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# Analog Electronics

Bill Crain

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# Bio

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Bill Crain, Sr. Research Engineer

The Aerospace Corporation

Space Science Applications Laboratory (SSAL)

- NASA Programs
  - TWINS (Two Wide-angle Imaging Neutral-atom Spectrometers) System Engineer / DPU Designer / I&T Lead (1997 to present)
  - TIMED/GUVI (Global Ultraviolet Imager) Instrument DPU Designer (1995 to 1997)
  - POLAR/CAMMICE (Charge And Mass Magnetospheric Ion Composition Experiment) Instrument DPU Designer and I&T Lead (1990 – 1995)
- Non-NASA programs
  - HiLET (High Linear Energy Transfer) Instrument Designer (2003 – present)
  - Dosimeter / Surface Charging Monitor Lead Engineer (2002 – 2004)
  - LENA (Low Energy Neutral Atom) Imager Lead Engineer (1994 – 1995)
  - Clementine Charged Particle Telescope Designer (1993)
- Internal Research Projects
  - Advanced Dosimeter Integrated Circuit Hybrid (2001 – present)
  - ESD Recorder Device for Spacecraft (2005)

# Status (1/3)

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- Analog electronics comprised of two printed circuit board designs
  - 3 Detector Boards in Telescope assembly
  - 1 Analog Processing Board (APB) in E-box
- Heritage approach from Polar CEPPAD/IPS unchanged from proposal
  - Amptek components are the right choice for CRaTER
  - Circuits optimized for CRaTER requirements
- Design plan
  - Low noise for good resolution
  - Low heat dissipation in telescope
  - Dynamic range wide enough to provide overlap between thick and thin detectors
  - Inflight calibration
  - Robust to temperature swing and signal overload conditions

## Status (2/3)

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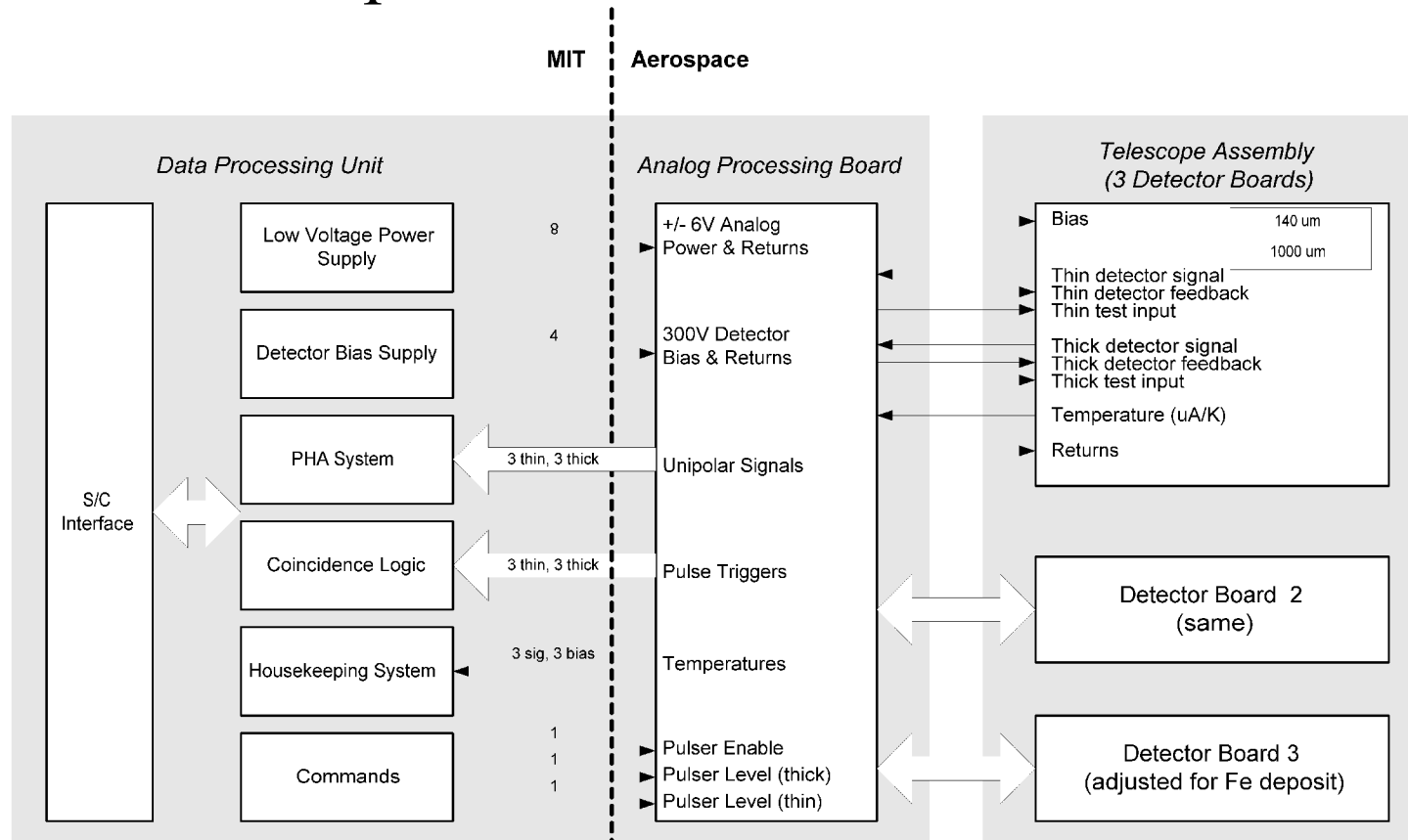
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- Requirements development for Analog Electronics on track for PDR

