SWIMSat: Science Weather and Meteor Impact Monitoring using a Low-Cost 6U CubeSat

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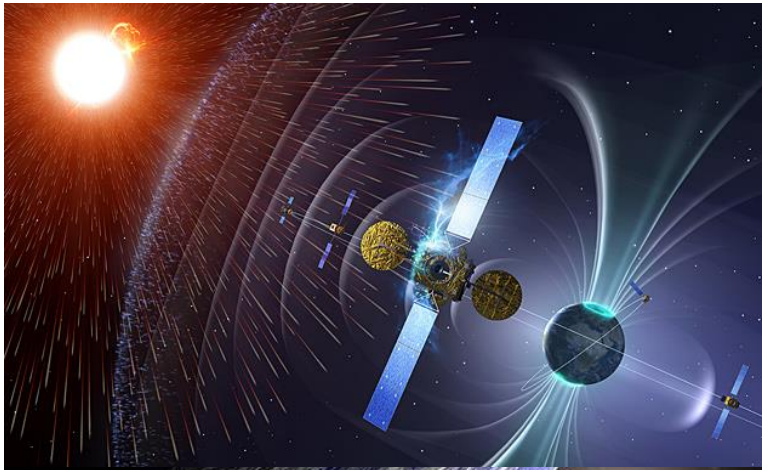
Presentation Outline

- Introduction to Space Hazards
  - Coronal Mass Ejections
  - Meteor Impacts
- Mission Overview
- Spacecraft Design Overview
- Challenges
- Project Future



