# Compact Vector Magnetometer for Pico Satellites

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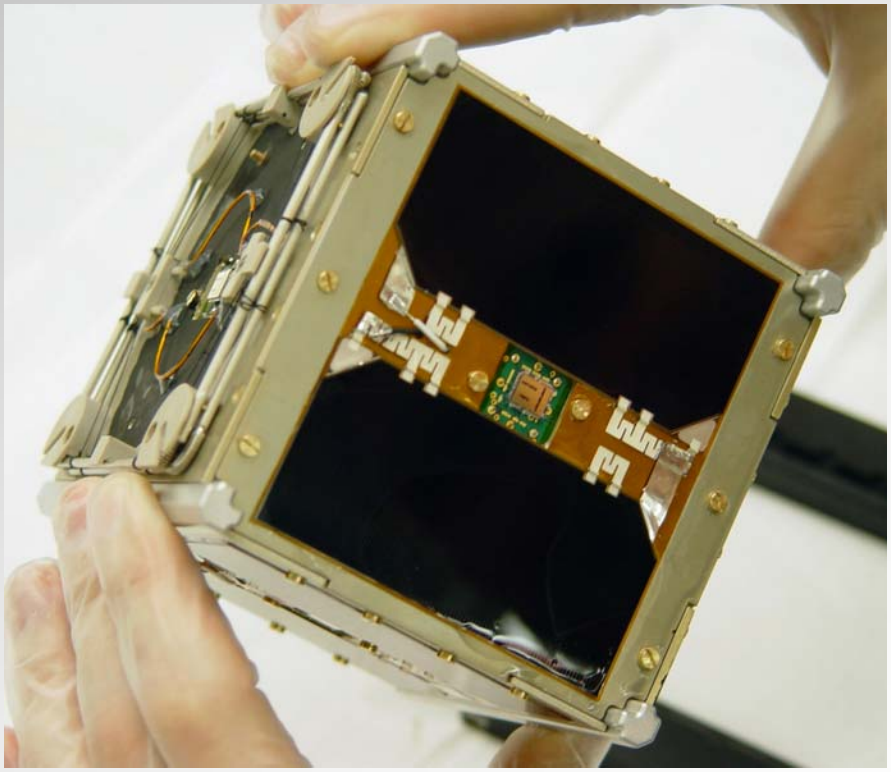
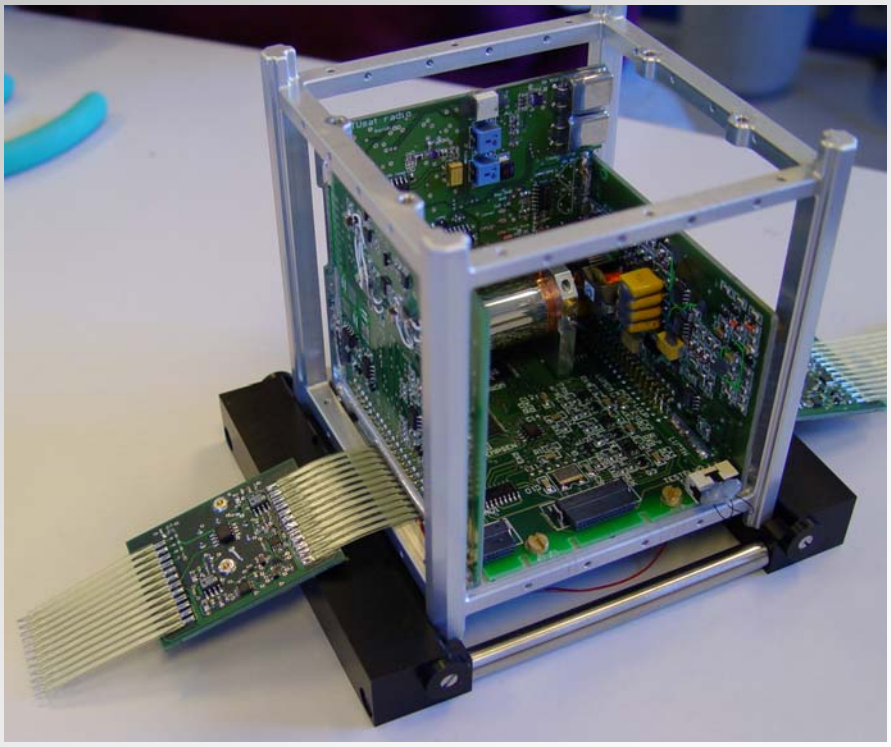


