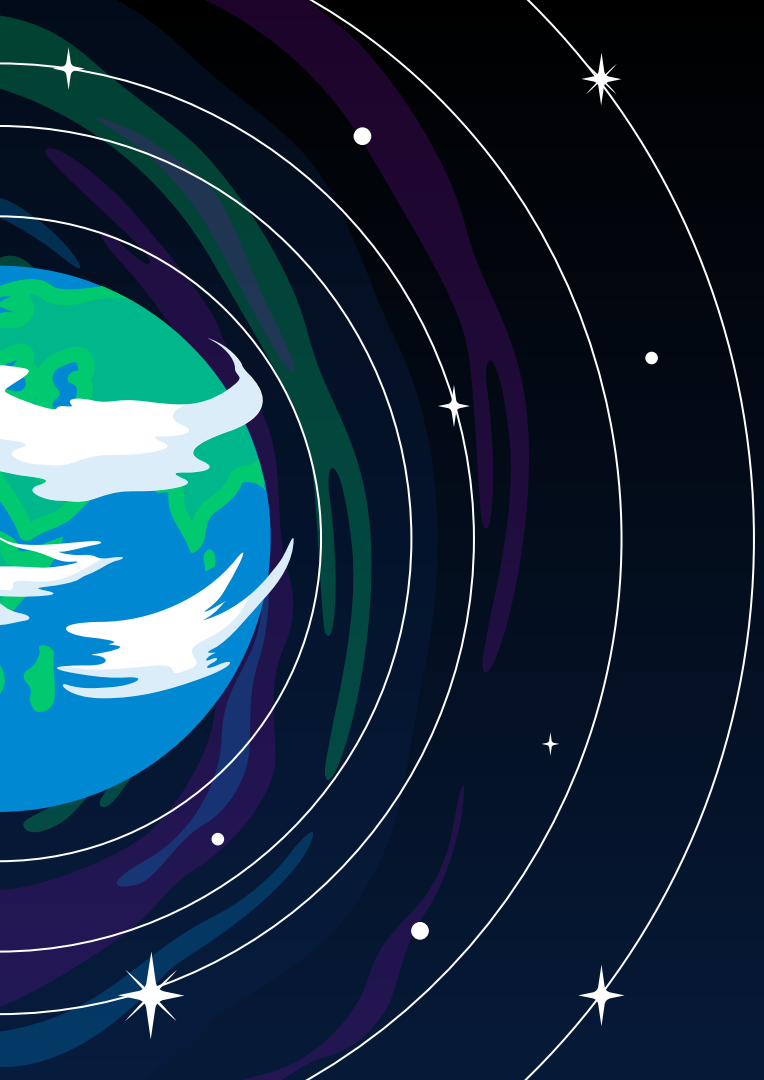

QUBESAT-2: Quantum CubeSat

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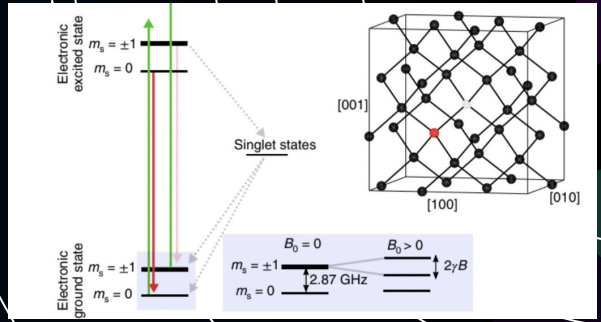
Space Technologies at Cal, UC Berkeley

