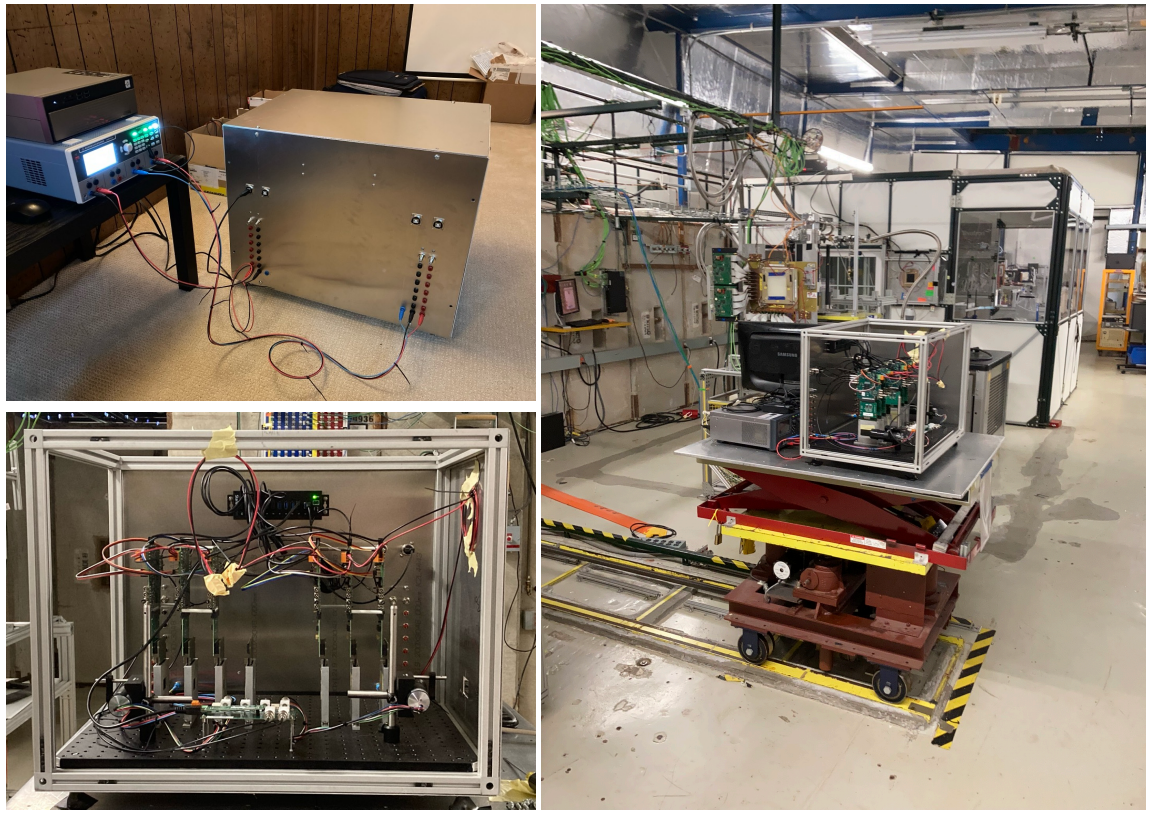
Fermilab Beam Tests for BabyMOSS

- **Fermilab Beam tests (Tucker Hwang, Danush Shekar, ZY)**
  - ✓ **4/29-5/1: initial check at LBL**
    - ✓ Checked the status of babyMOSS, DAQ and raiser boards, trigger PMT and scintillators, trigger boards, PS and PC
  - ✓ **5/2-5/7: assemble the telescope**
    - ✓ Received the box from UIC machine shop
    - ✓ Assembled babyMOSS and trigger detectors
    - ✓ Verified all the parts in-hand and working
  - ✓ **5/8-5/21: install and commission telescope at FTBF**
    - ✓ Using standalone codes
      - Using EUDAQ2 and Corryvreckan
  - **5/22-5/28: take and analyze data as primary user**
    - Efficiency, fake rate, spatial resolution at default setting
    - Cluster size as a function of incident angle at default setting
  - **6/5-6/25: add LGAD for timing reference**
  - **6/26-7/2: take and analyze data as primary user**