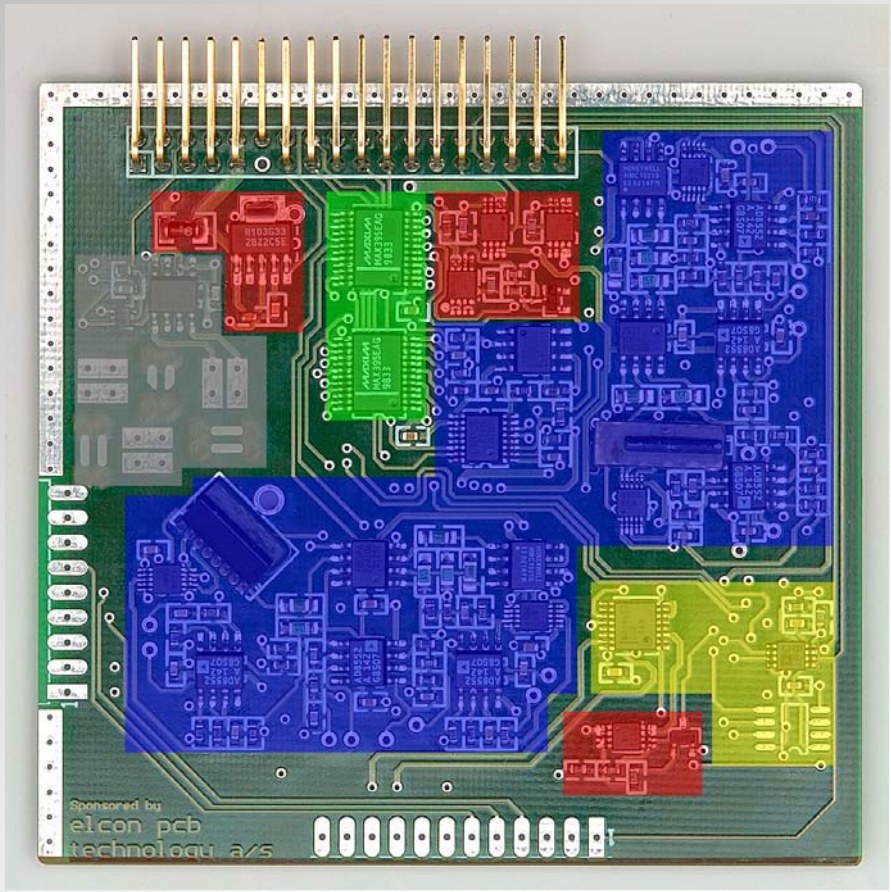
# DTUSAT – Student Project

- CubeSat concept
- Platform:
  - Power, Computer, Radio, and Attitude
- Payload:
  - Electrodynamic tether
- Approx. 20 man-years
- $150,000 budget



