



Quantum physics with CubeSats

13th Annual CubeSat Developers' Workshop

SSC16-WK-01

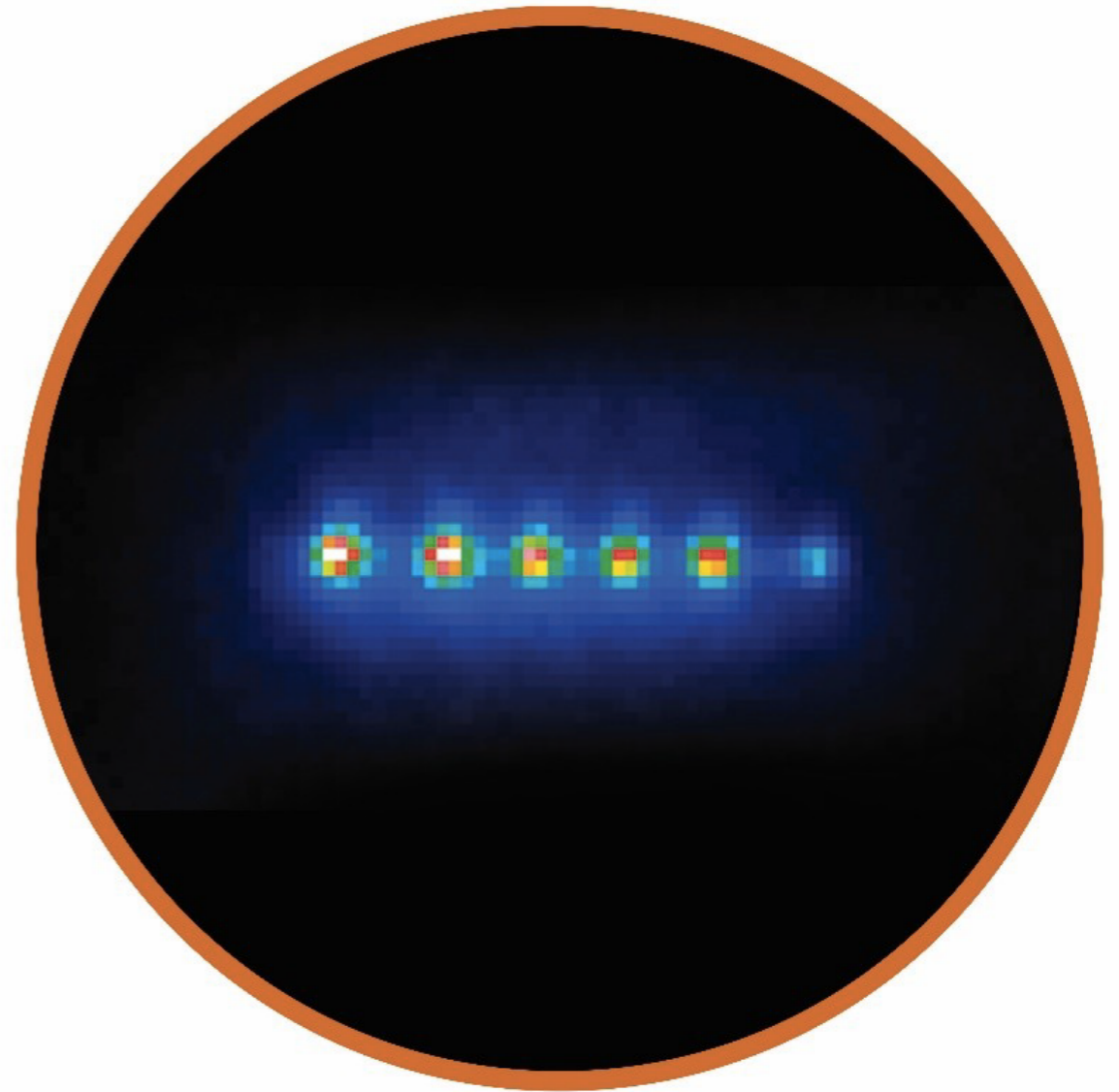
LOGAN, UTAH, USA (08/07/2016)

Rakhitha Chandrasekara

Quantum Information



photons



atoms

Quantum Key Distribution (QKD)

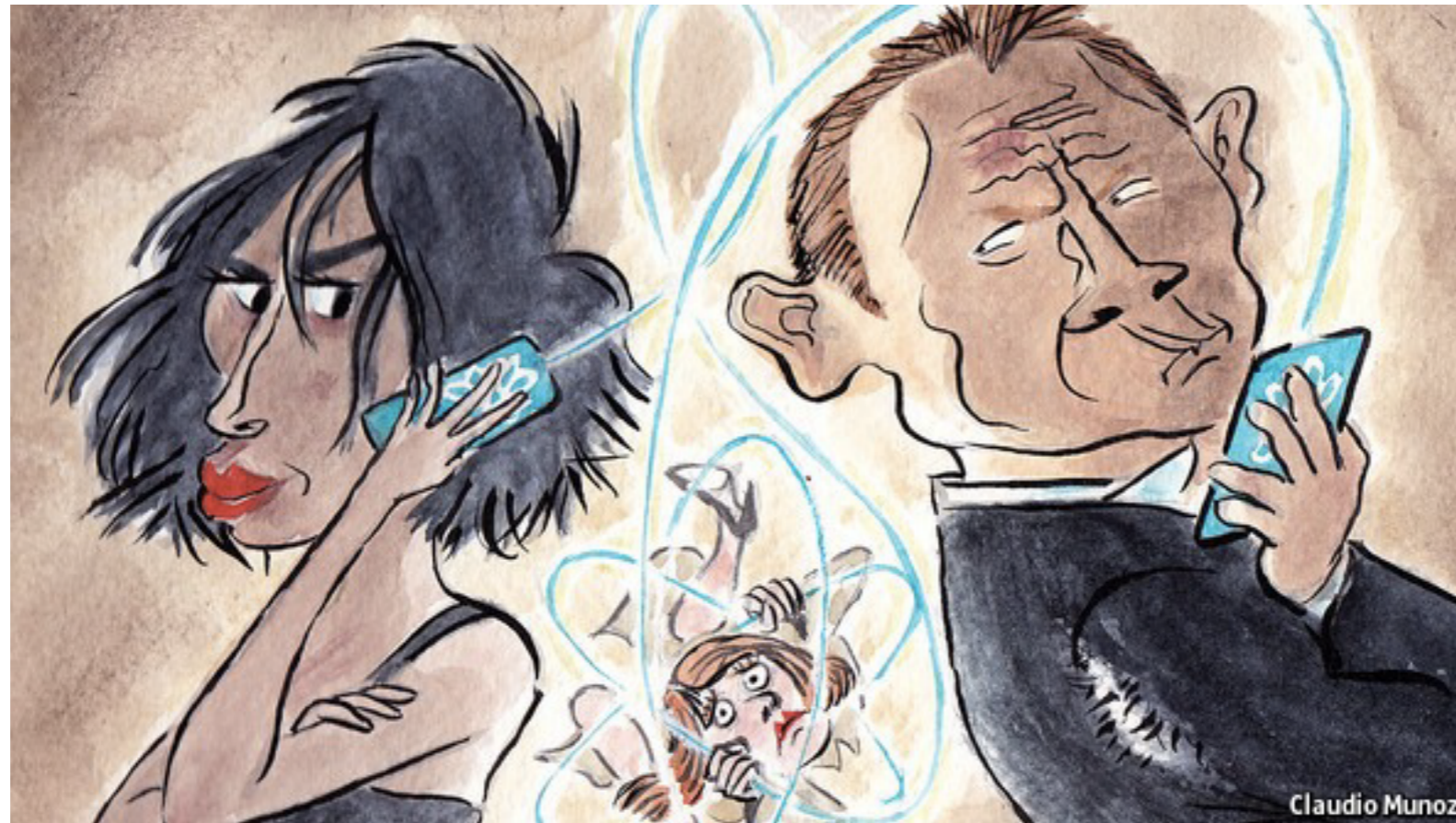
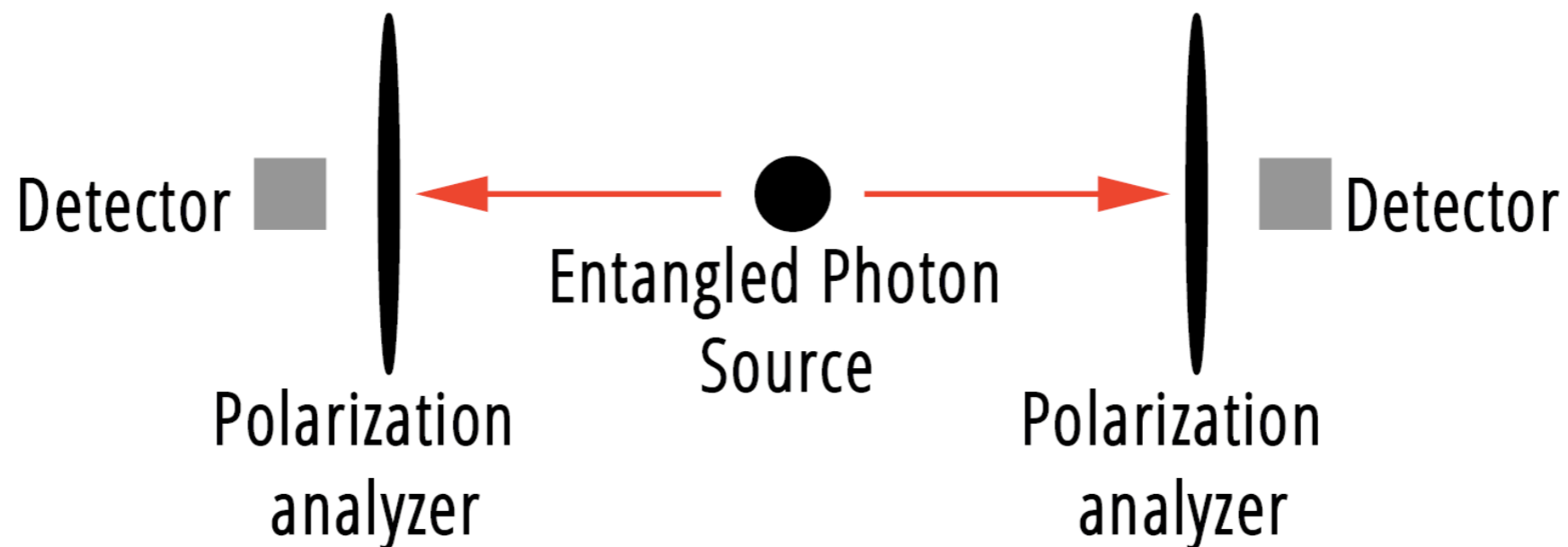


