



David Murphy

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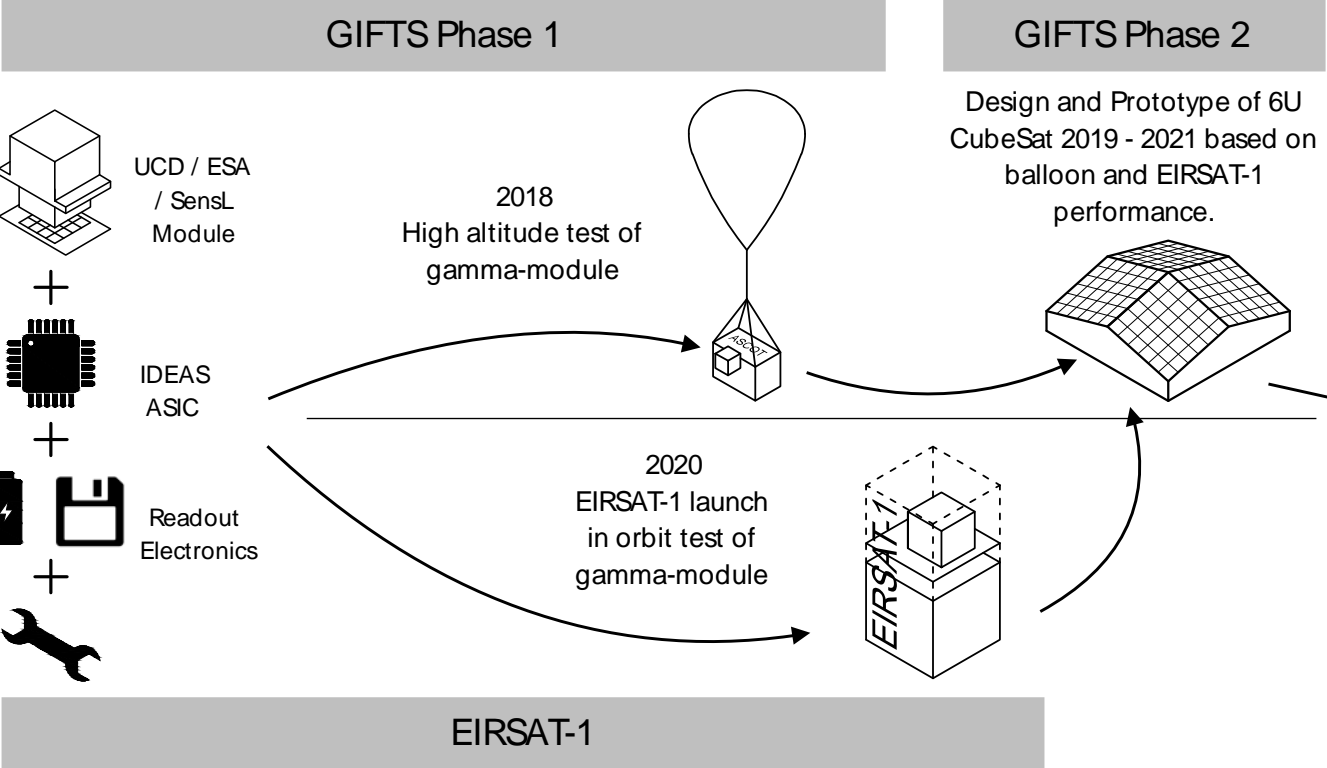
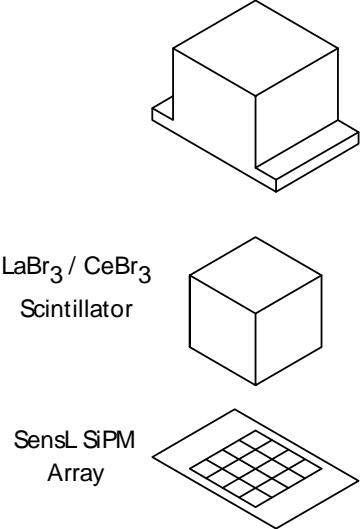
UCD Space Science Group

# GIFTS & EIRSAT-1

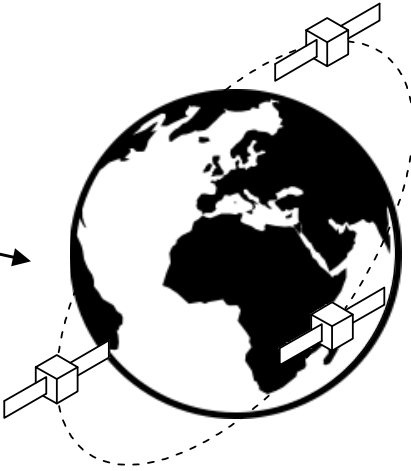


GIFTS – PI: S McBreen

## Current Heritage



## Future: CubeSat Constellation



GIFTS and EIRSAT-1 will lead to an Irish 6U CubeSat for the detection of counterparts to gravitational waves.

EIRSAT-1 – PI: L Hanlon

# The EIRSAT-1 Mission

- 2U CubeSat selected by ESA Fly Your Satellite in 2017
- 3 experiment payloads, each incorporating novel Irish technology
  - GMOD – a  $\gamma$ -ray detector based on design developed at UCD under contract to ESA
  - EMOD – to make LEO measurements of ENBIO's SolarBlack and SolarWhite thermal management coatings developed for Solar Orbiter
  - WBC – Wave Based Control, a control scheme for flexible mechanical systems, developed at UCD
- Critical Design Review phase currently being closed out
- Ambient Test Readiness Review has begun
- EQM assembly beginning soon

The EIRSAT-1 project is carried out with the support of the Education Office of the European Space Agency, under the educational Fly your Satellite! Programme.



