



# CubeSat: Innovation without Invention

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Tyvak / Cal Poly

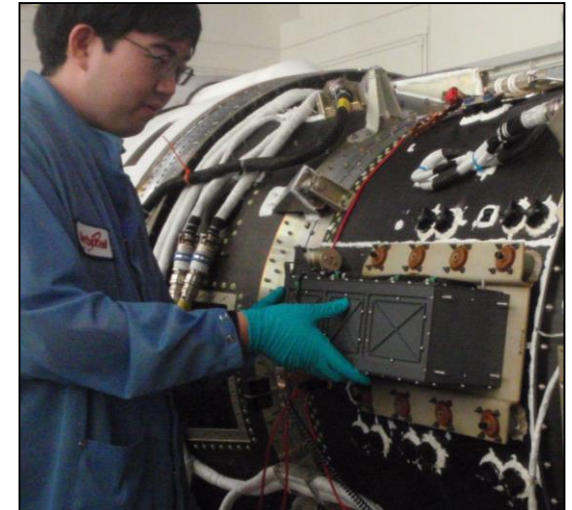
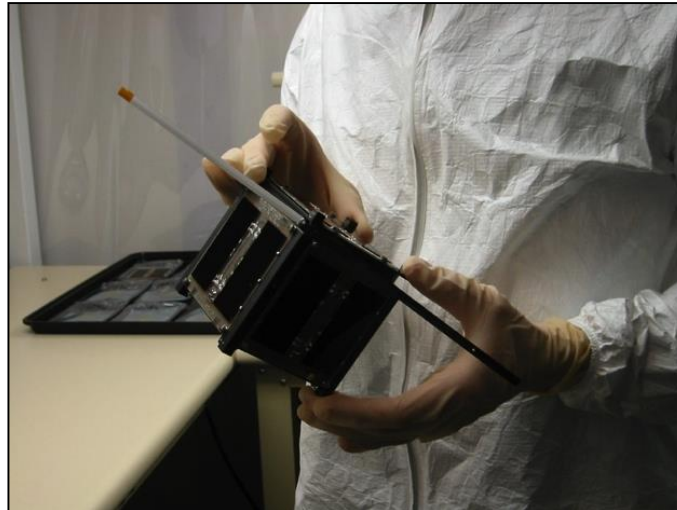
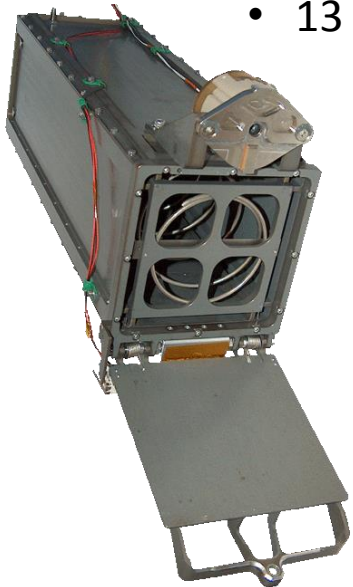
UNISEC 2016

CUBESAT  
California Polytechnic State University



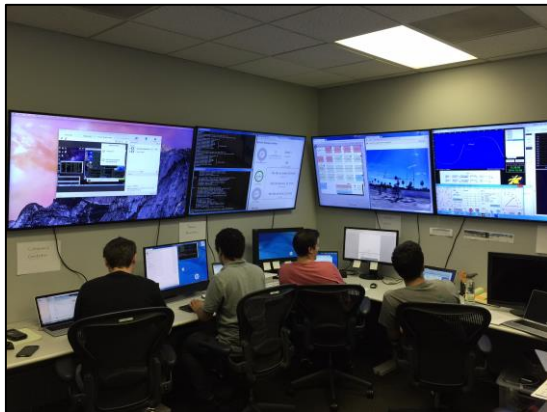
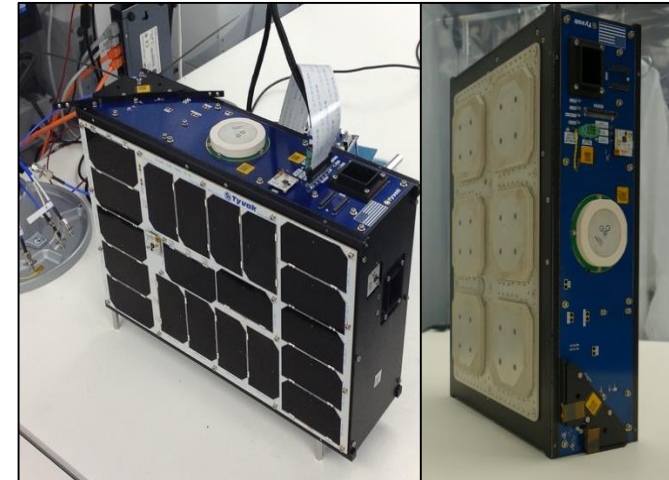
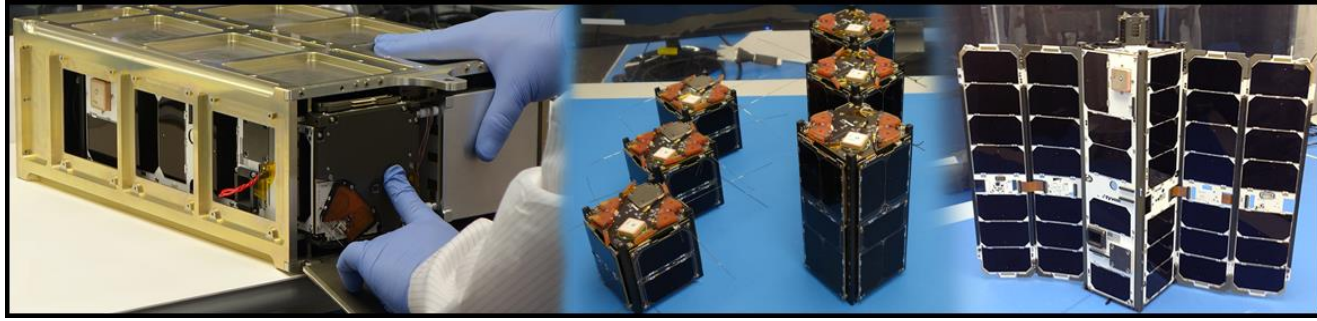
# Cal Poly