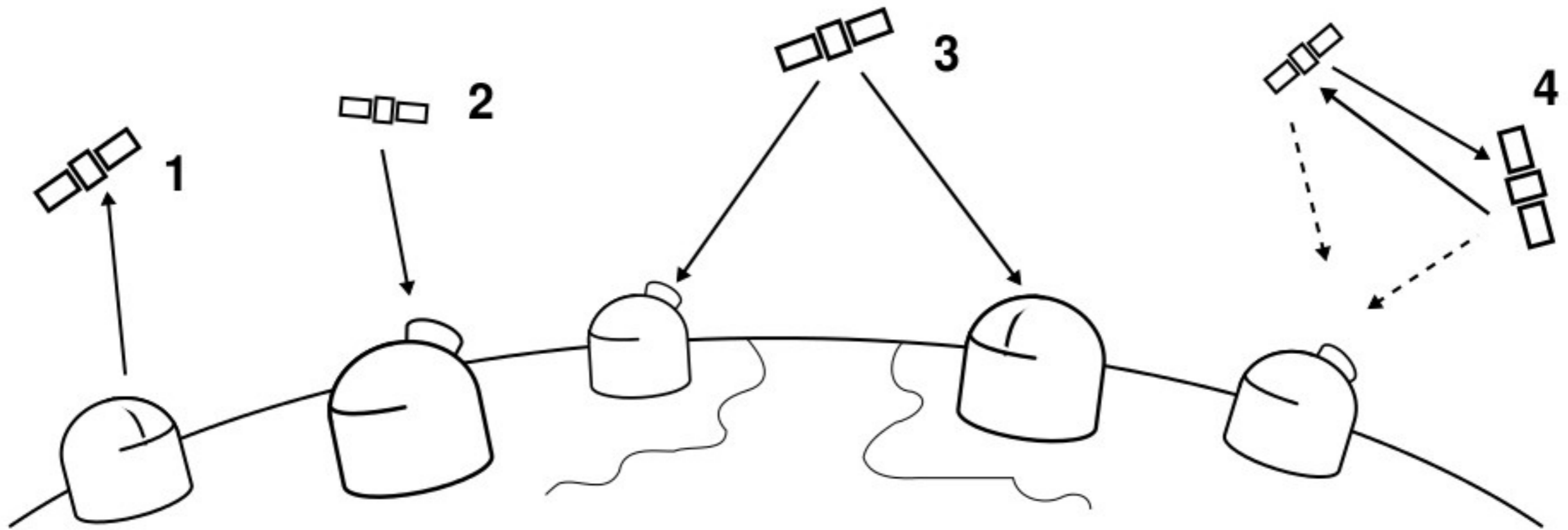
Image : The Solace of Quantum, The Economist, May 2013



Global QKD

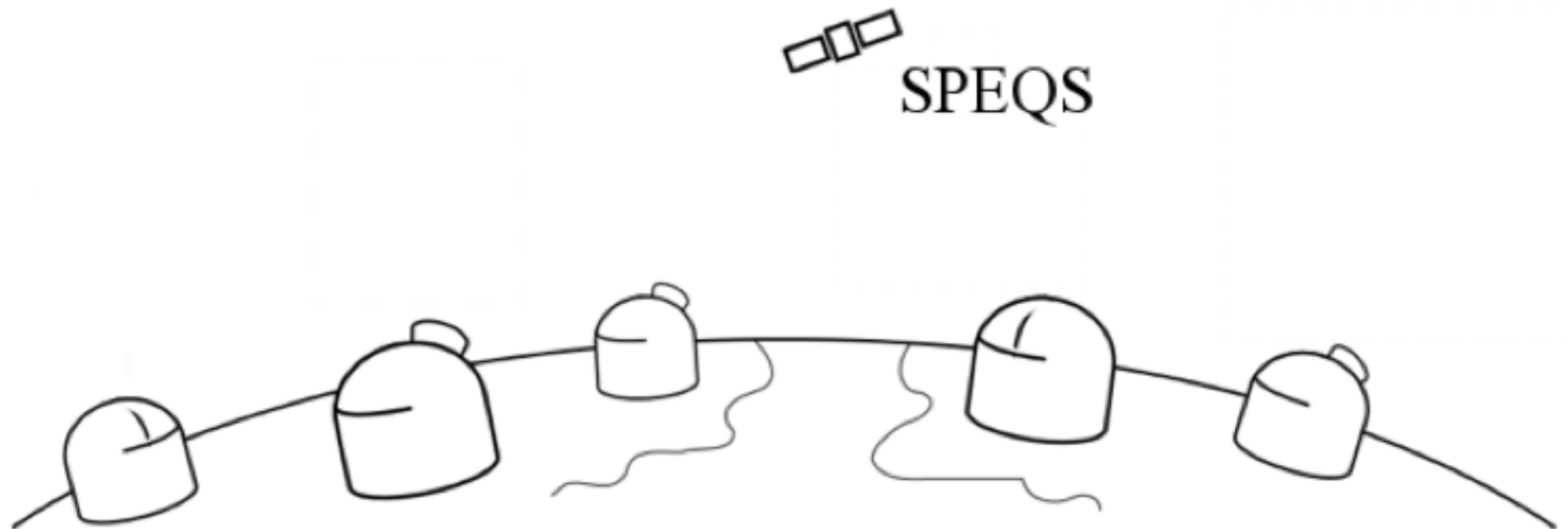


Global QKD Proposals



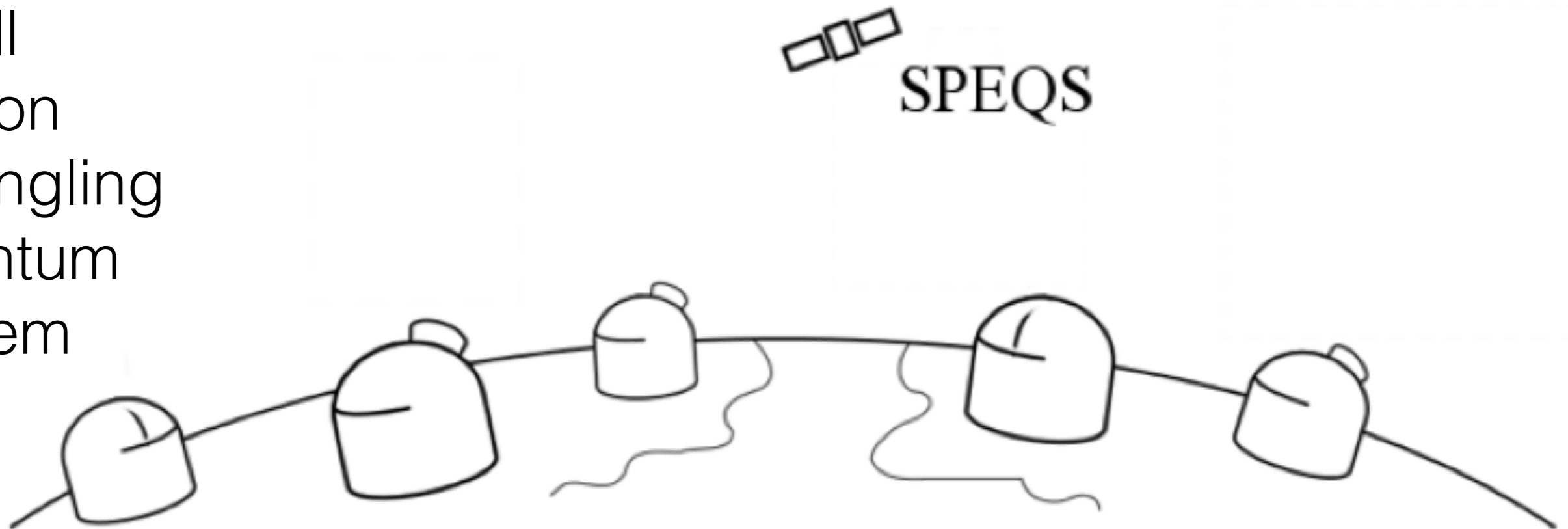
A QKD precursor

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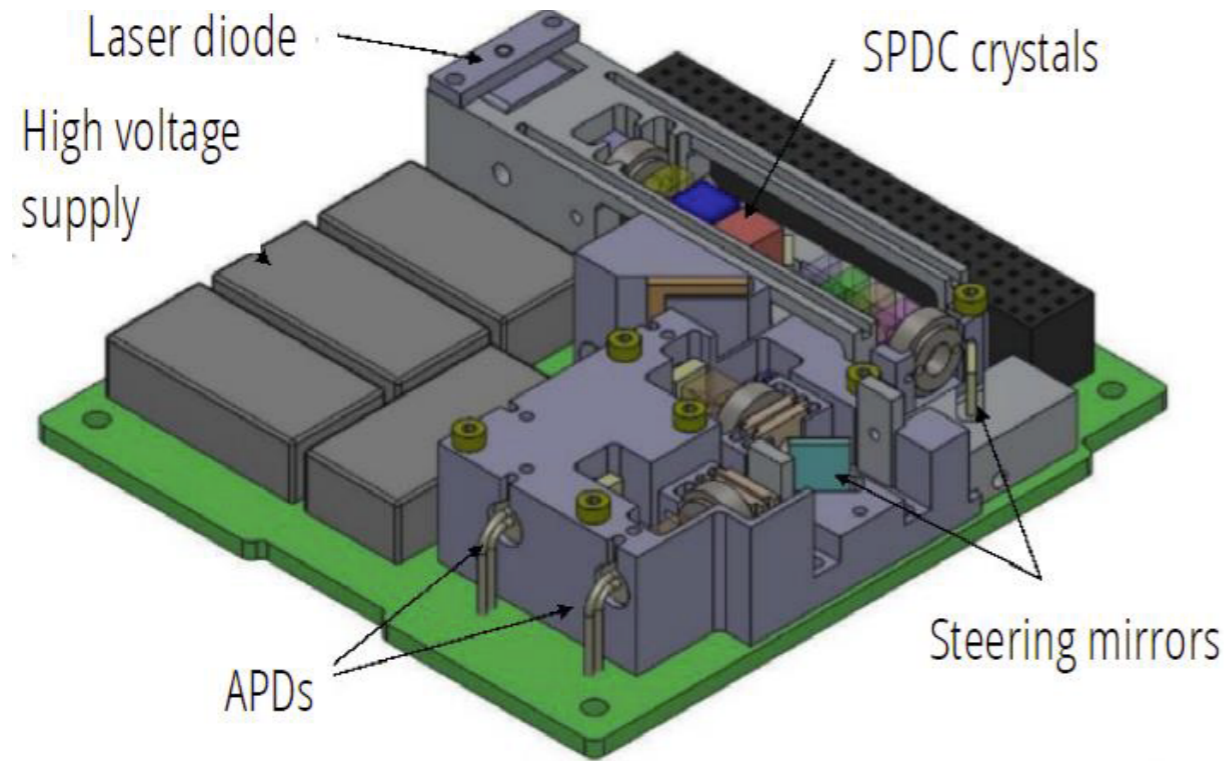


