

Space Weather Mitigation

Planet Hack 2026 Workshop #2

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Australian
National
University

Overview

1. Curveball
2. Risk identification
3. Infrastructure hardening /Protection of satellites
4. Operational response planning
5. Present results to ISECG

Image credit: merca20.com



Curveball



Independent of your findings and recommendations, ISECG intends to proceed with the \$100 billion deep-space satellite launch in 2035.

Together with your science-based prediction of solar activity in 2035 your team is asked to also make recommendations for satellite protection. Propose a cost-effective design solution to protect sensitive technology, including the satellite system, high-frequency radio communications, and electrical power grids.

- Design a solar-hardened satellite. Your design must include specific features that protect electronics from magnetic activity and radiation exposure.*
- Ensure your solution is cost-effective, avoiding the weight at launch penalties associated with full-scale radiation hardening.*
- Explain how your design protects the \$100 billion deep-space satellite system in a cost-effective way.*
- Incorporate this solution into your final video proposal.*



Planey Hack 2026

Day 1:

Background reading on space weather

Understanding the importance of sunspots for predicting solar storms and CME events

Analysis of series of SDO images to characterize sunspots: size, location on the sun's surface, duration, estimate the rotation speed of the sun, rotation speed as a function of latitude (differential rotation), number and frequency of sunspots (sunspot cycle) . ***Prediction of solar activity in 2035***

Day 2:

Finish sunspot analysis.

Background reading on threats to satellites from space weather

Study methods that scientists use to protect satellites today

Come up with your own ideas, designs, and concepts

Production of video with your team's recommendations.



Risk identification

World-wide needs in the area of space weather informational and predictive tools are growing rapidly.

At present, only a small fraction of the latest research results are being used to improve space weather forecasting.

Curveball requires the Planet Hack teams to develop tools for operational readiness and response arrangements ahead of possible intense solar activity in 2035.

No single technology can prevent all space-weather damage, so layered protection is the most effective approach. Think of a number of areas that can be combined for satellite protection.



Risk identification

Electronics: high speed plasma can penetrate satellite shielding and cause shorts, logic errors or permanent damage to components.

Solar panels: energetic radiation can reduce efficiency.

Navigation: GPS signals and timing can be disrupted, leading to loss of orientation.

Atmospheric drag : solar activity can heat Earth's upper atmosphere, increasing drag on low-orbit satellites, faster orbital decay, requires frequent thruster adjustments.

Communication: radio signals to control satellites can become disrupted.

The effects depend on the satellite's orbit, design and shielding. Some disturbances cause temporary errors, while others can permanently damage equipment.

Factor in weight at launch, e.g SpaceX Transporter Rideshare: Costs \$7,000 per kg (with a 50 kg /



Future of Protection

Future satellites will increasingly combine stronger hardware with intelligent software. No single technology can prevent all space-weather damage, so layered protection is the most effective approach.



Image credit: novaist.jp



Ideas - designs - concepts

Physical Defenses (Radiation Shielding)

- Use suitable shielding materials around sensitive electronics.
- Choose radiation-tolerant computer chips and components.
- Place vulnerable equipment inside protected sections of the satellite.
- Test components under simulated radiation conditions.

System Resilience (Radiation-Hardened Electronics)

- Use electronics designed to operate in high-radiation environments.
- Add error-detection and error-correction systems to computer memory.
- Use redundant computers or backup circuits.
- Automatically restart or isolate faulty systems when necessary.
- Example: commercial version of a processor costs \$35. The radiation hardened equivalent: \$47,000.



Ideas - designs - concepts

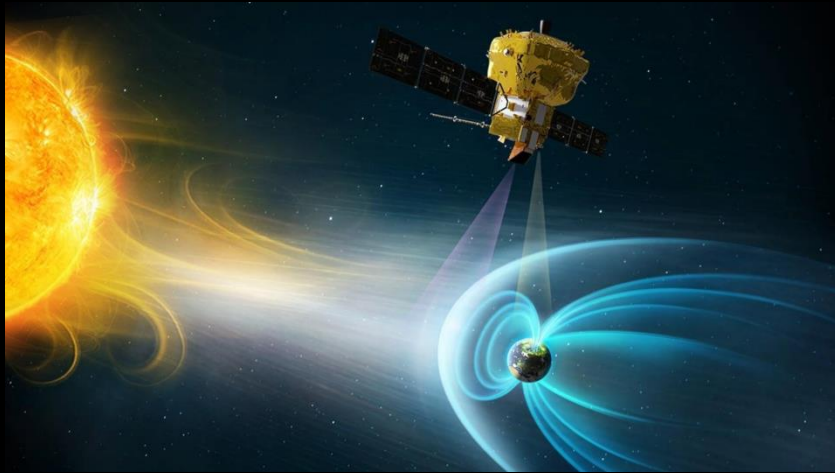


Photo by ESA

Monitoring and Early Warnings

- Monitor solar flares, solar particles and coronal mass ejections.
- Use space-weather alerts and forecasts.
- Send warnings to satellite operators before dangerous conditions arrive.
- Prepare protective actions in advance.

Safe Mode

- Switch off non-essential instruments.
- Reduce unnecessary electrical activity.
- Protect sensitive systems and preserve power.
- Maintain essential communications and monitor satellite health.
- Resume normal operations when conditions improve.



Ideas - designs - concepts



Image: NASA/Astronaut Scott Kelly

Orbit and Power Management

- Track the satellite's orbit using ground-based monitoring.
- Adjust the orbit when increased atmospheric drag changes its path.
- Monitor battery condition, solar-panel output and electrical charging.
- Use backup power systems and carefully designed electrical grounding.

Video Presentation

Be strategic about what to include in the 5min video. IMPORTANT: *having the best data and results is not enough if you cannot defend or explain it. Persuasive storytelling and confidence sway scoring panels who evaluate both the science and the delivery.*

Put together a compelling narrative for presenting the background, your research and recommendations to ISECG.

Present a problem-to-solution storytelling arc designed to keep the experts of the ISECG launch panel engaged.

Example: The Hook – Space Weather – The Threat – The High Stakes – The Research – Impact/Results - Outro



Planey Hack 2026 - Submission

PH26 teams are advisors to the ISECG launch panel.

There is still 7 years before launch and the \$100 billion satellite system is not built yet.

Your video must demonstrate your team's ability to predict solar activity in 2035 through independent, data-driven analysis, supported by a strong understanding of space weather and its potential impacts on satellites.

You also showcase your knowledge of how solar activity can affect satellite operations, infrastructure and performance. Present some original ideas, innovative conceptual designs or strategic recommendations for protecting satellites using advanced and emerging technologies.

Successfully communicating your findings and demonstrating your expertise will secure your appointment as permanent advisor to the ISECG project.



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