- Create & Maintain CubeSat Standard
- Develop Cal Poly CubeSats (CP series)
- Integrating and Launching CubeSats
  - Successfully Completed >20 Launch Campaigns
    - >140 CubeSat integrated, >50 P-PODs
    - 13 Different launch vehicles and 8 ranges



# Tyvak

- >40 Employees
  - 3 locations (Europe and US)
  - 100% US ownership
- Complete Space Mission Solutions
  - Design to Launch & Operations
- Advanced Small Spacecraft Systems
  - 1U to 12U+





# Definitions

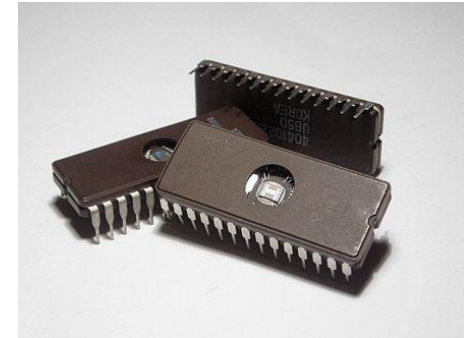
- **Invent:**

*create or design (something that has not existed before); be the originator of*

- **Innovate:**

*make changes in something established, esp. by introducing new methods, ideas, or products / introduce (something new, esp. a product)*

