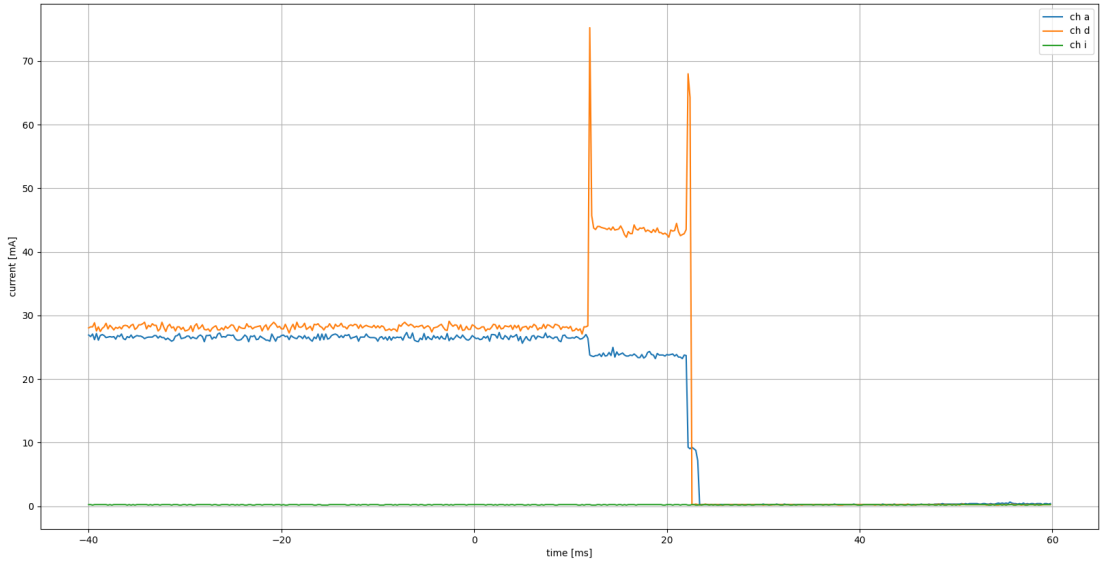
UCL SEL Tests for BabyMOSS

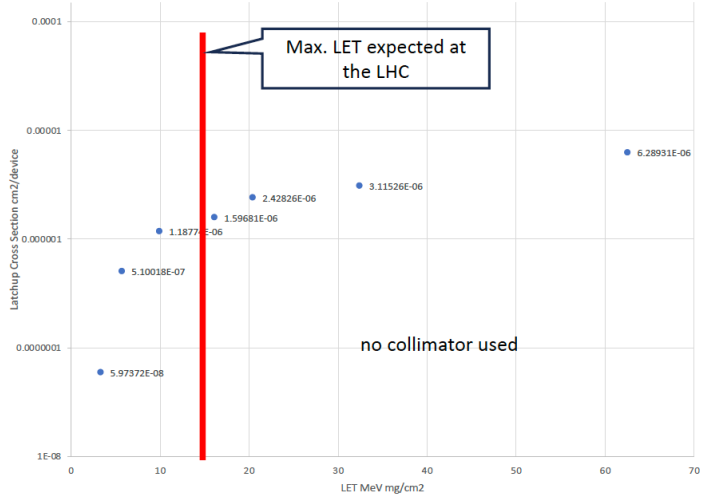
- **SEL tests with heavy ion beams at UCLouvain HIF Facility on March 5-6, 2024**



SEL results: LU Cross Section

Main observations:

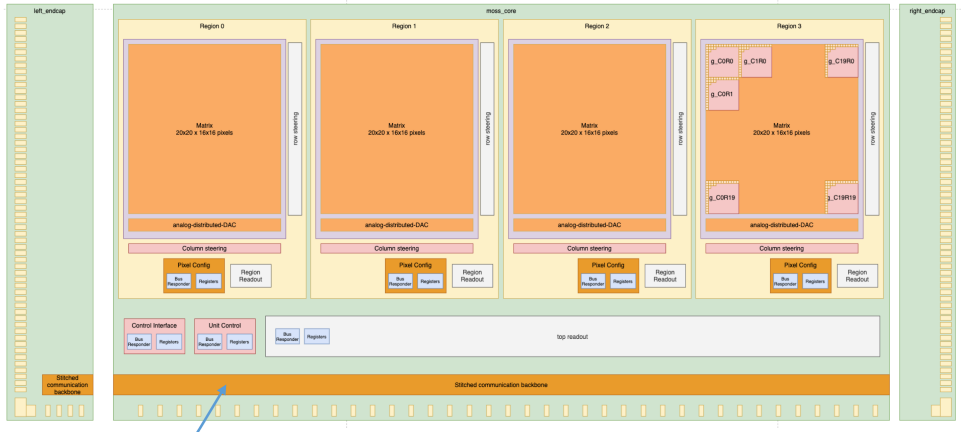
- no LU observed for highest available LET (^{124}Xe) and flux (1.5e4 ions/cm2/s) over 1.5h in the pixel matrix using a circular collimator
- many cross checks done
- LU observed for LET values below the maximum LET expected for the LHC

