Space News Update
— March 13, 2018 —

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SpaceX Chief Executive Elon Musk said March 11 the company could begin tests of part of its Big Falcon Rocket (BFR) launch system as soon as next year, reiterating a schedule he provided last month.

Musk participated in an on-stage interview, announced on less than a day’s notice, at the South By Southwest (SXSW) festival in Austin, Texas. During the appearance, he said the company was progressing on the development of BFR, which features a first-stage booster and upper-stage "spaceship," the latter able to travel to and land on the moon or Mars.

"We're making good progress on the ship and the booster," he said. "That design is evolving rapidly" from his presentation about the BFR concept at the International Astronautical Congress in Australia in September 2017, which itself was a revision of the design presented at the same conference a year earlier in Mexico. [The BFR: SpaceX's Mars-Colonization Architecture in Images]

Construction of the first prototype spaceship is in progress. "We're actually building that ship right now," he said. "I think we'll probably be able to do short flights, short sort of up-and-down flights, probably sometime in the first half of next year."

That schedule is similar to what Musk said Feb. 6, during a press conference at NASA's Kennedy Space Center following the successful inaugural launch of SpaceX’s Falcon Heavy rocket. "If we get lucky, we'll be able to do short hopper flights with the spaceship part of BFR maybe next year," he said then.

Those "hopper" flights, he said in February, would be analogous to the low-altitude flights of the company’s Grasshopper test vehicle, which demonstrated technologies required to do powered vertical landings of Falcon 9 boosters. "We would either do that at our South Texas launch site, near Brownsville, or ship-to-ship," he said, later saying those tests would "most likely" take place at the Brownsville site currently under construction.
Those hopper flights would go up to an altitude of several kilometers. "We'll do flights of increasing complexity," he said last month, including tests of heat shield technology.

Musk didn't provide new testing details in his SXSW interview, and offered a cautionary note about schedules. "People have told me that my timelines historically have been optimistic," he said. "So I'm trying to recalibrate to some degree here." That echoed his comments in Australia last year, where he described a schedule that called for the launch of the first BFR missions to Mars in 2022 "aspirational.

The interview covered a wide range of other topics, from his leadership of electric vehicle company Tesla to founding the tunneling startup The Boring Company to his concerns about artificial intelligence. He also stressed his worries about a war or other calamity setting back civilization on Earth, a motivation for establishing a presence on Mars.

"That's why it's important to get a self-sustaining base, ideally on Mars because Mars is far enough away from Earth that, if there's a war on Earth, the Mars base might survive," he said. "It's more likely to survive than a moon base."

Musk also briefly discussed Starlink, SpaceX's planned broadband satellite constellation that will provide connectivity to underserved areas and a low-cost alternative in more urbanized areas. Starlink, he added, will also provide revenue needed for SpaceX's Mars ambitions.

Musk didn't provide an update on the progress of Starlink itself, including the two demonstration satellites launched Feb. 22 as secondary payloads on a Falcon 9 mission from California.

At the same time Musk was speaking at SXSW, Dan Colussy, the former chief executive and chairman of Iridium, gave a speech at the MIT New Space Age Conference in Cambridge, Massachusetts. He noted the scale of Starlink, which could exceed 10,000 satellites, is far larger than Iridium's constellation of fewer than 100 satellites.

"I wish Mr. Musk well," Colussy said. "Based on his history, I expect him to succeed."
This is a Hubble Space Telescope image of galaxy NGC 1277. The galaxy is unique in that it is considered a relic of what galaxies were like in the early universe. The galaxy is composed exclusively of aging stars that were born 10 billion years ago. But unlike other galaxies in the local universe, it has not undergone any further star formation. Astronomers nickname such galaxies as "red and dead," because the stars are aging and there aren't any successive generations of younger stars. The telltale sign of the galaxy's "arrested development" lies in the ancient globular clusters that swarm around it. The reddish clusters are the strongest evidence that the galaxy went out of the star-making business long ago. Otherwise, there would be a lot of blue globular star clusters, which are largely absent. The lack of blue clusters suggests that NGC 1277 never grew further by gobbling up surrounding galaxies. The galaxy lives near the center of the Perseus cluster of over 1,000 galaxies, located 240 million light-years away from Earth. NGC 1277 is moving so fast through the cluster, at 2 million miles per hour, that it cannot merge with other galaxies to collect stars or pull in gas to fuel star formation. In addition, near the galaxy cluster center, intergalactic gas is so hot it cannot cool to condense and form stars. Credits: NASA, ESA, and M. Beasley (Instituto de Astrofísica de Canarias)

Astronomers have put NASA's Hubble Space Telescope on an Indiana Jones-type quest to uncover an ancient "relic galaxy" in our own cosmic backyard.

