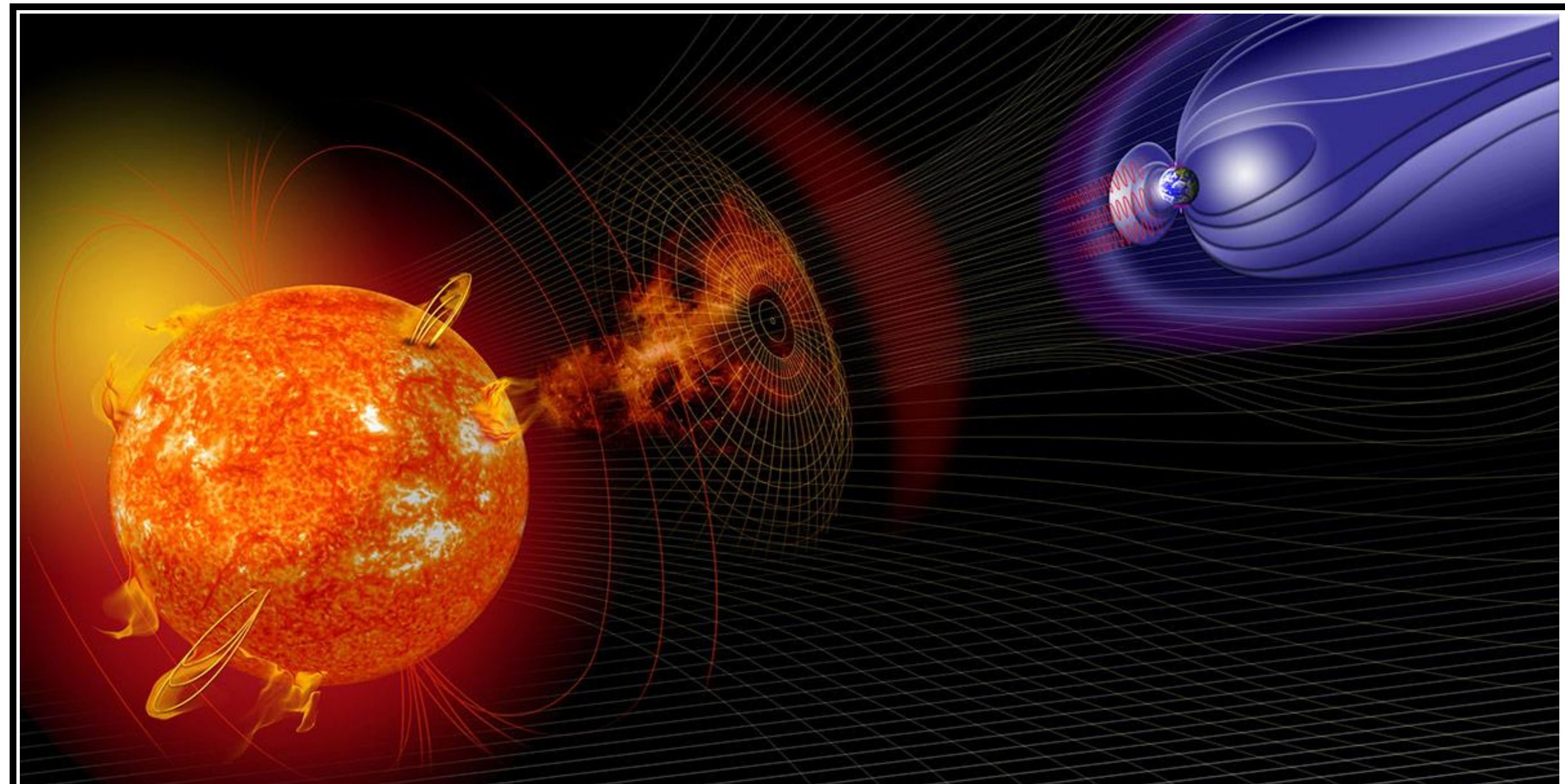


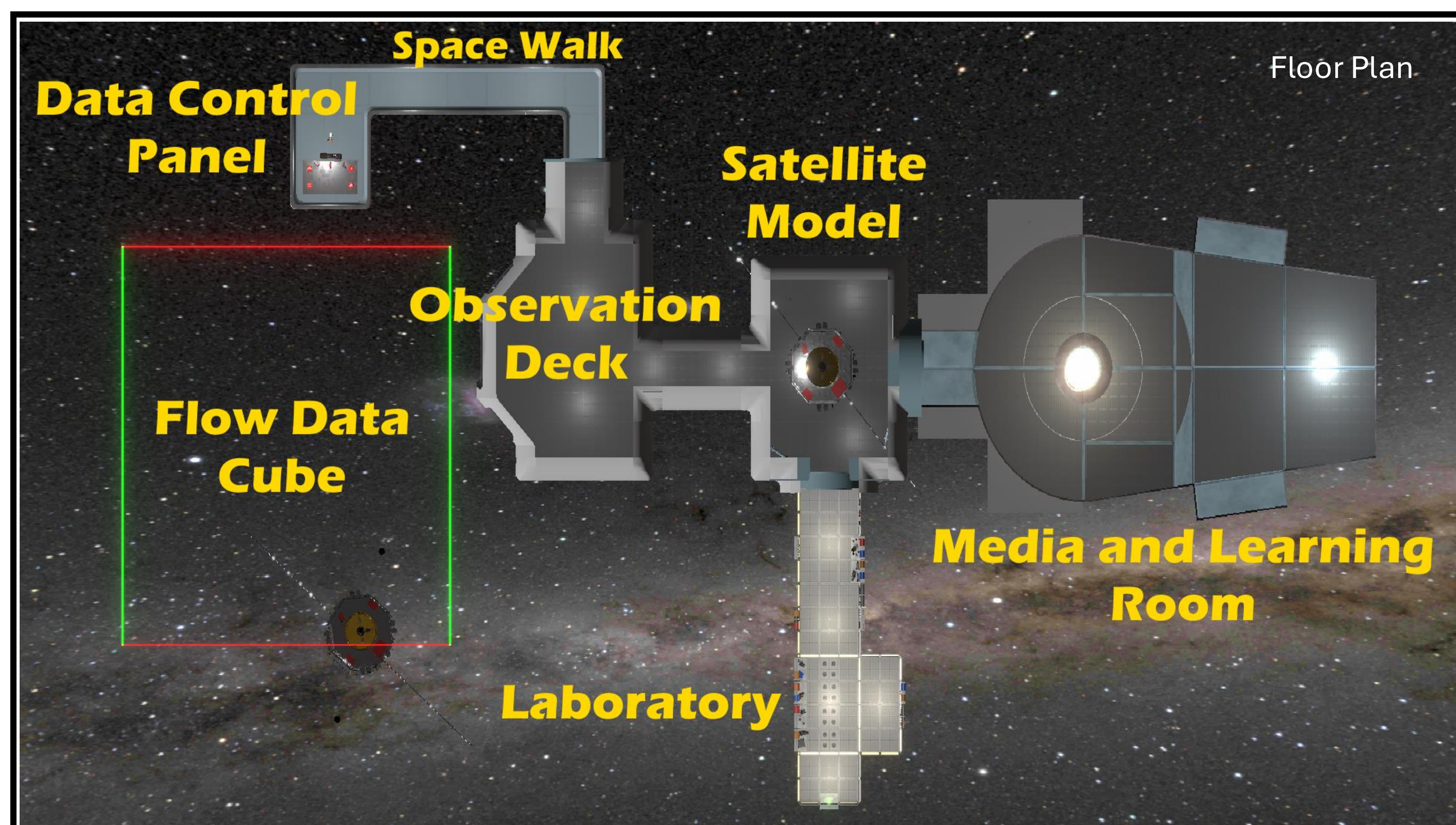


Space Weather



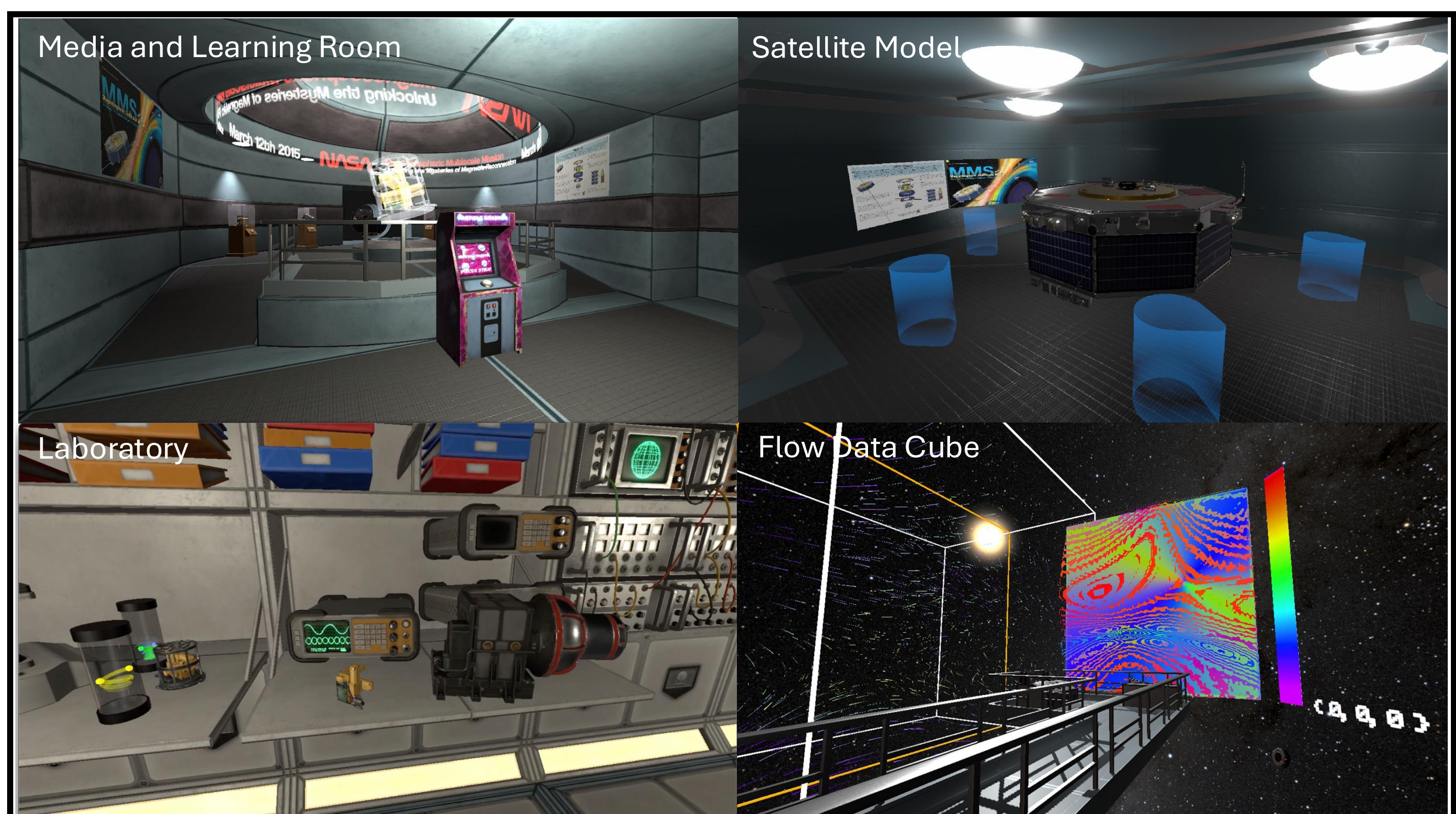
Space, like Earth, has weather. And just like hurricanes, tornadoes, and other storms can cause lots of damage, geomagnetic storms in space can also cause damage – damage to astronauts, satellites, and the society we have built on the ground. The University of New Hampshire is building satellites to better study and predict space weather. We have taken Space Weather events, as well as the satellites, instruments, and data we use to study them, and put them into a Space Station in Virtual Reality for all to enjoy. The space station has a media room for learning about space weather and satellite missions, games and instruments for interactive exploration, and a data viewing platform to visualize and explore space weather events. We are able to bring outer space closer to home so kids and adults alike can play with learn about space weather in a way we learn best -- by exploring.

