Dust Science:
High-Performance In-Situ Dust Analyzer (Hyperdust)

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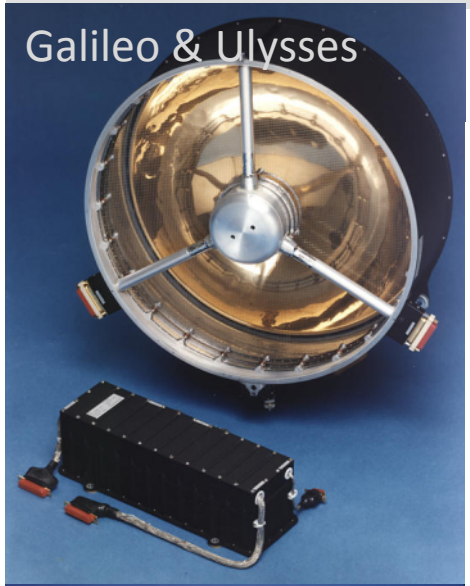
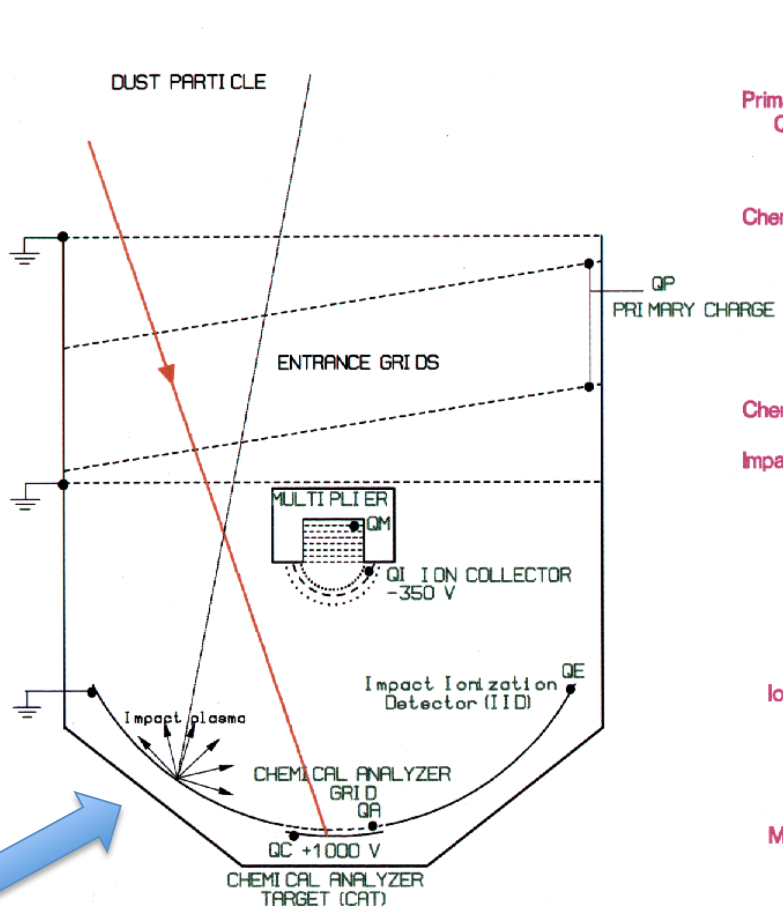
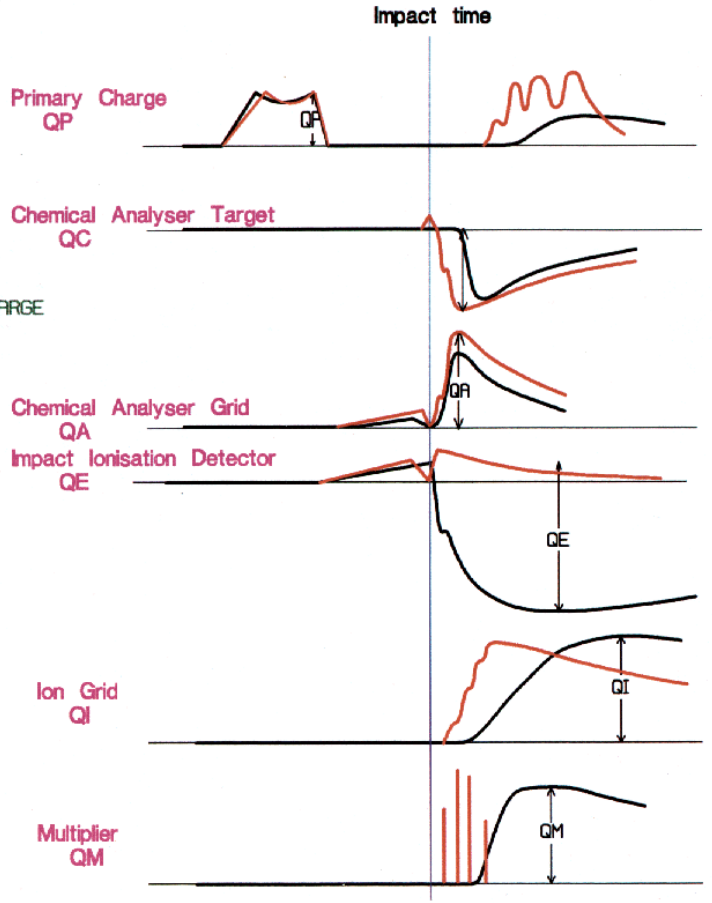
Galileo, Ulysses & Cassini dust instruments