The very rare and odd assemblage of stars has remained essentially unchanged for the past 10 billion years. This wayward stellar island provides valuable new insights into the origin and evolution of galaxies billions of years ago.

The galaxy, NGC 1277, started its life with a bang long ago, ferociously churning out stars 1,000 times faster than seen in our own Milky Way today. But it abruptly went quiescent as the baby boomer stars aged and grew ever redder.

The findings are being published online in the March 12 issue of the science journal Nature.
Though Hubble has seen such "red and dead" galaxies in the early universe, one has never been conclusively found nearby. Where the early galaxies are so distant, they are just red dots in Hubble deep-sky images. NGC 1277 offers a unique opportunity to see one up close and personal. "We can explore such original galaxies in full detail and probe the conditions of the early universe," said Ignacio Trujillo, of the Instituto de Astrofísica de Canarias at the University of La Laguna, Spain.

The researchers learned that the relic galaxy has twice as many stars as our Milky Way, but physically it is as small as one quarter the size of our galaxy. Essentially, NGC 1277 is in a state of "arrested development." Perhaps like all galaxies it started out as a compact object but failed to accrete more material to grow in size to form a magnificent pinwheel-shaped galaxy.

Approximately one in 1,000 massive galaxies is expected to be a relic (or oddball) galaxy, like NGC 1277, researchers say. They were not surprised to find it, but simply consider that it was in the right place at the right time to evolve - or rather not evolve - the way it did.

The telltale sign of the galaxy’s state lies in the ancient globular clusters of stars that swarm around it. Massive galaxies tend to have both metal-poor (appearing blue) and metal-rich (appearing red) globular clusters. The red clusters are believed to form as the galaxy forms, while the blue clusters are later brought in as smaller satellites are swallowed by the central galaxy. However, NGC 1277 is almost entirely lacking in blue globular clusters. "I've been studying globular clusters in galaxies for a long time, and this is the first time I've ever seen this," said Michael Beasley, also of the Instituto de Astrofísica de Canarias.

The red clusters are the strongest evidence that the galaxy went out of the star-making business long ago. However, the lack of blue clusters suggests that NGC 1277 never grew further by gobbling up surrounding galaxies.

By contrast, our Milky Way contains approximately 180 blue and red globular clusters. This is due partly to the fact that our Milky Way continues cannibalizing galaxies that swing too close by in our Local Group of a few dozen small galaxies.

It's a markedly different environment for NGC 1277. The galaxy lives near the center of the Perseus cluster of over 1,000 galaxies, located 240 million light-years away. But NGC 1277 is moving so fast through the cluster, at 2 million miles per hour, that it cannot merge with other galaxies to collect stars or pull in gas to fuel star formation. In addition, near the galaxy cluster center, intergalactic gas is so hot it cannot cool to condense and form stars.

The team started looking for "arrested development" galaxies in the Sloan Digital Sky Survey and found 50 candidate massive compact galaxies. Using a similar technique, but out of a different sample, NGC 1277 was identified as unique in that it has a central black hole that is much more massive than it should be for a galaxy of that size. This reinforces the scenario that the supermassive black hole and dense hub of the galaxy grew simultaneously, but the galaxy’s stellar population stopped growing and expanding because it was starved of outside material.

"I didn't believe the ancient galaxy hypothesis initially, but finally I was surprised because it's not that common to find what you predict in astronomy," Beasley added. "Typically, the universe always comes up with more surprises that you can think about."

The team has 10 other candidate galaxies to look at with varying degrees of "arrested development."

The upcoming NASA James Webb Space Telescope (scheduled for launch in 2019) will allow astronomers to measure the motions of the globular clusters in NGC 1277. This will provide the first opportunity to measure how much dark matter the primordial galaxy contains.

Source: NASA
3. Rosetta’s 67P is the Result of a Collision of Two Comets

![Smooth terrain in the Imhotep region on 67P C-G, showing layering (B) and circular structures or pits (circled). Credit: ESA/Rosetta](image)

The comet 67P/Churyumov-Gerasimenko, which was visited by Rosetta in 2014-15, certainly appears to be the result of a collision between two comets. A new study explains how and when the collision occurred. By ESA/Rosetta/OSIRIS –

Ever since we’ve been able to get closer looks at comets in our Solar System, we’ve noticed something a little puzzling. Rather than being round, they’re mostly elongated or multi-lobed. This is certainly true of Comet 67P/Churyumov-Gerasimenko (67P or Chury for short.) A [new paper](link) from an international team coordinated by Patrick Michel at France’s CNRS explains how they form this way.

