

The Magnetometer payload for the RADICALS mission

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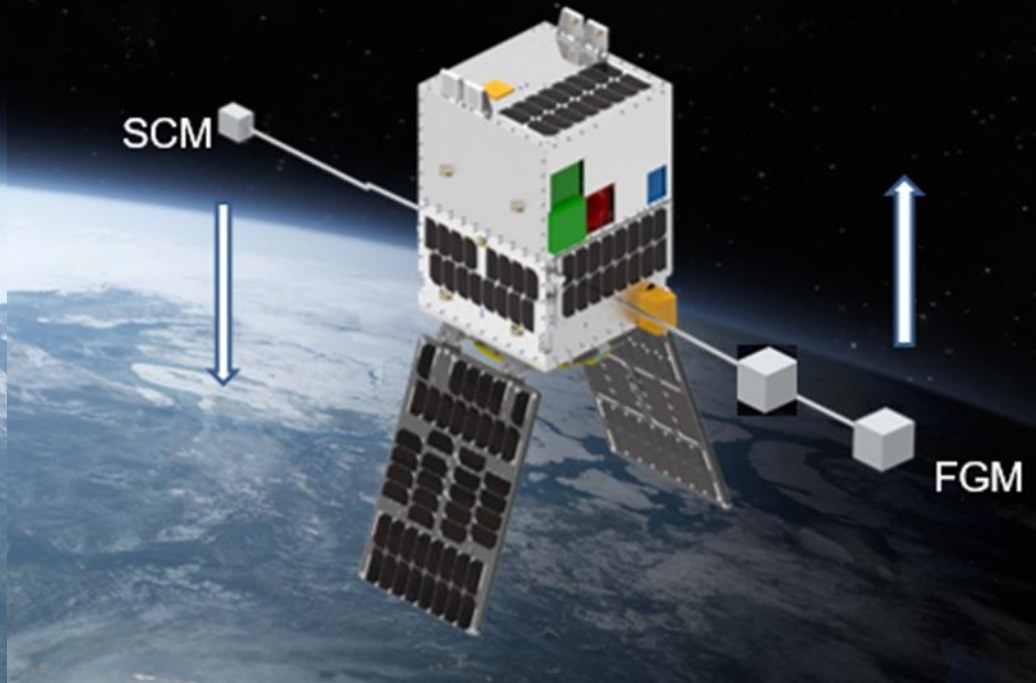


Magnetometers are needed to address the RADICALS science goals

What processes control the precipitation of space radiation into the atmosphere?

Instrument	Measurement	Motivation
Fluxgate Magnetometer (FGM)	Earth's vector B field DC	Determine Pitch Angle for HEPT measurements
	ULF and EMIC waves. (1 mHz - 10 Hz) > 100 pT	Assess role of plasma waves in scattering of radiation belt electrons into the loss cone
Search Coil Magnetometer (SCM)	ELF/VLF waves Chorus, Hiss, VLF transmitters (~200 Hz - 30 kHz) < 100 pT	Assess role of plasma waves in scattering of radiation belt electrons into the loss cone