Coronal Mass Ejections

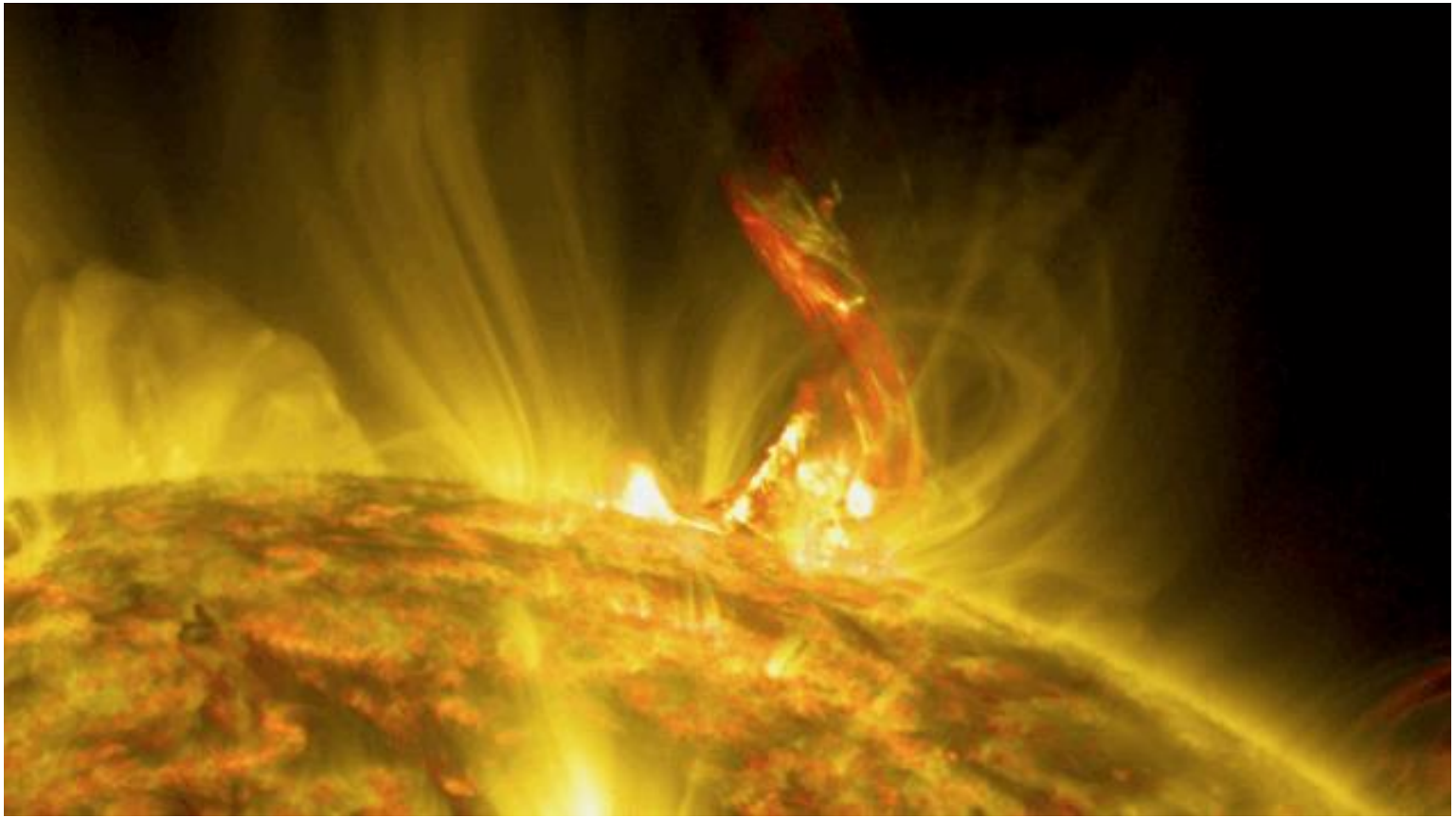


Photo Credit: http://giphy.com/gifs/space-fire-sun-RCk2tX2HLdzX2

Coronal Mass Ejections

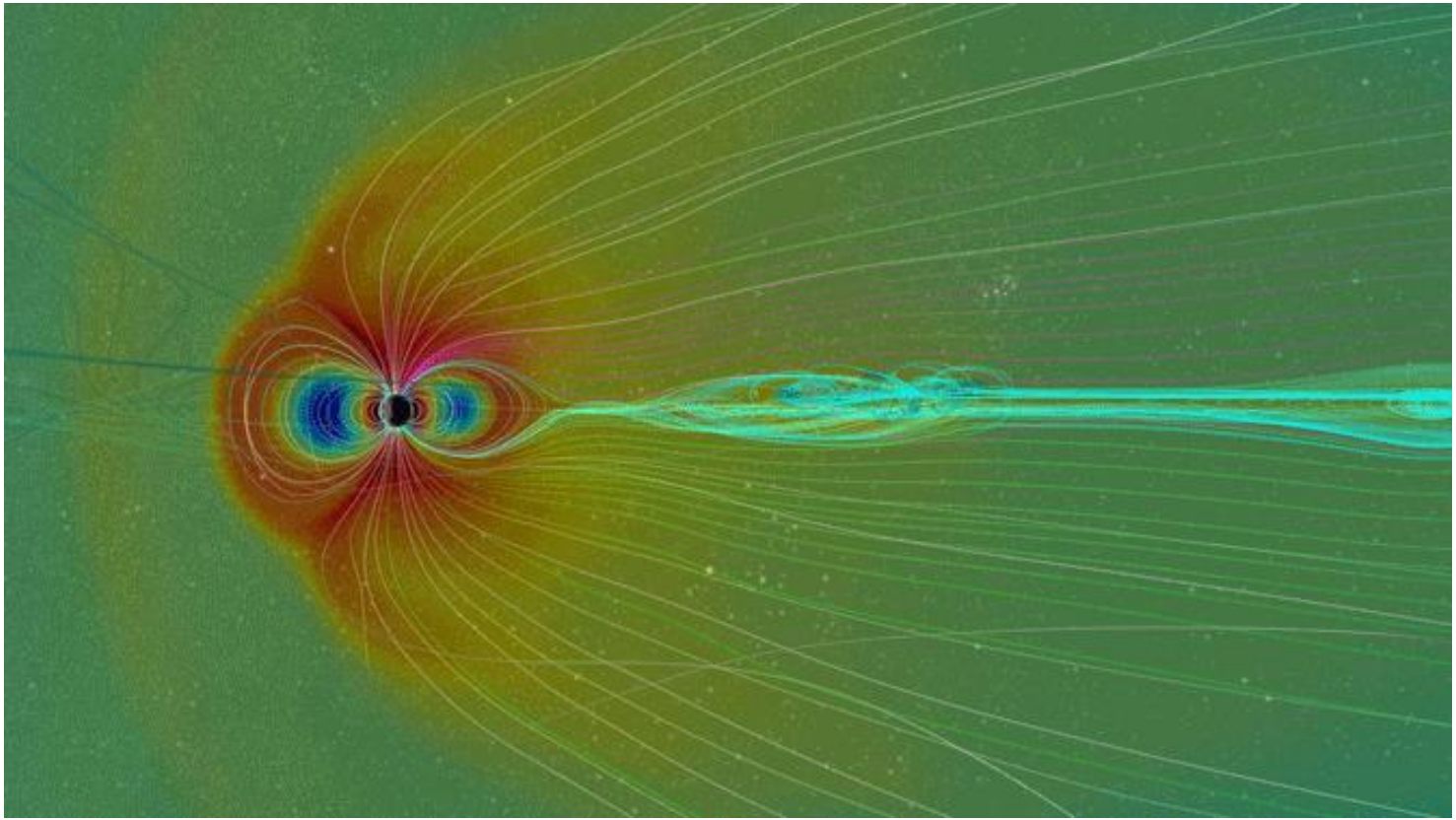


Photo Credit: https://svs.gsfc.nasa.gov/11660

Meteor Impacts

Chelyabinsk, 2013

Meteor Impacts

SWIMsat Network Goals

- Meteor flux and distribution
- Publicly released data

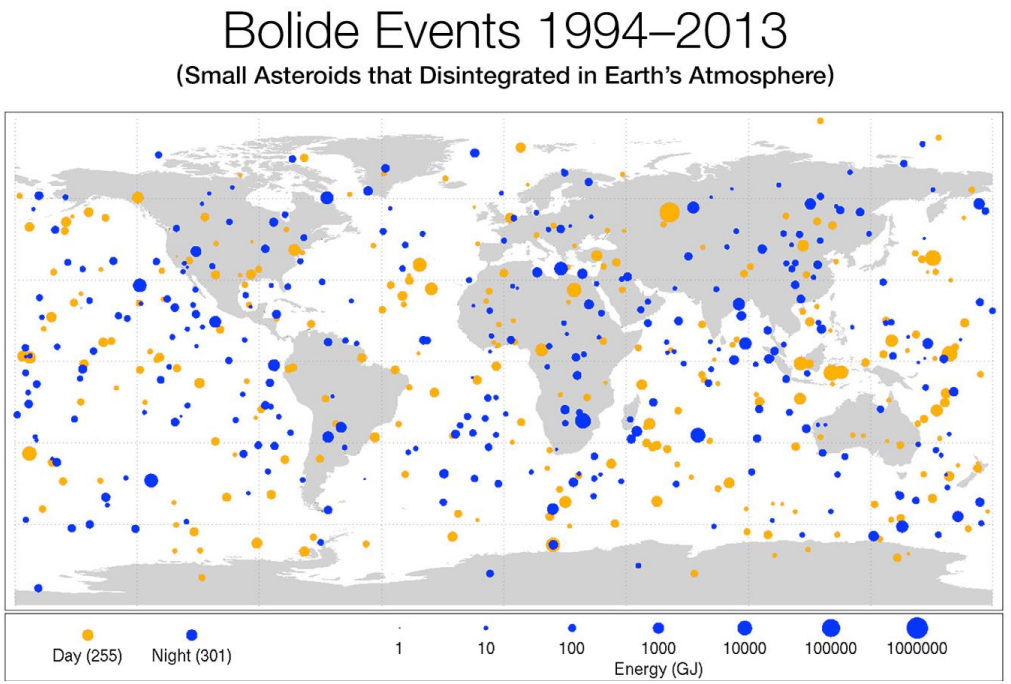


