TechEdSat - An Educational 1U CubeSat Architecture Using Plug-and-Play Avionics

Outline

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- Background
- The team
- About NASA Ames
- About AAC Microtec
- Mission objectives
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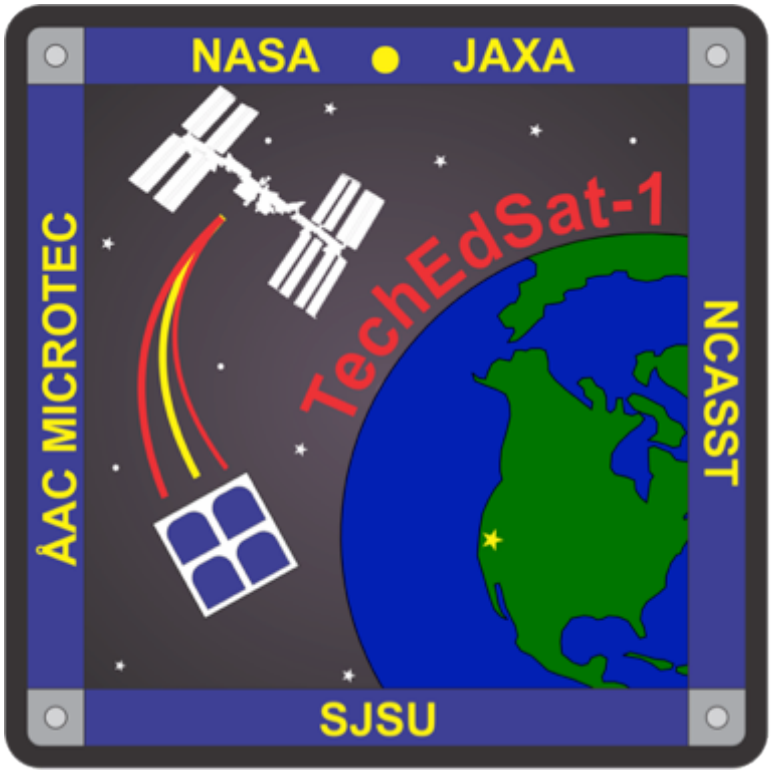

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Background

TechEdSat is a 1U cubesat developed in a joint project between:

- NASA Ames Research Center
  - Responsible for Integration and Launch Preparation

- ÅAC Microtec
  - Avionics, Data Handling System, Application Software

- San Jose State University
  - Students involved in satellite design from A to Z

The team

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The team at work

About NASA Ames

- Located in California's Silicon Valley
- Established 1939
- ~2,500 staff
- Research and engineering in diverse areas:
  - Small spacecraft
  - Low-cost missions
  - Entry systems
  - Supercomputing
  - NextGen air transportation
  - Airborne science
  - Biology and astrobiology
  - Exoplanets
  - Autonomy and robotics
  - Lunar science
  - Human systems integration
  - Wind tunnels
- Emphasis on partnerships and collaborations with universities, industry, other agencies

About ÅAC Microtec

ÅAC Microtec develops and supplies satellites, sub-systems, and components to the small satellite market

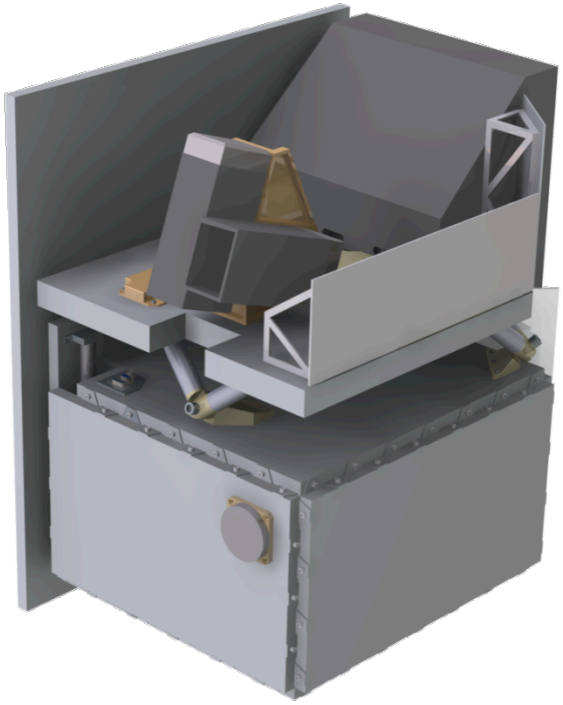
Spin-off company from Uppsala University, The Ångström Laboratory, Sweden in 2005

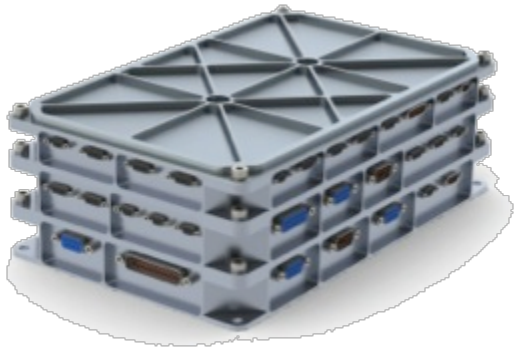
Locations

- Head Quarters: Uppsala Science Park, Sweden
- AAC Microtec North America Inc., NASA Ames CA
- Partners: HTL (JP), Soletop (Kr)

~30 Employees

4M€ Revenue, 2014





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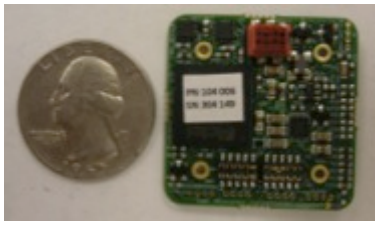
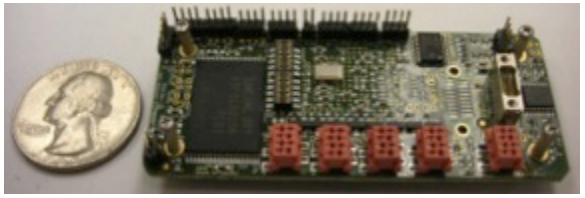
From a pile of small parts…