# Computer Analogy

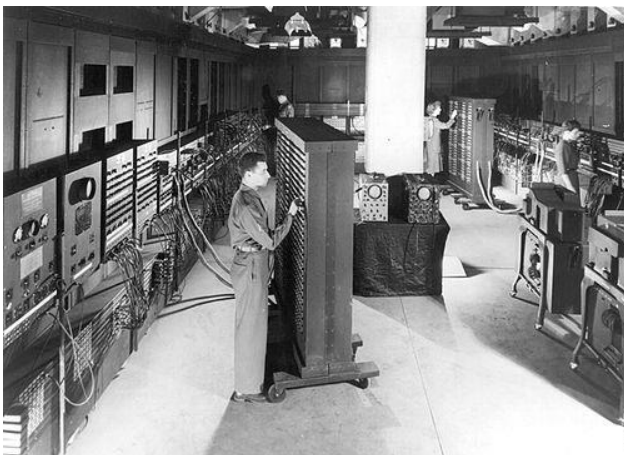


Mechanical

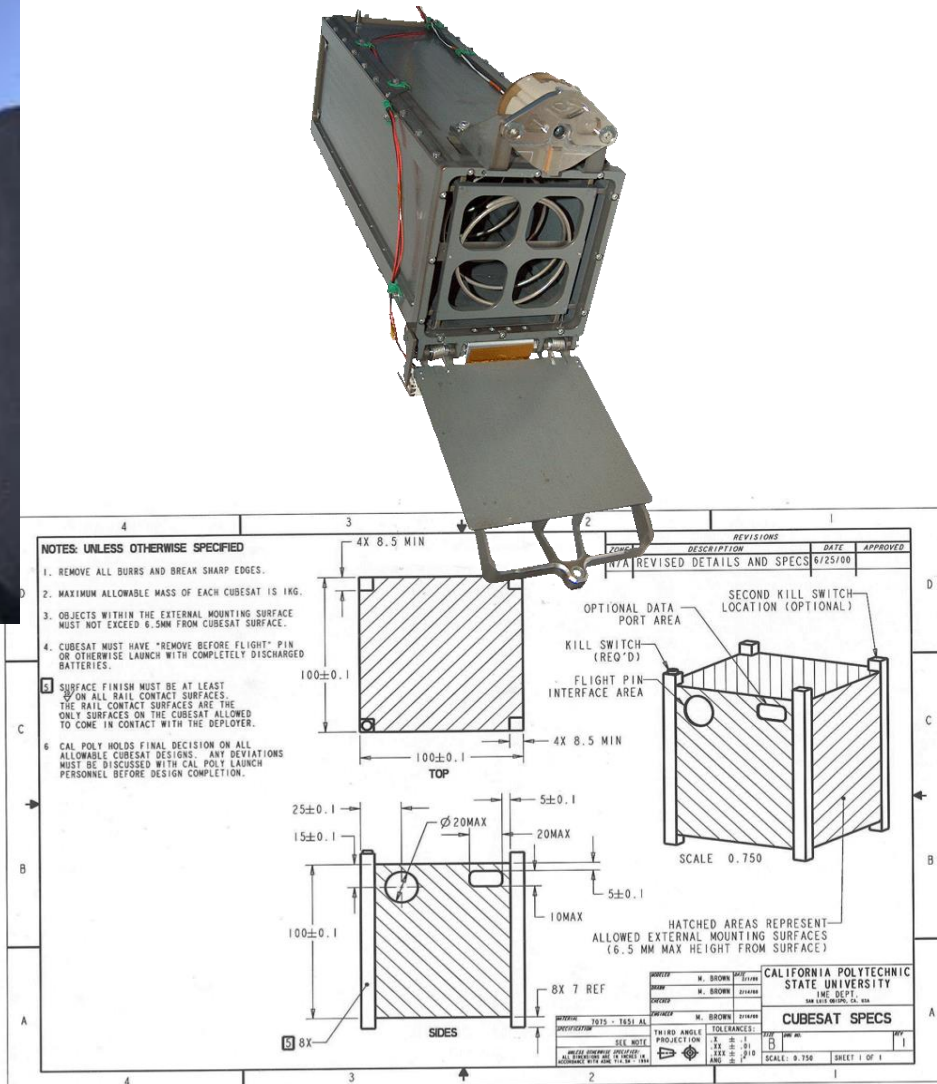
Vacuum Tubes

Transistors

Integrated Circuits



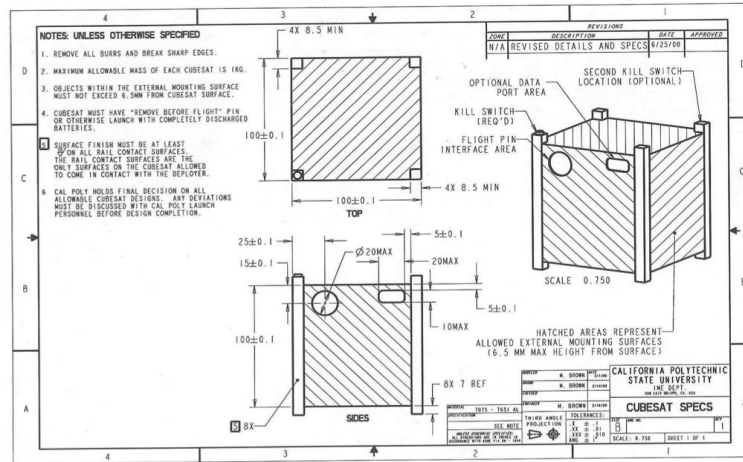
