



# Plankton, Aerosol, Cloud, ocean Ecosystem (PACE)



**Life of a Spacecraft (S/C)**

8/2/2022

Beth Weinstein  
PACE Observatory Manager

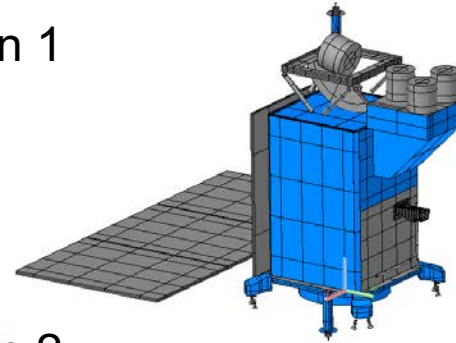


# Year 1 2015 - 2016

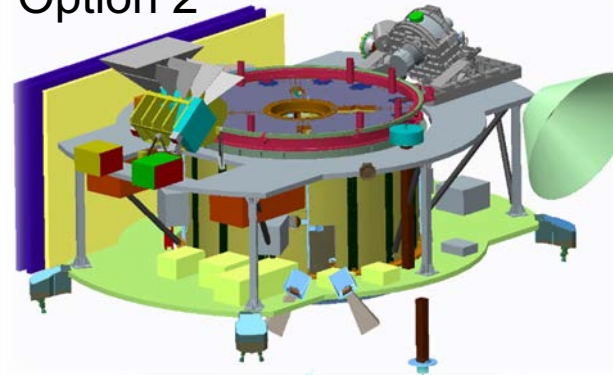


- Starting with very little info about the mission, a team made up of pieces of people from electrical, mechanical, thermal, navigation, software, etc. considered a few designs before settling on a rough concept of PACE
- From there, the team started many trades to fit within the threshold science requirements and the budget:
  - How many instruments should we have? What type of science? What resolution?
  - What bands and data rates to send science data?
- The largest trade was who should build the spacecraft; proposals were solicited from companies to compare to the NASA team's concept

