



Art in Space: The PACE-1 Technology Demonstration

Luke Idziak
June 24, 2021

NASA ARC

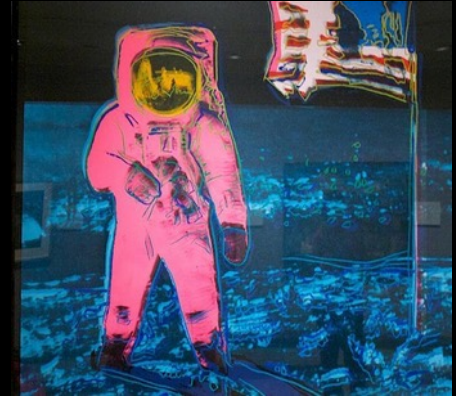


Images courtesy of NASA

Luke Idziak 2021



Art in Space at NASA and at Ames Research Center: A Rich History, Continuing Into The Future..



- The earliest collaboration between art and science at NASA: the creation of the NASA Art Program in 1962, just four years after the agency's establishment.

- Notable Artists Involved and Shown here:
Norman Rockwell; Andy Warhol; Robert Rauschenberg

- The artwork created shaped the stories of early spaceflight into a popular American mythology, one that inspires the collective imagination and a sense of shared accomplishment.

- First NASA Art Director: "The artists were really missionaries for NASA. I mean, they were carrying the message out like nothing else would."

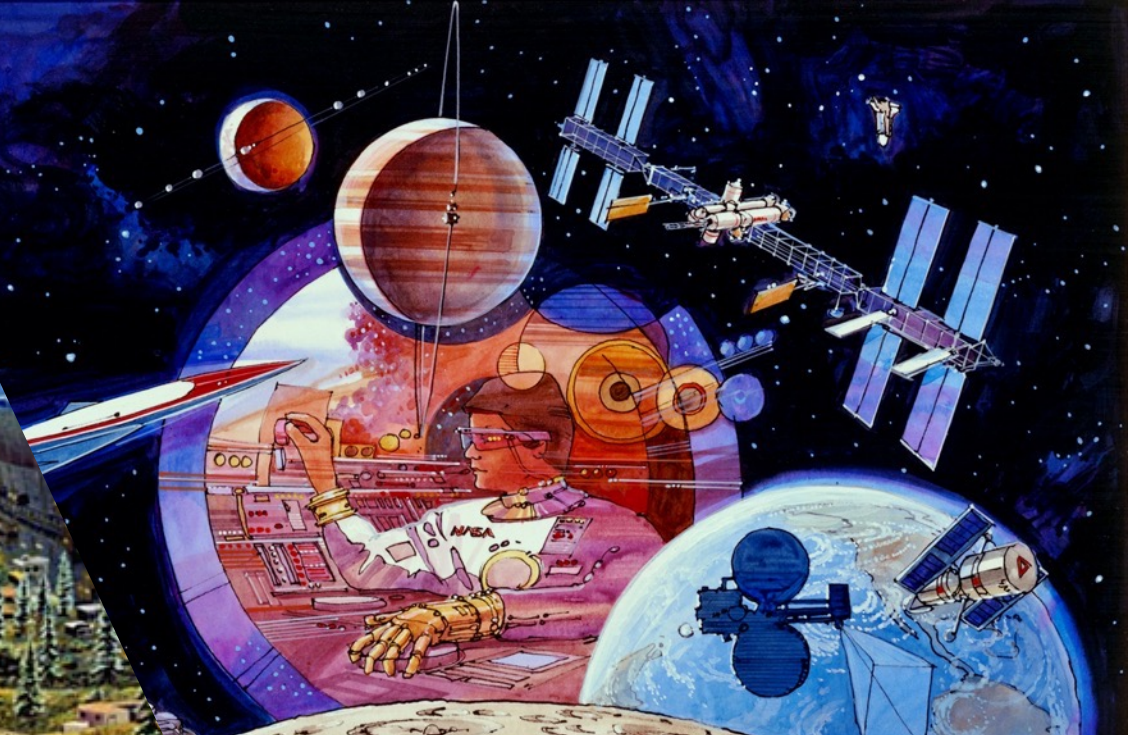
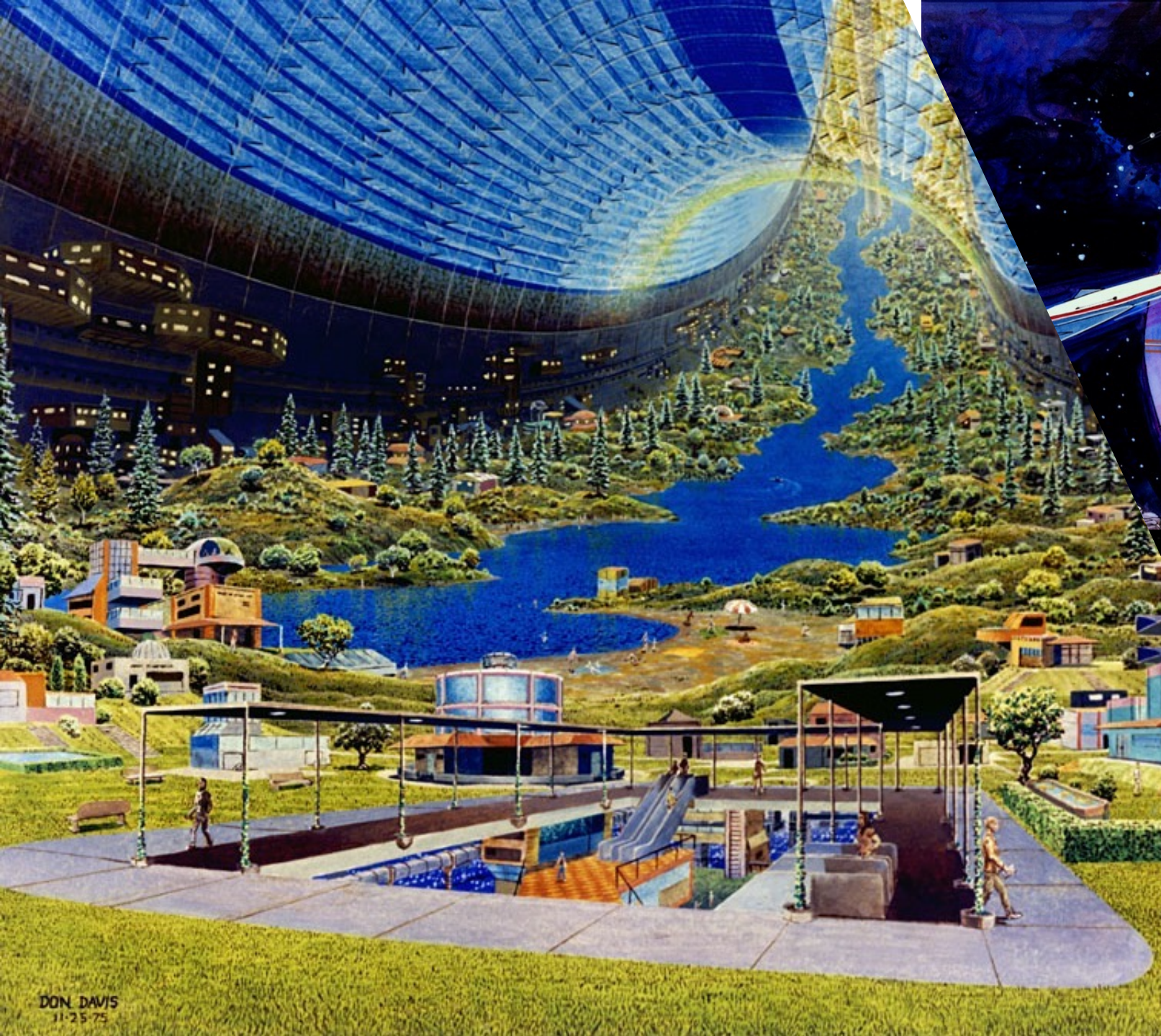




Art at Ames: Bringing together Artists, Scientists, and Engineers to fulfill the NASA mandate to engage, educate, and inspire.

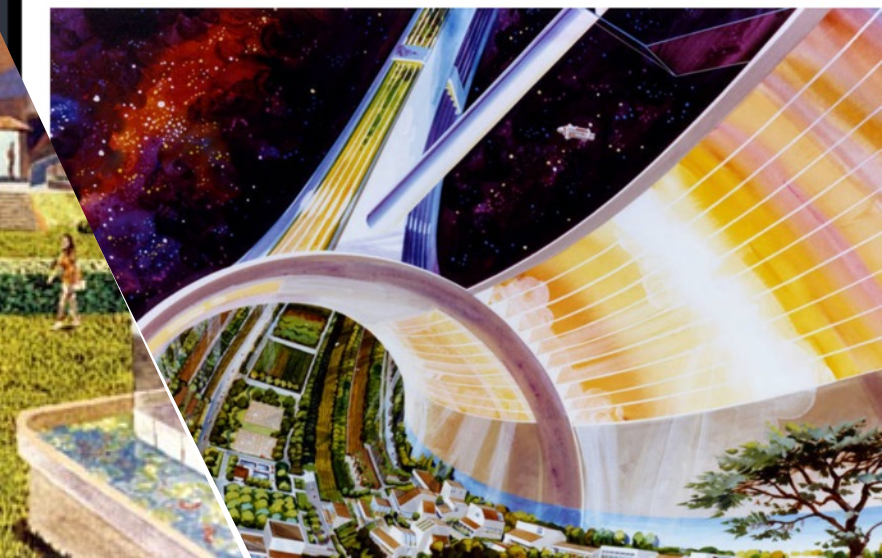


Iconographic Art at Ames: The 70's Stanford habitat concept design studies partnered NASA Ames scientists and engineers with external artist collaborator Rick Guidice to produce memorable paintings which continue to have a dramatic and lasting impact on the popular imagination of human activity in space.



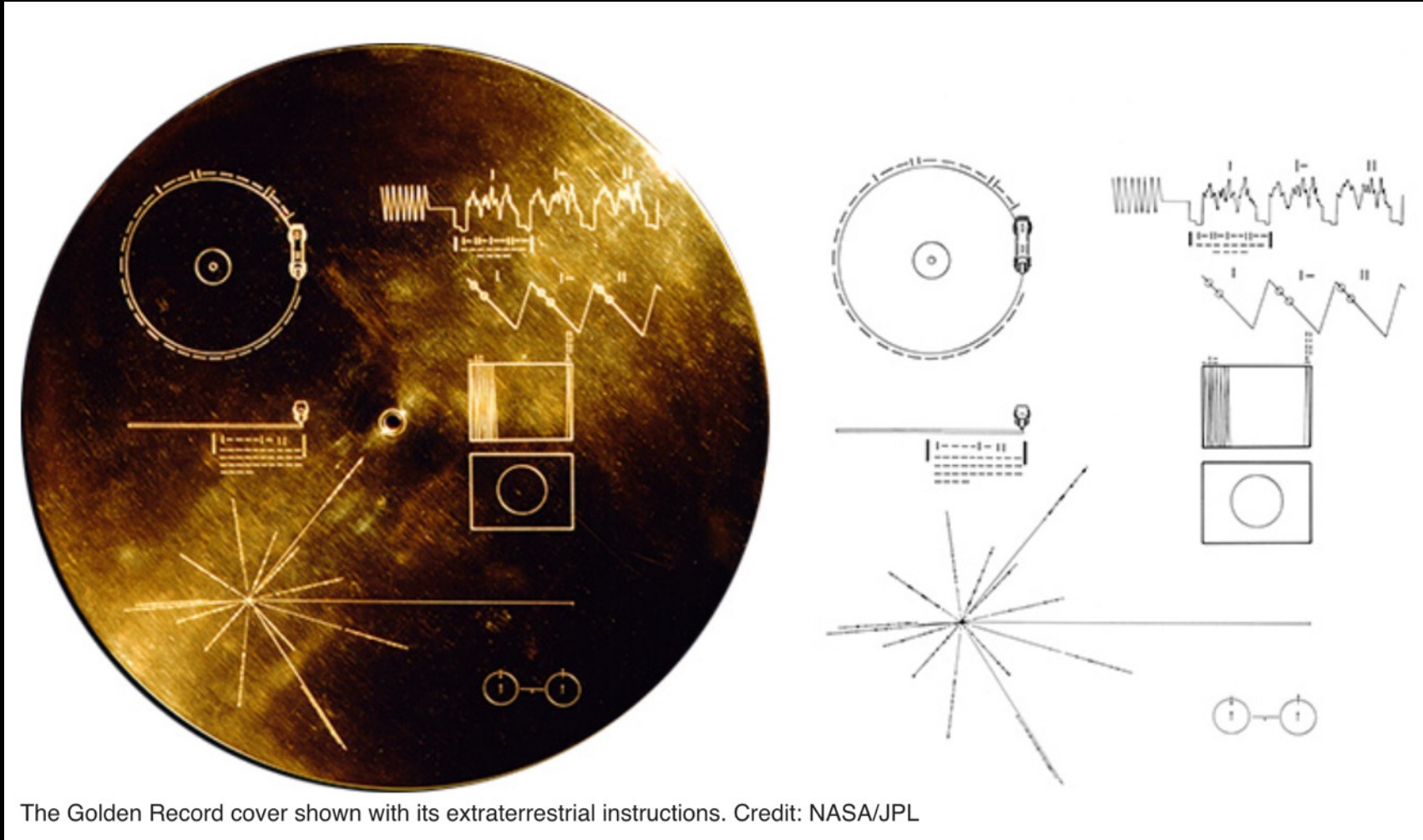
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NASA and Art: A Collaboration Colored with History



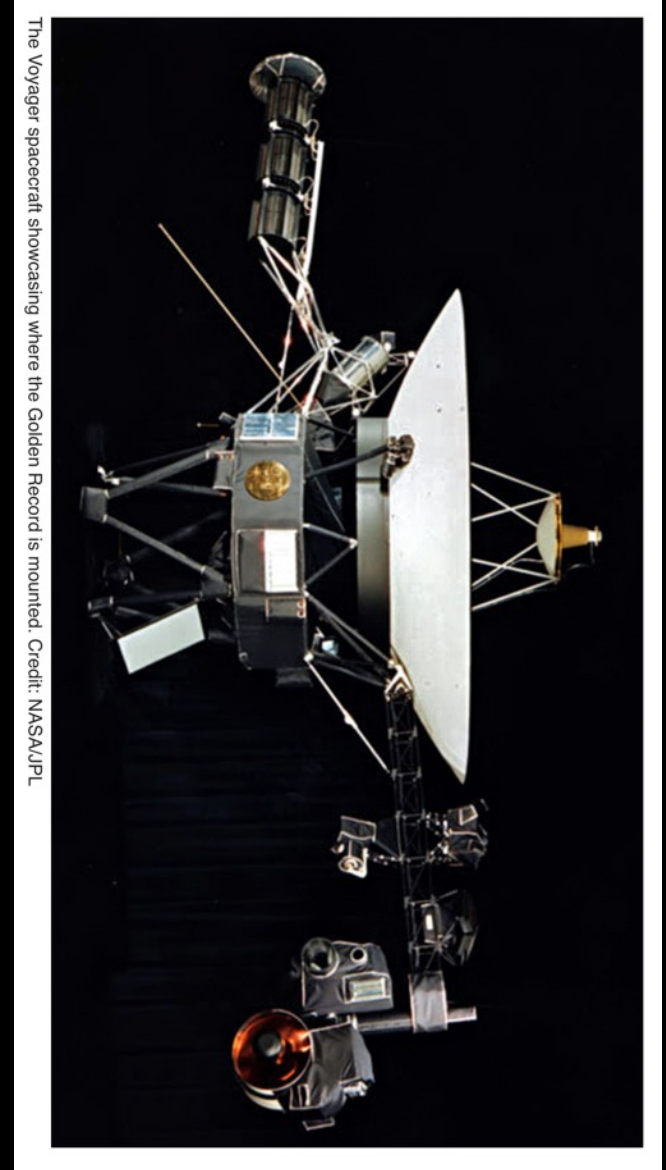


NASA Art in Space: The Voyager Golden Record



The Golden Record cover shown with its extraterrestrial instructions. Credit: NASA/JPL

Art Curator/Facilitator: Carl Sagan



The Voyager spacecraft showcasing where the Golden Record is mounted. Credit: NASA/JPL



NASA Art on the Moon: The Fallen Astronaut Sculpture

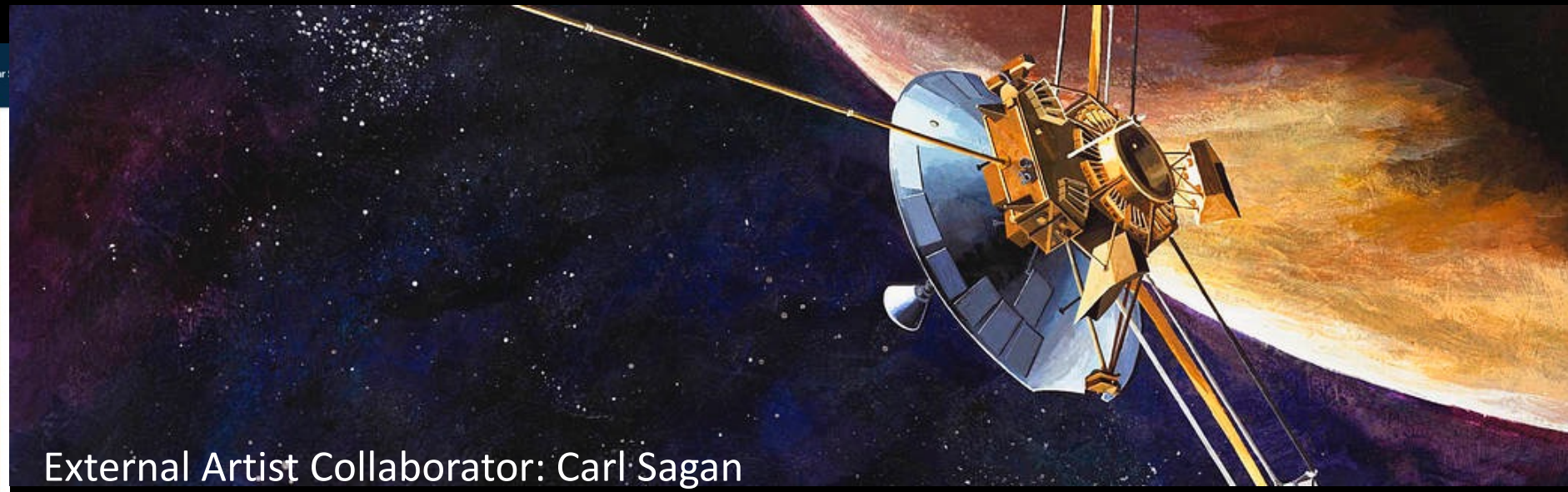
Fallen Astronaut is an aluminum sculpture created by external artist collaborator Paul Van Hoeydonck.

- A small stylized figure, depicting an astronaut in a spacesuit, is intended to commemorate the astronauts and cosmonauts who have fallen in the advancement of space exploration.
- Commissioned and placed on the Moon by the crew of Apollo 15 at Hadley Rille on August 1, 1971, next to a plaque listing the fallen 14.

