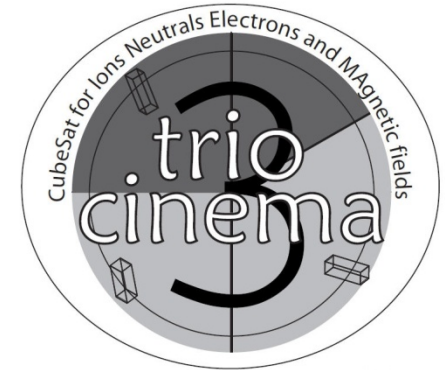


# CINEMA

## CubeSat for Ions, Neutrals, Electrons and Magnetic fields

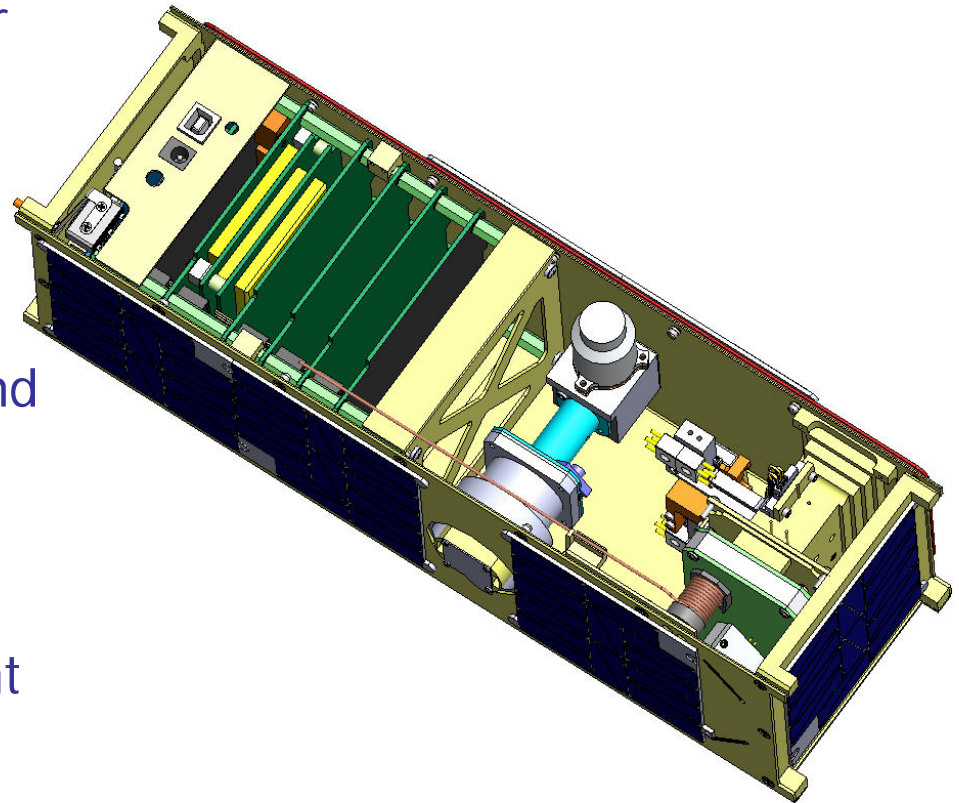
- UC Berkeley Space Sciences Lab
  - Collaborators: Imperial College London, Kyung Hee University, Seoul
- \$1m funding from US NSF under space weather CubeSat programme
- Launch 2011
- Science instruments
  - STEIN: energetic ions, electronics and neutrals
  - MAGIC: magnetometer (Imperial College London)
- Science goals
  - Imaging ring current using energetic neutrals
  - Electron microbursts
  - Auroral precipitation
  - Magnetospheric waves and fine scale structure



Space Sciences Laboratory, UC Berkeley  
Kyung Hee University of South Korea  
Imperial College London