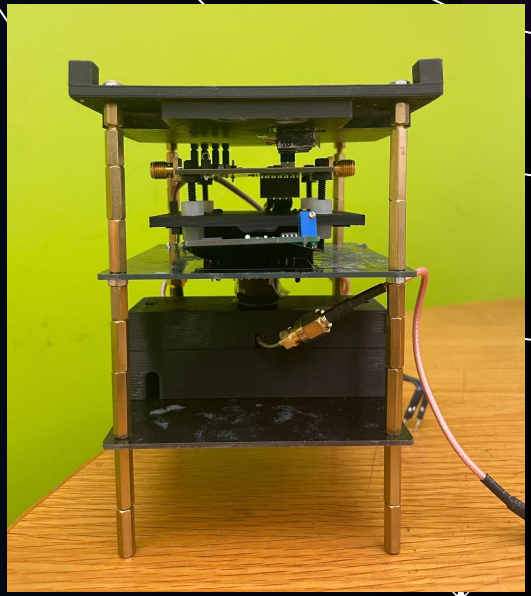
Project Overview

- Research the effects of LEO conditions on a quantum gyroscope based on nitrogen vacancy centers in diamond
- Exceed resolution, sensitivity, and drift stability limits of conventional gyroscopes (MEMs)
- Receive telemetry and ESR-level experimental data from payload to establish viability for future space applications

Payload: Quantum Gyroscope

- NV centers in diamond can be very sensitive to magnetic fields.
- A laser and 2.87 GHz signal can be applied to read out the rotation data via the fluorescence of the diamond.
- QubeSat aims to miniaturize this technology to fit on a CubeSat and evaluate its performance in the extreme environment of space



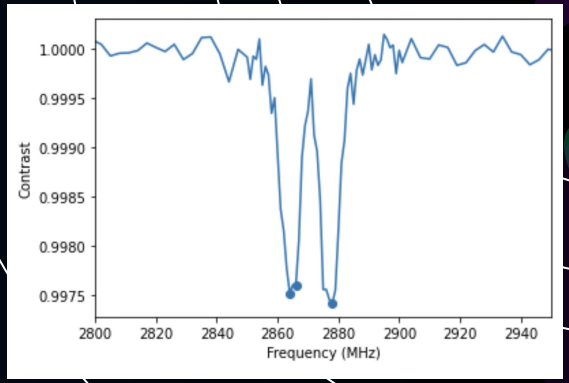


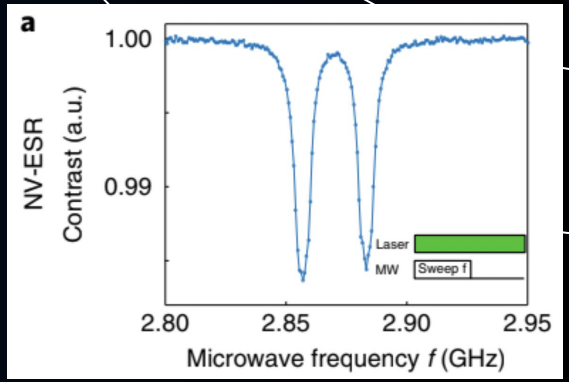
Benchtop Gyro Setup

Payload: Operating Principle

Overview: Measure system electron energy transitions through electron (and nuclear) spin resonance

- What We Learn:
  - Temperature
  - Magnetic field
  - Rotation rate (Berry Phase)
- Future Experimentation/Work:
  - Improve contrast for ESR and implement precision timing
    - Rabi Oscillations (magnetic and thermal background sensing)
    - Spin Echo (coherence control)