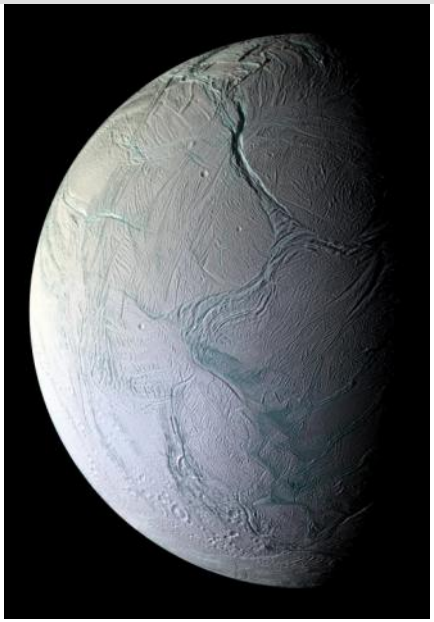


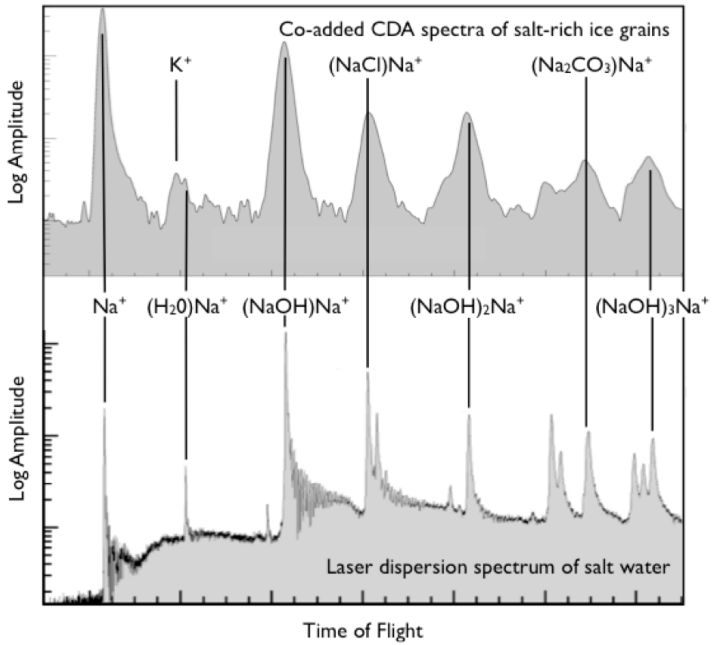


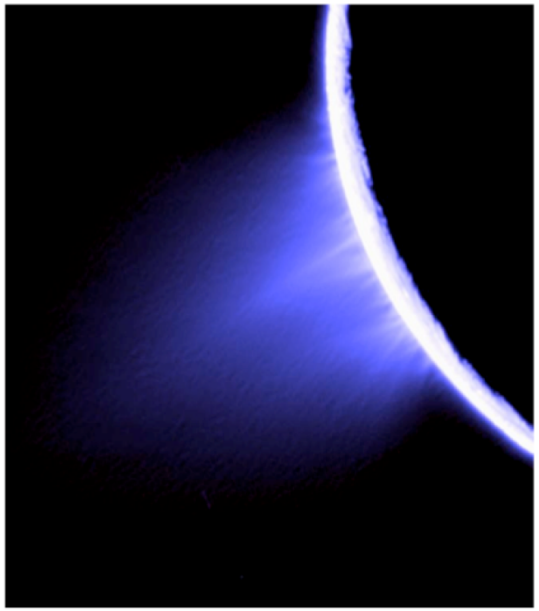


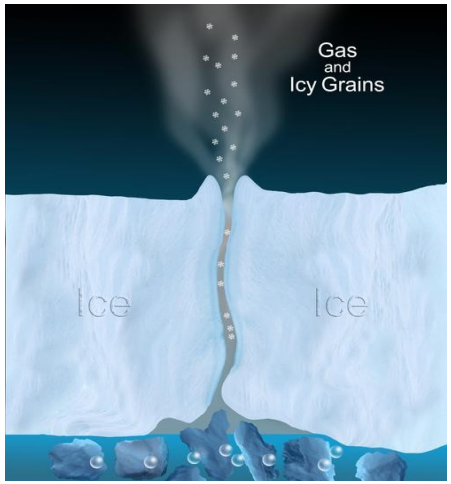
M/dM ~ 20-30

Plumes of Enceladus: planetary science with a dust analyzer



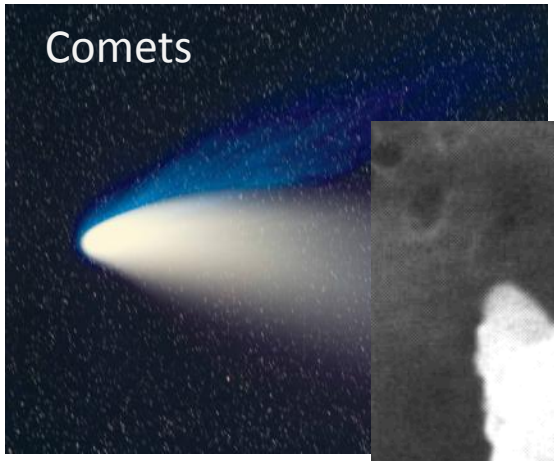