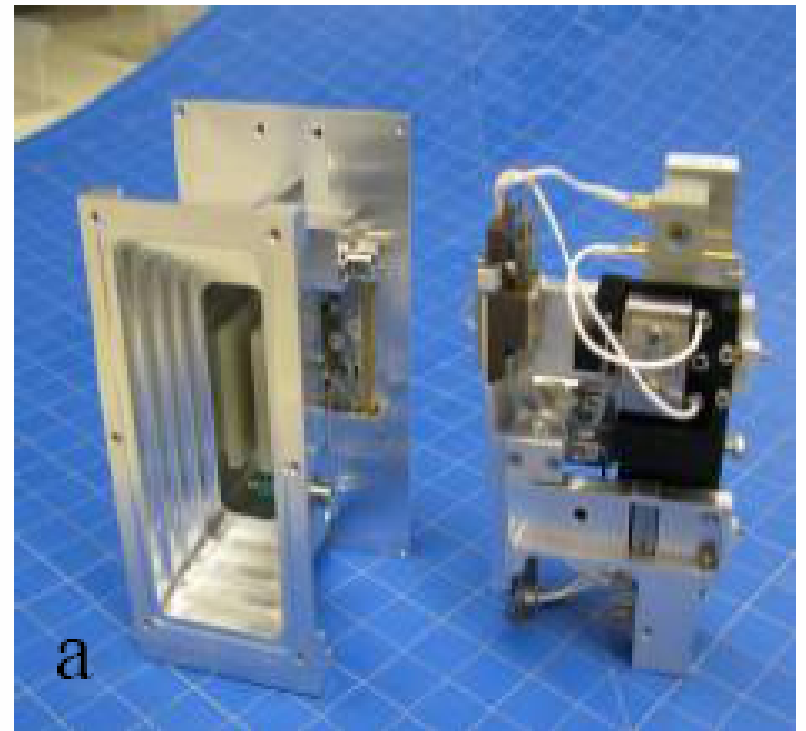
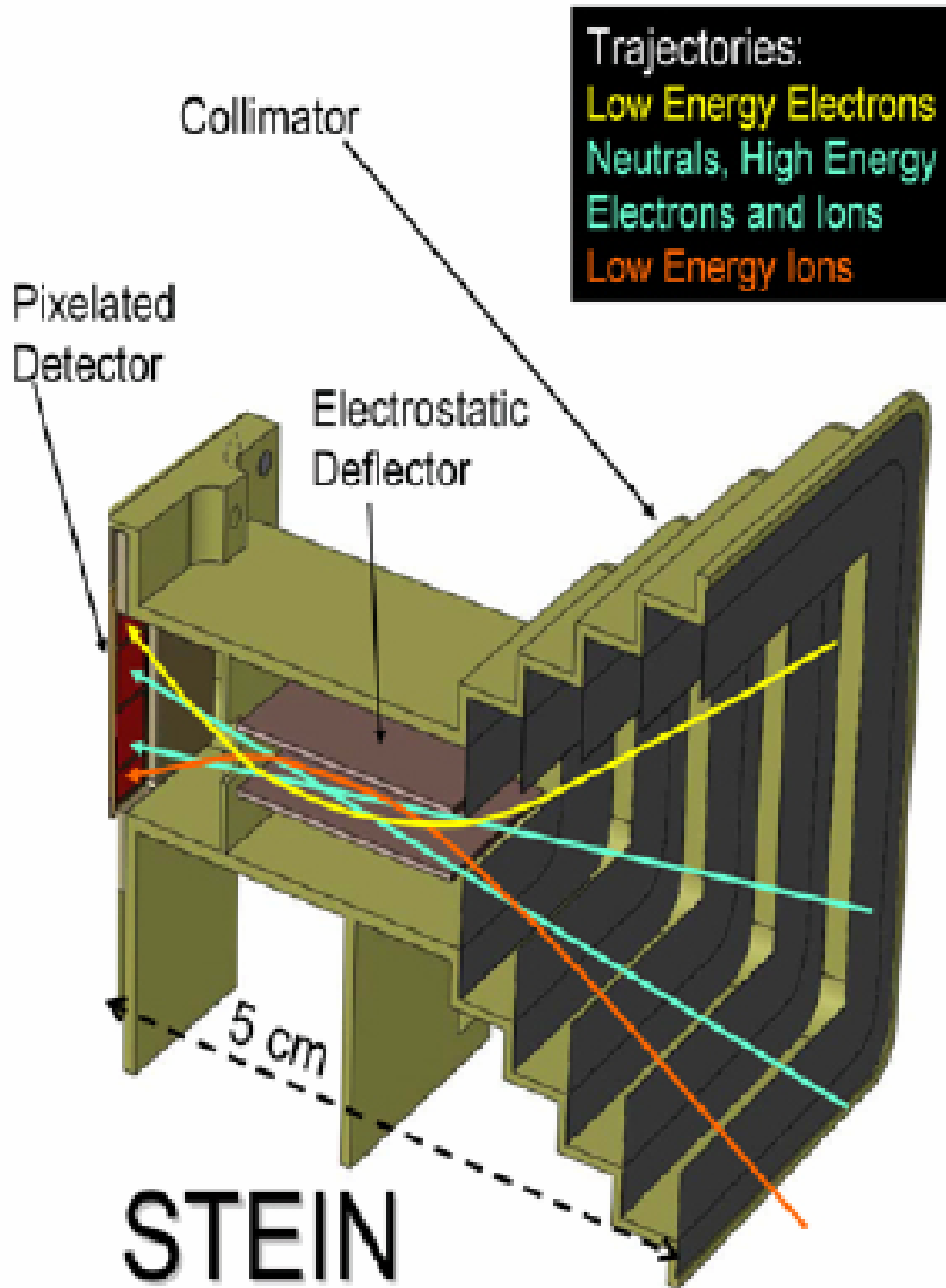
# CINEMA

