

CUBESAT

The Future of CubeSat

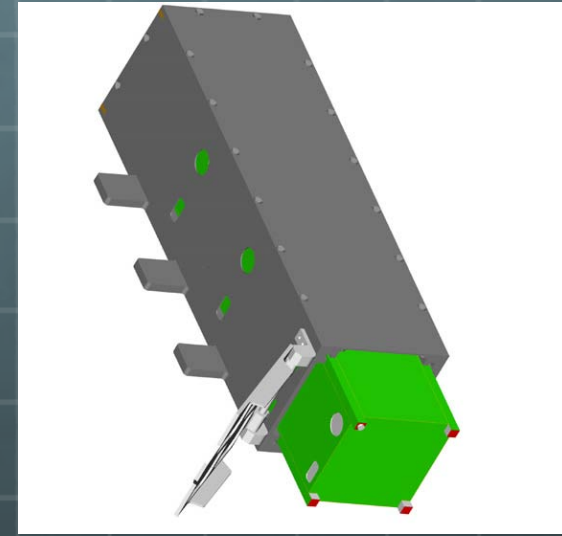
Jordi Puig-Suari
Cal Poly

9th CubeSat Workshop
San Luis Obispo, California
April, 2012

Look at the Past

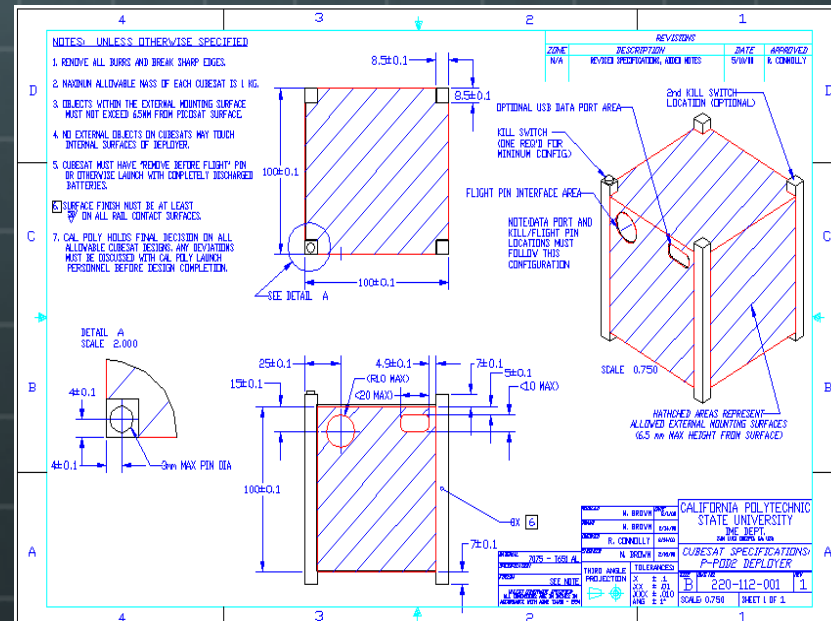
Year 2000 Industry view of CubeSats

- Too Small
- Not useful
- Just a toy
- Will never do anything for me



NO FUNDING !!!!

- No development direction
- No stop button



Why did it work?

- Community of Students & Industry Rebels
 - Creativity & Enthusiasm
 - Low-Cost Commercial COTS based systems
 - Risk Takers
 - Non Traditional Space Approaches