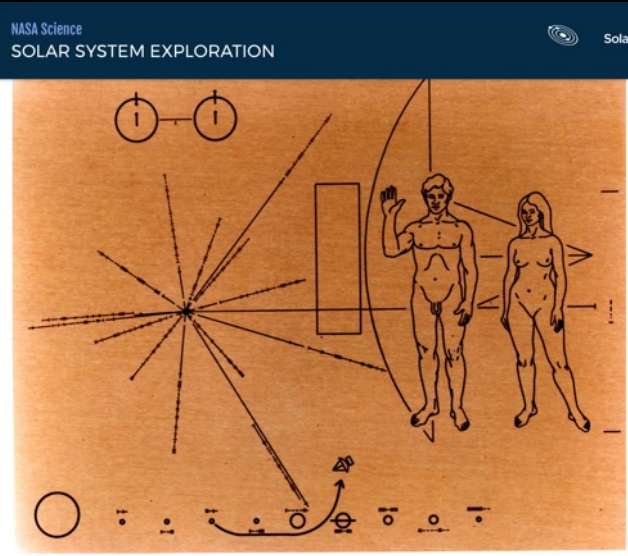




NASA Ames Art in Space: Pioneer 10 Plaque



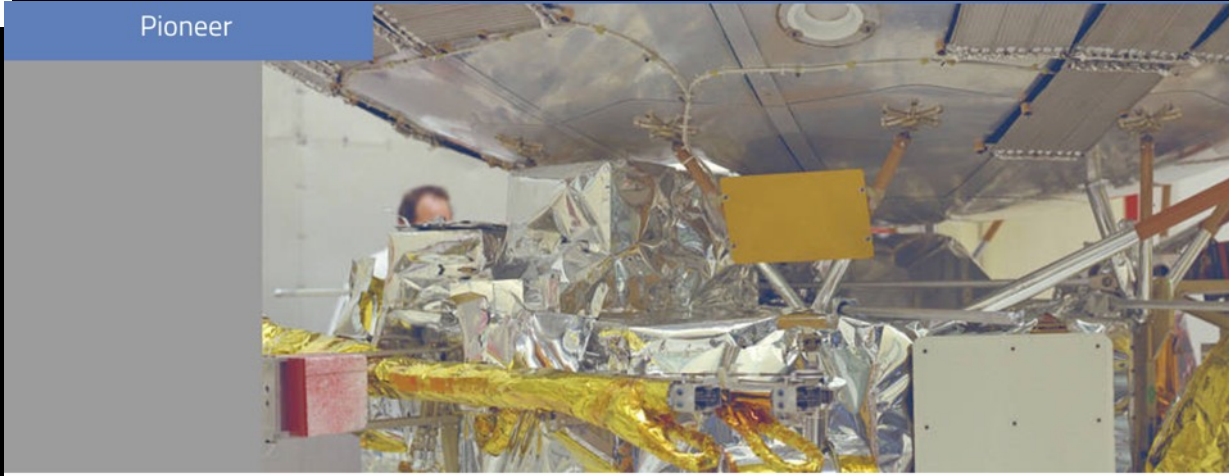
External Artist Collaborator: Carl Sagan



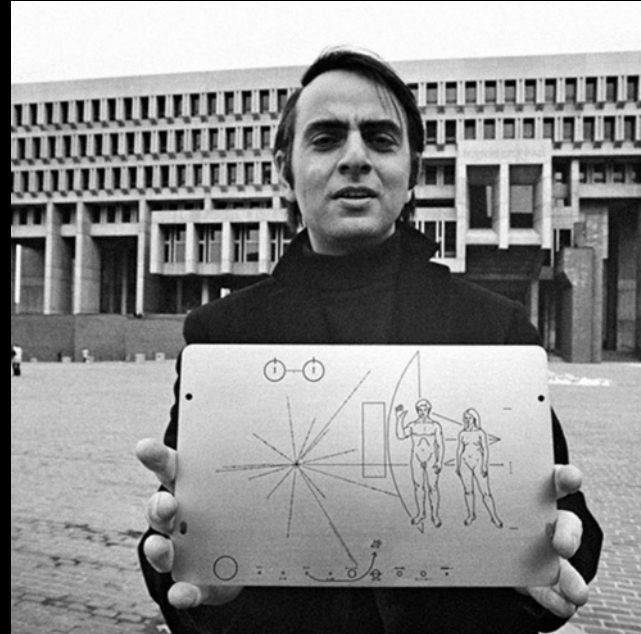
A detailed view of the visual message on the Pioneer plaques. Credit: NASA Ames



Pioneer Plaque

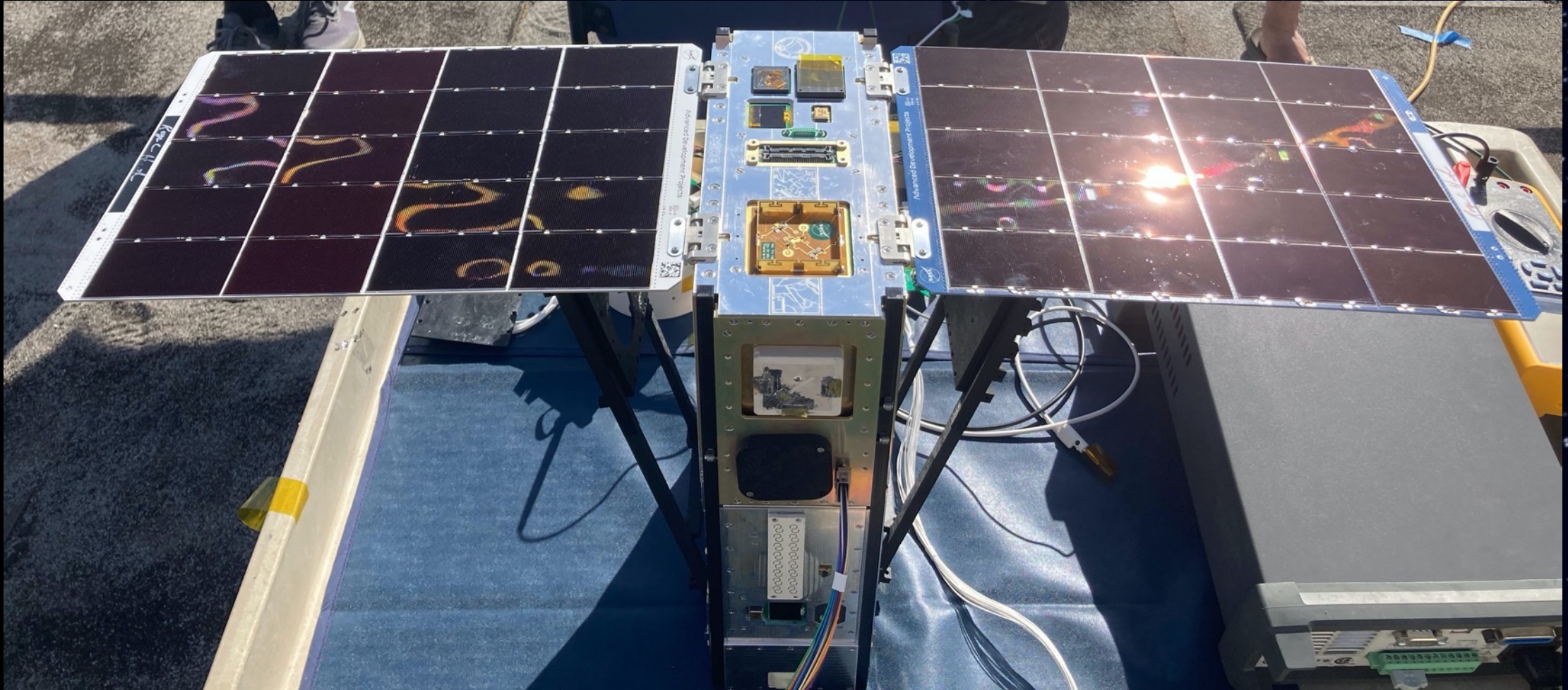


Feb 29, 2012
Ames Celebrates the 40th Anniversary of Pioneer 10





NASA Ames Art in Space: PACE-1 Laser Etched 6U Spacecraft





Opportunity:

PACE-1 required passive thermal control, to be achieved via thermal tapes.

Type 1: High emissivity

Type 2: Low emissivity

The opportunity arose for art here.

- PACE reached out to see if artwork could be added to the mission and curated/facilitated by Luke Idziak.

- Total creative control was given, as long as the thermal requirements were met.



Curating the first NASA group art show in space:

- A group of promising artists were identified and given general information about the mission and its objectives to see what inspiration would result.
- Artists Arno Geens, Selby Cole-Sohn, Mike Dabro, and Steven Johnson responded with exciting artworks that were then selected.
- As the specific thermal requirements and materials to be used on the spacecraft were finalized, an iterative process ensued where the artwork was customized for reproducibility in the chosen medium: high and low emissivity tape, and Kapton tape. Integrating artwork within the narrow surface percentage covering and material choices allowed was a unique and exciting learning experience for both the artists and the engineers.

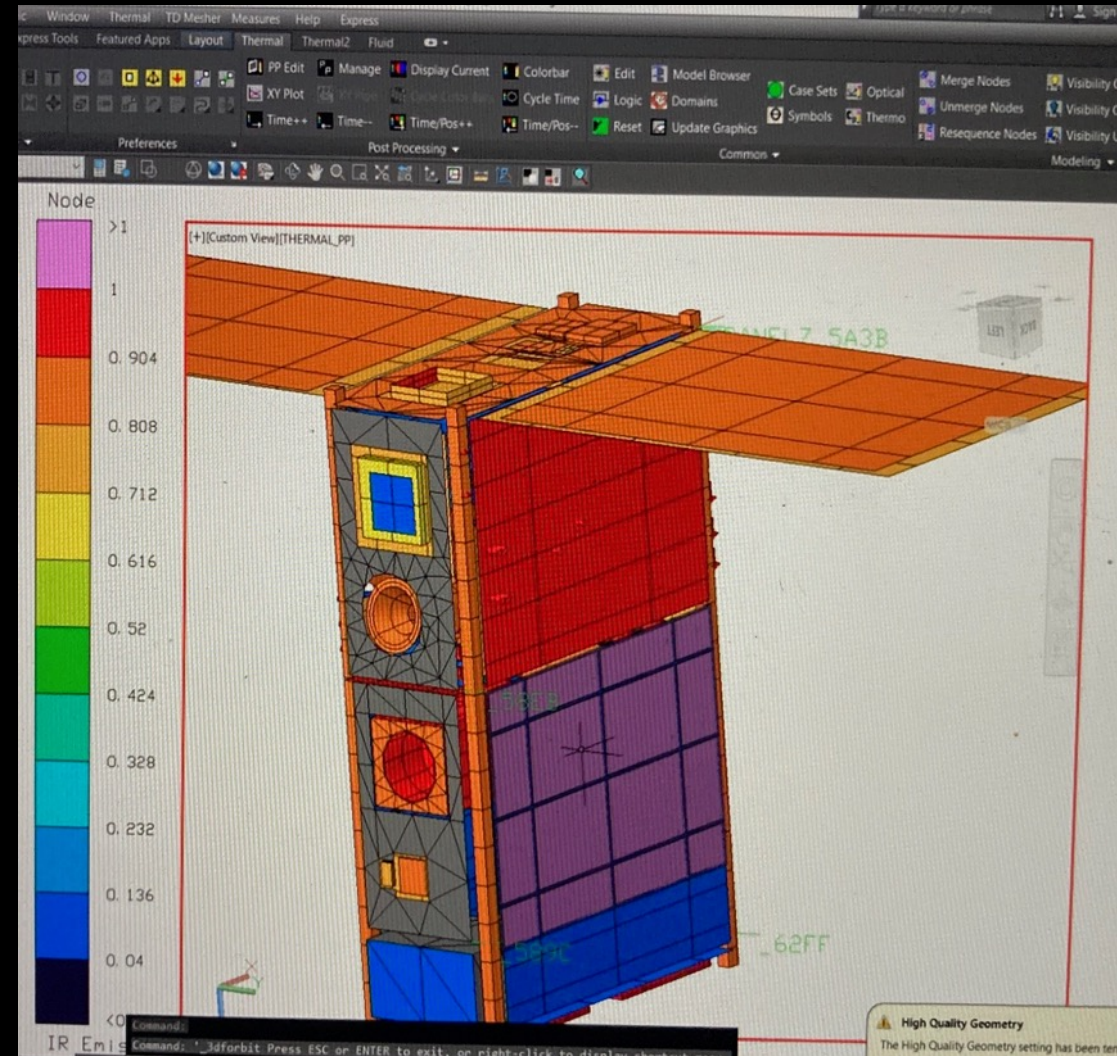


Matching Thermal Requirements and Artistic Medium

-Working together to realize the final product:
Thermal Engineer, Curator, and Artists

-Thermal analysis informed what materials were needed on different faces of the bus, which in turn informed the method of reproducing the artwork in two different, mission specific, techniques: Laser cut Kapton tape on low emissivity film, and direct laser etching on high emissivity film.

- Informed Iteration and collaboration with Engineer and Artist evolved certain aspects of the artwork and led to successful fabrication and integration of functional spacecraft materials and unique art.



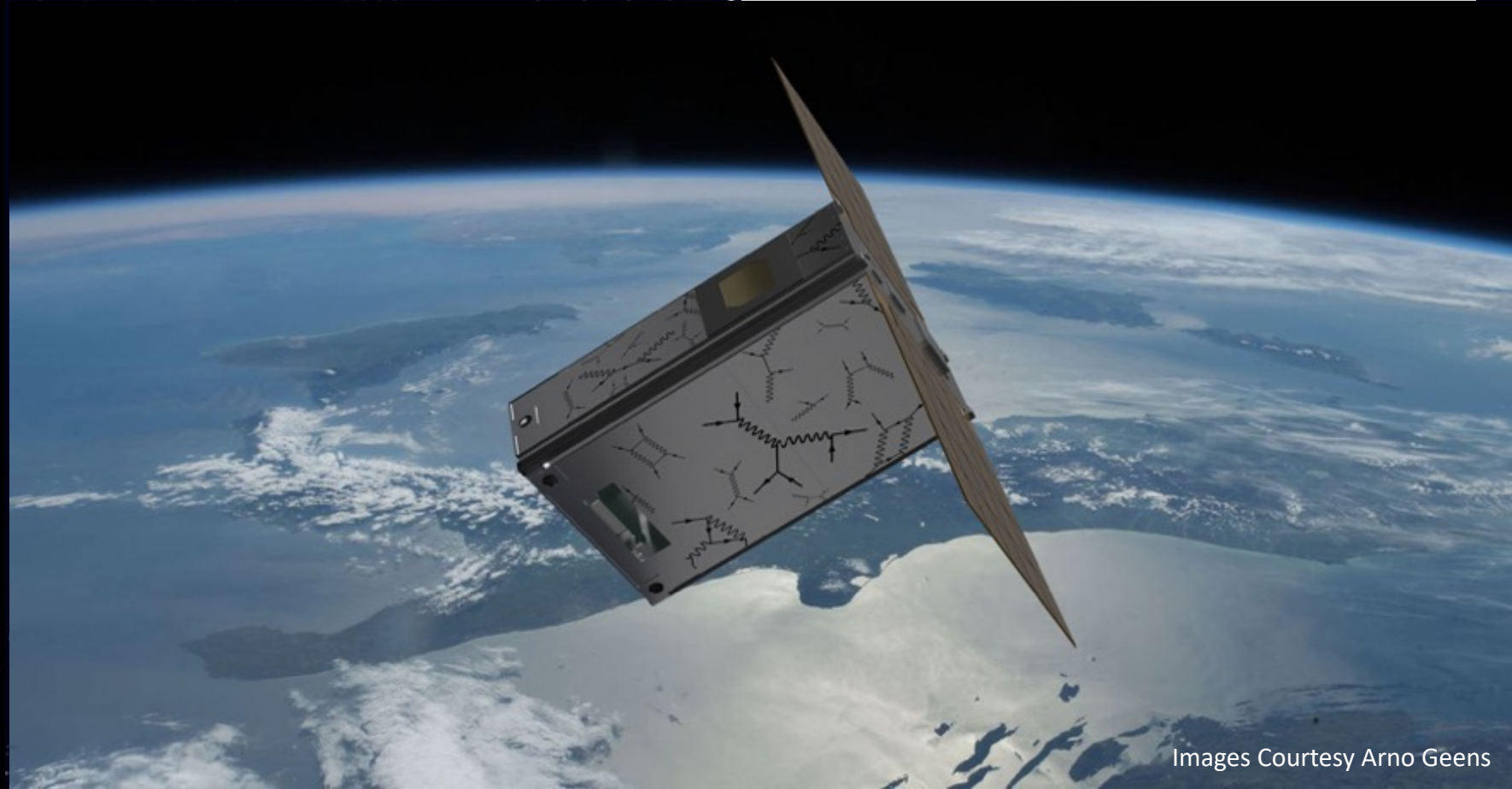
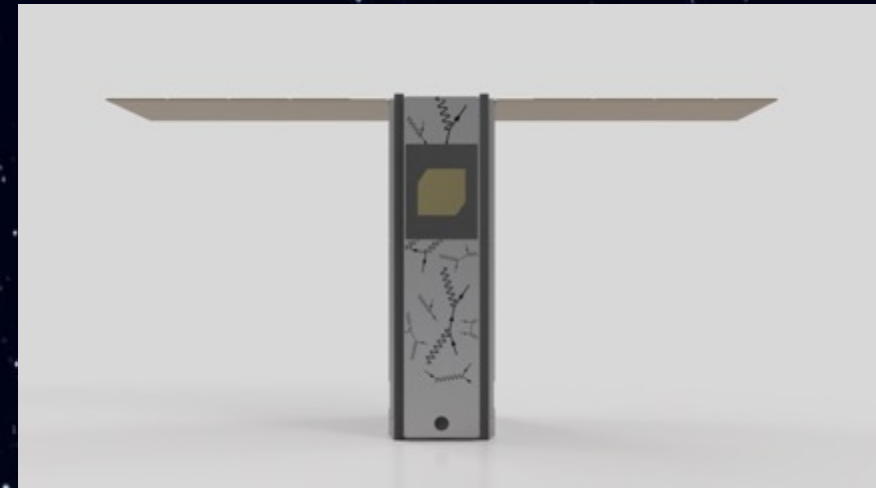
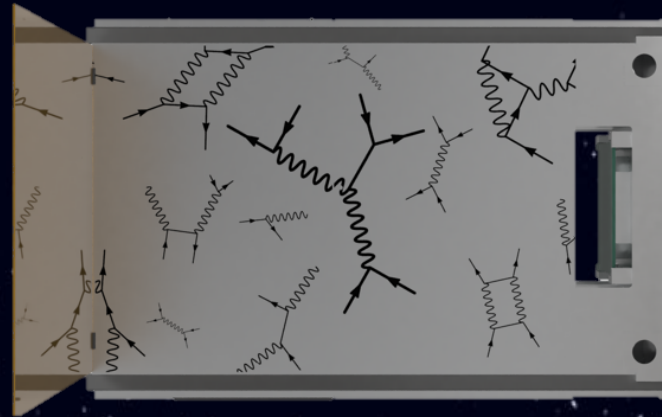


ART IN SPACE
Ames Research Center

Artist:
Arno Geens, Graphic Artist

Title:
Elementary Particle
Collisions

Description:
A stylization of the
famous Feynman
diagrams depicting deep
space radiation
interactions and events.