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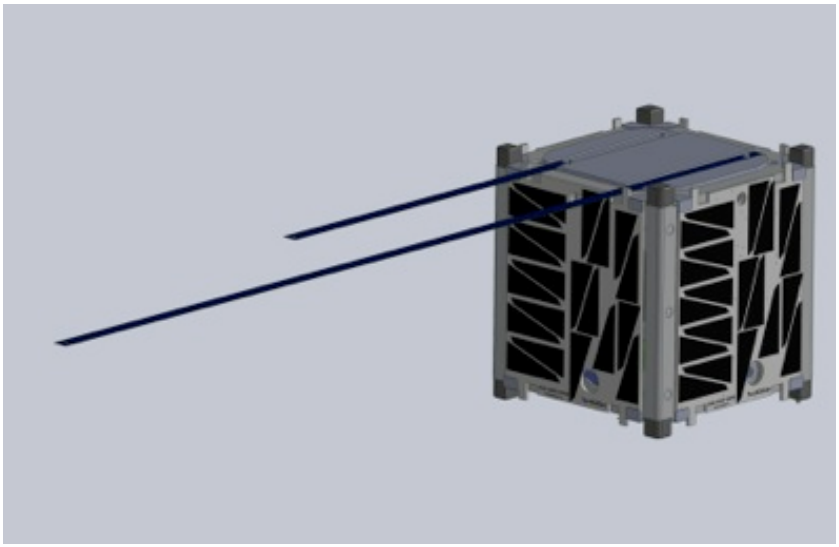
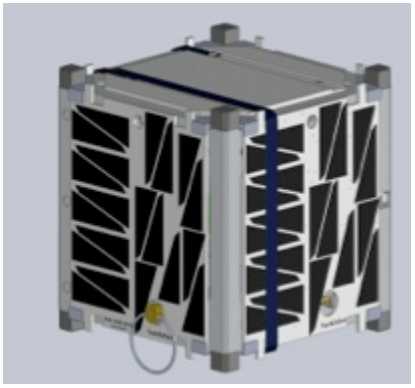
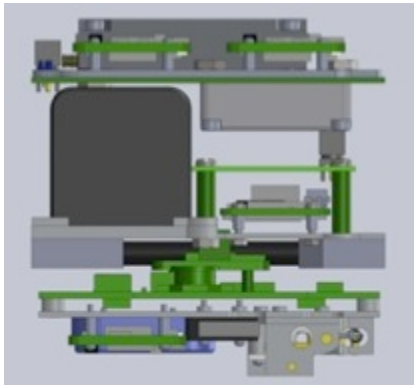
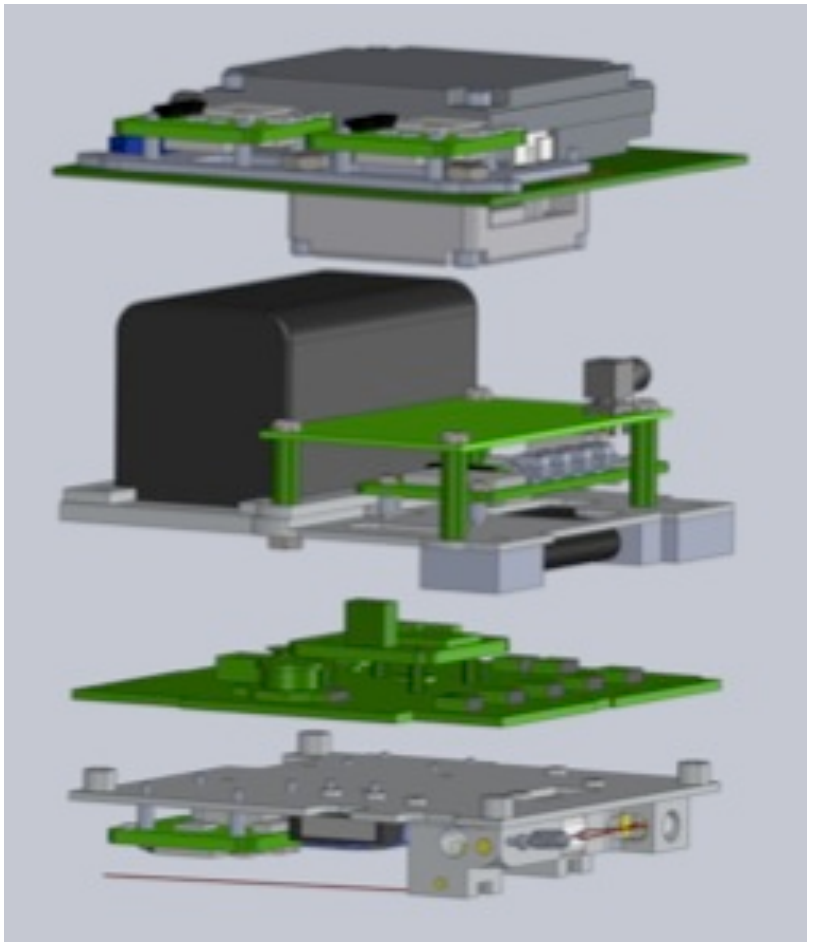
To a complete spacecraft design…









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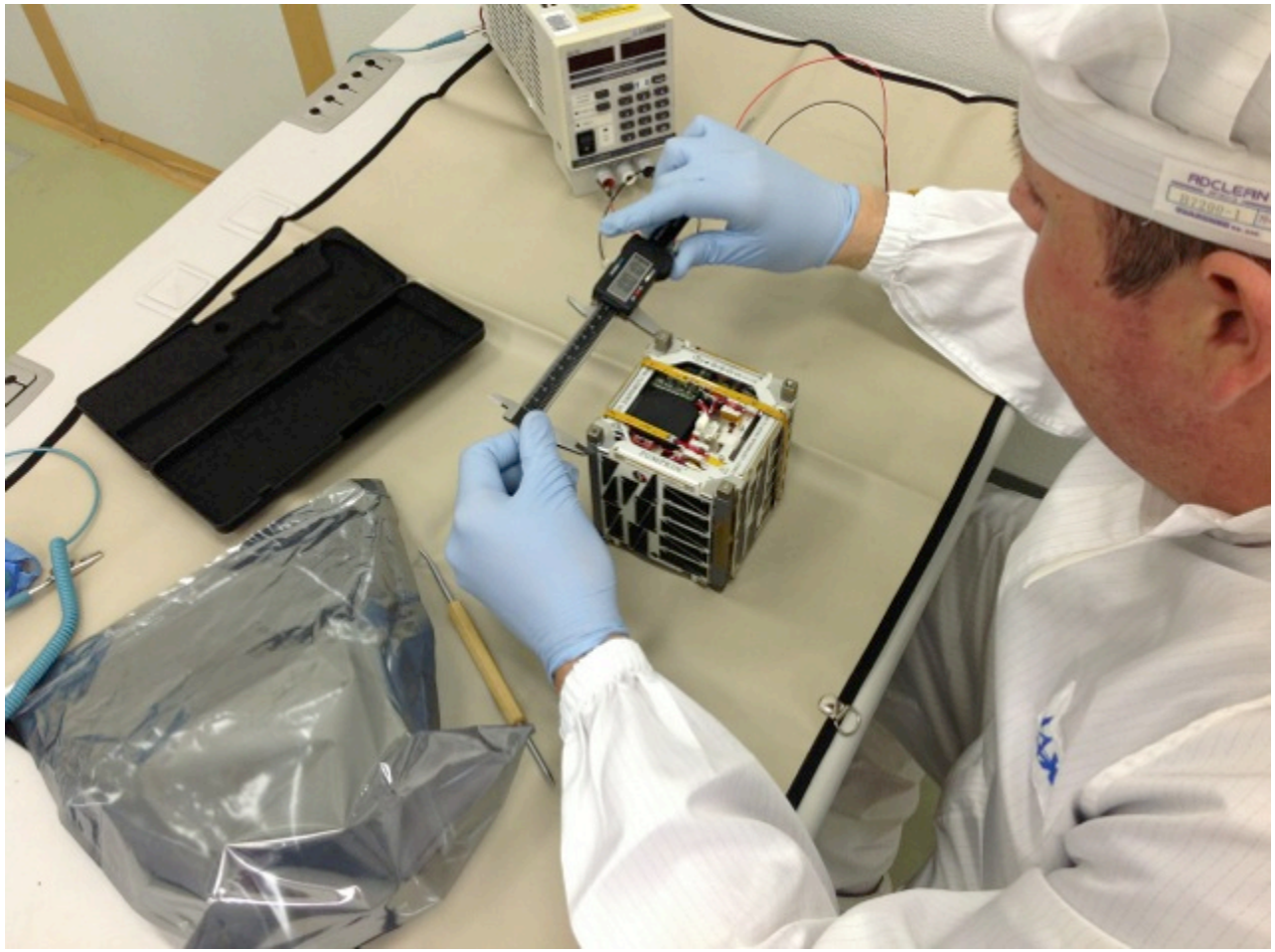