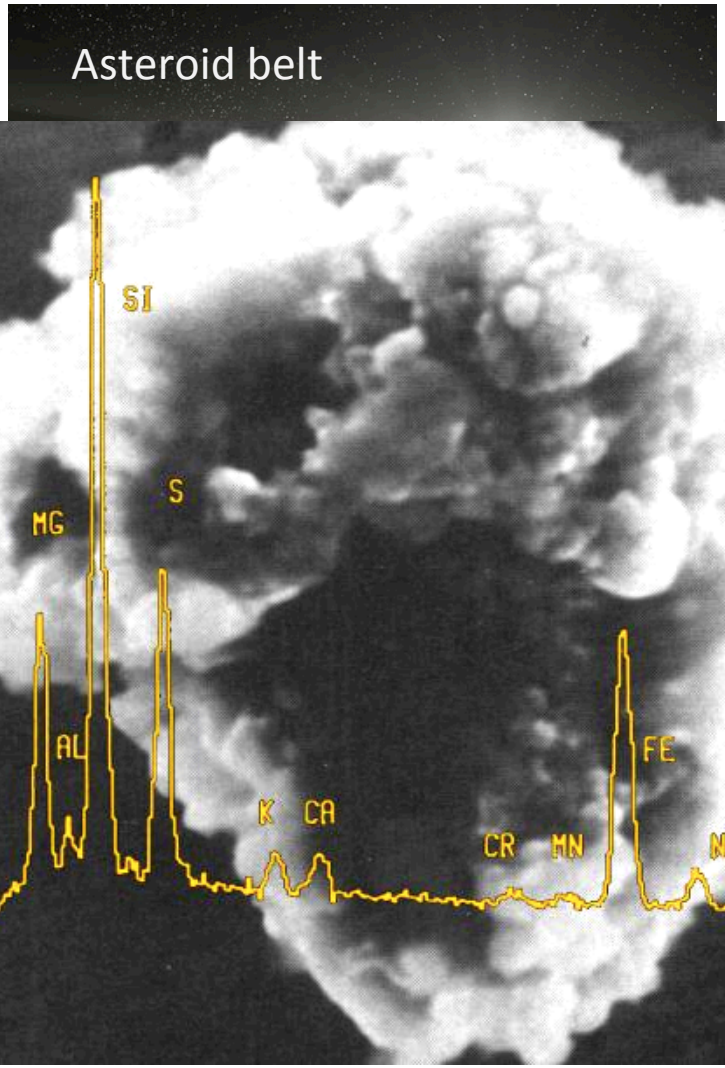


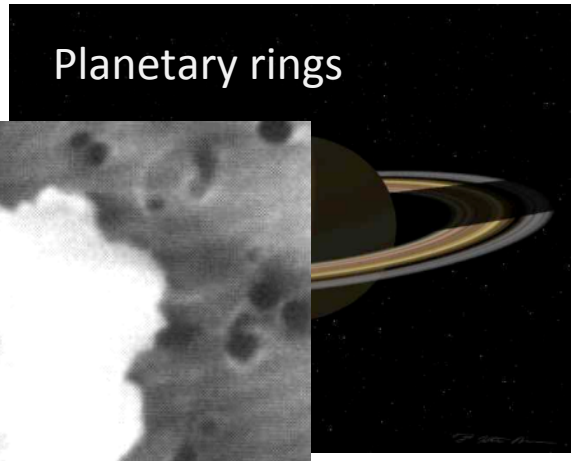


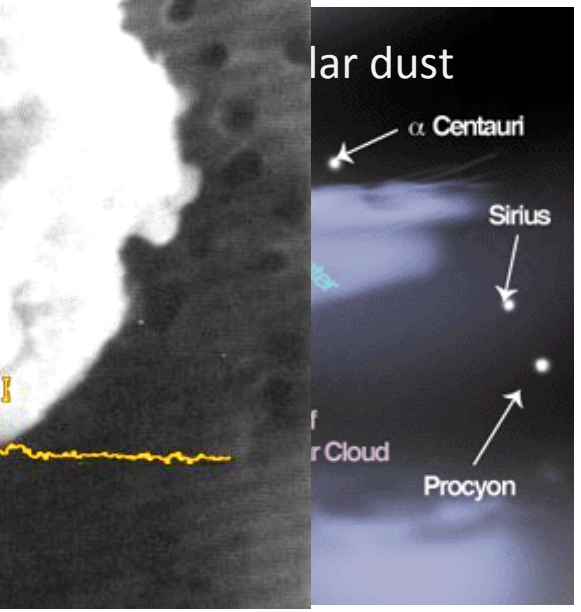
- Pronounced signatures of sodium and potassium salts in a water matrix
- Spectra benchmarked against laboratory measurements
- Physical picture of vents (Postberg et al., Nature 2009)