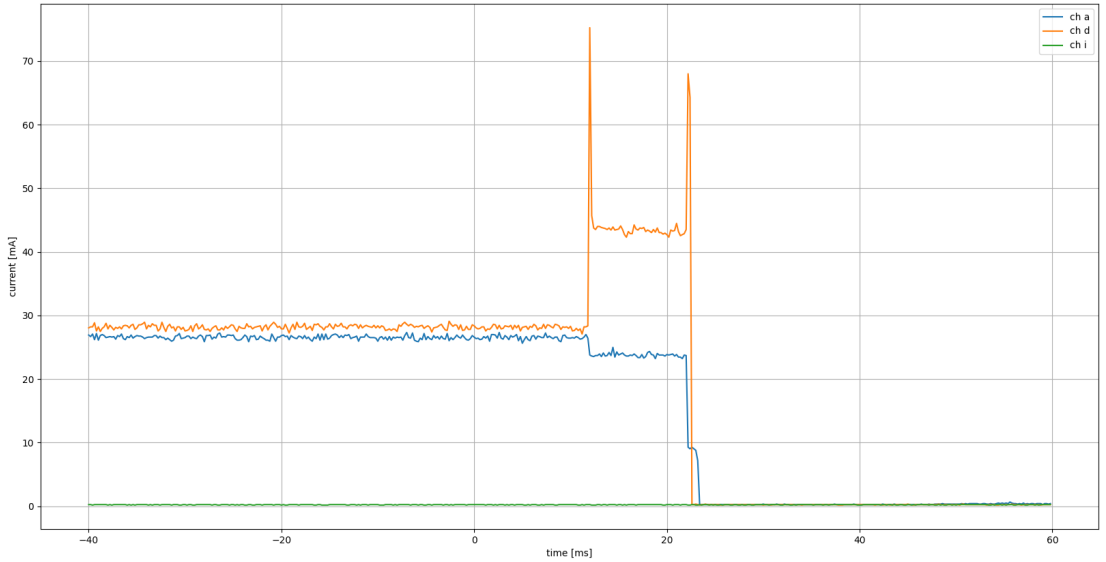
LBL BabyMOSS Telescope at FTBF



Opportunities to take leadership roles in SVT WP2

UCL SEL Tests for BabyMOSS

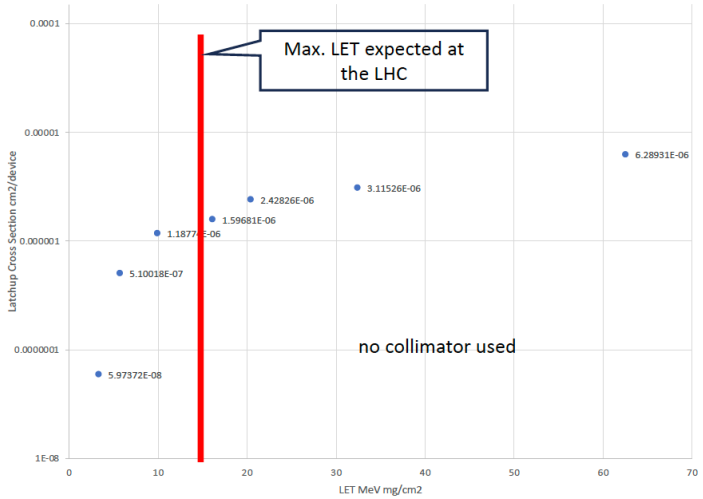
- **SEL tests with heavy ion beams at UCLouvain HIF Facility on March 5-6, 2024**



SEL results: LU Cross Section

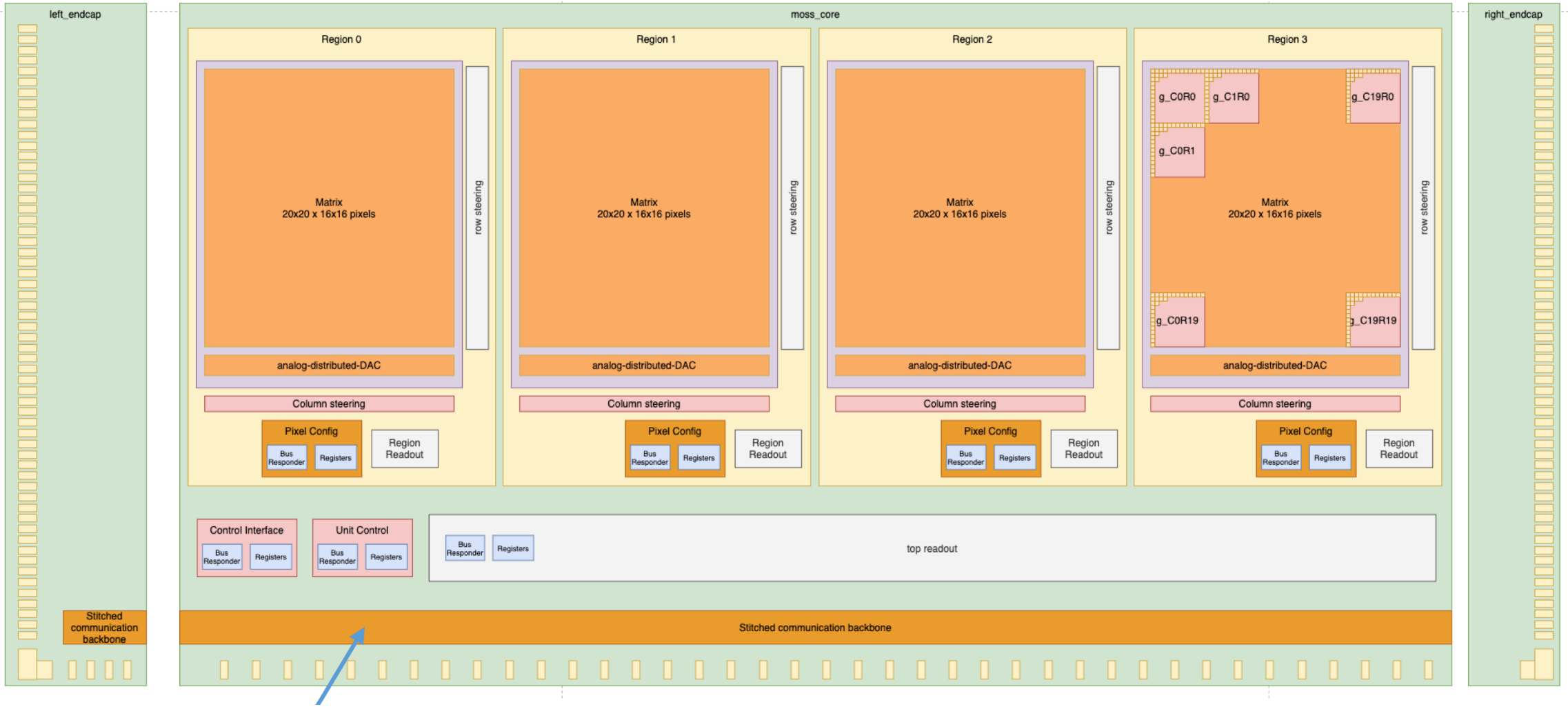
Main observations:

- no LU observed for highest available LET (^{124}Xe) and flux (1.5e4 ions/cm2/s) over 1.5h in the pixel matrix using a circular collimator
- many cross checks done
- LU observed for LET values below the maximum LET expected for the LHC



09/04/24 ITS3 WP3| H.Hillemanns, N.Minafra, M. Donner, T.Szollosova, F.Krizek, A.Kotliarov 8

Follow-up SEL Tests for BabyMOSS



LBL BASE Facility

- Berkeley Accelerator Space Effects Facility, LBNL https://cyclotron.lbl.gov/base-rad-effects
  - Heavy ions with fluxes up to 10^7 $cm^{-2}s^{-1}$ and LET between 1-100 MeV/(mg/cm^2)

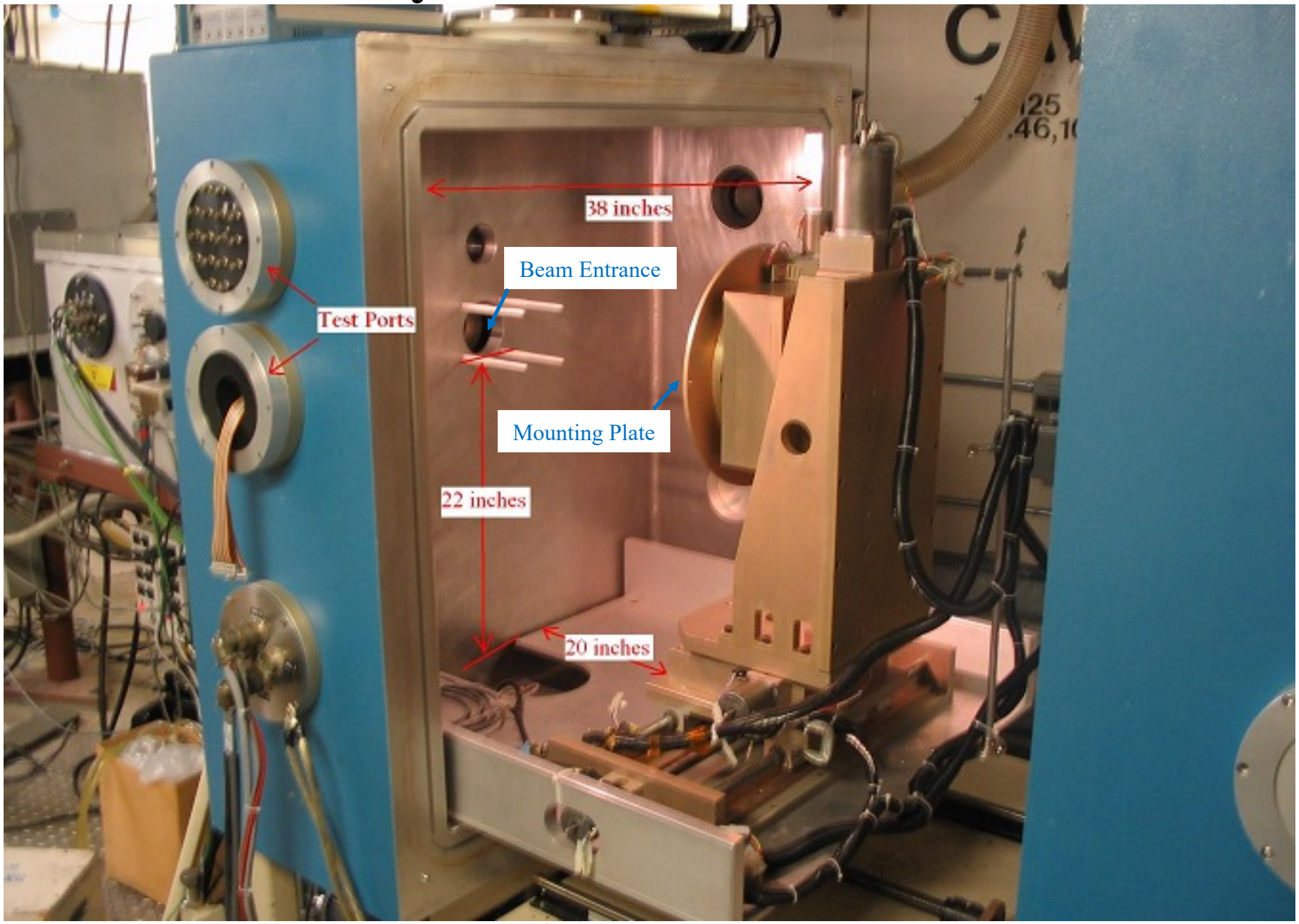
Ion	**Cocktail** (AMeV)	**Energy** (MeV)	**Z**	**A**	**LET (Entrance)** (MeV/mg/cm2)	**Range in Si (Max)** (μm)
B	**4.5**	44.90	5	10	**1.65**	78.5
N	**4.5**	67.44	7	15	**3.08**	67.8
Ne	**4.5**	89.95	10	20	**5.77**	53.1
Si	**4.5**	139.61	14	29	**9.28**	52.4
Ar	**4.5**	180.00	18	40	**14.32**	48.3
V	**4.5**	221.00	23	51	**21.68**	42.5
Cu	**4.5**	301.79	29	63	**29.33**	45.6
Kr	**4.5**	378.11	36	86	**39.25**	42.4
Y	**4.5**	409.58	39	89	**45.58**	45.8
Ag	**4.5**	499.50	47	109	**58.18**	46.3
Xe	**4.5**	602.90	54	136	**68.84**	48.3