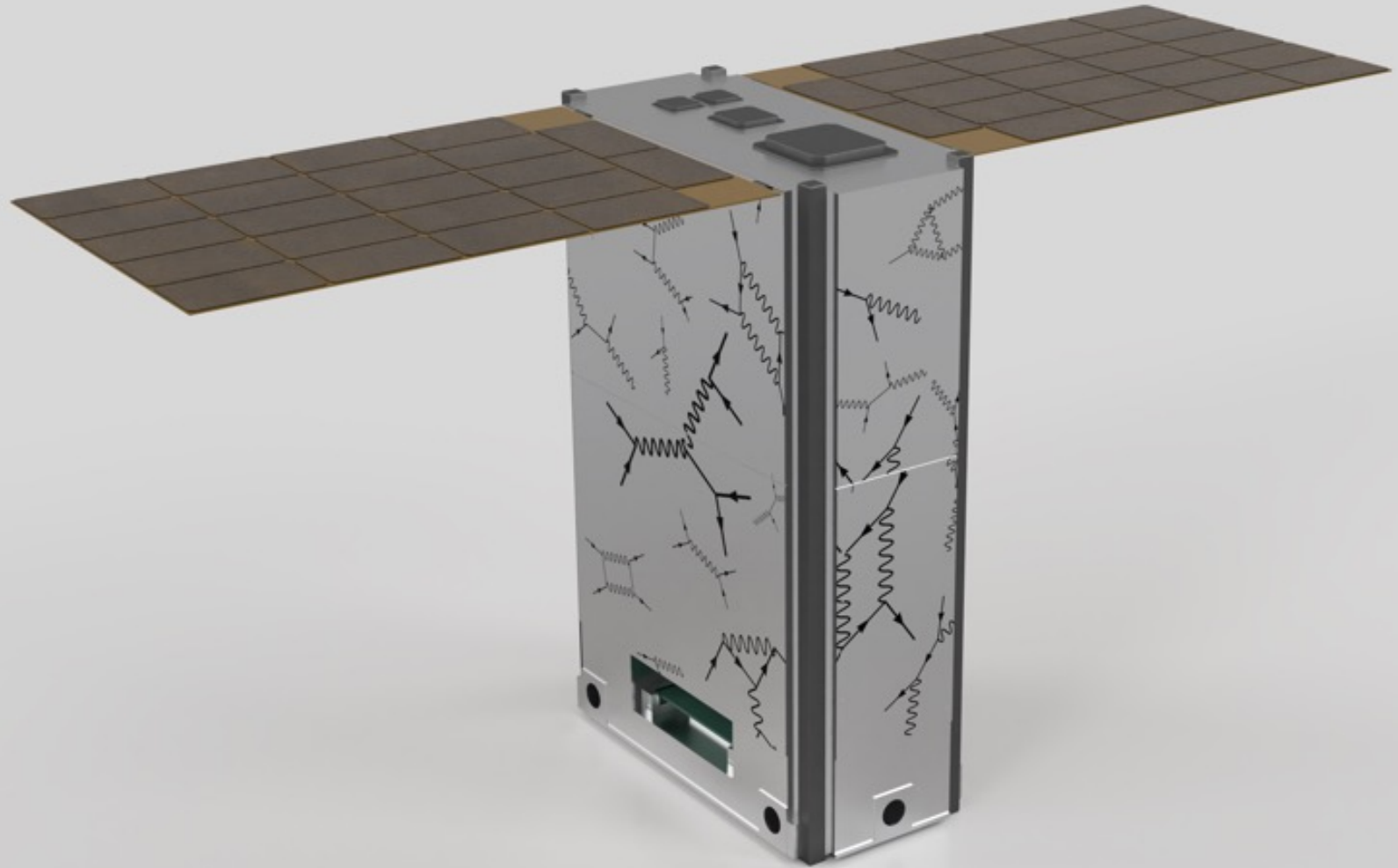


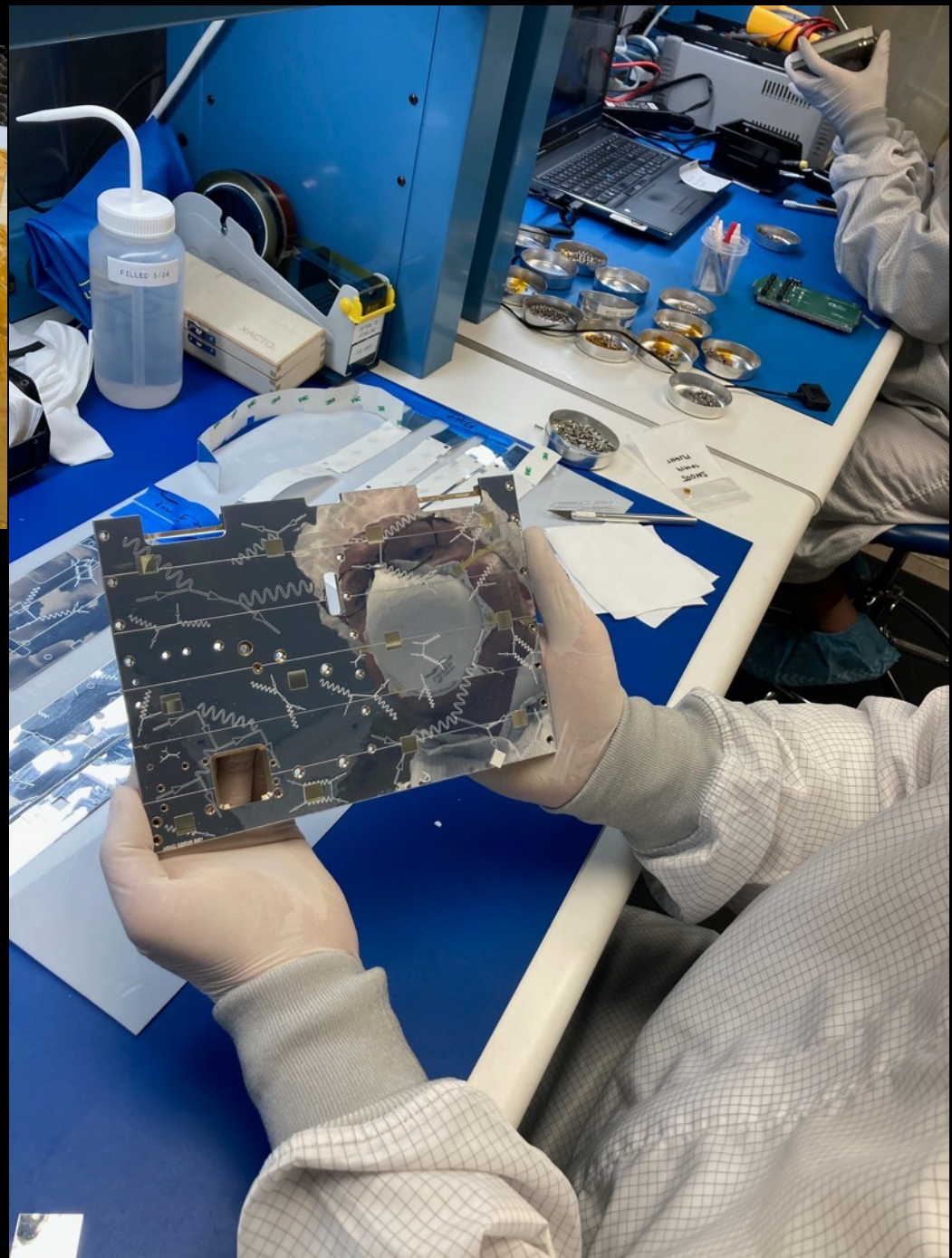
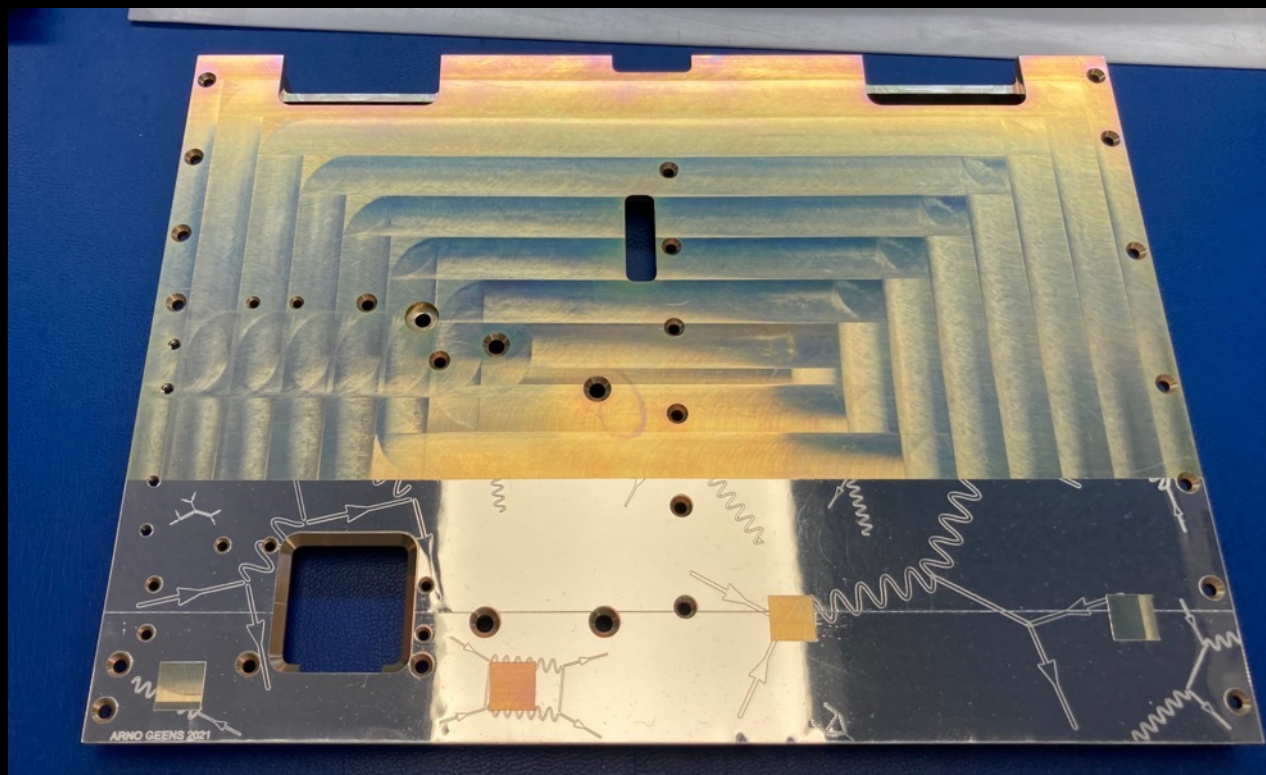
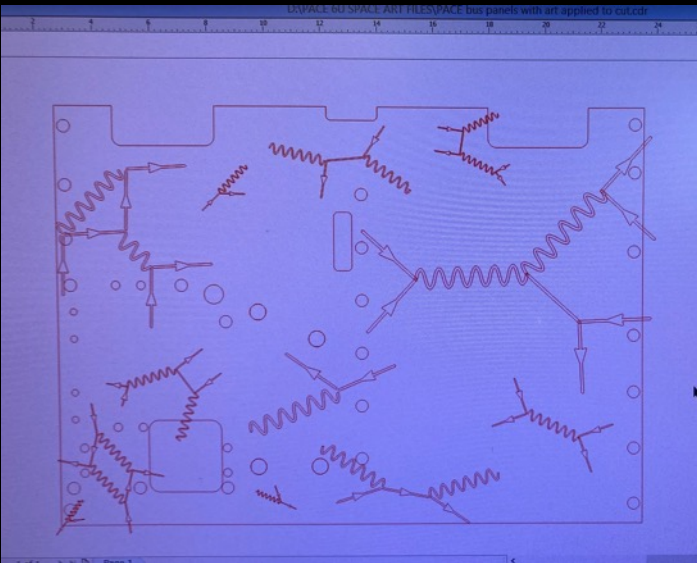
ART IN SPACE at Ames Research Center

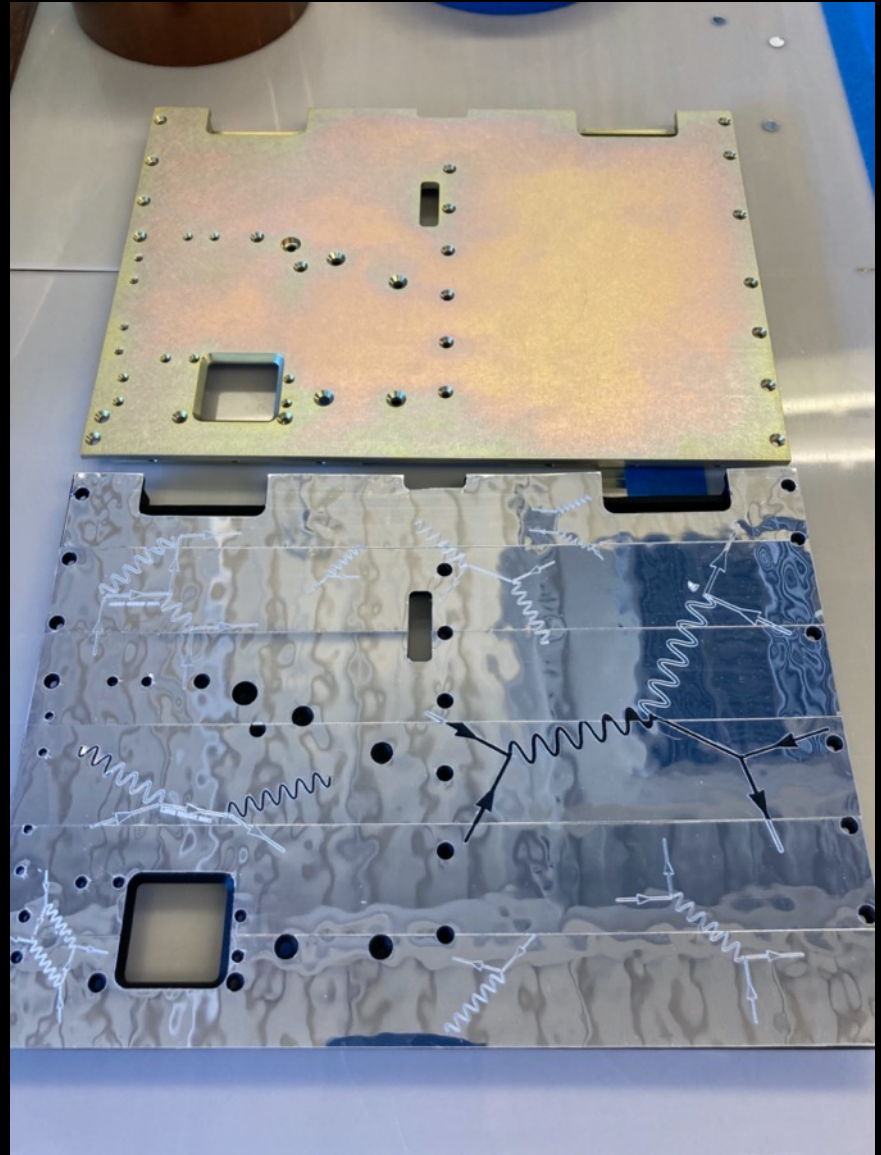
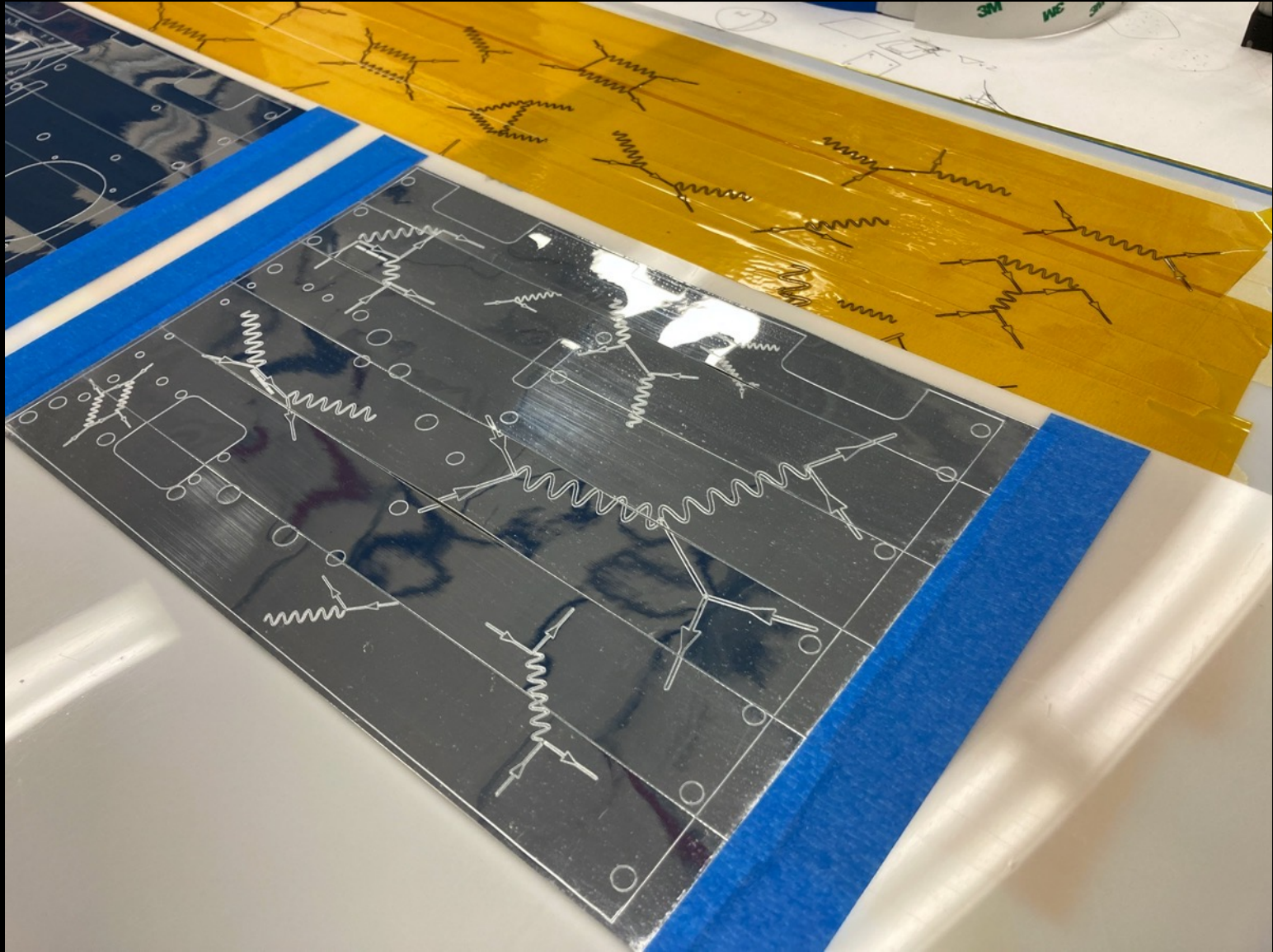
Artist:
Arno Geens, Graphic
Artist