# We Invented CubeSat



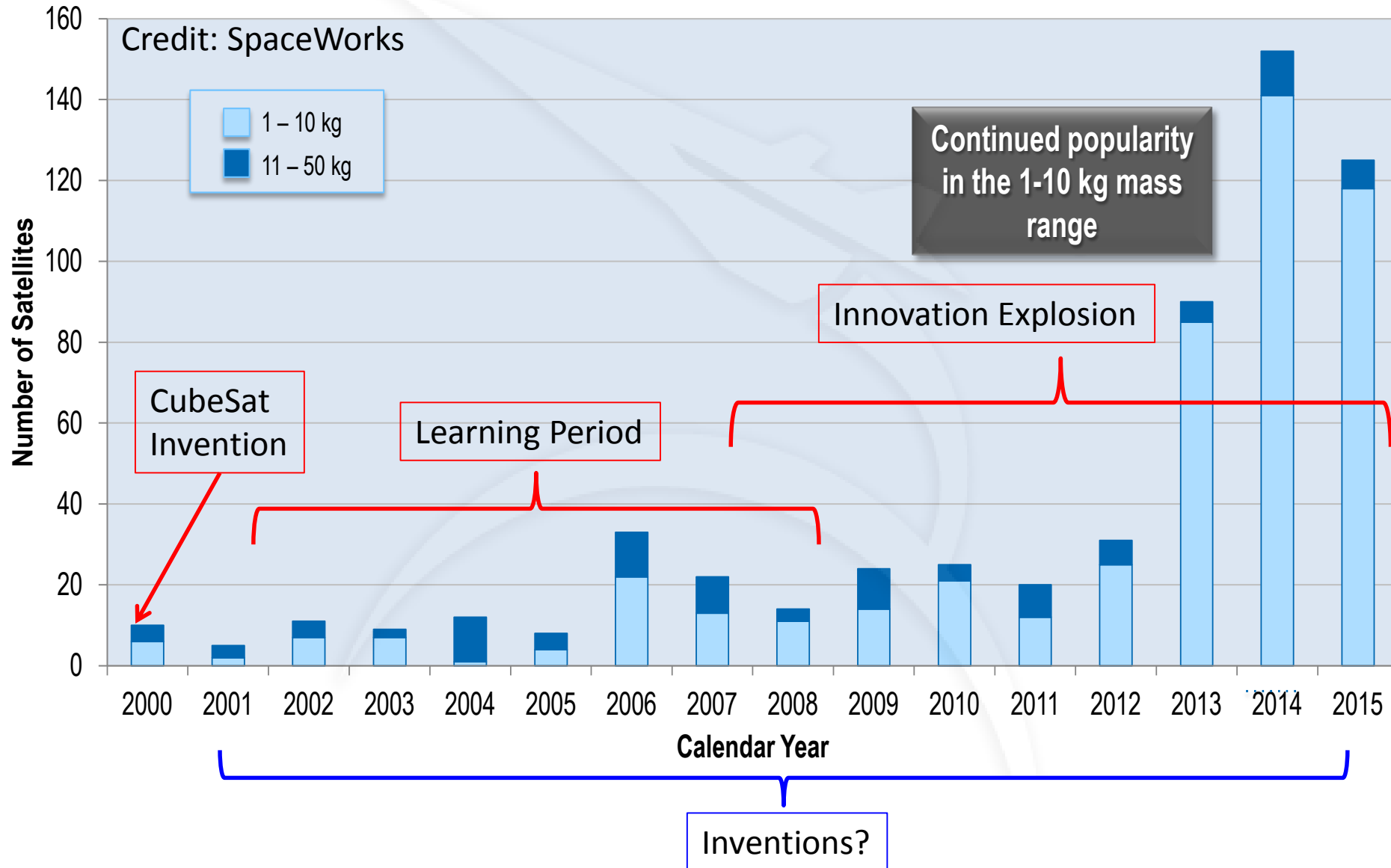


# We Invented CubeSat

- But what was new?



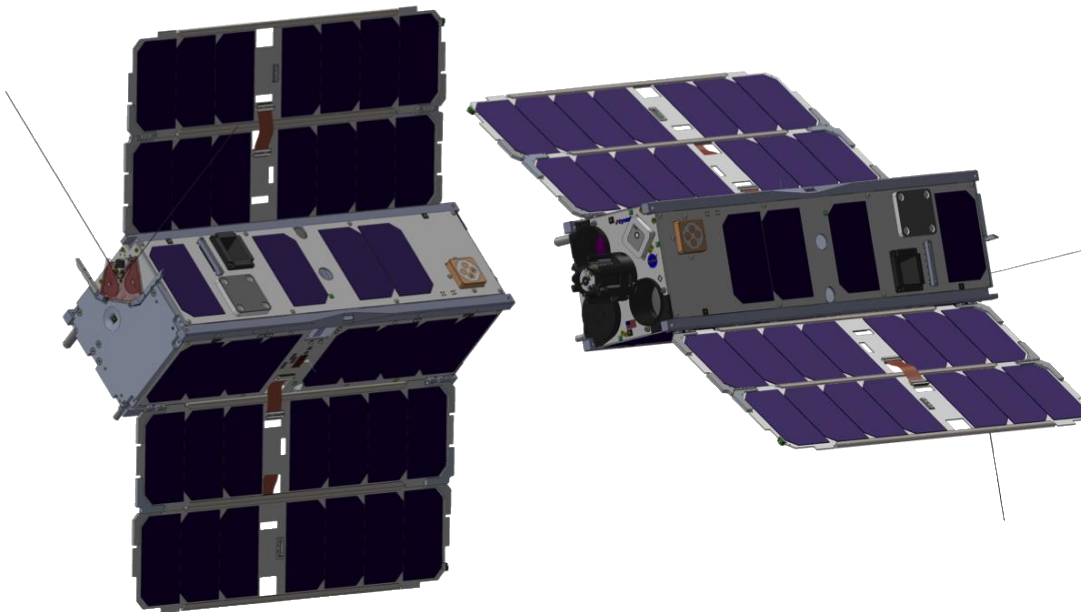
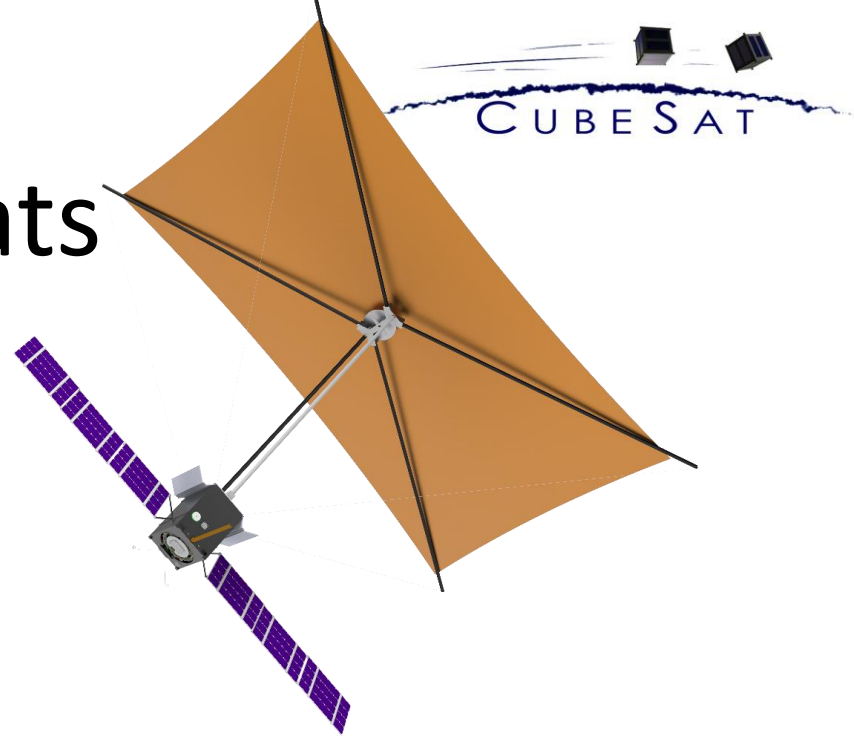
# CubeSats Success





