed cameras captured the changing glow of a high-tech paint that reveals rapidly fluctuating pressure during the rocket’s simulated ascent. The data was saved to a rack of hard drives, but, for the first time, it didn’t stop there.

The demonstration, which Roozeboom named Red Rover – a nod to the children’s recess game – sent as much as 400 terabytes of data straight from the wind tunnel to the supercomputer. That’s 800 times more than the laptop that typed up this story can hold and a record for the live transfer of data like this for immediate processing. Collaborating with the supercomputing experts at the NAS facility was essential for handling it all. They had taken the wind tunnel experts’ usual software for processing pressure-sensitive paint data and optimized it for real-time visualization.

The result: NAS’s supercomputer churned through the data coming in from the wind tunnel and revealed a visualization of the results, practically on the spot. The SLS design team watched on the 1/4 billion-pixel hyperwall – a floor-to-ceiling wall of screens – and immediately consulted with the experts at Ames. When the test conditions didn’t provide precisely the information needed, they were adjusted with a quick message over to the wind tunnel, and new data was collected. All without further ado or delay.

“This could be a tremendous benefit for programs early in the design cycle,” said Thomas Steva, an aerodynamics engineer on the SLS team at NASA’s Marshall Space Flight Center in Huntsville, Alabama who worked on the Red Rover project. “That’s a time where high-fidelity data is typically sparse.”

Roozeboom will now work closely with SLS team members at two other NASA centers – Marshall and Langley Research Center in Hampton, Virginia – to understand how the data should be processed and packaged to best meet their needs. This will help define what NASA’s commercial partners in both aviation and spacecraft design will need in the future, as the agency develops the new state of the art. Thanks to dual expertise in wind tunnel testing and advanced computing, designs for the Artemis program and more can be forged in real time.

Source: NASA
Space Image of the Week

21st Century M101

Explanation One of the last entries in Charles Messier’s famous catalog, big, beautiful spiral galaxy M101 is definitely not one of the least. About 170,000 light-years across, this galaxy is enormous, almost twice the size of our own Milky Way Galaxy. M101 was also one of the original spiral nebulae observed with Lord Rosse’s large 19th century telescope, the Leviathan of Parsonstown. In contrast, this multiwavelength view of the large island universe is a composite of images recorded by space-based telescopes in the 21st century. Color coded from X-rays to infrared wavelengths (high to low energies), the image data was taken from the Chandra X-ray Observatory (purple), the Galaxy Evolution Explorer (blue), Hubble Space Telescope (yellow), and the Spitzer Space Telescope (red). While the X-ray data trace the location of multimillion degree gas around
M101's exploded stars and neutron star and black hole binary star systems, the lower energy data follow the stars and dust that define M101's grand spiral arms. Also known as the Pinwheel Galaxy, M101 lies within the boundaries of the northern constellation Ursa Major, about 25 million light-years away.

Image Credit: NASA, ESA, CXC, JPL - Caltech, STScI
Source: APOD