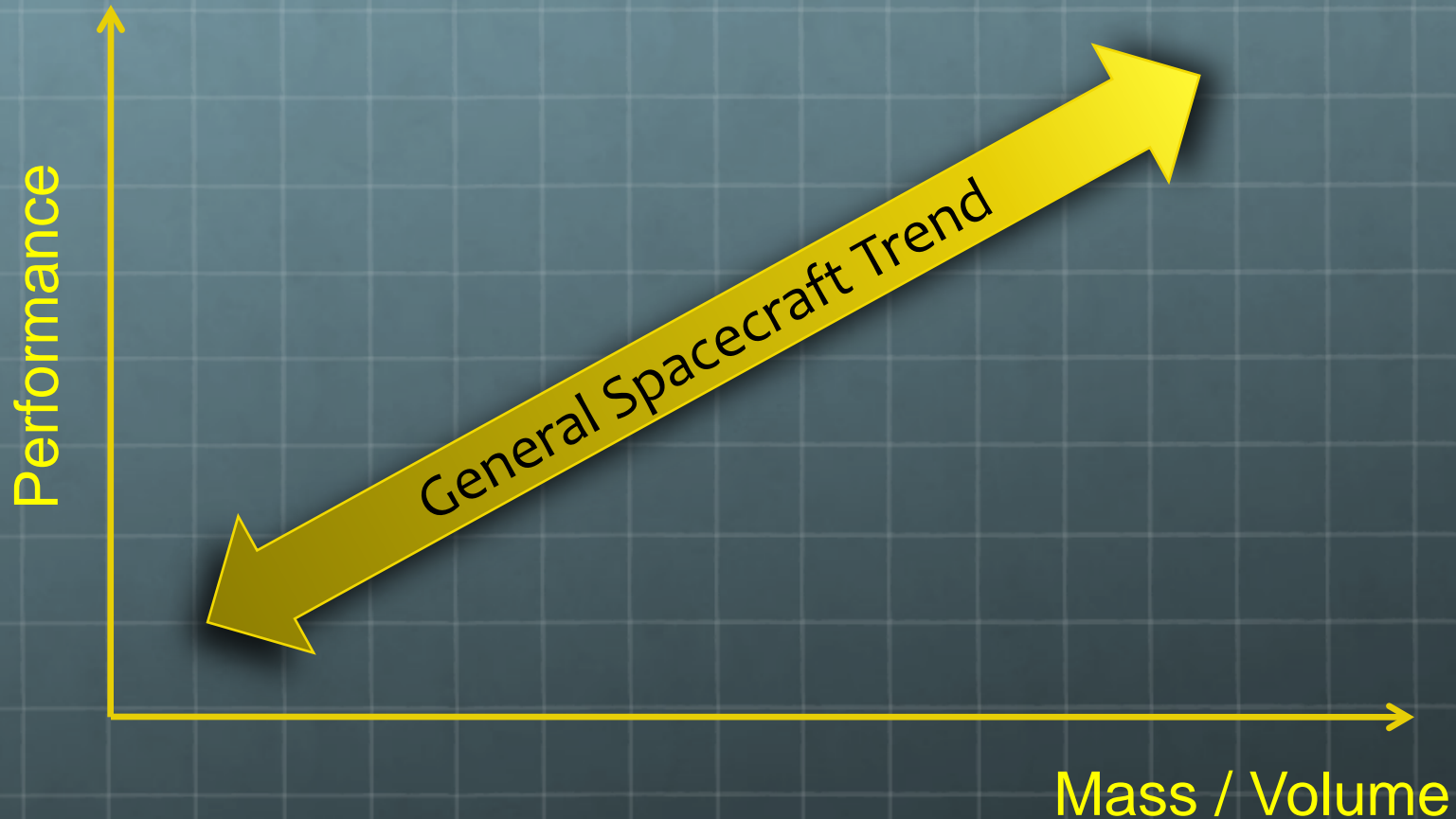
“Guerrilla Space”



Lesson for the Future

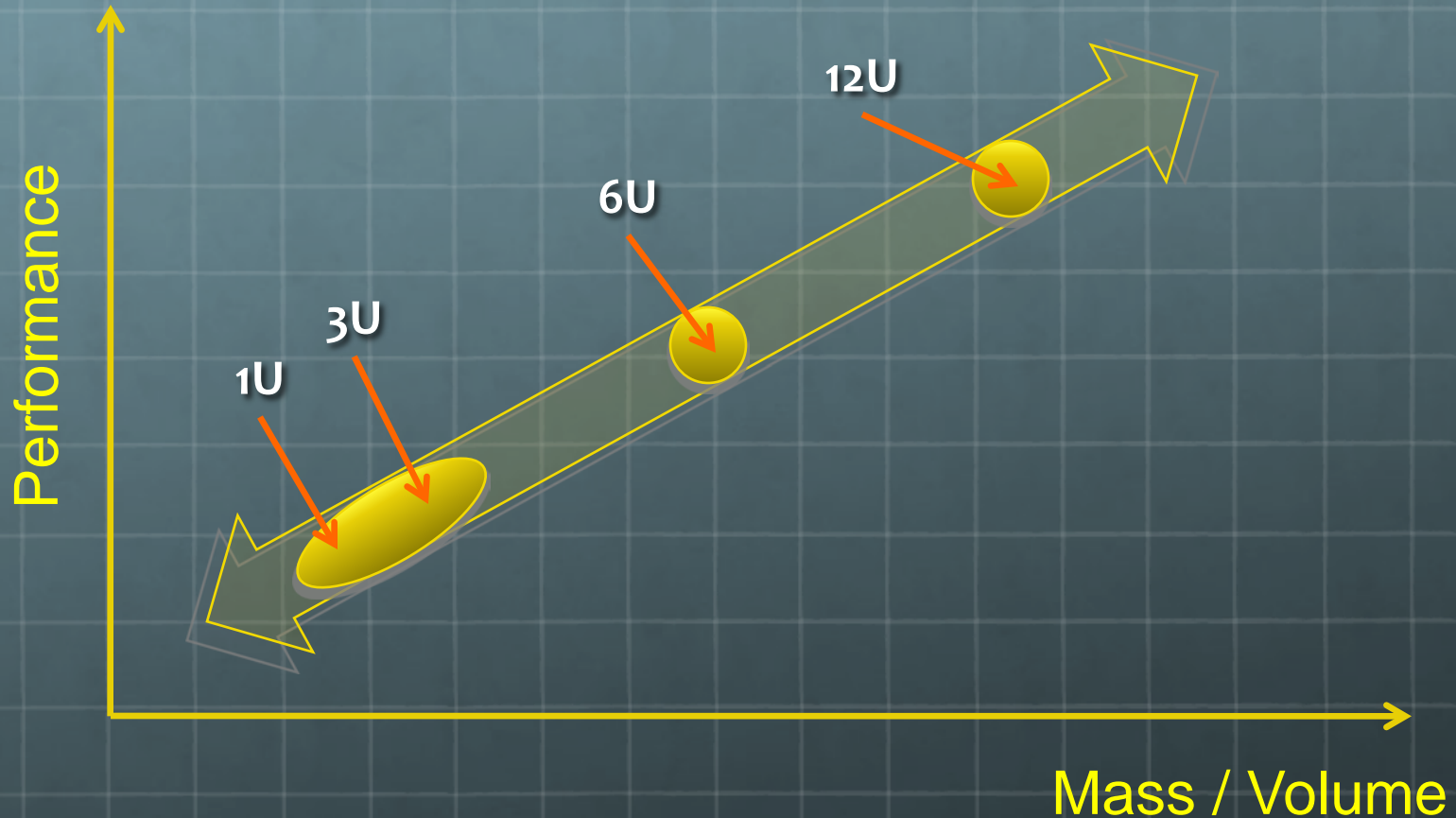
- 🌐 Crazy ideas become brilliant ideas when they work
- 🌐 Question your road map often
 - 🌐 Be aware of parallel paths (even small ones)
- 🌐 Funding helps but don't always follow the funding
 - 🌐 Rebels have a role to play
 - 🌐 Universities make good rebel bases

