

# Alabama State-Wide Initiative for a Cislunar Gamma-ray Burst Mission

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# Mission Introduction

## Alabama Space Grant Consortium leading a state-wide initiative to develop a cislunar mission

- Cislunar mission, targeting SLS-EM-2/3
- Primarily a student developed and operated spacecraft
- Collaboration between universities across the state to develop subsystems
- **Notional 3-year development time**

## Payload/Mission concepts request for proposal (RFP-1) solicited in Spring 2018

- Gamma-ray burst timing payload was selected

## Subsystem requests for proposal (RFP-2) solicited in Fall Semester 2018

- Several universities across the state submitted interest in working on subsystems



# Scientific Motivations

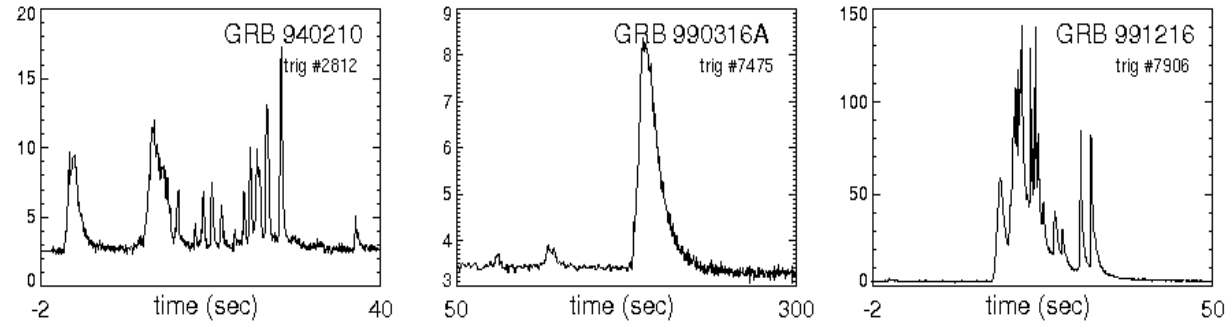
## Gamma-Ray Bursts (GRBs)

- Most highly energetic events in the universe: **Supernovas, Mergers**
- Counter parts to gravitational wave

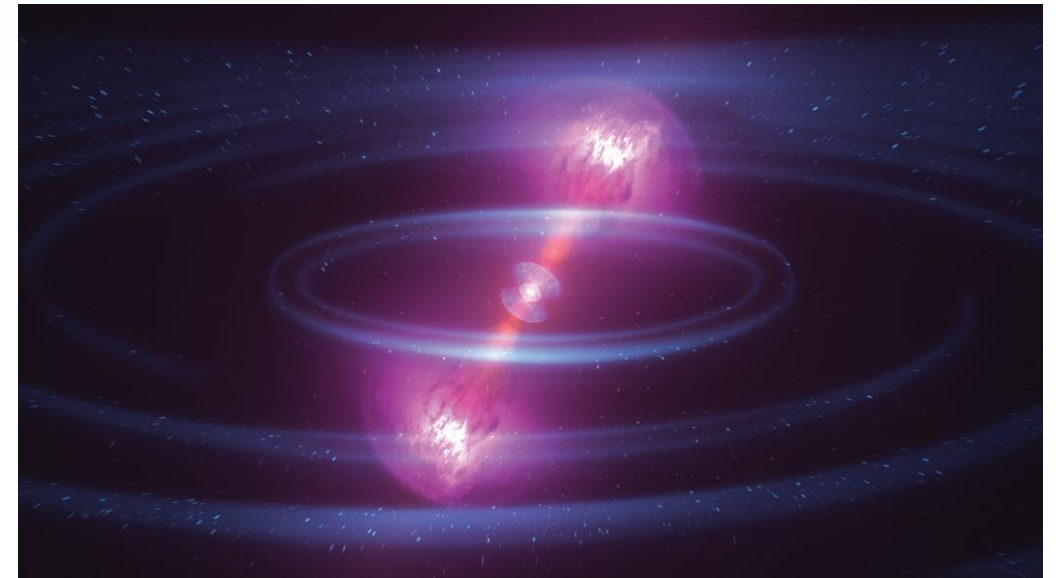
## Different Types of GRBs

- Timescale of GRB's can vary showing two distinct populations: **Short and Long GRBs**
- Wide variance in the light curves of GRBs
- Afterglow from the main burst → **follow-up multiwavelength observations**