The RADICALS Magnetometer Payload



Instrument Requirements

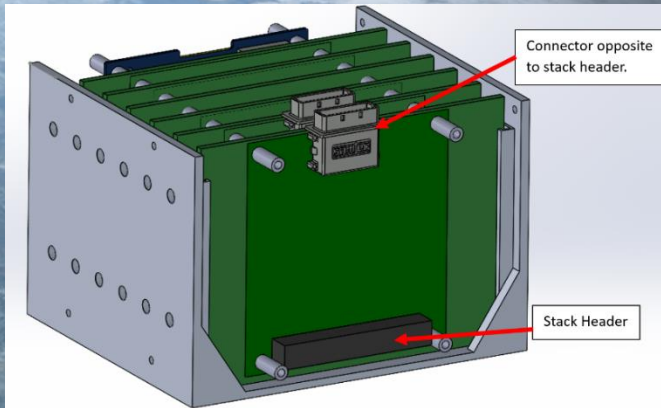
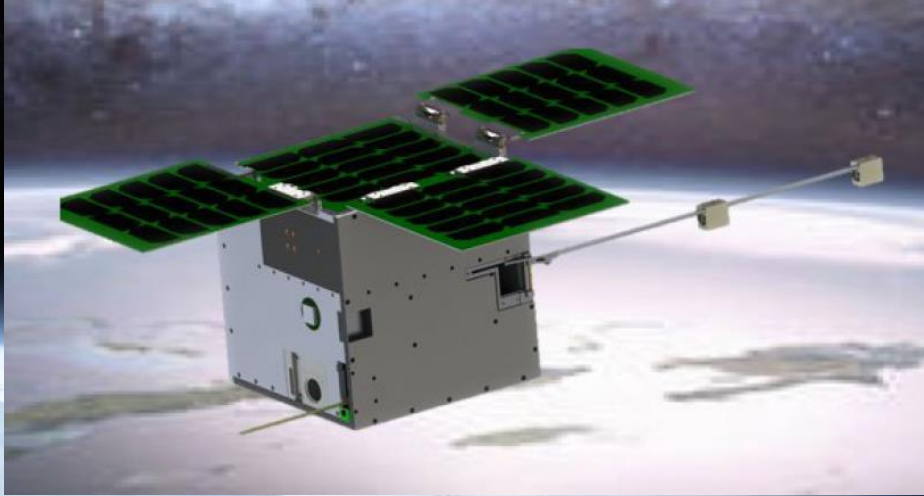
Science Goals \longrightarrow Measurement Requirements \longrightarrow Instrument Requirements

Instrument Requirement		Required performance	Projected performance
FGM	Range	+/- 65,536 nT	+/- 65,536 nT
FGM	Resolution	0.1 nT	0.01 nT
FGM	Minimum Sampling rate	20 sps	100 sps
FGM	Frequency Range	DC – 10 Hz	DC – 50 Hz
SCM	Amplitude Range	+/- 100 nT	+/- 10 nT
SCM	Resolution	10 pT at 1 kHz	< 1 pT at 1 kHz
SCM	Frequency Range	160 Hz to 30 kHz	160 Hz to 30 kHz
SCM	Sampling Rate	120 ksps	120 ksps
FGM SCM	Saturation Limit	31,000 nT/s at 0.1 Hz	31,000 nT/s at 0.1 Hz