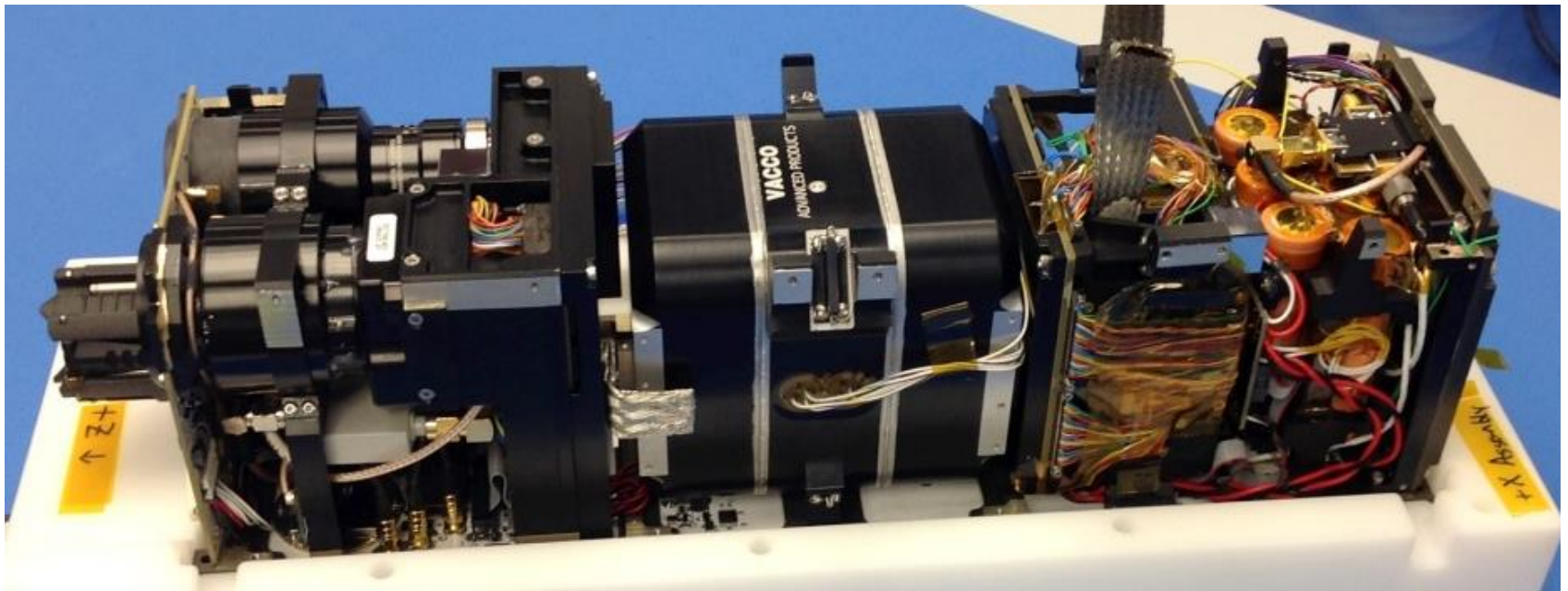
# “High-End” Small Sats

- High performance
- “Real” Missions
- **Innovation!!!**



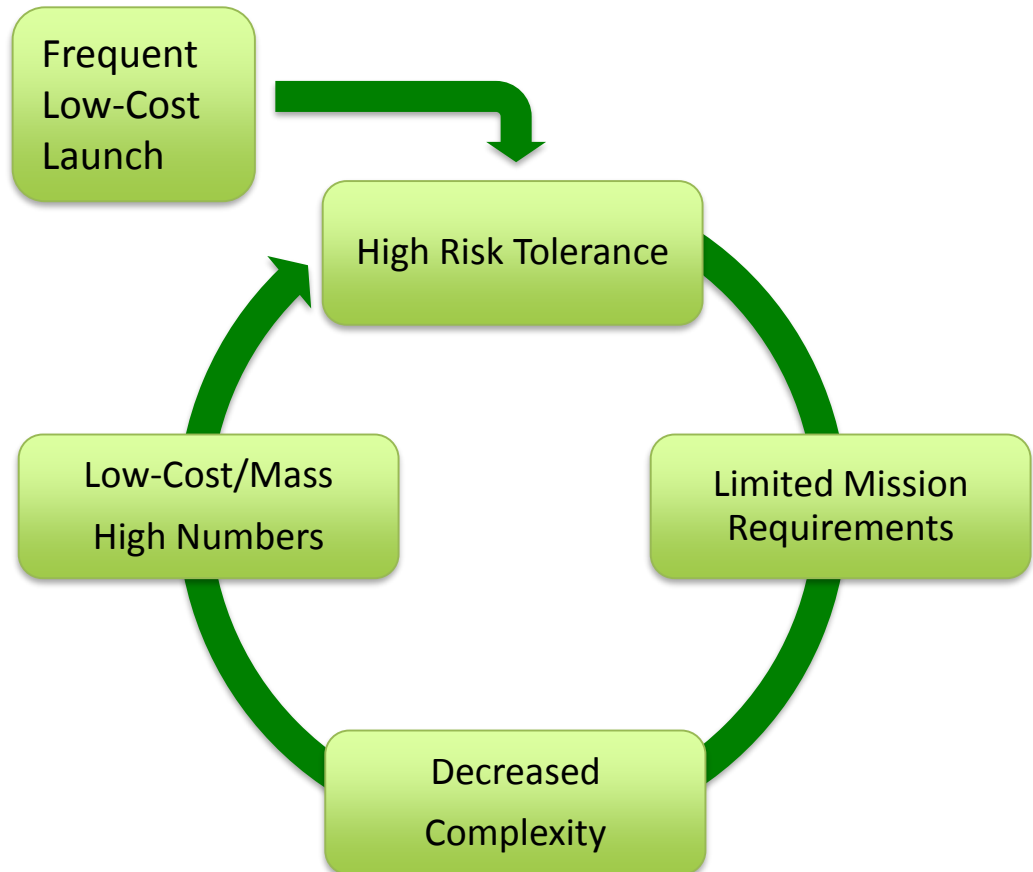
# “High-End” Small Sats

- Details