- Standard 3U CubeSat form factor
- Spin-stabilised, 4rpm
  - First ever spinning CubeSat
  - Magnetotorquers for ACS
- 90cm boom for MAGIC
- S-band comms to Berkeley ground station: 1Mbps
  - Very high for a CubeSat
- Considerable student involvement
  - Overseen by experienced staff
- CDR earlier this week
  - On track



# STEIN (SupraThermal Electron, Ion, Neutral) sensor

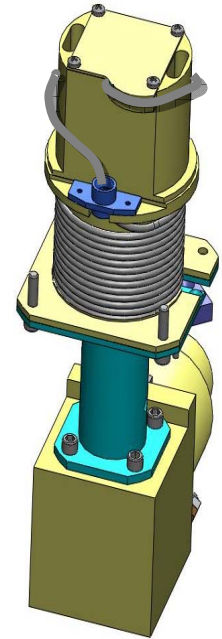
Energy range: ~2-300 keV  
Resolution: ~ 1keV FWHM  
Field of view ~15° x70°



# MAGIC

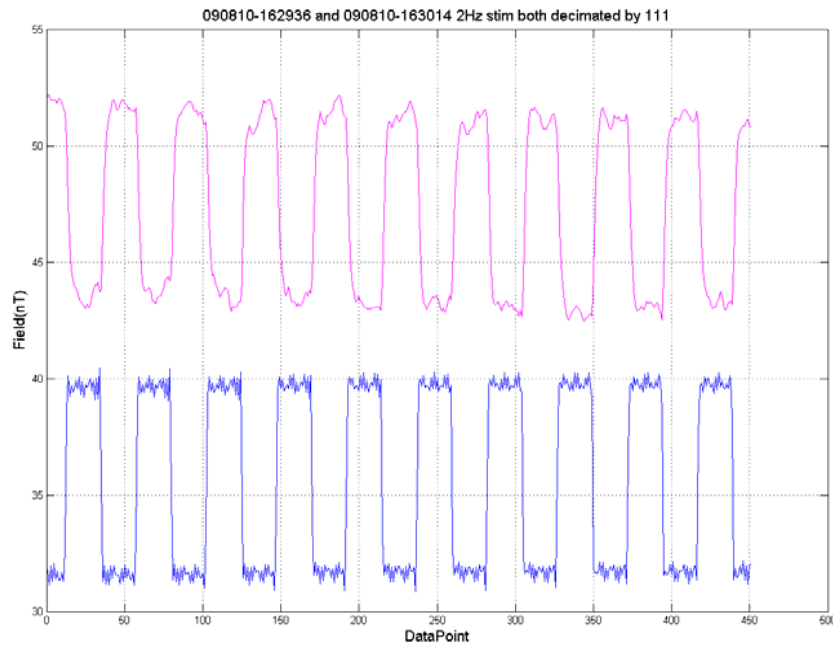
## Magnetometer from Imperial College

- Dual, 3-axis magnetoresistive magnetometer
  - First science application for a MR sensor in space
- One sensor on 90cm boom, one on electronics board
- Cadence up to 10 vectors/s, 338mW power
- Role
  - Contribute to spacecraft attitude determination
  - Measurement of local field direction for pitch angle determination
  - Detection and characterisation of local waves and structures
- No direct funding
  - MR development supported on existing STFC rolling grant
- Imperial cannot afford to provide two additional magnetometers for TRIO
  - No obvious solution at this point, need about £50k