FGM Heritage

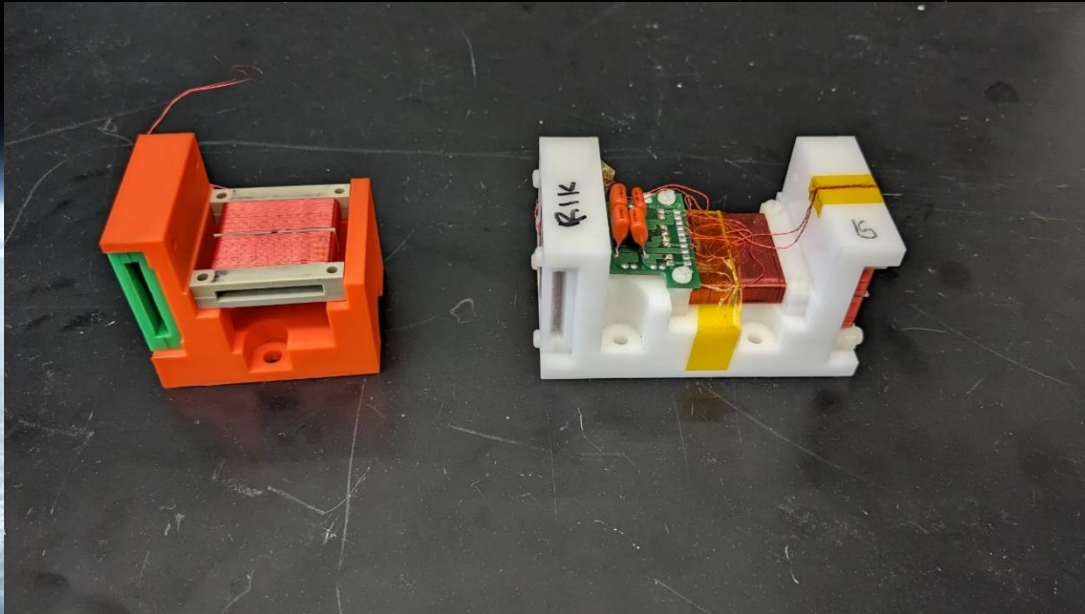


InspireSAT 3

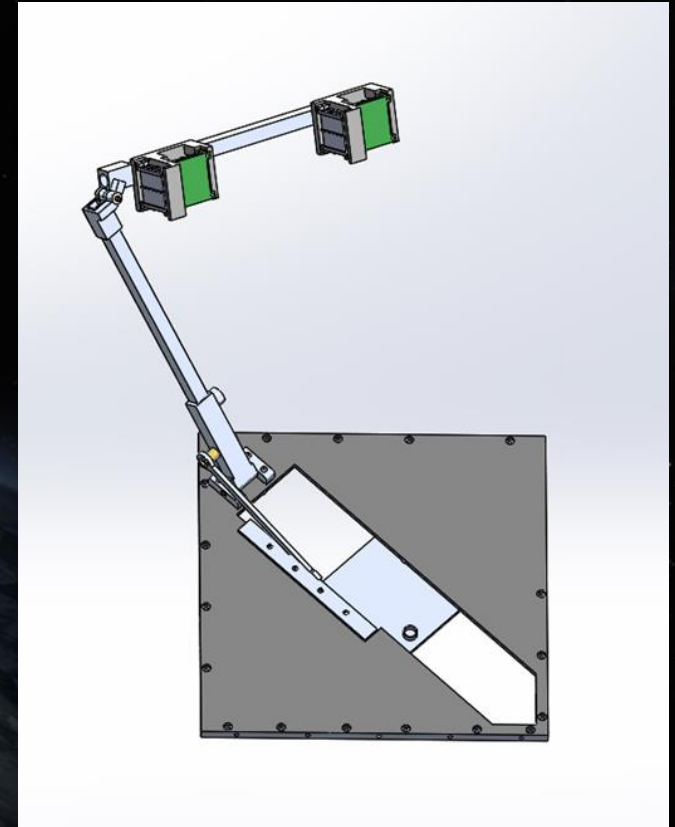


Integration and FlatSat testing at
LASP, summer 2024