# Where is Innovation Coming From

**Revolution  
in Space  
Processes**





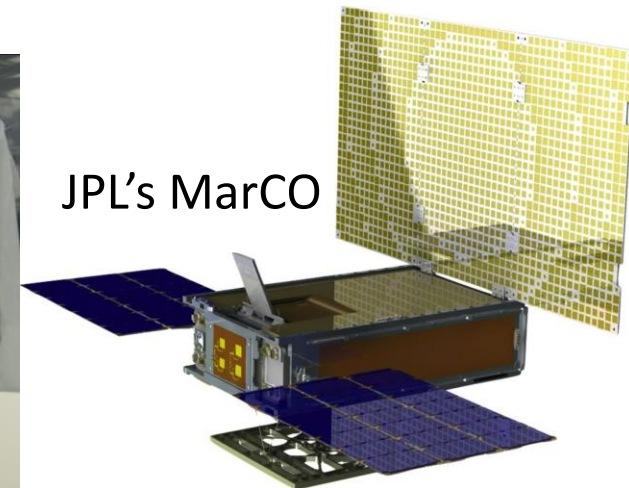
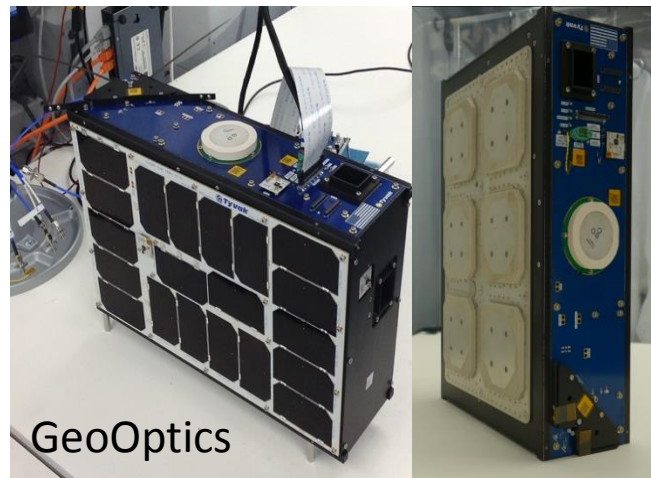
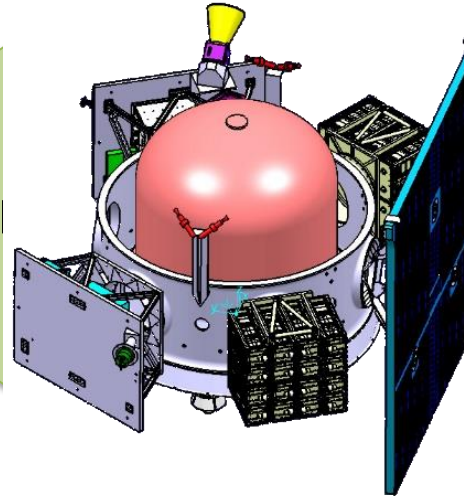