**What sources lead to these events?**



*Gamma Ray Light Curves from BATSE*

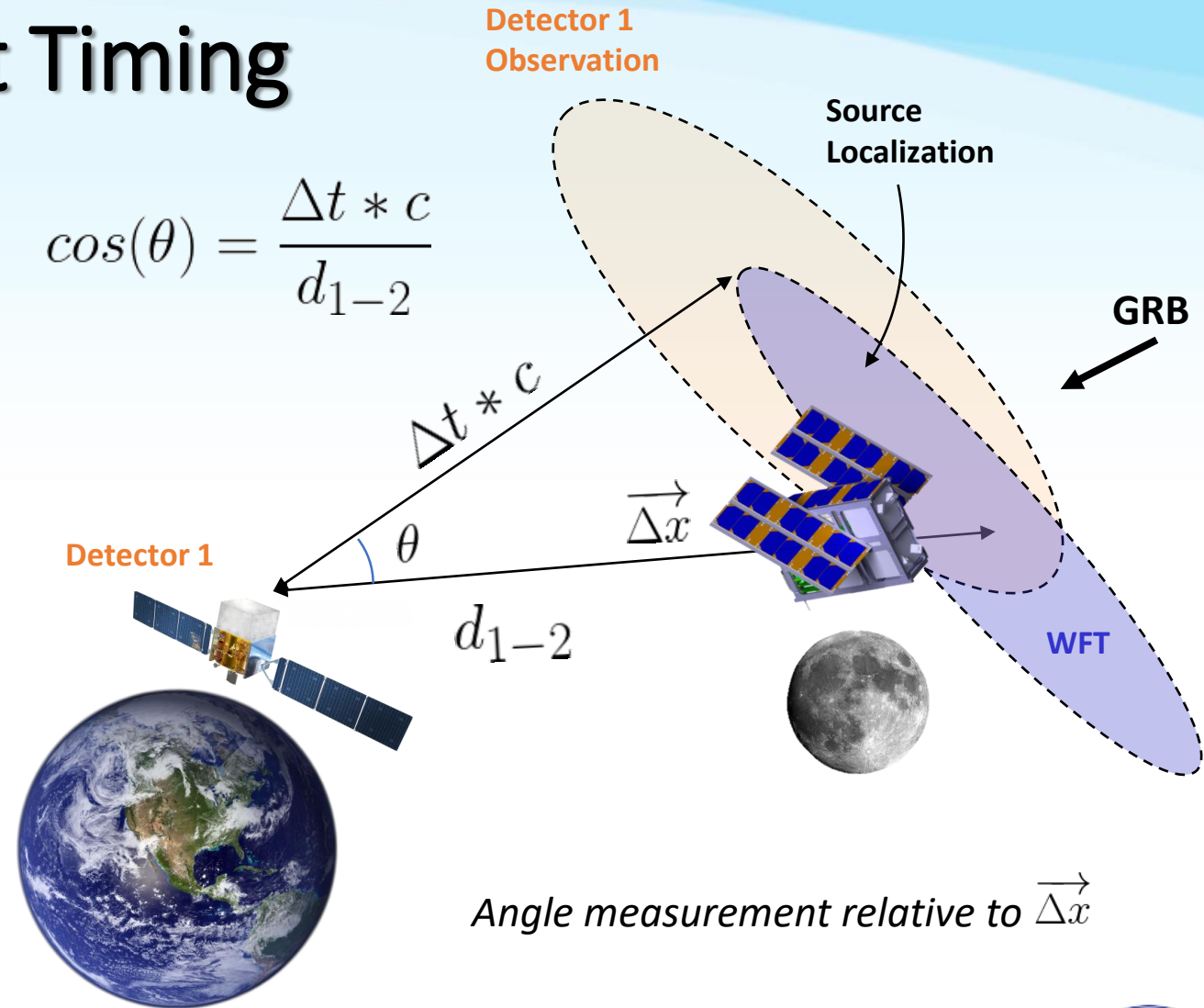