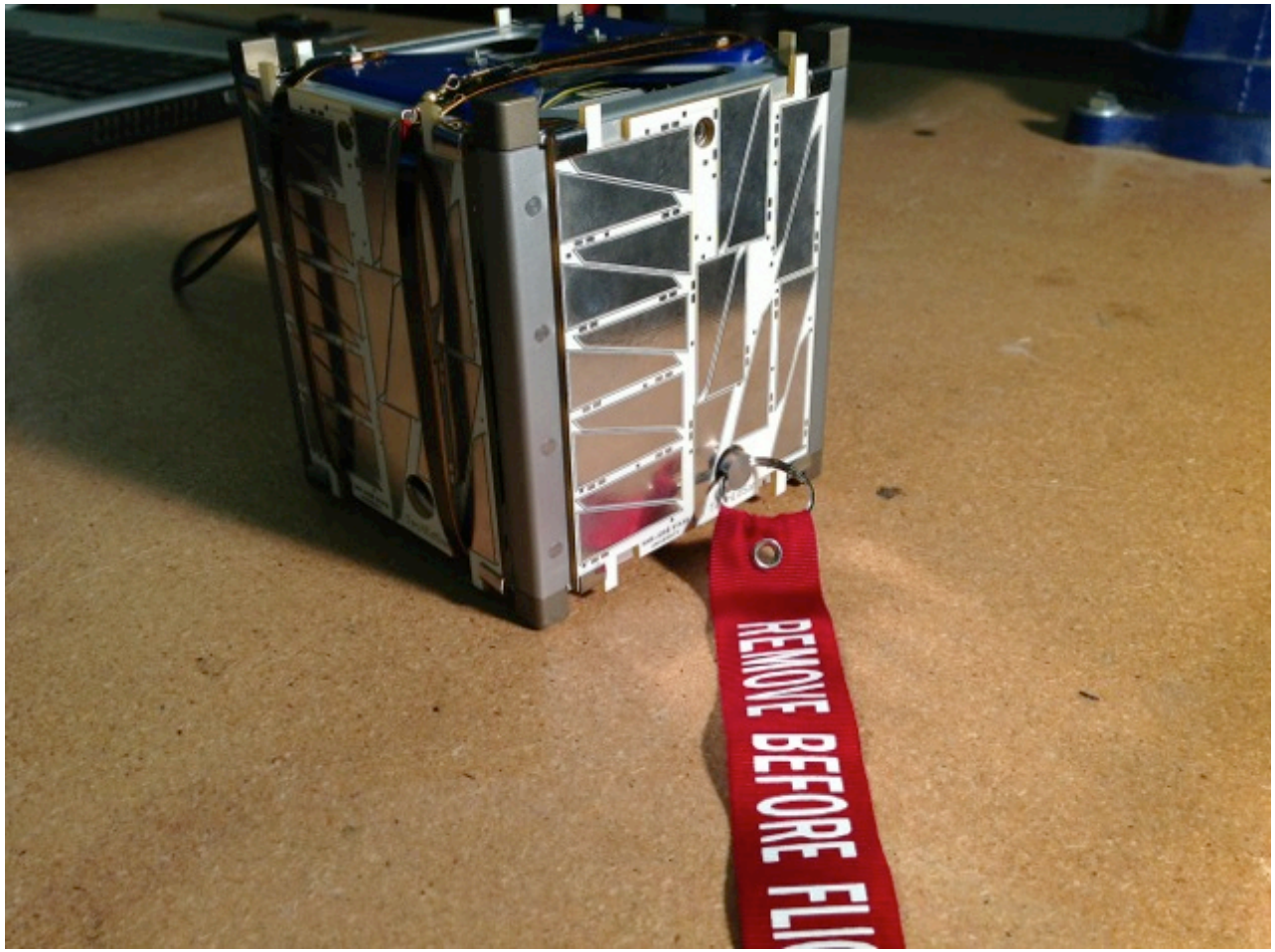
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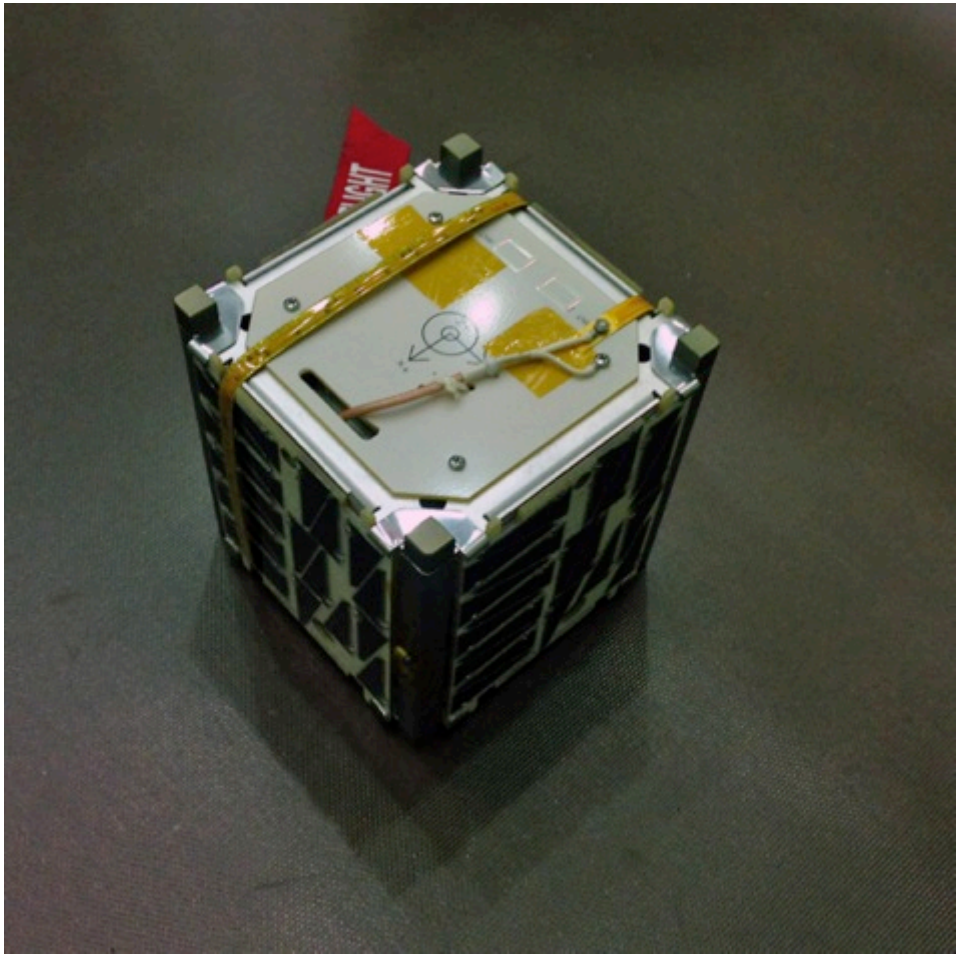

