TOTAL IMPULSE

JACKSON MODEL ROCKET CLUB
JMRC HUVARS
HURON VALLEY ROCKET SOCIETY
TRIPOLI ROCKETRY ASSOCIATION, INC.
TOTAL IMPULSE VOLUME 21, NO. 6
NOVEMBER - DECEMBER 2021

WORLD SPACEMODELING CHAMPIONSHIPS

REVIEW: KOSMO THREADED MOTOR RETAINER

JAMES WEBB SPACE TELESCOPE LAUNCHED

MEMBERSHIP

To become a member of the Jackson Model Rocketry Club and Huron Valley Rocket Society means becoming a part of our family. We have monthly launches and participate in many educational events. We encourage our members to actively participate in our club projects, running for office in our annual elections, contributing to our monthly newsletter with articles or tips, and offering services to the club in their area of expertise. We have many members comprised of children, men, women, professionals, lay people, educators and people from many other walks of life.
You may fill out an application at a launch or request an application from one of our board members at scott@sfsmindustries.com and mail it along with a check for the annual membership dues ($30.00 individual or $40.00 family) to our mailing address:

JMRC/HUVARS
C/O Bob Dickinson
5668 Big Fish Rd
Goodrich, MI 48438

Members enjoy participating in club projects, meeting an incredible group of positive people, and no launch fees!

COMM CHANNELS

There are several ways to keep in touch with the JMRC/HUVARS and it's members.

Website: http://www.jmrconline.org. Information includes directions to launch sites & schedule, range procedures, and instructions on how to join the club.

Groups.io: The JMRC groups.io site is a place to share files and also serves as our primary e-mail list serv. Follow this link to join, https://groups.io/g/jmrc

Facebook: If you have a FaceBook account search for "Jackson Model Rocket Club JMRC" and request to be added.

GroupMe: Our new chat channel for broadcasting notifications instantly using a free download client for IOS and Droid as well as by SMS text messaging. You can join the notification chat after creating a free account and following this link,
https://groupme.com/join_group/28013422/zc5IC1

EDITOR'S RANGE BOX

As we close the books on 2021 I find myself thankful for some events and less so for others. We were able attend several launches in Michigan as well as host some ourselves. Many of us attended a successful NARAM in Geneseo, NY. The mood and atmosphere was better than the previous year and the opportunity to see many friends in person helped a lot.
This winter season is seeing us suffer through another wave of Covid sweeping our state and other locations. This is a wet blanket for sure just when the situation was looking better. If it follows previous waves we should see a drop off once the temps begin to rise.
One event you can take advantage of during these cold Winter days is Virtual NARCON 2022. I took the time off last year and attended (virtually) and there were a lot of great presentations. Well worth the $25 attendance fee. For more information check out the NARCON 2022 information page.
I once again thank our newsletter contributors. This issue owes thanks to Steve Kristal and Herb Crites for their fine articles. Please consider sending a contribution of your own. Product reviews are always welcomed. Let others know about interesting products you have encountered!

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Launch/Event Calendar - 2022

- January 28-30 *NARCON 2022* (Virtual Event)
- March *Pending* (Horning)
- April *Pending* (Horning)
- May *Pending* (Horning)
- June *Pending* (Horning)
- LDRS 40 - June 9 - 12 (Lucerne, CA)
- NARAM 63 - July 16 - 22 (Springfield, MO)
- July *Pending* (Horning)
- August 14/15 *Crapshoot VII* (Muskegon)

NOTE: Launch dates are subject to change without notice. Be sure to call the "launch hotline" at 517.262.0510 for the latest weather and field information or sign up for the JMRC Notification GroupMe chat.

PRESIDENT'S CORNER

As the dawn of the new year rolls in I hope this year starts with everyone coming back from happy holidays with a safe and healthy leap into the new year.

As for the club, we want to venture forth with optimism and are attempting to set launch dates for 2022 as soon as the snow leaves with firm ground to traipse around. I hope everyone takes advantage of this build season to repair damaged birds as well as bring new ones to flight status. I foresee launches in our future and when they come we want everyone ready!

If anyone has exciting builds please share them on the forum (or newsletter! - Ed) so we can all enjoy and anticipate their upcoming flights. - Scott

About Total Impulse

Total Impulse is the official newsletter of the Jackson Model Rocket Club (JMRC), Tripoli Prefecture 96, NAR Section 620. Published Bi-Monthly, *Total Impulse* is a space-modeling newsletter devoted to representing the diversity of interests in today's hobby of model rocketry.

The editor of *Total Impulse* accepts material for inclusion from anyone.
Send correspondence to:
Jackson Model Rocket Club
Buzz Nau, Editor
E-mail: USSMidway@gmail.com

On the Cover: *Steve's dream come true. Emma and Steve Kristal, trophy winners together at the 2021 World Spacemodeling Championships held in Buzau Romania*

World Spacemodeling Championships - 2021

Steve Kristal

Sometimes your dreams come true in ways you don't expect.

The World Spacemodeling Championship was held in Buzau, Romania from October 2nd to 8th. The event was initially supposed to take place in July of 2020 but, due to Covid, was postponed until this year. For quite a while it looked like it wouldn't be held at all, repeatedly postponed from July of this year, and finally announced at the last possible minute.

U.S. team members had actually been selected in July 2019. But the long wait, very uncertain conditions in Romania, risk of Covid, and late announcement led many on the team to decline to go. In the end, the lack of participants led many of those who did go to pick up extra events and, this year, there were more spots to fill than ever before.

In the past, each of the 8 events had 3 team members. But this year, each team could have 4 members if one of the team members was female. This was not an innovation unique to Spacemodeling. It was the same for all the aviation competitions, promulgated by the international organizing body as a way to encourage more female participation. Oddly, Spacemodeling has always done better in this regard than most of the other flying competitions. And the U.S. team has always been well represented by women and girls.

The 2021 U.S. Team

Emma Kristal watching the Romanian Air Force Demonstration

In the end, 15 competitors made the trip to Romania this year and those of us who went were very glad we did. But it was certainly different from any prior WSMC. Covid precautions affected virtually every aspect of the competition. All competitors had to prove immunization just to get in the country and to participate in the event. Immunization cards were required to enter any restaurant in the country.

The event itself was modified to try to assure as much social distancing as possible. The opening ceremony, usually held in the city with much intermingling and entertainment was left out this year. Instead, there was a brief opening ceremony on the field and instead of the usual native dancing and singing, the Romanian Air Force put on an absolutely spectacular flight demonstration.

There was no beer tent on the field this year either. I know that sounds bizarre to NAR fliers, but European rocketry events always have a refreshment tent which sells sandwiches, soft drinks, and beer. This year there was a little hut that sold refreshments, but no gathering area to sit and chat with friends.

The event itself ran pretty much as usual, but medal ceremonies were much abbreviated. The actual medal stands for 1st, 2nd, and 3rd were spread apart. And the day we arrived we were all informed that the closing ceremony party, always a big deal, had been cancelled.

The final major influence of Covid on the event was that, for the first time ever, we all had to worry about whether we would actually be able to leave the country when the event was over. All U.S. airlines required a negative PCR test within 72 hours of getting on

a plane to the U.S. So not only did we have to figure out how to get those tests done in Romania, but we had to wait until our test results came in to know for sure we would be able to go home. Fortunately, none of us flunked our tests, but two of our teammates had their flight rerouted to go through Canada, and then got stuck there for 10 days.

The anxiety about being able to go home was very real.

After all the delay, and concerns, 15 U.S. team members, and 3 supporters, made the trip.