**fly your  
satellite!**



# The EIRSAT-1 Mission



EMOD Thermal Coupon Assembly

Structural Frame

Solar Panels

GMOD

EMOD

Attitude Determination and Control

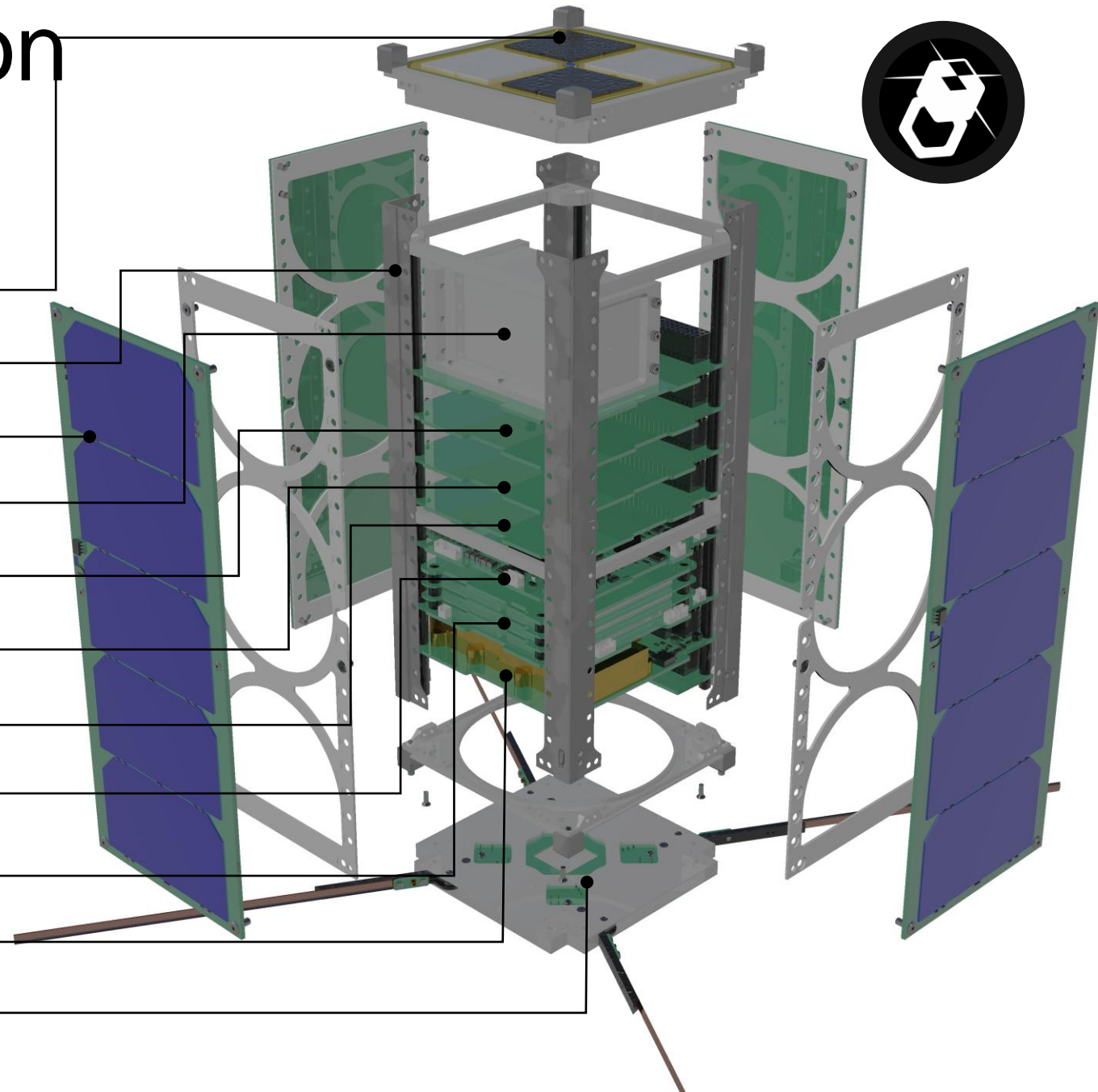
On-board Computer

EPS

Battery

Comms