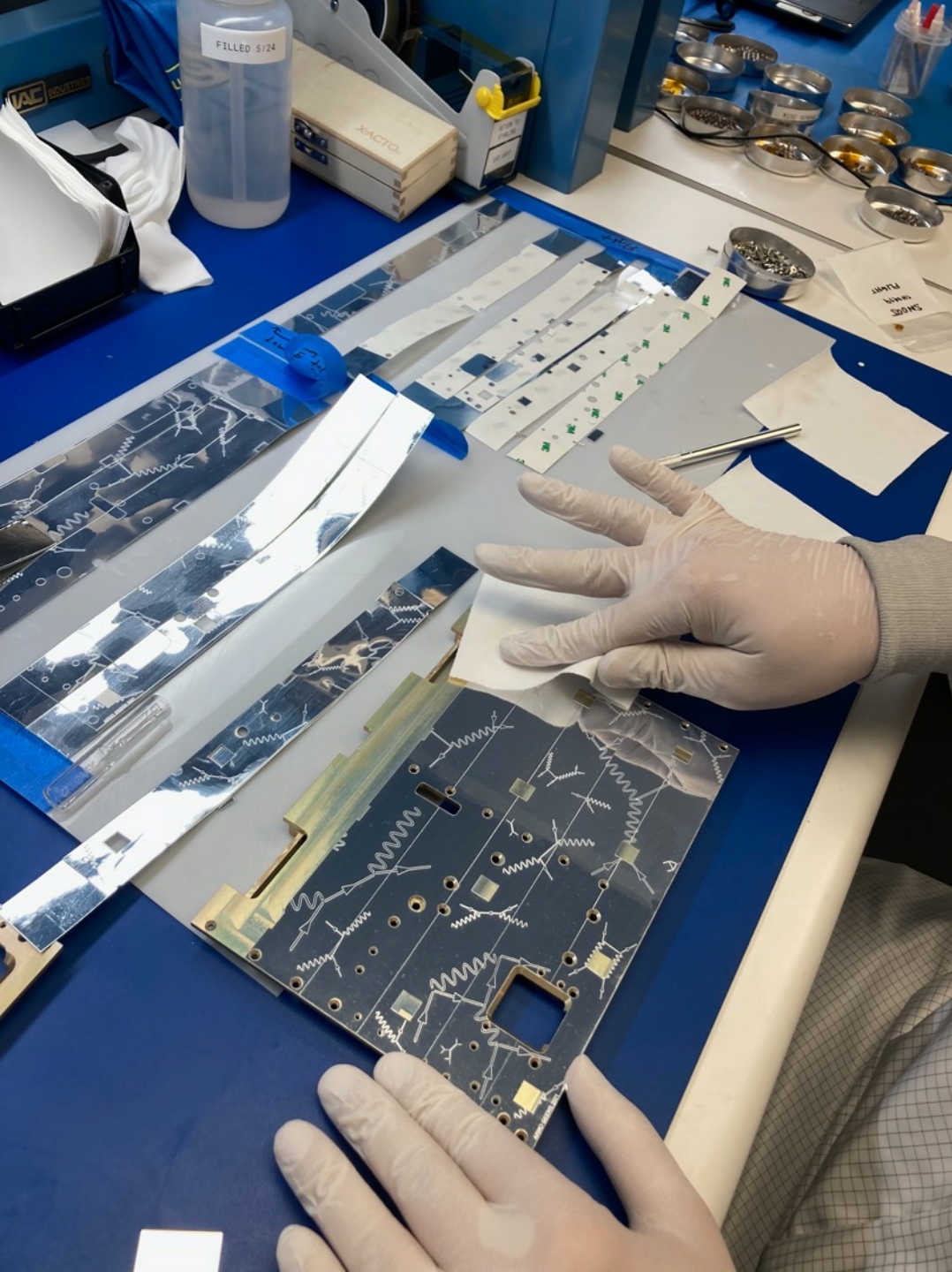
Title:
Elementary Particle
Collisions

Concept Renderings

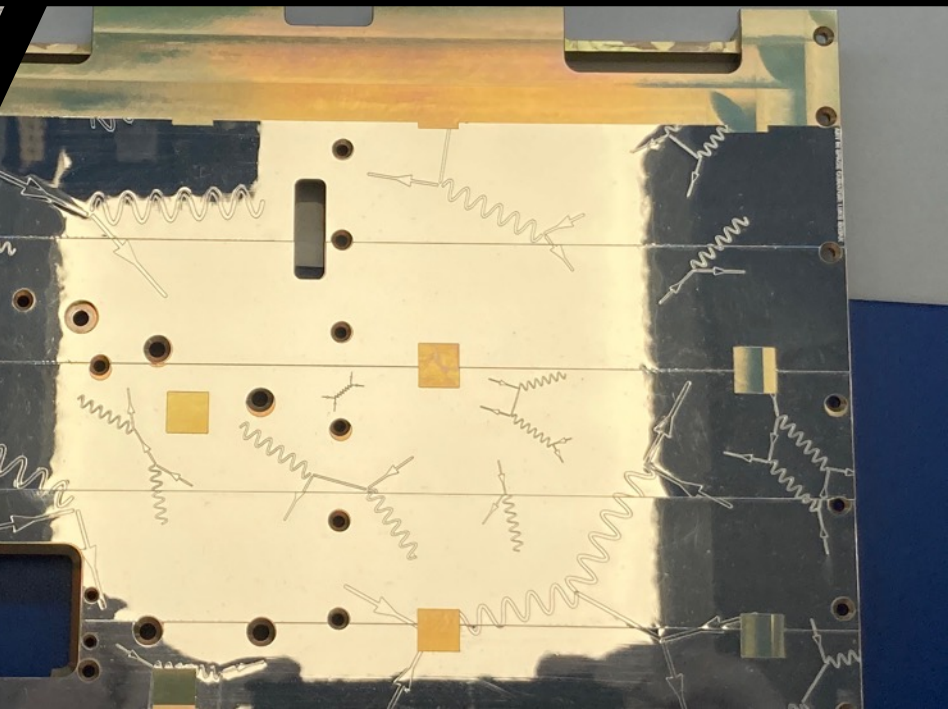
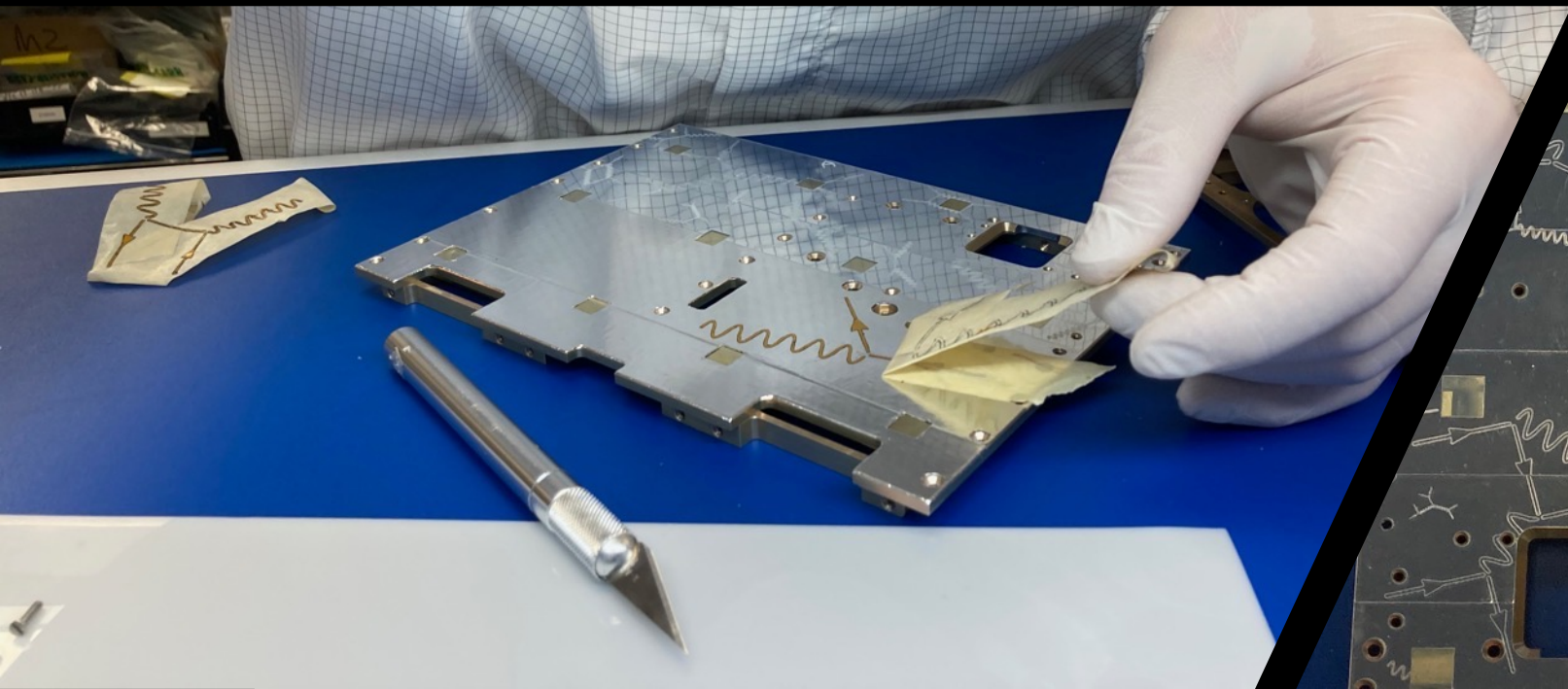
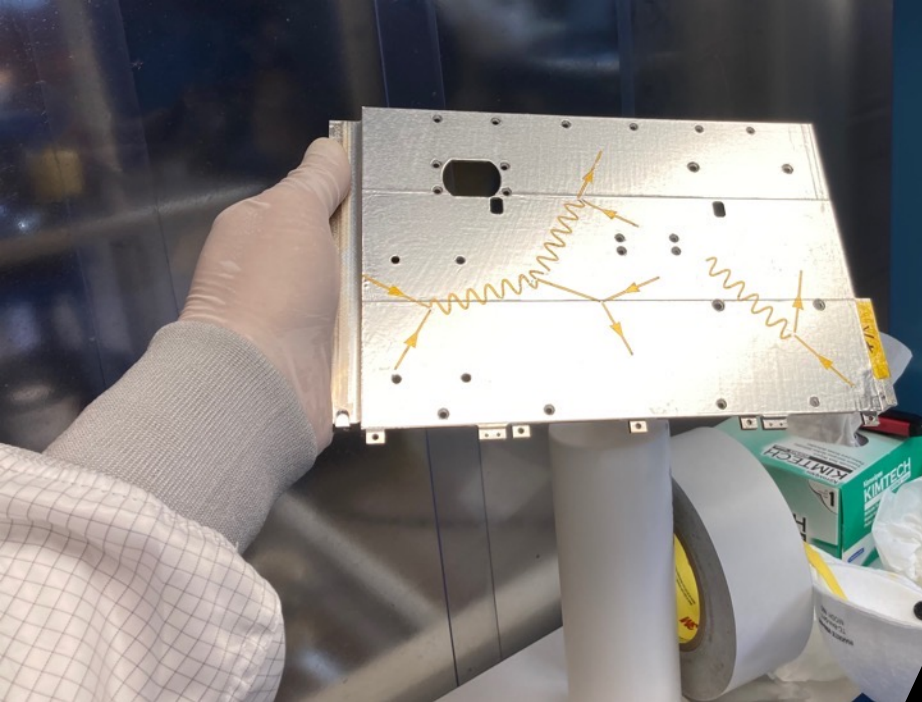








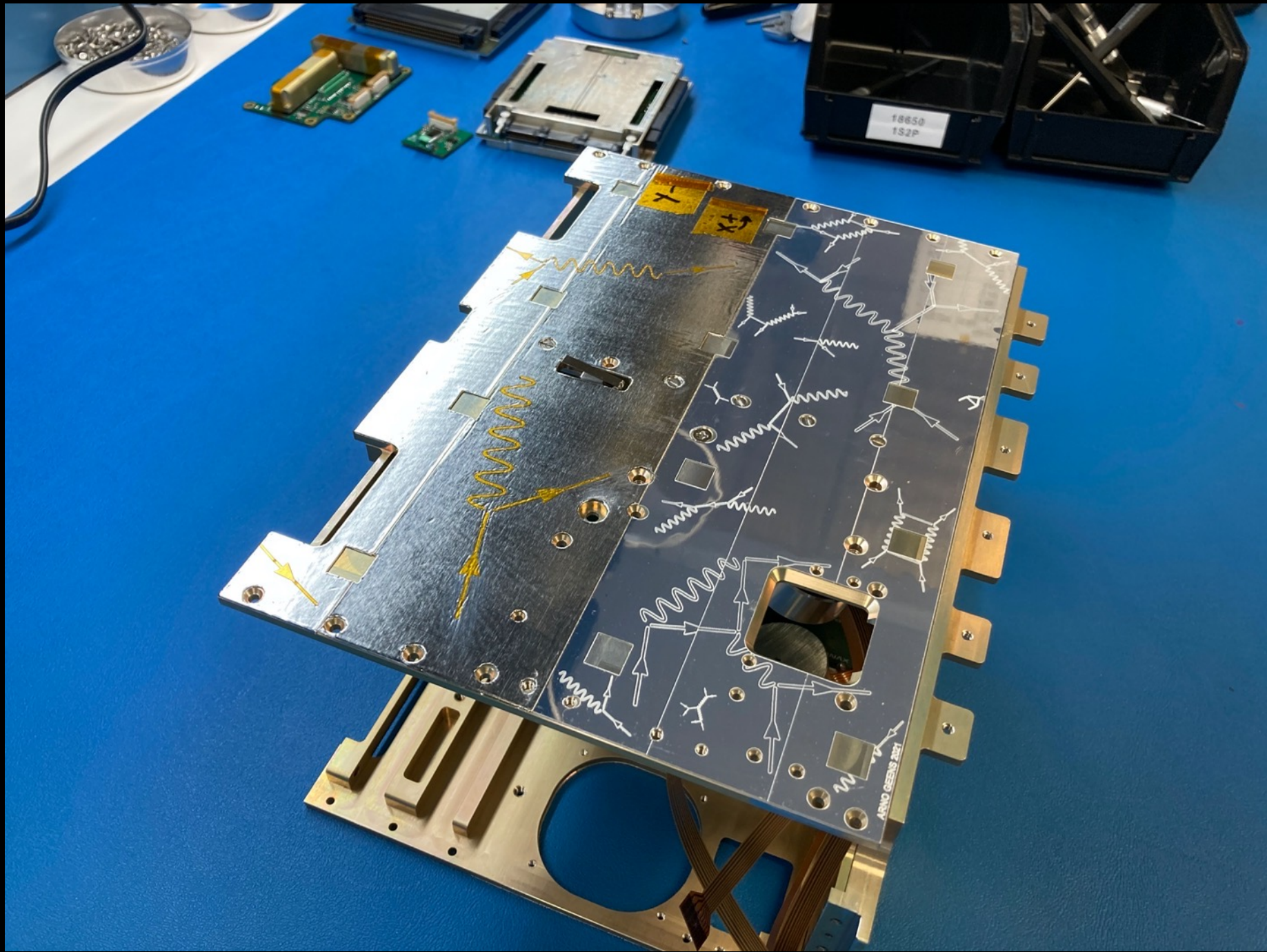
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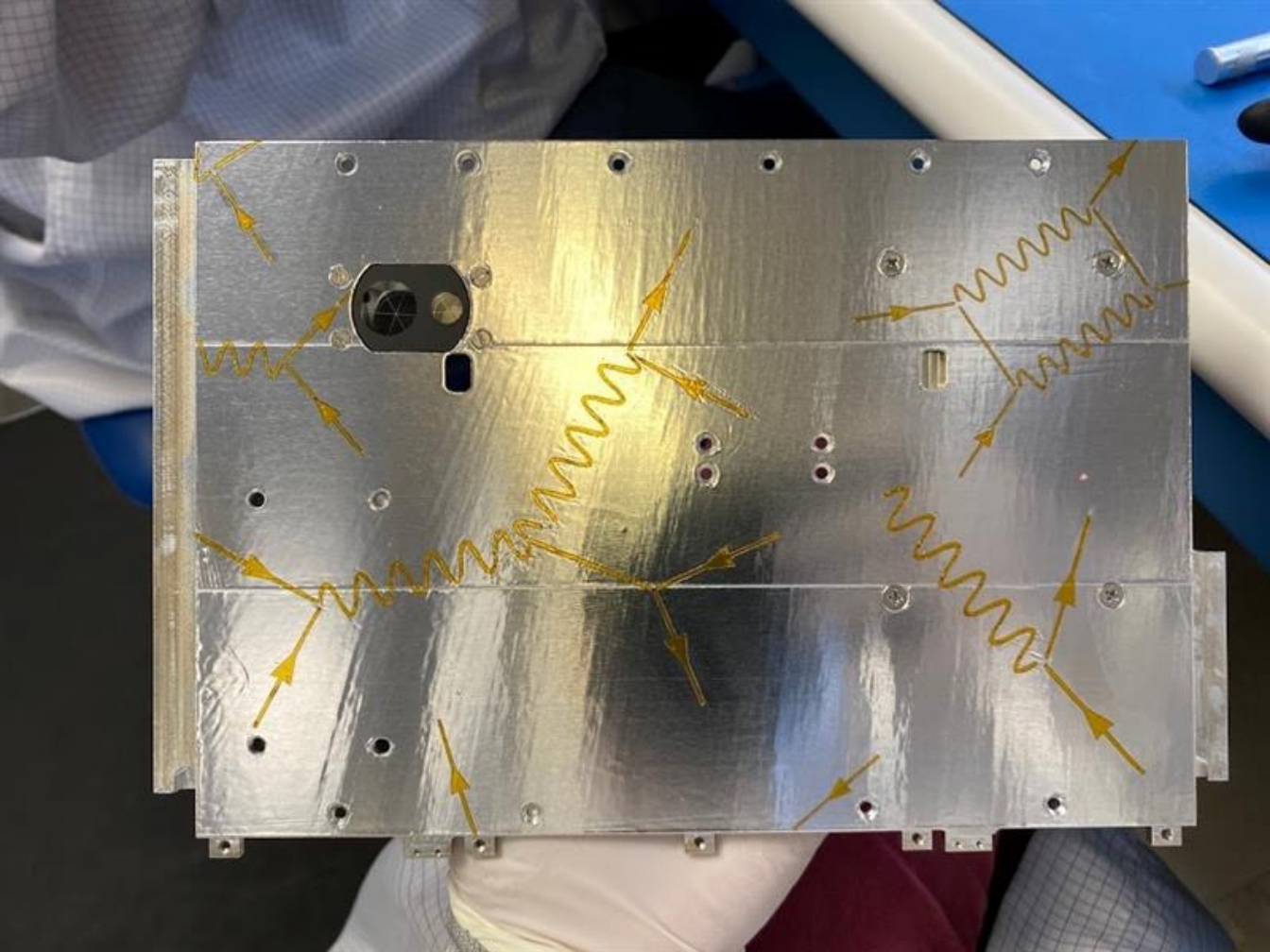




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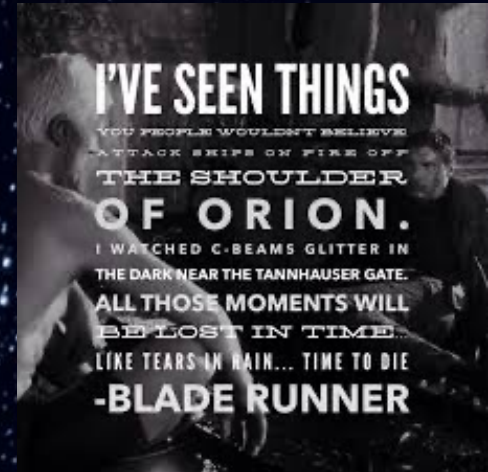
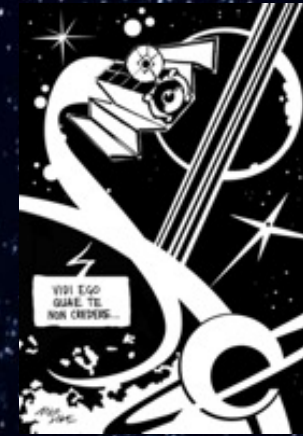


ART IN SPACE
Ames Research Center

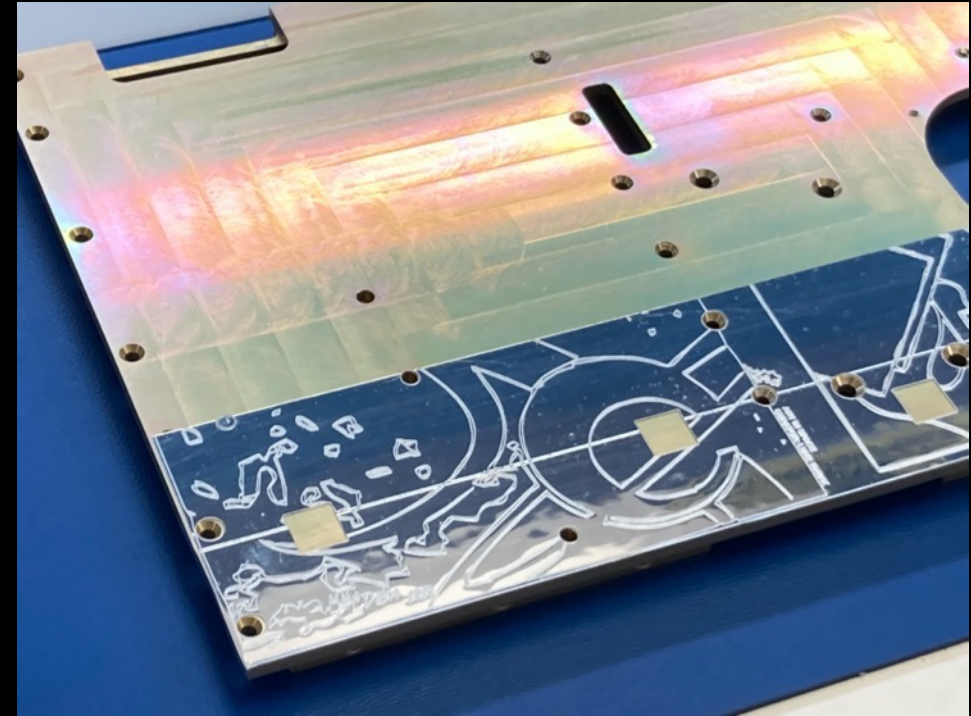
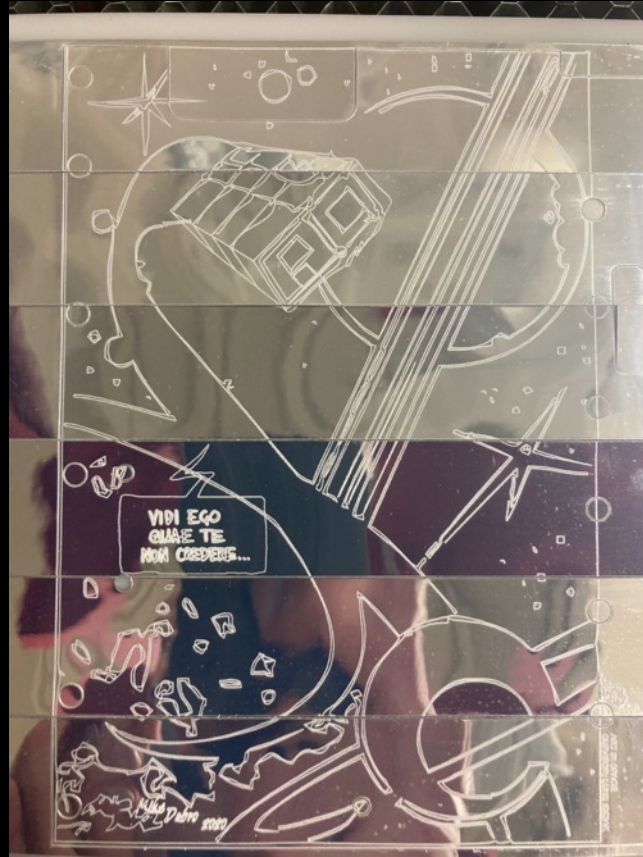
Artist: Mike Dabro, Comics Artist