A QKD precursor

Small
Photon
Entangling
Quantum
System

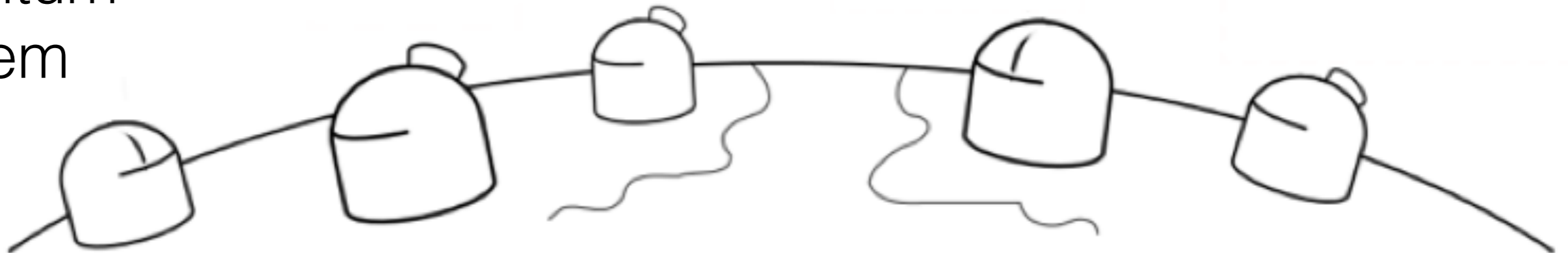


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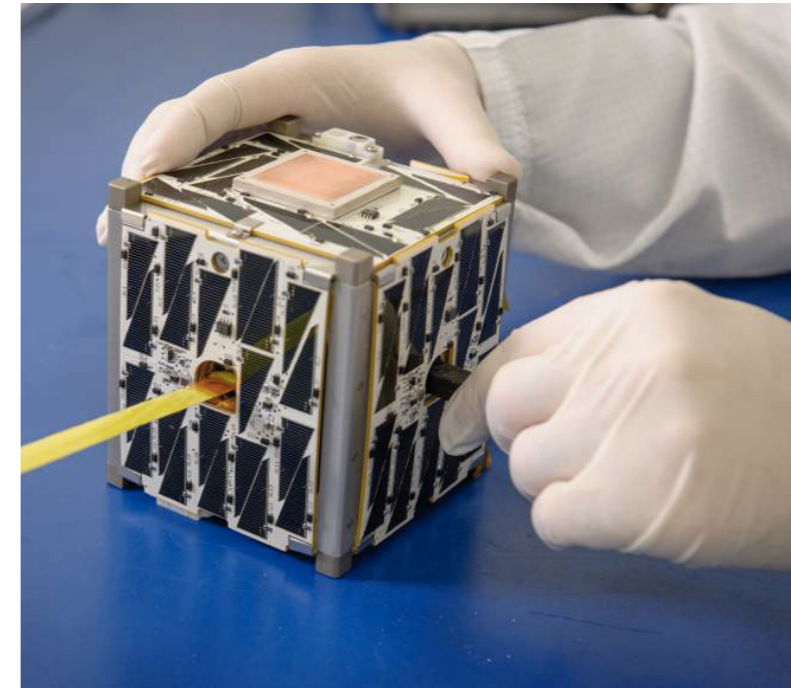
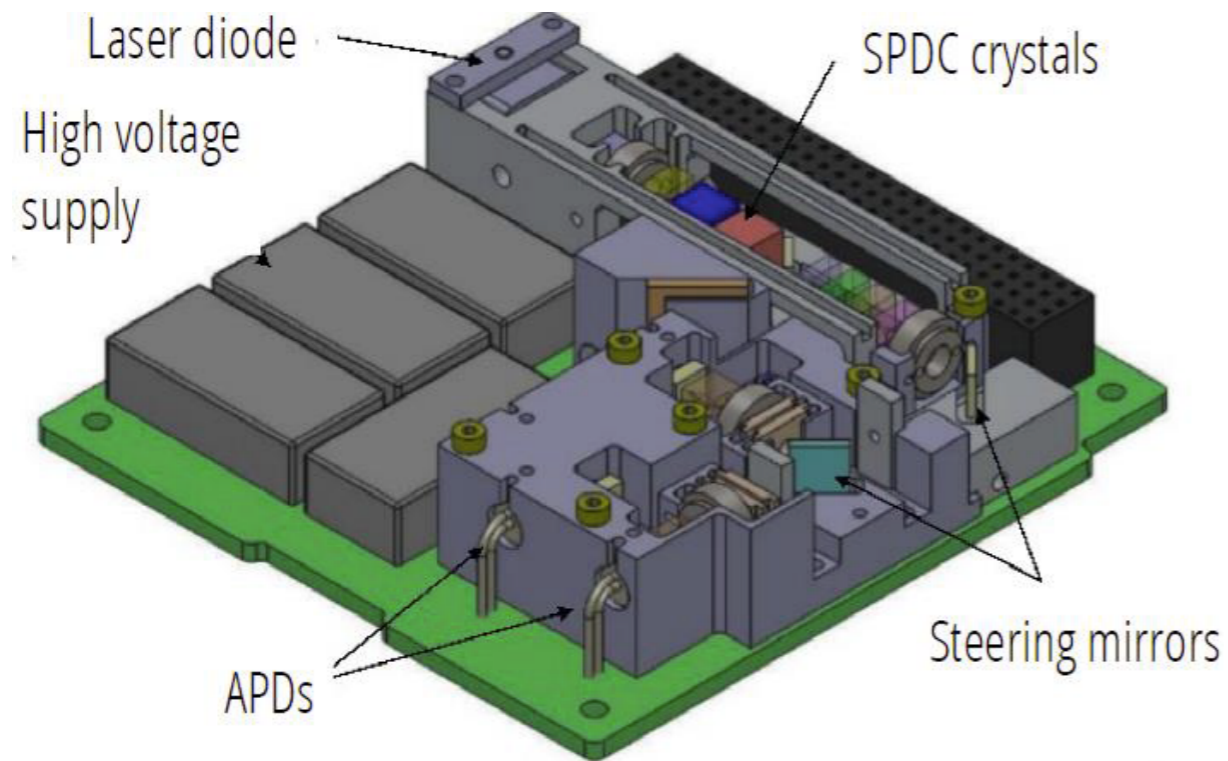


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SPEQS

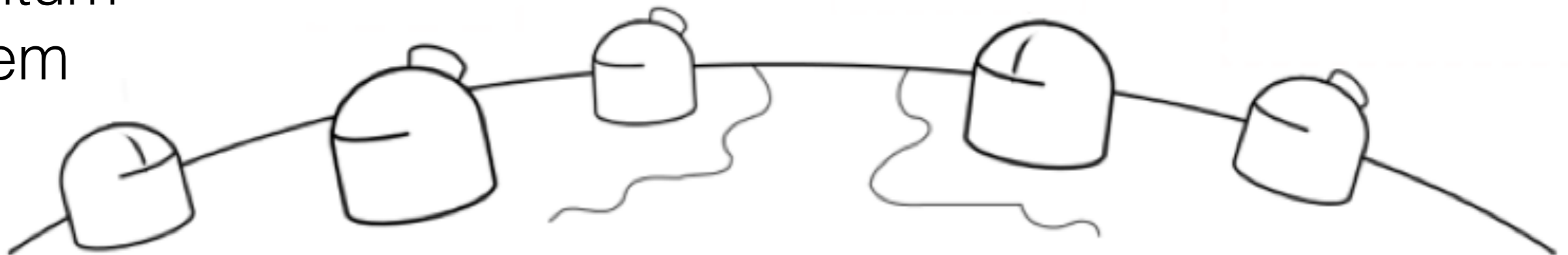


A QKD precursor

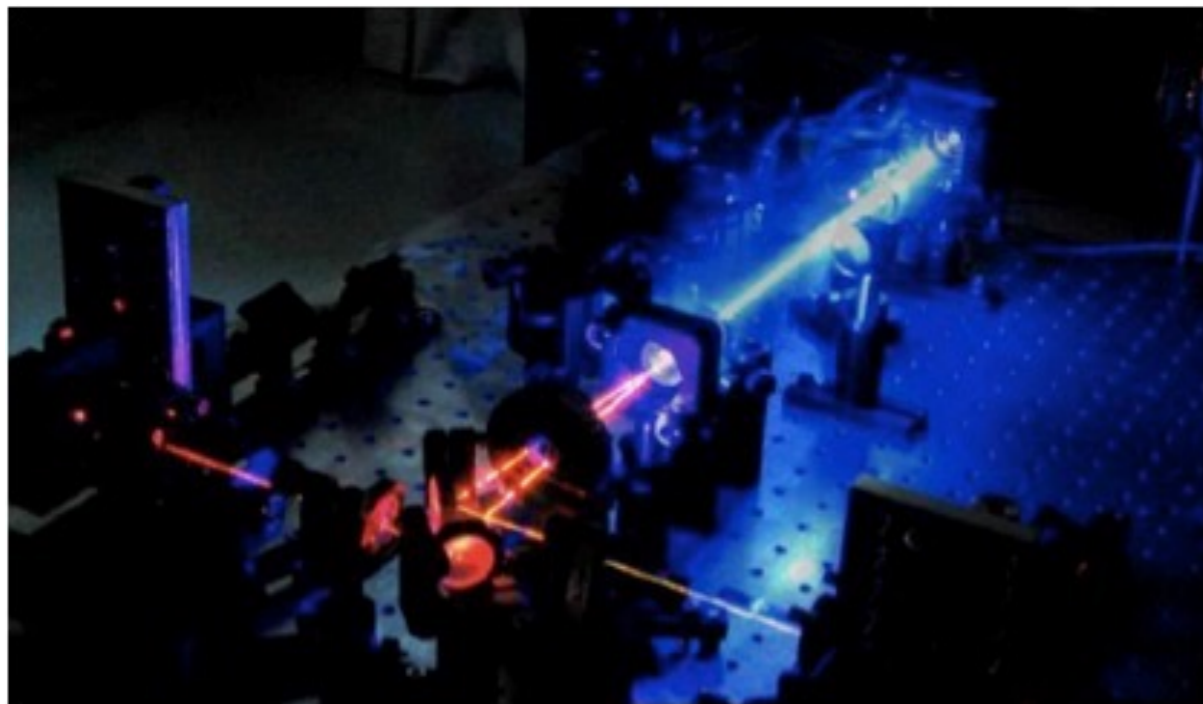


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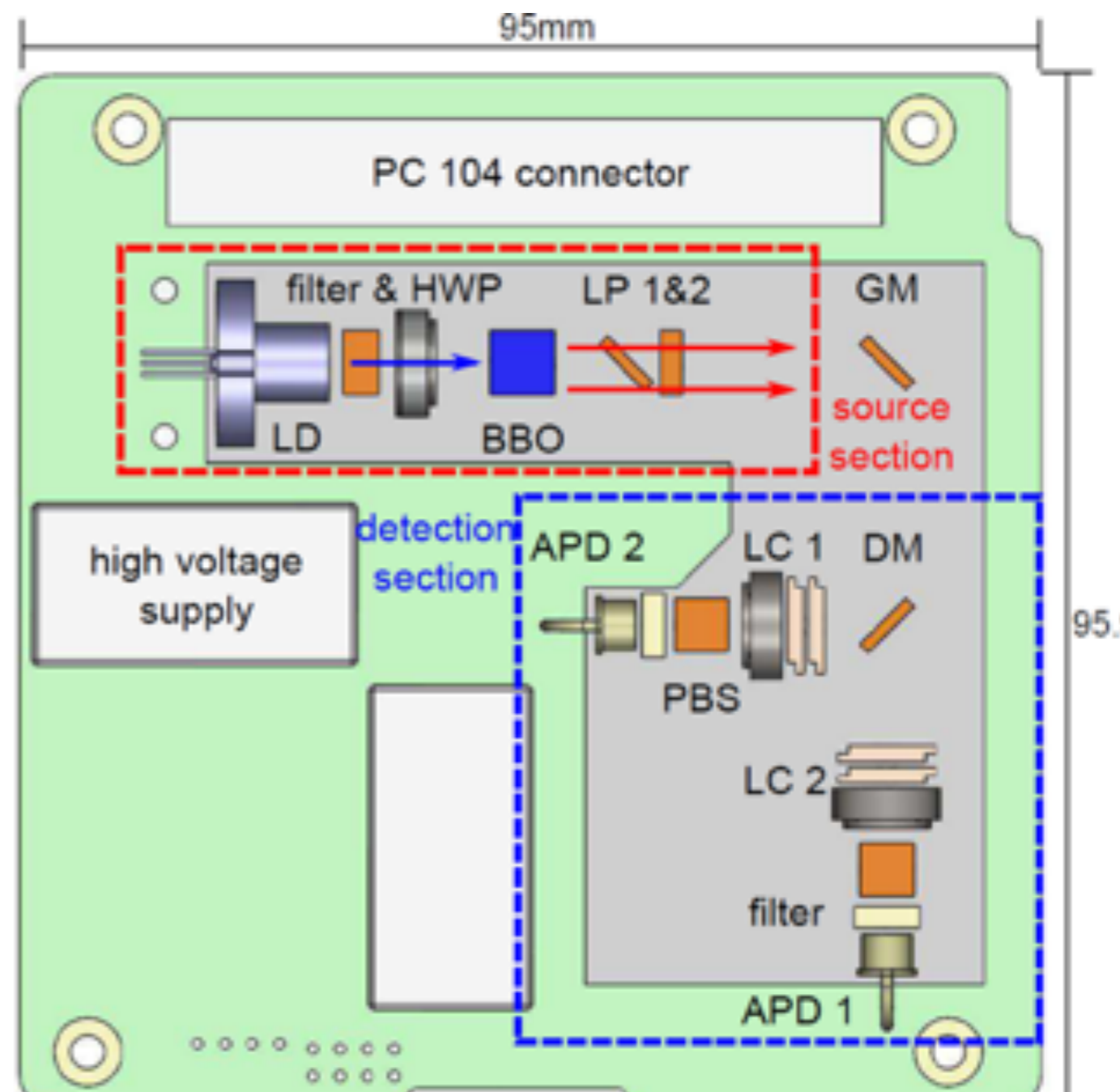