Space Physics in Virtual Reality



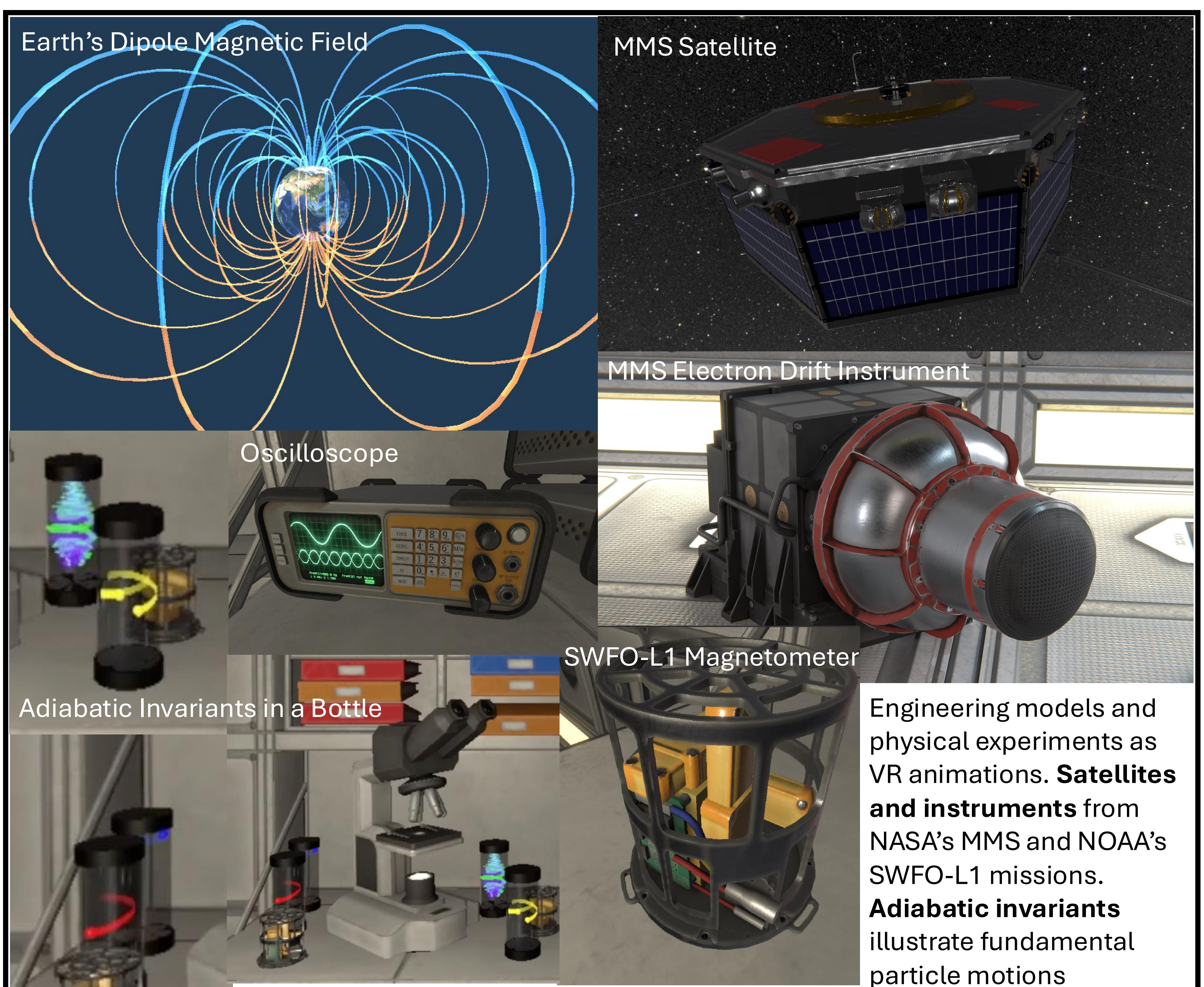
- A floor plan of the space station showing the explorable spaces.
- **Media and Learning Room**- Multi-media resources and assets to learn about Space Weather
 - **Satellite Model**- See life-size satellite model and their components
 - **Laboratory**- Interact with satellite components and plasma physics experiments
 - **Observation Deck**- See the sun-Earth system and gaze upon the Data Cube
 - **Flow Data Cube**- Explore data gathered in outer space and visualize Space Weather events
 - **Data Control Panel**- Interact with the Data Cube