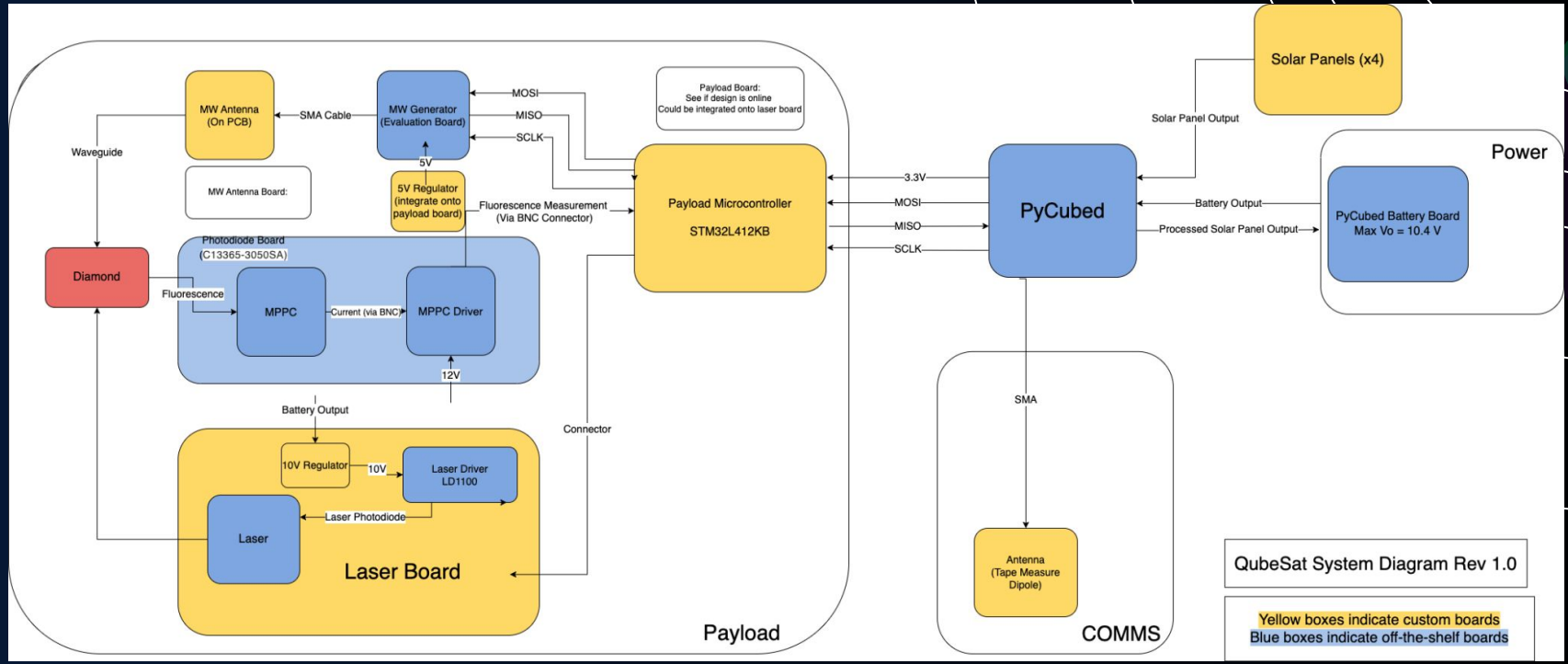


Mechanical: Overview

- 2U Form Factor: 20cm x 10cm x 10cm footprint
- Compiled mass budget ~ 2.2kg
- 6061 T6 Aluminum chassis with Anodized surface
- 4x Brass standoff columns
- RBF/Inhibit Switches
- Antenna deployment mechanism
    - Orthogonal dipole tape measure antenna

COMMs and Power Systems: Overview

- Radio specifications: Hope RF
  - Integrated with PyCubed, convenient API
- The Mainboard (PyCubed) will serve as the centerpiece for all the electrical components of the Qubesat. This includes:
  - Comms: HopeRF
  - Payload: Gyroscope
- In return, these boards will all exchange data with the mainboard which will store and transfer the data.
- Solar Panels connected to the Mainboard will charge the Battery Board
- On a Separate Cycle, the Battery Board will provide the power requirements of the connected Payload, Comms and Controls boards.


MW Antenna
(On PCB)
SMA Cable
MW Generator
(Evaluation Board)
MOSI
MISO
SCLK
Payload Board:
See if design is online
Could be integrated onto laser board
Solar Panels (x4)
Solar Panel Output
Waveguide
MW Antenna Board:
5V
5V Regulator
(integrate onto
payload board)
Fluorescence Measurement
(Via BNC Connector)
Payload Microcontroller
STM32L412KB
3.3V
MOSI
MISO
SCLK
PyCubed
Battery Output
Processed Solar Panel Output
Power
PyCubed Battery Board
Max Vo = 10.4 V
Photodiode Board
(C13365-3050SA)
Diamond
Fluorescence
MPPC
Current (via BNC)
MPPC Driver
12V
Battery Output
Connector
10V Regulator
10V
Laser Driver
LD1100
Laser Photodiode
Laser
Laser Board
Payload
SMA
Antenna
(Tape Measure
Dipole)
COMMS
QubeSat System Diagram Rev 1.0
Yellow boxes indicate custom boards
Blue boxes indicate off-the-shelf boards

Thank you!