The European Space Agency (ESA) spacecraft Rosetta visited 67P in 2014, and even placed its lander Philae on the surface. Rosetta spent 17 months orbiting 67P, and at its closest approach, Rosetta was only 10 km (6 mi) from 67P’s surface. Rosetta’s mission ended with its guided impact into 67P’s surface in September, 2016, but the attempt to understand the comet and its brethren didn’t end then.

Though Rosetta’s pictures of 67P are the most detailed comet pictures we have, other spacecraft have visited other comets. And most of those other comets appear elongated or multi-lobed, too. Scientists explain these shapes with a “comet merger theory.” Two comets collide, creating the multi-lobed appearance of comets like 67P. But there’s been a problem with that theory.

In order for comets to merge and come out looking the way they do, they would have to merge very slowly, or else they would explode. They would also have to be very low-density, and be very rich in volatile elements. The “comet merger theory” also says that these types of gentle mergers between comets would have to have happened billions of years ago, in the early days of the Solar System.
The problem with this theory is, how could bodies like 67P have survived for so long? 67P is fragile, and subjected to repeated collisions in its part of the Solar System. How could it have retained its volatiles?

In the new paper, the research team ran a simulation that answers these questions.

The simulation showed that when two comets meet in a destructive collision, only a small portion of their material is pulverized and reduced to dust. On the sides of the comets opposite from the impact point, materials rich in volatiles withstand the collision. They're still ejected into space, but their relative speed is low enough for them to join together in accretion. This process forms many smaller bodies, which keep clumping up until they form just one, larger body.

The most surprising part of this simulation is that this entire process may only take a few days, or even a few hours. The whole process explains how comets like 67P can keep their low density, and their abundant volatiles. And why they appear multi-lobed.

The simulation also answered another question: how can comets like 67P survive for so long?

The team behind the simulation thinks that the process can take place at speeds of 1 km/second. These speeds are typical in the Kuiper Belt, which is the disc of comets where 67P has its origins. In this belt, collisions between comets are a regular occurrence, which means that 67P didn't have to form in the early days of the Solar System as previously thought. It could have formed at any time.

The team’s work also explains the surface appearance of 67P and other comets. They often have holes and stratified layers, and these features could have formed during re-accretion, or sometime after its formation.

One final point from the study concerns the composition of comets. One reason they're a focus of such intense interest is their age. Scientists have always thought of them as ancient objects, and that studying them would allow us to look back into the primordial Solar System.

Though 67P—and other comets—may have formed much more recently than we used to believe, this process shows that there is no significant amount of heating or compaction during the collision. As a result, their original composition from the early days of the Solar System is retained intact. No matter when 67P formed, it’s still a messenger from the formative days.

This image from the simulation shows how the ejected material from two bodies colliding re-accretes into a bilobal comet.

Image: ESA/Rosetta/Navcam – CC BY-SA IGO 3.0

Source: European Space Agency  

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The Night Sky

Tuesday, March 13

- These evenings Leo strides up the eastern sky, with his brightest star Regulus in his forefoot and the Sickle of Leo extending upper left from there. About two fists lower left of Regulus are the two stars of Leo's tail: Delta Leonis (magnitude 2.5) and, below it, slightly brighter Beta Leonis, or Denebola: the tail tip.

- As evening grows late and this scene rises higher, look left of Denebola, by a fist or a little bit more, for the big, dim Coma Berenices star cluster. Its brightest members form an upside-down, tilted Y. It's visible even through some light pollution. If you can't see it naked-eye, binoculars reveal it well, looking rather ragged and more or less filling the field of view.

Wednesday, March 14

- With no Moon in the evening sky, this is a fine week to look for the zodiacal light if you live in the mid-northern latitudes — since the ecliptic tilts high upward from the western horizon at nightfall in March. From a clear, clean, dark site, look west at the very end of twilight for a vague but huge, narrow pyramid of pearly light. It's very tall and tilted to the left, aligning along the constellations of the zodiac. What you're seeing is sunlit interplanetary dust, orbiting the Sun near the ecliptic plane.

Thursday, March 15

- Orion tilts westward after dark now. As he turns down further, his three-star belt assumes its horizontal springtime position (seen from mid-northern latitudes). Orion's Belt is vertical when Orion is rising into the evening around Christmastime.