We truly had a wonderful team, and all the hardships definitely brought us closer. People really stepped up. Since we always had a junior and senior team flying at the same time that meant that 6 to 8 of us were flying at any given time. There was also a team manager at each lane, so it meant we usually only had a handful of folks available for recovery for the two different teams. Like I said, people REALLY stepped up. And our team supporters were fantastic as well.

Overall, the U.S. team did very well. The brightest spot was that Chris Flanigan finished as World Champion in the S4 Rocketglider event. This is a truly next-to-impossible accomplishment. Chris flew perfect scores, 3-minute maxes, in the first 3 rounds to become one of 5 people in the flyoffs. He then over-maxed again in the flyoff round to outfly everyone else. Truly an amazing achievement, especially when you consider that even with those incredibly long lasting flights, he never lost his model. The recovery team was able to recover it each time! Chris is the World Champion, but it was definitely a team accomplishment.

Chris Flanigan with his 1st place medal and trophy

I mentioned at the outset that sometimes your dreams come true in ways you don't expect. That definitely happened for me and my daughter Emma this year. This was the 6th World Championship that we've represented the U.S. in. But it was the first time we made the team, both as seniors, in the same event. It was my dream to stand on the medal stand at a World Championship together with Emma.

Emma and I have always specialized in the altitude events. So we were terribly excited in 2019 when we both made the S1B altitude team. It would be the first time we would be on the same senior team in the same event. The fact that we made the team with Emma's old junior teammate, Allison VanMilligan, just made it that much better. Emma, Allison, and I are all really good at this event. Allison had won the event as a junior. I had finished team second 5 years ago in Ukraine and Emma finished team third 3 years ago in Poland.

Our models were better than ever before. And because of the new add-a-member rule we were allowed to add our good friend, Dr. Bob Kreutz, to our team. Dr. Bob is a former World Champion in this event. So we were sure we were going to do really well.

But it didn't happen.

Let me just say that we had lots of motor problems. At WSMC we always use European motors. We bought from our usual suppliers but just had lots of problems. Of the 4 U.S. fliers I was the only one to have any qualified flights. Truly a huge disappointment. But, honestly, as bad as our results were, furiously working to succeed with that group was actually really fun. Which, honestly, is the reason we do it in the first place.

Emma and Steve trying to make things work

So how did the dream come true, then?

Well, as I mentioned, because of the "girl" rule, the senior streamer team was able to add a fourth. I finished 4th at the flyoffs, so I was on the team. Then, because of Covid, one of our best streamer fliers decided not to go. Emma was 5th at the flyoffs so Emma joined the team as well. Our two teammates were Allison VanMilligan and Kevin Kuczek.

Allison and Kevin were both going to be flying a type of model Kevin and Allison's dad, Tim, developed. Carbon Veil models made in a female mold using a new body shape developed by Kevin. The shape is an extremely technical laminar flow design, still meeting all the FAI model size requirements, but resulting in markedly reduced drag. These models are also extremely light weight, critical for streamer contests. With nosecone, body tube, and fins, these models weigh roughly 5 grams, yet are strong

enough to withstand boost and flight, even off a piston. An absolutely stunning achievement.

Emma and I have always done well in streamer, not because of spectacular models, but because our streamers perform very well.

Once the team was decided, in late August, Kevin contacted me and asked if Emma and I would like to fly his models. I was well aware of how labor intensive these are to make but Kevin offered 5 of his "rejects" if Emma and I wanted to fin them up and fly them. I told him Emma and I would be happy to do whatever he and Alison wanted us to do. As it turns out, he sent the 5 body tubes and Emma and I put them together. We made brand new streamers and pistons and were ready to go. Because of our limited supply, 2 each to fly, and one for both of us to practice with, we couldn't actually practice with them until we got to Romania.

But when we opened the box with the models in it we were shocked to discover hairline cracks in all the models. Instead of simple bubble wrap I had filled the empty space in the transport box with large plastic packing balloons. Apparently enroute they must've expanded and crushed the models. So Emma and I set to work with mylar tape repairing them. When we test flew our first one it flew spectacularly. So well in fact that we decided not to piston launch them. They would have gone higher with pistons but it's just another failure mode that can get you disqualified if it doesn't work properly.

I explained that to Kevin and was very surprised the morning of the competition that he decided to forgo pistons as well. The final

Streamer team on the medal stand

element that led to our success in the event was another Kuczek innovation, a new type of weather monitor. Many of you may be familiar with kestrel hand-held weather stations that many competitors use to monitor for warm air. Well Kevin created his own super version of the same thing, and it was truly amazing.

We all flew very well. Kevin finished in 2nd place just one second behind the world champion. And we finished second as a team. So, Emma and I were on the medal stand together. Not in the way I had anticipated but a dream come true, nevertheless.

Overall, this year's World Spacemodeling Championship was very different from what we expected but it turned out to be spectacular in its own way.

The next World championship will be held here in the United States in July 2023. Tryouts for the team will be this coming summer at NARAM in Missouri. I'm really hoping that many of you will try out for the team.

Jim McLachlin's NCR Archer

The ground on the field was dried and cracked making recovery very treacherous

VIEW FROM THE FLIGHT LINE

2021: A Retrospective

DALE HODGSON

Well, here it is, December 2021 one week before Christmas. I'd like to say it's the end of another flying year but I really can't. This whole pandemic thing has really messed with us; not just from a work standpoint but a personal standpoint as well. Vacations have to be thought of differently, anything we do for fun has been impacted. Most of this I can handle, adapt and move on but it's REALLY bolloxed our so-called flying year. I got to fly exactly two, count 'em, two times. Once in August, once in October. Bada Bing…that's it. Seriously? I've flown more in a weekend in years past than I got to this year and I'm not liking it. Not much we could do about it though; at least we did get to fly together as much as we did. I could say that it could have been much worse but I'm not going to jinx anything going forward. Nor do I want to make any predictions as to what's coming for 2022; that's a crapshoot at best. At least as of right now we do have Horning's #1 and #2 available to us; many thanks to Buzz for getting that squared away. I'm truly grateful to have flown as much as I did; albeit begrudgingly.

I tried filling in the blanks and voids by buying and building; I think I have enough kits and parts to carry me well into retirement…well, who am I trying to kid, I'm hooked so I'll probably get the next big thing whenever that happens. One thing I did learn from 2021 though; it's trying to adapt, attempt some new things and expand my own horizons a bit. The last couple of launches we had were Mis-Fire Alleys; meaning we brought our own launch equipment to the field. Before the first one I didn't have anything but it didn't deter; others had equipment that was readily shared. So, I thought I'd pay that forward in a couple of ways; first was to contact our very own Fred Ziegler at Fade to Black (not to mention my Debauchery Brother Extraordinaire…as is Chris Palmer, just check out our shirts!). For those that do not know Fred all that well he is an exceptional rocketeer as well as an awesome metal fabricator and welder. I took the plunge and bought one of his extreme launch outfits (you guys didn't think I would ever do anything standard, did you?) so now I have a launch setup to handle both regular 1010 and those 1515 big boys. I did get to use the setup at our last launch; perfect operation doesn't even begin to cover it. But of course, when I jump on a theme, I jump on it big time. A couple of years ago I acquired a launch tower to be able to fly competition low power. Again, Fred to the rescue, he fabricated and build a stand for it. I thought I was done but…read on. At our last launch we were discussing a fairly new trend; at least for me. I've always flown rails for my high power, rods for my low power. With the advent of mini and micro rails that are becoming commonplace launch rods be coming to an end for me for the most part. I love the concept of rails over rods, they are more stable and easier to work with. I've had a couple of mishaps with rods over the years, mainly rod whip that caused a couple of my projects to hurl off in some crazy directions at even crazier trajectories. Rails, even these new minis and micros will keep this from happening. So again, I talked with ol' Fred….he has an entire mini launcher system available that will be perfect for these small rails so yep; I put my order in. Can't wait to try them out. There are buttons available for both mini and micro setups so that will no longer be an issue. New builds will have them; I will come up with a way to retrofit older projects. And of course, I will be more than happy to share so if we do get to fly more in 2022, I'll have it all there. Should be a great time.