Dust is abundant within the Solar System

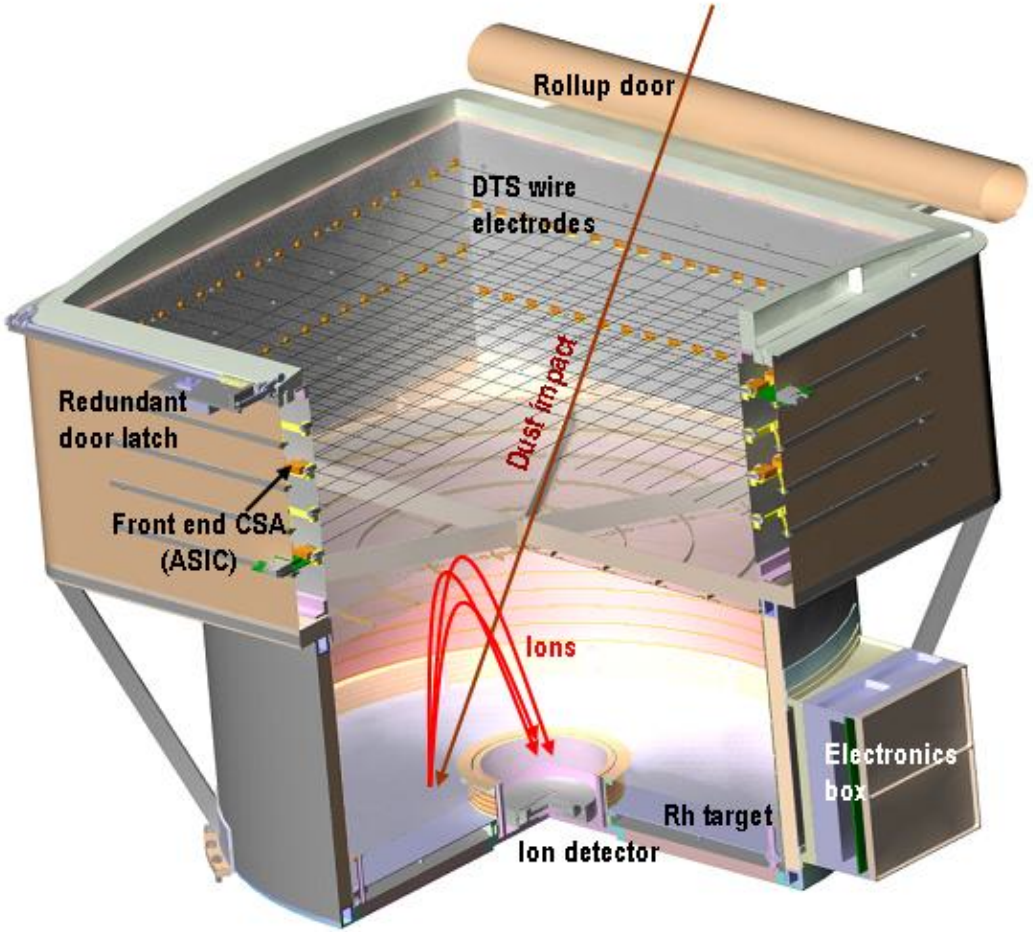








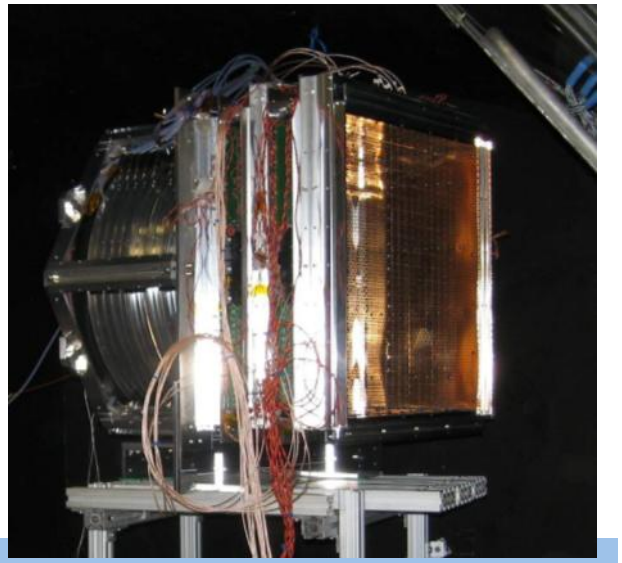
Advanced Dust Analyzer: Dust Telescope



Effective target area: ~ 0.1 m^2

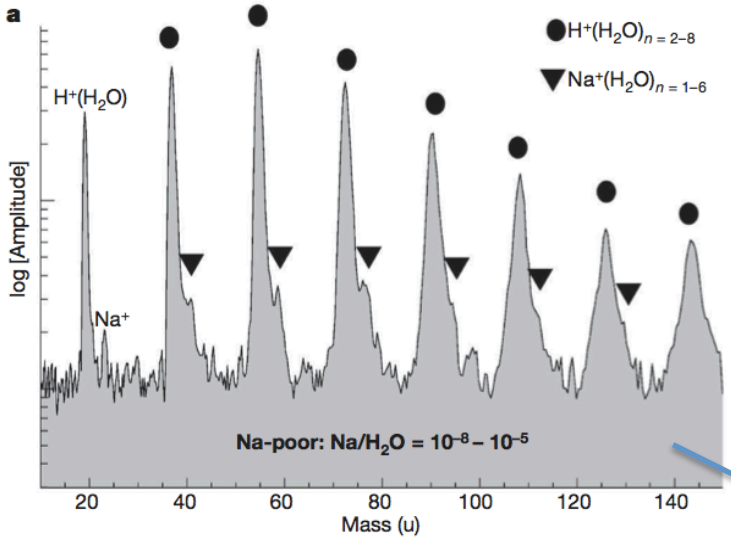
Velocity: < 1% accuracy
Direction: < 1 degree

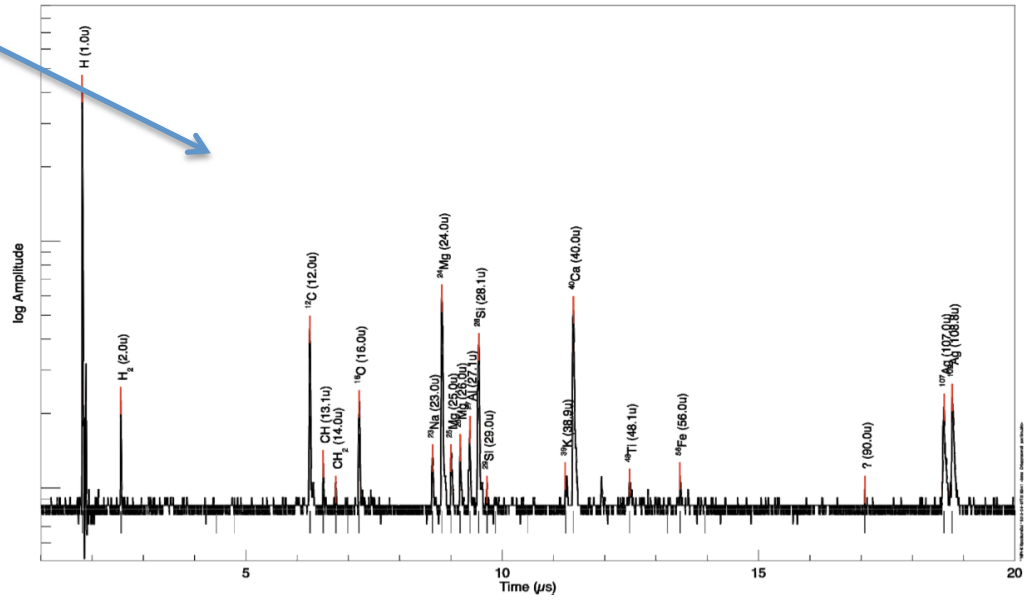
Mass resolution: M/dM > 200



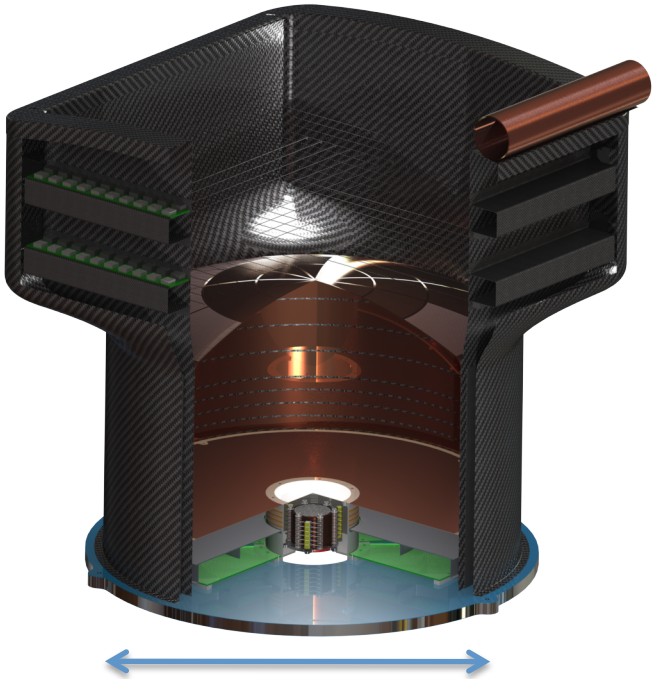
Dust Trajectory Sensor + Chemical Analyzer