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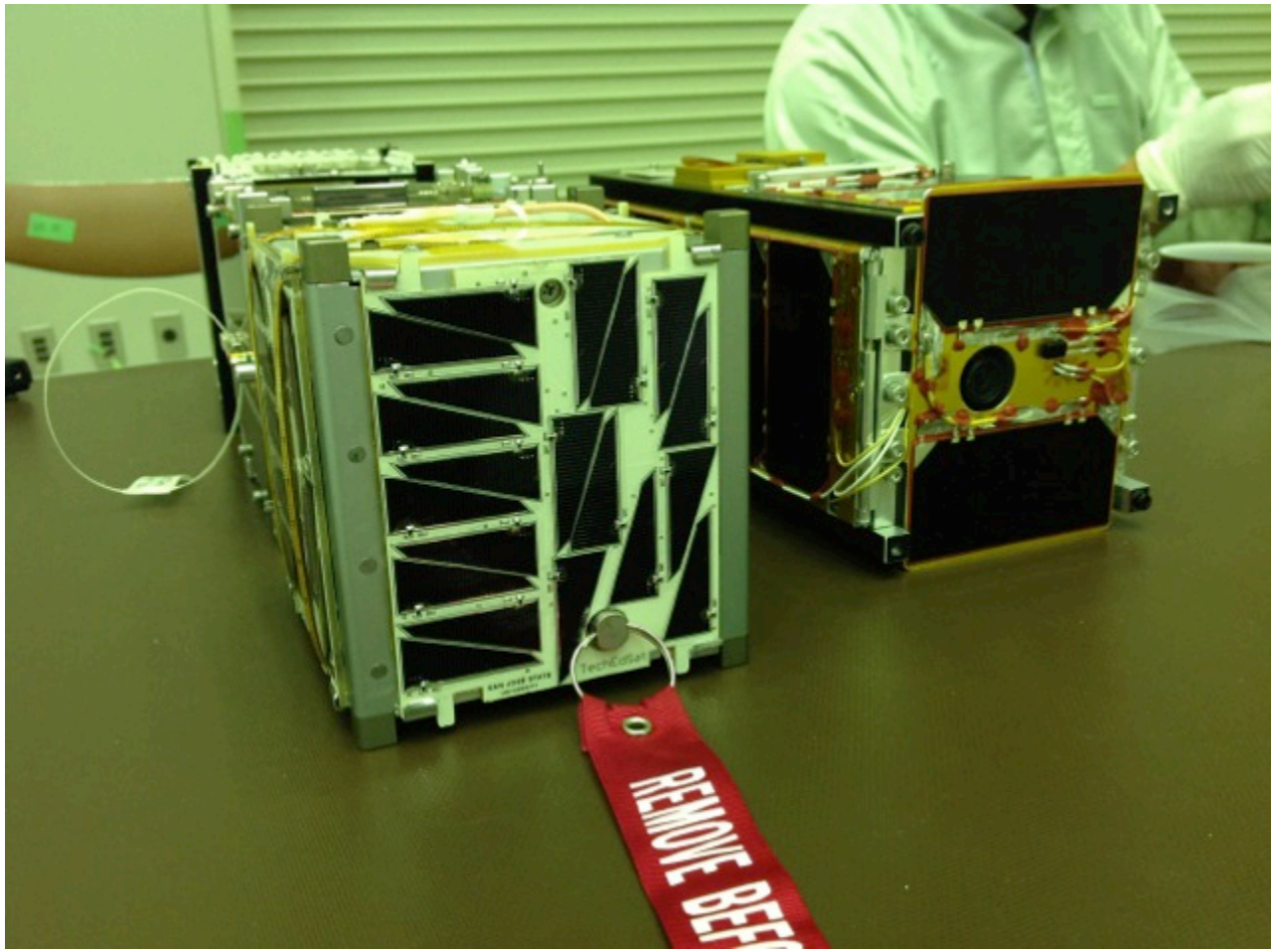

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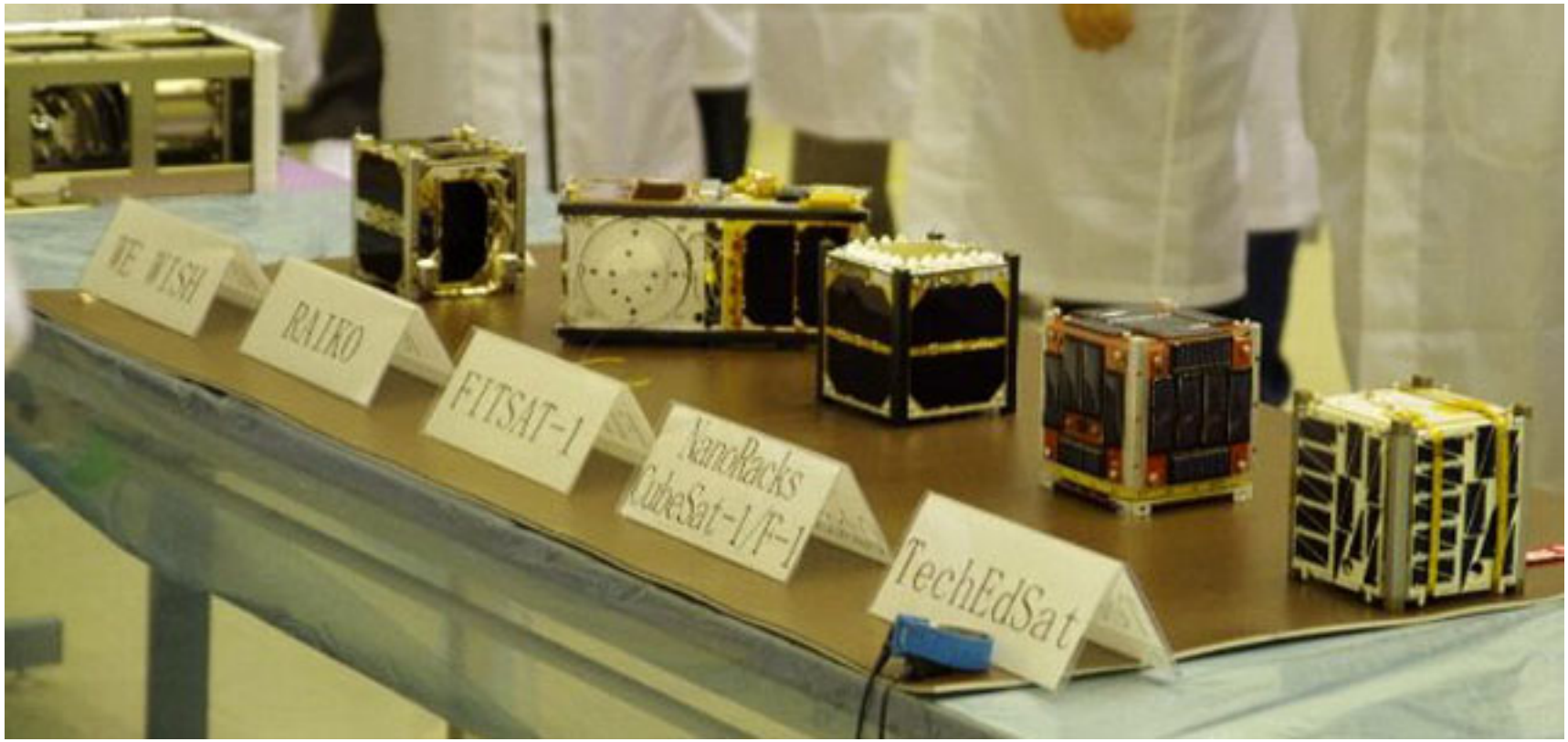