One other thing did come out of 2021 that is pretty cool; Scott Miller came up with some very cool 3D kits that I and a couple of others had the privilege of flying to work out any kinks in design. Flights reviews were available in our last newsletter so if anyone missed them simply refer back. Anyway, the glitches have been identified and corrected. From what I hear more designs are in the future, including some kits that will handle 18mm motors. Pretty cool stuff if you ask me. I really do not know much about this 3D thing; others in the group do. Certainly not an expert but definitely like the results thus far. I was asked for some ideas; not that I'm all knowing but I did throw some stuff out there like staged projects; payload capable projects and cluster setups just to name a few. In other words, I'm curious as to what is available in low power traditional kits that can be translated to 3D. Did I mention gliders? For now though I'll concern myself with flight tests; I think I'm as good as anyone when it comes to pushing envelopes. That's what makes it all so much fun. All I need now is the opportunity to do it. It's probably not a good idea to wish time away, but I hope the pandemic thing turns endemic before too long so we all can get back out to the flight line and do what we love doing.

Product Review: Kozmo Bear Claw 54mm Motor Retainer

Herb Crites

There's a fairly new rocketry component maker in town! Kozmo Rockets (www.kozmorockets.com) has assembled a modest line of premium, mostly high power-oriented rocket building supplies that have gradually but steadily expanded in recent years under the well-regarded, online supplier of Aerotech rocket motors, BuyRocketMotors dot com. Kozmo has just introduced a new line of thread-on motor keepers it's dubbed the Bear Claw Retainer, currently available for 38mm and 54mm motor tubes.

Figure 1. Just introduced under the BuyRocketMotors/Kosmo line of rocketry supplies, the Bear Claw Motor Retainer rivals the form and function of those long produced by industry-leader Aero Pack

The Good

The Bear Claw is one gorgeous, excellently-crafted-in-the-Republic-of-Texas, rocket motor retainer. Functionally and materially, it appears to be in most every way the equal of industry-benchmark Aero Pack's line of 6061-T6 aluminum motor keepers…though for now at least, far more limited in variety and sizes than what Aero Pack serves up.

The Bear Claw retainer's cap threads onto its body smoothly and quickly, without cross-threading, binding, or jumping off under firm tightening. The raised internal ribs on the retainer body's forward half that is epoxied (JB Weld recommended) to the aft, outer surface of the motor tube are deep and plentiful. So when the epoxy cures, they should provide a strong, permanent attachment to the motor tube. There are no instructions that accompanied my retainer, aside from the epoxy to use. So, I would advise the user to rough-up the motor tube's engagement area with coarse sand paper before installing the Bear Claw retainer. Be sure to clean the retainer's ribbed bonding area, too, using ace-

tone, to remove any manufacturing oils or dust that might compromise the bond.

Appearance-wise, the Kozmo Bear Claw caps are available with a very flashy red, blue, or gold anodization. They've got some fancy, aggressive knurling on the side of the cap, too, in either a jaunty slant or bold, cross-hatch pattern. The cosmetics leave the Aero Pack's fine, vertical cap knurling and any-color-you-want-so-long-as-it's-black, plain-Jane looks relegated to runner-up in *this* beauty contest.

Figure 2. Kosmo's Bear Claw motor retainers are available in 38mm and 54mm. They come in gold, blue, or red anodization options, and are machined with either slant or diamond knurling on the cap sides. The bases are in black, only. (Illustration taken from the Kosmo Rockets web site.)

The Not So Good

In the 54mm size I purchased, the Kozmo Bear Claw is claimed to provide a snug fit onto BRM's own filament-wound motor mount tubes. But they don't specify whether they mean their standard 54mm fiberglass tubes (OD: 2.242", +-.003") or their thin-wall style (OD: 2.232", +-.003"). I tested the fit on my own slightly thicker-walled 54mm Blue Tube (OD 2.260"), and the Bear Claw body refused to slide on at all, despite a strong but prudent amount of force. Maybe after a good bit of sanding on the Blue Tube it *will* fit up properly. I'll give that a try when I use the Bear Claw on my next 54mm motor-powered build.

By comparison, Aero Pack's more mature retainer line currently offers three different 54mm motor tube OD mount sizes: *P* for various phenolic and fiberglass motor tubes; *L* for LOC/Precision paper, Madcow paper, or Blue Tube vulcanized cellulose pipes; and *L2* for 2.242" OD motor tubes. Aero Pack retainers thus accommodate virtually any popular motor tube that a builder might choose. And if he or she selects something completely unconventional as their motor tube (Christmas wrapping paper core? Leg lamp conduit? Bamboo?), Aero Pack additionally markets a 54mm universal retainer body sporting a sturdy flange, allowing bolt-on attachment to a centering ring (minimum airframe ID of 3.00") instead of being epoxied to the end of the motor tube.

And despite the Kozmo online store's description claim that *"Caps are compatible with legacy motor retainers using an ACME style thread"*, this apparently does NOT mean compatibility with the Aero Pack retainer. The 54mm Bear Claw cap's square ACME threads will not properly engage with the visibly finer, square, "quick turn" threads Aero Pack describes it uses on its own 54mm retainer body and cap.

JMRC HUVARS Club News

Flying Field Update

In the next couple of weeks the Board of Directors will begin reaching out to the new management at MIS (Michigan International Speedway) in an effort to re-establish flying dates at the Graves Campground launch site. We are hopeful that the new owners will be more responsive this year instead of near silence we received the past couple of years. This isn't a great time to talk to them about group outings considering the high infection rate in the state right now, but it was to be expected during the cold months and rates should wane again when it warms up.

Regardless, we still have Horning's 1 and 2 launch sites with Horning 1 likely being available throughout the Summer after hay cuttings (roughly every four weeks, weather depending).

We will look for opportunities to use the larger Horning 2 field when we can.

The club is always looking for new fields. If you have potential site in mind please reach out to the board.

NAR Section Grants Available for 2022

The NAR provides $250 grants to sections for the purchase of safety and launch operations equipment. With the joining of our two sections we can request up to $500. We are always looking for ideas from the membership for ways we can improve our launch operations. Let the BOD know if you have an idea which we could apply towards a grant application. It doesn't have to be one big thing and many small things add up.

NAR 2021-22 RCP (Rule Change Proposals) Cycle Open

The RCP is the process for changing rules in the Sporting Code. The current change proposals are now open for comment at the NAR Website. Here is a brief list of the changes requested for 2021-2022.

- Require altimeters for tracking
- Add C and D Dual Eggloft Altitude to the NRC event list
- Include D Dual Eggloft as an NRC event
- Include B class Helicopter Duration to the NRC event list
- Include B class Streamer Duration to the NRC event list
- Clarify mission point documentation for Scale/Sport Scale
- Reinforce punishment for egregious bad behavior
- Remove requirement to exceed an existing record by 1%
- New altimeters approval and availability
- Remove return rule 30.9.2 for NARAM
- Change Craftsman events to "Blind Judging"
- Allow any streamer attachment method for Streamer Duration
- Revise R&D scoring
- Align Sport Scale Mission Points rule
- Permanently add Sport Scale, Concept Scale, and Classic model as NRC events
- Standardize temperature recording at NARAM check-in

Big Bertha Contest Is NOT a Go!