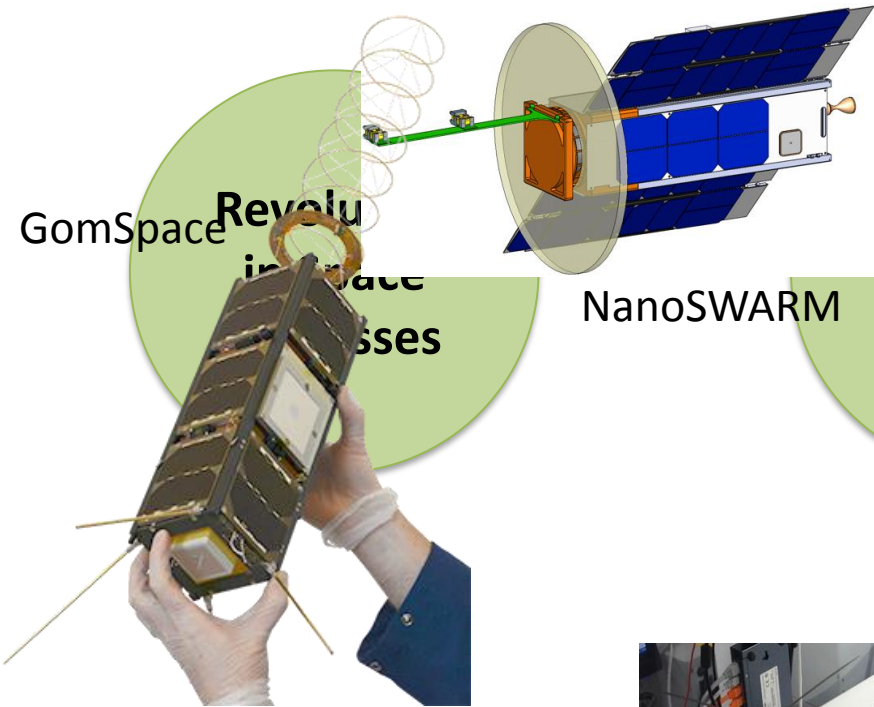
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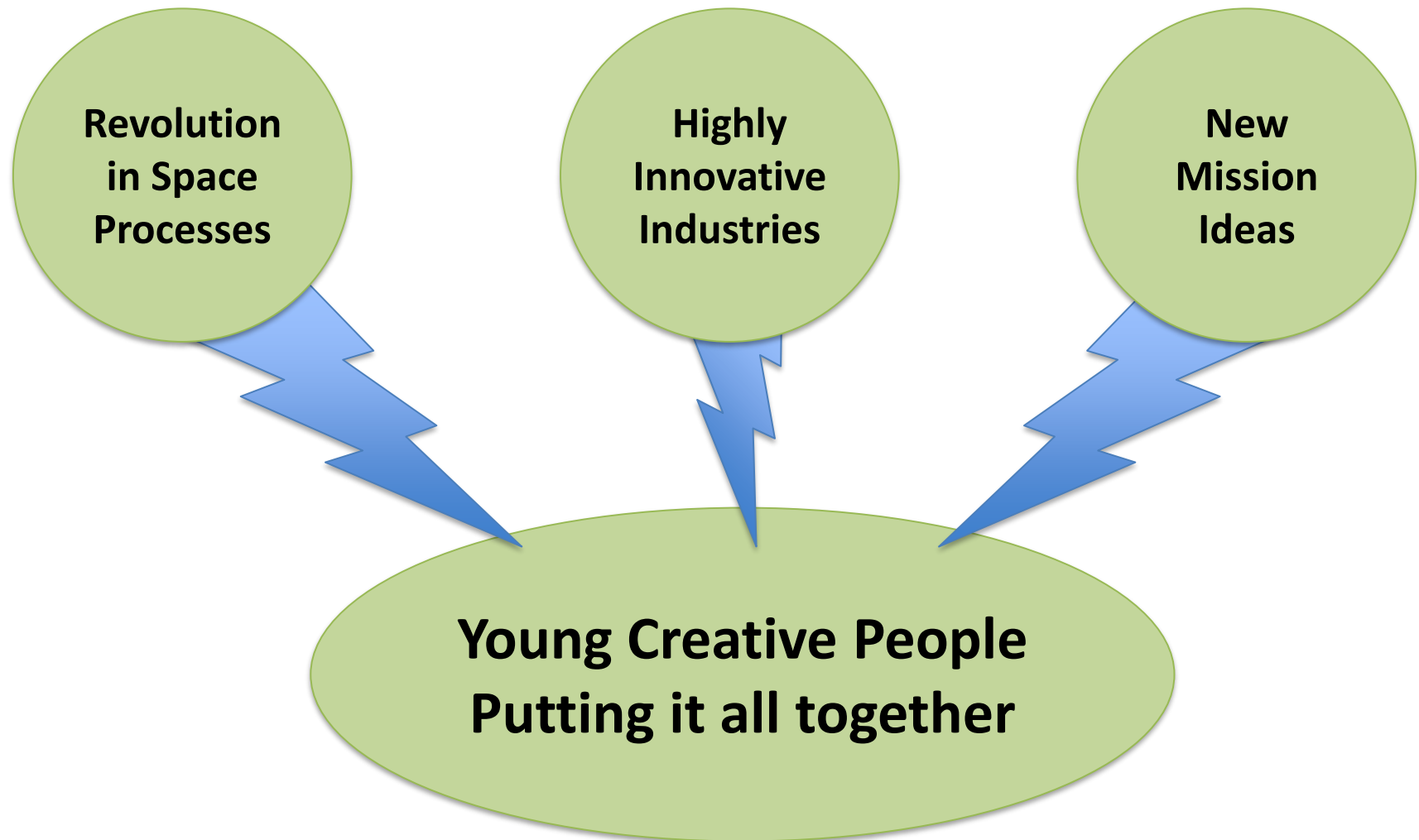
**Highly  
Innovative  
Industries**