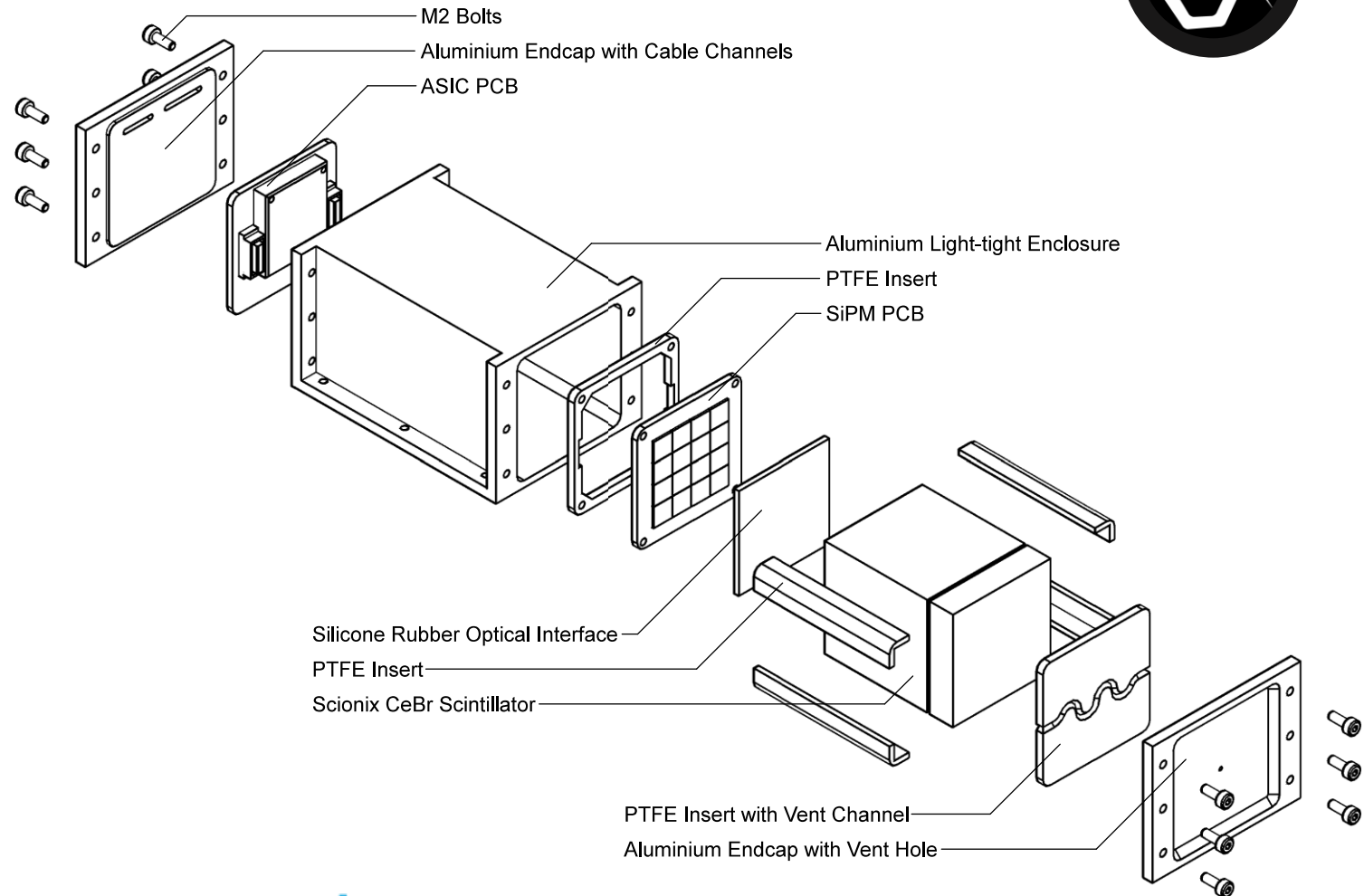
Antenna



# GMOD – The Gamma-ray Module



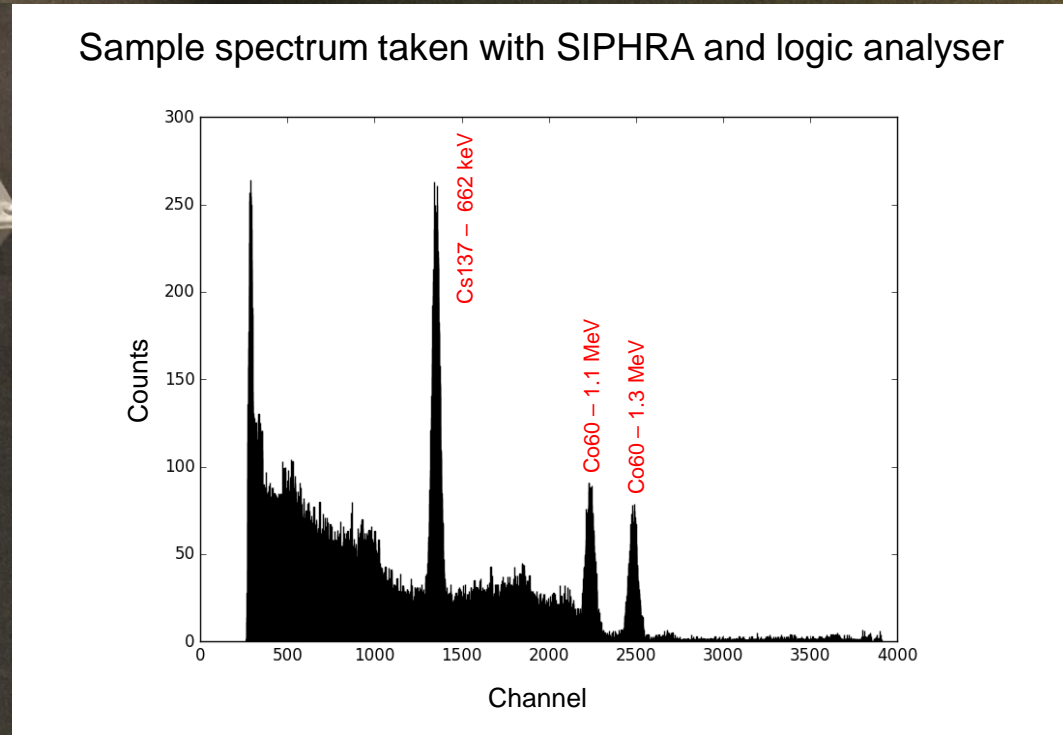
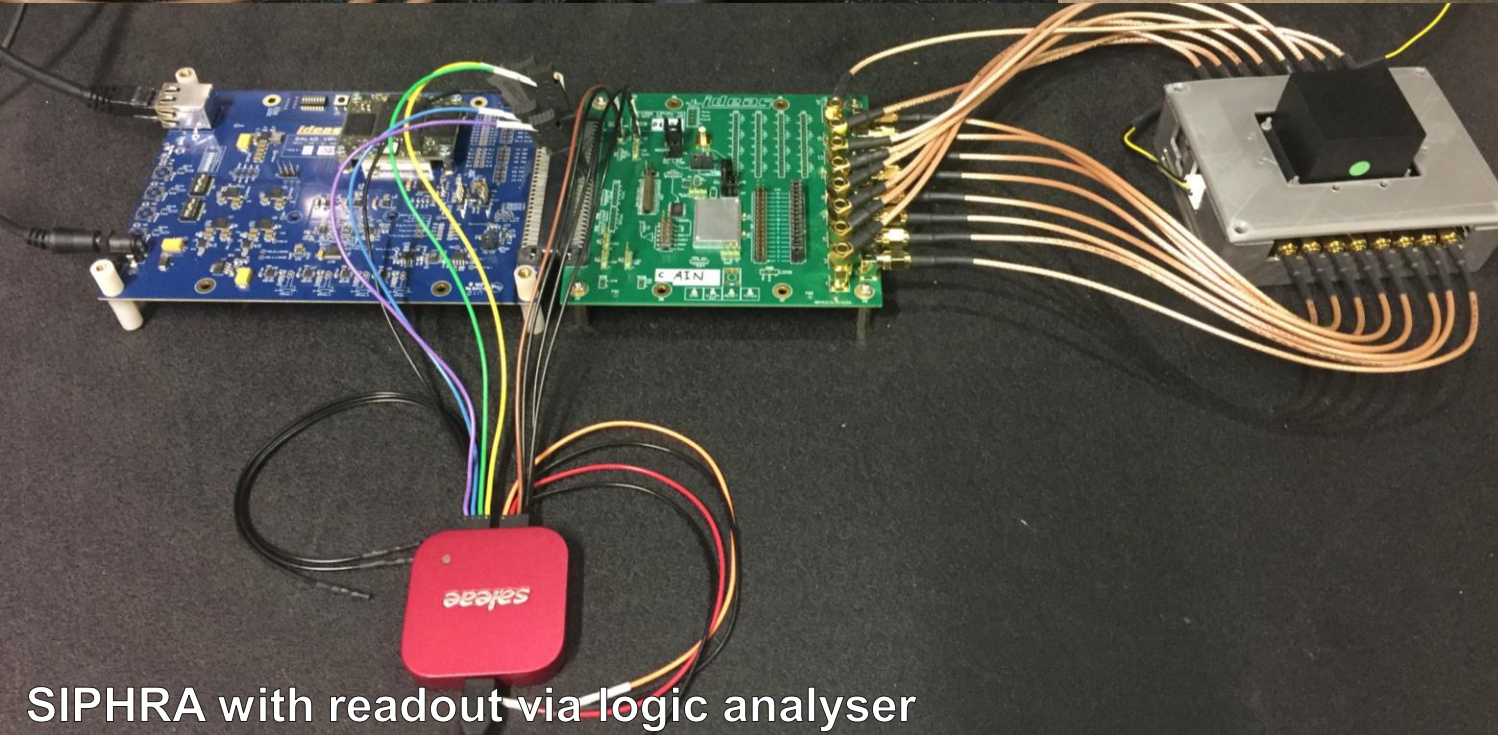
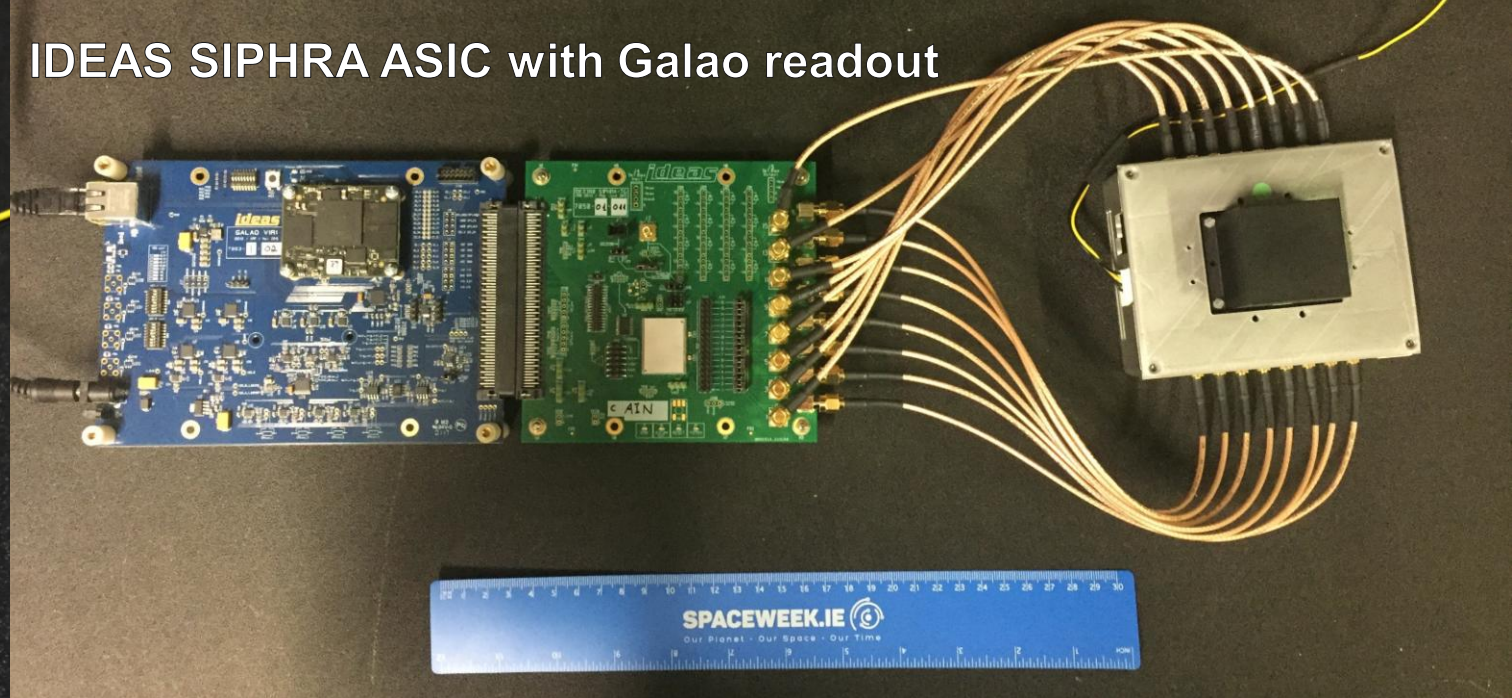
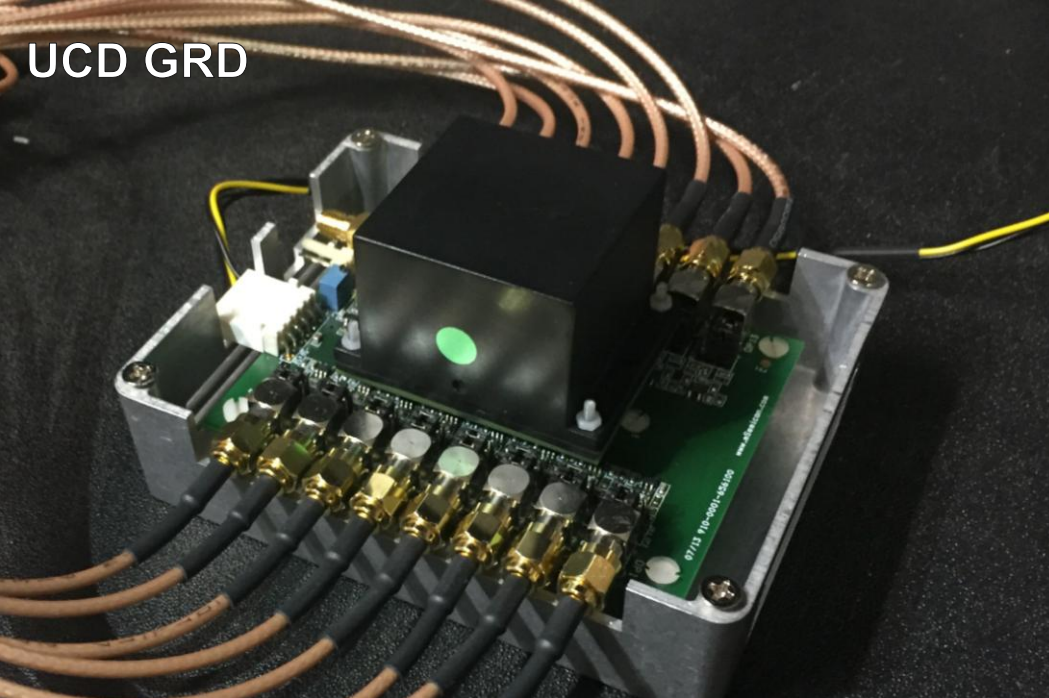
- GMOD is a scintillator-based gamma-ray detector
- 4×4 pixel SiPM array
  - Based on SensL J-series
  - Custom in-house array
- Scionix Cerium Bromide Scintillator
- SIPHRA ASIC by IDEAS
- Custom in-house GMOD Motherboard
  - Onboard Data-processing
  - Support Electronics