Future Growth of The Standard



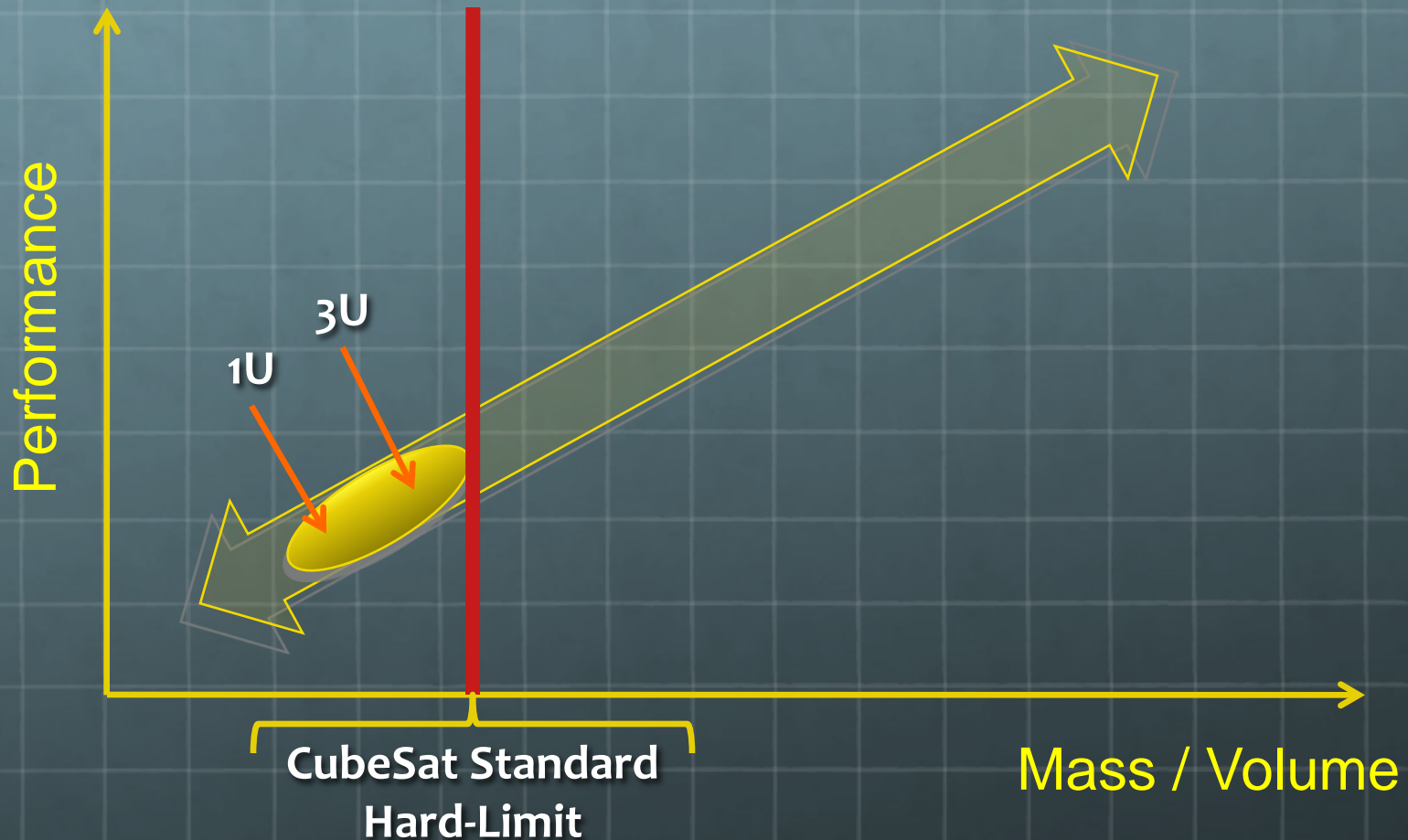
- 🌐 **Standard Space view**
- 🌐 **Bigger sometimes required by physics (Apperture)**