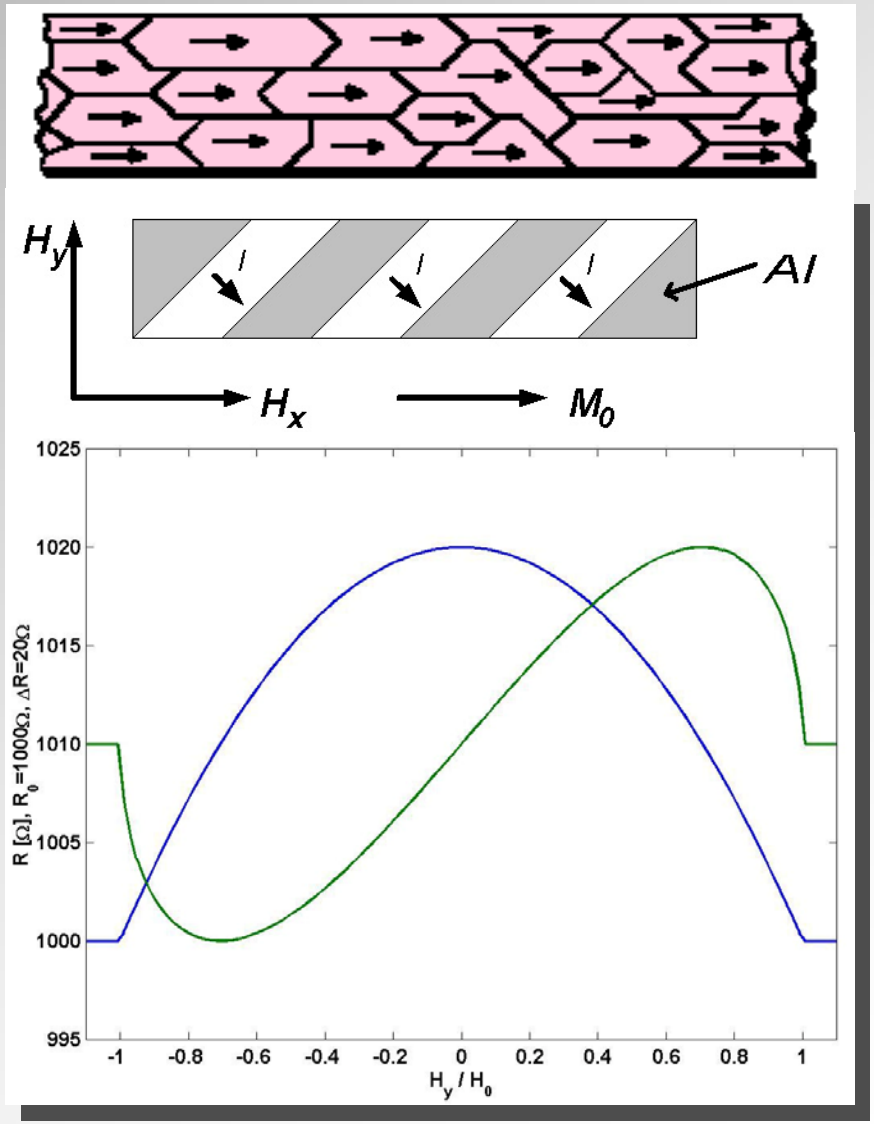
# ACDS/Magnetometer Subsystem

- Constraints:
  - Size: 80×84×10mm³
  - Mass: 35g
  - Power: 10mW(avg)
  - Temp: –10 to +70°C
- Requirements:
  - Range: ±50,000nT
  - Accuracy: 300nT~ 1°



# Magnetoresistive Sensor

- Permalloy thin film
- *Al*-mask added to achieve linear region
- Honeywell HMC1021
  - Wheatstone bridge
  - integrated set/reset coil
  - integrated bias coil



# Compensation Principles

1) Offset:
   - set/reset operation enables phase reversal from sensor to ADC
2) Linearity:
   - closed loop operation using bias coil makes the sensor operate in constant field
3) Noise:
   - low pas filtering, both analog and digital

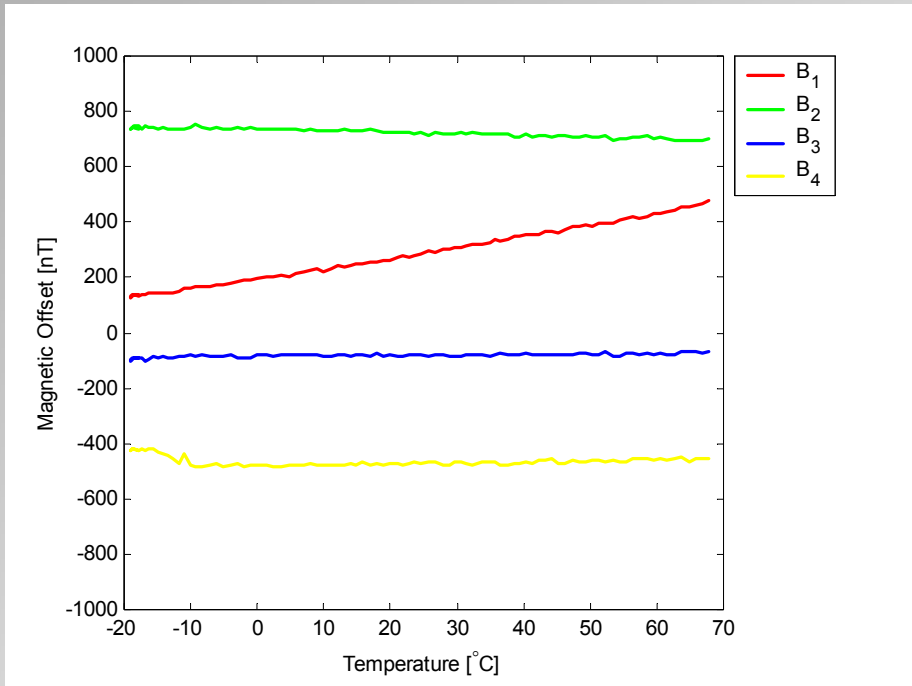
System equations from 1) and 2):