Designed by Vern Estes, the Big Bertha is the iconic model rocket throughout the decades. Make Vern proud and enter your Big Bertha in this fun contest we will be holding at a 2022 Launch. Stand by for further updates as we get closer to flying season.

Goal

Make three flights with a single model (Big Bertha) and attempt to score the best in **FOUR** different events.

Vehicle

As mentioned, this is a Big Bertha contest. If you don't have a Big Bertha then any rocket with at least 18" of BT-60 and four fins will do. If you wish to build one from scratch you can download the plans here at JimZ Plans

Events

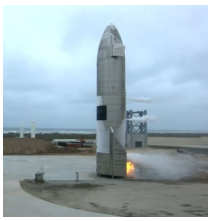
A Parachute Duration – Using an A impulse motor and parachute of any size, get a longest possible duration. Remember, you need to get it back for the other events!

B Streamer Duration PLUS Spot Landing - That's right, two events in one. Using a B impulse motor and streamer for recovery get the longest possible duration AND land closest to the target mark that will be placed randomly at the field.

C Altitude (altimeter) – Using a C impulse motor and electronic altimeter reach the highest altitude. I will have a couple of altimeters to loan out if you don't have a suitable altimeter.

Buzz Nau is sponsoring a rocket design contest for the club. First place will be awarded $50. Runners up will receive kits to be named later. The rules are simple;

- The design needs to be original
- The design must be capable of using currently available motors
- While you do not need to build or fly your submission, the design must be stable
- No up or down scales or modifications of commercial kits
- Entries can be submitted using Rocksim, OpenRocket or other drawing applications
- Hand drawn designs are allowed. Just scan and email them
- Entries will be judged by the BOD
- Deadline for submissions is open till further notice
- Send submissions to USSMidway@gmail.com



CURRENT EVENTS IN SPACE EXPLORATION

Wow, what a conclusion to 2021. We saw 24 launches in the final two months of the year including a couple of milestones. SpaceX made their 100th successful landing of a Falcon booster vehicle. Astra made it to orbit finally and in a shorter time than it took SpaceX to accomplish this goal. Rocket Lab made another successful step towards catching their boosters mid-air via a helicopter, and the James Webb Space Telescope is on its way to Lagrange Point 2.

JAXA finally launched the RAISE 2 mission which had been originally scheduled for October. The multi satellite payload was flown on 9 November aboard an IHI Aerospace Epsilon vehicle from Uchinoura Space Center in Japan. The Rapid Innovative payload demonstration Satellite 2 was developed and built by Mitsubishi as a collaborative test that includes six experiments from partner groups. There were eight other rideshare satellites deployed in a sun-synchronous orbit.

Epsilon vehicle with RAISE 2 satellite launch - JAXA photo

JAXA concluded their launches for the year on 22 December with a Mitsubishi H-IIA 204 vehicle carrying the Inmarsat I-6 F1 telecommunications satellite built by Airbus Defence and Space. Launched from the Tanegashima Space Center in Japan, the Inmarasat I-6 is thought to be the largest and most sophisticated telecom satellite ever deployed.

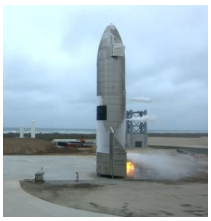
Japanese H-IIA with Inmarsat I-6 launch - JAXA photo

Crew-3 was the first of seven SpaceX launches in the last two months of the year. The crew of four astronauts lifted off aboard a Falcon 9 on 11 November from Kennedy Space Center and docked with the ISS the following day. The crew includes Commander Raja Chari, Pilot Thomas Marshburn, NASA Mission Specialist Kayla Barron, and ESA Mission Specialist Matthias Mauer. Their expected stay at the ISS is six months. This was the first flight of the Crew Dragon capsule *Endurance* and the second flight for the Falcon 9 booster which made a successful landing aboard the droneship *A Shortfall of Gravitas.*

Falcon 9 with Crew Dragon C210 Endurance capsule - NASA photo

The next SpaceX flight took place several days later on 13 November also from Cape Canaveral. The Starlink Group 4-1 mission lofted the first 53 Starlink v1.5 satellites into shell 4. This was the Falcon 9 booster's ninth flight which landed safely on the droneship *Just Read the Instructions.* Both payload fairings were also recovered.

SpaceX Starlink 4-1 Falcon 9 rises from the fog - SpaceX photo

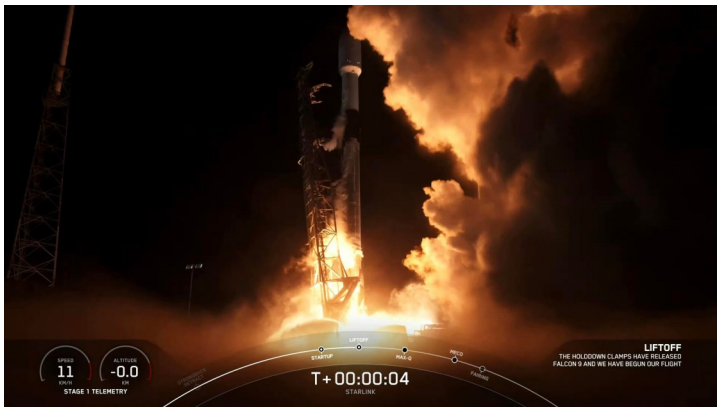


CURRENT EVENTS IN SPACE EXPLORATION

In an exciting change of pace for payloads, SpaceX launched the DART (Double Asteroid Redirection Test) experiment on 24 November aboard a Falcon 9 from Vandenberg Space Force base, CA. The experiment is expected to impact asteroid Dimorphos in an attempt to deflect its orbit. Along for the ride is the rideshare satellite from the Italian Space Agency that will deploy before impact and record the event. It was the Falcon 9 booster's third flight. It landed aboard the droneship *Of Course I Still Love You* and both payload fairings were recovered as well.

Falcon 9 lofting the DART space vehicle - SpaceX photo

Starlink 4-3 was the second group of Starlink satellites deployed to shell 4. The Falcon 9 booster lifted off on 2 December from Cape Canaveral Space Force Station, successfully adding another 48 satellites to the constellation. It was the booster's ninth flight and landed aboard the droneship *A Shortfall of Gravitas.*



SpaceX mission Starlink 4-3 liftoff - SpaceX live feed

On 9 December SpaceX launched the IXPE (Imaging X-ray Polarimetry Explorer) satellite aboard a Falcon 9 from Kennedy Space Center. As the name implies, IXPE will measure the polarity of X-rays from deep space objects. The Falcon 9 booster recovered on the droneship *Of Course I Still Love You* for its fifth landing. Both fairing halves were also salvaged.

Falcon 9 with IXPE satellite the day before launch - NASA photo

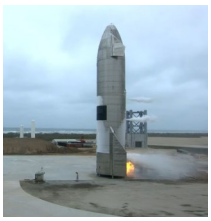
On 18 December the Starlink 4-4 mission added the third group of Starlink v1.5 satellites to shell 4. The 52 satellites were deployed from a Falcon 9 that was launched from Vandenberg Space Force Base. It was the booster's eleventh flight and successful landing on the droneship *Of Course I Still Love You*. This brought the total number of Starlinks launched to over 1,900.

Liftoff of Starlink 4-4 - SpaceX photo

Later, on the same day SpaceX launched the Turksat 5B communications satellite aboard a Falcon 9, this time from the Cape Canaveral Space Force Station. The Turksat 5B was built by Airbus Defence and Space and will provide comms to Turkey, Europe, the Middle East, and partially Asia and Africa.