*Artist visualization of a neutron star mergers*

# Gamma-Ray Wave Front Timing

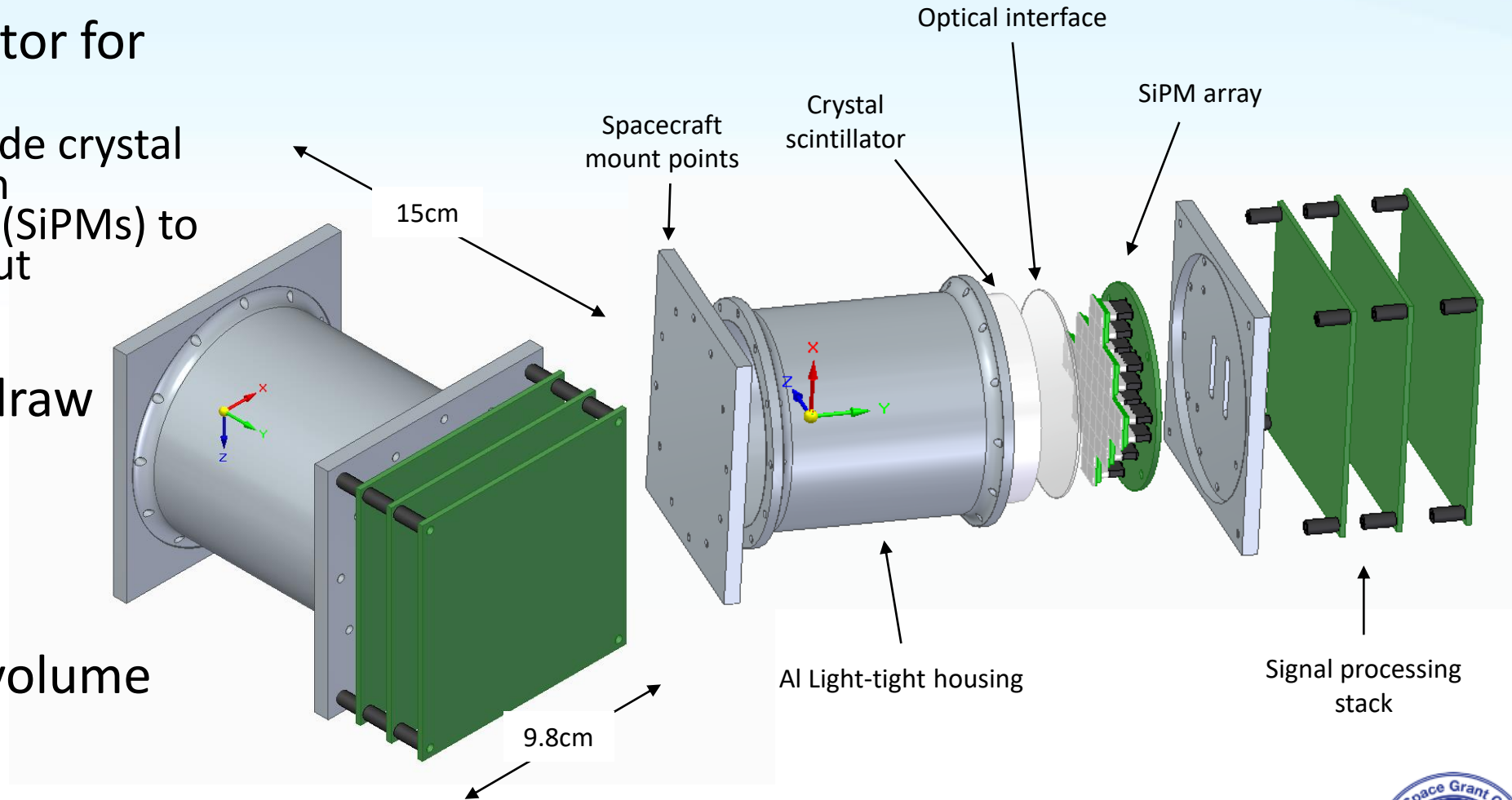
## GRB Timing Mission:

- Localization of GRB's vary in accuracy depending on platform (Swift, Fermi)
- Wave front timing (WFT) between separated detectors allows vastly improved localization → **determine source progenitors location for follow up**
- Cislunar based GRB CubeSat is an ideal application for this kind of mission!



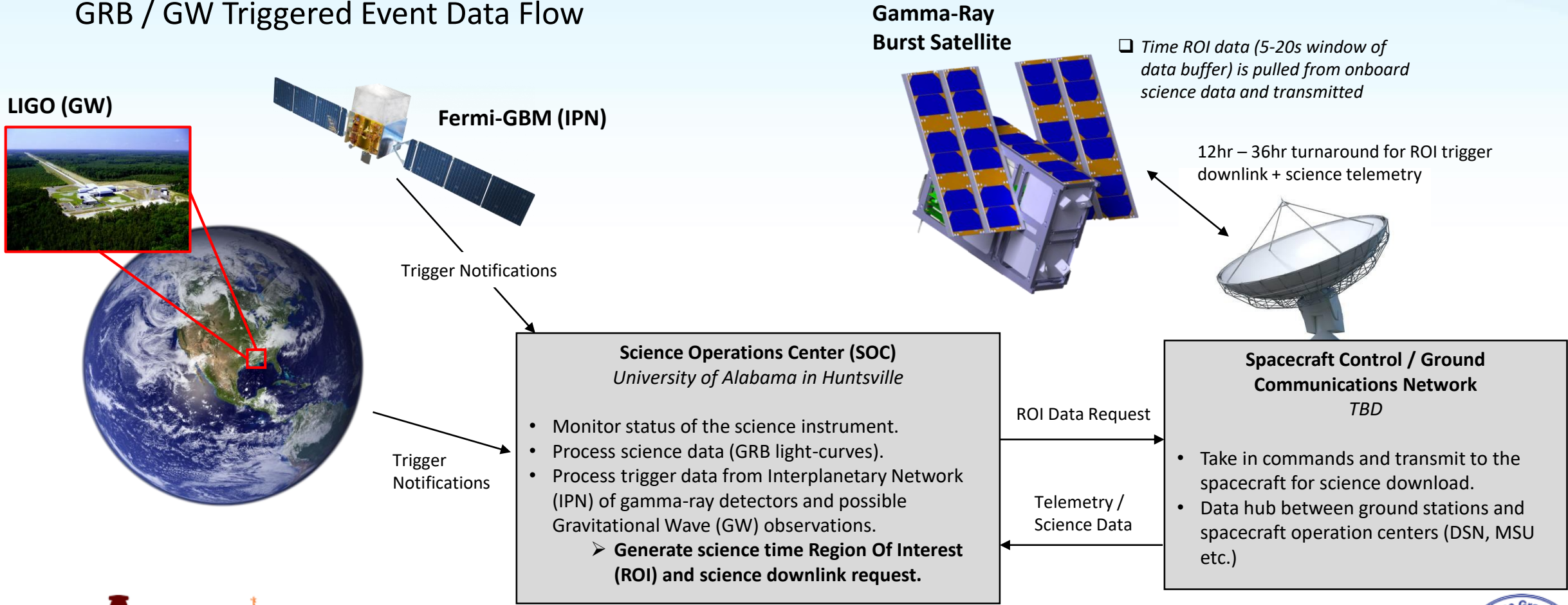
# Payload Overview

- Scintillation detector for gamma-rays
  - Uses Cesium Iodide crystal coupled to Silicon Photomultipliers (SiPMs) to detect light output
- ~2W continuous draw
- ~2-3kg
- Targeting 1.5-2U volume