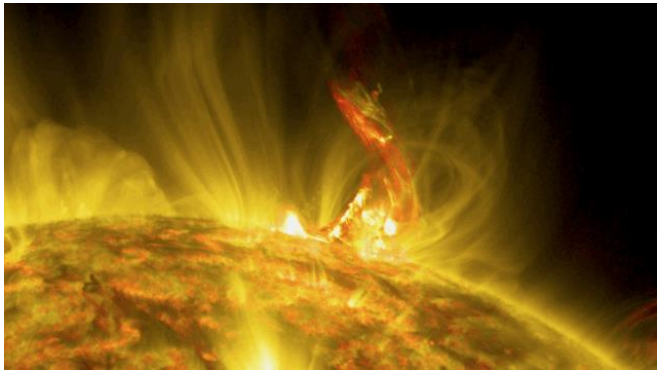
Photo Credit: http://www.jpl.nasa.gov/news/news.php?release=2014-397

Goals

Dedicated satellite network for space hazards:

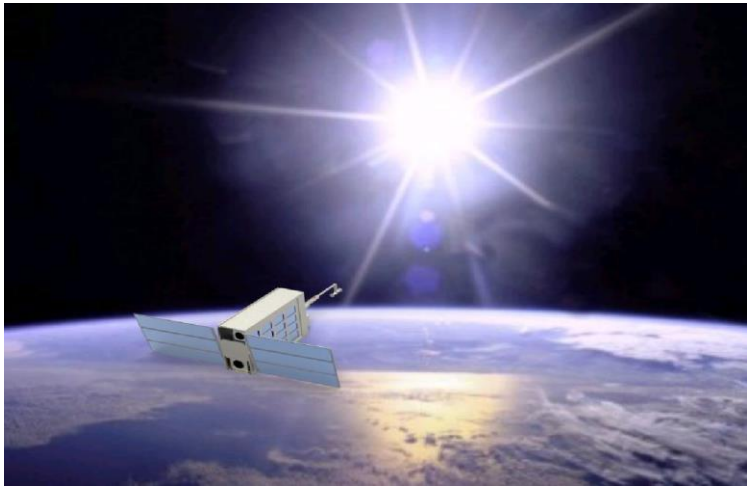
- Real-time monitoring
- Provide alerts/warnings
- Forecasting*

*Provide minutes to hours forewarning



Mission Overview

- Low-cost 6U (36 x 24 x 12 cm) CubeSat
- Near continuous, autonomous monitoring
- Geostationary Orbit (GEO)
- 2 year mission