Space Physics in Virtual Reality



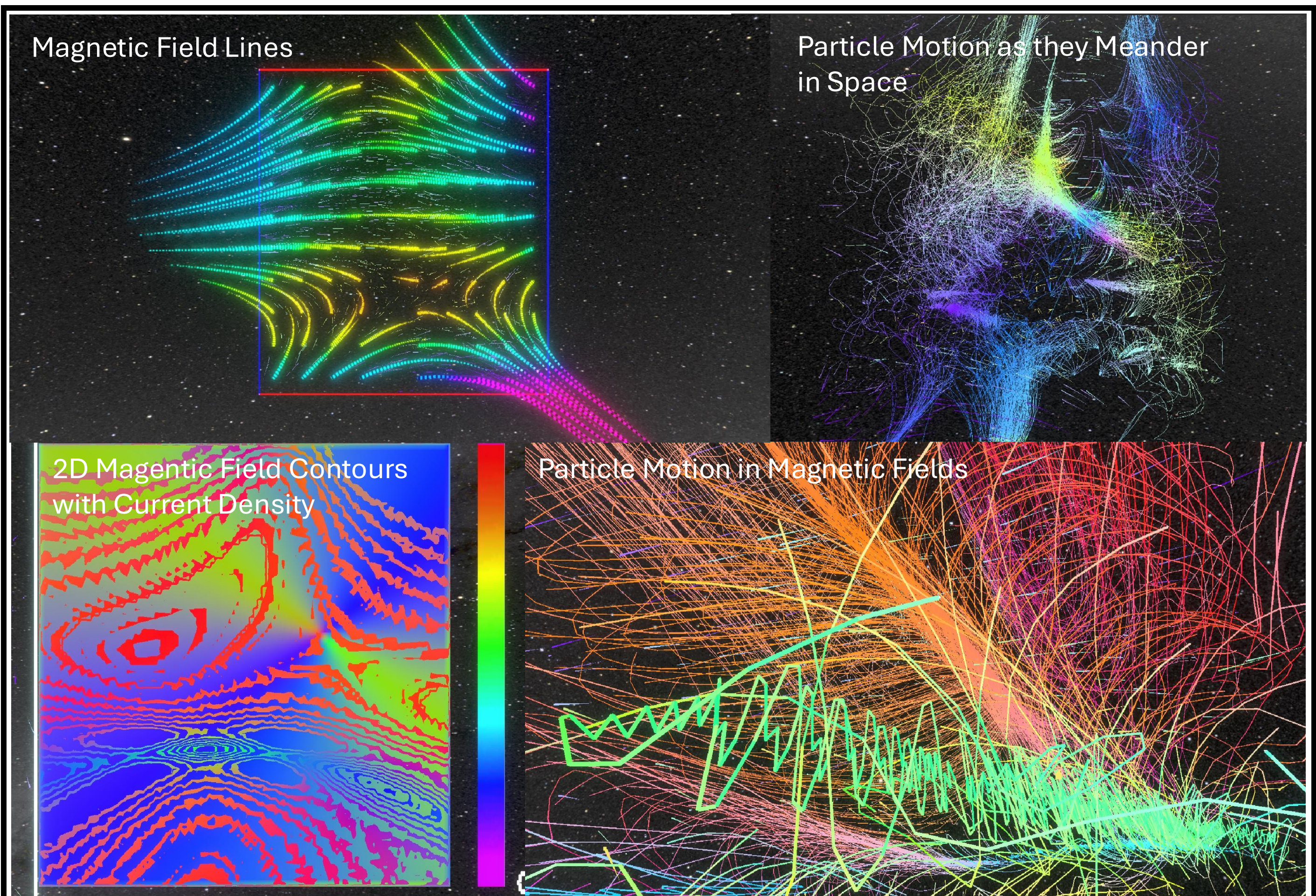
- Media and Learning Room**
 Display with assets that can be projected into the hologram; old-school arcade games with integrated plasma physics, and information for learning about Space Weather
- Satellite Model**
 A life-size model of the MMS satellite with all of its instruments on display
- Flow Data Cube**
 Visualize and interact with outer space. Toss plasma balls, explore Space Weather events, and see how energy conversion happens
- Laboratory**
 Pick-up and investigate satellite hardware and experiments