# Payload Concept of Operations

## GRB / GW Triggered Event Data Flow



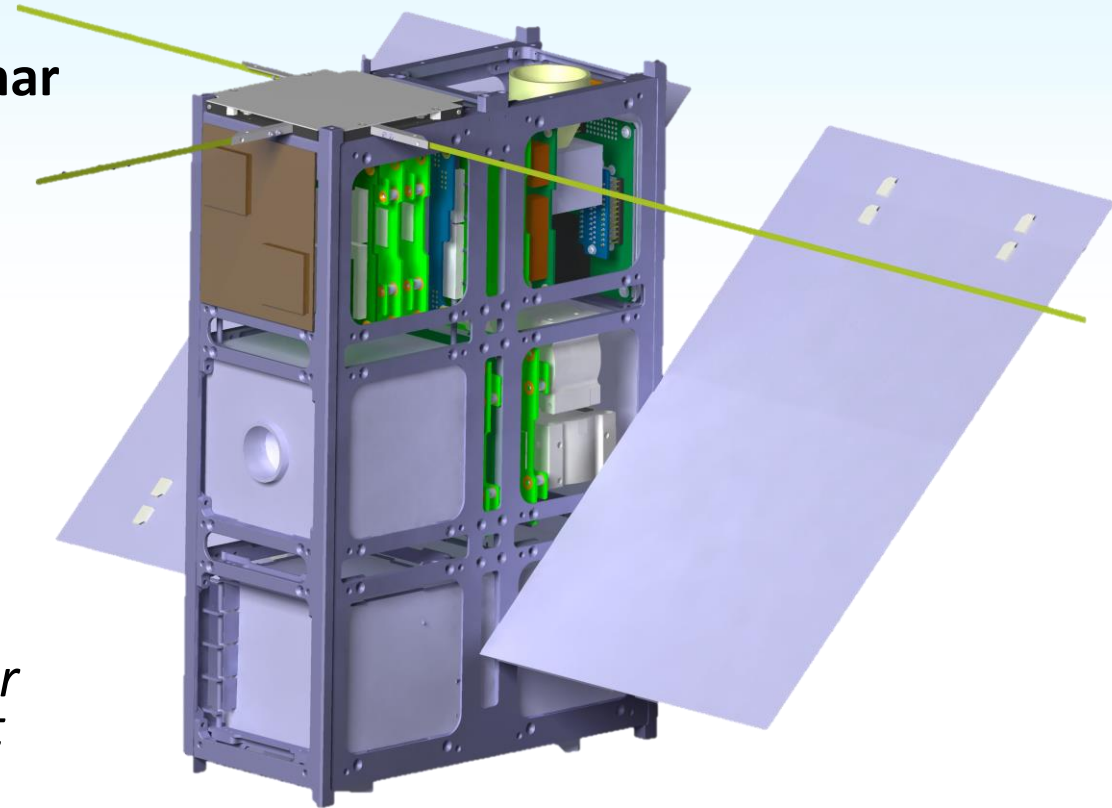
# Spacecraft Overview

## Requirements:

- Operate at distances of  $> 15,000$  km  $\rightarrow$  Targeting Lunar Distant Retrograde Orbit (LDRO)
- 3-6 Month mission duration
- Maintain stable orientation during science collection
- Provide triggered ROI data downlink

## Notional Spacecraft:

- 6U Spacecraft Volume
- Propulsive elements for orbital maneuvering  $\rightarrow$  *Lunar insertion maneuver from heliocentric SLS deployment*
- RCS and reaction wheels for attitude keeping