Sensor Head and Boom Design

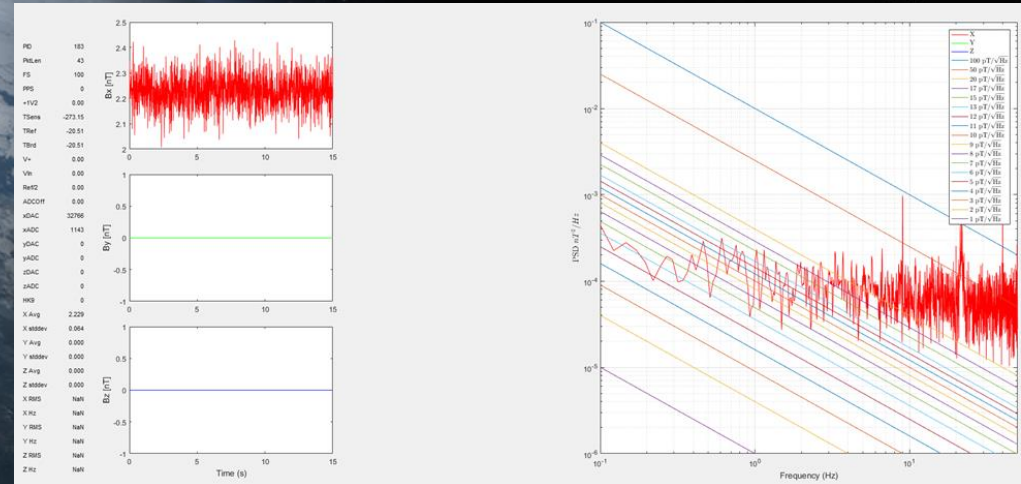
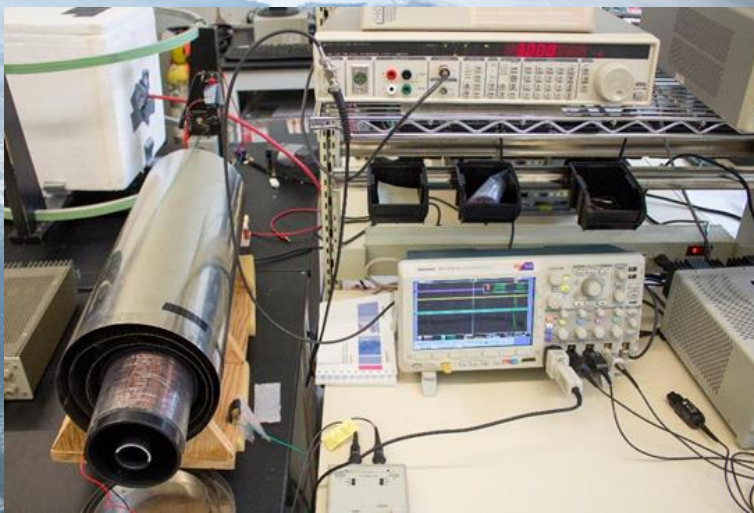
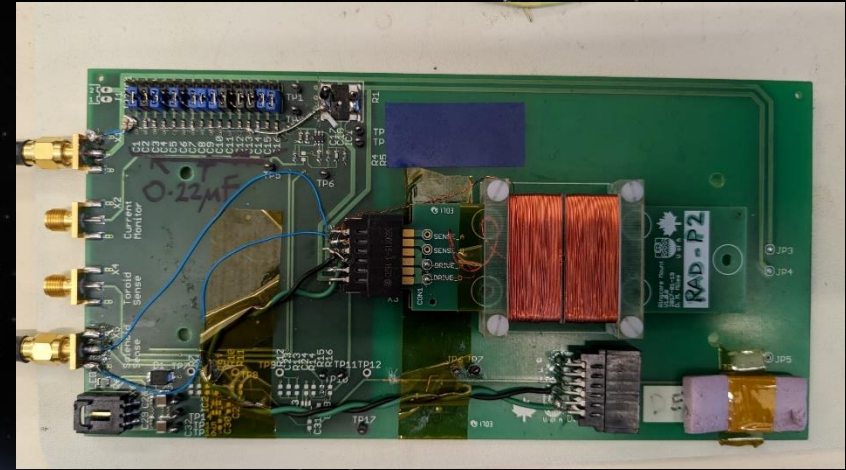
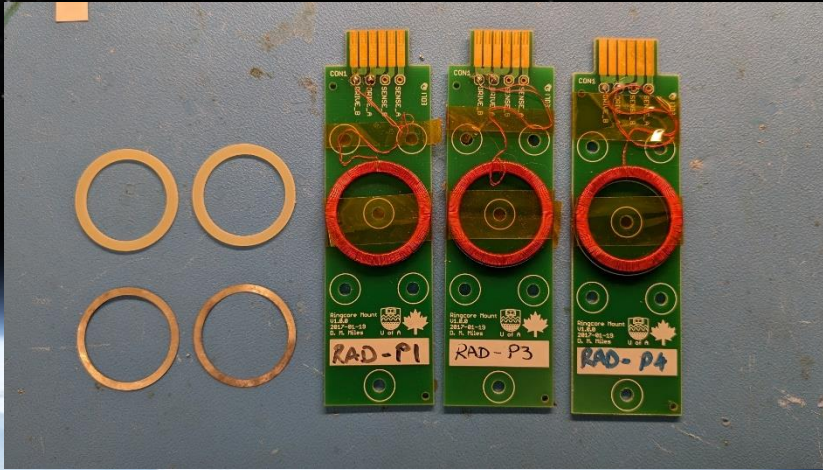