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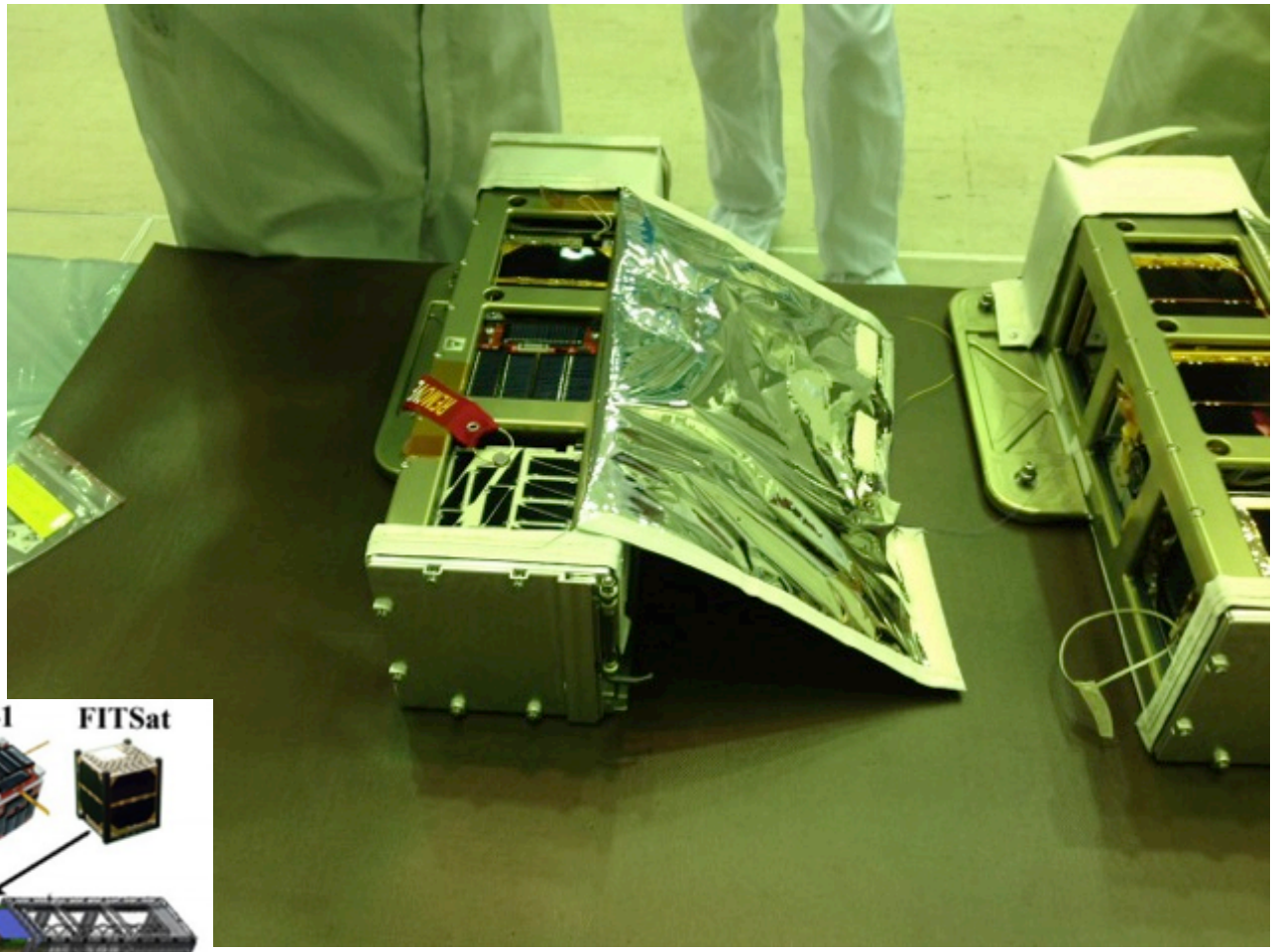

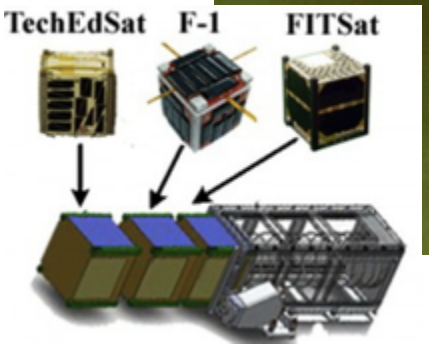

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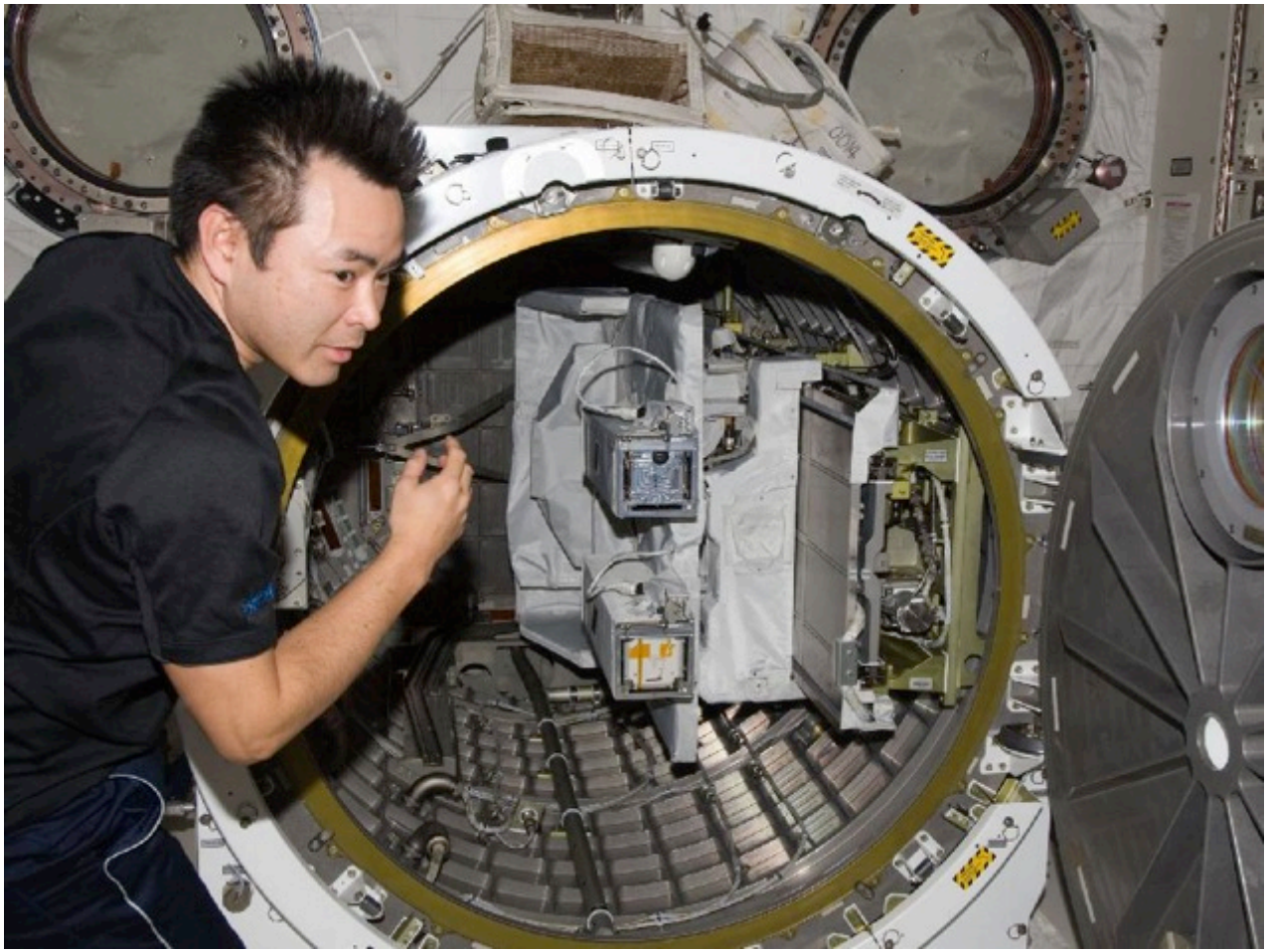