Requirement	Thin Detectors	Thick Detectors
Number of Channels	3	3
Matching	Same w/in 10% (TBD)	Same w/in 10% (TBD)
Max. Energy Deposit	1.25 GeV Fe	100 MeV H+
Low E Threshold	2 MeV	200 keV
Noise (Resolution)	< 30 keV rms	< 30 keV rms
Max. Singles Rate	< 10 kHz	< 10 kHz
Output	Linear / Log (TBD)	Linear

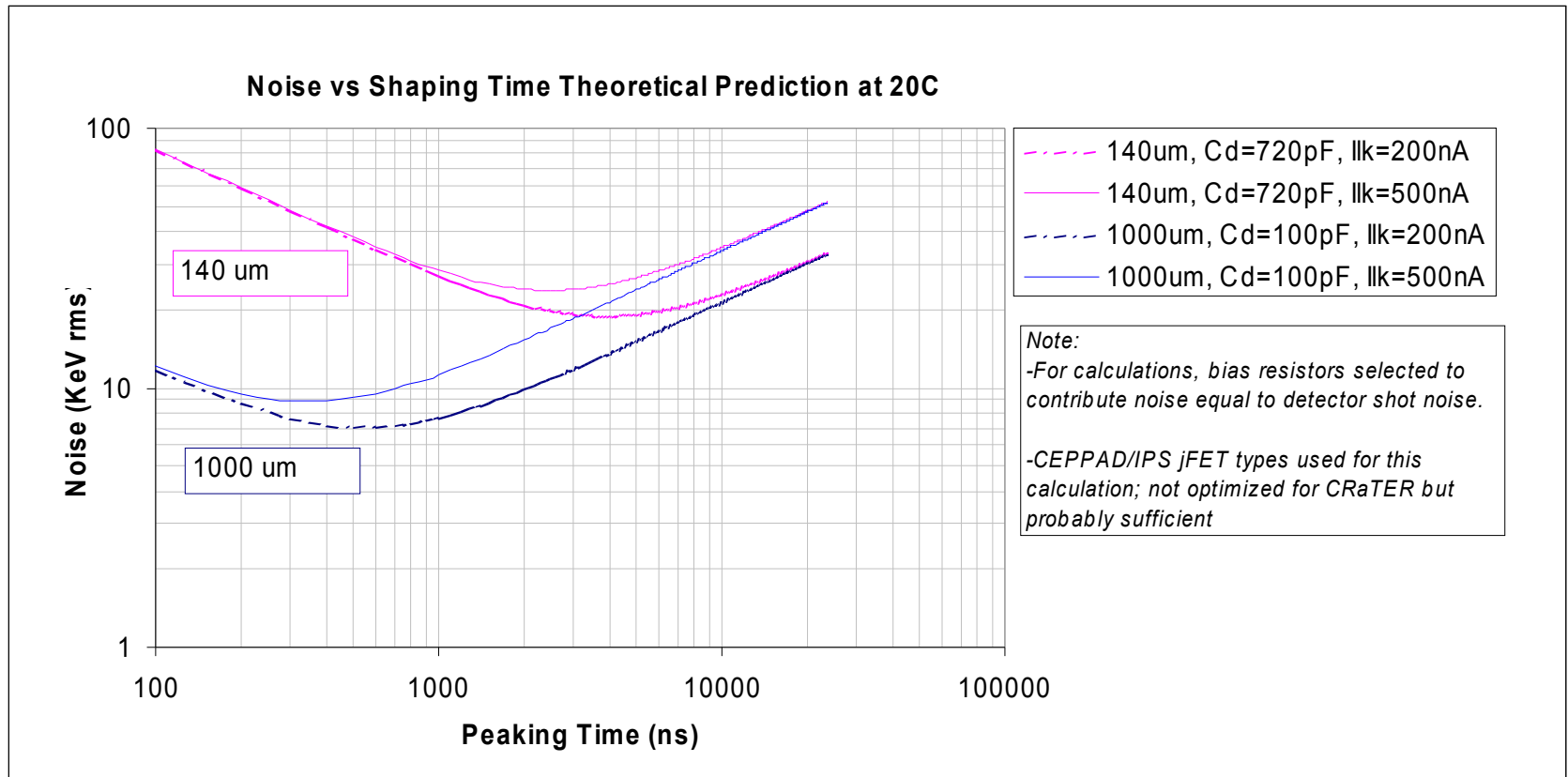
# Status (3/3)

- Interface partitioning defined and ready for detailed ICD development



# Noise Prediction

- Random noise calculations for typical and max leakage currents give  $<30$  keV in thin detector and  $\sim 10$  keV in thick detector at optimum shaping times



# Issues/Questions

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- Detector boards will perform best at colder temperatures
  - Thermal isolation may be beneficial, especially between Ebox and Telescope
- Susceptibility concerns
  - Microphonics
  - Chassis common mode coupling to front and back detectors (consider isolating CRaTER mounting interface)