Falcon 9 with Turksat 5B prior to launch - SpaceX photo

Just four days after the double launch, SpaceX put up the CRS-24 (SpX-24) resupply mission to the ISS. The Cargo Dragon capsule (209) loaded with nearly 3,000 kg of supplies (and Christmas presents) rode atop a Falcon 9 booster launched from the Kennedy



CURRENT EVENTS IN SPACE EXPLORATION

Space Center and docked at the ISS the next day. The expected mission duration is 30 days. It was the first launch for the booster which also made the historic 100th successful landing of a Falcon class booster. Despite a dead center landing on the droneship *Just Read the Instructions*, the booster had shifted drastically during the ride back to the Cape and was clearly damaged. All four landing legs as well as engine nozzles showed significant damage that will require major repair work.

Falcon 9 with Cargo Dragon SpX-24 supplies and experiments - NASA photo

arianespace
arianeGROUP

The first launch from Arianespace this period occurred on 16 November and consisted of deploying three CERES French military reconnaissance satellites from a Vega launch vehicle. This was the third Vega launch of 2021 and the satellites were deployed successfully.

Arianespace Vega with CERES recon satellite lifts off - Arianespace photo

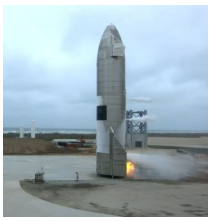
Arianespace used a Soyuz ST-B booster with Fregat-MT upper stage to launch two ESA navigation satellites as part of the European Union's Galileo navigation program. The launch occurred on 4 December at ESA French Guiana launch facility.

Arianespace Soyuz ST-B lifts off with two Galileo satellites - Arianespace photo

After numerous delays, cost overruns, and technological hurdles the James Webb Space Telescope was launched aboard an Ariane 5 from the ESA French Guiana Space Centre on 25 December. The launch and subsequent course correction burns have been flawless as the telescope has begun its journey to Lagrange Point 2. It has also started its transformation from payload to telescope.

James Webb Telescope lifts off atop an Ariane 5 - Arianespace photo

OneWeb 12 was the final launch from Arianespace in 2021 on 27 December. The Soyuz 2.1b with Fregat upper stage deployed 36 OneWeb internet communications satellites which now number



CURRENT EVENTS IN SPACE EXPLORATION

nearly 300. The Soyuz 2.1b was launched from Baikonur Cosmodrome by ROSCOSMOS as a subcontractor for Arianespace.

OneWeb 12 launch from Baikonur Cosmodrome - Arianespace photo

ROCKET LAB

Rocket Lab performed two launches this period, the first, the Electron *Love At First Insight*, flew on 18 November from the Mahia Peninsula in New Zealand. The payload successfully reached orbit and consisted of two earth observation satellites for the Blacksky constellation. The booster was also recovered successfully by parachute in the Pacific Ocean. It was a dry run for using a helicopter to perform a mid-air capture of future Electron boosters and was also considered successful.

Launch of Electron launch vehicle Love At First Insight - Rocket Lab photo

A second Electron launch by Rocket Lab, *A Data With Destiny*, was made on 8 December from the Mahia Peninsula in New Zealand and again with two Blacksky Earth observation satellites. This time however, there was no attempt to recover the booster.

Launch of Electron launch vehicle A Data With Destiny - Rocket Lab photo

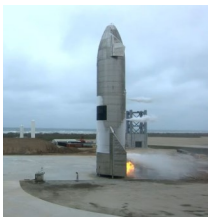
ASTRA

Astra joined the ranks of orbital vehicles with the successful launch of their Rocket 3.3, LV007 on 20 November from the Pacific Spaceport in Kodiak Alaska. This was the second attempt by Astra in 2021 and fourth overall. The payload was an inert mass simulator, but future missions will deploy DoD satellites.

Astra's Rocket 3.3 LV007 on its way to orbit - Astra photo

РОСКОСМОС

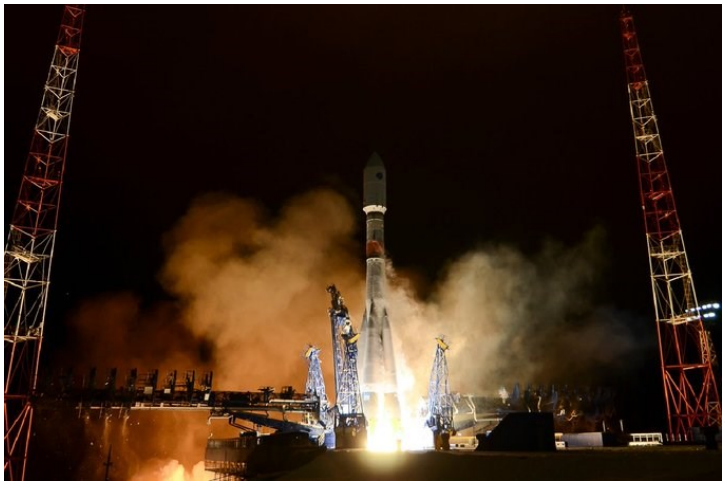
The Uzlovoy Module *Prichal* was launched by ROSCOSMOS aboard a Soyuz 2.1b on 24 November from the Baikonur Cosmodrome. The module docked with the Russian section of the International Space Station (ISS) two days later. The module contains 6 docking ports to be used with other Russian vehicles.



CURRENT EVENTS IN SPACE EXPLORATION

Soyuz 2.1b lifting off to the ISS with the Prichal Module - ROSCOSMOS photo

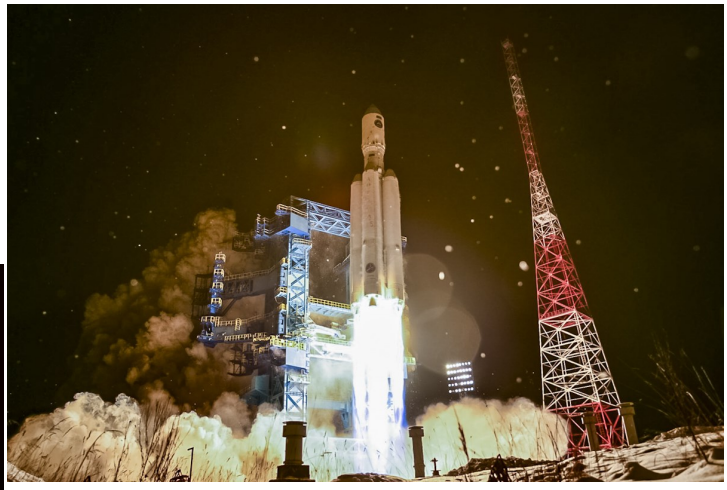
The next ROSCOSMOS Soyuz 2.1b launch carried the EKS 5 Tundra missile early warning satellite for the Russian Ministry of Defense. Satellite deployment was successful.



Soyuz 2.1b lifts off with EKS 5 EW satellite - ROSCOSMOS photo

On 13 December ROSCOSMOS launched a pair of telecommunications satellites, Ekspress AMU-3 & 7 on a Proton M booster from the Baikonur Cosmodrome. Both satellites were successfully placed in geosynchronous orbit for the Russian Satellite Communications Company.

The final launch in 2021 occurred on 27 December by ROSCOSMOS. This was a test flight of a Persei upper stage atop an Angara A5 booster. The test was deemed a failure when the Persei upper stage failed to ignite for a second time. The payload was a mass simulator for the Ministry of Defense. Angara is planned as a replacement for the Proton booster vehicle.



Angara A5 with a test Persei upper stage - ROSCOSMOS photo

On 7 December ULA launched the Space Test Program 3 (STP-3) payloads aboard an Atlas V 551 from the Cape Canaveral Space Force Station to a geosynchronous orbit. There were two main payloads, each carrying multiple experiments that were sponsored by the USAF and USSF.