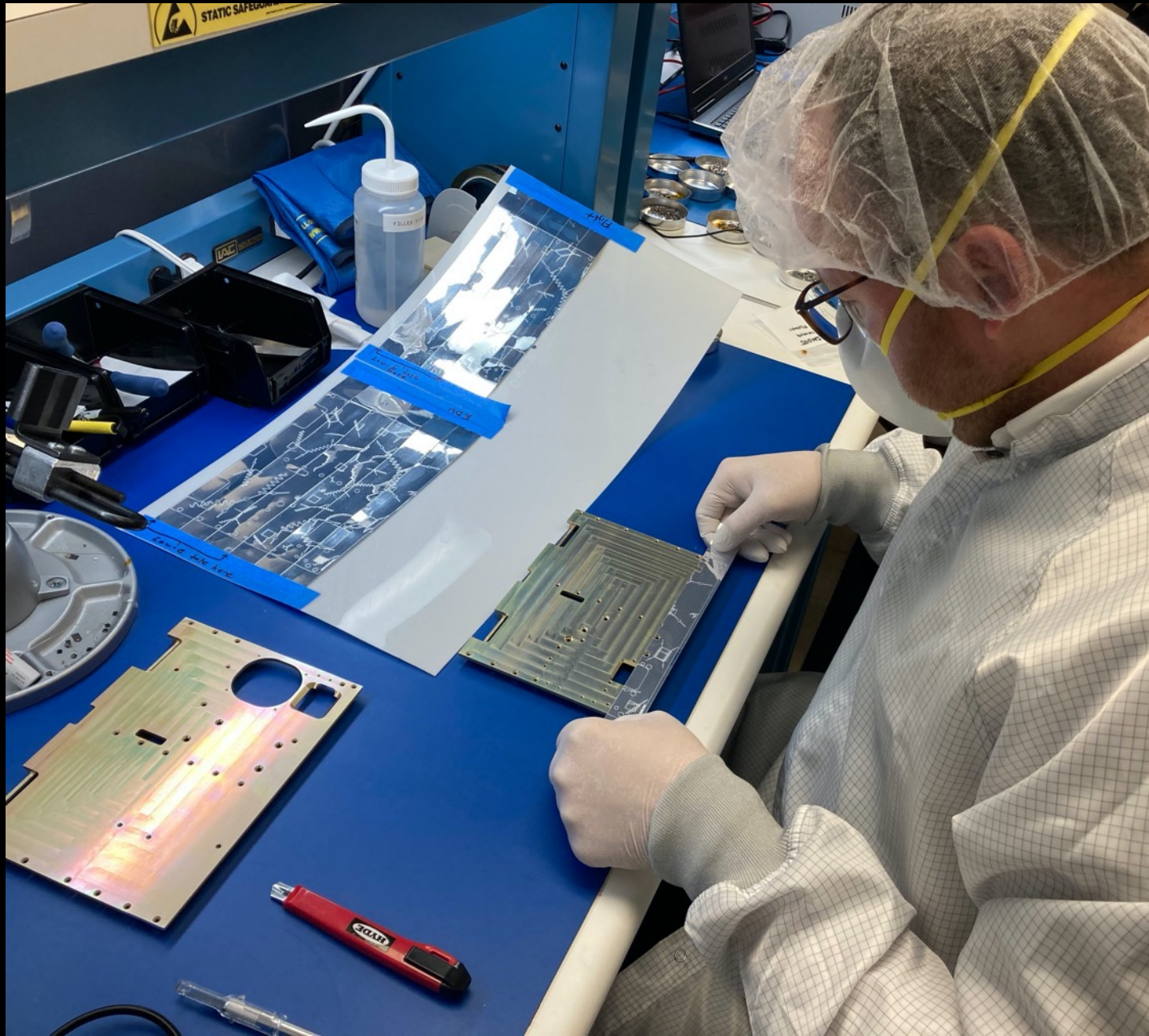
Title: Cosmic Voyager

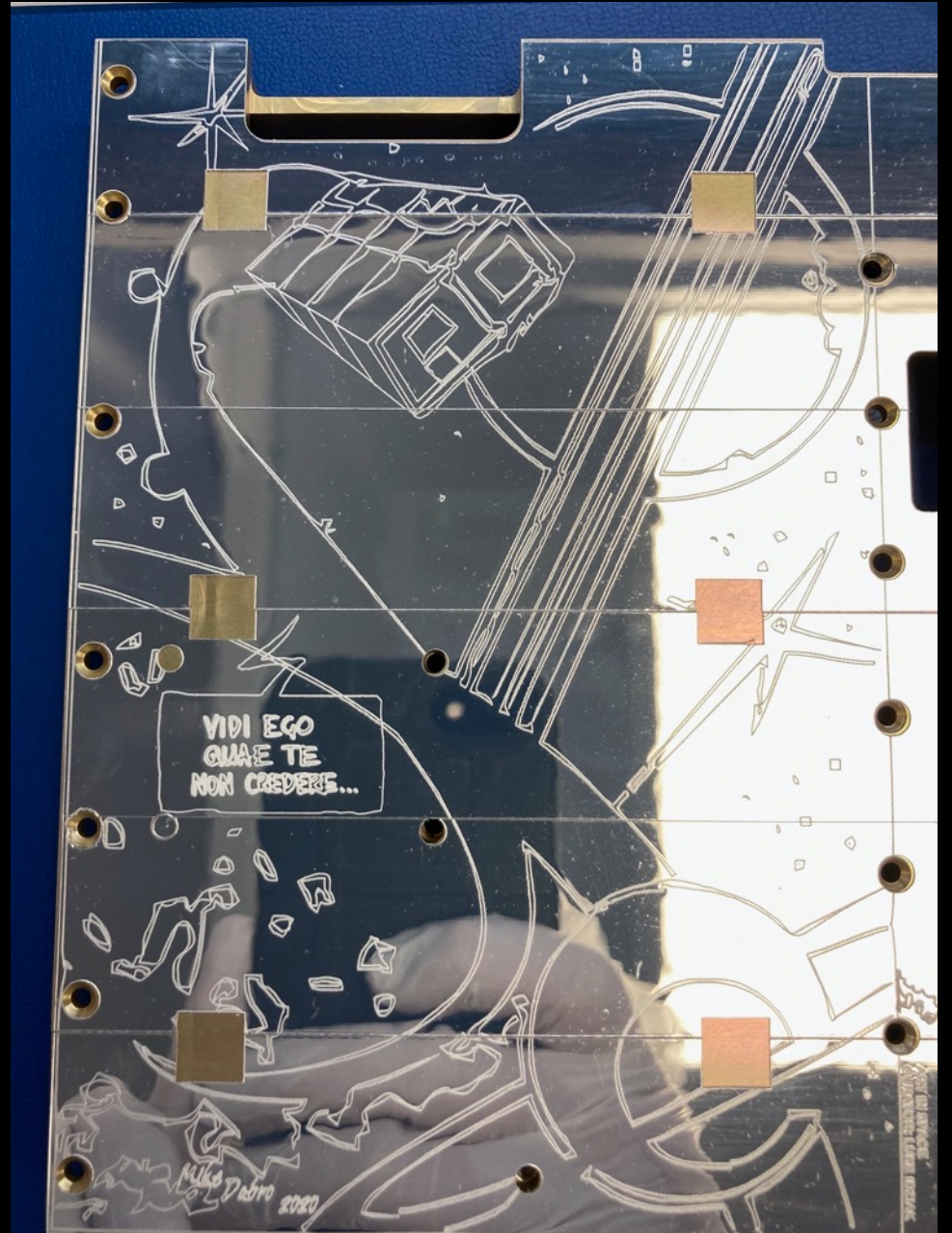
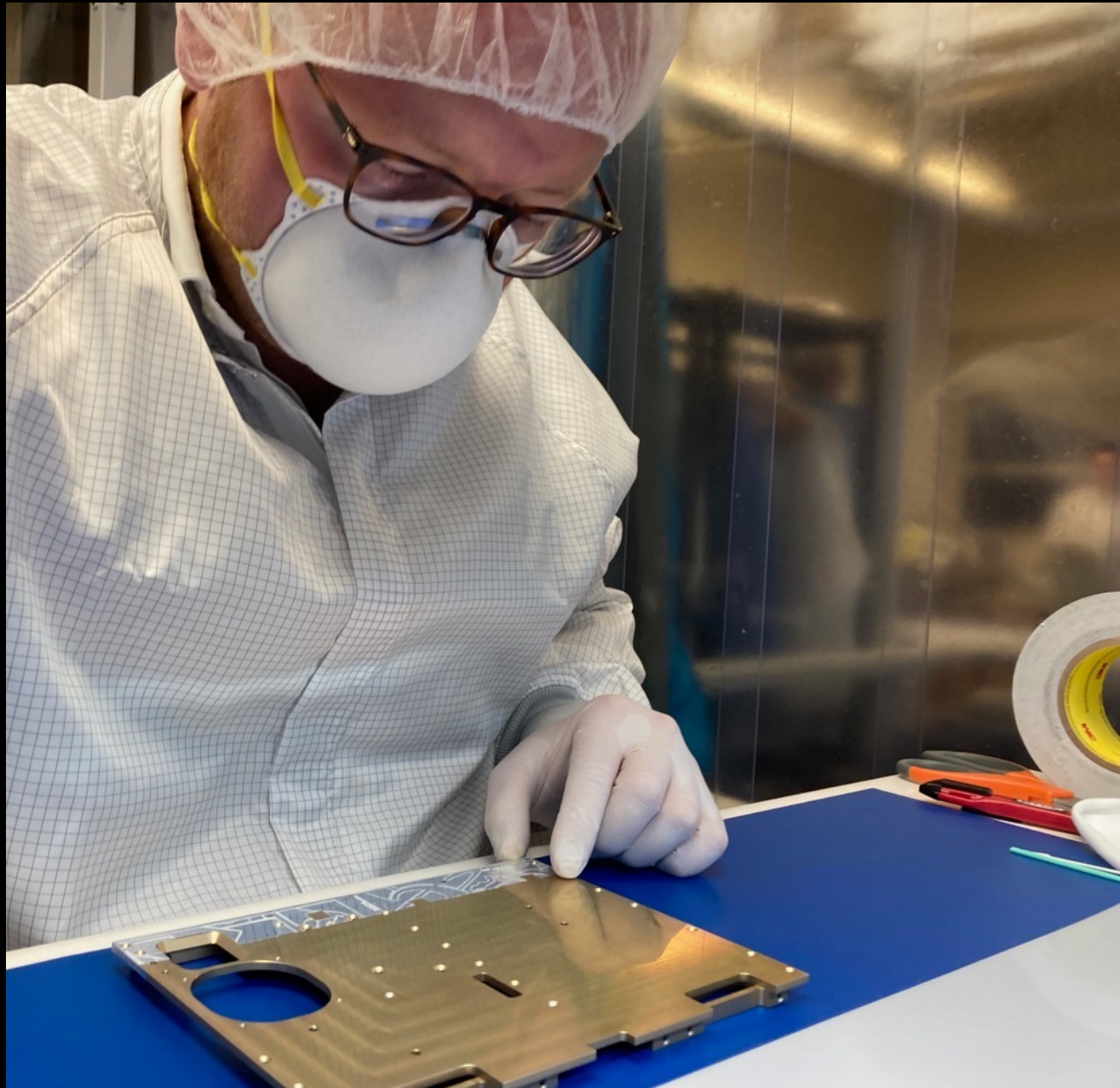
Description: A spacecraft leaves Earth, traveling on a mission of exploration and discovery; its later message to us: *"I've seen things you wouldn't believe"*. An homage to the famous description of space adventure in the sci-fi movie Bladerunner. An additional, hidden message is worked into the shapes of the trajectory, planets, rings, and stars which all come together to spell out "SPACE".