IS-3/RADICALS FGM sensor vs ground-based



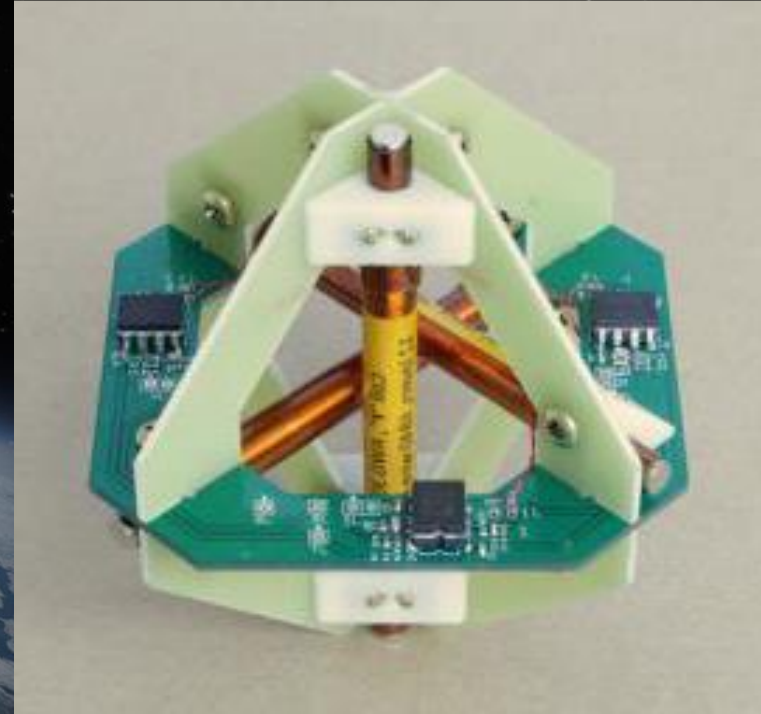
IS-3 FGM Boom

Ringcore Tests



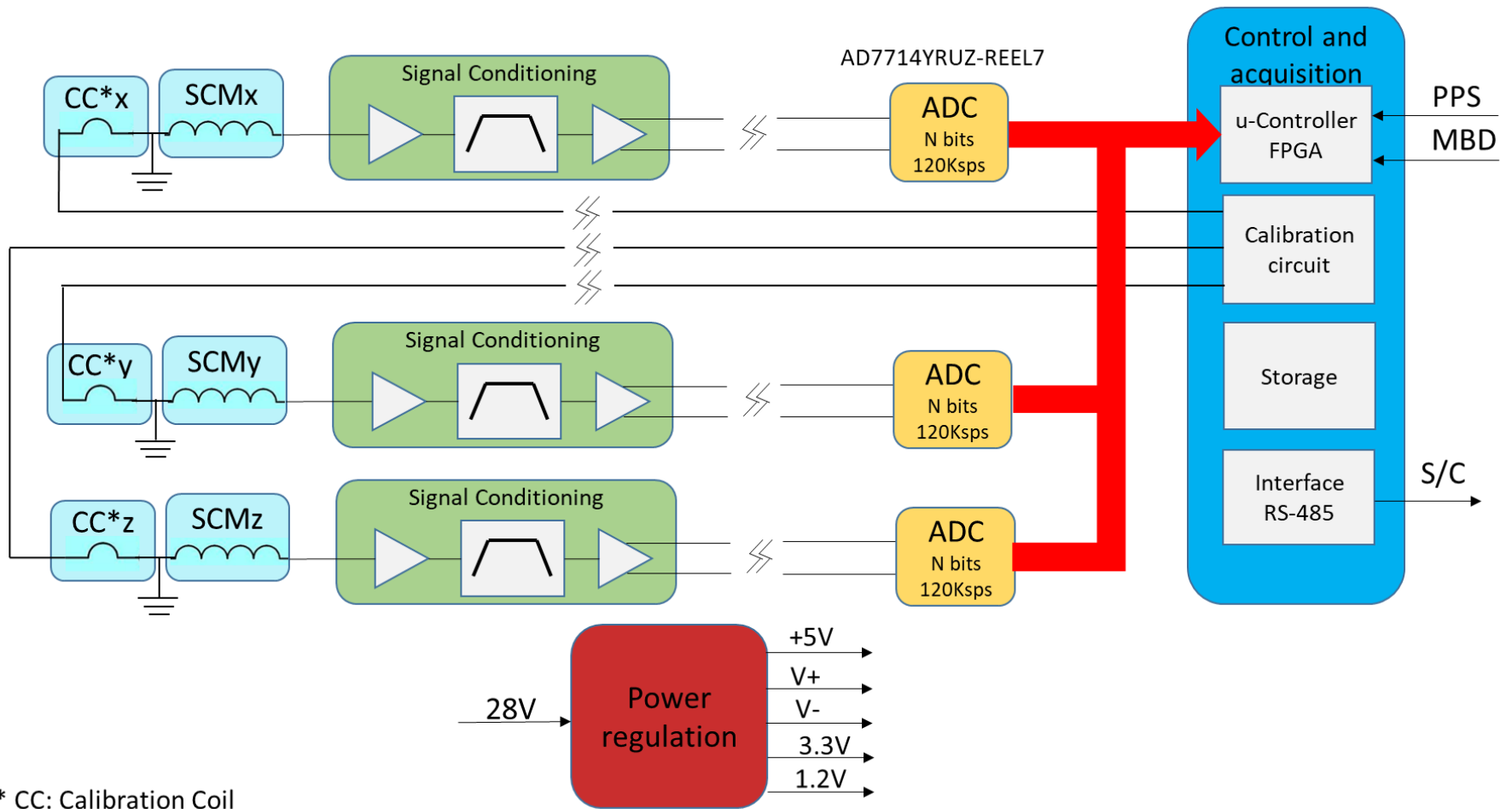
Search Coil Magnetometer (SCM)

Property	Value
Amplitude measurement range	+/-10 nT (TBD)
Frequency measurement range	200 Hz to 50 kHz
Noise floor at 1 kHz	~0.1 pT/vHz
Power consumption (Vs = +/-9 V)	220 mW
Permalloy Core length	95 mm
Sense Coil Length	60 mm
Sense coil construction	12 layers x 570 turns of AWG 39 wire
Envelope dimensions	85 x 85 x 98 mm
Mass (without cable)	170 g