Tb	**4.5**	724.17	65	159	**77.52**	52.4
Ta	**4.5**	805.02	73	181	**87.15**	53.0

Tentative BASE Run Plan

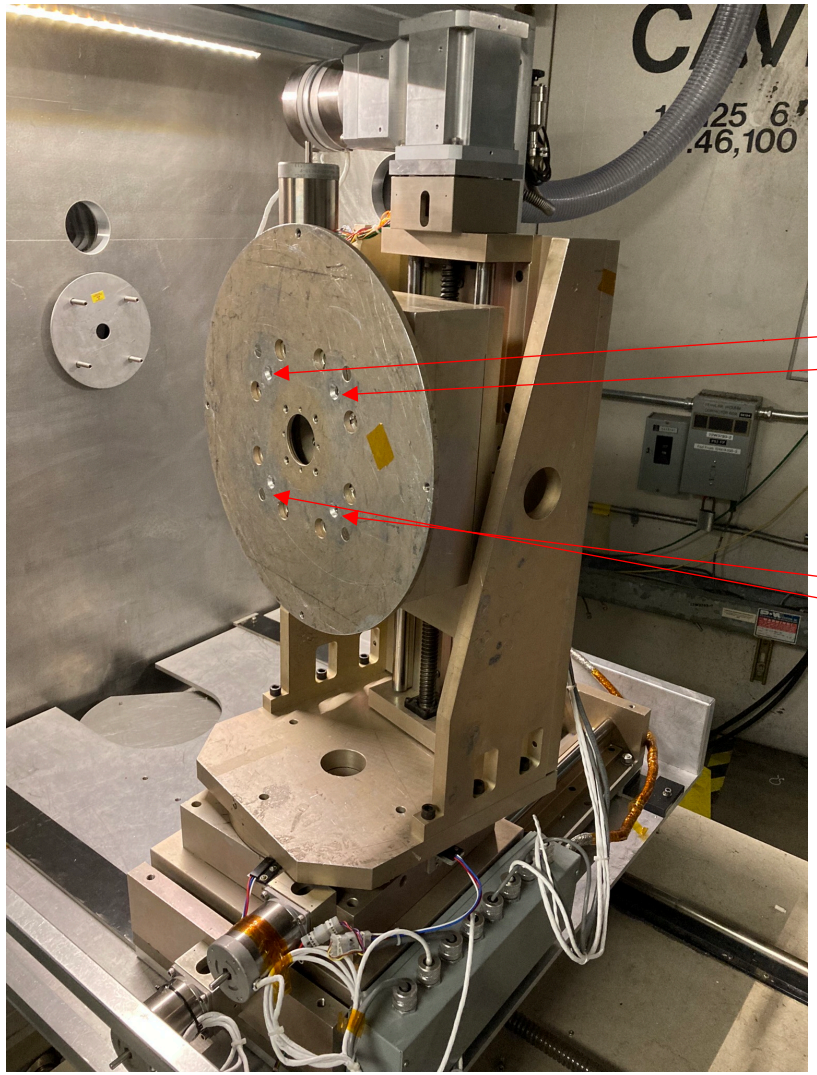
A BabyMOSS sensor connected to readout electronics boards will be exposed to ion beams at BASE to study the single event latchup (SEL) effects. The measurement will start from (1) identifying circuit components that are sensitive to SEL effects, by using the Xe beam with high flux and customized collimators to scan the beam over the surface of a BabyMOSS sensor. The measurement will continue to (2) quantify the SEL cross-section as a function of LET with Xe, Kr, Cu, V, Ar, Si, Ne, N and B beams with reducing LET. The fluxes will be optimized so that the latchup rate does not exceed 0.2 Hz. The cross-section is anticipated to range between 6x10-6 cm2/device with Xe and 6.0x10-8 cm2/device with Ne. Measurement (1) can take up to 3 hours for a sensor, while measurements (2) can take 3 hours for one sensor, which will bring the total running time to about 12 hours for two sensors. If available run time is limited, a minimum four hour is requested to conduct measurements with Xe(1) Cu(2) Ar (2) Ne(2) and N(2) on one sensor.