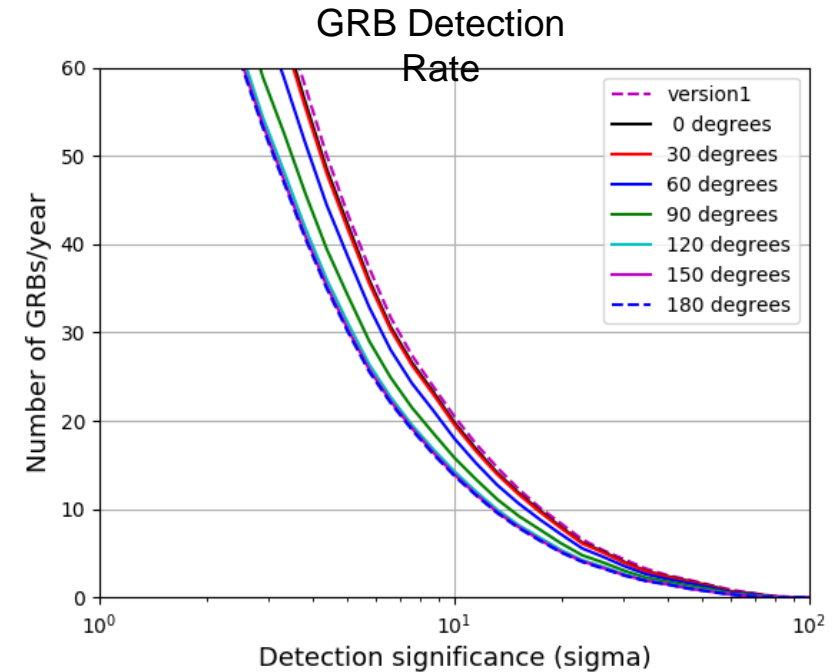
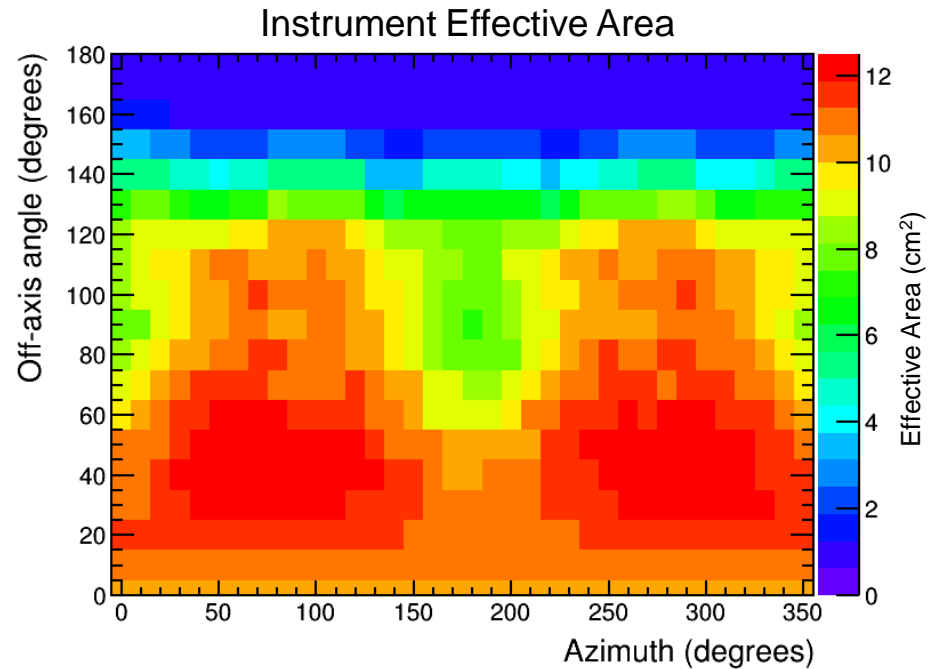
**sensL**  
sense light