SCM for EPEX Balloon mission

Search Coil Magnetometer (SCM) Block Diagram



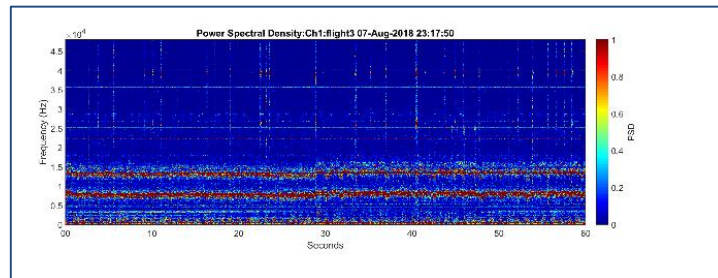
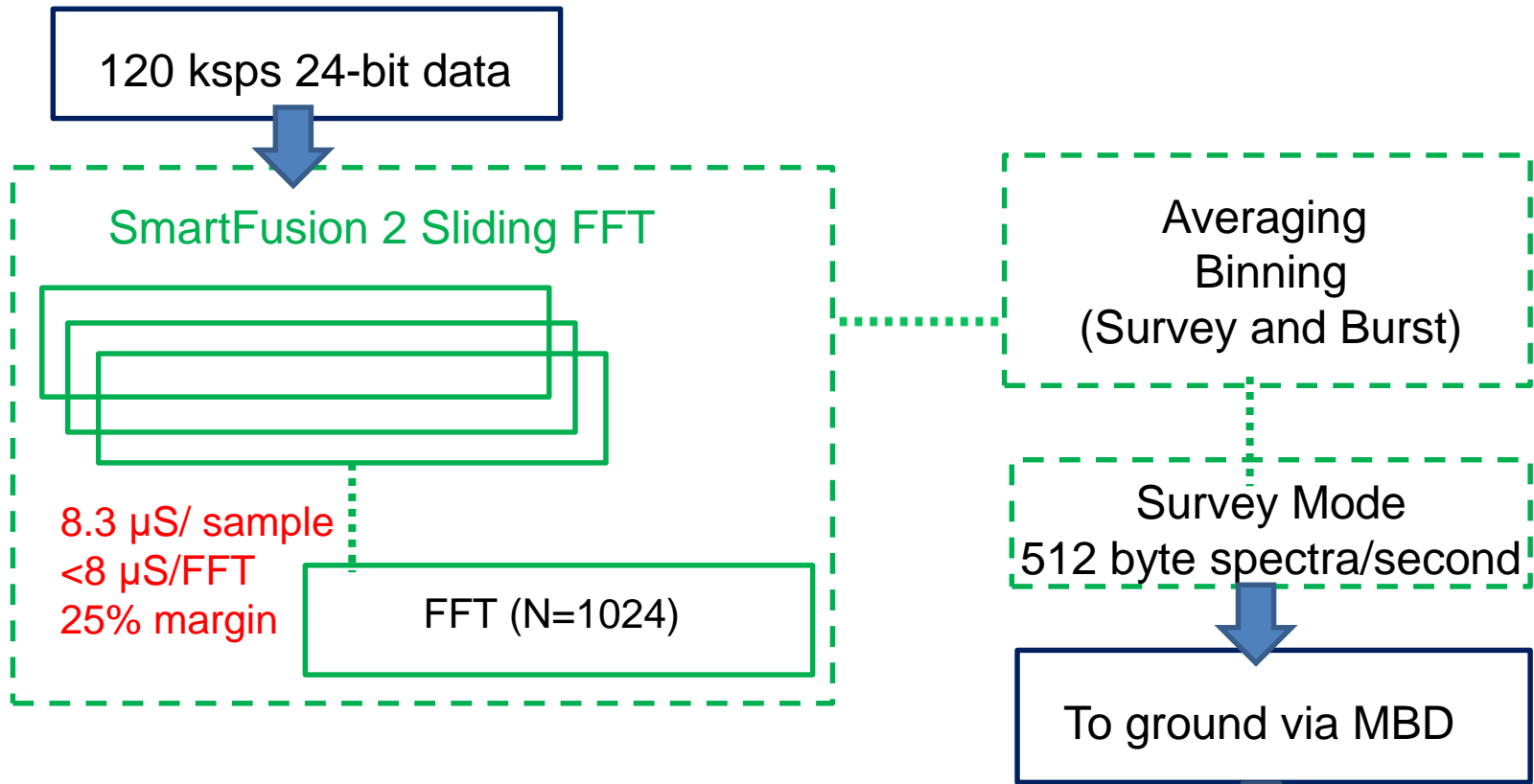
* CC: Calibration Coil