Planned CubeSat Growth Path



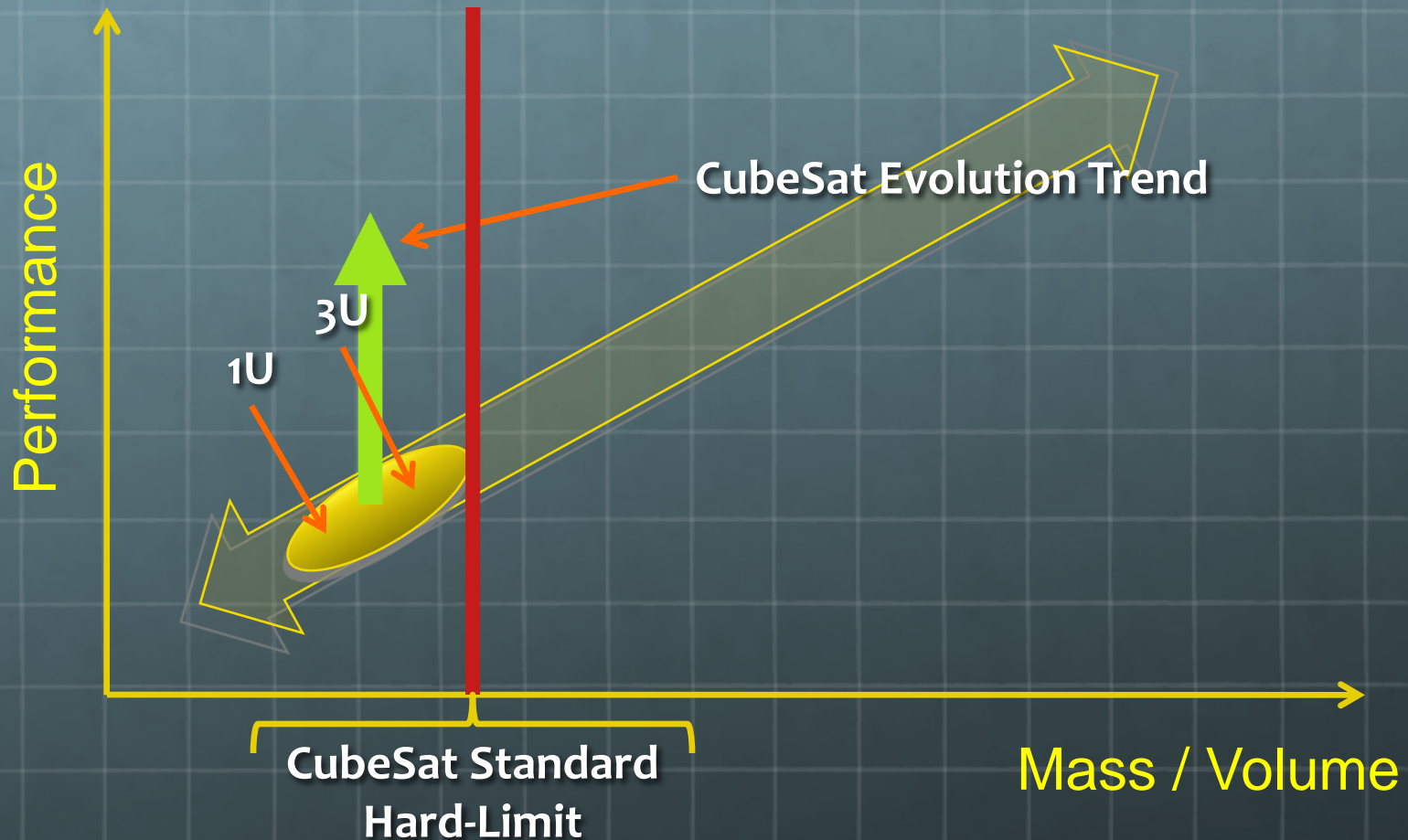
- 🌐 Bigger form factor represents “Easy Path” to performance increase
- 🌐 “Easy Path” not available initially