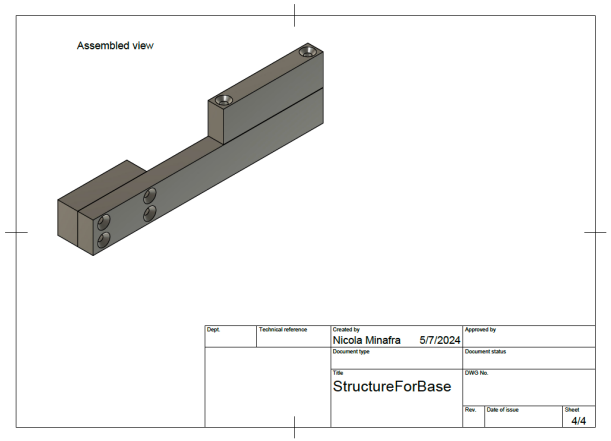


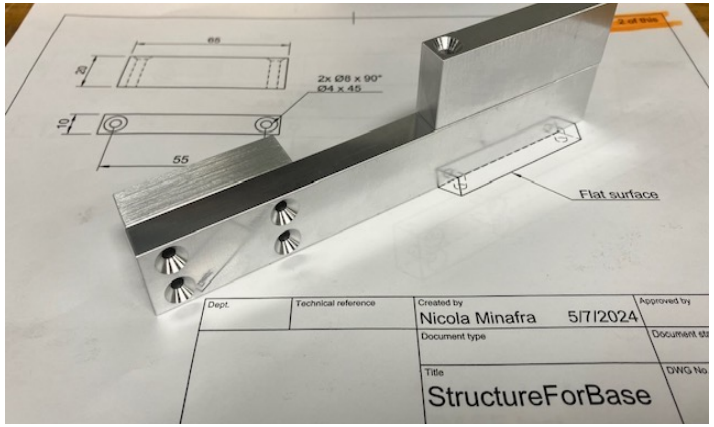
09/04/24 ITS3 WP3| H.Hillemanns, N.Minafra, M. Donner, T.Szollosova, F.Krizek, A.Kotliarov 8

BabyMOSS SEL Test at BASE - Objectives

- Reproduce SEL behavior observed at UC Louvine
- Identify SEL-sensitive areas on the babyMOSS using motion-controlled collimators