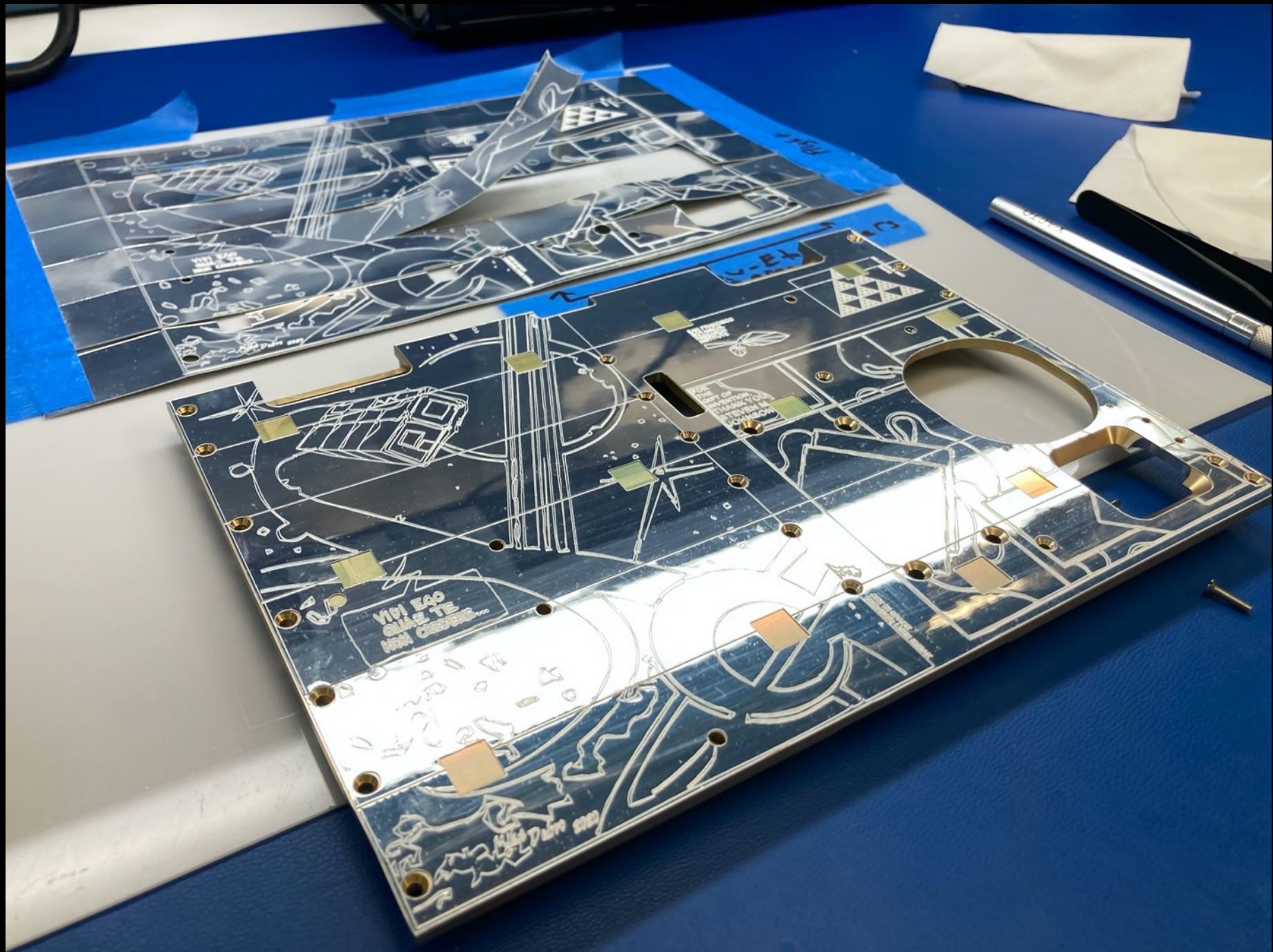


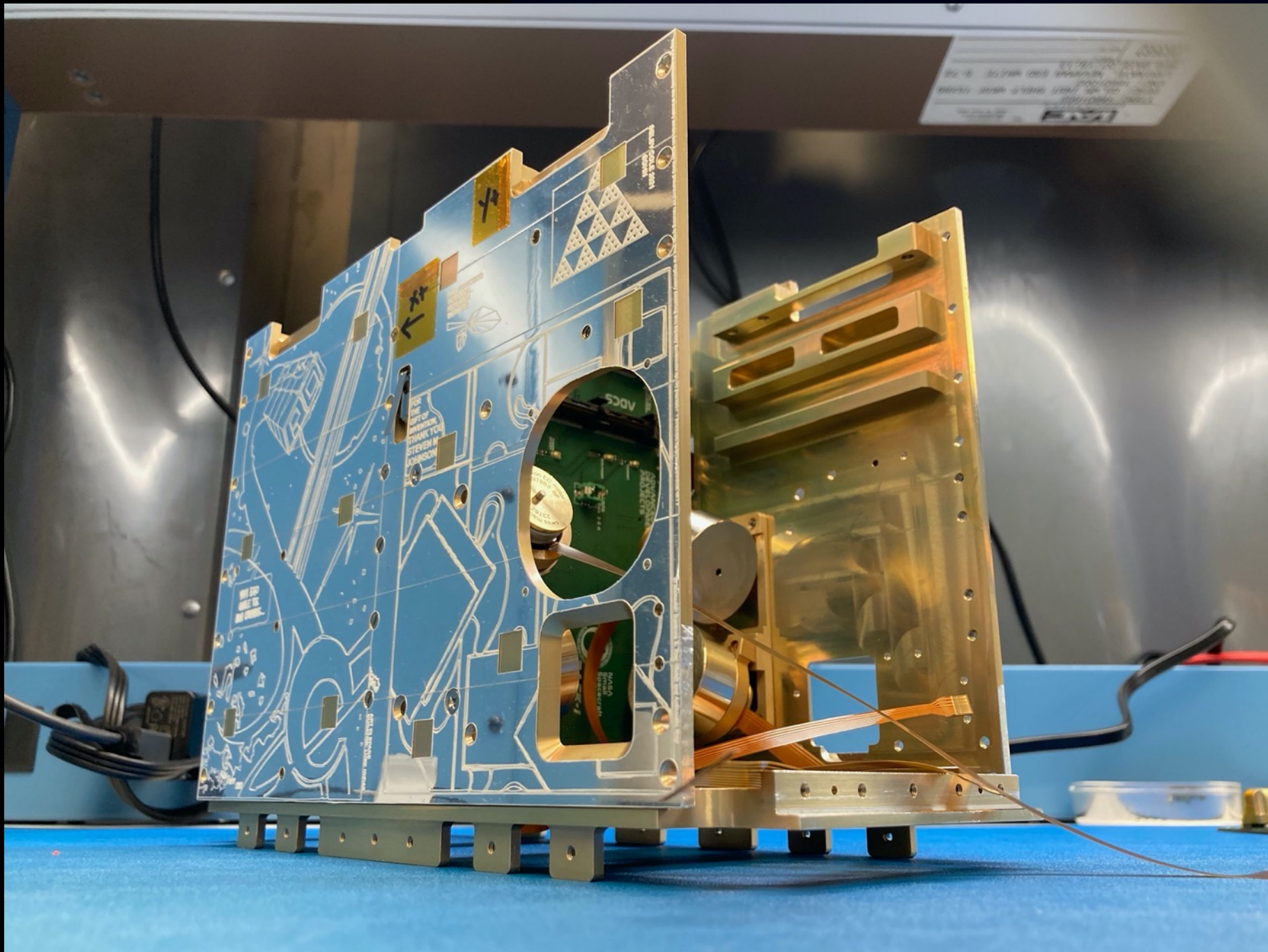
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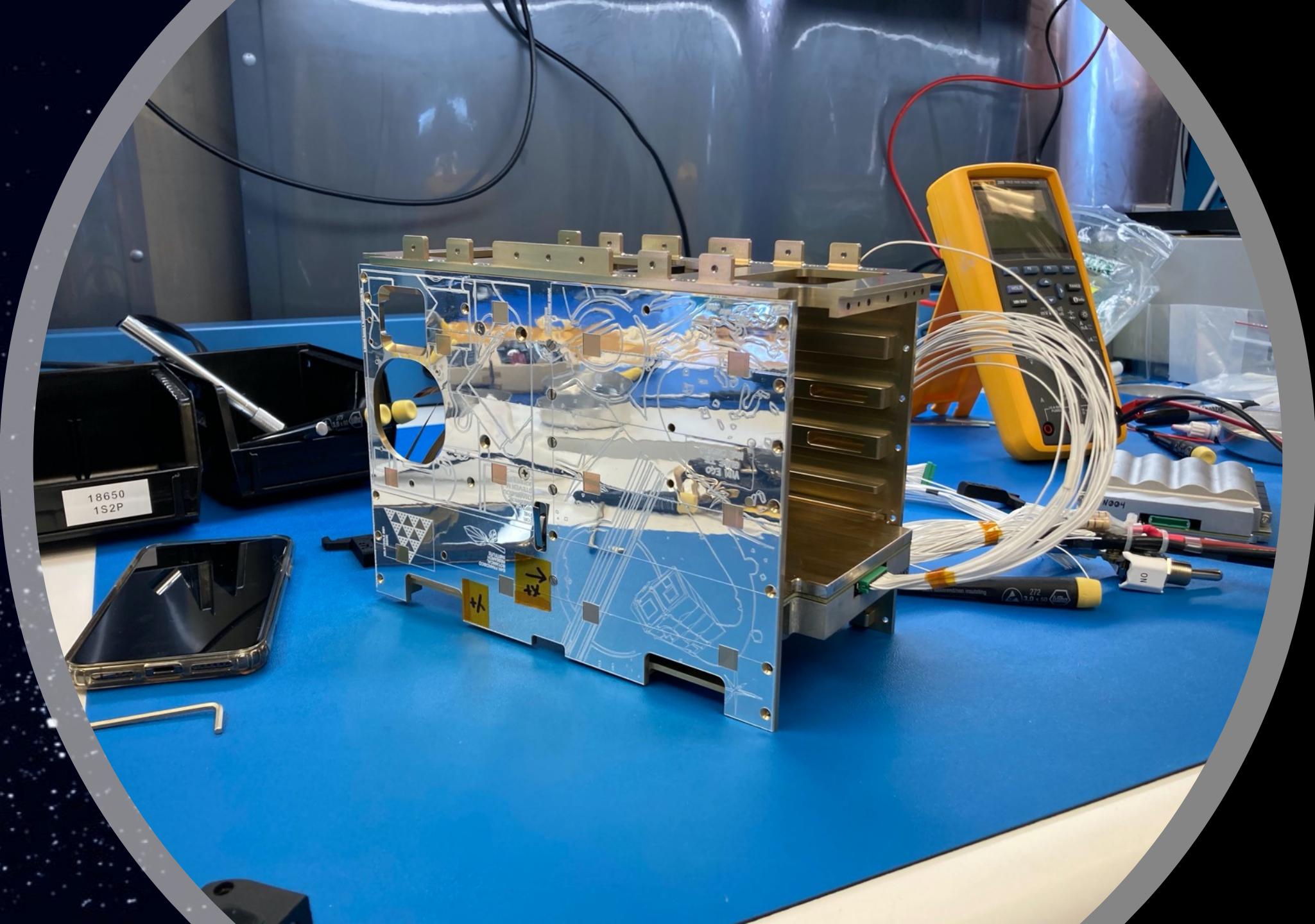












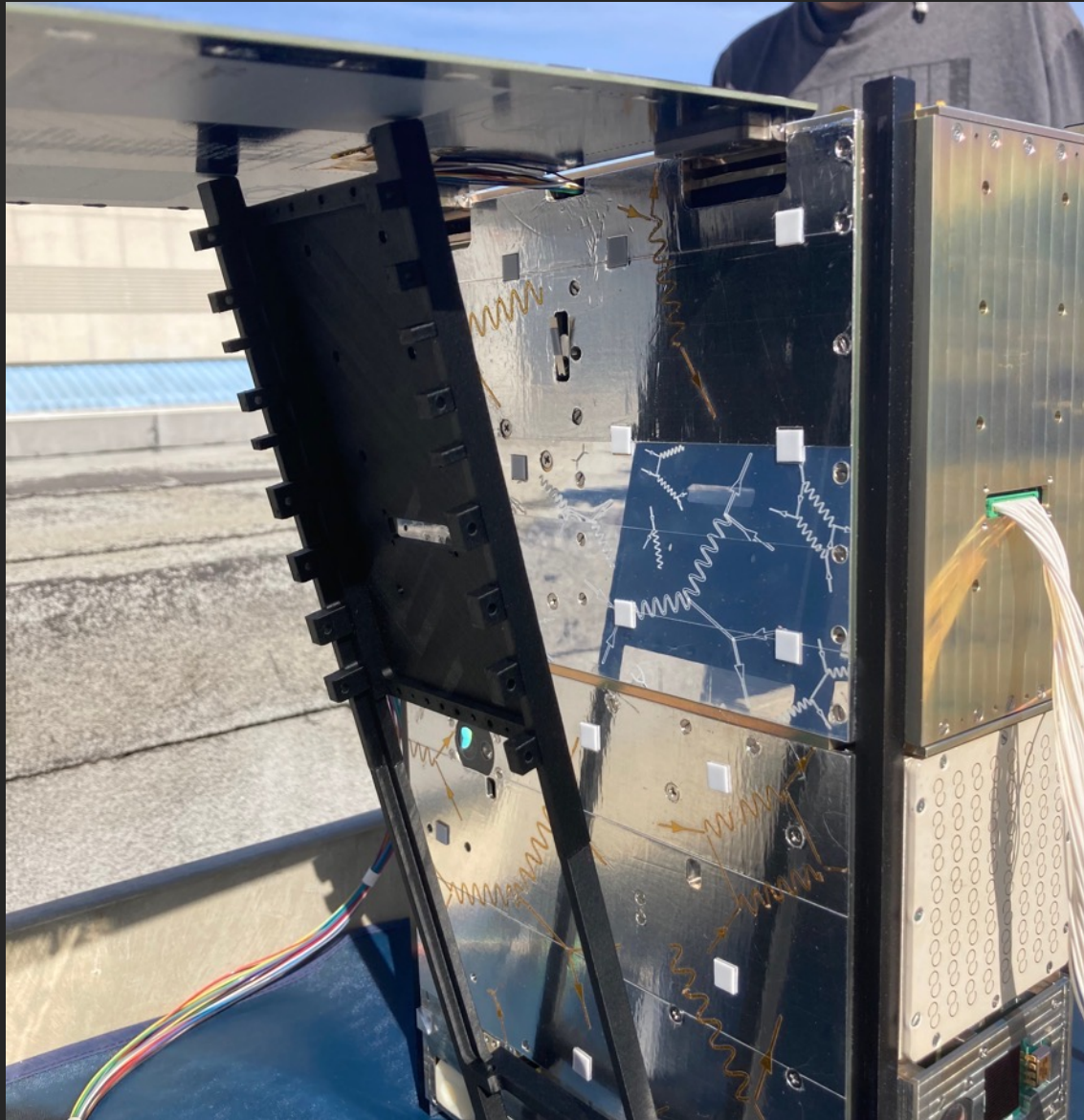
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3.0 x 50
Ultra



RF Test Flight Experiment
1118-02-08 12





ART IN SPACE at Ames Research Center

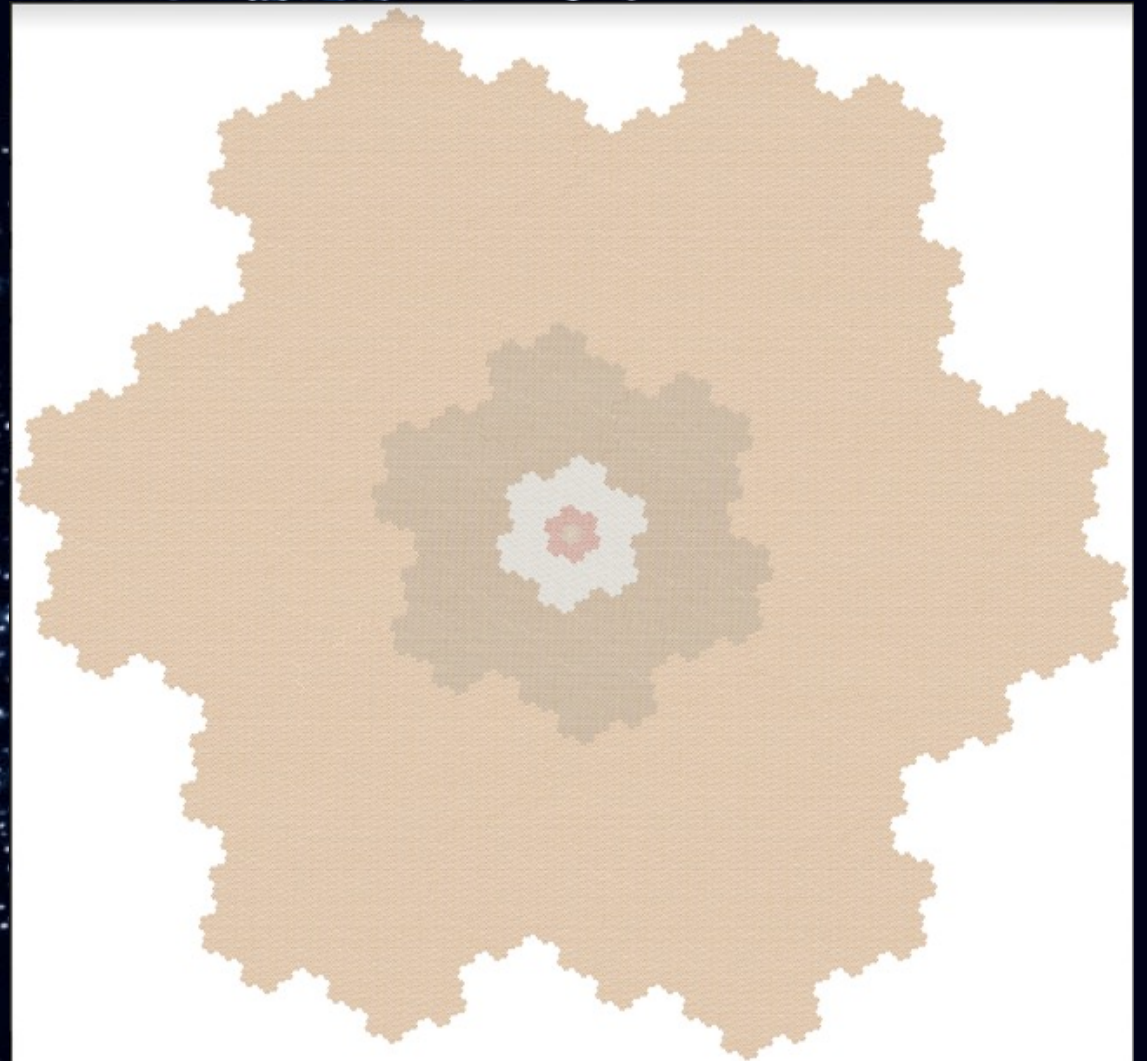
Artist: Selby Sohn, Data Visualizer

Title: The View From Above

Description:

High-resolution fractal pixel density, with each pixel and its corresponding negative space serving to represent and memorialize each person lost to the Covid-19 pandemic through the shadows they no longer cast upon the face of the Earth.

(close up detail)