Initial State



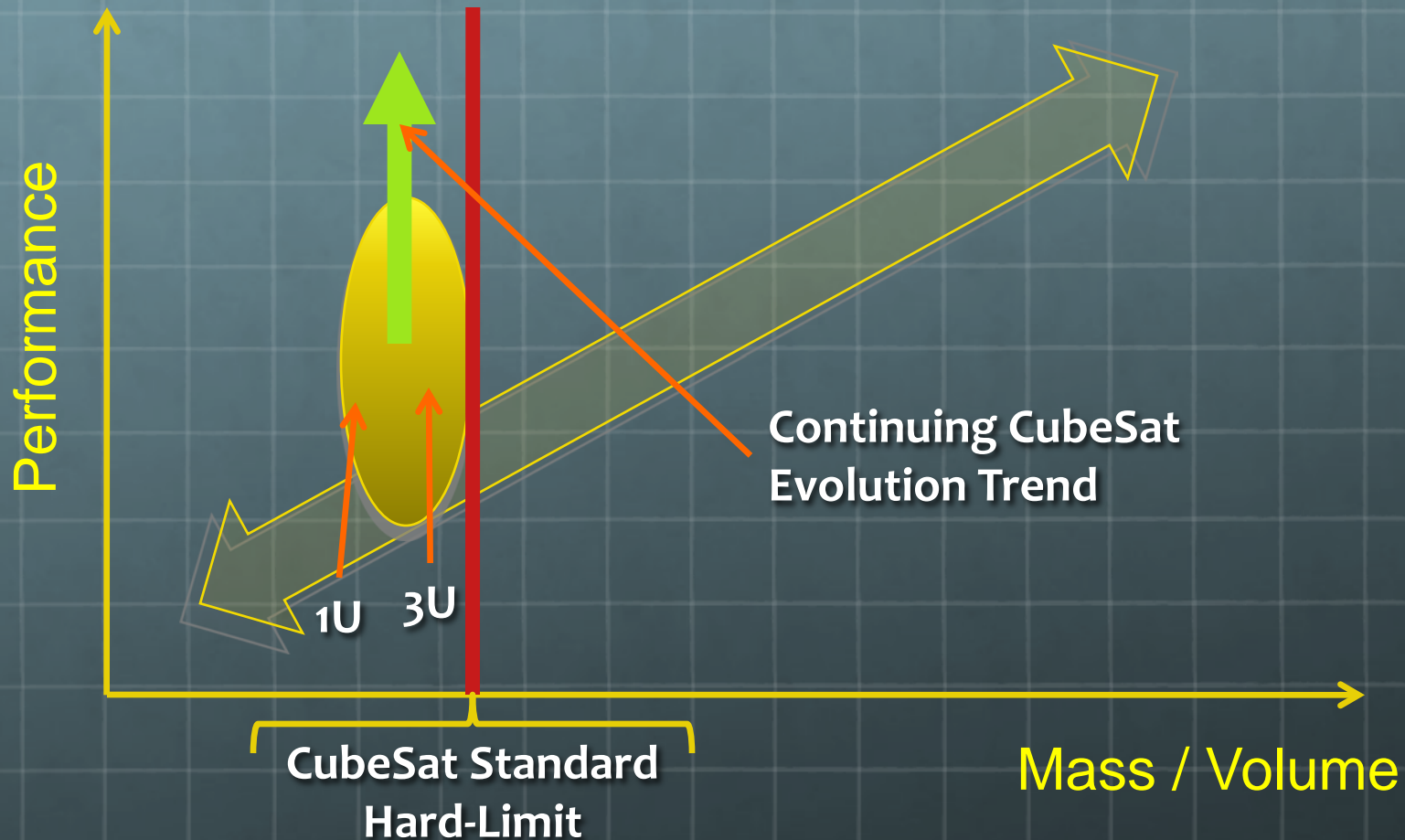
- 🌐 CubeSat Standard was a hard barrier to growth
- 🌐 Forced “Guerrilla Space” approach