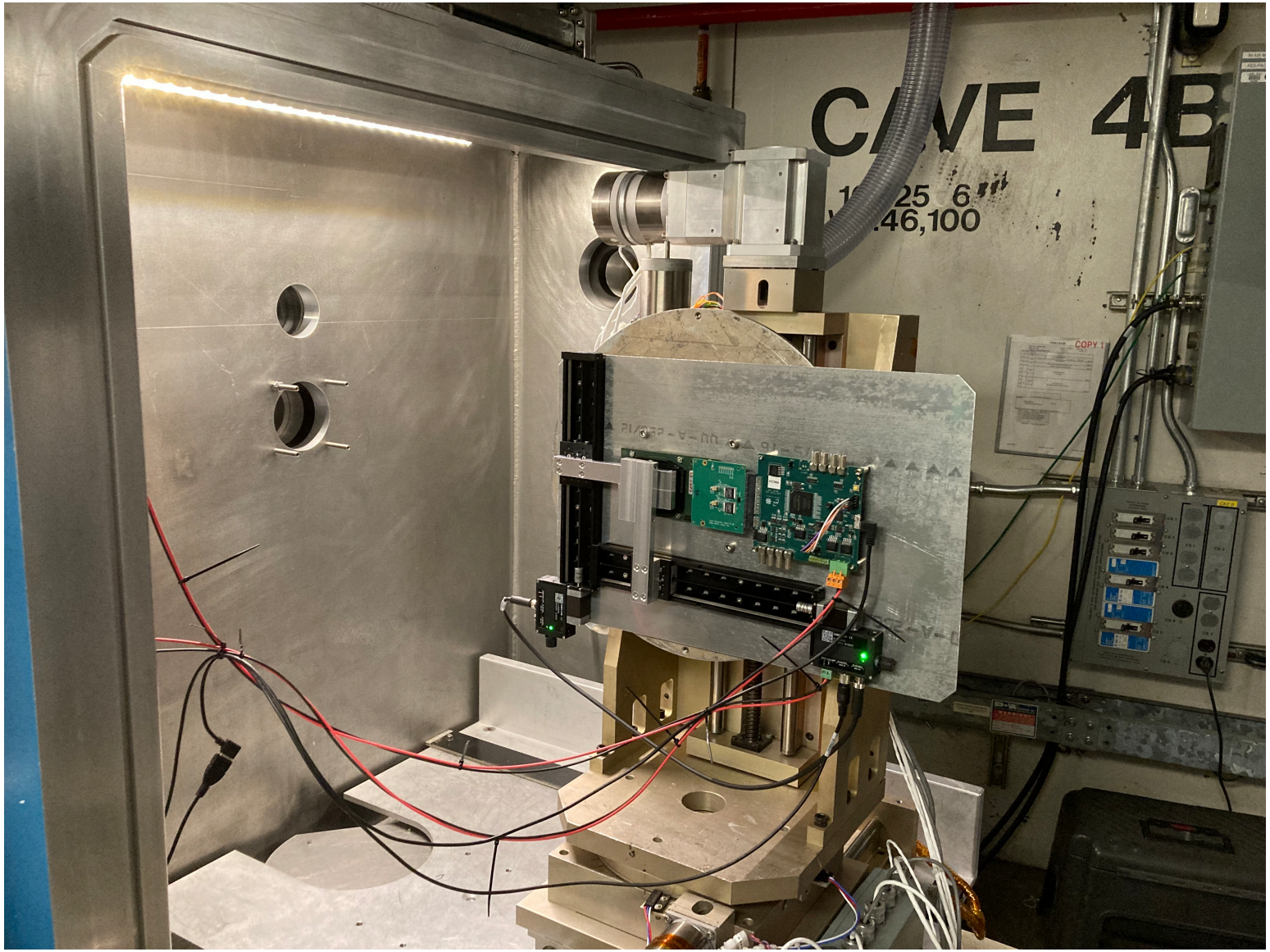


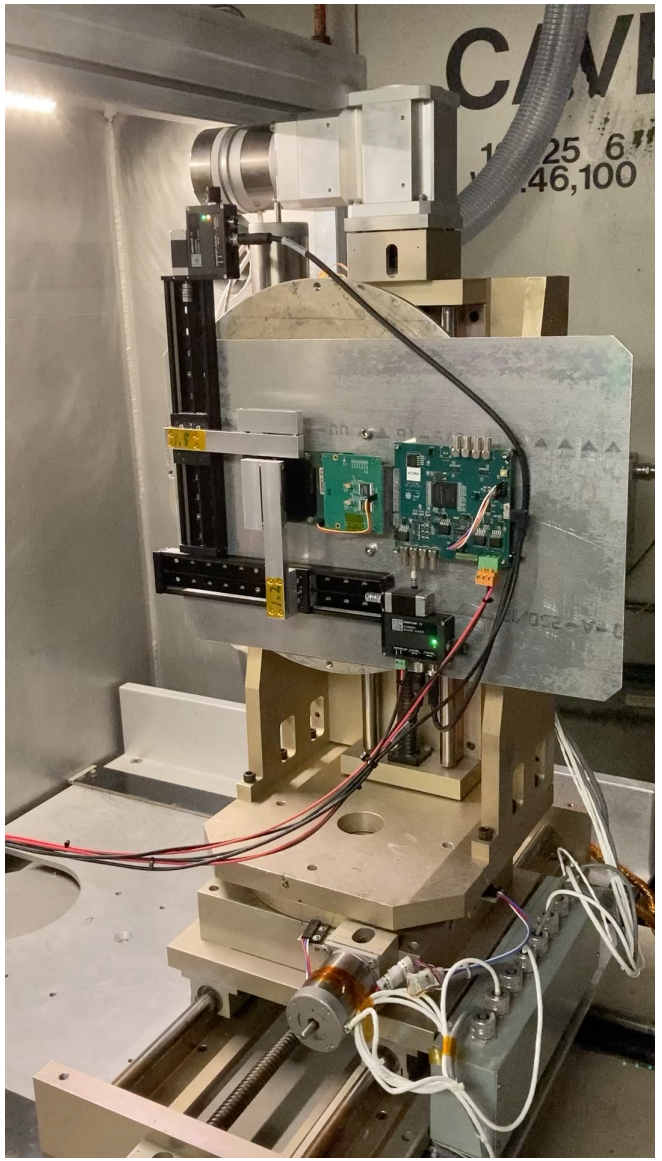


- Measure SEL cross-section as a function of LET with a focus at low LETs

Ion	LET (MeV/mg/cm2)	Cross section (cm^2/device)	Flux ($cm^{-2}s^{-1}$)
$Xe^{(1)}$	68.84	$6.3x10^{-6}$	$1x10^{5-6}$
$Kr^{(2)}$	39.25	$3.1x10^{-6}$	$6.5x10^{4}$
$Cu^{(2)}$	29.33	$2.4x10^{-6}$	$8.3x10^{4}$
$V^{(2)}$	21.68	$1.6x10^{-6}$	$1.3x10^{5}$
$Ar^{(2)}$	14.32	$1.2x10^{-6}$	$1.7x10^{5}$
$Si^{(2)}$	9.28	$5.0x10^{-7}$	$4.0x10^{5}$
$Ne^{(2)}$	5.77	$6.0x10^{-8}$	$3.3x10^{6}$
$N^{(2)}$	3.08		$1x10^{7}$
$B^{(2)}$	1.65		$1x10^{7}$