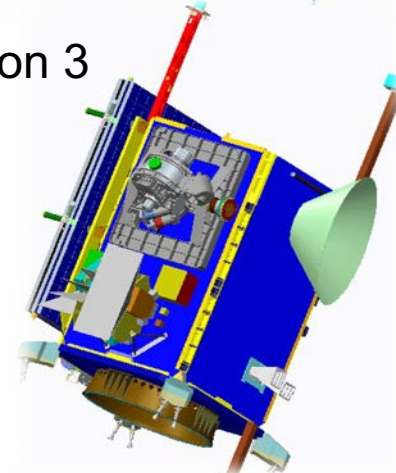
Option 1



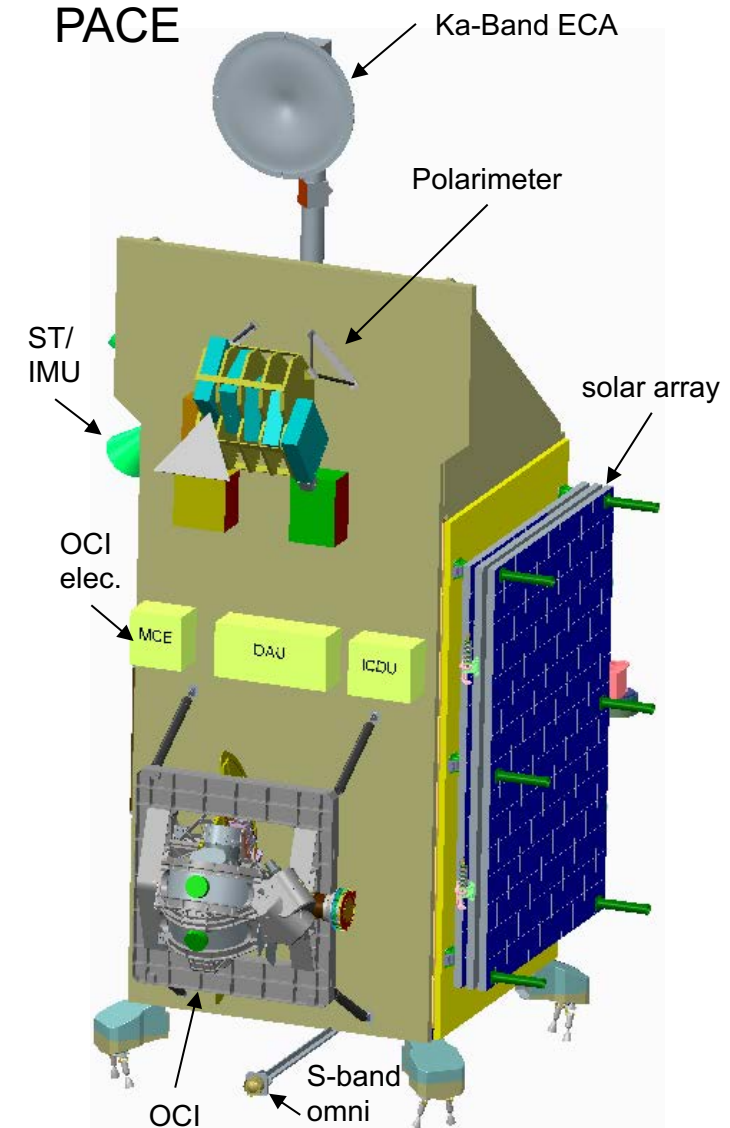
Option 2



Option 3



PACE



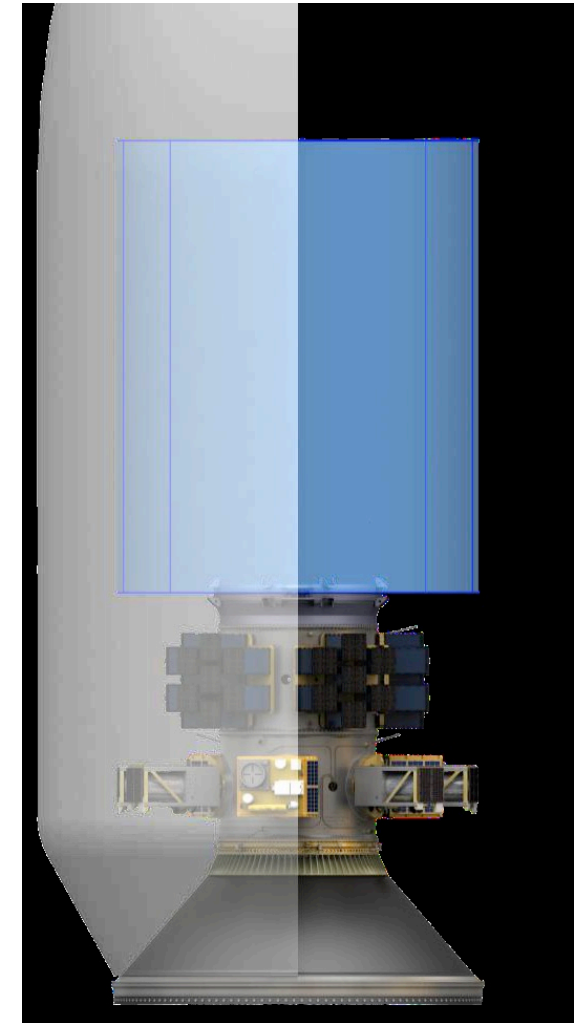
# of people working on the S/C: ~3  
 Launch date: 8/2022



# Year 2 2016 - 2017



- NASA Headquarters decided that NASA GSFC should build the spacecraft!
- So, the team went to work:
  - Developing requirements
  - Starting the design
  - Buying parts before we even had requirements or designs; some take a year to get
  - Adding more team members
- This was also the 1<sup>st</sup> year being cancelled in the president's budget
  - So, we spent the year trying to save our mission politically and fiscally by clinging to the latest tech, e.g., encryption, launch vehicle ride share, laser communication, green propulsion, delay tolerant networking)
  - We would be cancelled 3 more times after this



Space Flight Industries – SpaceX Falcon 9  
Dedicated Rideshare Integrated Payload Stack