Initial Evolution



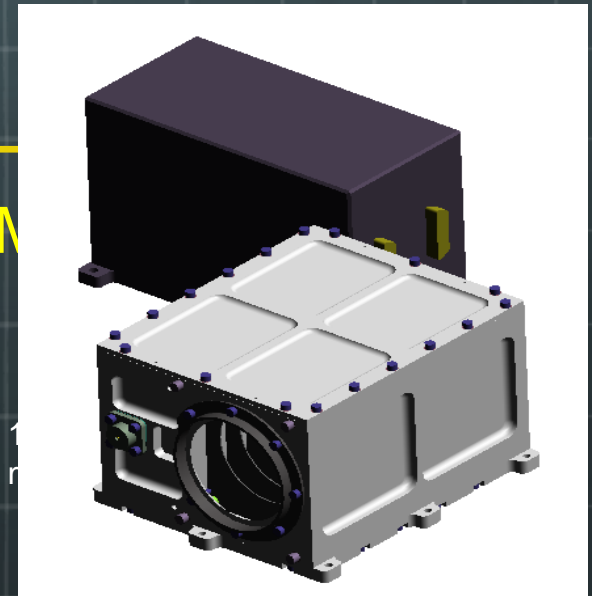
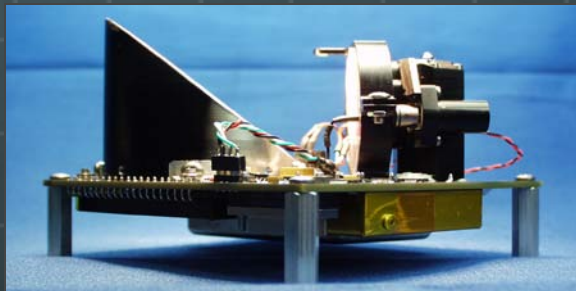
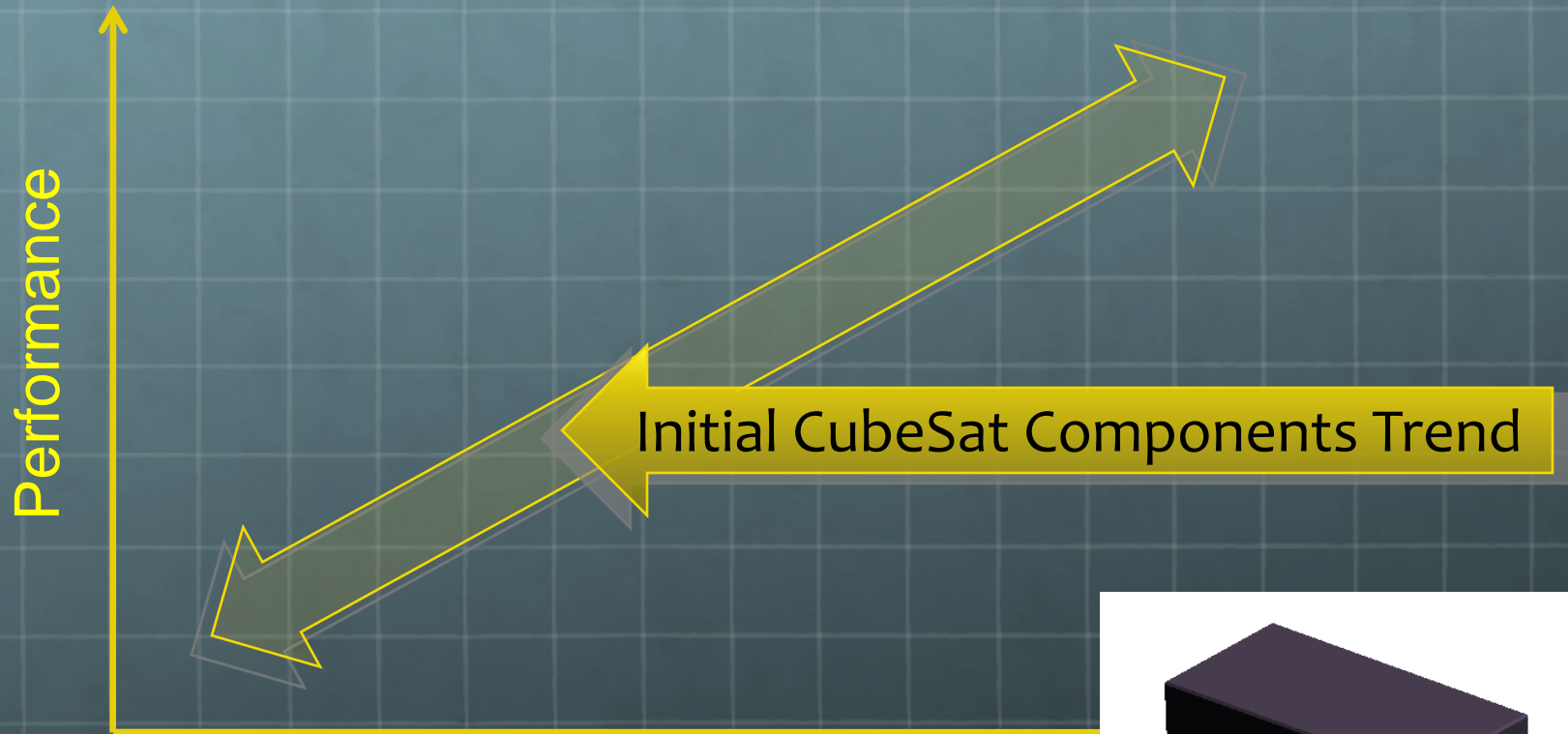
- 🌐 Creative mission and system design
- 🌐 High performance COTS parts
- 🌐 Redefined risk-posture