Assets



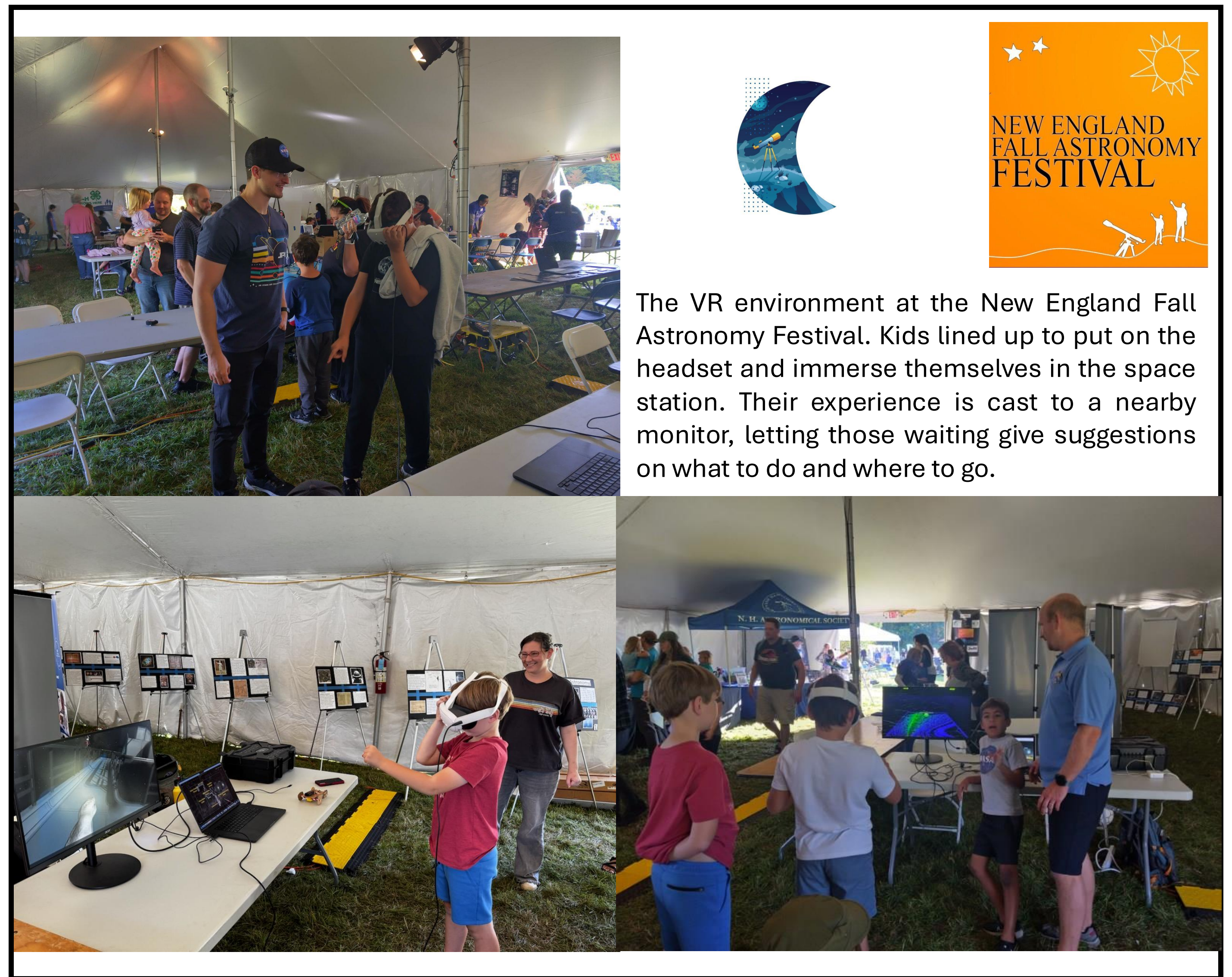
Engineering models and physical experiments as VR animations. **Satellites and instruments** from NASA's MMS and NOAA's SWFO-L1 missions. **Adiabatic invariants** illustrate fundamental particle motions