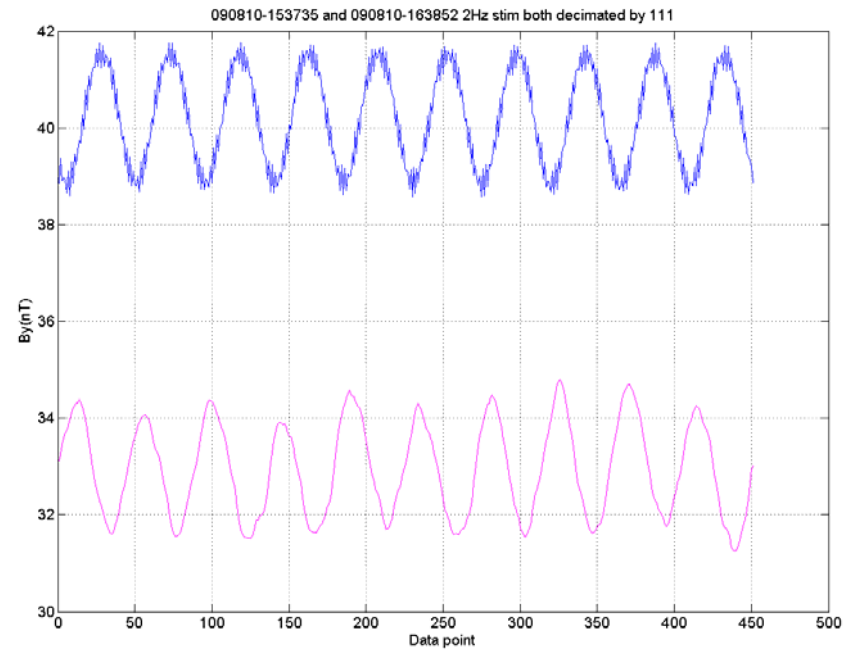


# MAGIC performance

8nT ptp 2Hz Square Wave



2nT ptp 2Hz Sine Wave

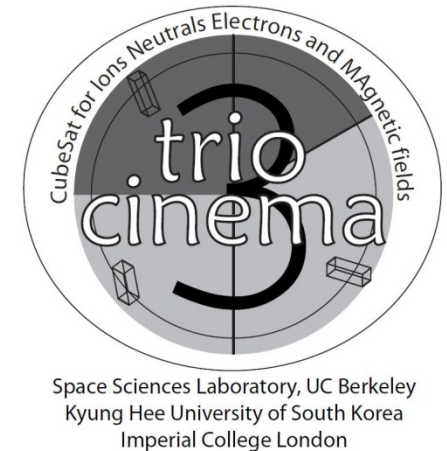


# TRIO-CINEMA: 3 CubeSats

- KHU has considerable funding through World-Class Universities programme
- Will build two additional CINEMA spacecraft
- Major student involvement
  
- Launch with, or soon after, CINEMA
  
- Benefits:
  - Redundancy
  - Stereoscopic ring current imaging
  - Multi-point particles and fields
- Imperial hopes to provide magnetometers (no funding at present)

# TRIO-CINEMA and the UK

- Ideal complement to existing assets
  - Preparation for RBSP?
  - Great link to ground-based magnetometers
- Clear space weather focus
- Lots of student involvement (about 20 at Imperial so far)
- Based on external funding: very cheap to UK
- CubeSats as a possible model for future UK spacecraft
- Question
  - How to leverage CINEMA involvement to get more UK money in space weather?



# CINEMA (Cubesat for Ions, Neutrals, Electrons, MAgnetic fields)