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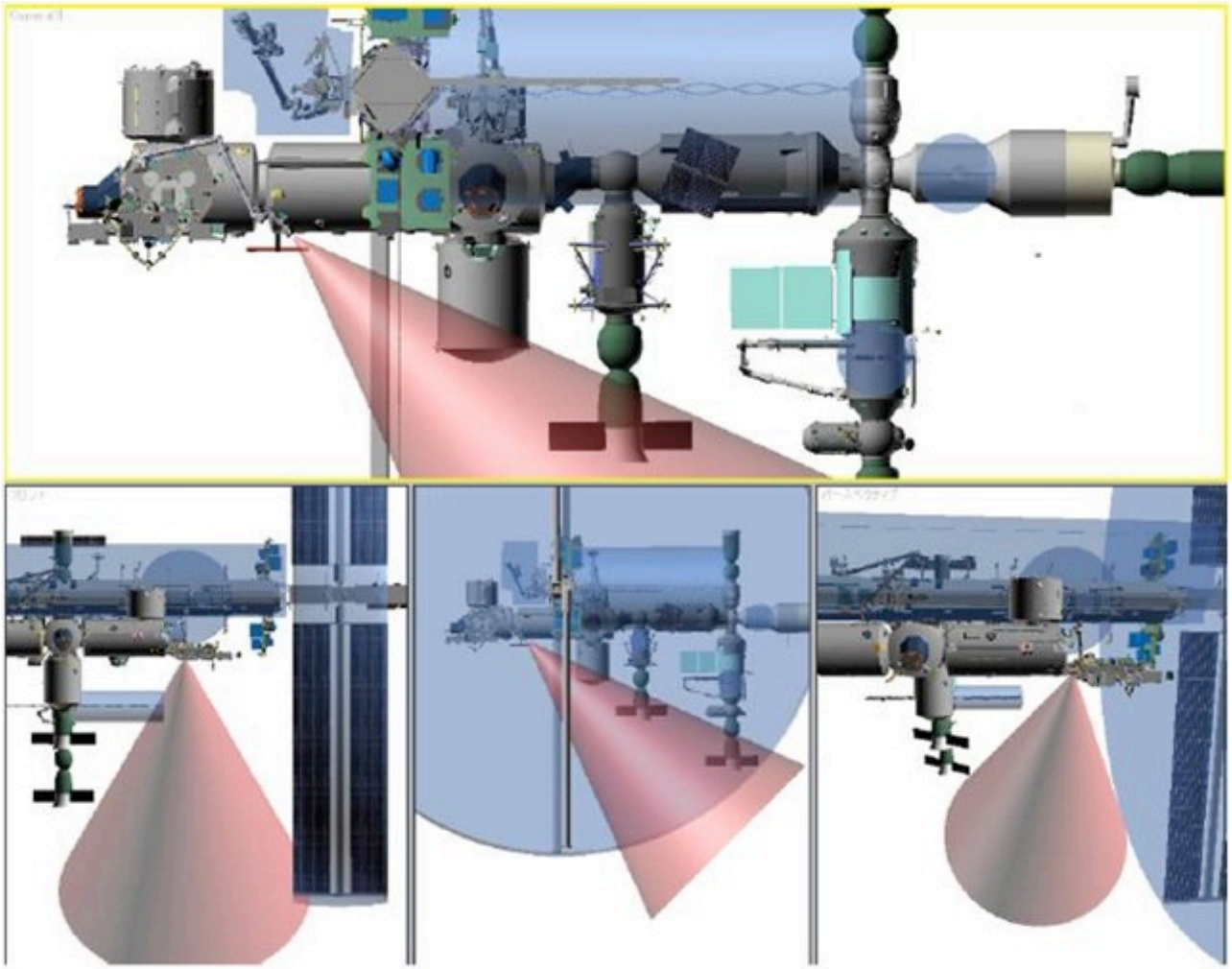

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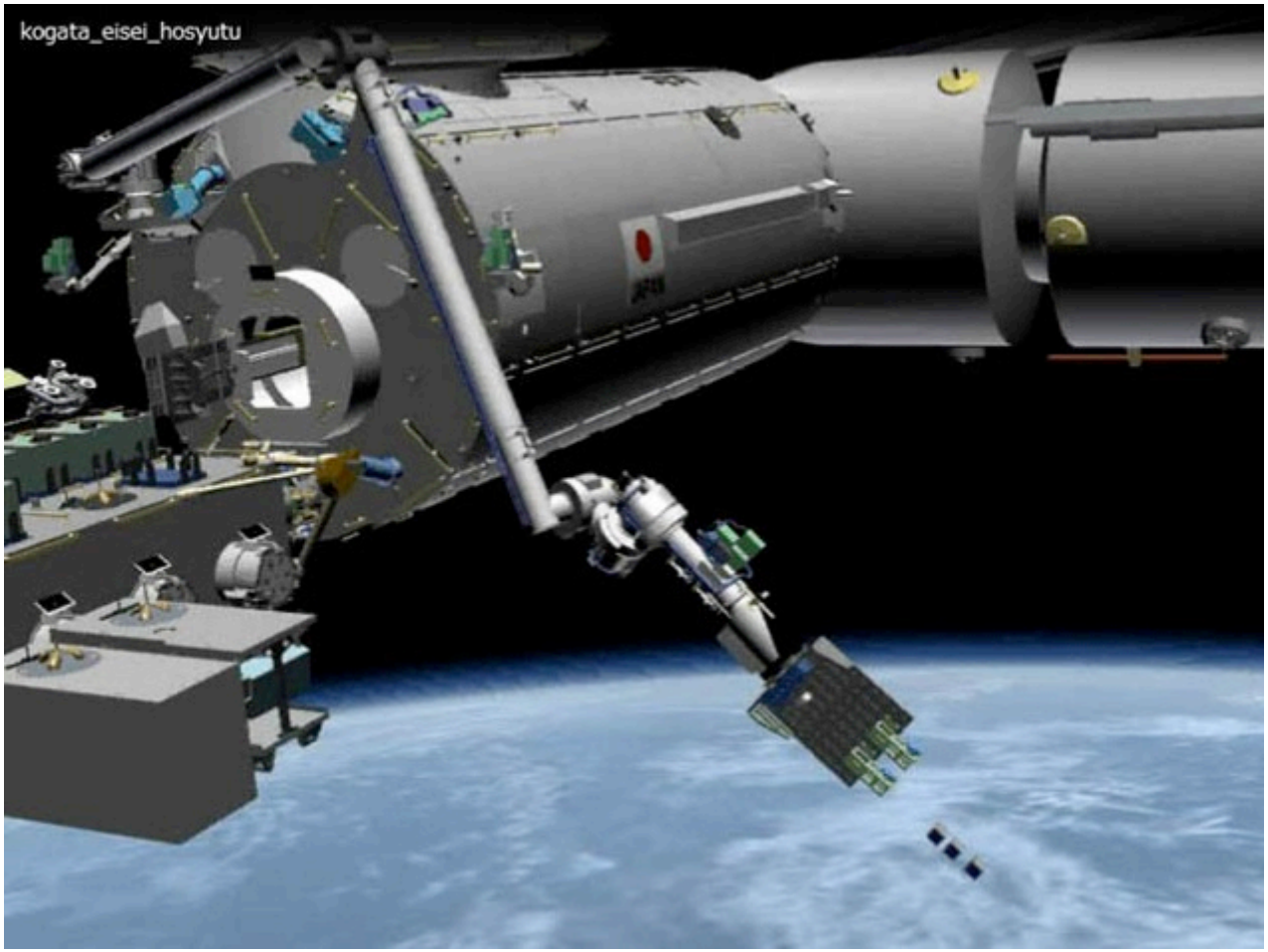