Performance increase (M/dM >= 200)

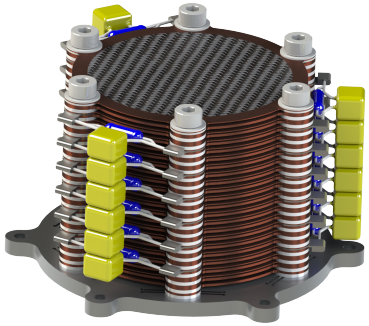




Hyperdust development definition



40 cm



- **Low mass instrument** using composite materials and shape optimization
- **High dynamic range ion detector**
- Multichannel electronics (**ASIC**) for accurate dust trajectory measurements
- Develop to **TRL 6**
- Current **TRL is 4+**

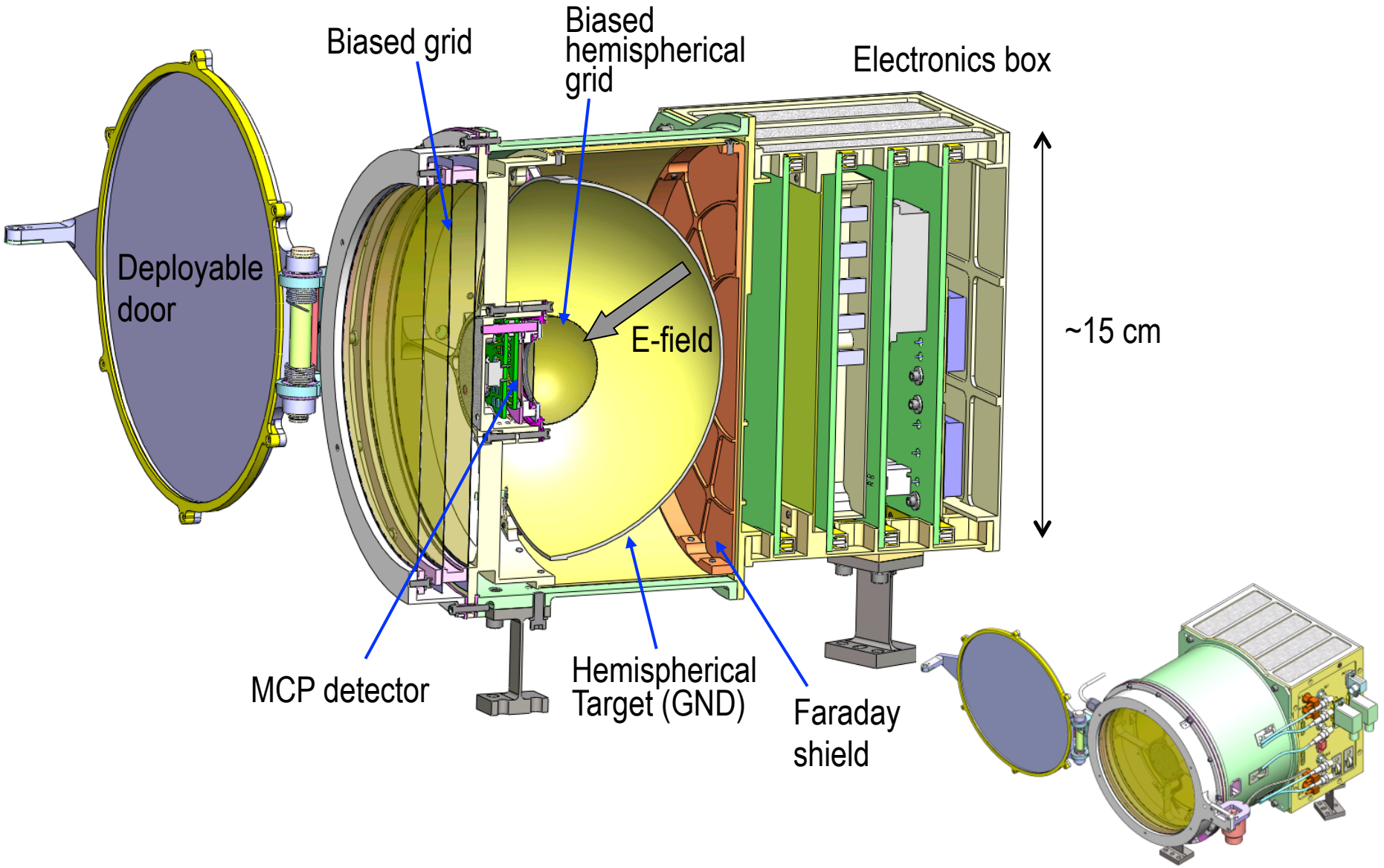
- Current status: CDR is the summer of 2014

Table 2. Characteristics of dust analyzer instruments

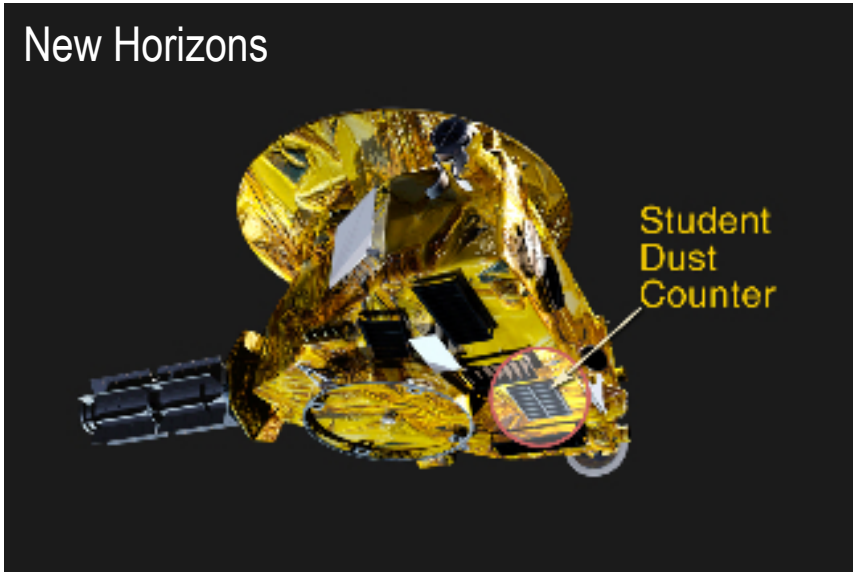
Type	CDA	PIA/PUMA/CIDA	Dust Telescope*	*HyperDust***
Spectrometer	Linear TOF	Reflectron TOF	Reflectron TOF	Reflectron TOF
Mass res. (M/dM)	< 50 (20-30 typical)	~ 100-200	≥ 200	≥ 200
Trajectory meas.	Yes, 2 axis	No	Yes, full 3D	Yes, full 3D
Sensitive area [cm^2]	160 (chem. analyzer)	5-90	600	600
Mass [kg]	**17**	**19** (PUMA)	**11.3**	**5.5**