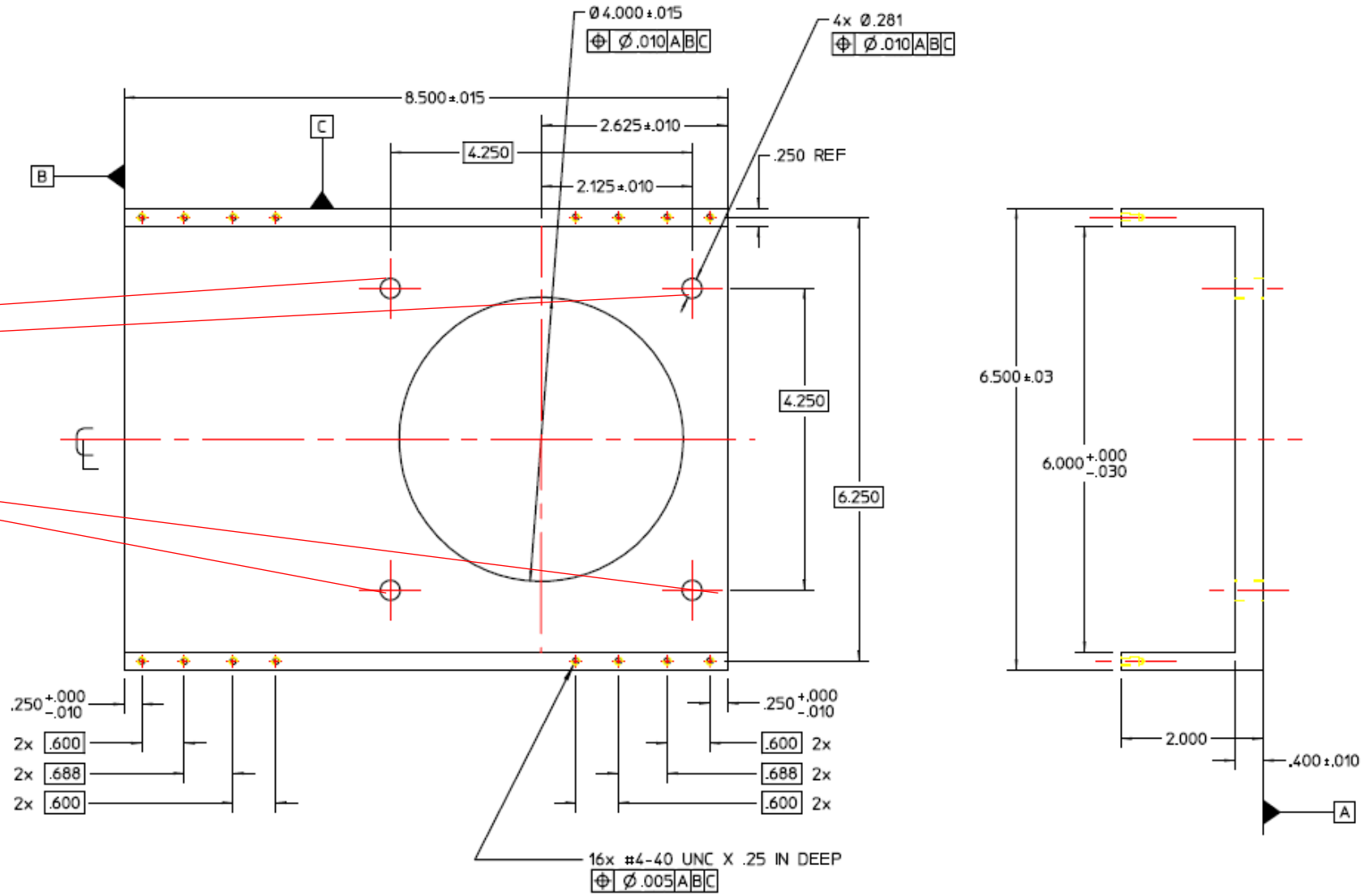
Ion	Cross section (cm^2/device)	Flux ($cm^{-2}s^{-1}$)	Duration (min)
$Xe^{(1)}$	$6.3x10^{-6}$	$1x10^{5-6}$	180
$Kr^{(2)}$	$3.1x10^{-6}$	$6.5x10^{4}$	15
$Cu^{(2)}$	$2.4x10^{-6}$	$8.3x10^{4}$	15
$V^{(2)}$	$1.6x10^{-6}$	$1.3x10^{5}$	15
$Ar^{(2)}$	$1.2x10^{-6}$	$1.7x10^{5}$	15
$Si^{(2)}$	$5.0x10^{-7}$	$4.0x10^{5}$	15
$Ne^{(2)}$	$6.0x10^{-8}$	$3.3x10^{6}$	15
$N^{(2)}$		$1x10^{7}$	30
$B^{(2)}$		$1x10^{7}$	60
Total time per sensor			360