Proton M lofting the Ekspress AMU-3 & 7 satellites - ROSCOSMOS photo

ULA Atlas V 551 STP-3 mission prior to launch - ULA photo

Vintage Ad

CHANCE VOUGHT'S *Regulus II* supersonic missile for the U. S. Navy uses essential Hamilton Standard equipment. This installation is another example of Hamilton Standard's leadership in the design and production of equipment, propellers, or electronic components for more than 50 modern types of turbine or rocket powered aircraft and missiles.

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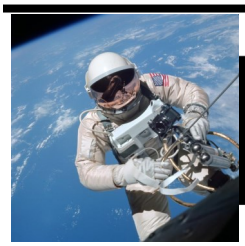


THIS MONTH IN AEROSPACE HISTORY

Source—NASA / ROSCOSMOS Archives

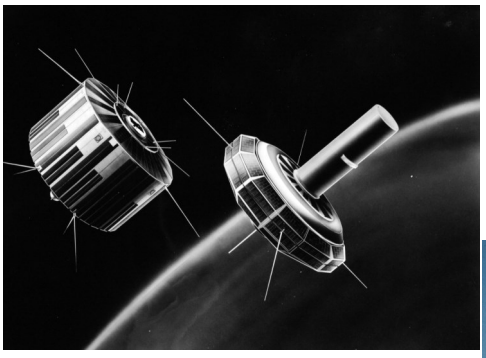
450 Years Ago - 1571
December 27: Astronomer Johannes Kepler born

120 Years Ago - 1906
December 30: Sergey Korolev born, Zhitomir, Ukraine USSR

75 Years Ago - 1946
December 9: Bell X-1 first powered flight

December 17: First night firing in the U.S. of a V-2. Missile No. 17 launched from the White Sands Missile Range, NM

60 Years Ago - 1961
November 15: Transit IV-B launched by Thor Ablestar from Cape Canaveral



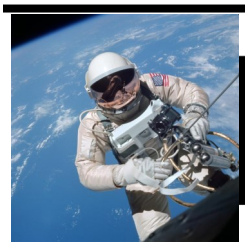
November 16: Discoverer 35 launched by Thor Agena from Vandenberg AFB.
November 18: Ranger 2 launched by Atlas Agena from Cape Canaveral

November 21: The Air Force launched a Titan ICBM from Cape Canaveral carrying a target nose cone to be used in Nike-Zeus antimissile-missile tests. This was the first Titan ICBM to be fired from Cape Canaveral by a military crew
November 28: The prime contract was awarded to North American Aviation for the development and construction of the Apollo spacecraft
November 29: Enos, a 37.5 pound five-year-old male chimpanzee, sent aloft from Cape Canaveral in a capsule atop a Mercury Atlas 5 rocket

December 12: Discoverer 36 launched from Vandenberg Air Force Base with special payload, OSCAR 1. It was Amateur Radio's first satellite and the world's first piggyback satellite

55 Years Ago - 1966
November 6: Lunar Orbiter 2 launched by Atlas Agena from Cape Canaveral. Photographed lunar landing sites from lunar orbit

November 11: The last Gemini flight, *Gemini XII* (GTA-12), was launched from Cape Canaveral. During this mission, American astronauts James A. Lovell, Jr. and Edwin E. "Buzz" Aldrin, Jr. completed three EVAs and a docking with an Agena target vehicle.



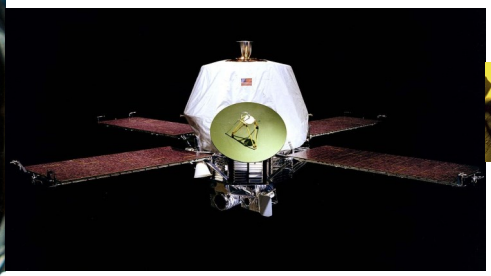
THIS MONTH IN AEROSPACE HISTORY

Source—NASA / ROSCOSMOS Archives

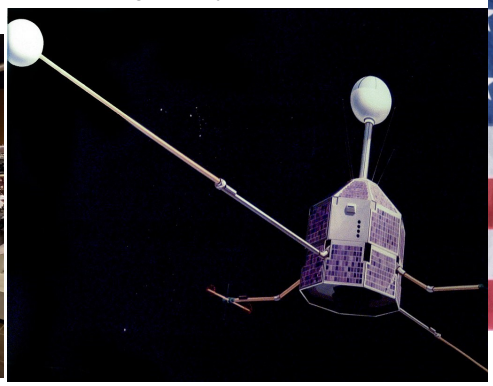
December 7: ATS 1 launched by Atlas Agena from Cape Canaveral
December 14: Biosatellite 1 launched by Delta from Cape Canaveral

December 22: First HL-10 glide flight, Bruce Peterson pilot, DFRF

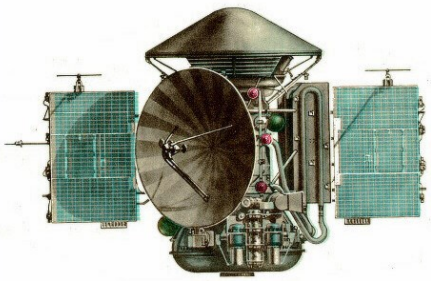
50 Years Ago - 1971
November 13: Mariner 9 becomes first spacecraft to orbit another planet – Mars. Transmitted 6,876 pictures. Launched May 30, 1971.



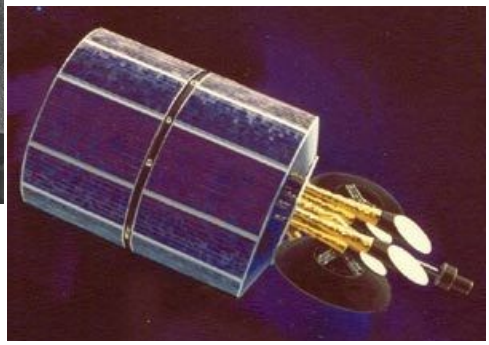
November 15: Explorer 45 (Explorer S-Cubed A) launched by a Scout from San Marco Range, Kenya



December 2: USSR Mars 3 lands on Mars, launched May 28, 1971. First unmanned landing on Mars



December 19: Intelsat 4 F-3 launched by Atlas Centaur from Cape Canaveral

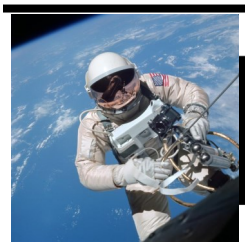


40 Years Ago - 1981
November 4: Venera 14 launched (USSR Venus Lander/Flyby) by Proton K from Baikonur

November 12: STS-2 (Space Shuttle *Columbia*) launched from KSC. Crew: Joe H. Engle and Richard H. Truly. Landed November 14 at Edwards Air Force Base (EAFB). Mission Duration: 2 days, 6 hours

November 19: RCA-Satcom 3-R launched by a Delta from Cape Canaveral

December 15: Intelsat 5D F-3 launched by Atlas Centaur from Cape Canaveral



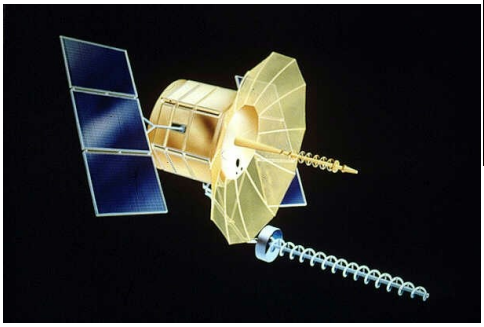
THIS MONTH IN AEROSPACE HISTORY

Source—NASA / ROSCOSMOS Archives

35 Years Ago - 1986

November 13: Polar Beacon and Research satellite aka Polar Bear launched. BEAR is an acronym for Beacon Experiment and Auroral Research. It was part of the Air Force STP P87-1 mission. Launched by a Scout from Vandenberg AFB. It was used to study communication interference caused by solar flares and aurora activity in support of the military.