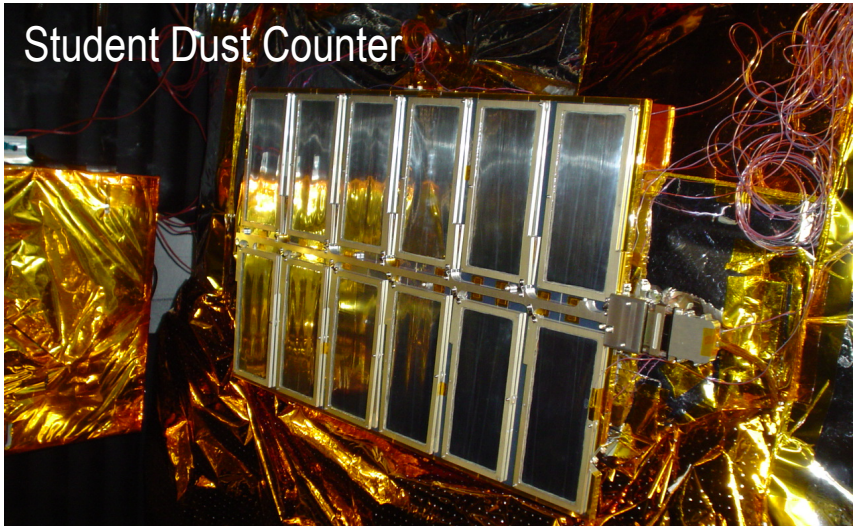
Ion detector dynamic range >10^6

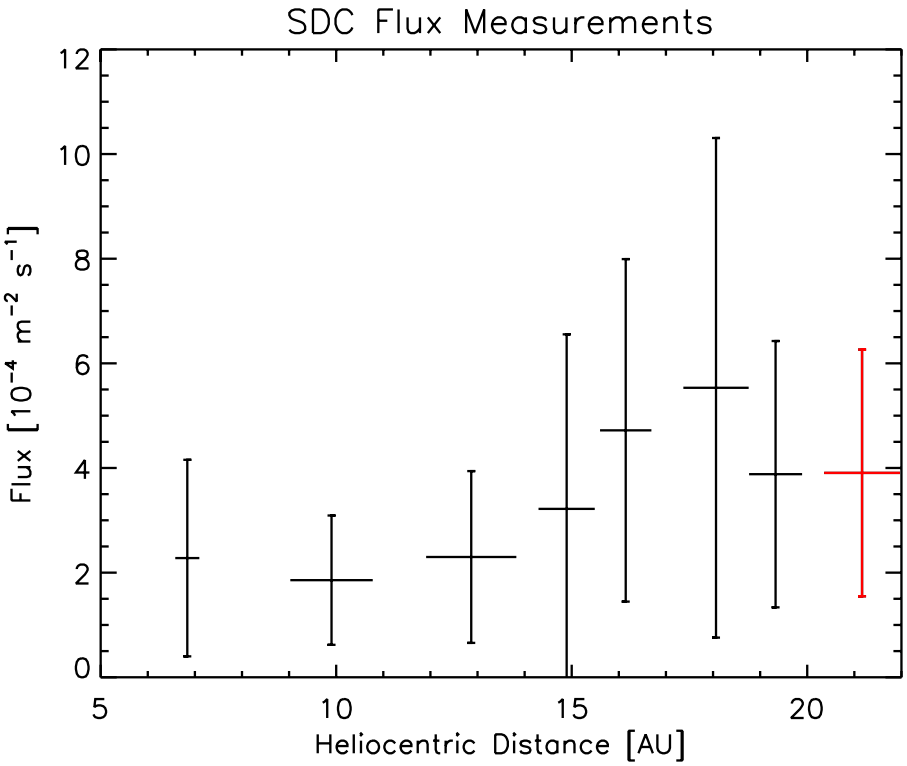
LDEX Instrument



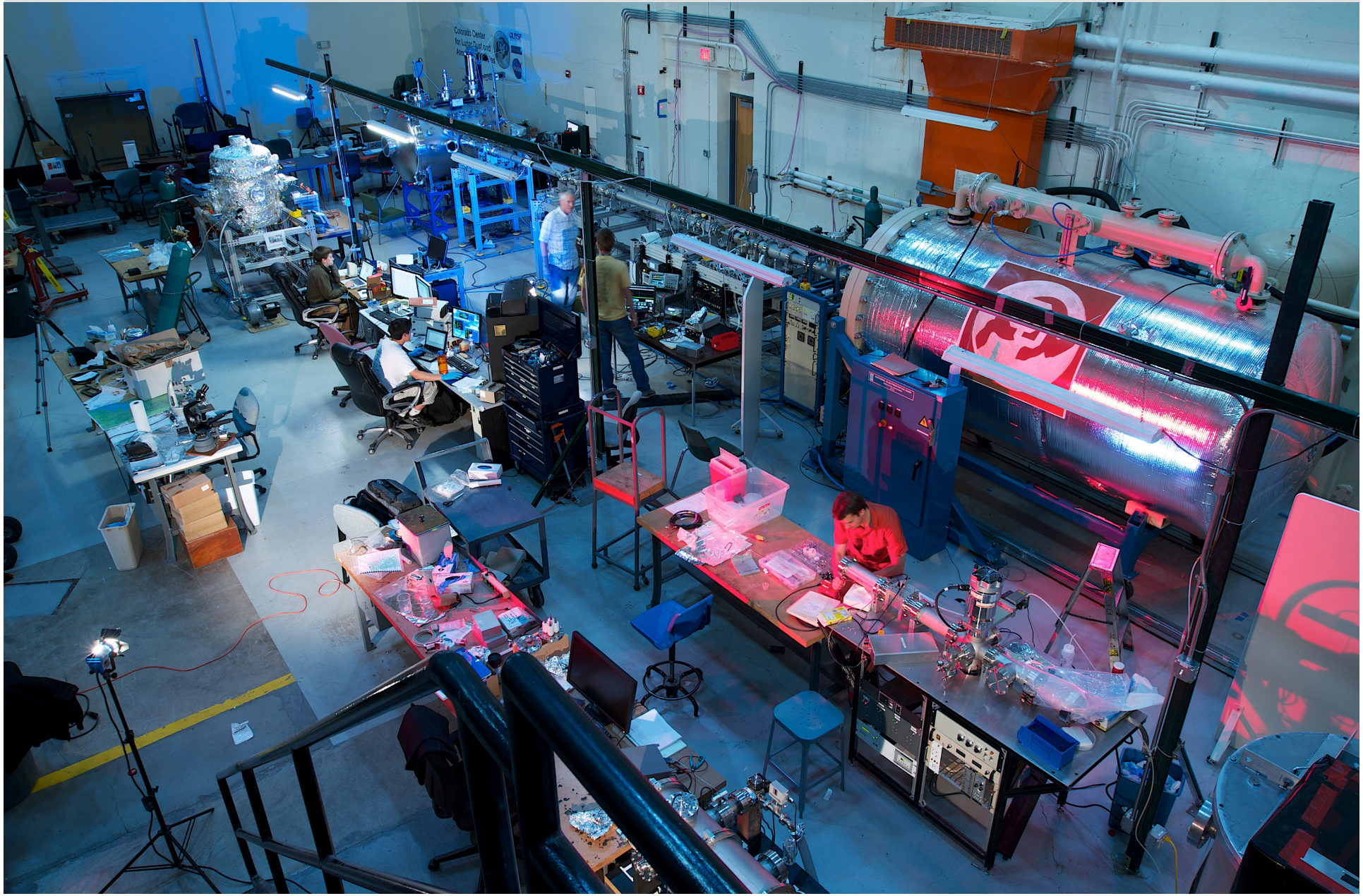
Student Dust Counter (SDC): PVDF dust detectors