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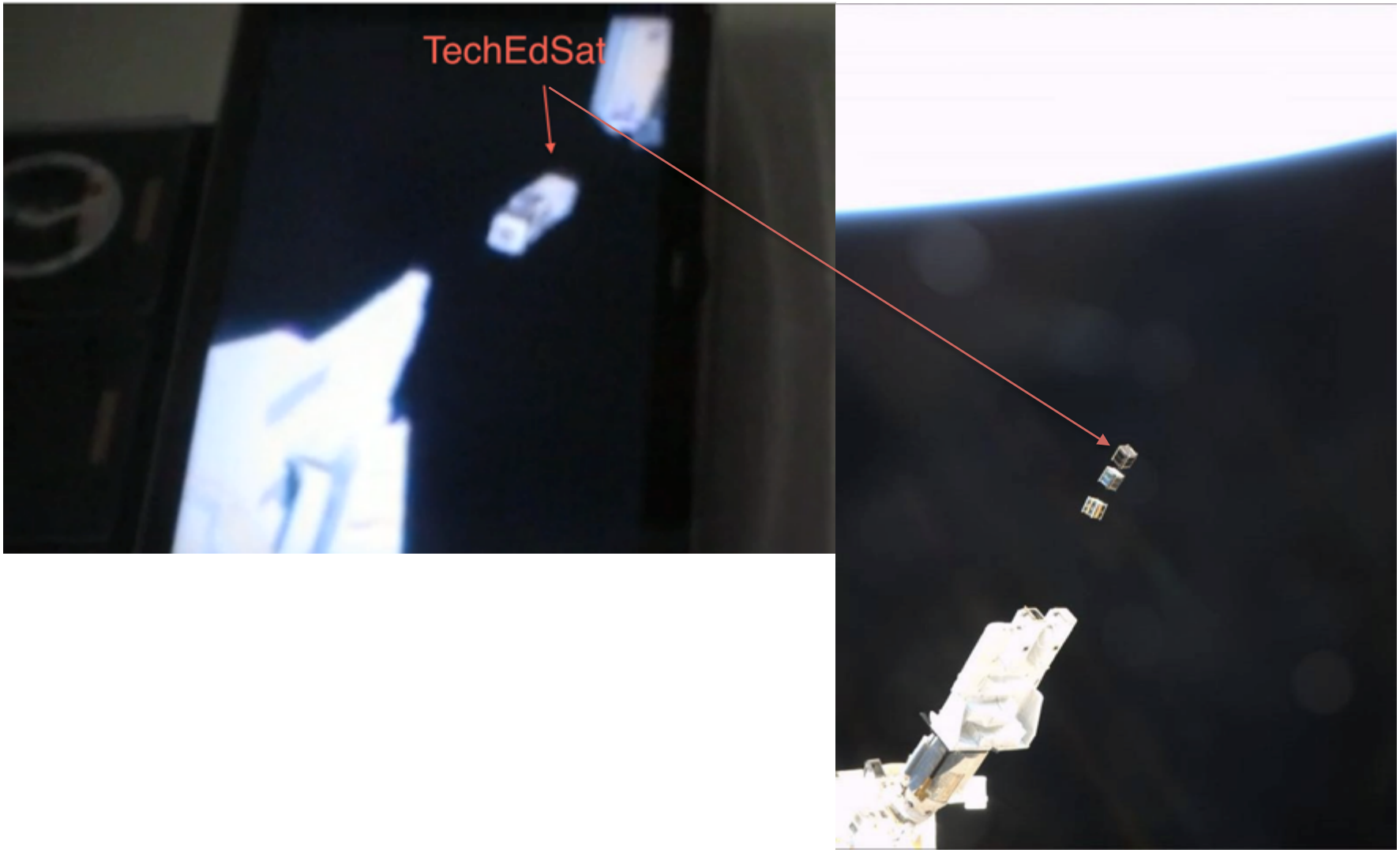

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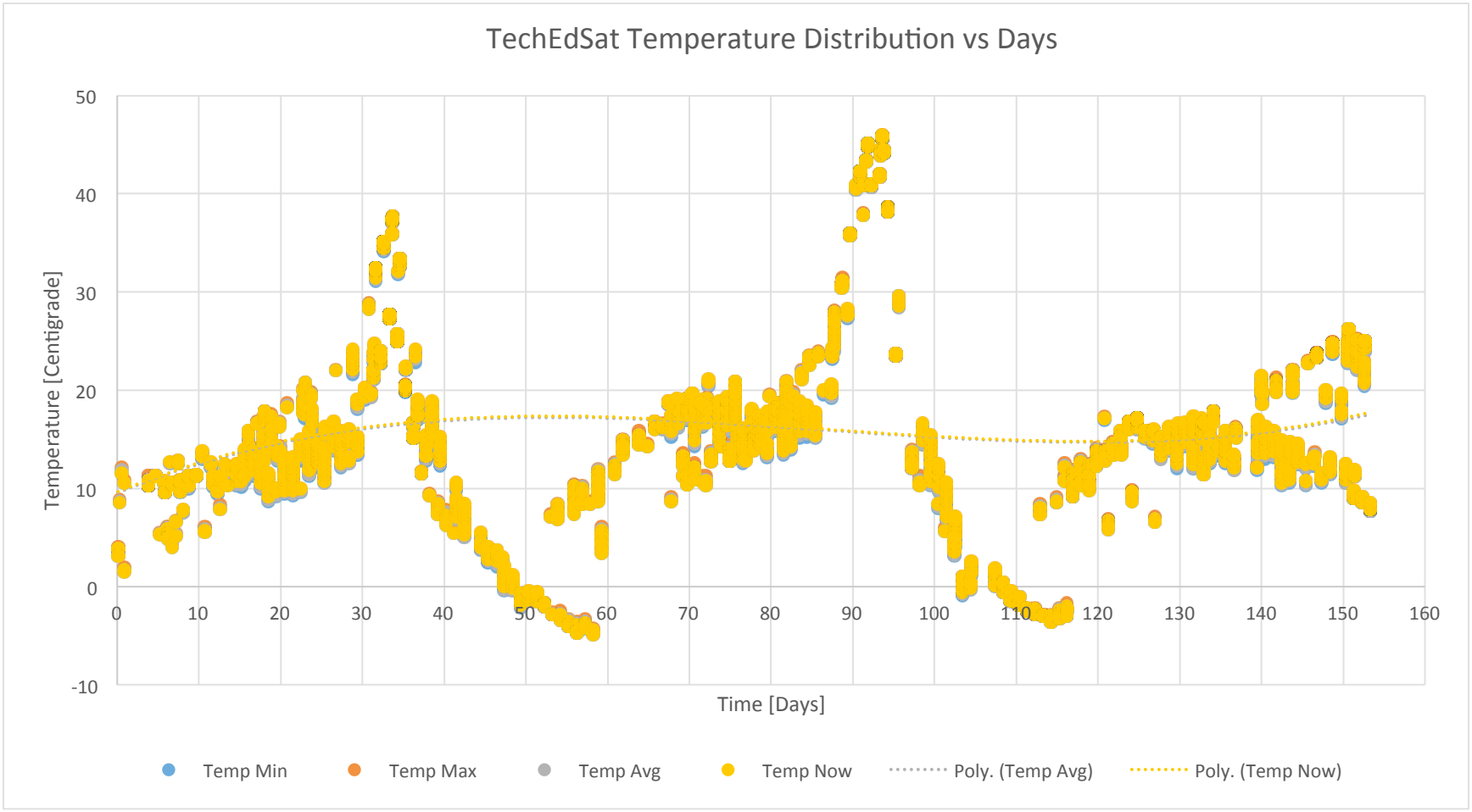
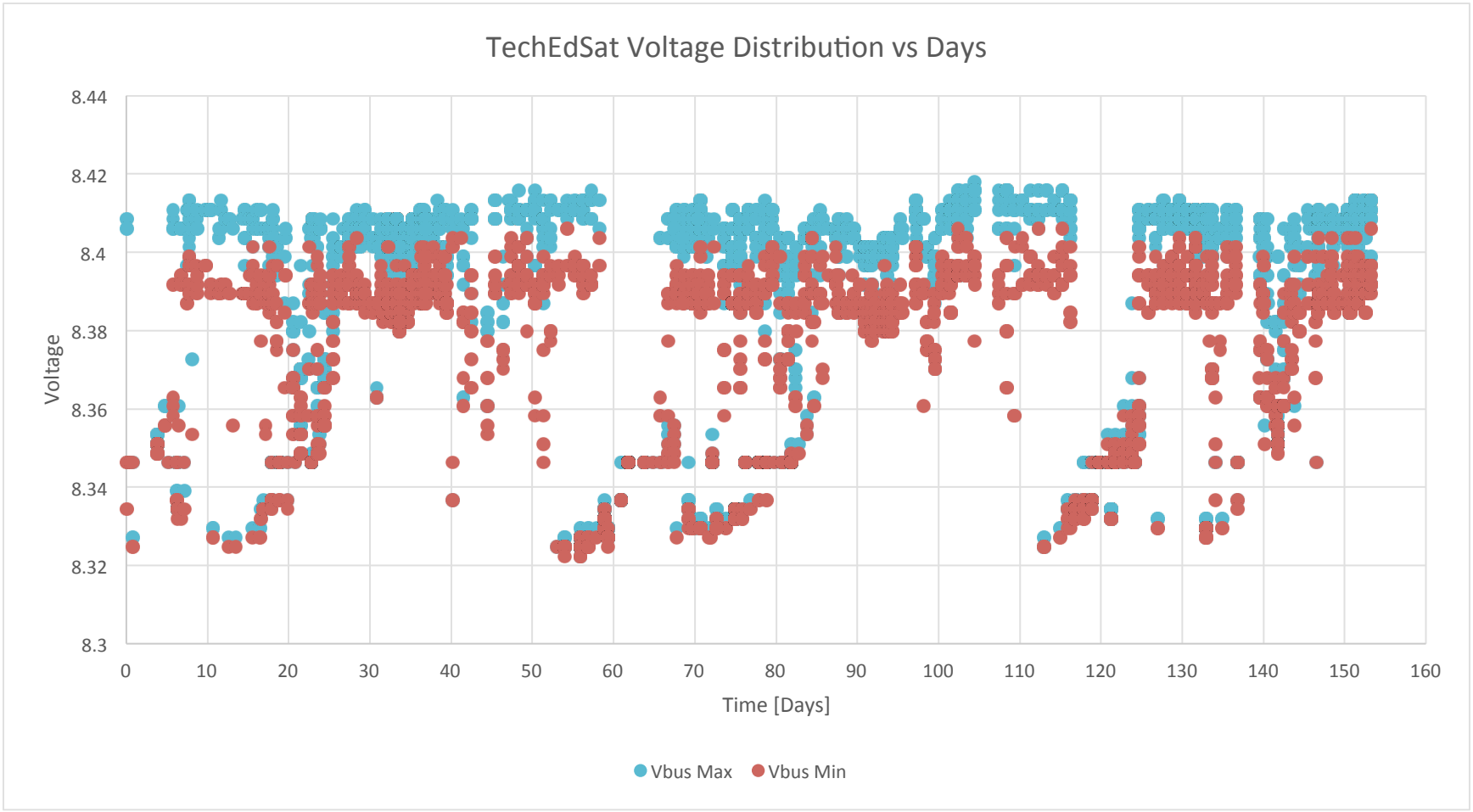
Mission Objectives