Friday, March 16

- The sky's biggest asterism (informal star pattern) is the Winter Hexagon. It fills the sky toward the south and west right after dark these evenings. Start with brilliant Sirius in its bottom, nearly south. Going clockwise from there, march upper left through Procyon, then up to Pollux and Castor near the zenith. Then head lower right through Menkalinan to bright Capella, lower left to Aldebaran, farther lower left to Orion's foot Rigel, and back to Sirius.

- Betelgeuse shines inside the Hexagon, below center.

Saturday, March 17

- As the turn of spring approaches (spring begins on March 20th this year), watch the low east-northeast for the rise of the "Spring Star," Arcturus. Find the Big Dipper high in the northeast and follow the curve of its handle around down, by a little more than a Dipper-length, to see where Arcturus will be.

- New Moon (exact at 9:12 a.m. EDT).

Source: Sky and Telescope
ISS Sighting Opportunities (from Denver)

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Sighting information for other cities can be found at [NASA’s Satellite Sighting Information](#).

NASA-TV Highlights  (all times Eastern Time Zone)

**Tuesday, March 13**

- 10 a.m. - ISS Expedition 55 In-Flight Interview with KYW-TV, Philadelphia and Flight Engineers Scott Tingle of NASA and Norishige Kanai of the Japan Aerospace Exploration Agency (JAXA) (all channels)
- 1 p.m. - ISS Expedition 55 In-Flight Interview with NPR’s 1A Program from WAMU Radio, Washington, D.C. and Flight Engineers Scott Tingle of NASA and Norishige Kanai of the Japan Aerospace Exploration Agency (JAXA) (starts at 1:25 p.m.) (all channels)

**Thursday, March 15**

- 4 p.m. - Video File of Pre-Launch Activities by the ISS Expedition 55-56 Crew (Artemyev, Feustel, Arnold) in Baikonur, Kazakhstan (Recorded March 4-15) (NTV-3 (Media))

**Friday, March 16**

- 10:30 a.m. - ISS Expedition 55 Educational In-Flight Event with the National Science Teachers Association in Atlanta (starts at 10:40 a.m.) (all channels)
- 11:30 a.m. - SpaceCast Weekly (all channels)

Watch NASA TV online by going to the [NASA website](#).
Space Calendar

- Mar 13 - Comet 74P/Smirnova-Chernykh Closest Approach To Earth (2.556 AU)
- Mar 13 - Comet C/2017 M3 (PANSTARRS) Closest Approach To Earth (4.458 AU)
- Mar 13 - Apollo Asteroid 2018 EE Near-Earth Flyby (0.098 AU)
- Mar 13 - Asteroid 278141 Tatooine Closest Approach To Earth (1.034 AU)
- Mar 13 - Asteroid 697 Galilea Closest Approach To Earth (2.345 AU)
- Mar 13 - Lecture: Space Traffic Control, London, United Kingdom
- Mar 13 - Colloquium: Galaxies at Cosmic Dawn - Exploring the First Billion Years with Hubble and Spitzer - Implications for JWST, Greenbelt, Maryland
- Mar 13 - Colloquium: Atmospheres and Climates of Rocky Exoplanets - What Earth Teaches Us About Them, and What They Can Teach Us About Earth, Tucson, Arizona
- Mar 13-15 - Nuclear Astrophysics at Rings and Recoil Separators Workshop, Darmstadt, Germany
- Mar 13-15 - Workshop: Science with Precision Astrometry, Baltimore, Maryland
- **Mar 14 - PI Day**
- Mar 14 - Moon Occults Asteroid 433 Eros
- Mar 14 - Apollo Asteroid 2018 EU2 Near-Earth Flyby (0.026 AU)
- Mar 14 - Apollo Asteroid 2018 EU1 Near-Earth Flyby (0.035 AU)
- Mar 14 - Apollo Asteroid 2017 RY15 Near-Earth Flyby (0.073 AU)
- Mar 14 - Asteroid 8925 Boattini Closest Approach To Earth (1.151 AU)
- Mar 14 - Aten Asteroid 367943 Duende Closest Approach To Earth (1.202 AU)
- Mar 14 - Colloquium: A Deeper View of the Universe Near and Far with the MWA, Sydney, Australia
- Mar 14-16 - Strings, Cosmology, and Gravity Student Conference, Brussells, Belgium
- Mar 14-16 - Workshop: Holography, Quantum Entanglement and Higher Spin Gravity II, Kyoto, Japan
- Mar 15 - Mercury At Its Greatest Eastern Elongation (18 Degrees)
- Mar 15 - Comet 125P/Spacewatch Closest Approach To Earth (1.243 AU)
- Mar 15 - Comet P/2012 K3 (Gibbs) At Opposition (2.875 AU)
- Mar 15 - Comet 257P/Catalina At Opposition (4.018 AU)
- Mar 15 - Comet C/2017 D3 (ATLAS) At Opposition (4.595 AU)
- Mar 15 - Comet C/2016 E1 (PANSTARRS) Closest Approach To Earth (7.650 AU)
- Mar 15 - Apollo Asteroid 2018 EH Near-Earth Flyby (0.024 AU)
- Mar 15 - Asteroid 48472 Mossbauer Closest Approach To Earth (1.186 AU)
- Mar 15 - Atira Asteroid 2013 JX28 Closest Approach To Earth (1.254 AU)
- Mar 15 - Asteroid 10093 Diesel Closest Approach To Earth (1.483 AU)
- Mar 15 - Colloquium: Unravelling the Origin and Evolution of Magmatic Lunar Volatiles, Tucson, Arizona