Data Visualizations

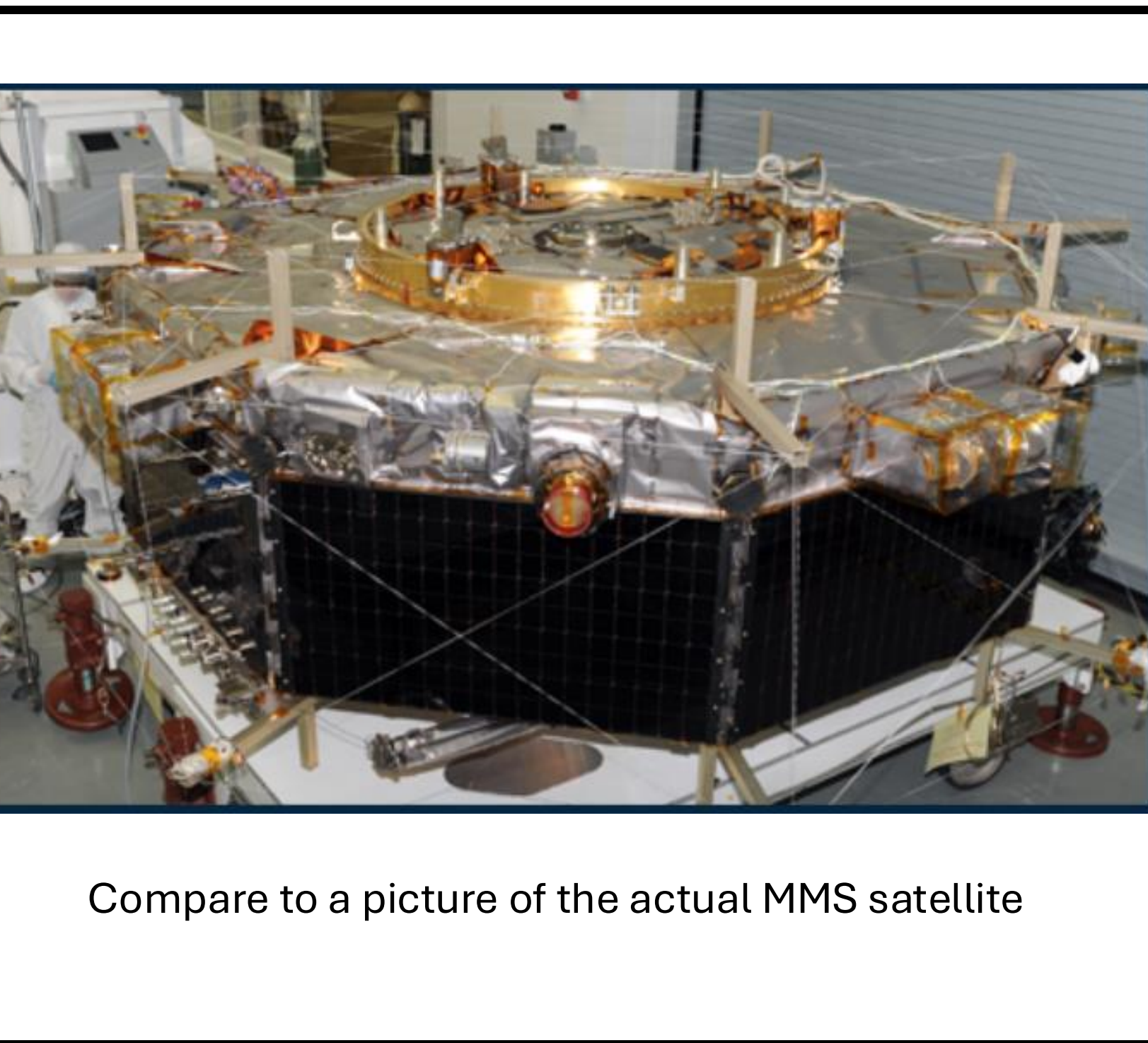
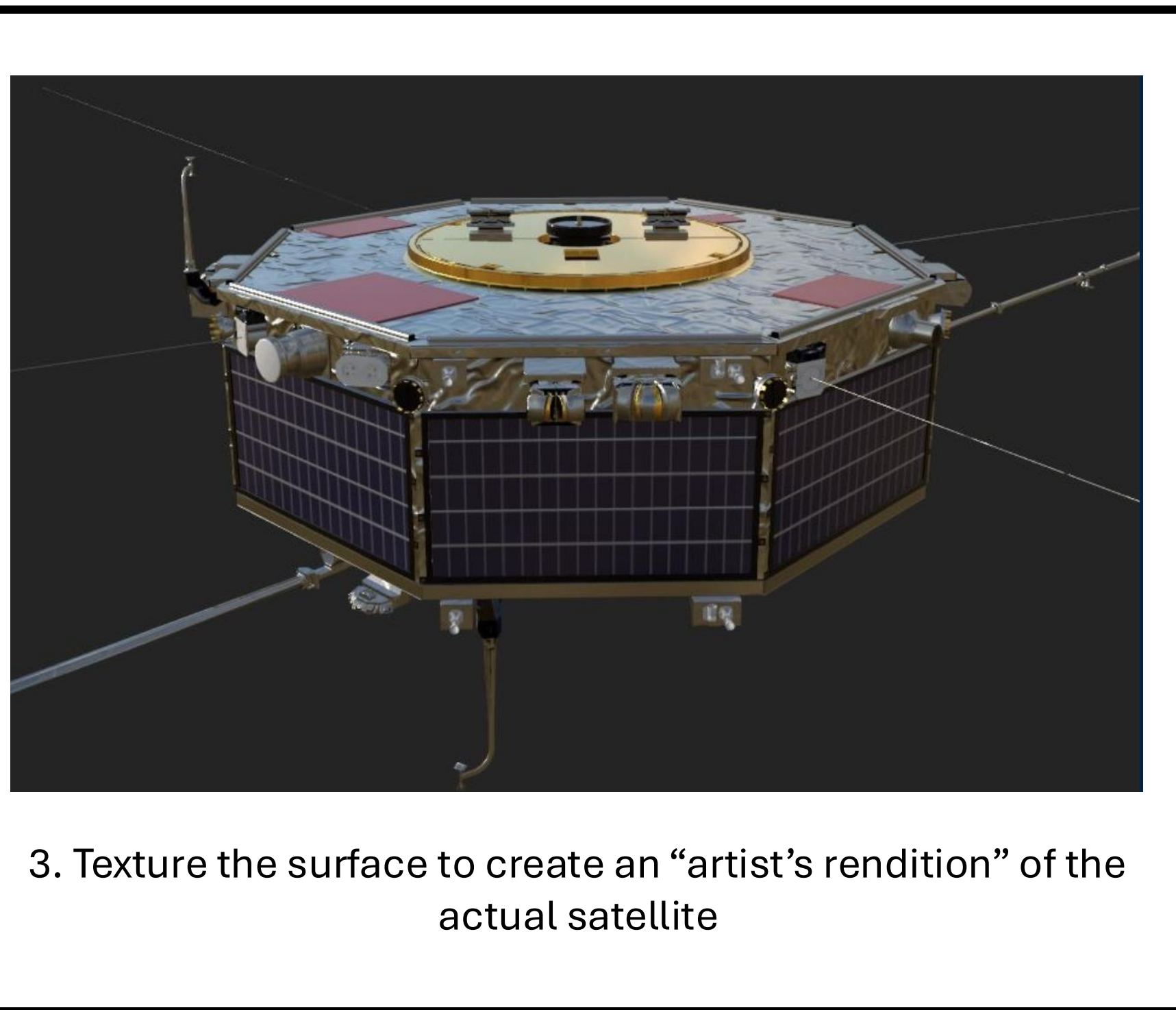
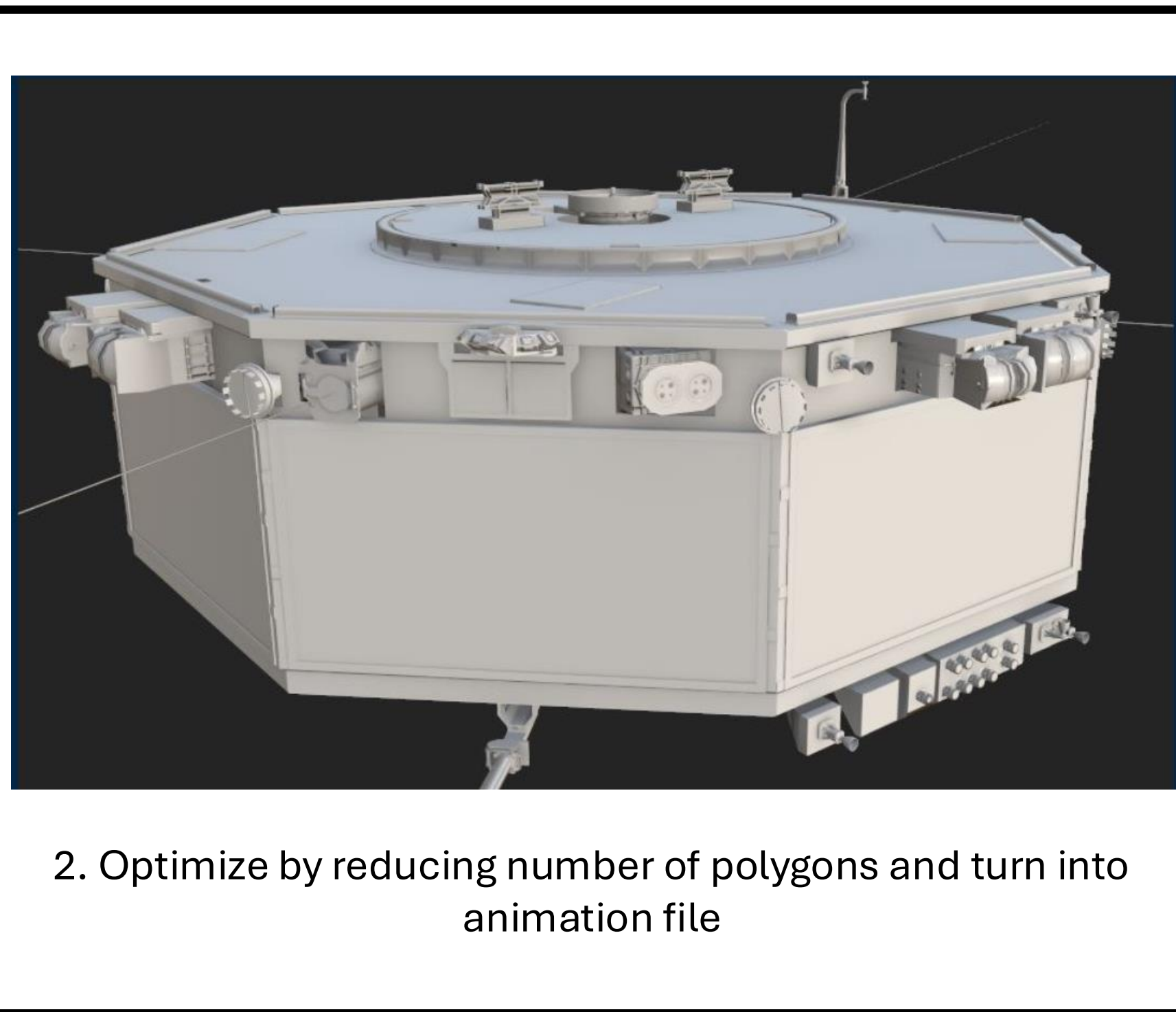
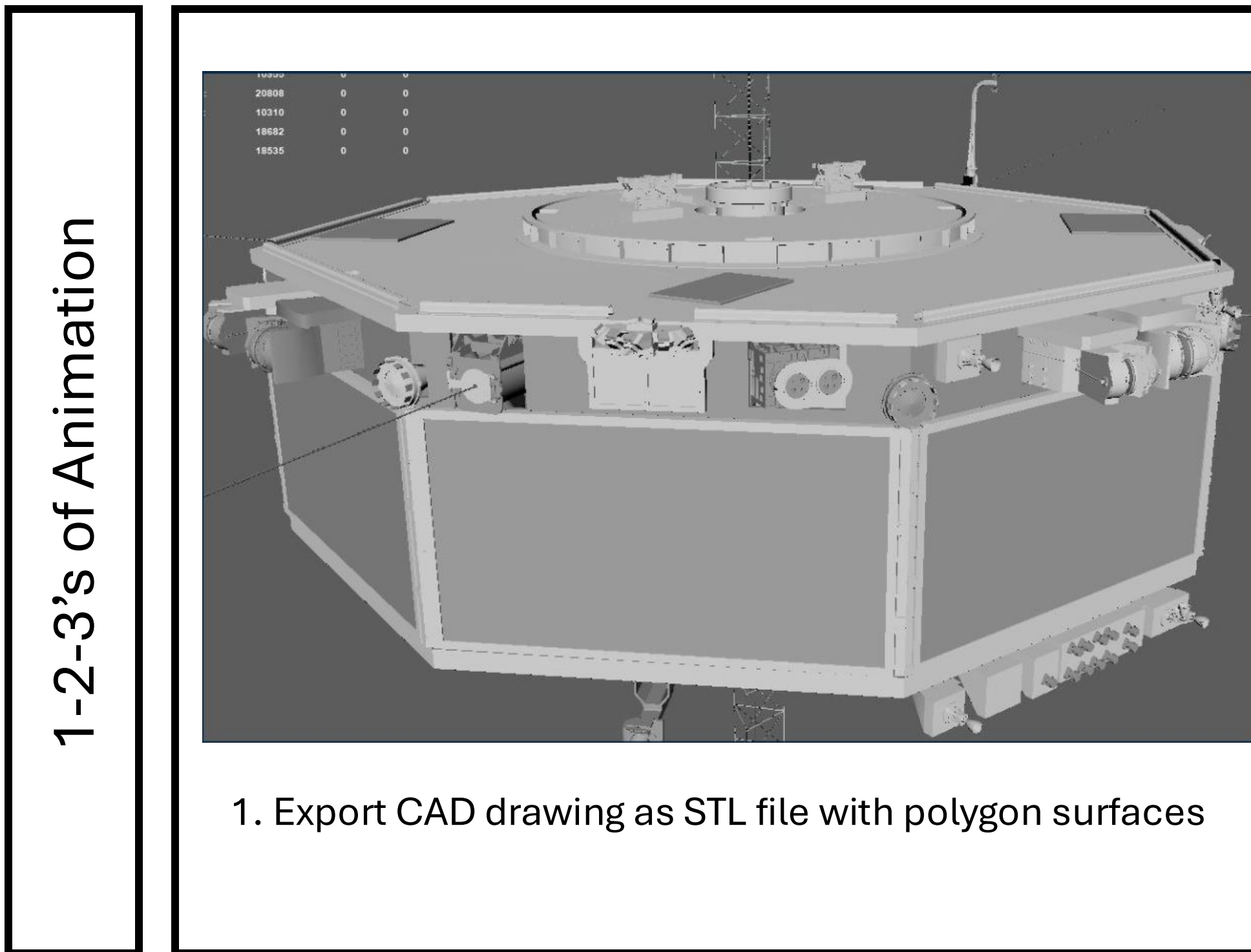


Visualizations show the state of Space Weather events as observed in space. **Magnetic Field Lines and Contours** show how the Sun and Earth magnetic fields break and reconnect. **Particle Motion** shows how particles meander and are energized. **Current Density** illustrates how energy is transported from one region to another.

Education and Outreach



The VR environment at the New England Fall Astronomy Festival. Kids lined up to put on the headset and immerse themselves in the space station. Their experience is cast to a nearby monitor, letting those waiting give suggestions on what to do and where to go.



1-2-3's of Animation

1. Export CAD drawing as STL file with polygon surfaces

2. Optimize by reducing number of polygons and turn into animation file

3. Texture the surface to create an "artist's rendition" of the actual satellite

Compare to a picture of the actual MMS satellite

Future Steps

- Create visualizations for peer-reviewed publications
- More Outreach
 - Visit local schools, museums, planetariums, etc.
 - Attend more conferences
- Incorporate More Data
 - Time series reconstructions to show how space weather events evolve
 - Plasma distribution functions to show how the plasma is arranged and energized
 - General simulation data to show a wider variety and controlled set of phenomena
- Incorporate more satellites, instruments, and laboratory experiments

Acknowledgements

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