**ideas**  
Integrated Detector Electronics AS





# GMOD – Performance Simulations

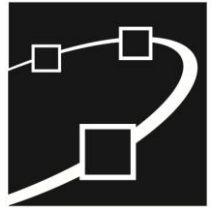


- Monte Carlo simulation of  $25\text{mm} \times 25\text{mm} \times 40\text{mm}$  CeBr<sub>3</sub> crystal in EIRSAT-1 spacecraft
- Effective area shown is a measure of sensitivity to 50keV to 300keV photons from a typical GRB

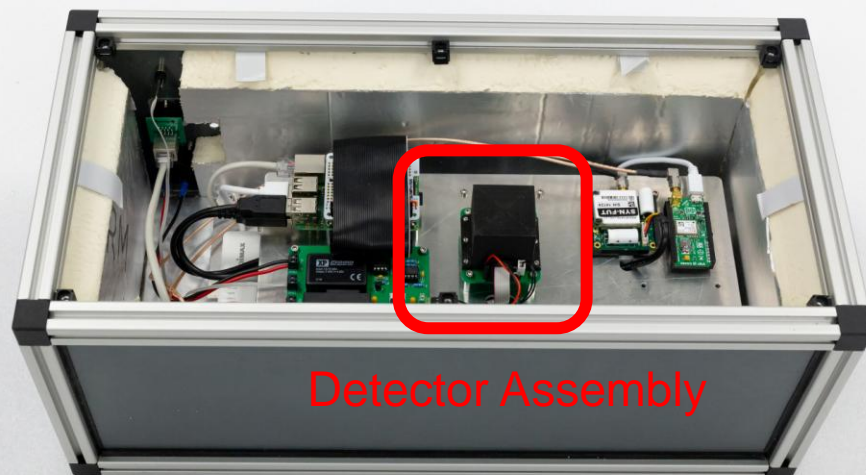
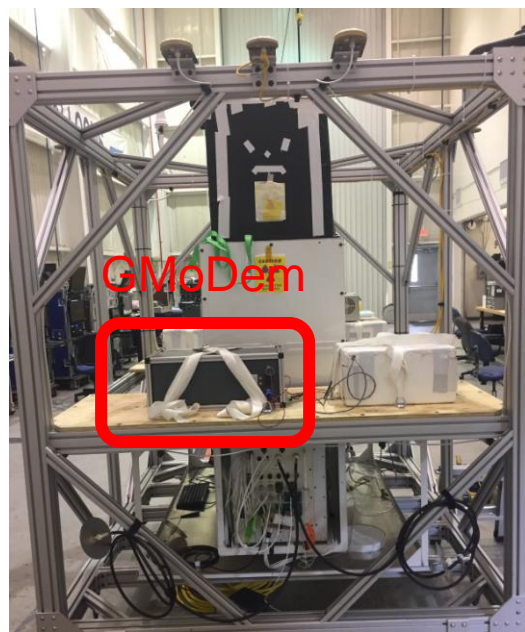
- Simulations of BATSE 4B GRB catalog indicate detection of  $\sim 20$  GRBs / year at a significance of 10 sigma
- More GRBs can be identified at lower significance by coincidence with other instruments