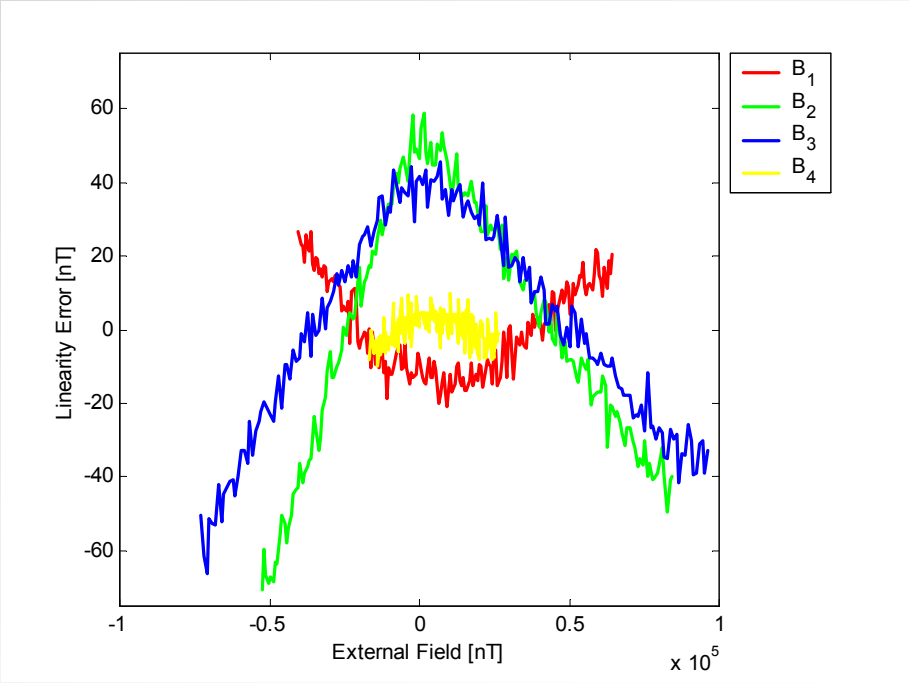
$$EU_{ADC} = \pm \frac{A_{buffer} A_{I-to-V}}{S_{bias} V_{LSB}} B_{ext} + \frac{V_{offset}}{V_{LSB}}$$

$$EU_{comp} = \frac{EU_{ADC,reset} - EU_{ADC,set}}{2} = \frac{A_{buffer} A_{I-to-V}}{S_{bias} V_{LSB}} B_{ext}$$