Images Courtesy Selby Sohn

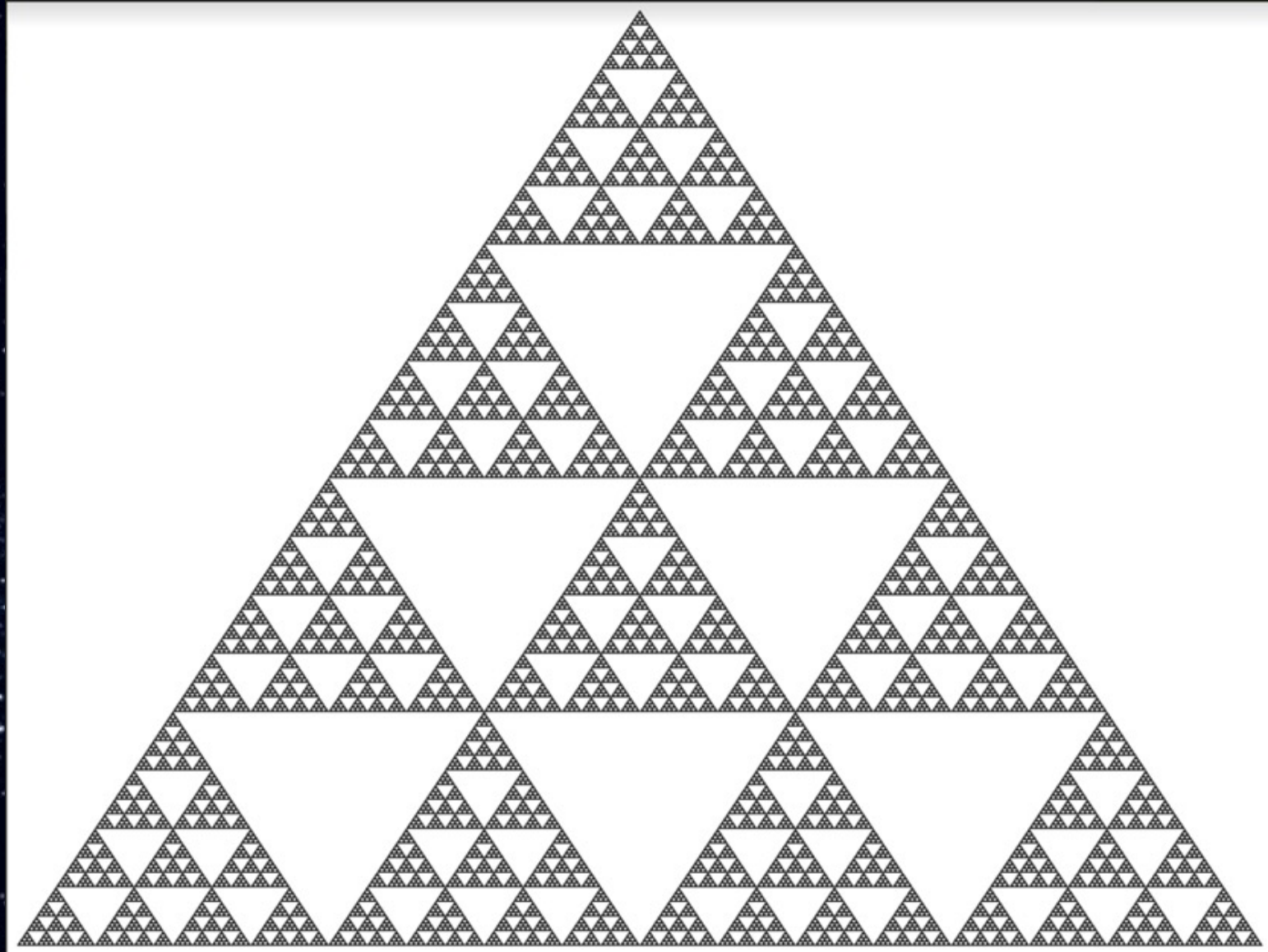


Artist: Selby Sohn, Data Visualizer

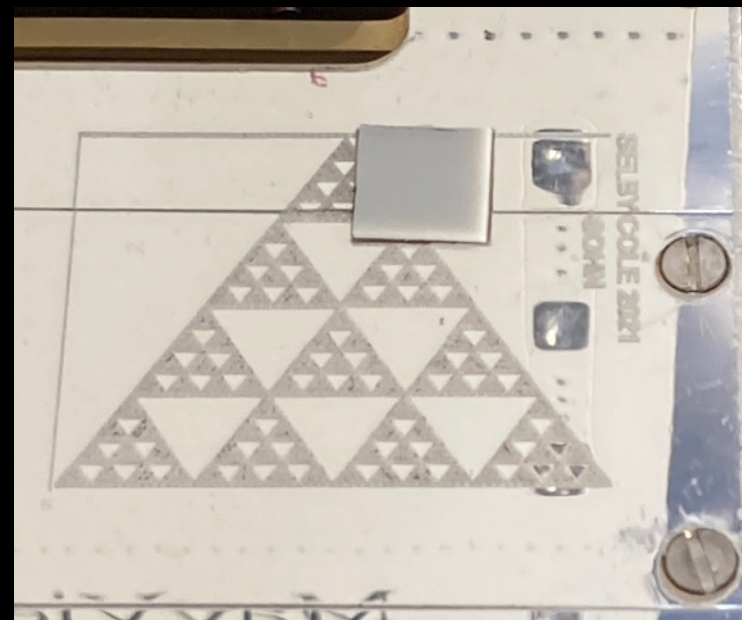
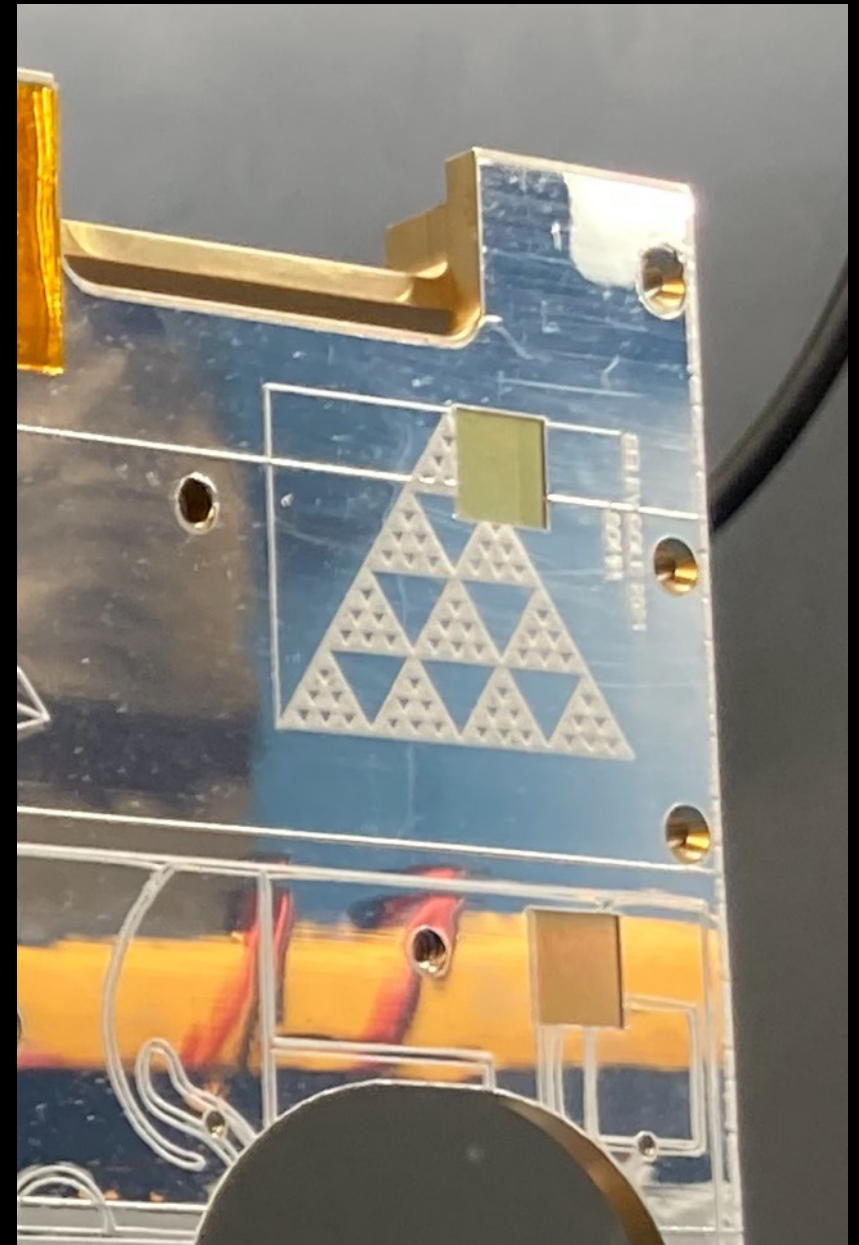
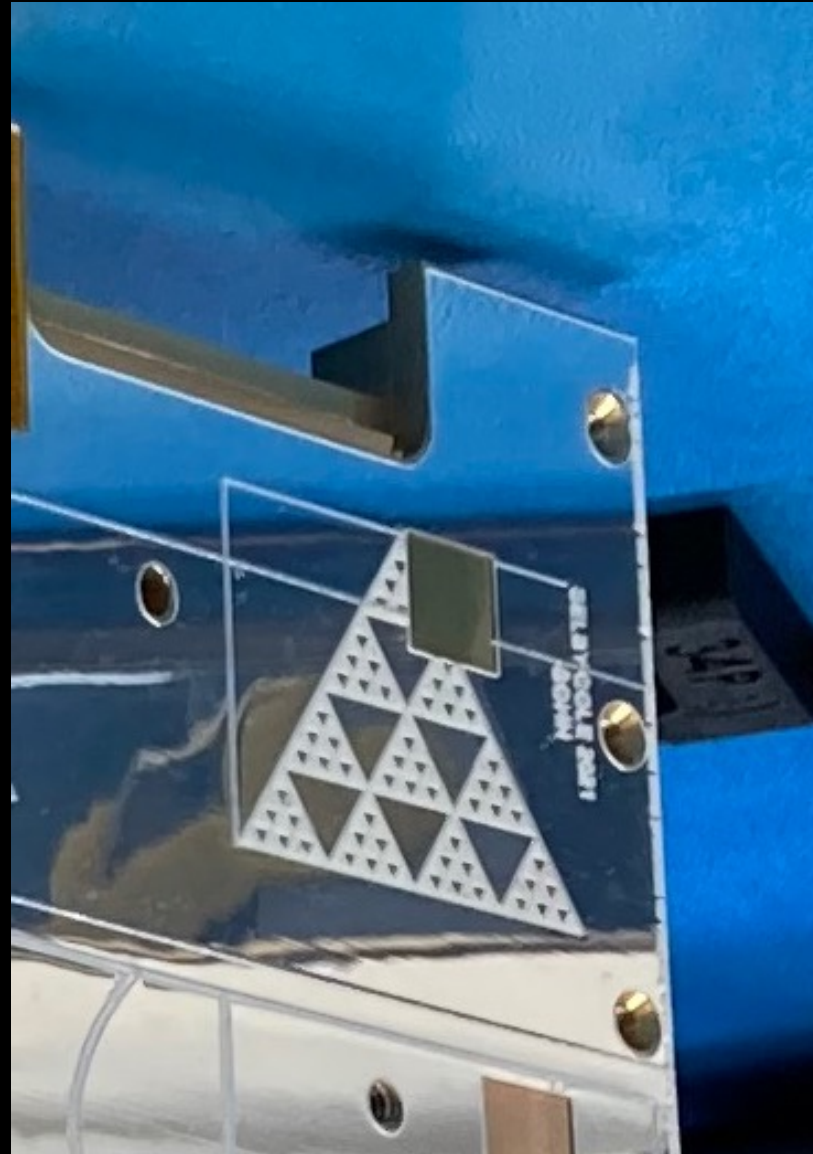
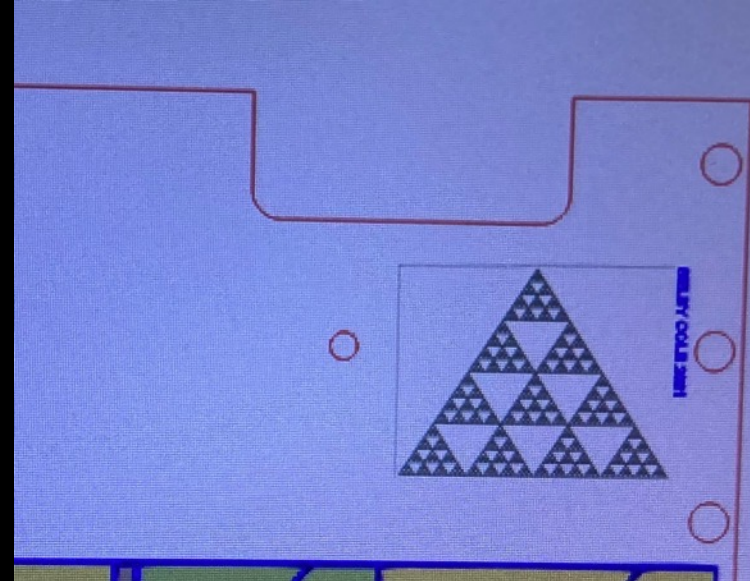
Title: The View From Above

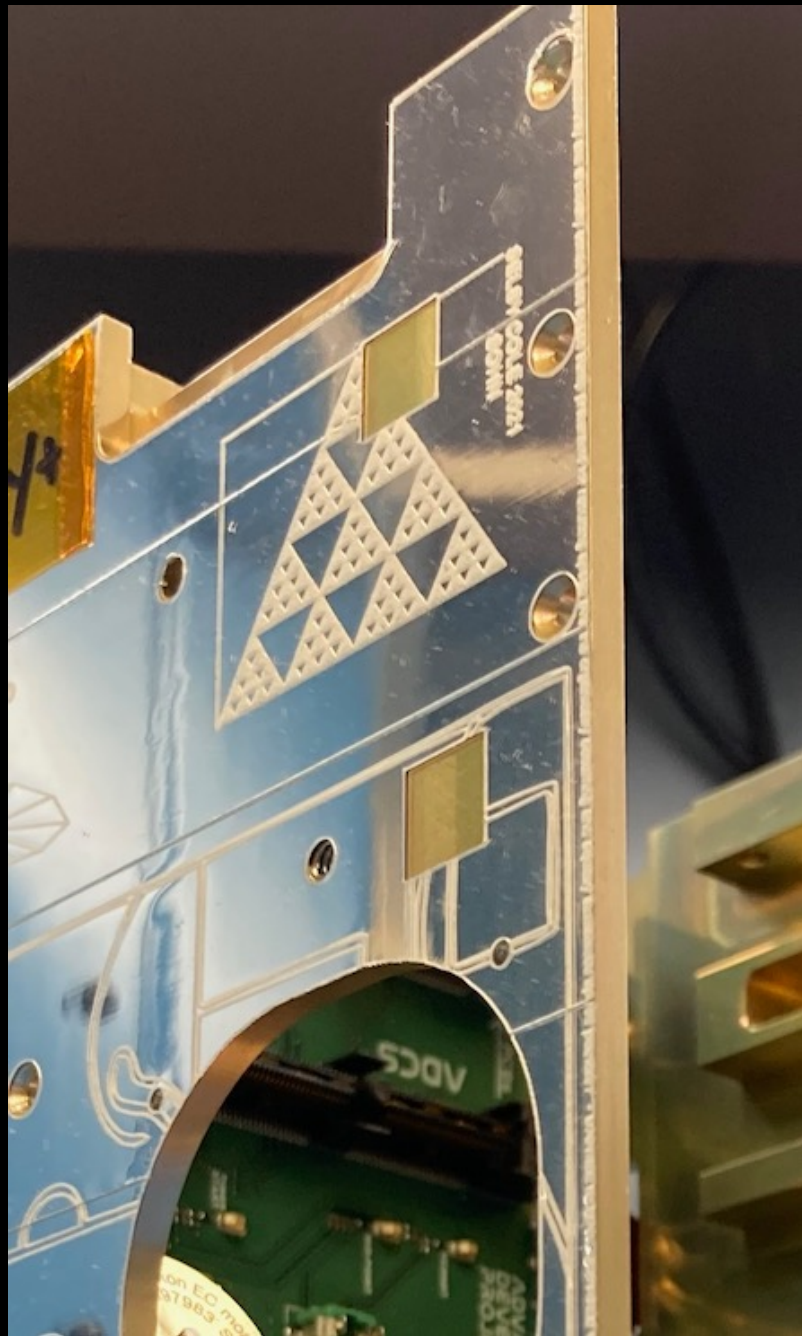
Description:

High-resolution fractal pixel density, with each pixel and its corresponding negative space serving to represent and memorialize each person lost to the Covid-19 pandemic through the shadows they no longer cast upon the face of the Earth.



Process:





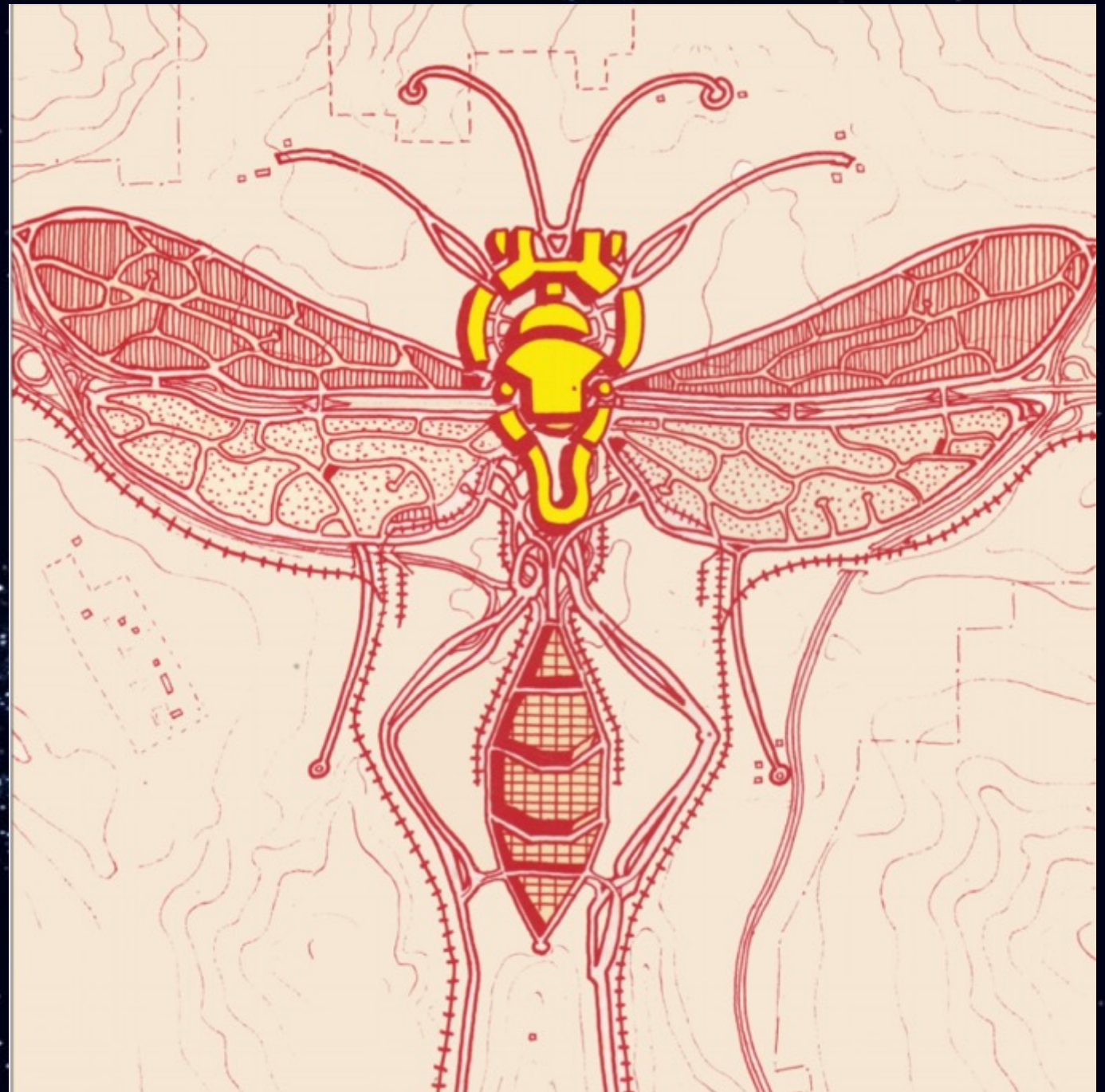


ART IN SPACE
at Ames Research Center

Artist:
Steven Johnson, Industrial
Illustrator

Title:
The New Hive/Swarm
Cityscape

Mission Statement:
*Radiation and the
Insect Centric Future,
Seen From Space;
and
Solar Radiation Flux Wind*



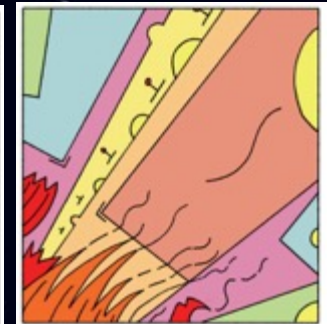
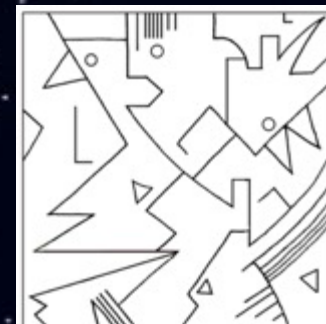
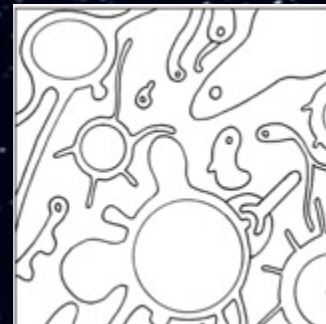
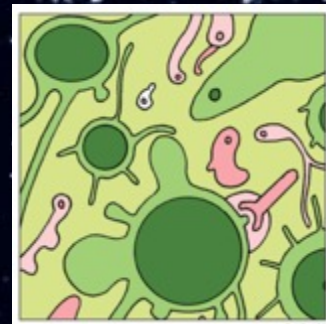
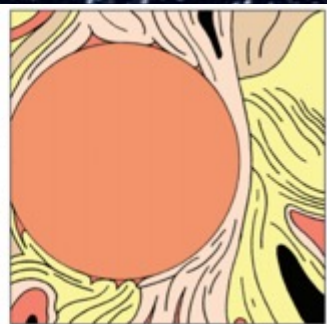
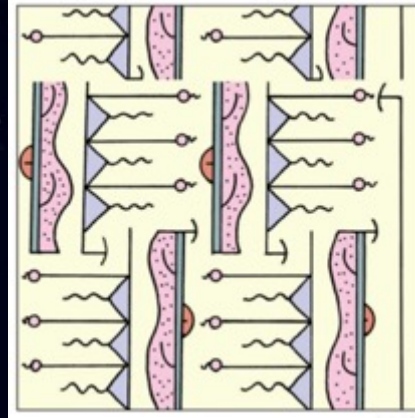
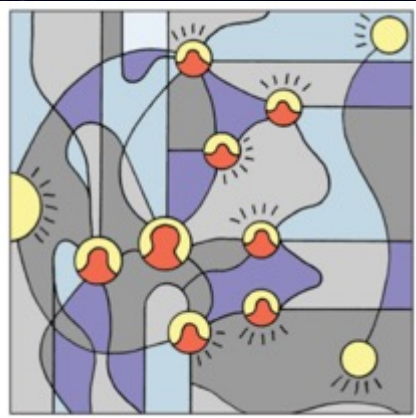
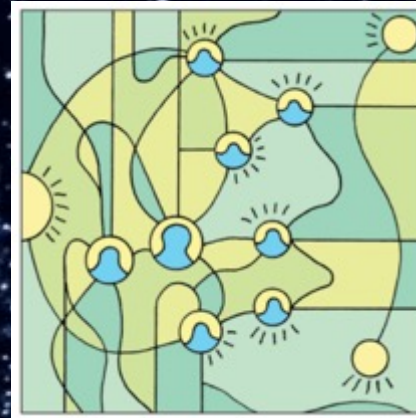
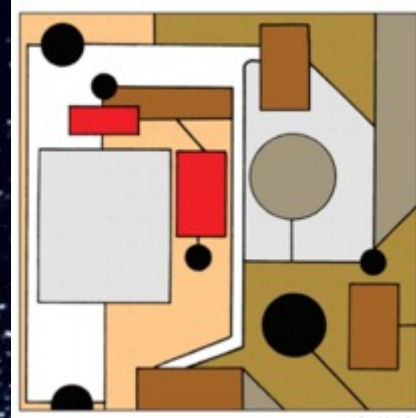
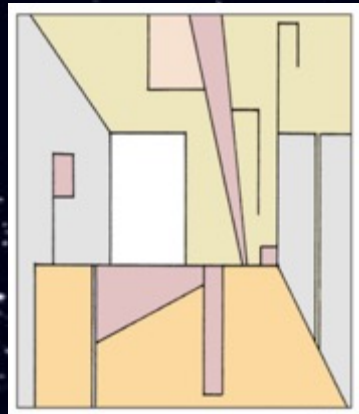
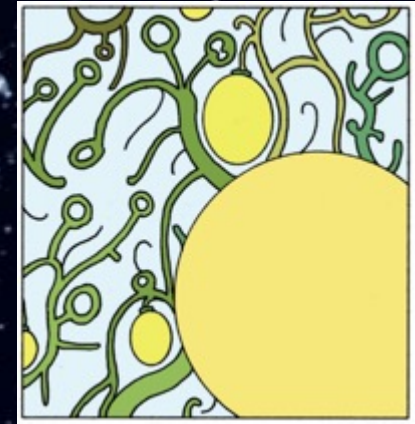
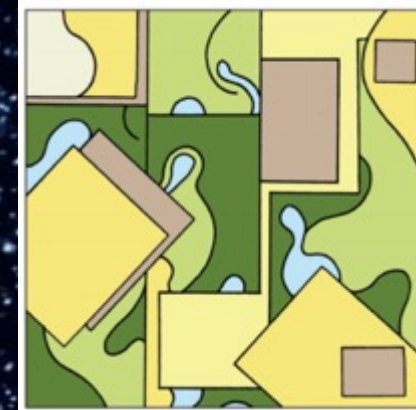
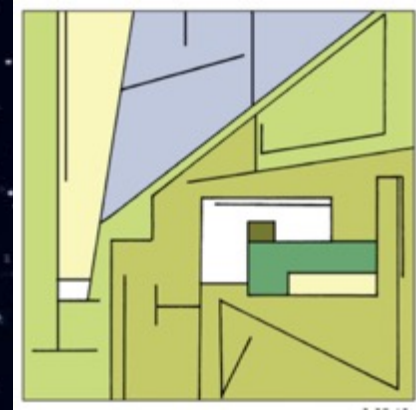