BabyMOSS SEL Test at BASE – Setup

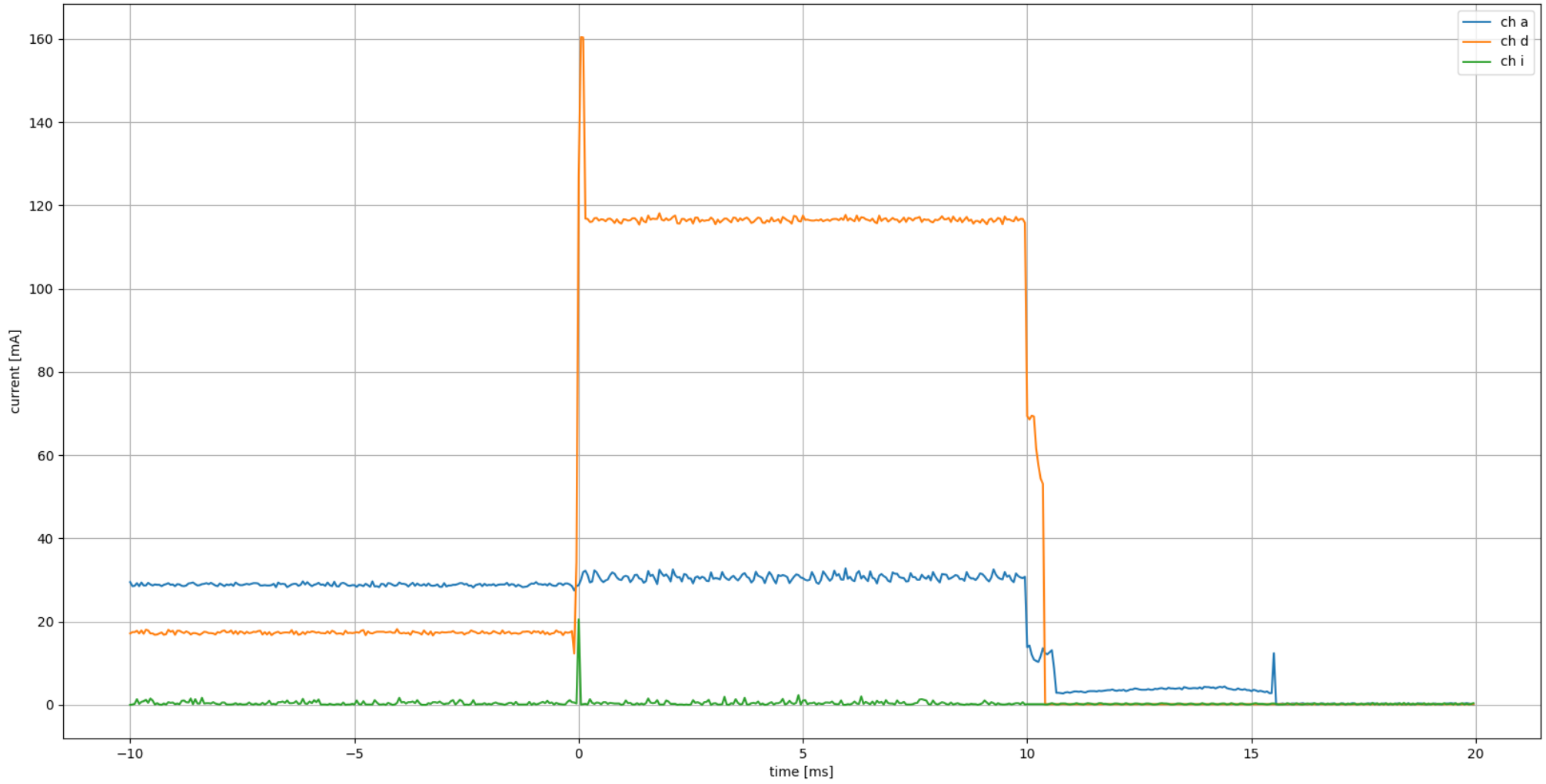




BabyMOSS SEL Test at BASE – Schedule

- **May 22**
  - 07:00-16:00 installation and commissioning
- **May 23**
  - 08:00-11:30 beam tuning
  - 11:35-11:50 $4x10^3$ $cm^{-2}s^{-1}$ Xe beam with maximum intensity limited by contaminations
  - 12:10-16:40 Y beam
  - 16:40-17:30 switching to a good uncontaminated Xe source
- **May 23-24**
  - 17:30-08:30 Xe beam with intensity up to $4x10^5$ $cm^{-2}s^{-1}$
    - 17:30-03:00 scan in X-Y with 1.5-mm collimator gap in X and 1.2-mm collimator gap in Y
    - 03:00-04:30 reduce the collimator gap sizes
    - 04:30-08:30 scan in X-Y with 0.2-mm collimator gap in X and 0.2-mm collimator gap in Y