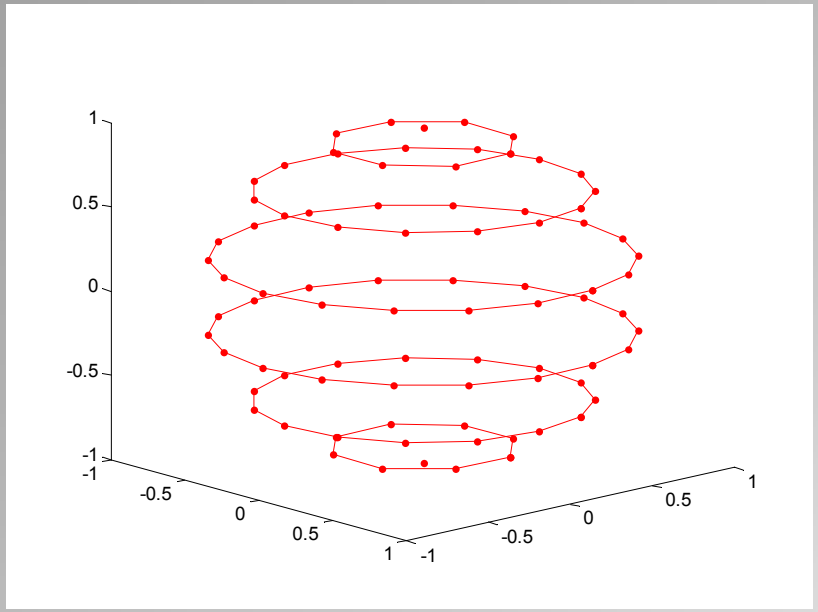
# Performance

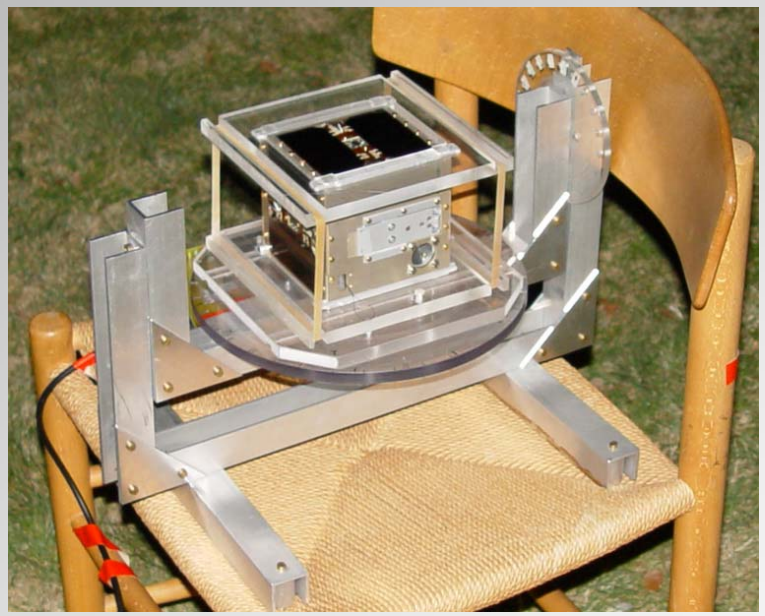
- Offset error is 800nT and highly linear; linearity error is 30nT
- Linearity error is 60nT, but could be reduced to 20nT
- Noise is $15nT_{rms}$

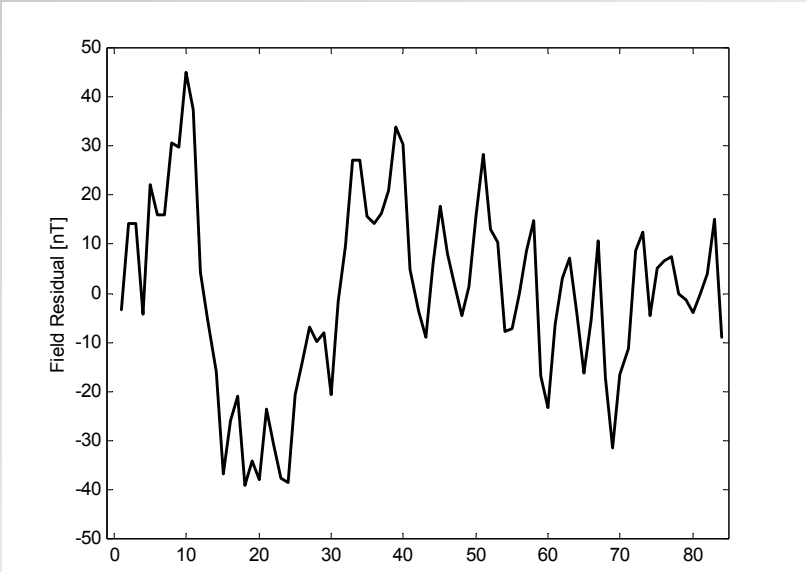


# Scalar Calibration





# Summing Up

- Performance: 90(50)nT resolution, 45nT$_{peak}$ noise
- Launched June 30$^{th}$ from Plesetsk, Russia
  - no transmission received from DTUsat
- Project home page: www.dtusat.dtu.dk