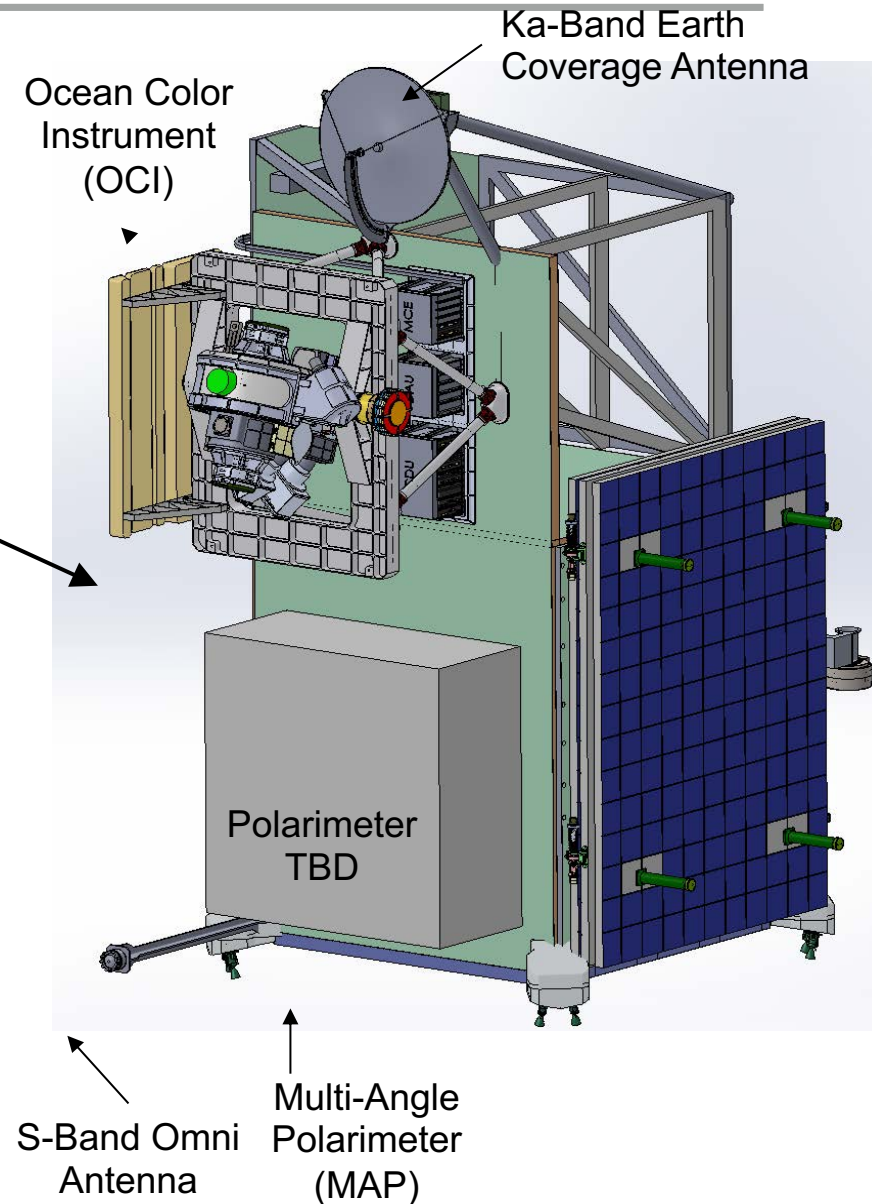
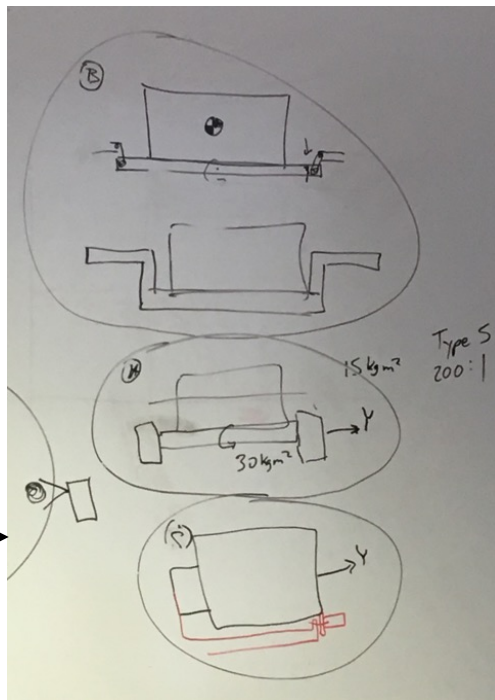
*# of people working on the S/C: ~17*  
*Launch date: 8/2022*



# Year 3 2017 - 2018



- Spacecraft concept was still in flux – we still don't know what instruments we had on the mission (only 2 shown here, but had as many as 5 at one point)
- Non-NASA: NASA cannot build everything itself, so started requesting proposals for components despite not knowing exactly what the spacecraft would look like
- NASA: For things NASA was building
  - Built engineering test unit (ETU) boards
  - Refined concepts for other components