Mission Success

Success Criteria

- Successful detection of an M class solar flare event

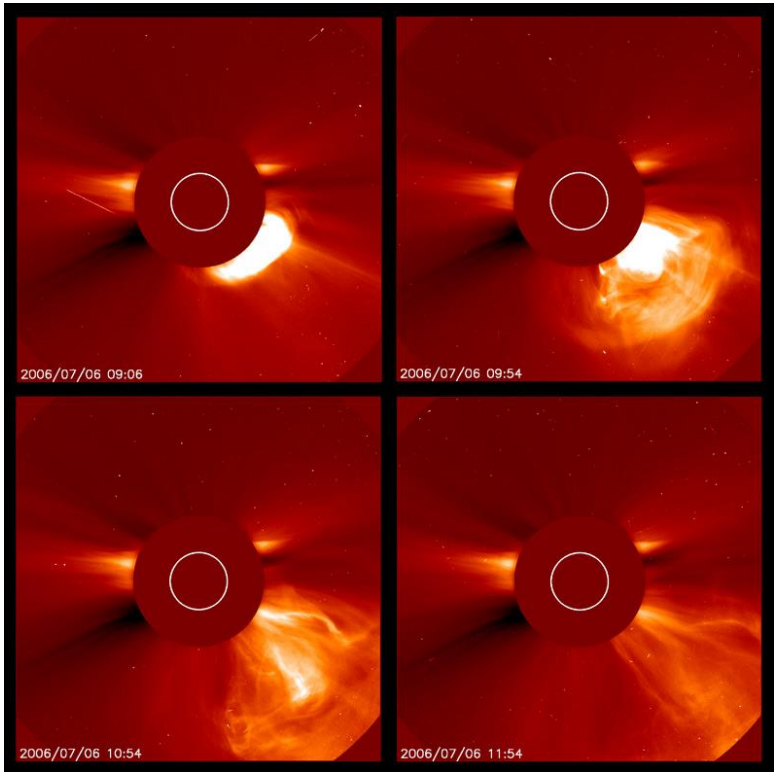
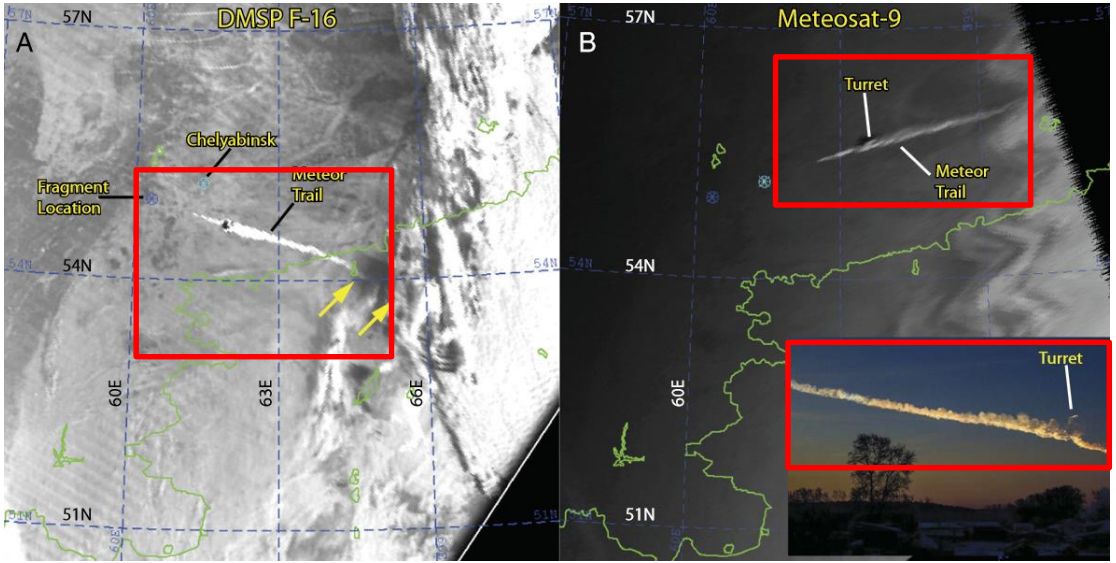


