EIRSAT-1 / GMOD



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On behalf of Lorraine Hanlon, Sheila McBreen, Alexey Ulyanov Joseph Mangan, Sarah Walsh, Rachel Dunwoody, and the EIRSAT-1 Team



EIRSAT-1

- 2U CubeSat designed by students and staff at University College Dublin
- Part of the 2nd round of ESA's 'Fly Your Satellite!' programme
- 3 experiment payloads, each incorporating novel Irish technology
 - GMOD a scintillator and SiPM based γ -ray detector
 - EMOD to make LEO measurements of SolarBlack and SolarWhite thermal management coatings developed for Solar Orbiter
 - WBC a control scheme for flexible mechanical systems, developed at UCD
- First Irish Satellite!!!









European Space Agency









GMOD The Gamma-ray Module

- Based on previous detector built at UCD GRD
- Uses several novel technologies:
 - SiPMs by Irish company SensL (now part of OnSemi)
 - ASIC by Norwegian company IDEAS
 - Modern, bright scintillator CeBr3
- In orbit demonstration and performance verification
- Many GMOD units can be combined for use in Compton / Compton-Pair telescopes.







Detector Assembly

aeajes

IDEAS SIPHRA ASIC with Galao readout

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Sample spectra taken with SIPHRA / GRD



GMoDem Gamma-ray Module Demonstrator

- Piggy-back flight on ASCOT (PI: Bloser)
- Launch from NASA Columbia Scientific Balloon Facility, TX.
- Short preparation time few months.



GMoDem Detector Assembly

- 25mm×25mm×20mm CeBr from Scionix
- 4 × 2 × 2 J-series SensL SiPM arrays
- 3D printed enclosure





UCD MSc Space Science and Technology

- Satellite Subsystems Laboratory
- Student Teams build "TupperSats"





GMoDem Gamma-ray Module Demonstrator

- Detector
 - CeBr
 - J-series SiPM arrays
 - SIPHRA
 - Galao
- Bias Supply
 - Inhouse design & production
- Readout & Storage
 - Raspberry Pi (via Python)
 - USB Flash Memory
- Comms
 - Iridium 9603 Short Burst Data Modem
- Telemetry
 - GPS ublox M8
 - Pressure MS5611
 - Temp (SiPM, internal, external) DS18b20
- Structure
 - Aluminium extrusion
 - 600mm × 300mm × 200mm





GMoDem

Site of a



GMoDem - Flic

- Flight Number: ٠
- Date/Time Launched: 5 July, 20 •
- Experiment Weight: 585 kg
- Float Altitude:
- Total Float Time:
- Total Flight Time:
- Distance: .



Д

1600 P

735 km



19:00

20:00

22:00



- Detector recovered with very loose and warped enclosure
- Preflight Sodium 22 calibration: 511keV @ Ch1526
- Inflight: 511keV @ Ch 798
- Poor optical coupling explains bad resolution reduction in scintillation light of $\sim 2 =$ increase in resolution of $\sqrt{2}$

GMoDem





GMoDem – Flight Spectrum







GMOD - Physical Design









GMOD - Resolution

40k



1400

3



Simulations - MEGAlib







Simulations - Effective Area





Simulations - Effective Area







Simulations - GRBs





• 50 - 300 keV for a GRB with α =-1.1, β =-2.3, Epeak = 300 keV.

- Based on BATSE4B catalog.
- ~18/year at 10 sigma.

GMOD / EIRSAT-1 Next Steps

EIRSAT-1 Flight Model Assembly

- Done
- EIRSAT-1 Full Functional Testing
 - Ongoing finishing this week

GMOD FM Characterisation

• Beginning 11 July 2022

EIRSAT-1 Vibration Testing

• Beginning 18 July 2022

EIRSAT-1 TVAC Testing

• Beginning 25 July 2022

Flight Acceptance Review

• September 2022

Flight Model Delivery

• October / November 2022

Launch

• Vega-C VV23 – estimated January 2023



COMCUBE Compton Polarimeter on a CubeSat

Goals:

- Simulation of GRB Compton polarimetry capability within a CubeSat footprint & prototype balloon flight
- Qualification of technologies for future gamma-ray missions in MeV-GeV energy range

People:

- CNRS-CSNSM Tatischeff (PI)
- UCD Hanlon
- CEA Laurent
- INFN Morselli

- CNRS-IRAP von Ballmoos
- UMainz Oberlack
- LIP Da Silva
- CNRS-IPNO De Sereville
- MPP Mertens











COMCUBE Simulations

COMCUBE Payload (4U)





Polarization capability: With 4(16) spacecraft 5(20) GRBs/yr with $MDP_{99\%} > 30\%$

COMCUBE Balloon - Current Mechanical Design



Christine Le Galliard

COMCUBE Next Steps and Balloon Flight

Final Mechanical design

• November 2022

Mechanical Manufacture

• November 2022 – February 2023

Electronics and Firmware Complete

• March 2023

Instrument Integration

• March 2023

Software Complete

• April 2023

Functional and Environmental Testing

• April – June 2023

Ready to Ship

• End of June 2023

Balloon Flight:

- Application submitted to CNES
- Planned launch from Timmins

Thank you! Questions?