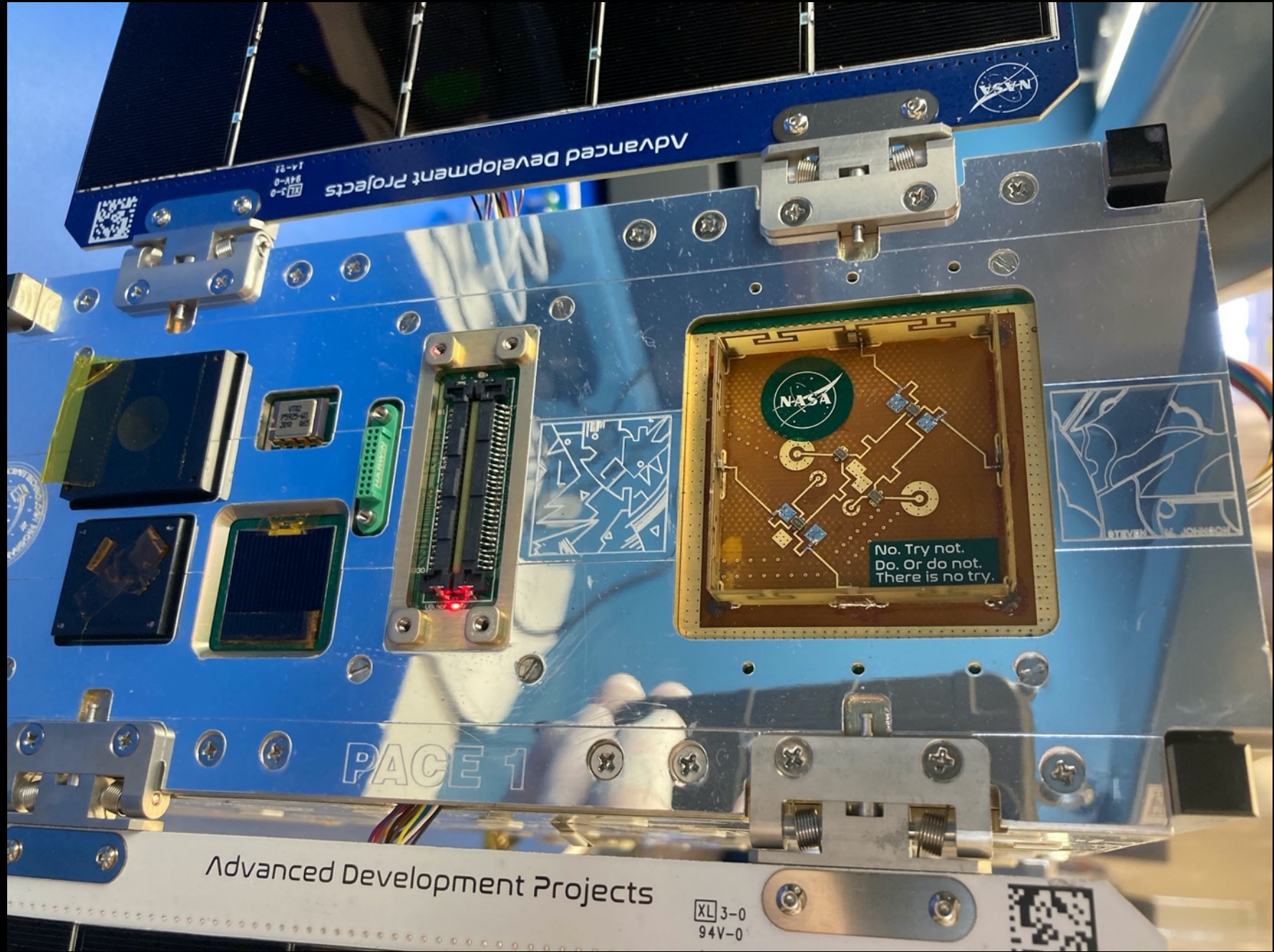
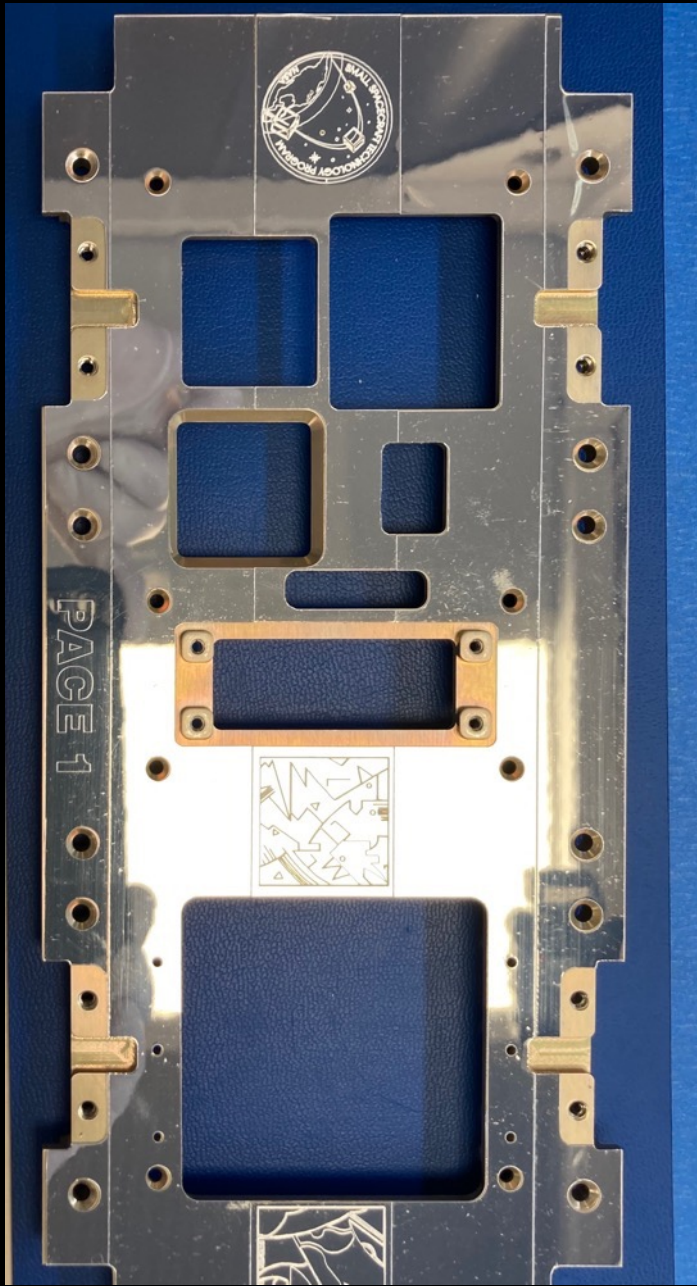
ART IN SPACE at Ames Research Center

Education and Outreach through Science+Art

Artist:
Steven Johnson

Description:
Abstracts reminiscent
of satellite imagery
from orbit.
Landscapes and futuristic
topographical
camouflage
type patterns.
Biological
cell processes and
circuitry in reaction to
high energy particles in
outer space.







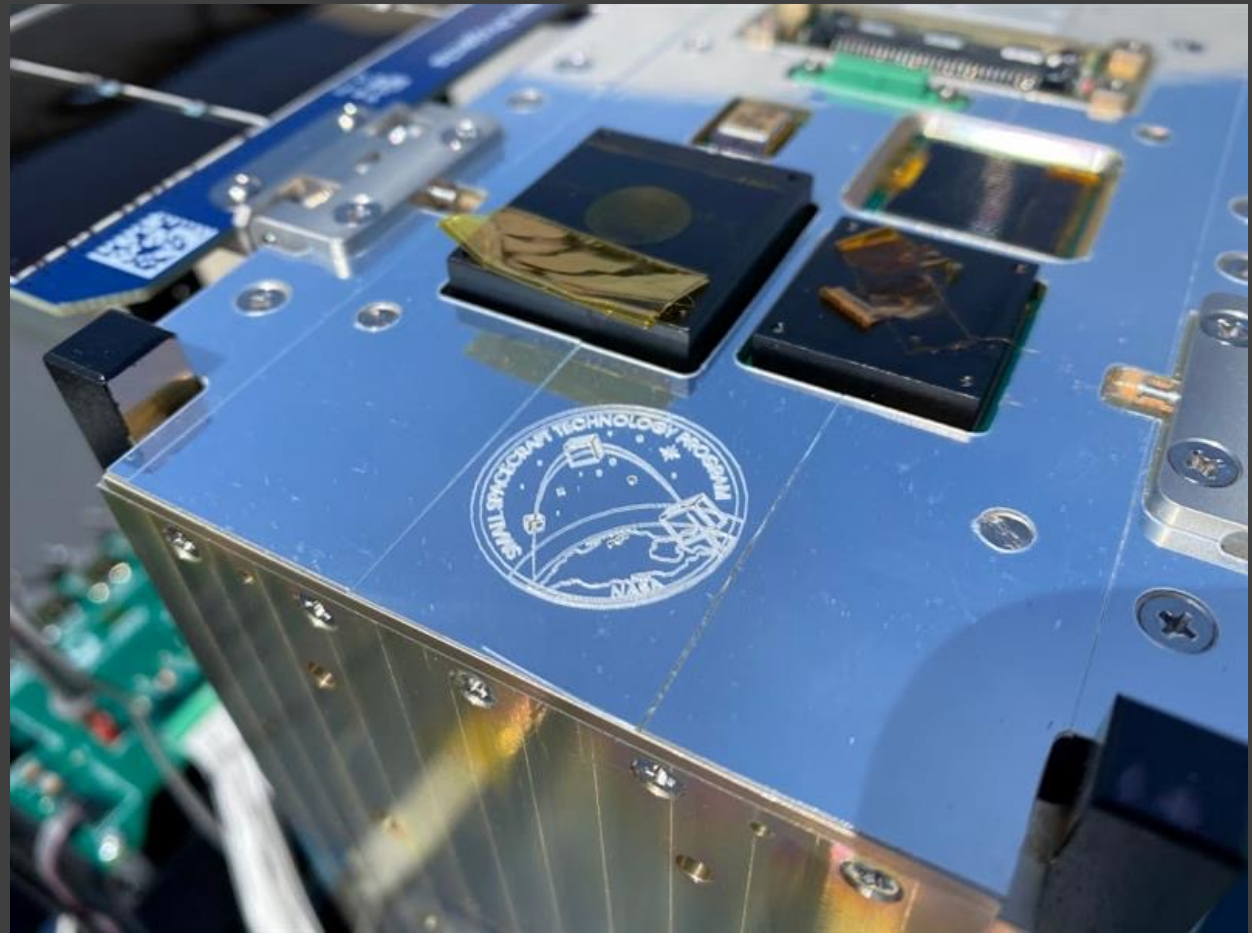






PACE-1 : Art Integration Lessons

- The addition of art to this spacecraft was an opportunistic way to add artistic value using only material required for the spacecraft (thermal emissivity film), without adding extra mass, risk, or schedule impacts to the project.
- This is an example of what can be done at relatively no/little cost, and how art in space can be achieved to provide enrichment to the longstanding NASA goals of providing education, outreach, engagement to inform the public and create interest for a new generation in not only STEM, but STEAM fields as well.



Thanks to SSTP for making PACE-1 possible!

I'm very pleased to have been able to contribute to this technology demonstration and support the first art in space at Ames since the Pioneer mission, and I look forward to doing so again for PACE 2 if the opportunity arises.



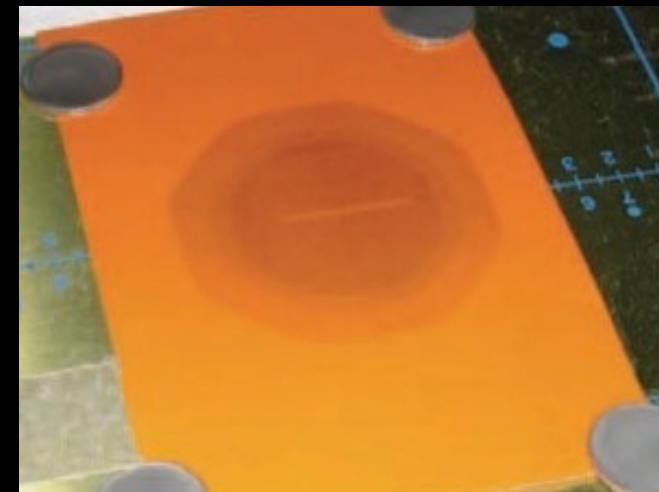
Future Concepts: Art and Science Sensor Fusion for Spacecraft

Passive Radiation Sensors Concepts for Spacecraft:

Radiographic or radiochromic film is an interesting artwork reproduction medium that can be precisely laser cut / etched and applied to spacecraft exteriors.

Artwork imagery is inscribed or cut into the film surface and can have a time delay reveal feature. Multiple film layers can be used in certain areas to create shading and patterns.

Using onboard or remote cameras can image the total dose experienced by the spacecraft to aid in determination and failure analysis, space weather environment characterization, etc.





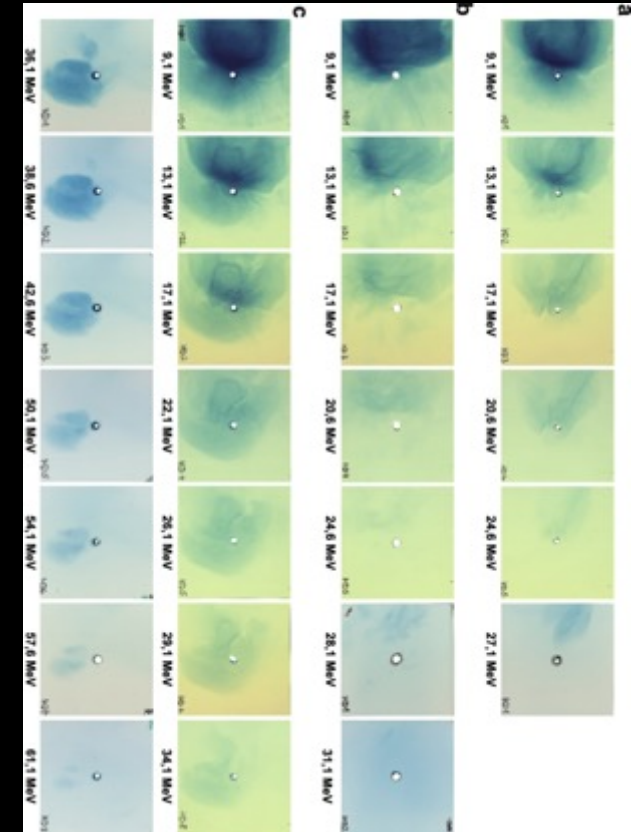
Future Concepts: Blending Art and Science to create Passive Sensors

Other ideas for s/c exterior films that can also be used to display artwork and designs: Sensitive films for x-rays, gamma rays, other types of radiation. Atomic oxygen detecting films. Magnetic field and solar wind detection films or coatings.

Artwork applied as a film can have sections which curl or raise from the surface after exposure to certain radiation emissions, etc. - a further visual indicator. This 3D aspect can be an integral part of the final art work, which reaches its full expression only after the radiation sensing mission segment is complete; a joining of art and science to perform environmental sensing and resulting data indication.

Radiographic film can be sandwiched in Kapton to mitigate offgassing.

Commercially available radiographic films:
12x17" size for 6U bus face





Blending Art and Science at NASA: Process Experience and Rationale

Art in space necessarily becomes a multidisciplinary collaboration between the artist, who must become a technologist in the process, and the engineering and science team of the mission who must discover how mission requirements determine the eventual form of the artwork. Both sides must think and work together to achieve the final result, art in space, while taking into account various factors that mutually affect the mission and the artwork, ie: thermal and sensor requirements, as well as material off-gassing and strict dimensional constraints.

An exercise in minimalism results, in which the bare functional aspects of the spacecraft work to inform the artwork and lead it to become crafted out of the very same materials and surface coatings that allow the mission to succeed. In this way, the art and the engineering become intertwined intimately and work together to achieve the science goals and the art goals of the mission.

The engineers and scientists learn valuable lessons from the artists, and the artists learn valuable lessons from the science and engineering team. In addition to providing essential public outreach and education, the union of these two seemingly disparate areas may well result in novel and unique concepts for new sensors types and configurations. When creative people from a diverse set of disciplines collaborate, the sky is no longer the limit..



Blending Art and Science at NASA

- As an agency, NASA has long had the mandate to provide public education and outreach about its missions. Starting in the 1960's the NASA Art Program has partnered with external artists to create striking and imagination provoking artwork that demonstrates, in an accessible manner, the hard work, excitement, and engineering that goes into making spaceflight missions and their exploration and science discovery goals possible. NASA Ames has had a sizable role to play in using art to capture the imagination and popularize space activities, notably the space habitat torus painting of Rick Guidice, produced to visually explain the futuristic concepts generated at Ames in the 1970's.
- At Ames, the PACE team is continuing in this NASA tradition by curating a selection of artwork that will emblazon the exterior of the PACE 1 mission, a 6U smallsat which launches in late June 2021, and which seeks to demonstrate rapid, low cost options for validating spaceflight components that will function in the high radiation environment of outer space. The exterior of PACE 1 is layered in a reflective emissivity film which aids in thermal regulation of the spacecraft, and which also provided a unique canvas upon which selected artworks were laser etched. One half of the spacecraft contains patterns which are an artistic rendering of the famous Feynmann diagrams which depict high energy particle collisions, and the other faces of the s/c contain interpretations of Earth features as seen from space, along with a fractal pattern, in which each pixel commemorates and pays homage to the lives lost to Covid-19.
- This unique collaboration between the engineering and science team and the artists, allowed both sides to come together and learn about the exacting requirements for materials used in space, and what was possible given these limitations and how they could be made into opportunities. In this way, the art was not merely an add-on, but was integrated fully into the functional fabric of the spacecraft, and provided a valuable opportunity for people of very disparate backgrounds to communicate and brainstorm. This boundary area between the arts and sciences is where the newest and most exciting concepts emerge that will go on to reshape the future, and NASA Ames is proud to be at the forefront of promoting this sort of valuable collaboration. The potential to create artworks that also serve as sensors or space environment indicators by virtue of their materials, configuration, and surface micro patterning is also an intriguing concept that arose, and which holds promise for future missions in which functional art becomes a regular augmentation feature.



Blending Art and Science at NASA

- The future of Art in Space at NASA Ames is bright, and through this unique pairing of science, engineering, and art, we hope that a new generation can be introduced to the excitement and discovery potential of the work that NASA performs on a daily basis.
- The historical NASA Art Program pioneered the depiction of spaceflight activities, producing epochal works of art that allowed all those on Earth to gain a sense of connection and immediacy to the far flung reality of the spacecraft venturing out into the Solar System. At NASA Ames in the modern day, mission teams are taking this one step further by integrating artwork directly into the spacecraft themselves. The artwork will first serve as visually striking exteriors that capture the public imagination and provide priceless and essential outreach, and will eventually also take on a functional role in missions by serving in a new role, never before attempted in spaceflight history, as "Sensor-Art", where the very nature of the artwork also serves in a functional, mission supporting role.
- NASA Space Art Program in History: <https://www.nasa.gov/feature/nasa-and-art-a-collaboration-colored-with-history/> and https://www.nasa.gov/50th/50th_magazine/arts.html
- Art in space is a long held NASA tradition, most famously the golden record and plaque on Voyager and Pioneer, respectively. Art in space is something with a long NASA tradition and something which may seem "unnecessary and non-essential" to the engineering and science of the mission, but which in fact, pays huge future dividends in terms of public engagement and excitement. Many more people know about the mission due to the iconic artistic etchings on the gold plaque than they do about the original mission goals of the spacecraft. In the example of voyager, the art was not only decoration, but was indeed functional and part of the mission goal itself, of human voyage and discovery, as a message to any future discoverers.
- I want to thank Anh, Dayne, and the entire PACE mission team, and the SSTP leadership, for making this possible and for their gracious time and support



Blending Art and Science at NASA

- Art also provides a historical record. After all, what often is left over of great ages in history is art. As Lester Cooke, one of the NASA art program's original founders, wrote, "I hope that future generations will realize that we have not only scientists and engineers capable of shaping the destiny of our age, but also artists worthy to keep them company."