Image Credit: NASA/ESA

Mission Success

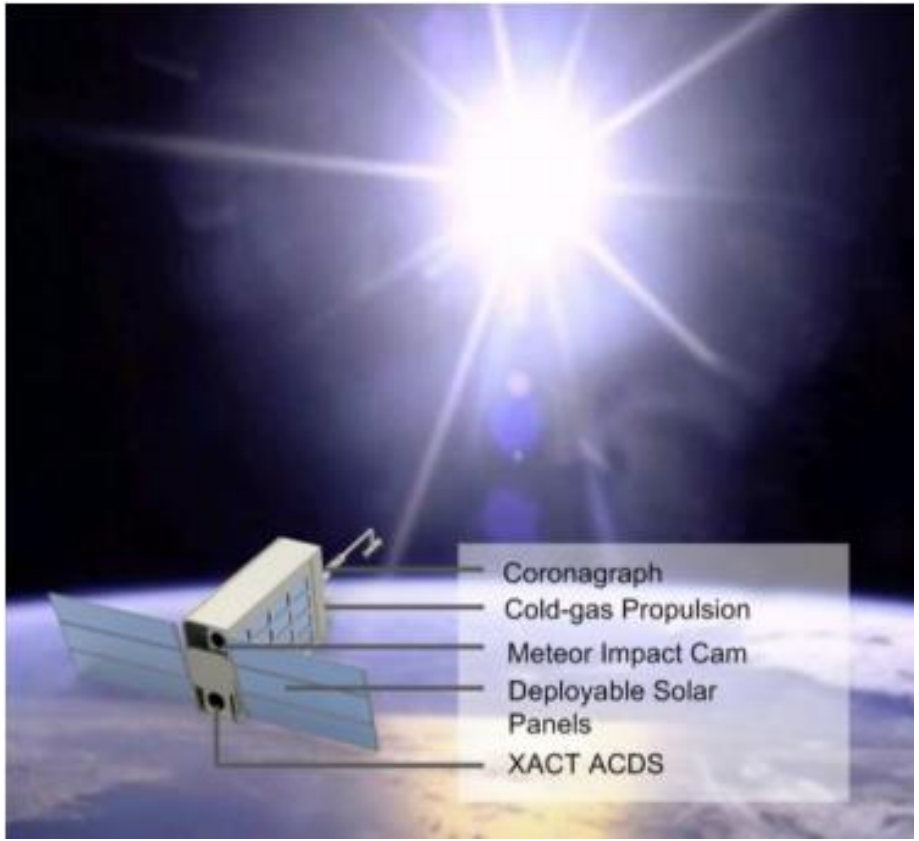
Success Criteria

– Successful detection of at least one 0.1 kT or larger airburst



[1] Earth-viewing satellite perspectives on the Chelyabinsk meteor event: Steven D. Miller, William C. Straka, III, A. Scott Bachmeier, Timothy J. Schmit, Philip T. Partain, and Yoo-Jeong Noh