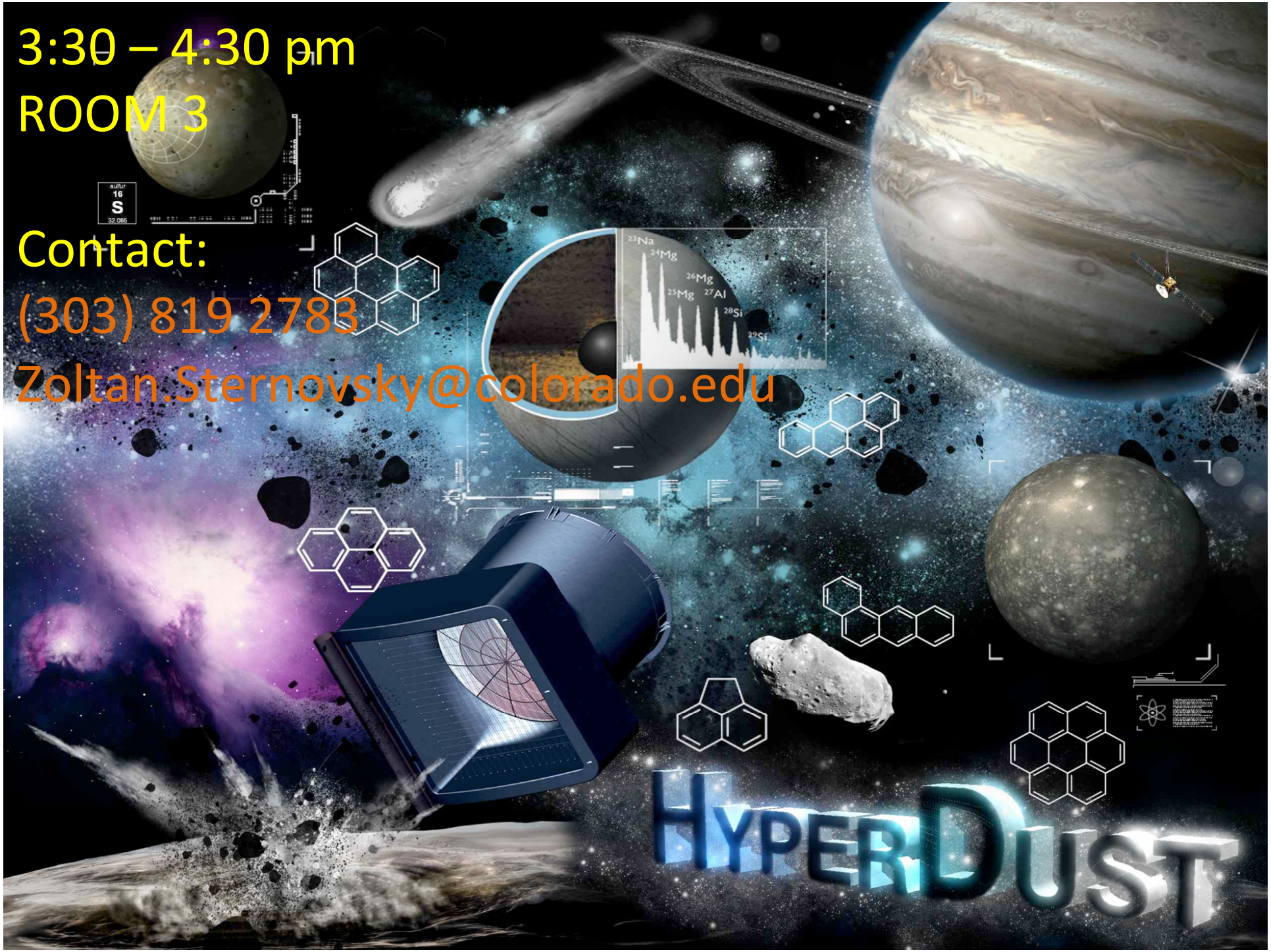


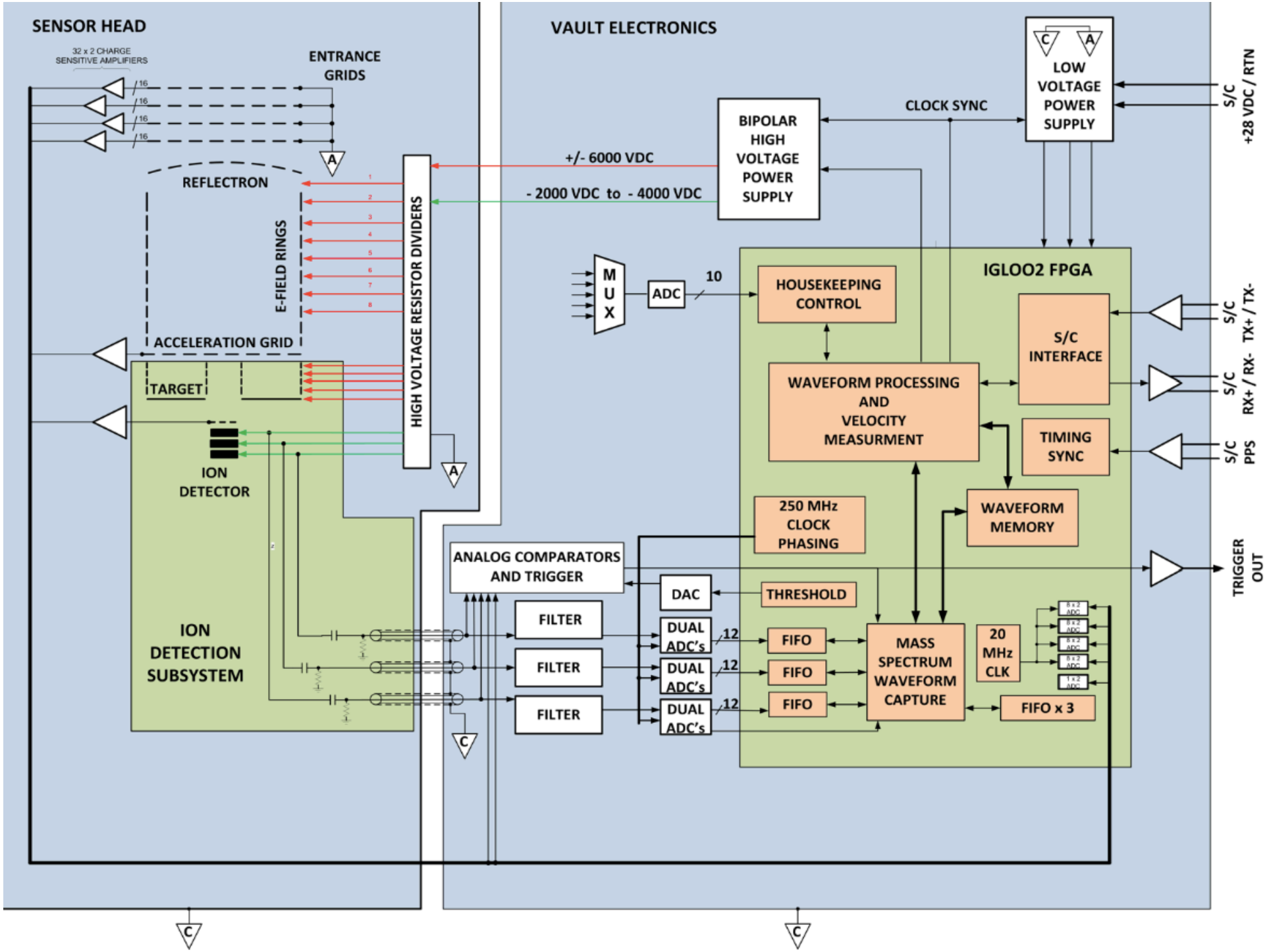
3 MV dust accelerator at LASP, Univ. of Colorado



Examples of outstanding dust related science questions

- Analysis of **cometary and asteroidal** dust in the interplanetary space
- Analysis of the **dust near the sun** (chemical differentiation, dynamics)
- **Interstellar dust** (chemistry, dynamics)
- **Surface chemistry and geological processes of airless bodies** (Europa, Ganymede, Moon,…)
- The **dust torus around Mars** is awaiting discovery
- Dynamics and charging of **slow moving** dust near the surface of the Moon or asteroids
- Sources, nature and distribution of **organic matter** (e.g. interstellar dust, Europa's surface,…)
- Characterizing **micrometeoroid impact hazard** for various locations