PEPPER-X Sounding Rocket

- Single Axis SCM will be flown on a sounding rocket from Wallops later in 2024
- De-risking and testing of sensor, pre-amp, filter stages as well as data product generation.
- **Details in talk by Erik Halliwell at 15:30 today**
- Note that the RADICALS Microburst Detector (MBD) will trigger burst mode data collection in the SCM.
- **Details in talk by Anant Kumar T.K. in 20 minutes.**



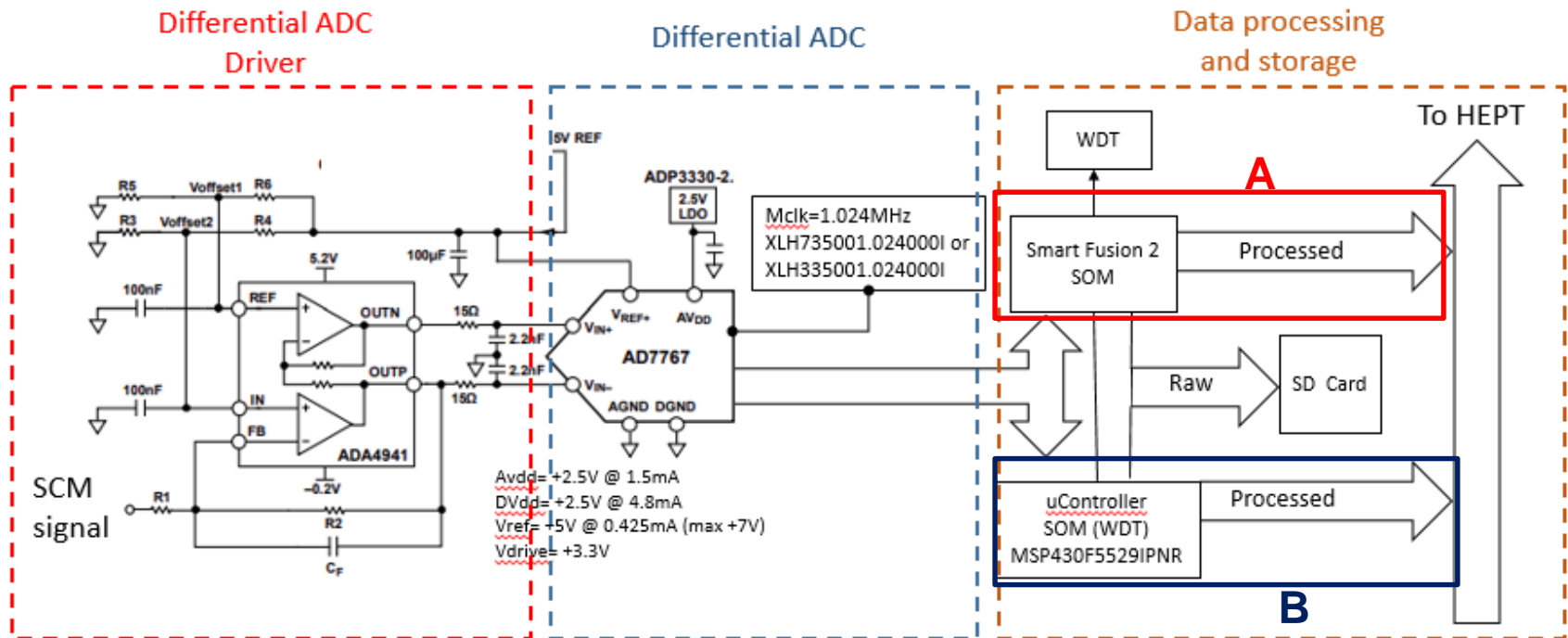
Spectral Product Software (Simulation)



Thank You



SCM Block Diagram



Option A: SmartFusion 2

Option B: Microcontroller TI MSP430

SCM Frequency Response