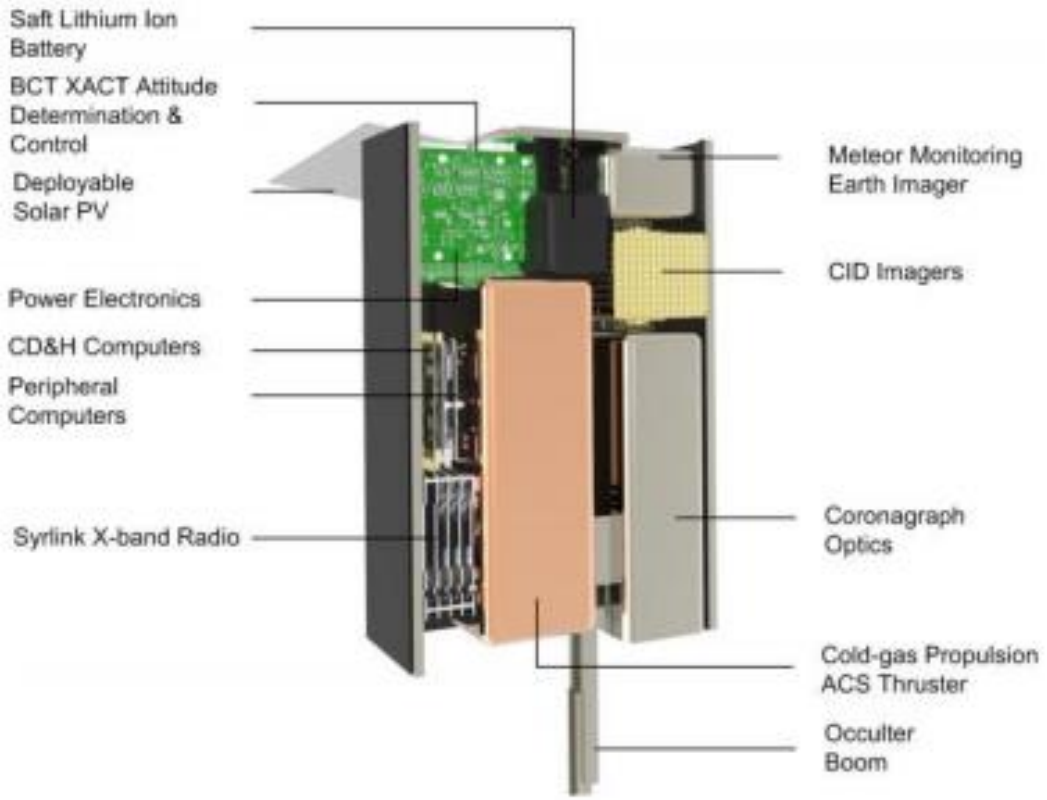
SWIMSat Spacecraft



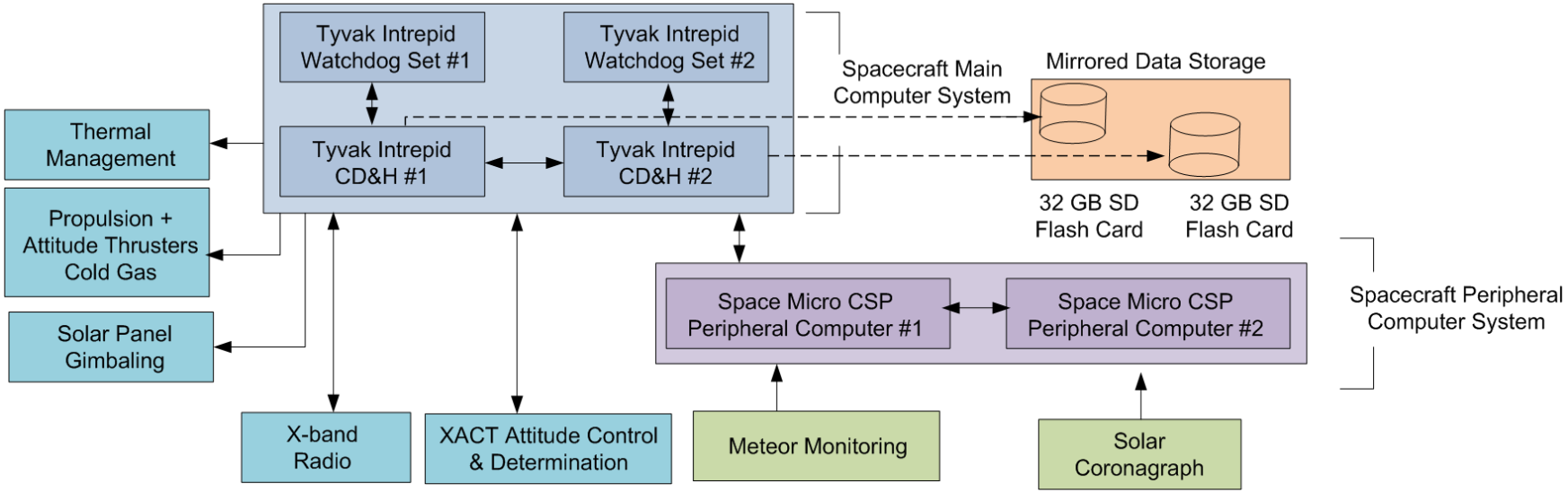
Design

- Typical 6U bus/ components
- Instruments
  1) Coronagraph
  2) Meteor camera

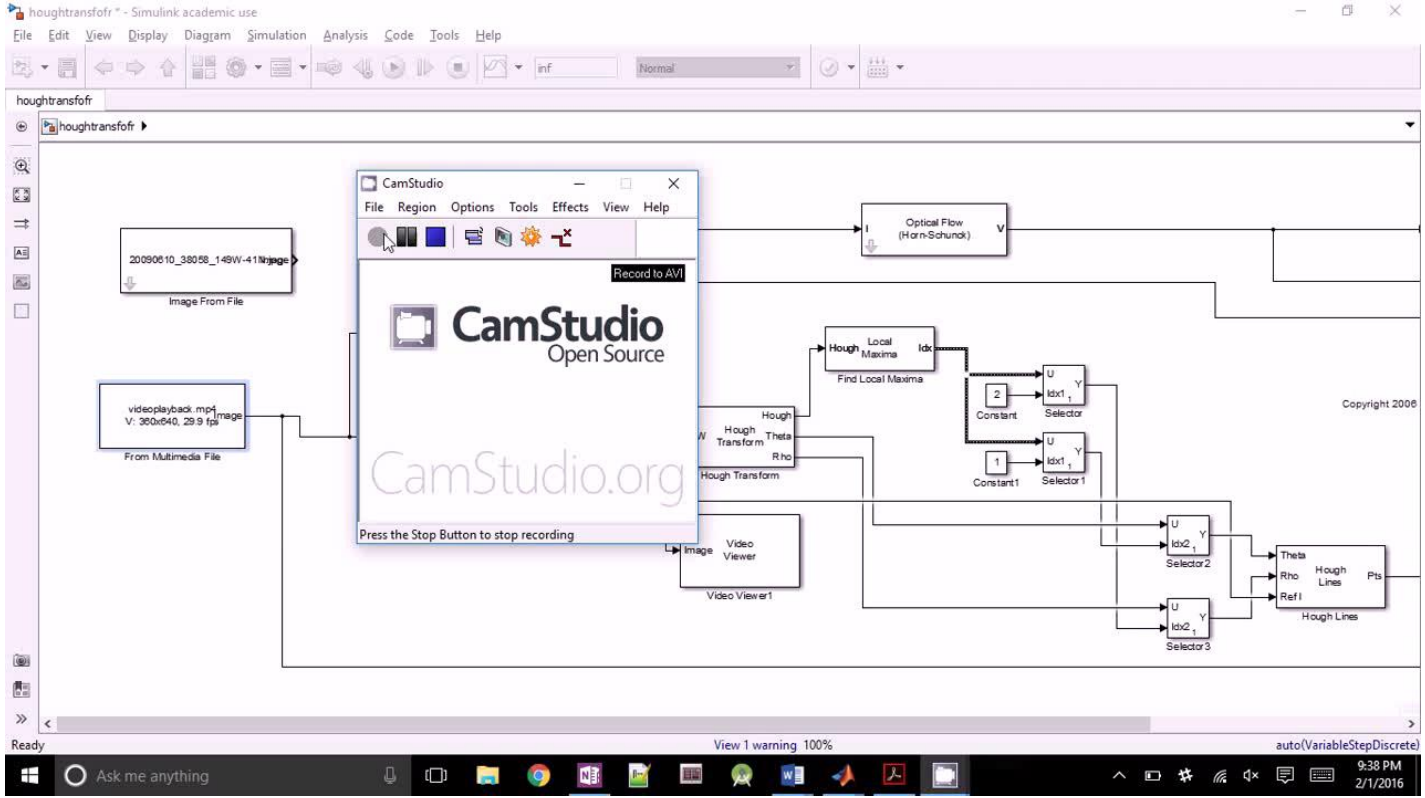
SWIMSat Spacecraft



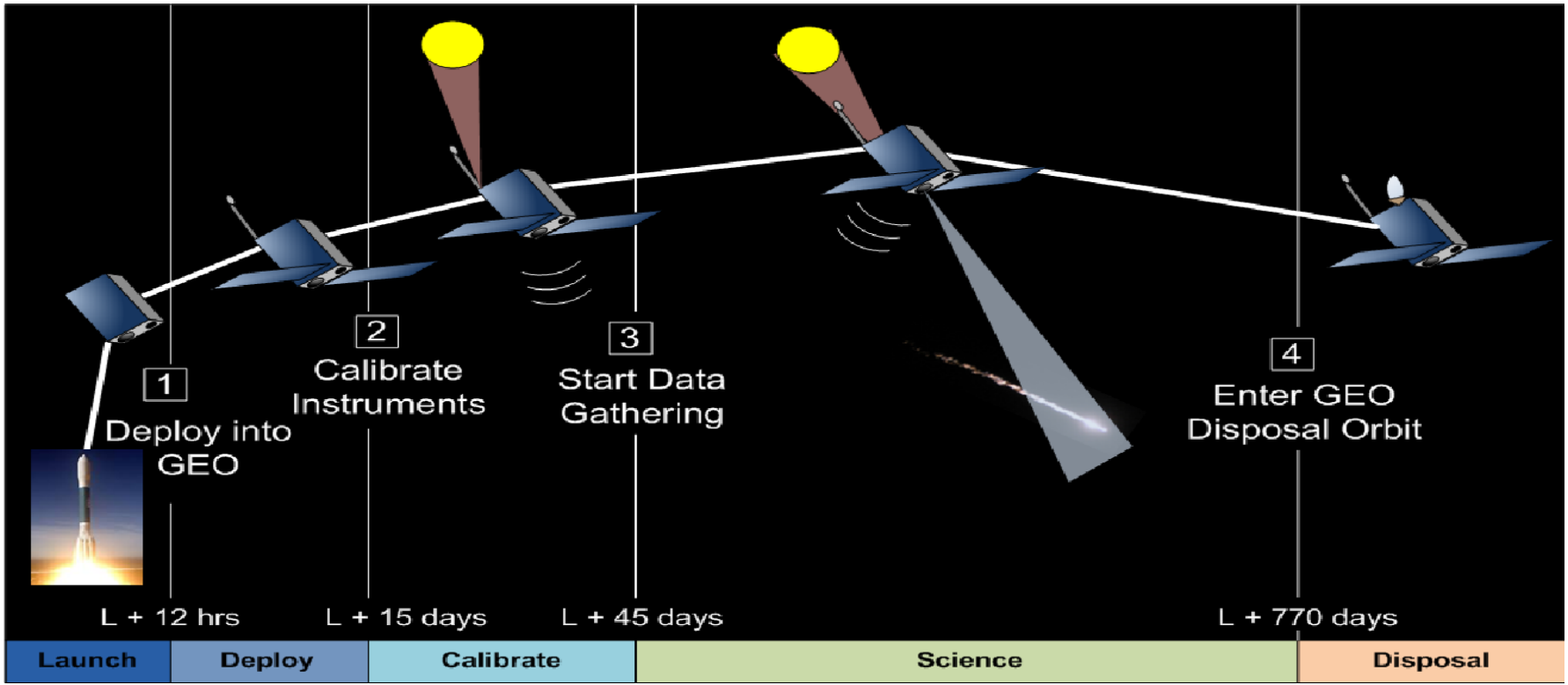
Hardware Architecture



On Board Algorithm



SWIMsat Conops



MSat Alternative

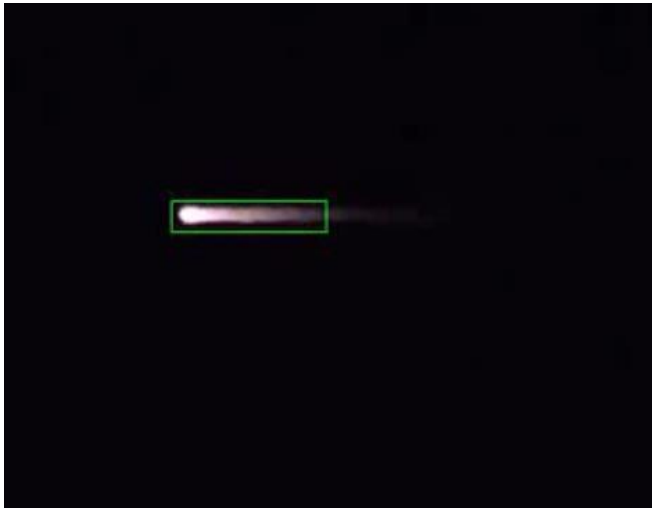
Mission	SWIMSat	MSat
Size	6U	3U
Number of Sats	1	1-2
Orbit	GEO	LEO
Science	CMEs, Meteors	Meteors