# Where is Innovation Coming From

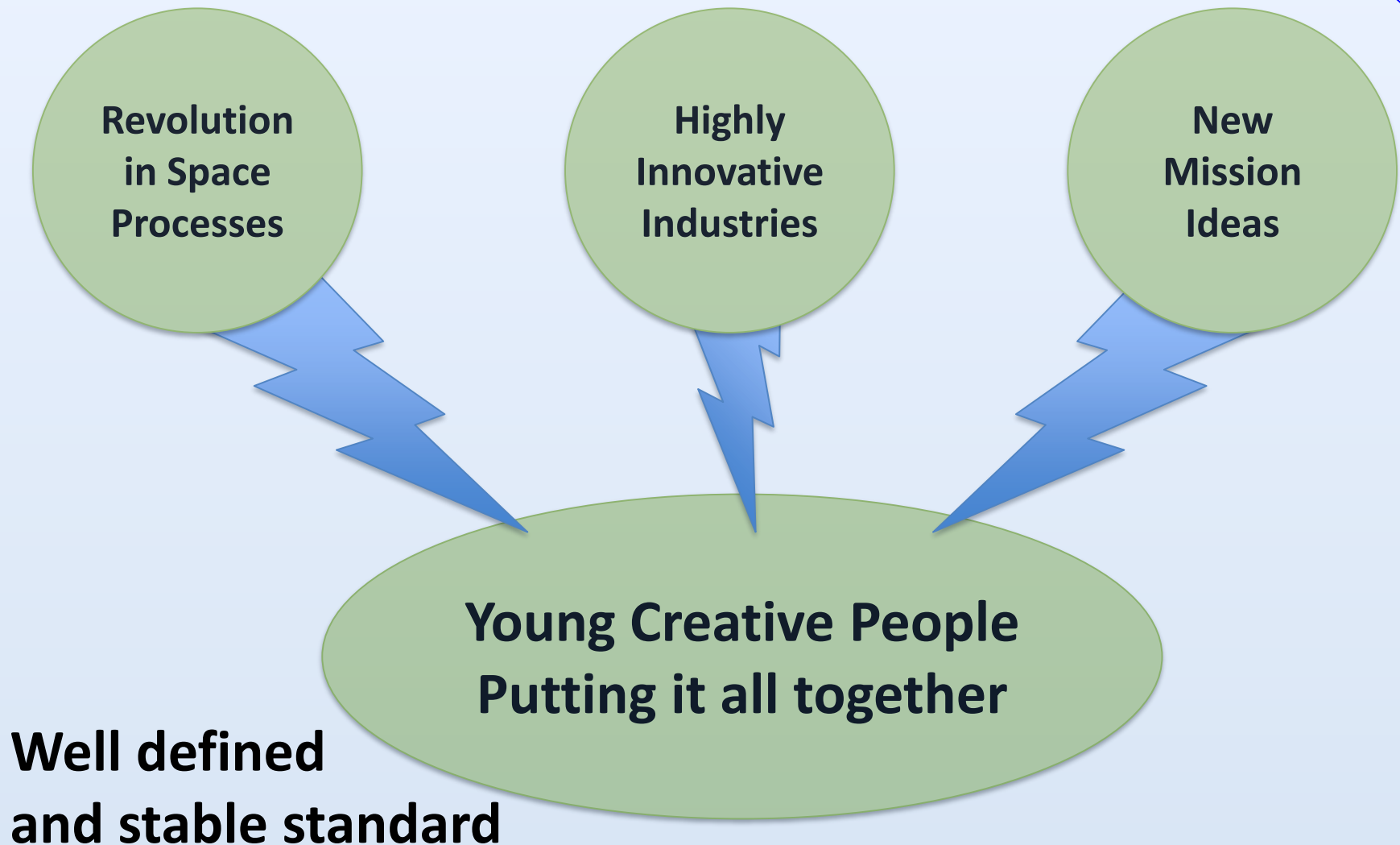


# Where is Innovation Coming From





# Where is Innovation Coming From



# Conclusions

- Do not wait for an invention
  - It is infrequent
- Look around for Innovations
  - Outside our field
- Experts are not always the innovators
  - Fresh ideas are key
- We are still learning
  - Good time to get in

# Final Thoughts for Young People

- **DO**
  - Space is now open to all
- **TRY**
  - Take risk and learn from failures
- **INNOVATE**
  - Don't be afraid of Crazy Ideas
- **QUESTION THE EXPERTS**
  - We did what could not be done
- **REMMEMBER TO HAVE FUN !!!**





Thank You



Questions?