Current State

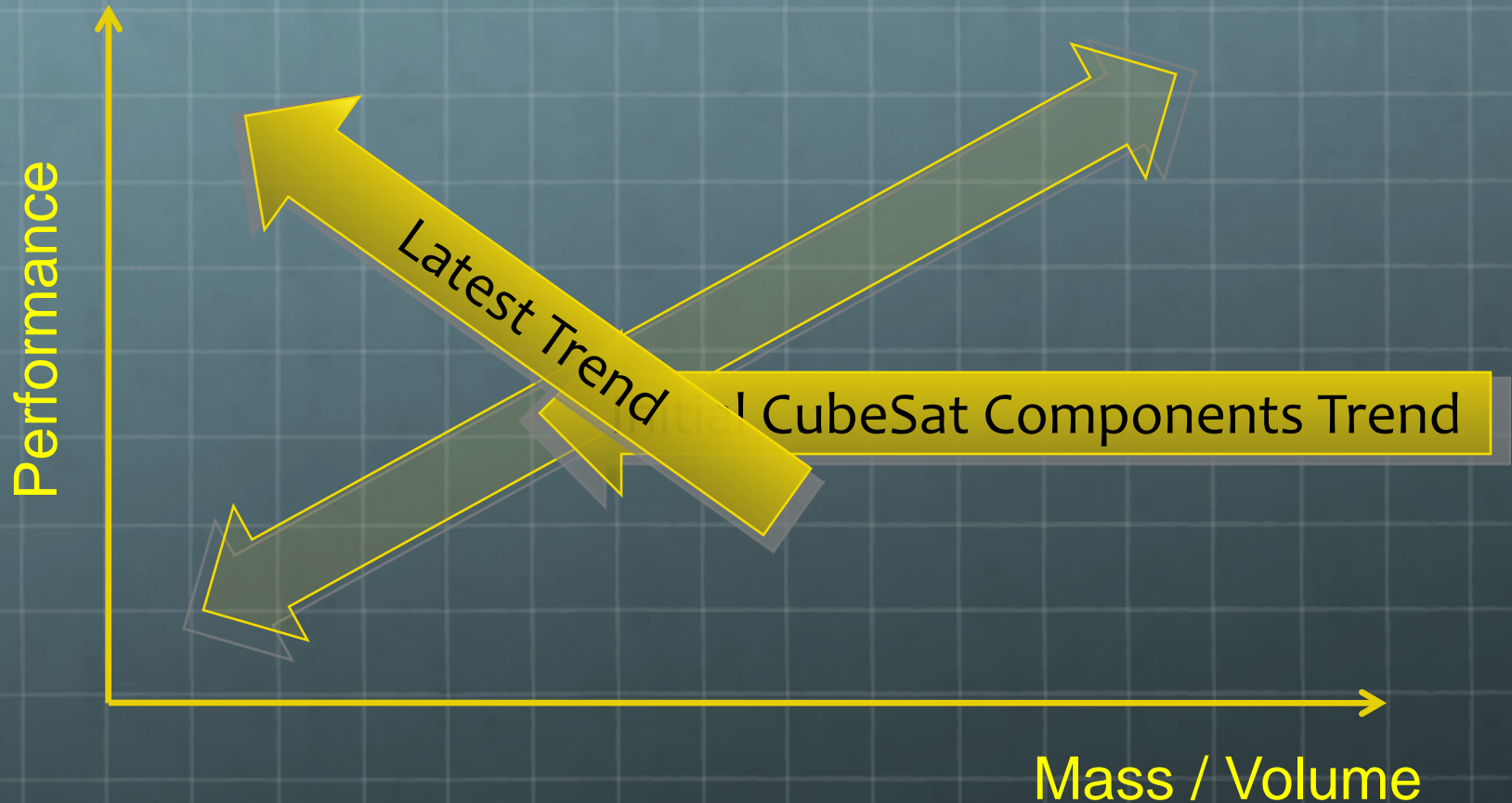


- 🌐 Current standards are still evolving
- 🌐 Following commercial electronics revolution
- 🌐 Not close to performance limits