# University Collaboration

## Utilize experience and assets across the state

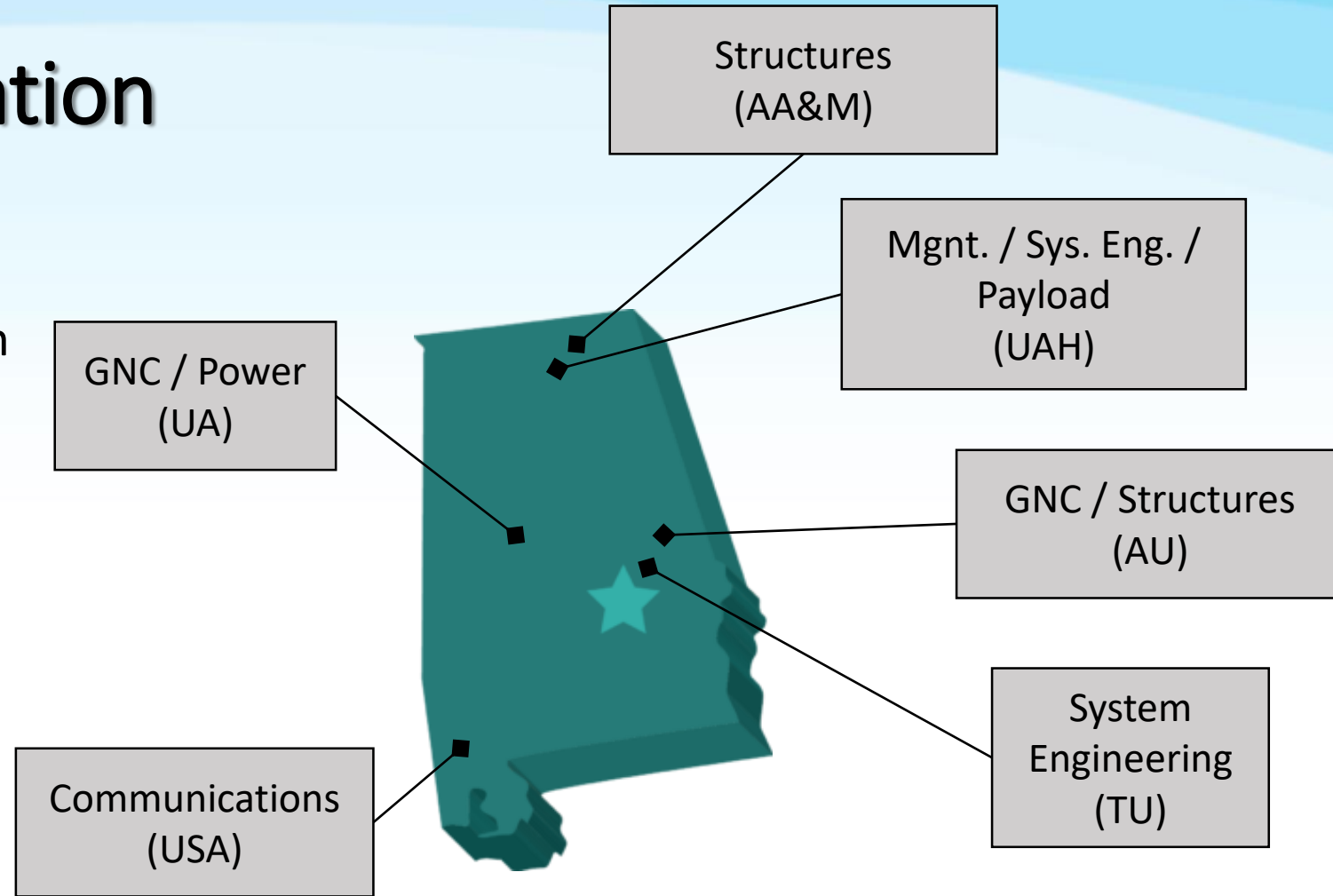
- Bring together a diverse student team and leverage institutional knowledge

## Coordinate satellite development

- Student involvement in all aspects of developing a collaborative spacecraft

## Opportunity

- Engage universities with limited CubeSat experience





# Conclusion and Status

Alabama Space Grant Consortium is leading a state-wide initiative to develop a cislunar mission

- Gamma-ray burst timing mission selected
- Teams across the state have responded and a large collaboration is in progress

## Mission Concept Review (April 5<sup>th</sup> 2019)

- Workshop held with reviewers, good turnout and progress

## Preparing for EM-2 Payload Solicitation



Gamma-Ray Burst Localization