BabyMOSS SEL Test at BASE – Objective I

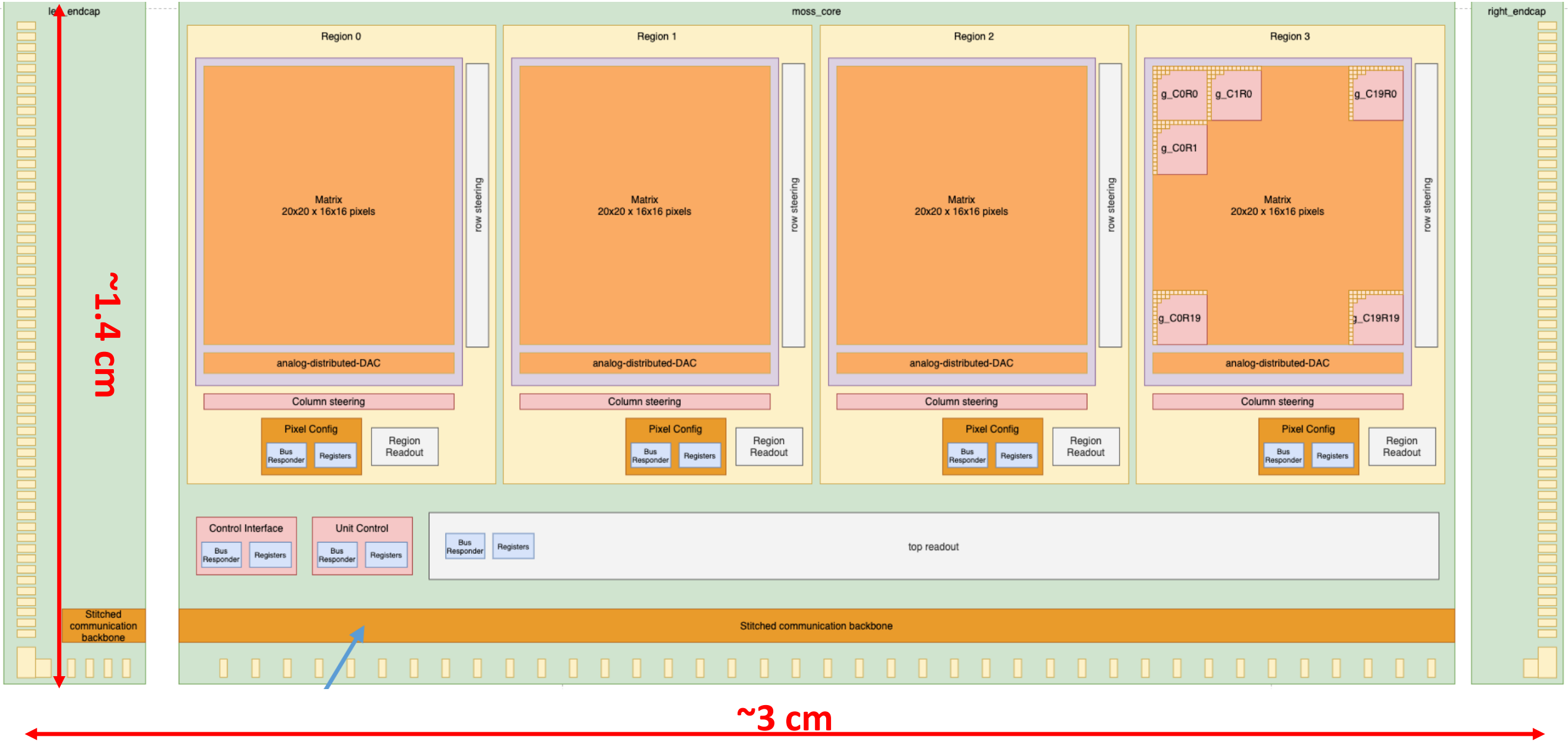


BabyMOSS SEL Test at BASE – Objective II

- Y scan between -12 mm to +12 mm with 1.2 mm gap and 0.5 mm step size, and no X collimator
  - SEL at Y=-7.0, -6.5, -6.0, -5.5, -5.0, +5.5, +6.0, +6.5, +7 mm

- X scan between -20 mm to +20 mm with 1.5 mm gap and 1.25 mm step size, Y collimator at -6.0 mm
  - SEL at X=-3.75, -2.5, -1.25, +10.0 mm
- X scan between -20 mm to +20 mm with 1.5 mm gap and 1.25 mm step size, Y collimator at -5.5 mm
  - SEL at X=-3.75 mm

- Y scan between [-6, -4.35] with 0.2 mm gap and 0.15 mm step size, no X collimator
  - SEL at Y=[-5.85, -4.5]
- X scan [-6.05, -1.10] with 0.2 mm gap and 0.15 mm step size, no X collimator
  - SEL at X=[-5.15, -4.7], [-3.65, -3.5], [-2.6, -2.15]
- X scan between [-5.15, -2.15] and Y scan between [-5.85, -4.5] with 0.2 mm gap and 0.15 mm step size
  - X=-5.00, Y=-4.95
  - X=-4.85, Y=-4.95


left_endcap
moss_core
right_endcap
Region 0
Region 1
Region 2
Region 3
Matrix
20x20 x 16x16 pixels
row steering
analog-distributed-DAC
Column steering
Pixel Config
Bus Responder
Registers
Region Readout
g_C0R0
g_C1R0
g_C19R0
g_C0R1
g_C0R19
g_C19R19
Control Interface
Unit Control
top readout
Stitched communication backbone
~1.4 cm
~3 cm

Summary and Outlook

- UCB/LBL: Anjali, Barak, Barbara, Emma, Zhenyu
- CERN: Hartmut, Nicola

- Reproduced SEL behaviors on babyMOSS at BASE with Y and Xe beam
- Searched for SEL-sensitive areas on babyMOSS with motion-controlled collimators
  - SEL behaviors observed from top peripherals, but not pixel matrices or endcap peripherals
  - SEL behaviors observed in 3 distinguish regions within top peripherals. One region can be located within an area of 0.35x0.20 mm^2 in X*Y with a precision of 0.05 mm, while the other two regions within a X-window size of 0.35 and 0.65 mm, respectively.
- Next steps:
  - Finish data analysis and report the findings to ITS3 (within ~1 week)
  - Request to put on the wait-list to complete the X-Y and LET scans (~4 hours)