SPEQS



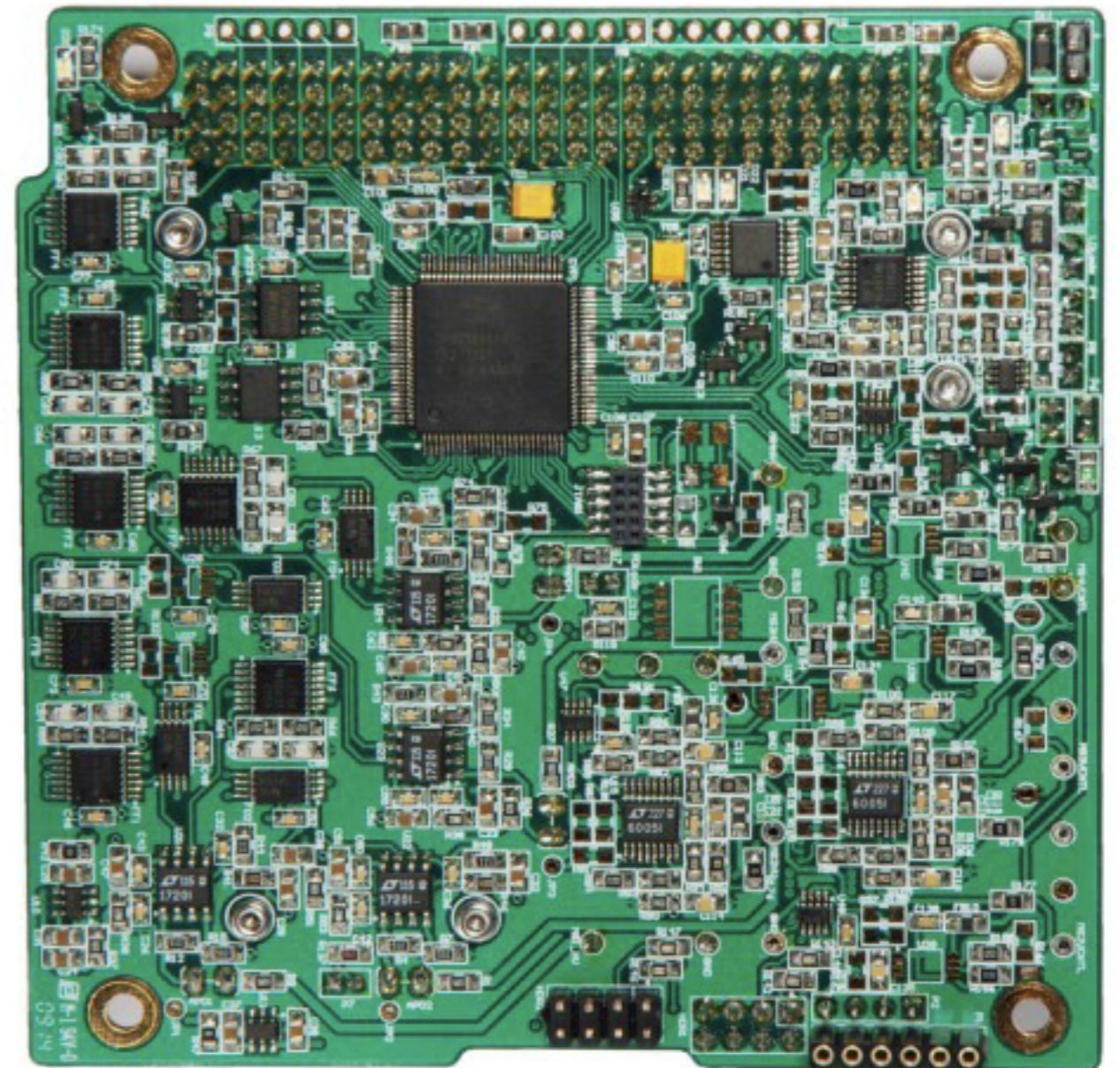
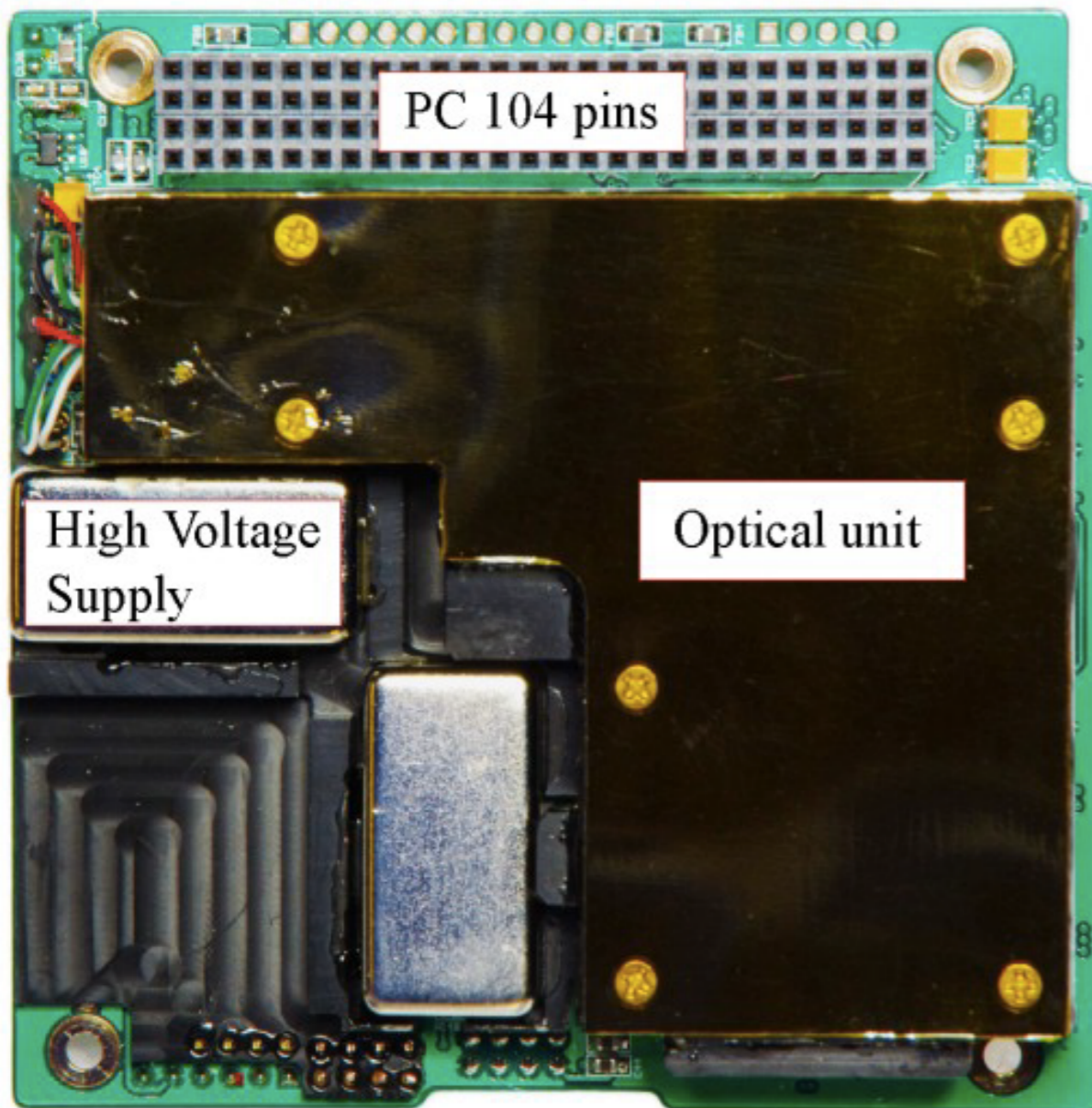
Entangled sources & Cubesats



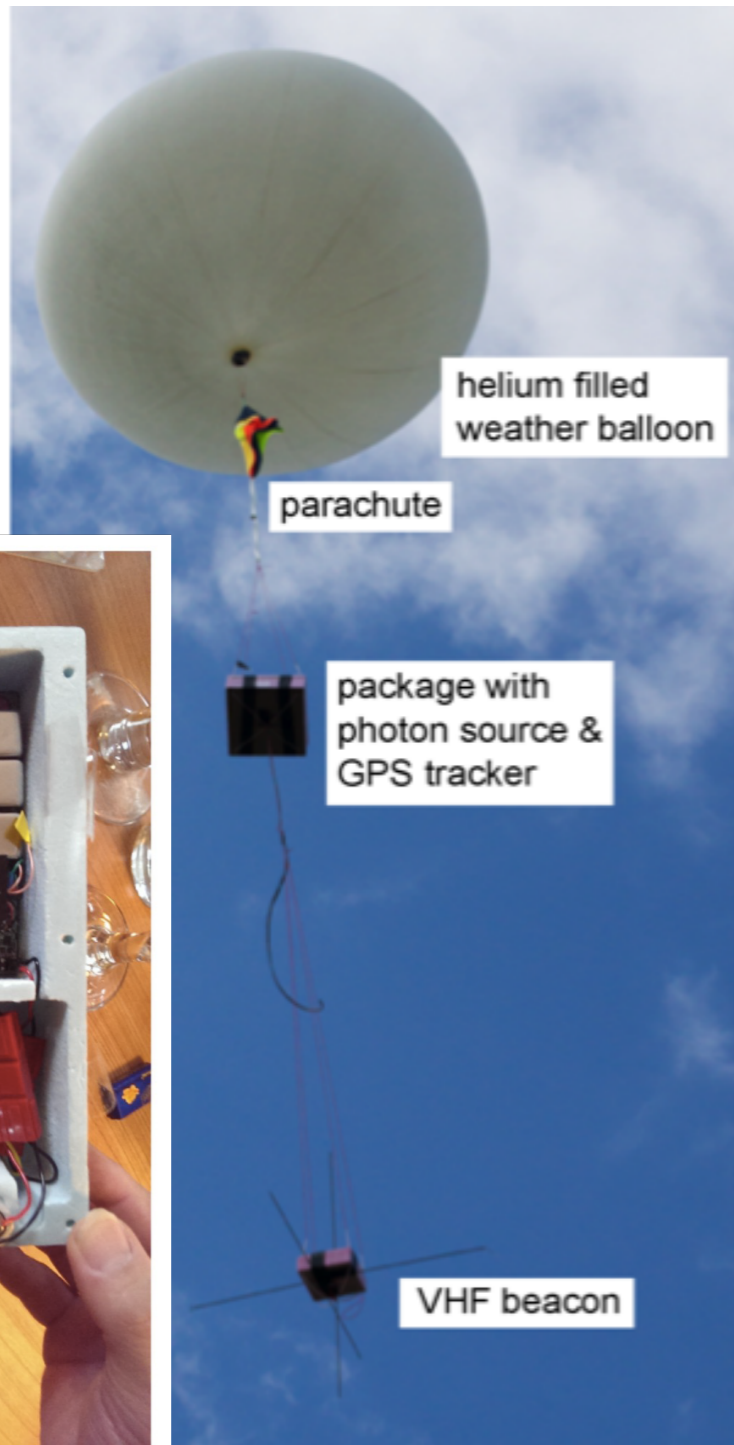
SWAP



The Small Source



SPEQS Space Heritage



2013

Scientific Reports, vol. 4,6366 (2014)