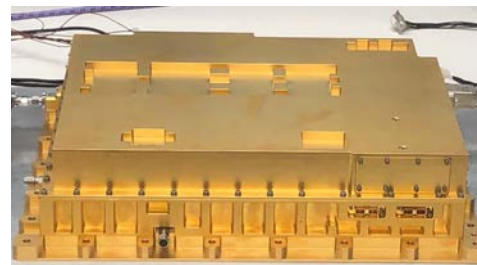
# of people working on the S/C: ~62  
 Launch date: 8/2022



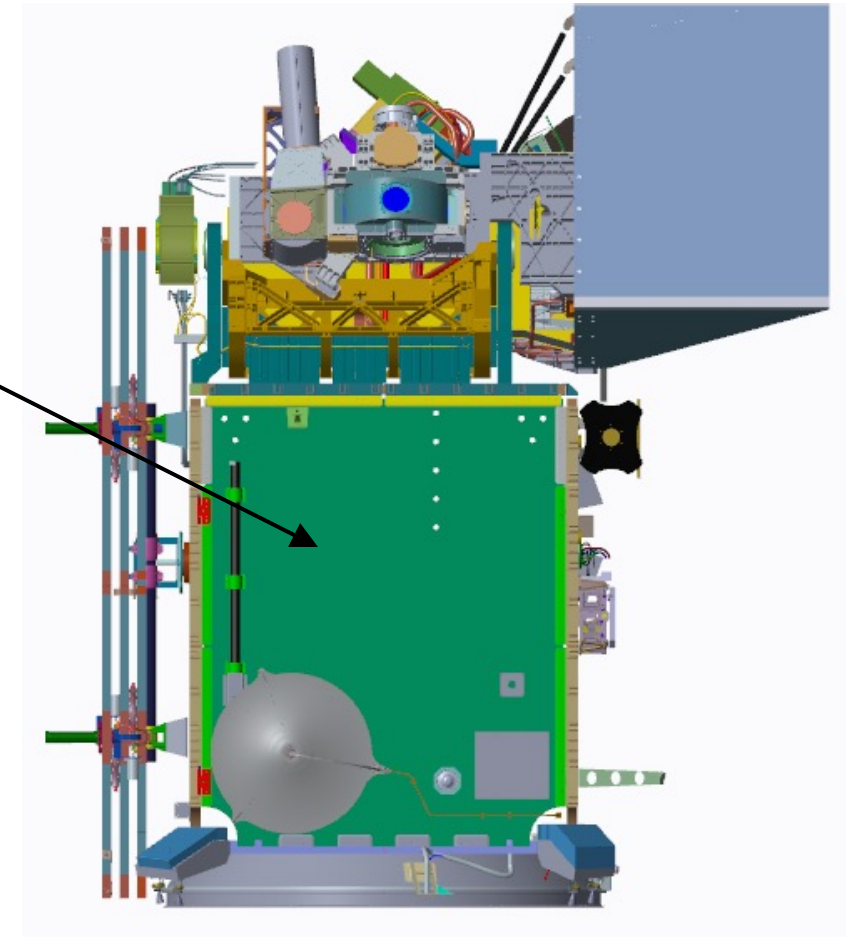
# Year 4 2018 - 2019



- Spacecraft concept finally matured (we ended up with 3 instruments!), so could finally buy the custom structure panels
- Non-NASA: We selected the companies to build the spacecraft components. It turns out there is only ~2 - 3 companies in the world that can build each of our components!
- NASA: Meanwhile at NASA...Engineering test units (ETUs) were built and tested to prove out the NASA component designs