# GIFTS – GModem: The GMOD Demonstrator

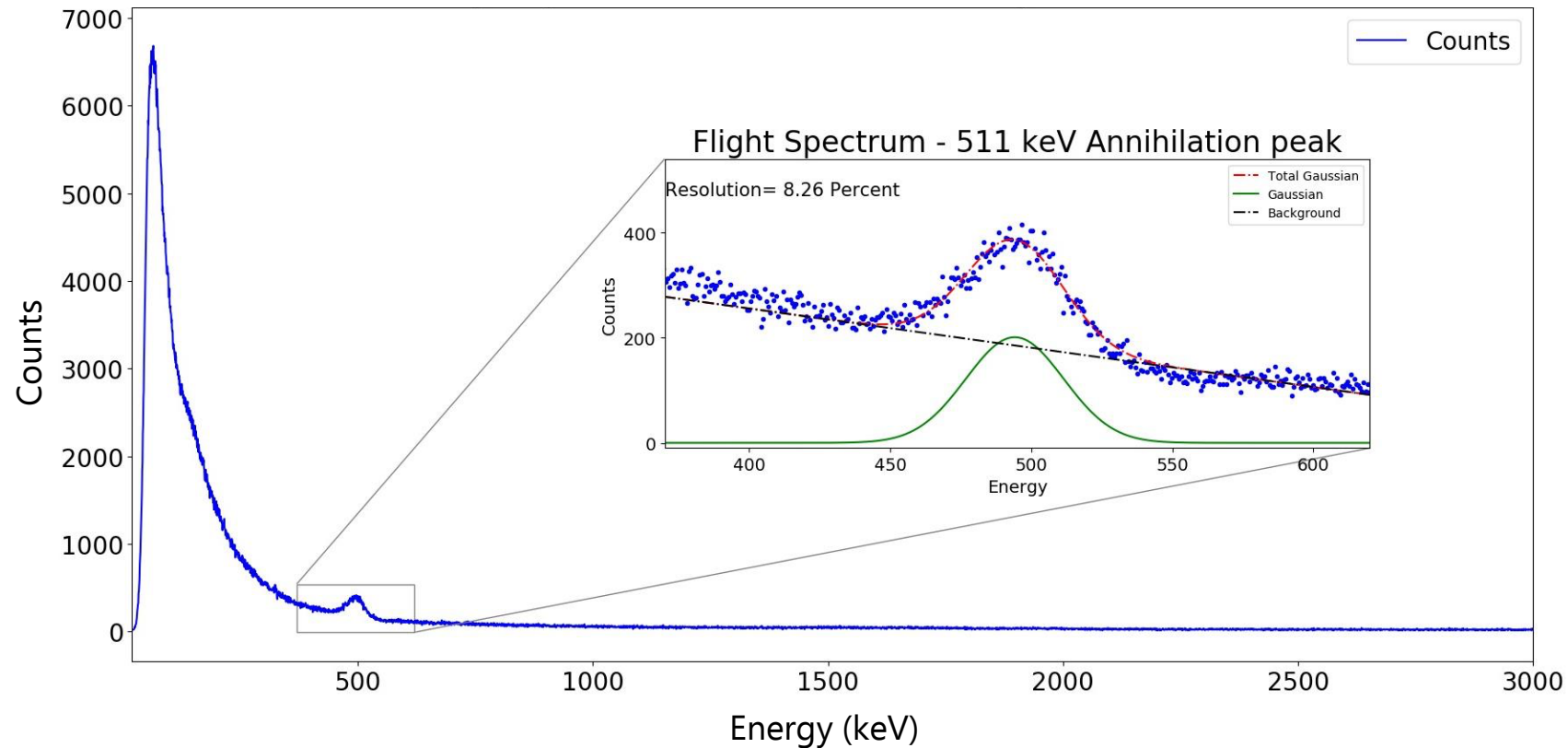


- Flew piggyback on the Advanced Scintillator Compton Telescope (ASCOT, PI: P Bloser) as Flight 1660P from the Columbia Scientific Balloon Facility in Palestine, Texas.
- Float altitude 37.4km for >5 hours.
- Hardware: SIPHRA ASIC, CeBr3 Scintillator, SensL J-Series SiPMs.





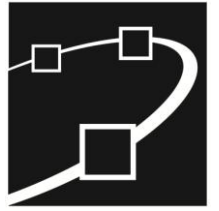
# GIFTS – GMoDem



- Results from flight still being analysed, but initial results are promising. The detector functioned well throughout the entire flight and after landing.

# GIFTS – Future

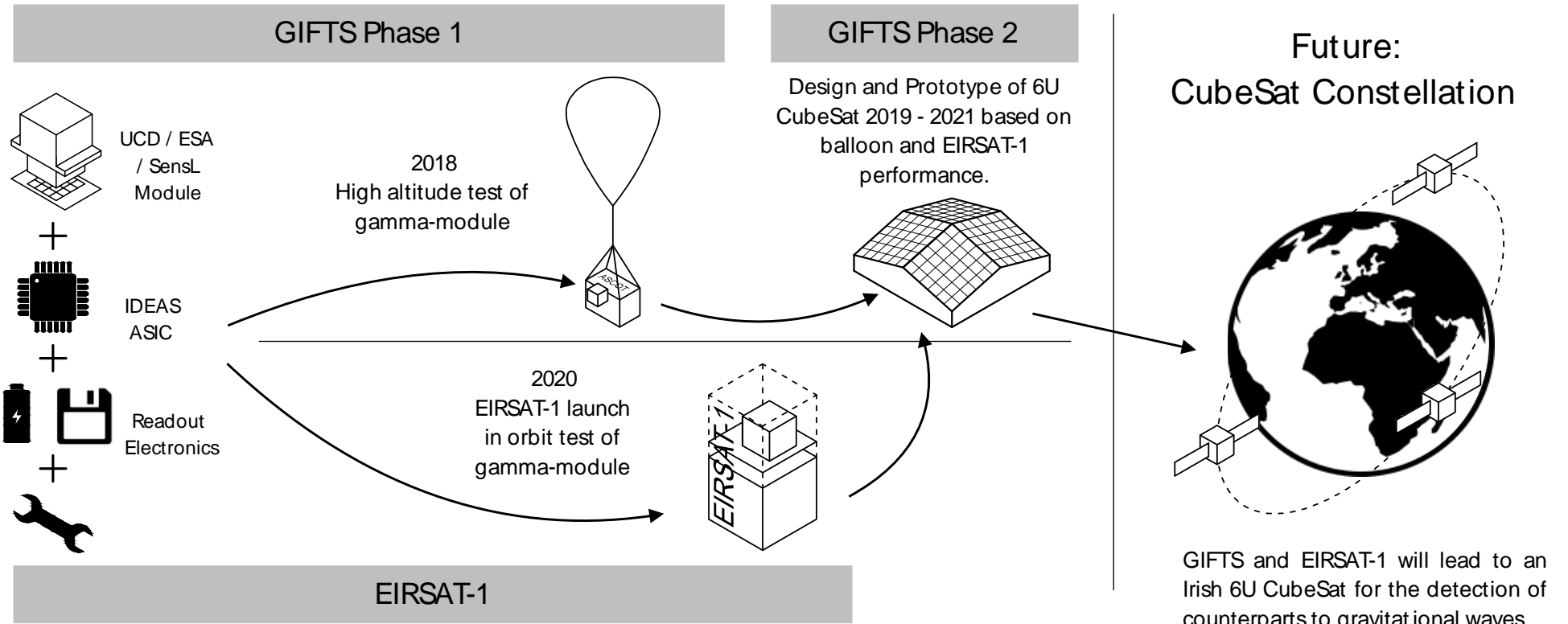
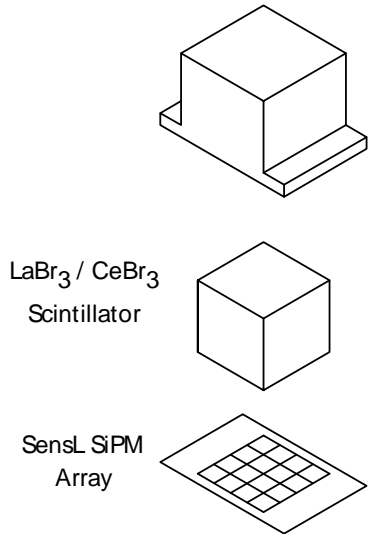
- Funding has been secured to design and build a 1U sized instrument. (with many thanks to BurstCube team for support!)
- Would ideally form part of a 4U instrument collaboration in a 6U CubeSat.
- Capabilities at UCD Space Science Group have been significantly increased in context of the EIRSAT-1 project.
  - 7 graduate students in group now working on spacecraft design and assembly – many more at UCD in Mechanical and Materials Engineering collaborating on EIRSAT-1 and potential future projects.
  - 2x new cleanroom facilities:
    - one focusing on mechanical and vibration testing,
    - one focused on gamma-ray instrumentation and final spacecraft integration.