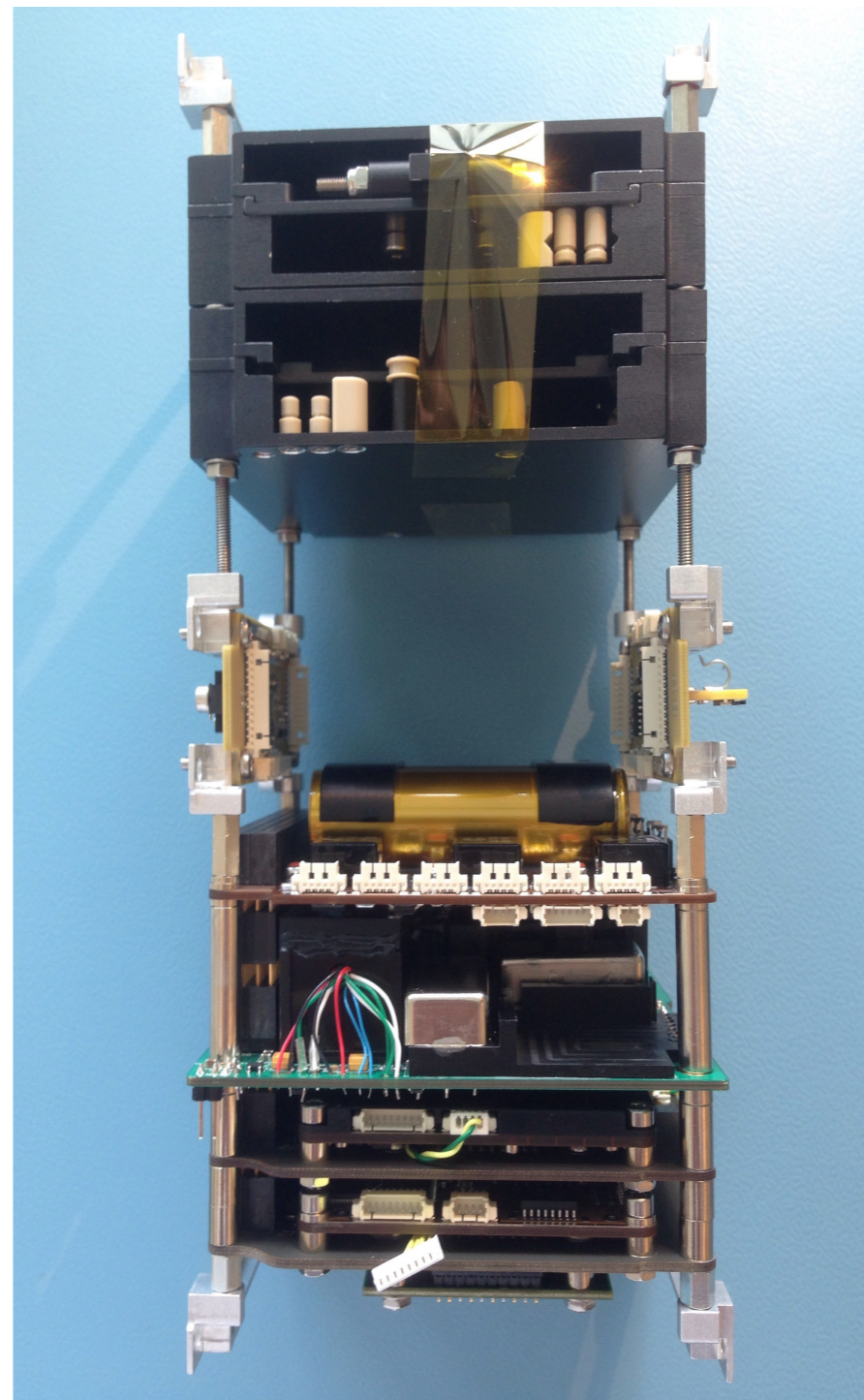
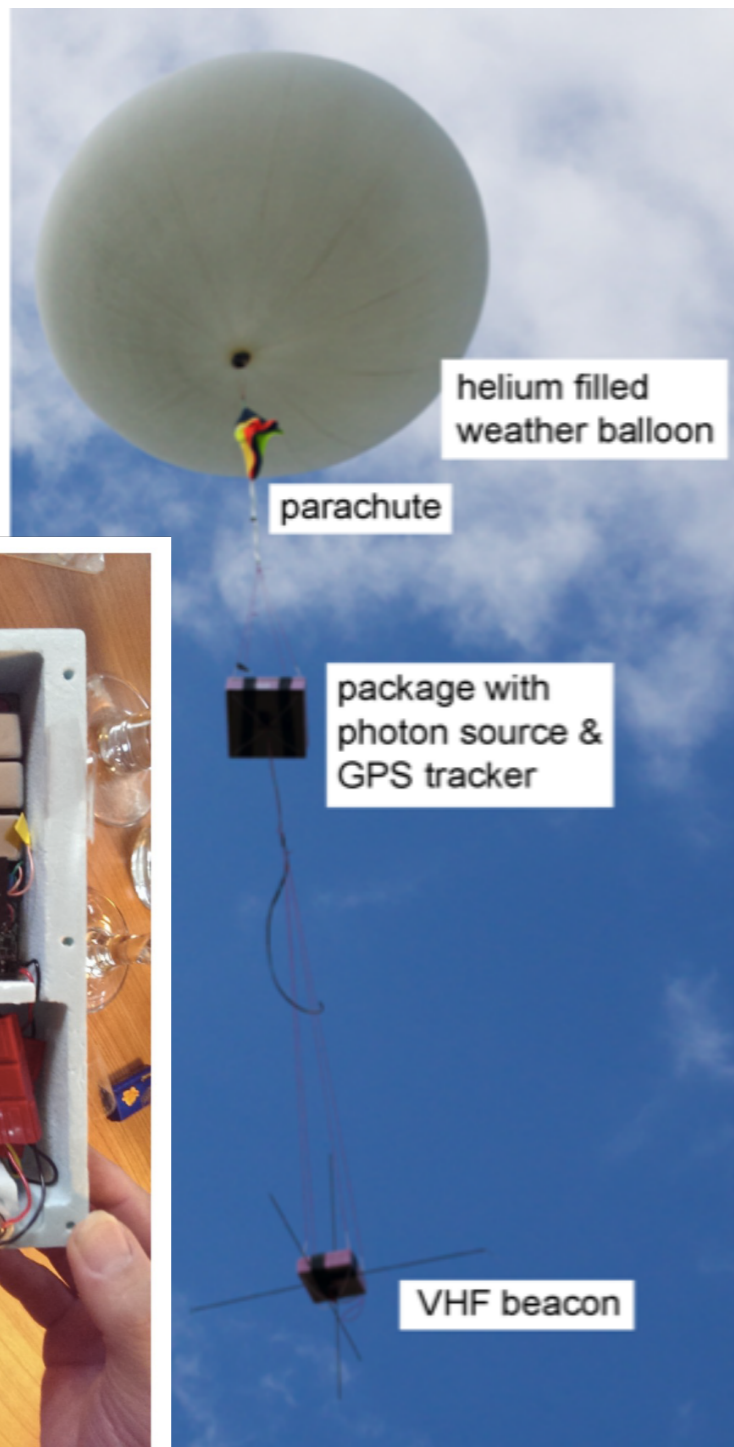