Transmitter ETU



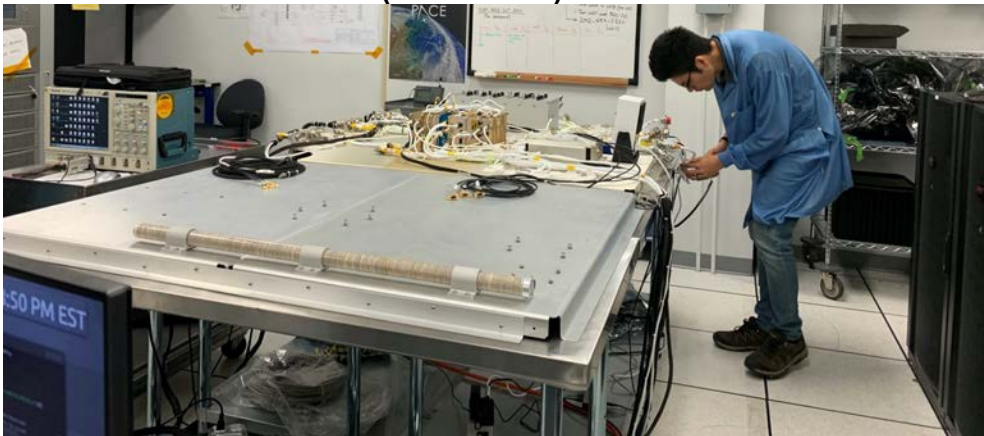
*# of people working on the S/C: ~108*  
*Launch date: 8/2022*



# Year 5 2019 - 2020



- Non-NASA: We visited the many people building our components and confirmed they would work with the NASA design
- NASA:
  - Finalized the design
  - Started building flight components
  - Built a flat satellite (FlatSat!) with the ETUs

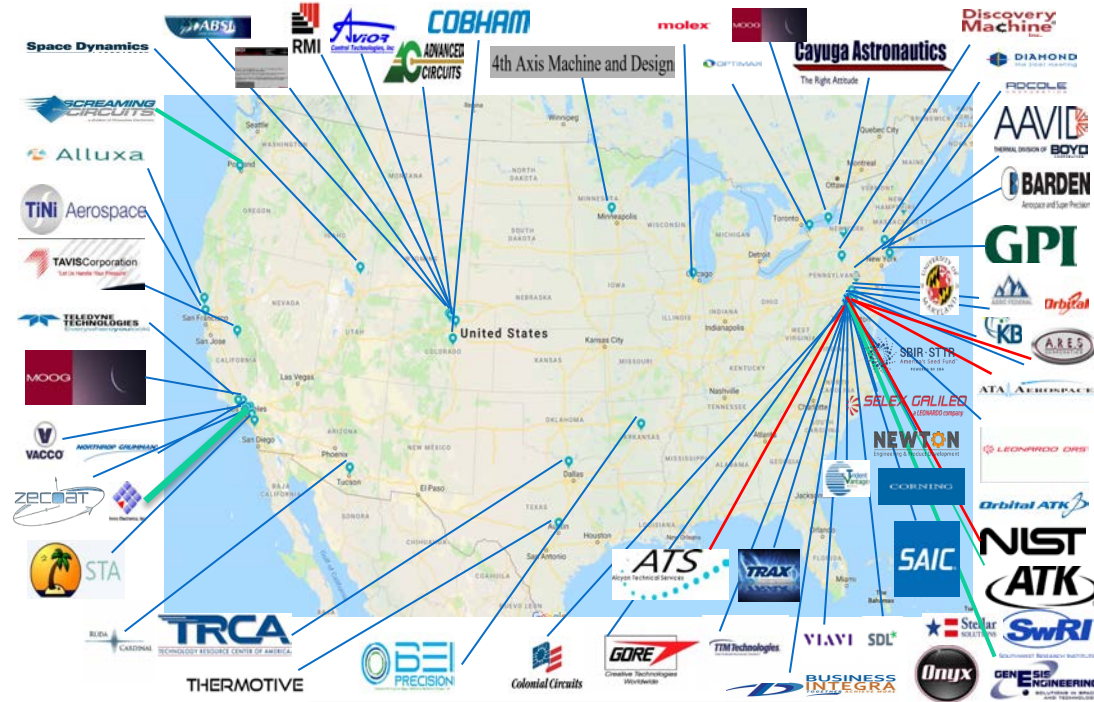


- We were furloughed for 6 weeks and were not able to talk to each other or the companies making our components, so we had a few surprises when we could finally talk to them

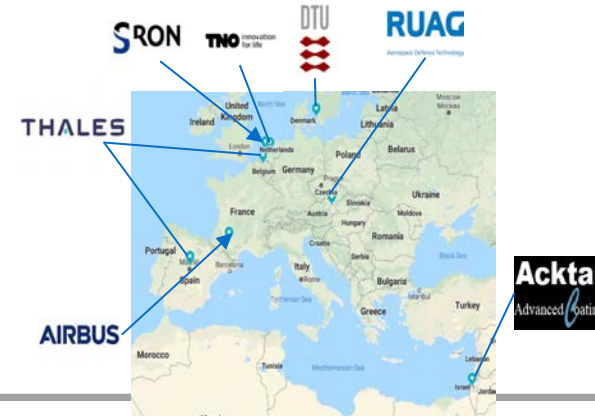
# of people working on the S/C: ~140

Launch date: 3/2023

## Domestic Partners



## Foreign Partners





# Year 6 2020 - 2021



- Got shutdown by COVID for 5 months
- When we got back, we lost another month because we could not find **one screw** in 70,000 packages that have been stacking up
- Non-NASA: Continued to work with companies to deliver components