BASE Heavy Ion Beam Vacuum Chamber

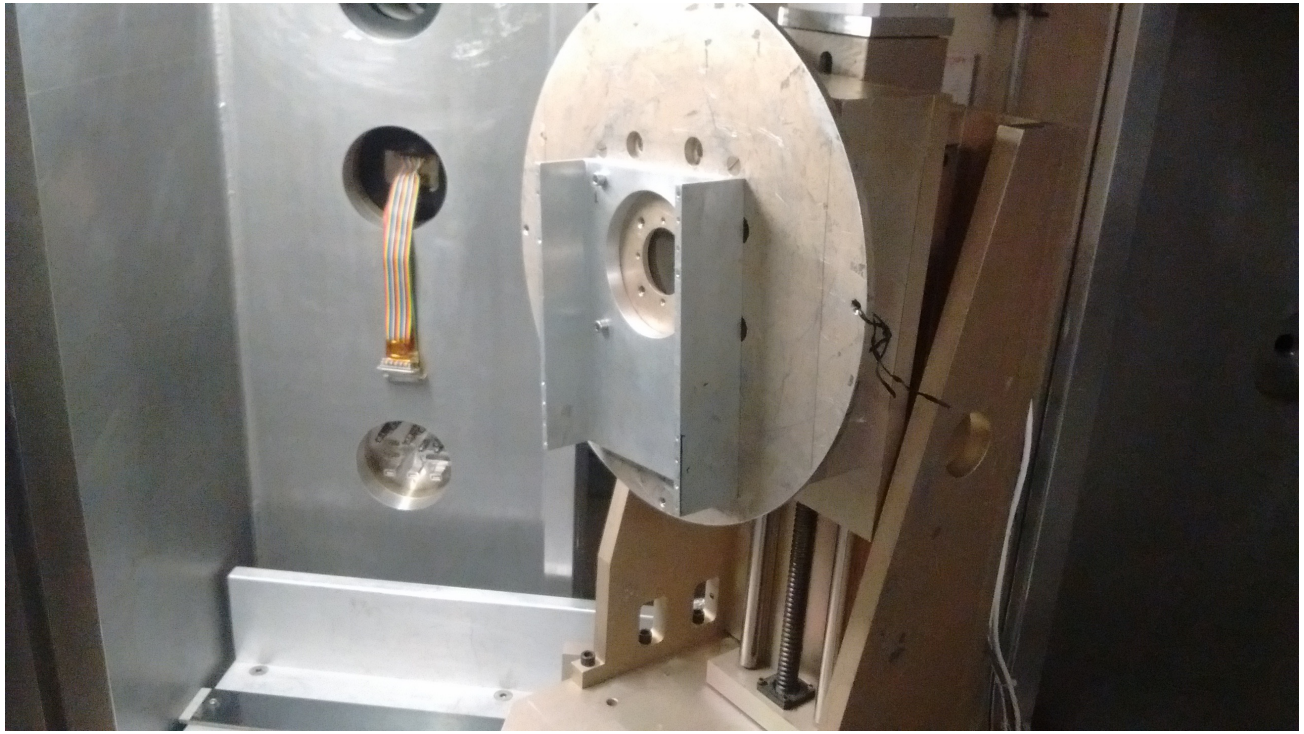


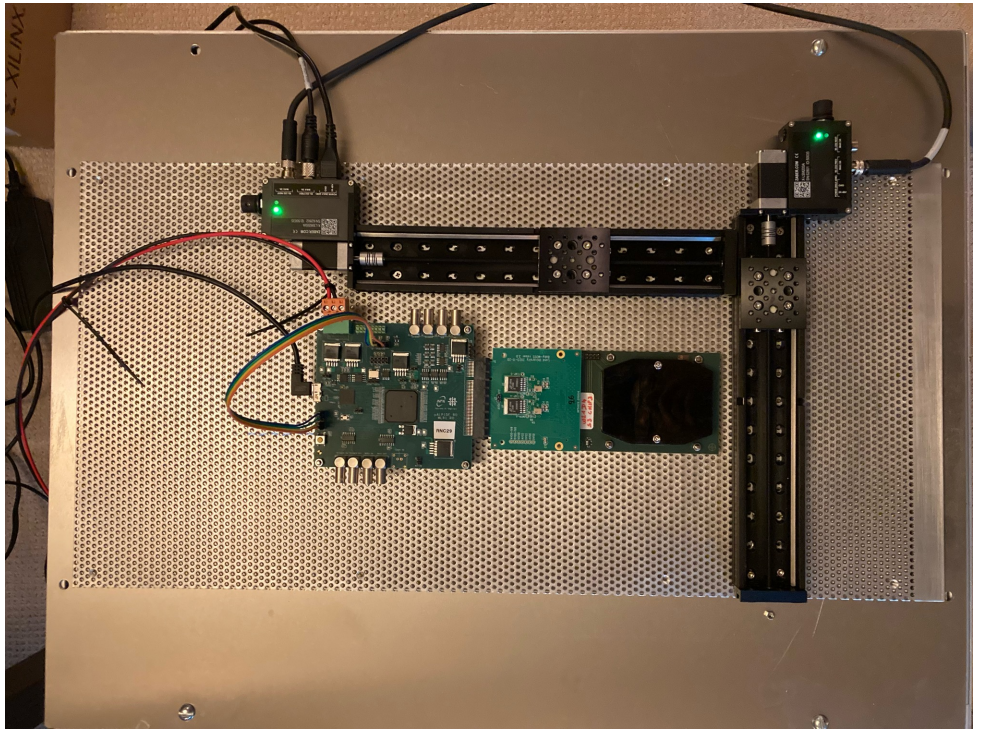
Mounting Plate and Bracket





Mounting Bracket and BabyMOSS Setup

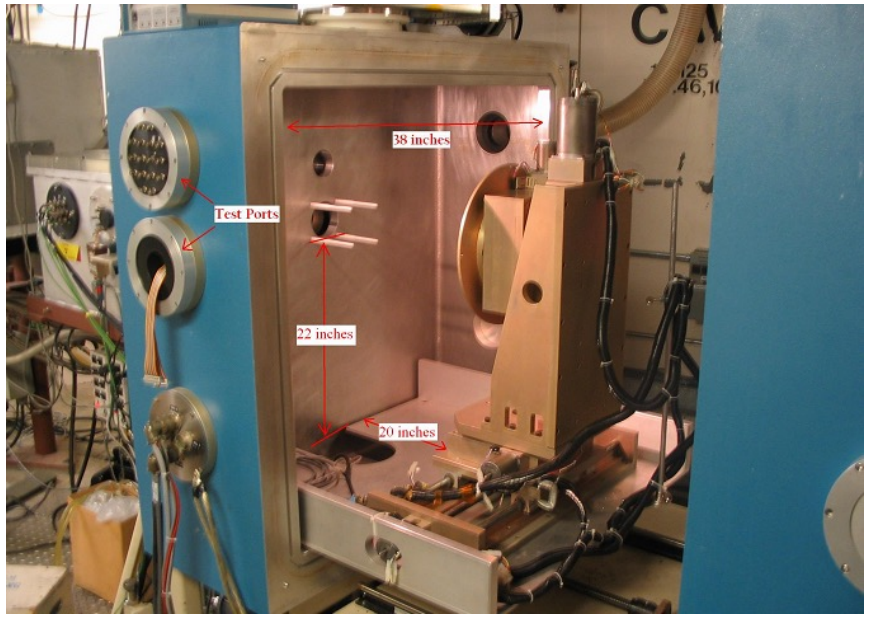


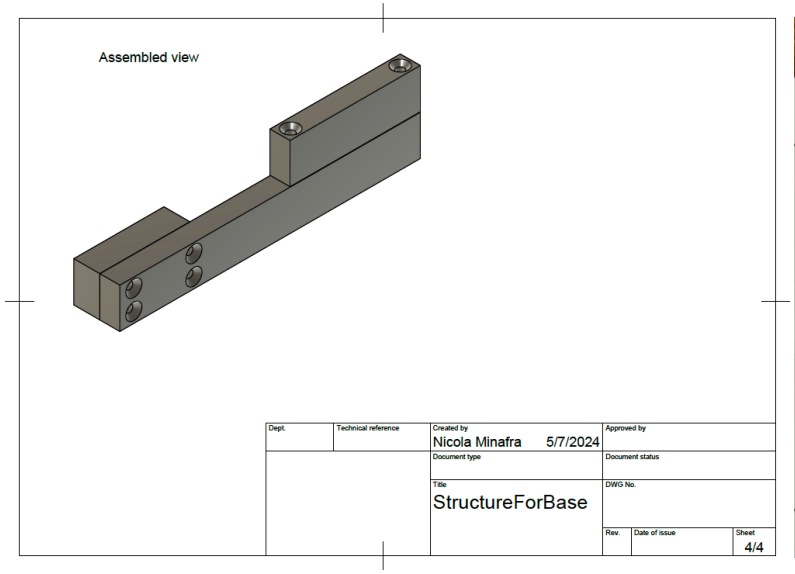


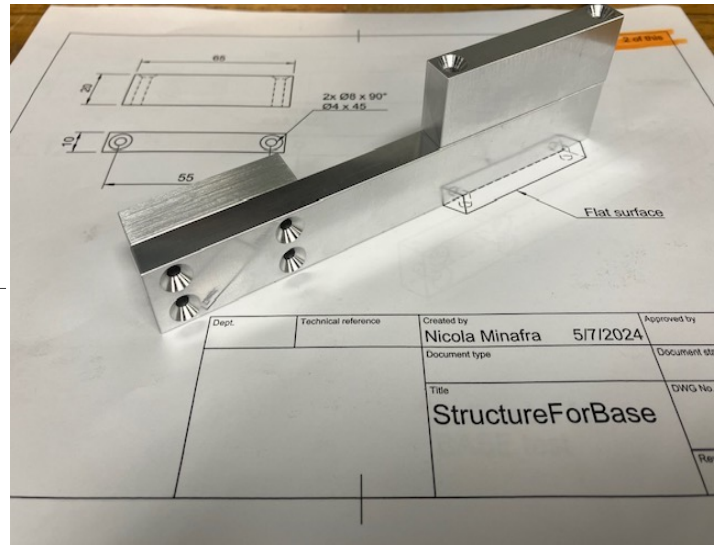