Photo courtesy of GomSpace APS

Sci. Rep. 6, 25603, 2016

SPEQS Space Heritage



2013

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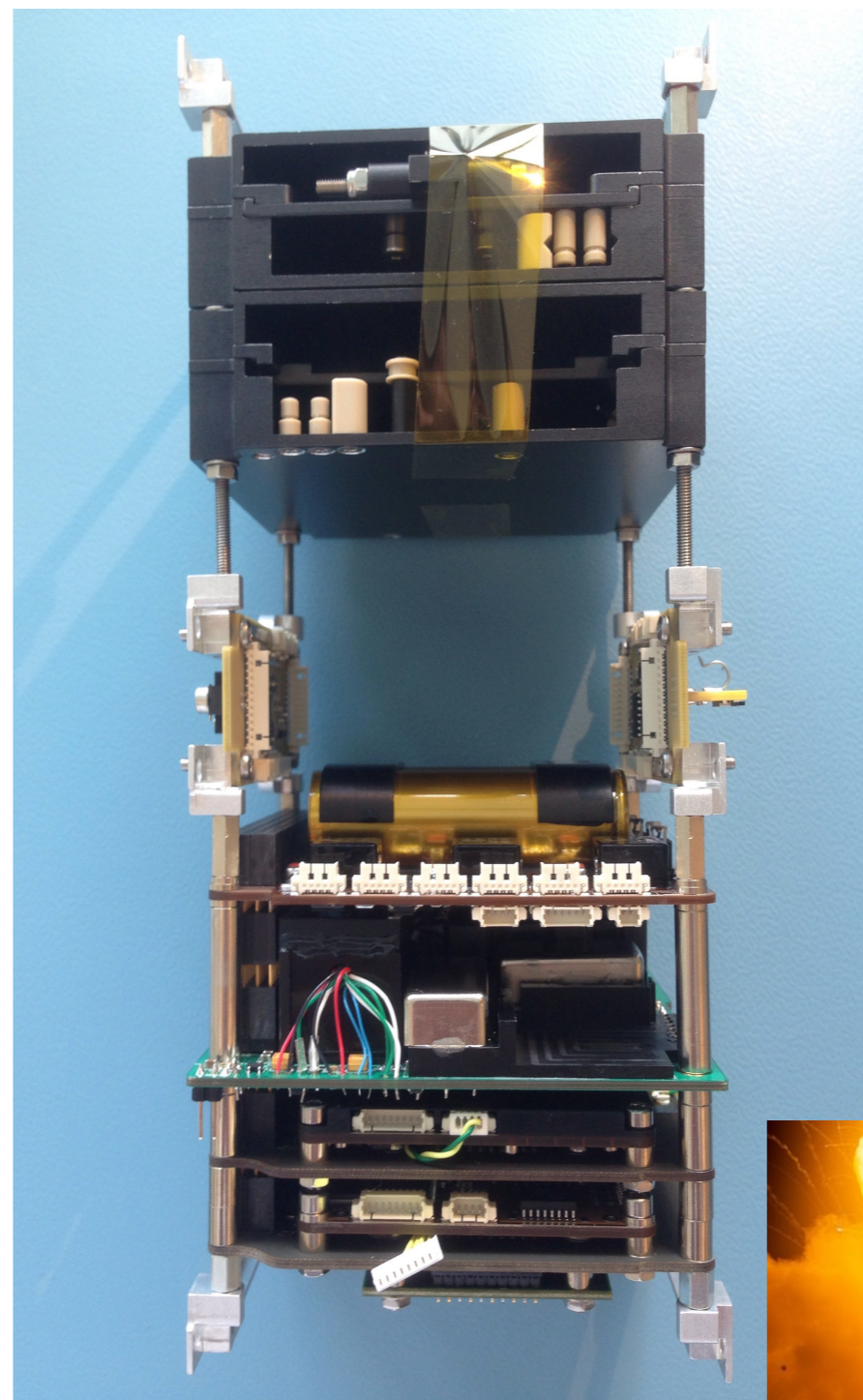
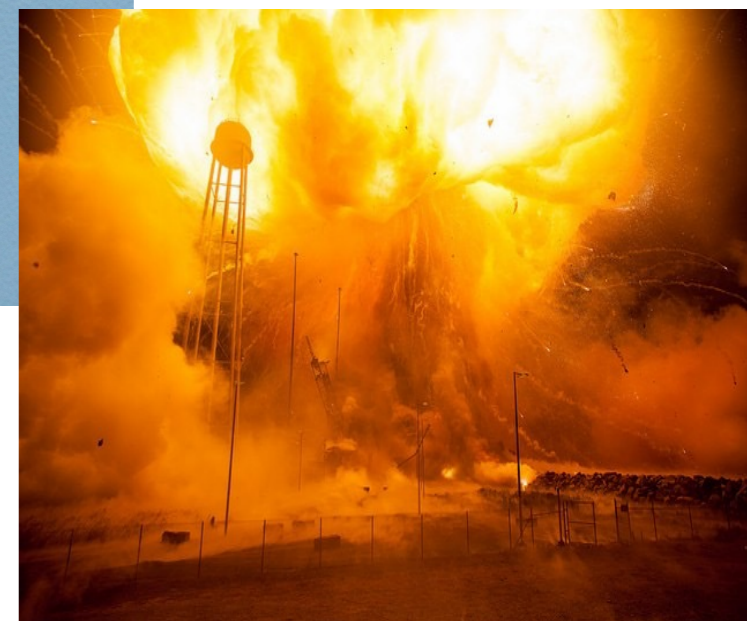
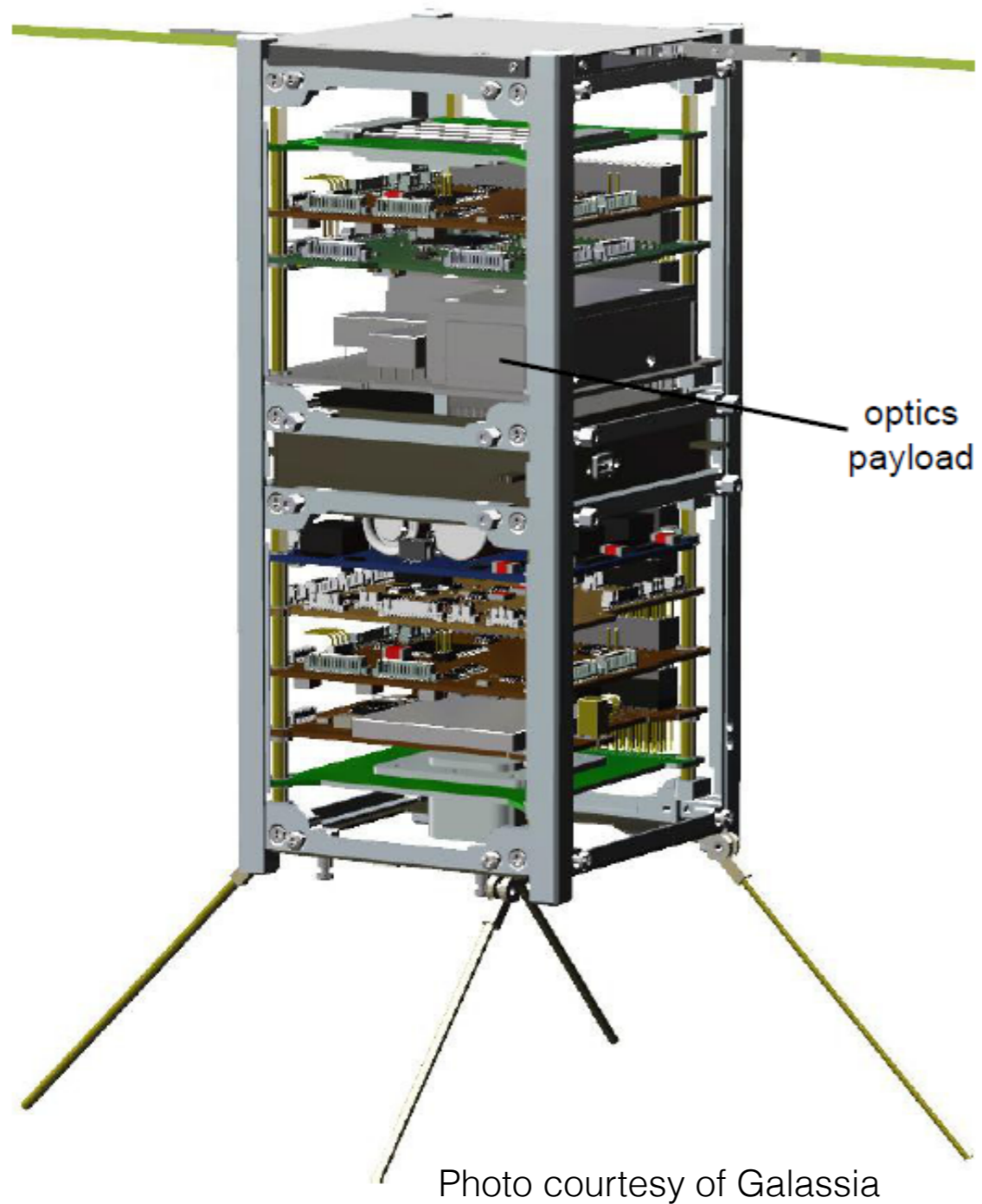


Photo courtesy of GomSpace APS

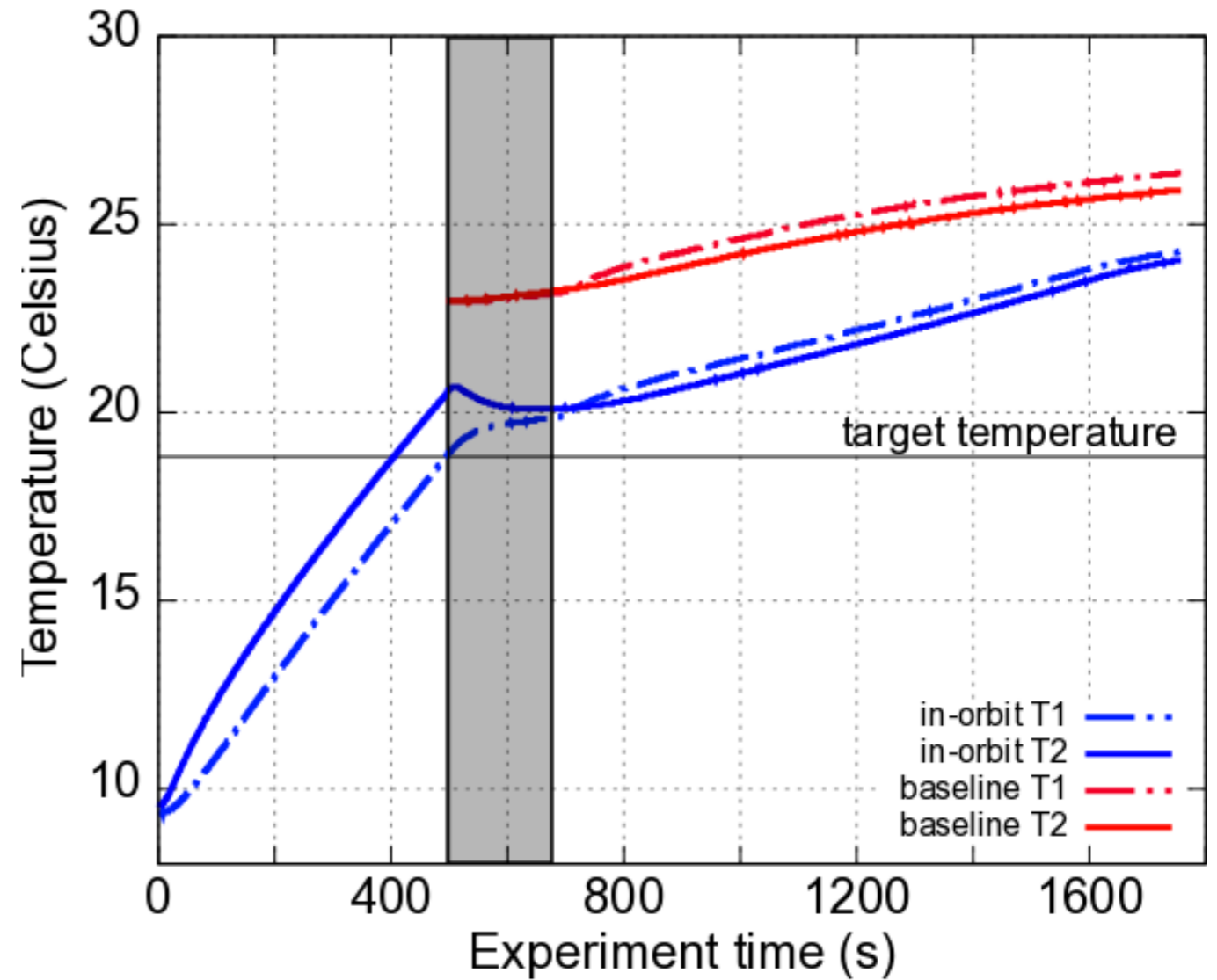
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Galassia Mission - 2015