Earth FOV	Disk (5000 km)	Swath (1000 km)
Instruments	2	1
Propulsion	Yes	No

Challenges

- Low TRL
- Operation in GEO
- In-house development
- Meteor detection algorithm

Autonomy

- Space hazards are rare, but critical to detect
- Not feasible to perform continuous monitoring by humans
- Onboard autonomous algorithm for continous monitoring/tracking
- Images and video of event transmit to ground

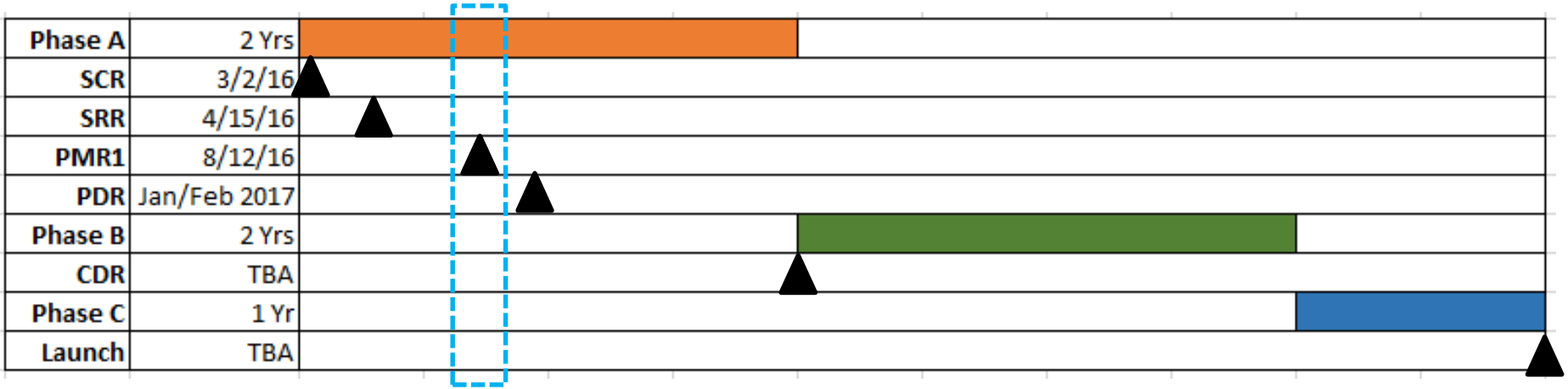


Next Steps

- Viability of prototype CubeSat for space hazard monitoring
- Coverage vs. altitude vs. launch opportunities

Next Steps

SWIMsat Mission Schedule



Phase A	2 Yrs
SCR	3/2/16
SRR	4/15/16
PMR1	8/12/16
PDR	Jan/Feb 2017
Phase B	2 Yrs
CDR	TBA
Phase C	1 Yr
Launch	TBA

Acknowledgements

UNP Team

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- Himangshu Kalita, Ravi Nallapu, Salil Rabade, Andrew Warren, Shota Ichikawa, Akshay Choudhari, Mercedes Herreras-Martinez

References

1. http://www.nasa.gov/content/goddard/the-difference-between-flares-and-cmes
2. http://solarscience.msfc.nasa.gov/CMEs.shtml

THANK YOU!!!