Source: JPL Space Calendar

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Food for Thought

World-First Firing of Air-Breathing Electric Thruster

In a world-first, an ESA-led team has built and fired an electric thruster to ingest scarce air molecules from the top of the atmosphere for propellant, opening the way to satellites flying in very low orbits for years on end.

ESA’s GOCE gravity-mapper flew as low as 250 km for more than four years thanks to an electric thruster that continuously compensated for air drag. However, its working life was limited by the 40 kg of xenon it carried as propellant – once that was exhausted, the mission was over.

Replacing onboard propellant with atmospheric molecules would create a new class of satellites able to operate in very low orbits for long periods.

Air-breathing electric thrusters could also be used at the outer fringes of atmospheres of other planets, drawing on the carbon dioxide of Mars, for instance.

“This project began with a novel design to scoop up air molecules as propellant from the top of Earth’s atmosphere at around 200 km altitude with a typical speed of 7.8 km/s,” explains ESA’s Louis Walpot.

A complete thruster was developed for testing the concept by Sitael in Italy, which was performed in a vacuum chamber in their test facilities, simulating the environment at 200 km altitude.
A ‘particle flow generator’ provided the oncoming high-speed molecules for collection by the Ram-Electric Propulsion novel intake and thruster.

There are no valves or complex parts – everything works on a simple, passive basis. All that is needed is power to the coils and electrodes, creating an extremely robust drag-compensation system.

The challenge was to design a new type of intake to collect the air molecules so that instead of simply bouncing away they are collected and compressed.

The molecules collected by the intake designed by QuinteScience in Poland are given electric charges so that they can be accelerated and ejected to provide thrust.

Sitael designed a dual-stage thruster to ensure better charging and acceleration of the incoming air, which is harder to achieve than in traditional electric propulsion designs.

“The team ran computer simulations on particle behavior to model all the different intake options,” adds Louis, “but it all came down to this practical test to know if the combined intake and thruster would work together or not.

“Instead of simply measuring the resulting density at the collector to check the intake design, we decided to attach an electric thruster. In this way, we proved that we could indeed collect and compress the air molecules to a level where thruster ignition could take place, and measure the actual thrust.

“At first we checked our thruster could be ignited repeatedly with xenon gathered from the particle beam generator.”

As a next step, Louis explains, the xenon was partially replaced by a nitrogen–oxygen air mixture: “When the xenon-based blue color of the engine plume changed to purple, we knew we’d succeeded.

“The system was finally ignited repeatedly solely with atmospheric propellant to prove the concept’s feasibility.

“This result means air-breathing electric propulsion is no longer simply a theory but a tangible, working concept, ready to be developed, to serve one day as the basis of a new class of missions.”

Source: European Space Agency

Test Set-up Credit: ESA
Explanation: This tantalizing array of nebulas and stars can be found about two degrees south of the famous star-forming Orion Nebula. The region abounds with energetic young stars producing jets and outflows that push through the surrounding material at speeds of hundreds of kilometers per second. The interaction creates luminous shock waves known as Herbig-Haro (HH) objects. For example, the graceful, flowing arc just right of center is cataloged as HH 222, also called the Waterfall Nebula. Seen below the Waterfall, HH 401 has a distinctive cone shape. The bright bluish nebula below and left of center is NGC 1999, a dusty cloud reflecting light from an embedded variable star. The entire cosmic vista spans over 30 light-years, near the edge of the Orion Molecular Cloud Complex some 1,500 light-years distant.