SEL Tests at BASE for BabyMOSS

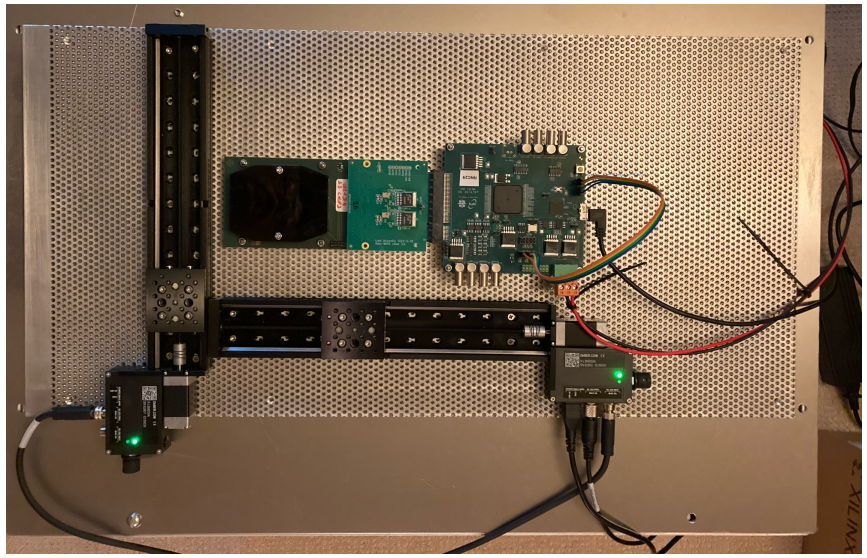
- **Single Event Latch-up Test at BASE (Anjali, Emma, Barbara, ZY)**
  - ✓ **5/5-5/14: design and make support and collimators**
  - **5/17 10am-2pm: initial check at BASE**
    - **Test mount the babyMOSS setup inside the vacuum chamber**
    - **Receive in-person training**
  - **5/18-5/22: integrate moving stage and babyMOSS softwares**
  - **5/23 8am-11:59pm: actual test at BASE**
    - **Identify sensitive sensor areas using collimators**
    - **Measure SEL cross-section as a function of LET**

BASE Cave-4B









Opportunities to take leadership roles in SVT WP2