December 4: Fleetsatcom 7 launched by Atlas G Centaur from Cape Canaveral



30 Years Ago - 1991

November 24: STS-44 (Space Shuttle *Atlantis*) launched from KSC. Crew: Frederick D. Gregory, Terence T. "Tom" Henricks, James S. Voss, Story F. Musgrave, Thomas J. Hennan, and Mario Runco. Deployed the third Defense Support Program satellite. Landed Dec. 2 at Edwards Air Force Base (EAFB). Mission Duration: 6 days, 23 hours

November 28: First in series of improved Block 5D-2 satellites in the Defense Meteorological Satellite Program, launched by Atlas E from the Vandenberg AFB

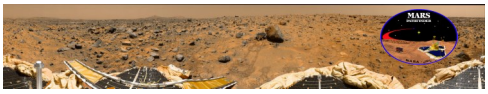
25 Years Ago - 1996

November 4: Galileo probe flyby of Callisto

November 7: Mars Global Surveyor launched by Delta 2 from Cape Canaveral. Arrived at Mars on 12 September 1997. First successful U.S. mission to arrive at Mars since the Viking landers in 1976. Contact lost November 2006.

November 19: STS-80 (Space Shuttle *Columbia*) launched from KSC. Crew: Kenneth D. Cockrell, Kent V. Rominger, Tamara E. Jernigan, Thomas D. Jones, and F. Story Musgrave. Deployed German-built Orbiting and Retrievable Far and Extreme Ultraviolet Spectrograph-Shuttle Pallet Satellite II (ORFEUS-SPAS II) and Wake Shield Facility (WSF). Landed December 7 at KSC. Mission Duration: 17 days, 16 hours

December 4: Mars Pathfinder launched aboard a Delta II 7925 launch vehicle from Cape Canaveral Air Station. Landed on Mars on July 4, 1997



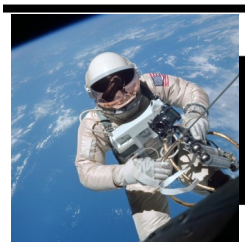
December 24: Bion 11 launched from Plesetsk cosmodrome by a Soyuz-U rocket. It carried a capsule housing two monkeys and several newts, snails, beetles, fruit flies, and small plants to study their responses and behaviors under microgravity

20 Years Ago - 2001

November 27: DirecTV-4S, a geosynchronous communications spacecraft that provides 300 local TV channels to 41 metropolitan communities, was launched by an Ariane 44LP rocket from Kourou

December 5: STS-108 (Space Shuttle *Endeavour*) launched from KSC. Crew: Dominic L. Gorie, Mark E. Kelly, Linda M. Godwin, and Daniel M. Tani. 12th Space Shuttle flight to the International Space Station (ISS). Carried an Italian cargo module, the Raffaello Multi-Purpose Logistics Module (MPLM), that was attached to the Unity module of the ISS. Also, Expedition 3 & 4 crews exchange. Landed December 17 at KSC. Mission Duration: 11 days, 19 hours

December 7: TIMED (Thermosphere, Ionosphere, Mesosphere Energetics and Dy-



THIS MONTH IN AEROSPACE HISTORY

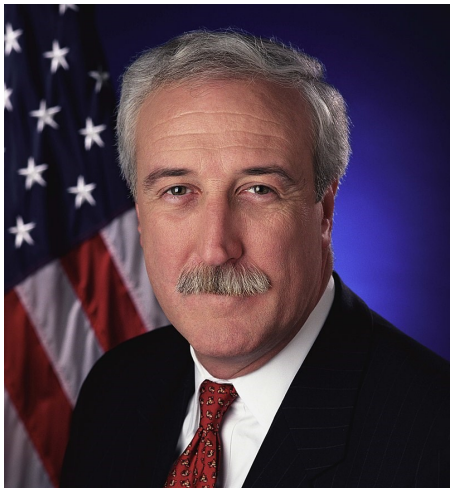
Source—NASA / ROSCOSMOS Archives

namics) ionospheric research satellite launched by a Delta 2 rocket from Vandenberg AFB

December 7: Jason 1, an American French (NASA-CNES) oceanographic satellite was launched by a Delta 2 rocket from Vandenberg AFB to supplement and extend the TOPEX/Poseidon mission results by monitoring the sea surface level and wave heights

December 16: STARSHINE 2, a US high school educational microsatellite was deployed from STS-108. It was built with the participation of 25,000 students in 26 countries and very similar to the STARSHINE 3 that was launched in September 2001

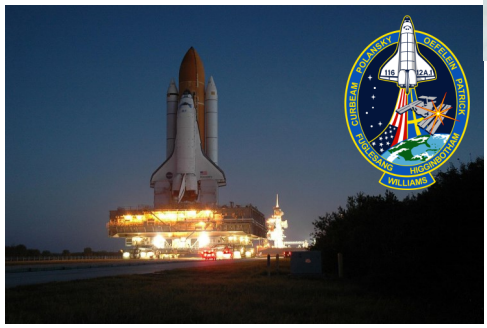
December 21: Sean O'Keefe takes office as tenth NASA Administrator



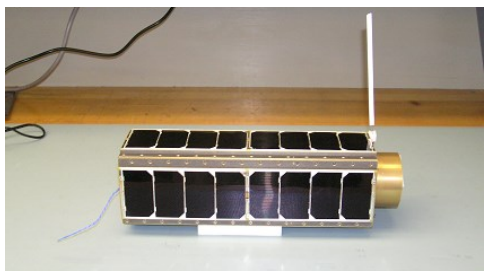
15 Years Ago - 2006

November 17: Navstar 59, also known as USA 192, as GPS 2RM F-3, and as GPS 2R-16, an American navigational satellite in the GPS fleet, was launched by a Delta 2 rocket from Cape Canaveral

December 10: STS-116 (Space Shuttle *Discovery*) launched from KSC. Crew: William A. Oefelein, Joan E. Higginbotham, Mark L. Polansky, Robert L. Curbeam, Nicholas J.M. Patrick, Sunita L. Williams, and the European Space Agency's Christer Fuglesang (Sweden). International Space Station Flight 12A.1. Rewired the International Space Station's power system, paving the way for further construction. Landed December 22 at KSC. Mission Duration: 12 days, 21 hours



December 16: GeneSat 1, a NASA-Ames nanosatellite, was launched by a Minotaur rocket from Wallops Island. The 10 kg craft carries E. Coli bacteria to monitor the effect of space radiation by protein-sensing optical instruments

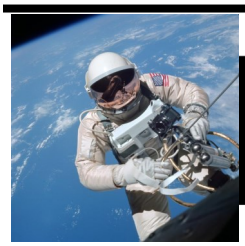


10 Years Ago - 2011

November 8: Phobos-Grunt (alternatively Fobos-Grunt) was a Russian mission designed to land on the Martian moon Phobos and return a sample to Earth. The Fregat upper stage failed to fire and the spacecraft remained in Earth orbit. The orbit decayed until it entered the Earth's atmosphere on January 15, 2012.