Component Trends

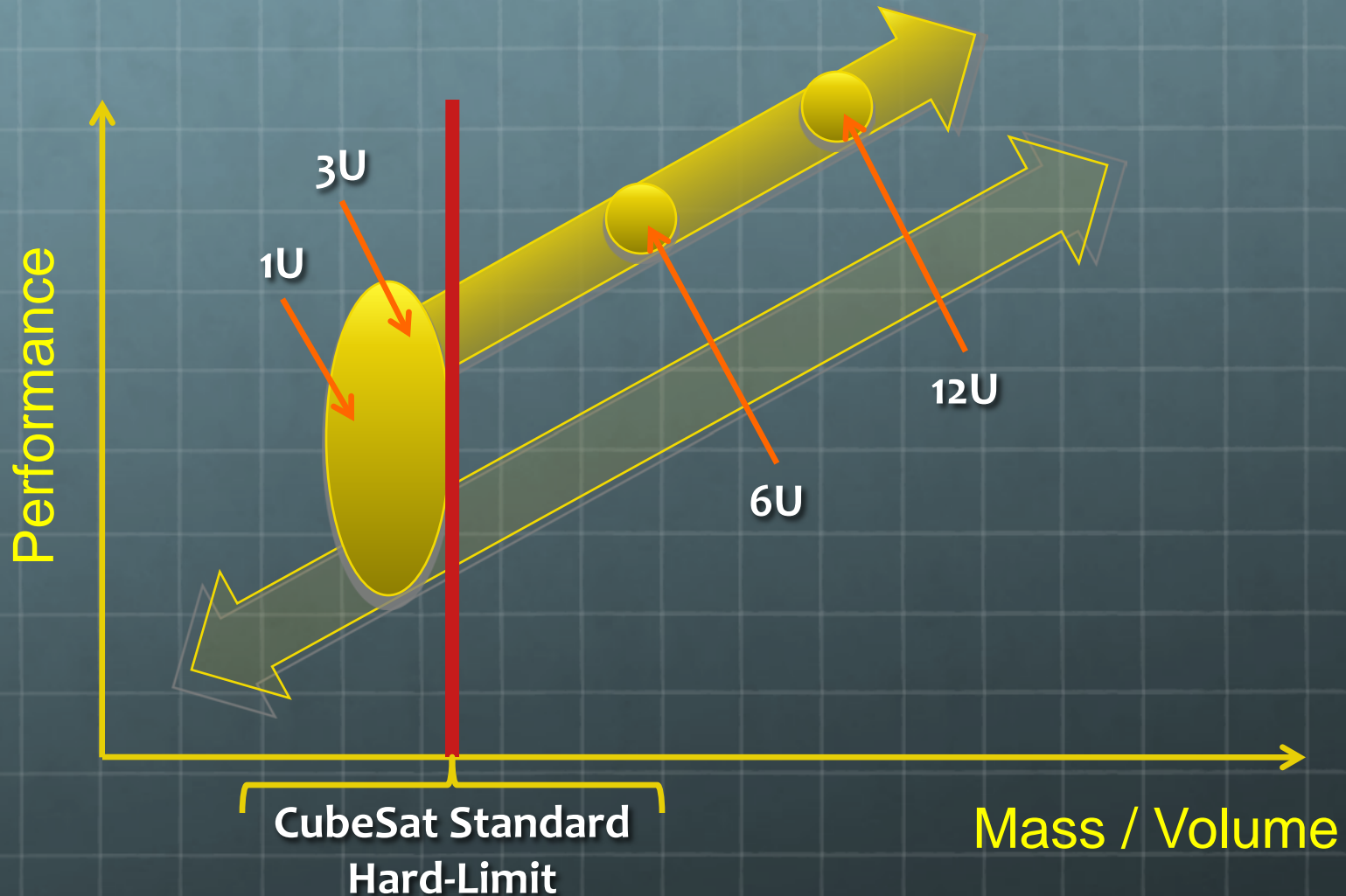


Component Trends



- 🌐 Improving performance while reducing size
- 🌐 Exponential increase in performance at 1U and 3U
- 🌐 Some missions still need bigger system

Enhanced Growth



🌐 New form large factors benefit from previous size restrictions and resulting innovation

Lesson for the Future

- 🌐 Avoid using size increases as “easy path” to performance
 - 🌐 Use it when “needed”
- 🌐 Maintain focus on constrained small form factors
 - 🌐 Innovation engines
 - 🌐 Low-cost launch capability available
 - 🌐 Good match for universities (remember the rebels)
 - 🌐 Performance is increasing quickly
- 🌐 Maintain form standardization

A photograph taken from space showing a small, dark, rectangular satellite in orbit above Earth's cloud-covered surface. The satellite is positioned in the lower-left quadrant of the frame. The Earth's surface is covered in white and grey clouds, with some darker patches of land or water visible. The background is a deep blue, representing the Earth's atmosphere and the void of space.

Thank You

www.cubesat.org

Photograph taken by AeroCube-2, April 17, 2007