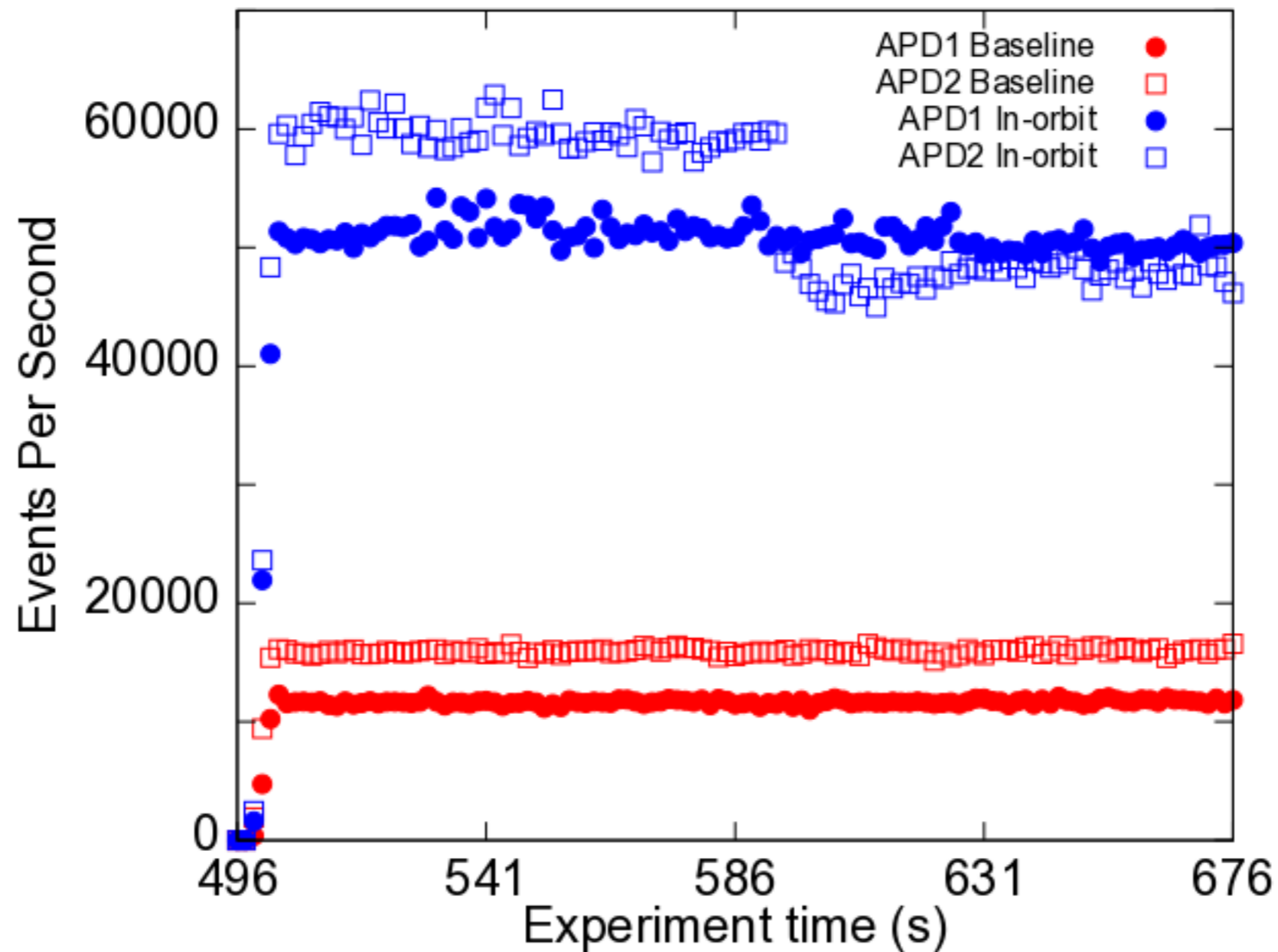


Galassia Mission - 2015

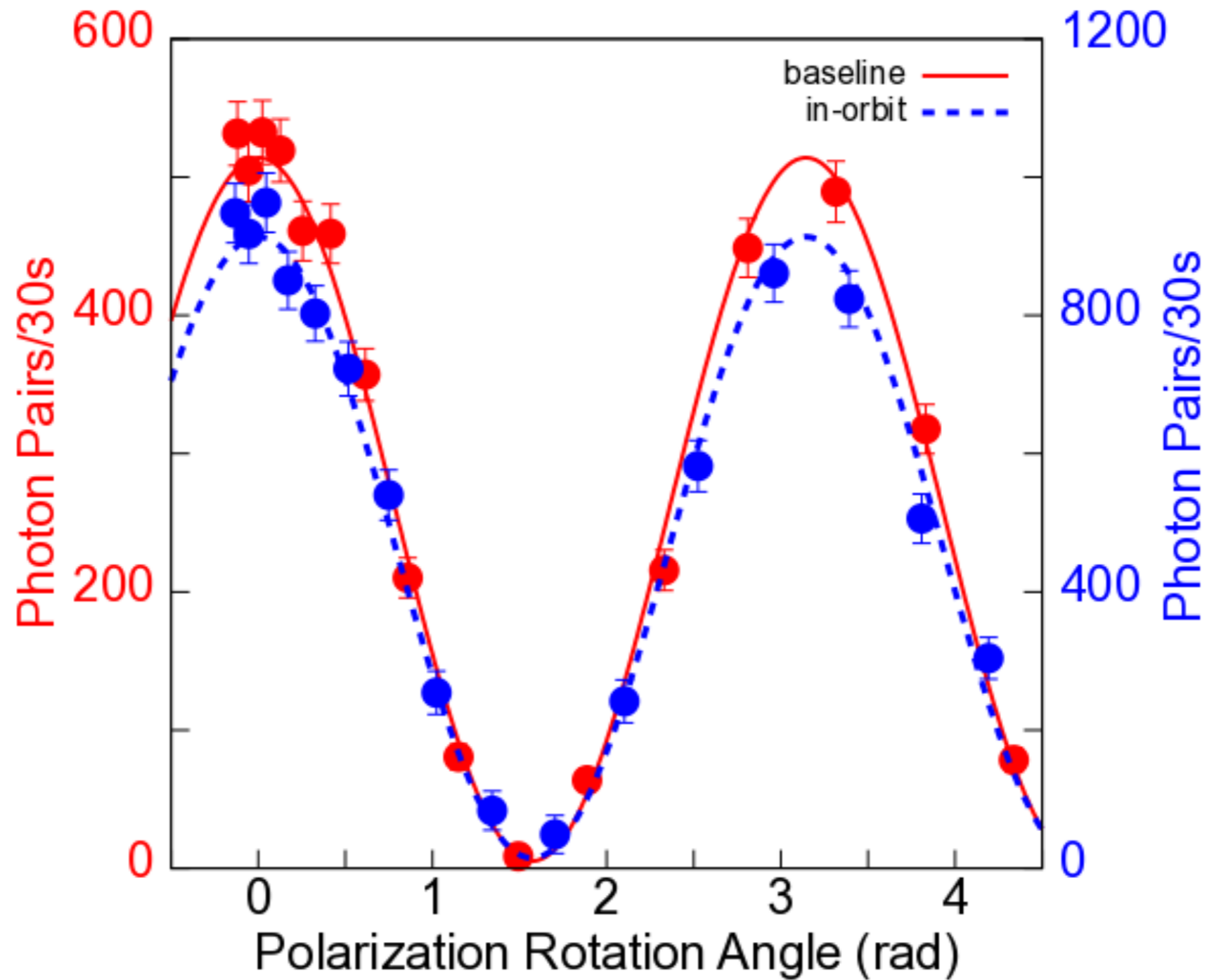


In orbit SPEQS performance

Detector dark counts



In orbit correlations



SPEQS road map

	SPEQS-1 CS	<i>SPEQS-1</i>	<i>SPEQS-2</i>
Brightness	3,000	<i>3,000</i>	<i>1,000,000</i>
Visibility	96%	<i>96%</i>	<i>99%</i>
Efficiency	1%	<i>1%</i>	<i>20 %</i>
Power (peak)	2.5W	<i>2.5W</i>	<i>10W</i>
Mass	0.3kg	<i>0.5kg</i>	<i>1kg</i>
Volume	0.25U	<i>0.5U</i>	<i>0.75U</i>

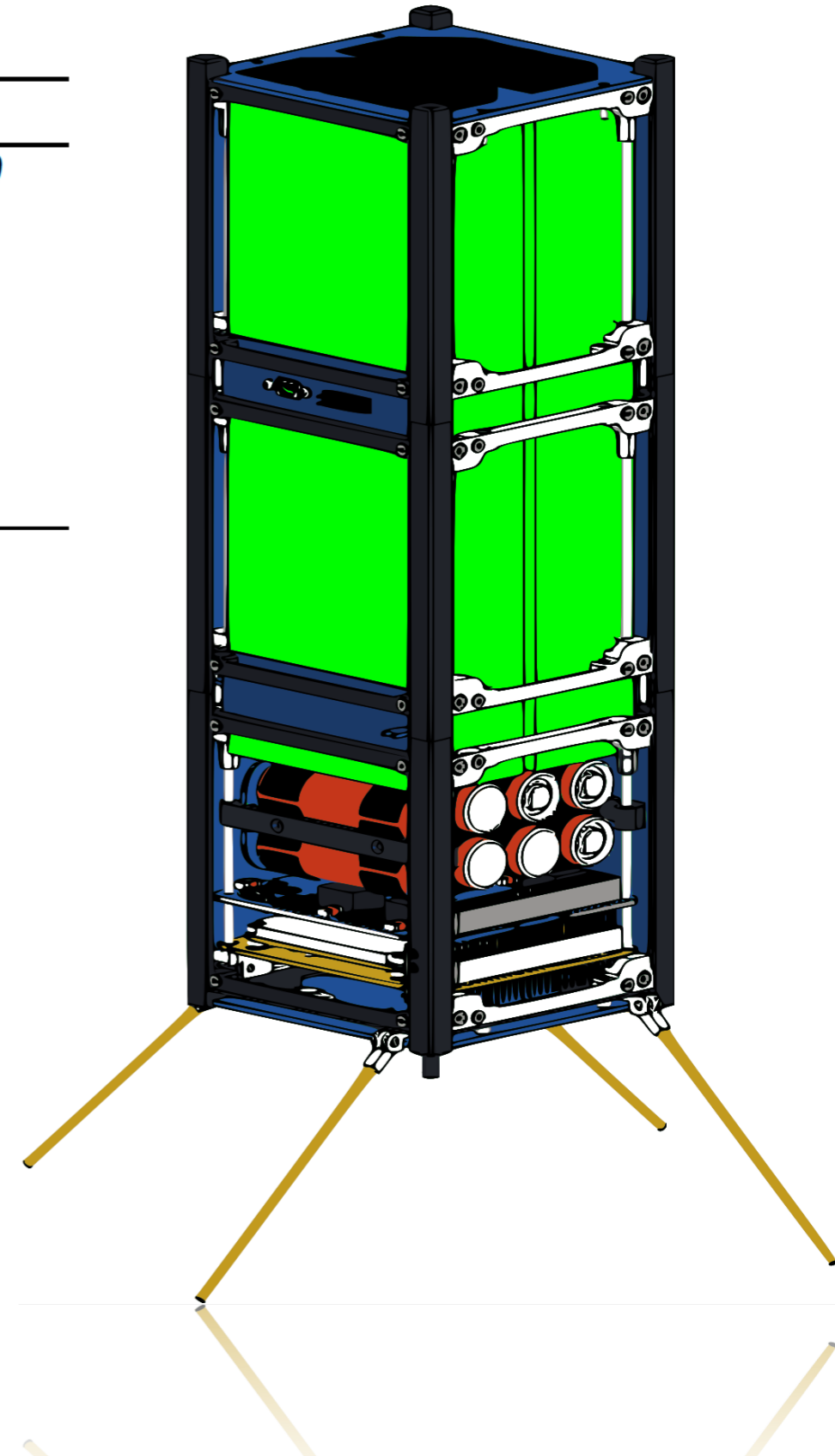
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Done