- Build a 1U cubesat within 6 months from kickoff to launch
- Demonstrate and evaluate the Space Plug-and-Play avionics hardware and software from ÅAC Microtec.
- Investigate both Iridium and Orbcomm intersatellite communication as a method of eliminating the requirement for a physical ground station in Nano satellite missions.
- Demonstrate the capabilities of the JAXA J-SSOD aboard the ISS, and be one of the first cubesats to be deployed from the ISS.


TechEdSat Temperature Distribution vs Days
Temperature [Centigrade]
50
40
30
20
10
0
-10
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
Time [Days]
Temp Min
Temp Max
Temp Avg
Temp Now
Poly. (Temp Avg)
Poly. (Temp Now)


TechEdSat Voltage Distribution vs Days
Voltage
8.44
8.42
8.4
8.38
8.36
8.34
8.32
8.3
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
Time [Days]
Vbus Max
Vbus Min

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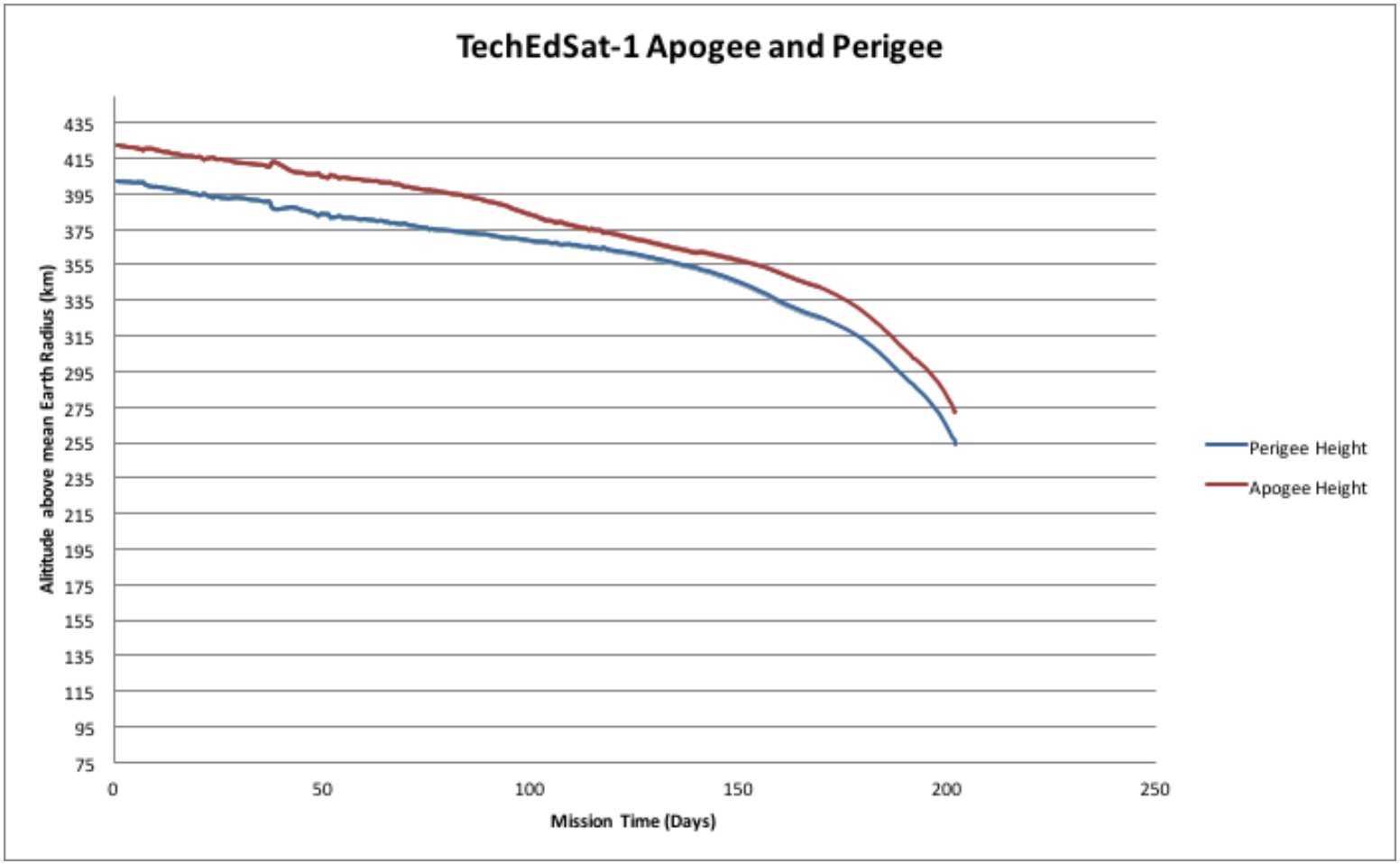

Mission Results

- Fault-tolerant functionality (EDAC on RAM, TMR, etc) has been demonstrated
- One single event latchup on the RAM was detected and automatically corrected
- Rapid Integration Architecture has been demonstrated
- Feasibility of inter-satellite communication as possible downlink for cubesats has been demonstrated from ground due to regulatory issue
  - Demonstrated from orbit on subsequent missions

Future Opportunities

- We fully expect the design philosophy pioneered by TechEdSat to continue, resulting in:
  - High performance, low cost missions
  - Rapid spacecraft development and integration
- NASA Ames and AAC Microtec are assessing mission concepts that demand robust high performance:
  - Deep space science and exploration missions, e.g. to Europa
  - Long-duration Earth-orbiting satellites

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Questions?