GPS Receiver



Coarse Sun Sensors

- NASA: Continued building components when we were allowed back

*# of people working on the S/C: ~150  
Launch date: 1/2024*

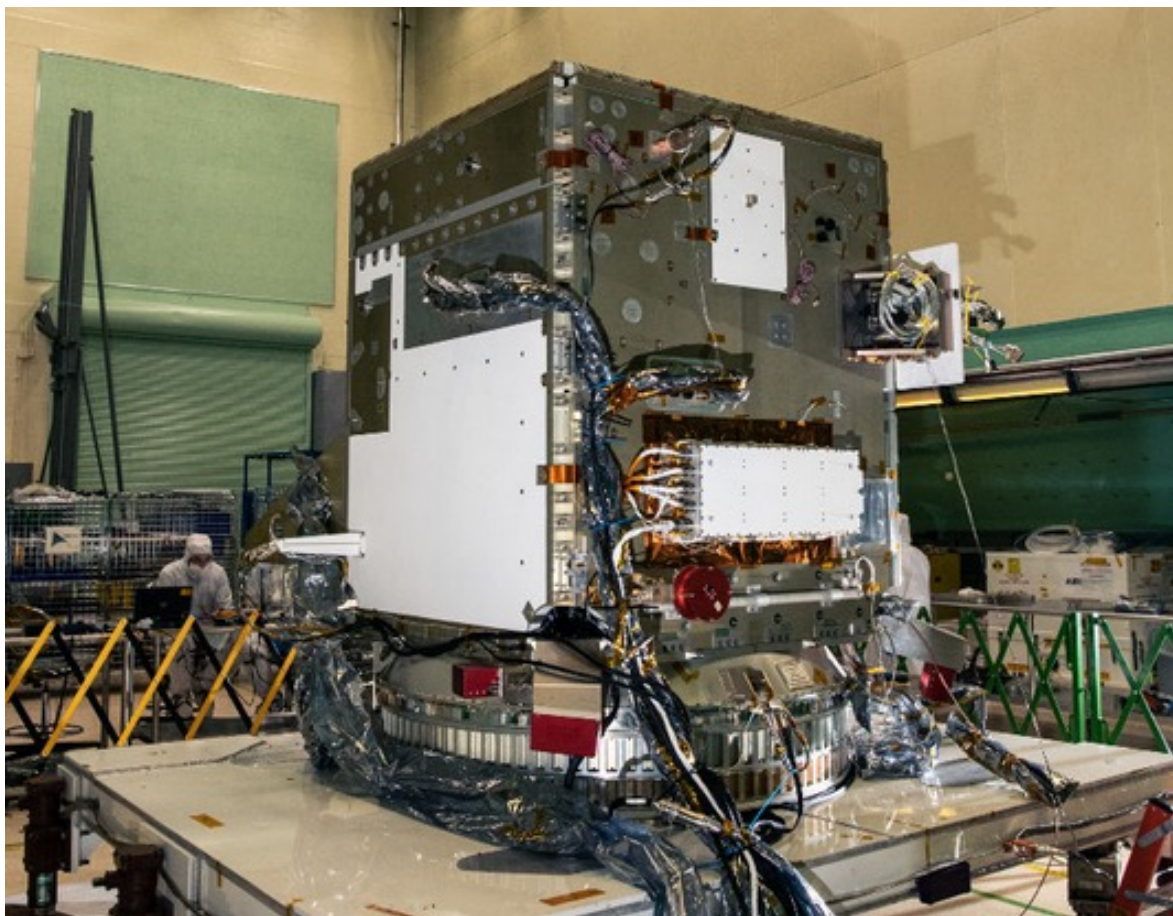




# Year 7 2021 - 2022



- Finally, we built a spacecraft!



*# of people working on the S/C: ~130  
Launch date: 1/2024*





# It Takes a Team!