# Questions?



## Current Heritage



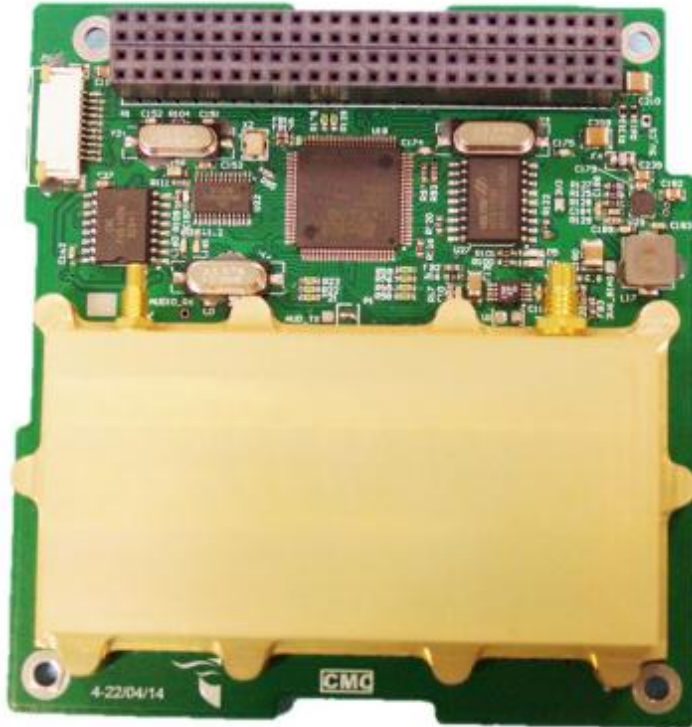
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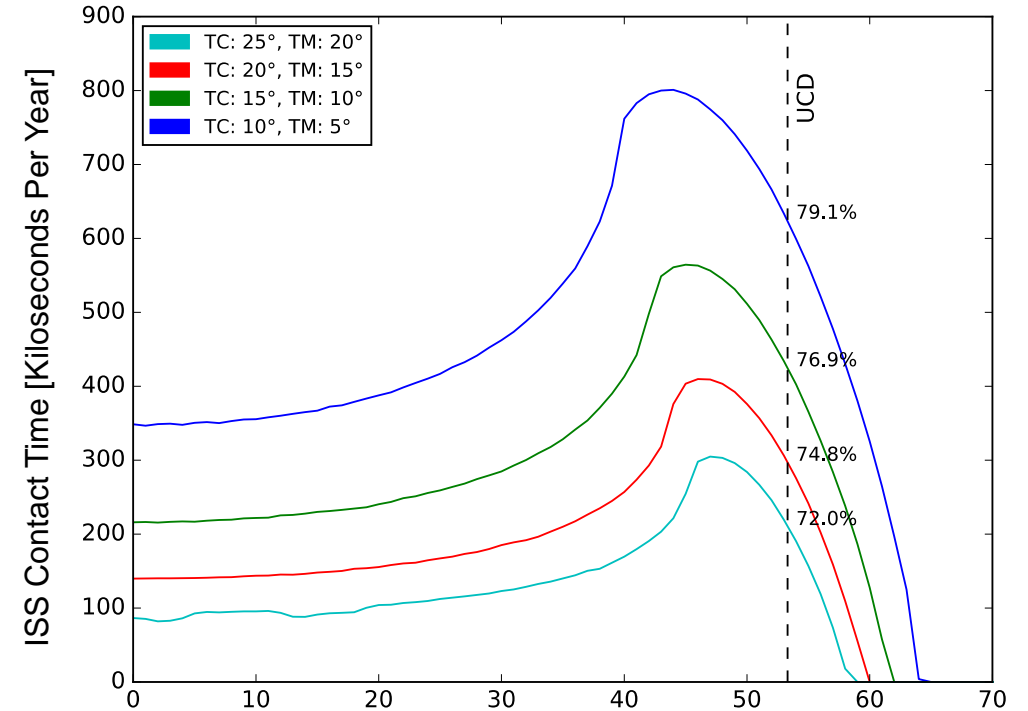


# EIRSAT-1 Comms



- CPUT VUTRX Transceiver
  - UHF uplink
  - VHF downlink
- Data rates up to 9600 baud with GMSK

## ISS Orbit Communication Suitability



- Ground Station will be constructed at UCD School of Physics
- Nominal ~29 minutes of contact with EIRSAT-1 per day
- Performance considerably better than ground stations in equatorial regions