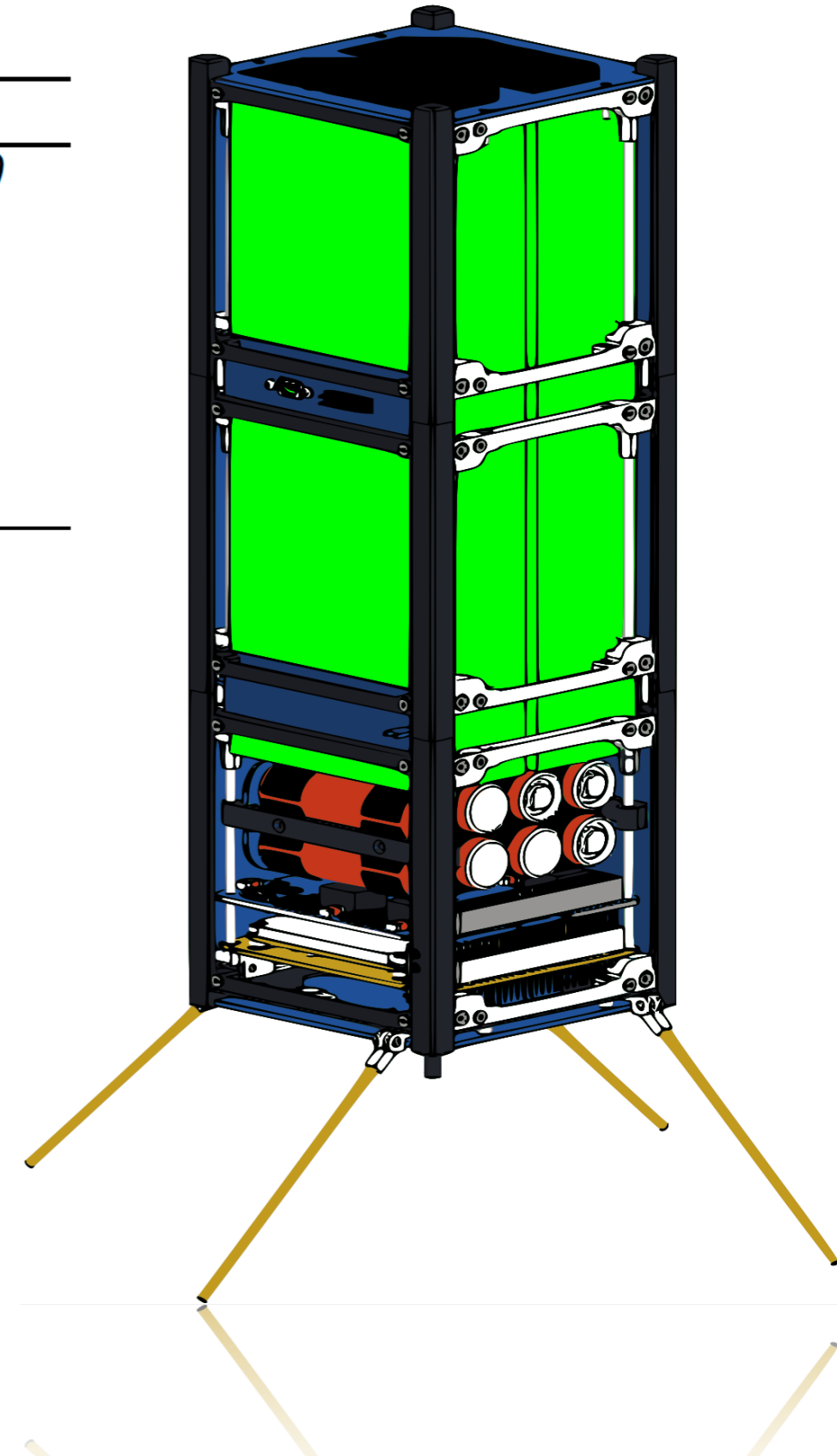


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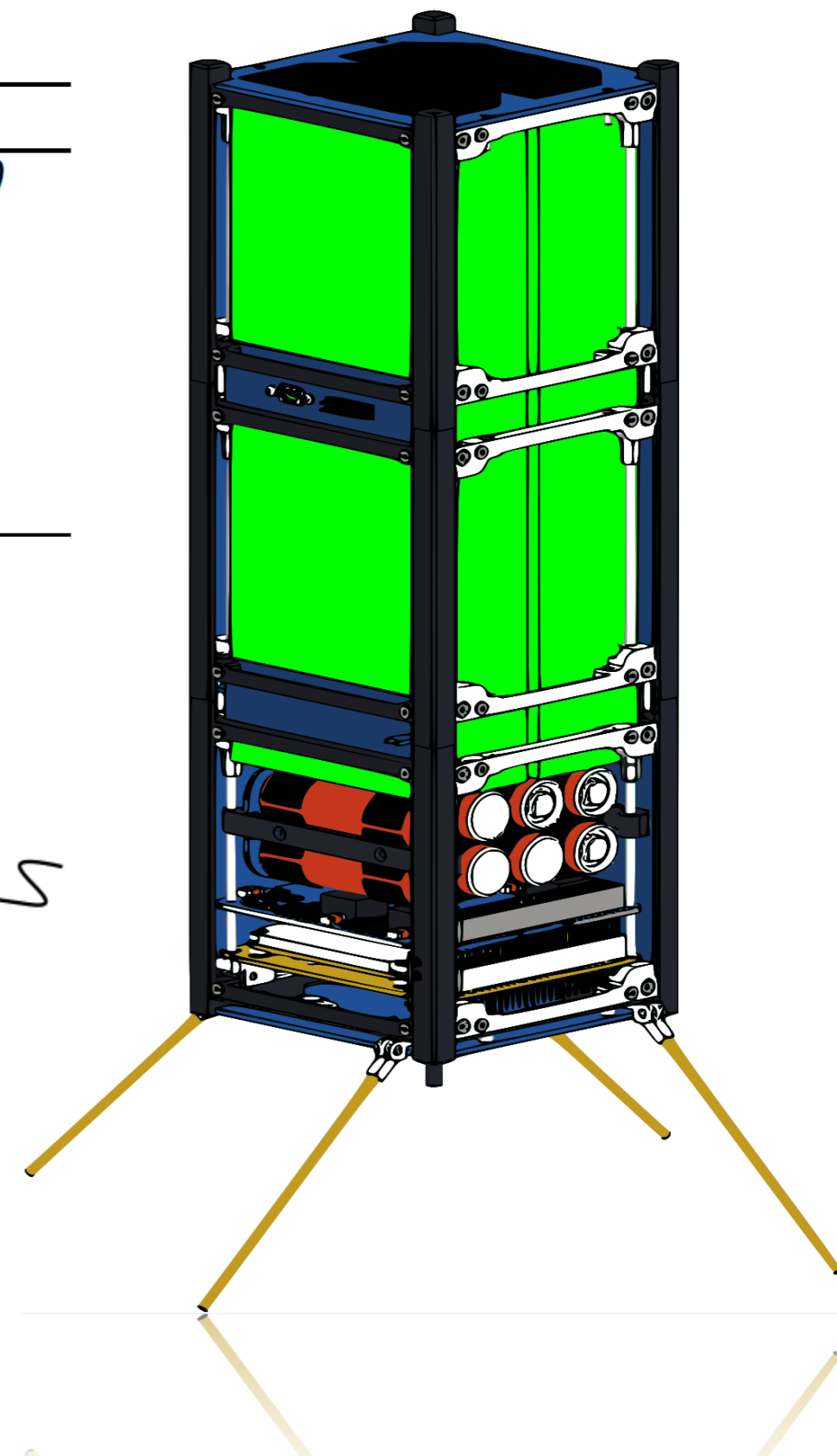
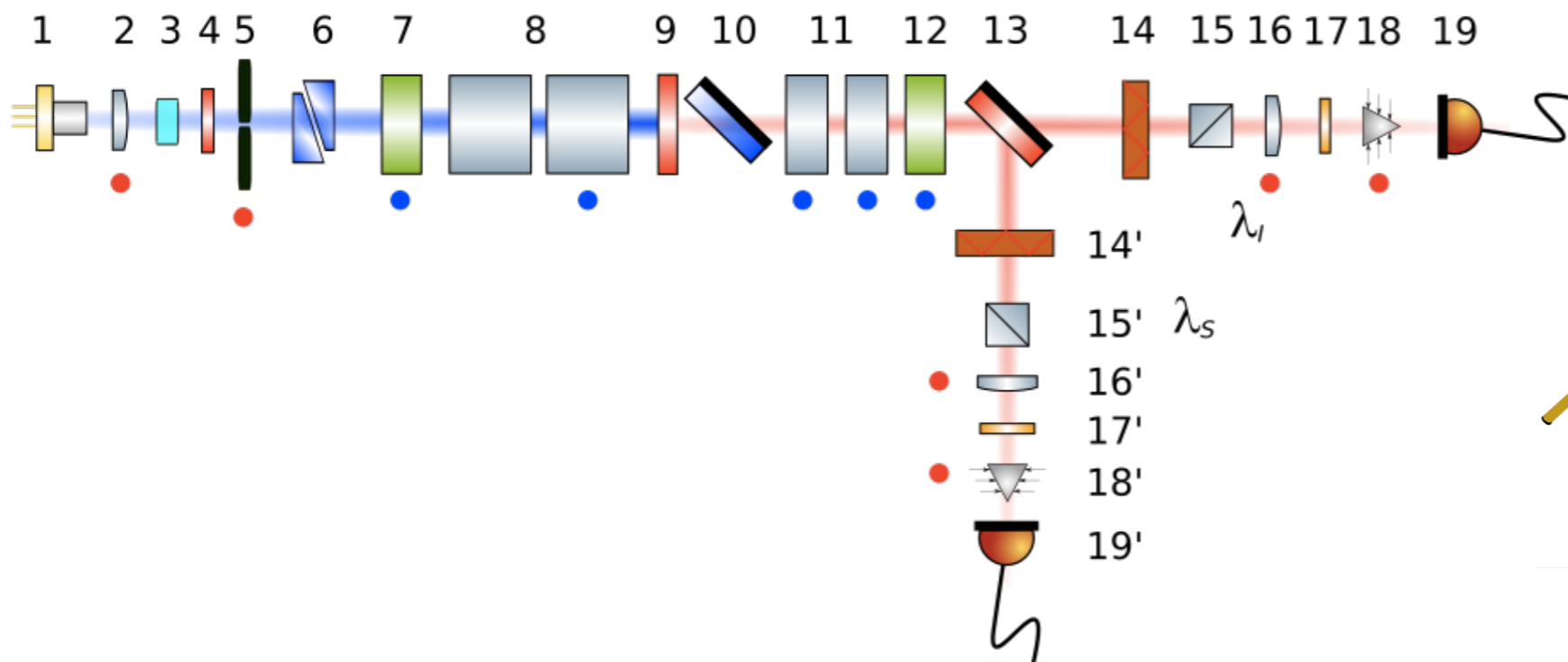


SPEQS road map



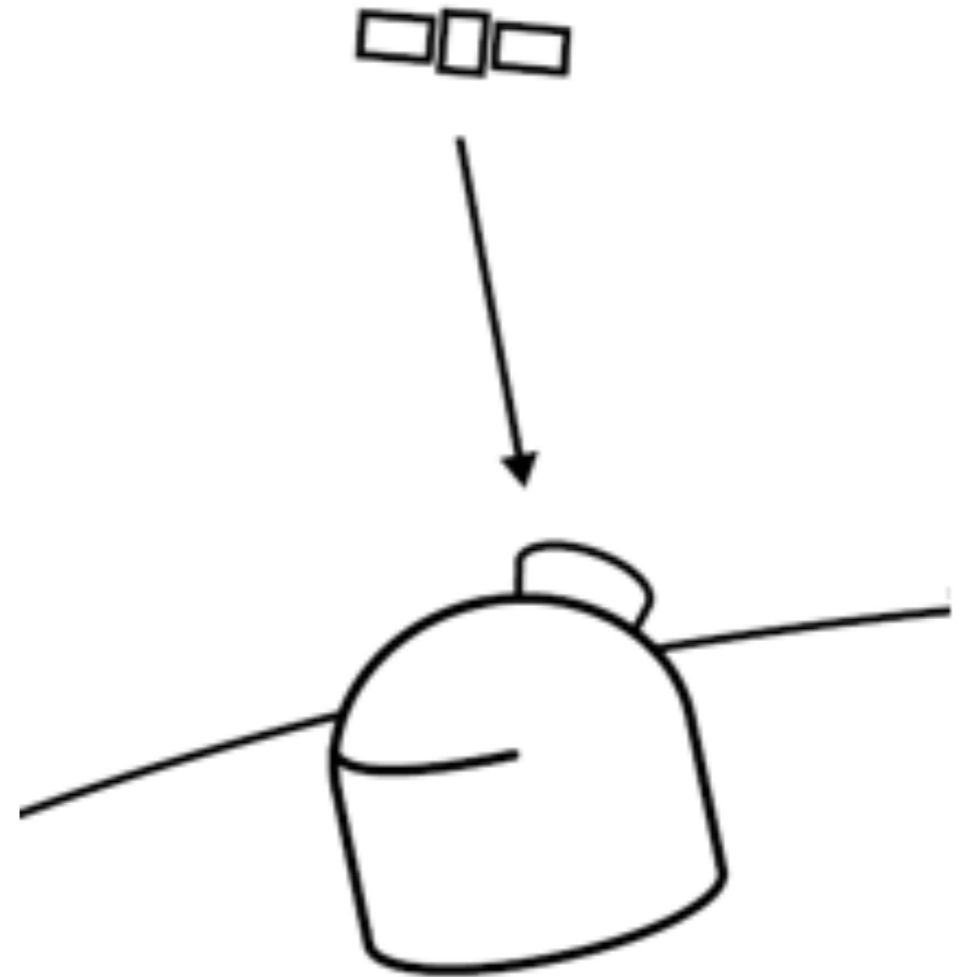
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Done



Space based QKD demo

- Optical ground stations
- micro radian ADCS
- Optical beam steering
- High accuracy position knowledge
- satellite to satellite QKD demo partners



Welcome
Collaborators

**NATIONAL
RESEARCH
FOUNDATION
PRIME MINISTER'S OFFICE
SINGAPORE**



**Ministry of Education
SINGAPORE**

Thank you

<https://sites.google.com/site/phylej/contact-us>

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