3:30 – 4:30 pm
ROOM 3
Contact:
(303) 819 2783
Zoltan.Sternovsky@colorado.edu
HYPERDUST


SENSOR HEAD
32 x 2 CHARGE SENSITIVE AMPLIFIERS
ENTRANCE GRIDS
REFLECTRON
E-FIELD RINGS
ACCELERATION GRID
TARGET
ION DETECTOR
ION DETECTION SUBSYSTEM
HIGH VOLTAGE RESISTOR DIVIDERS
VAULT ELECTRONICS
+/- 6000 VDC
- 2000 VDC to - 4000 VDC
BIPOLAR HIGH VOLTAGE POWER SUPPLY
CLOCK SYNC
LOW VOLTAGE POWER SUPPLY
S/C +28 VDC / RTN
IGLOO2 FPGA
MUX
ADC
10
HOUSEKEEPING CONTROL
S/C INTERFACE
S/C TX+ / TX-
S/C RX+ / RX-
WAVEFORM PROCESSING AND VELOCITY MEASURMENT
TIMING SYNC
S/C PPS
250 MHz CLOCK PHASING
WAVEFORM MEMORY
ANALOG COMPARATORS AND TRIGGER
TRIGGER OUT
DAC
THRESHOLD
FILTER
FILTER
FILTER
DUAL ADC's
DUAL ADC's
DUAL ADC's
12
12
12
FIFO
FIFO
FIFO
MASS SPECTRUM WAVEFORM CAPTURE
20 MHz CLK
FIFO x 3