November 14: Soyuz TMA-22 was launched from Baikonur by a Soyuz launch vehicle. Crew: NASA astronaut Dan Burbank; and Russian cosmonauts Anton Shkaplerov and Anatoly Ivanishin. The craft docked with the ISS Poisk module on 16 November 2011. This is the final flight of a Soyuz-TMA capsule. Future missions will be flown by a TMA-M spacecraft, the newer digital Soyuz spacecraft

November 26: The Mars Science Laboratory (MSL), nicknamed Curiosity, is a large rover launched from Space Launch Com-



THIS MONTH IN AEROSPACE HISTORY

Source—NASA / ROSCOSMOS Archives

plex 41 on Cape Canaveral Air Force Station with the objective of exploring the Martian environment as a former or current habitat for life

December 21: Soyuz TMA-03M, the first of the Russian Soyuz TMA-M series spacecraft, launched from Baikonur by a Soyuz launch vehicle. Crew: ESA astronaut André Kuipers, cosmonaut Oleg Kononenko, and NASA astronaut Don Pettit. It successfully docked with the International Space Station's (ISS) Mini Research Module-1 (MRM -1) "Rassvet" Nadir docking port on December 23

5 Years Ago - 2016

November 17: Soyuz MS-03 spacecraft launched by a Soyuz FG launch vehicle from Tyuratam (Baikonur Cosmodrome). Crew: Oleg Novitsky, Thomas Pesquet, and Peggy Whitson. (Expedition 50). Peggy Whitson set NASA record for cumulative time in space- 665 days

November 19: The Geostationary Operational Environmental Satellite-R Series (GOES-R), the next generation of geostationary weather satellites, launched by an Atlas V launch vehicle from Cape Canaveral

December 9: HTV-6, An unmanned cargo spacecraft launched to resupply the International Space Station, launched by an H-2B launch vehicle from Tanegashima, Japan.

December 15: Cyclone Global Navigation Satellite System (CYGNSS) launched by a Pegasus XL launch vehicle from Cape Canaveral. The CYGNSS mission uses eight micro-satellites to measure wind speeds over Earth's oceans, increasing the ability of scientists to understand and predict hurricanes. Each satellite will take information based on the signals from four GPS satellites

LAUNCH WINDOWS

Launch dates from SpaceFlight.com

January 6, 2022
Falcon 9 - Starlink 4-5
Launch site: Kennedy Space Center
A SpaceX Falcon 9 rocket will launch with another batch of 49 Starlink internet satellites.

January 2022
LauncherOne - Above the Clouds
Launch site: Cosmic Girl, Mojave Air and Space Port
A Virgin Orbit LauncherOne rocket will launch on its fourth flight after dropping from a modified Boeing 747 carrier jet. The mission will be Virgin Orbit's second operational launch, carrying small satellites for the U.S. military's Space Test Program, Spire, and the Polish company SatRevolution.

January 2022
Electron - BlackSky 16 & 17
Launch site: Mahia Peninsula, New Zealand
A Rocket Lab Electron rocket will launch two small second-generation satellites for BlackSky's commercial fleet of Earth observation spacecraft. Delayed from September and December.

January 13, 2022
Falcon 9 - Transporter 3
Launch site: Cape Canaveral Space Force Station
A SpaceX Falcon 9 rocket will launch the Transporter 3 mission, a rideshare flight to a sun-synchronous orbit with numerous small microsatellites and nanosatellites for commercial and government customers.

January, 2022
Falcon 9 - Starlink
Launch site: Kennedy Space Center
A SpaceX Falcon 9 rocket will launch with another batch of Starlink internet satellites.

January 21, 2022
Atlas 5 - USSF 8 (GSSAP 5 & 6)
Launch site: Cape Canaveral Space Force Station
A United Launch Alliance Atlas 5 rocket will launch the USSF 8 mission with the fifth and sixth satellites for the Space Force's Geosynchronous Space Situational Awareness Program, or GSSAP, designed to help the military track and observe objects in geosynchronous orbit. The rocket will fly in the 511 vehicle configuration with a five-meter fairing, one solid rocket booster and a single-engine Centaur upper stage.

January 24, 2022
Falcon 9 - CSG 2
Launch site: Cape Canaveral Space Force Station
A SpaceX Falcon 9 rocket will launch the second COSMO-SkyMed Second Generation, or CSG 2, radar surveillance satellite for ASI, the Italian space agency.

January, 2022
Falcon 9 - Starlink
Launch site: Kennedy Space Center
A SpaceX Falcon 9 rocket will launch with another batch of Starlink internet satellites.

Early 2022
Falcon Heavy - USSF 44
Launch site: Kennedy Space Center
A SpaceX Falcon Heavy rocket will launch the USSF 44 mission for the U.S. Space Force. The mission is expected to deploy two spacecraft payloads directly into geosynchronous orbit, one of which is the military's TETRA 1 microsatellite.

TBD. 2022
SSLV - Demonstration Launch
Launch site: Satish Dhawan Space Center
India's Small Satellite Launch Vehicle (SSLV) will launch on its first orbital test flight. Consisting of three solid-fueled stages and a liquid-fueled upper stage, the SSLV is a new Indian launch vehicle designed to carry small satellites into low Earth orbit.

TBD, 2022
SSLV - BlackSky Global
Launch site: Satish Dhawan Space Center
India's Small Satellite Launch Vehicle (SSLV) will launch on its first commercial mission with four Earth observation satellites for BlackSky Global, a Seattle-based company. The rideshare mission for BlackSky is being arranged by Spaceflight.

TBD, 2022
PSLV - RISAT 1A
Launch site: Satish Dhawan Space Center
India's Polar Satellite Launch Vehicle (PSLV), designated PSLV-C52, will launch the Indian RISAT 1A radar Earth observation satellite.

Early 2022
Starship - Orbital Test Flight
Launch site: Starbase, Boca Chica Beach
A SpaceX Super Heavy and Starship launch vehicle will launch on its first orbital test flight. The mission will attempt to travel around the world for nearly one full orbit, resulting in a re-entry and splashdown of the Starship near Hawaii.

February 15, 2022
Soyuz - Progress 80P
Launch site: Baikonur Cosmodrome
A Russian government Soyuz rocket will launch the 80th Progress cargo delivery ship to the International Space Station. The rocket will fly in the Soyuz-2.1a configuration.

February 19, 2022
Antares - NG-17
Launch site: Wallops Island
A Northrop Grumman Antares rocket will launch the 18th Cygnus cargo freighter on the 17th operational cargo delivery flight to the International Space Station. The mission is known as NG-17. The rocket will fly in the Antares 230+ configuration, with two RD-181 first stage engines and a Castor 30XL second stage.

February 20, 2022
Soyuz - OneWeb 13
Launch site: French Guiana
An Arianespace Soyuz rocket, designed VS27, will launch on a mission from the Guiana Space Center in South America. The Soyuz will launch 34 satellites into orbit for OneWeb, which is developing a constellation of hundreds of satellites in low Earth orbit for low-latency broadband communications. The Soyuz-2.1b (Soyuz ST-B) rocket will use a Fregat upper stage.

February 28, 2022
Falcon 9 - Axiom Mission 1
Launch site: Kennedy Space Center
A SpaceX Falcon 9 rocket will launch a Crew Dragon spacecraft on its sixth flight with astronauts. The commercial mission, managed by Axiom Space, will be commanded by former NASA astronaut Michael López-Alegría. Paying passengers Larry Connor, Mark Pathy, and Eytan Stibbe will also be on-board for the 10-day mission to the International Space Station.

World Spacemodeling Championships - 2021

Lots of medals this time for the U.S. team

U.S. S8 RC Rocketglider Team

Team Manager Matt Steele with our host, General Ion Guzu

Interesting British helicopter design