Supported by:

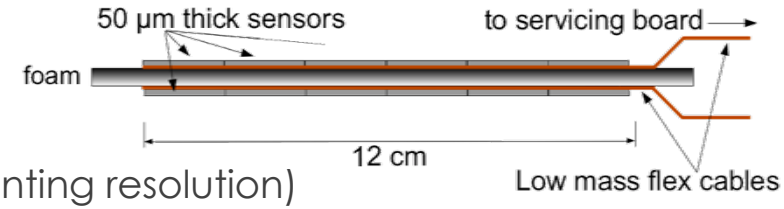
PLUME for BEAST II phase 2: status

J. Baudot, A. Besson, G. Claus,
M. Goffe, A. Perez, I. Ripp-Baudot,
M. Szelezniak, V. Zeter

8th BELLE II VXD workshop
Trieste, 2015 September 11

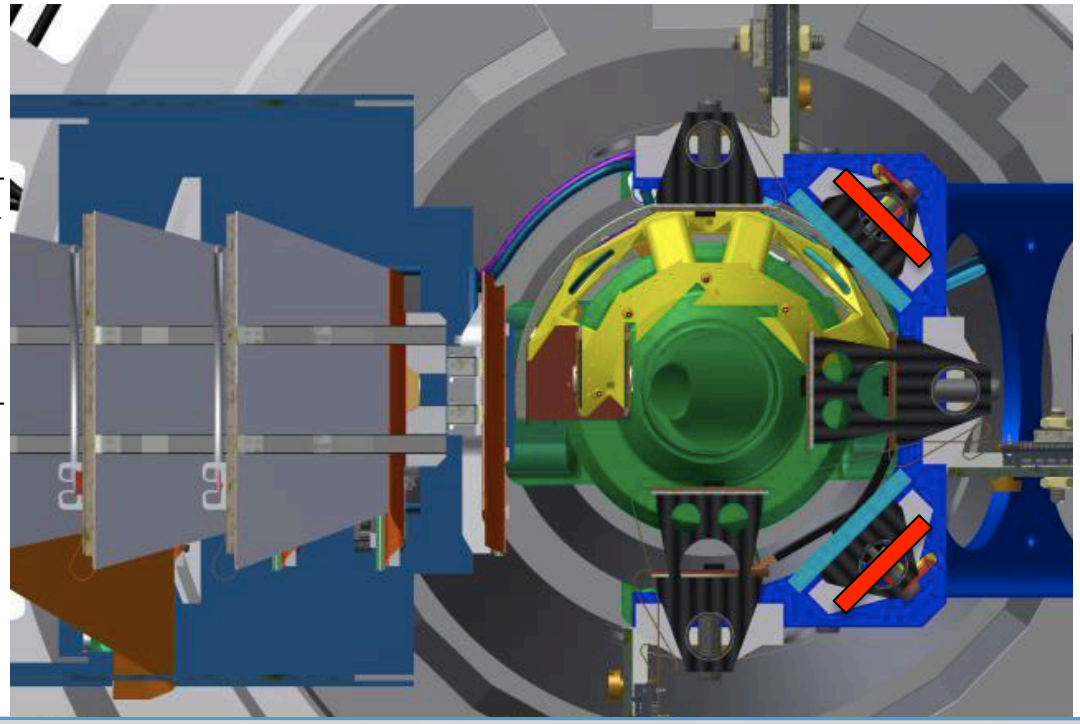
- Setup proposed
- Insights from simulation
- Hardware readiness
- Tasks list

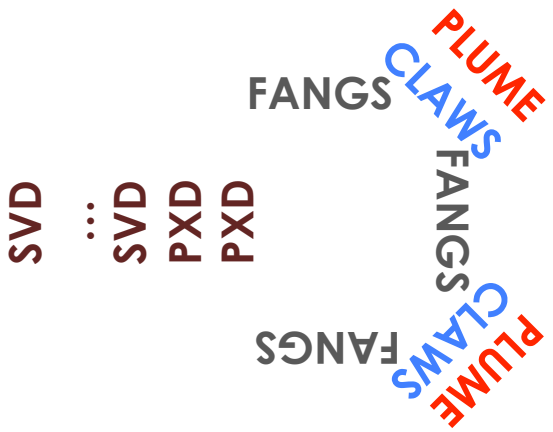
Setup proposed



- Basic Idea
  - Benefit from PLUME assets
    - granularity, counting rate, 2-points/layer (= pointing resolution)
- Geometry
  - Proposition elaborated in January 2015 at Münich meeting
  - Set two PLUME (spatial granularity) ladders within the two CLAWS (time granularity) φ acceptance

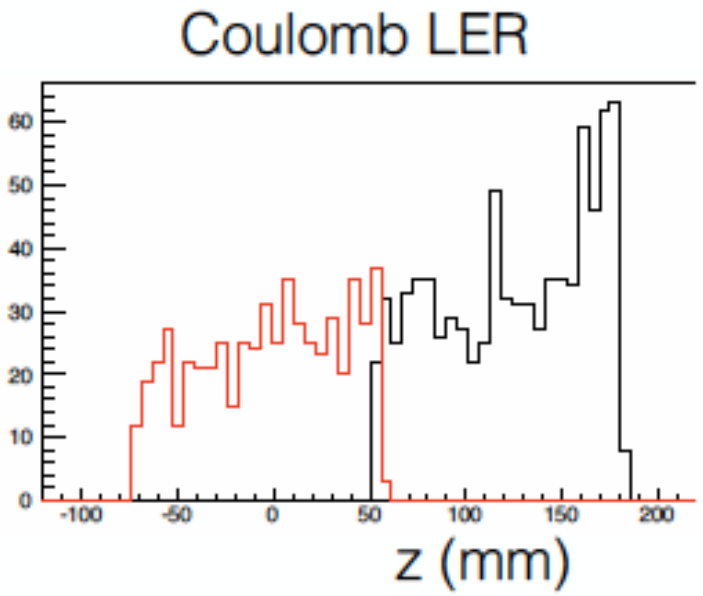
from Carlos'FANGS presentation, April 2015





Simulations: occupancy

- Fully processed through BASF2 (Igal)
  - Phase 3 beam parameters: 10 ms
  - phase 2 geometry:
    - $radius_{PLUME}$ = 5.5 cm
    - horizontal PLUME ladders
  - Coulomb + Radiative Bhabha + Touschek
  - Missing: synchrotron + 2-photon pairs



- Low occupancy rate

  = raw count for 10 ms phase 3 in highest sensor
  / 80 (RBB) or 10 (Touschek & Coulomb)
  / 100 (integration time 100 µs)
  * 3 (average cluster multiplicity)

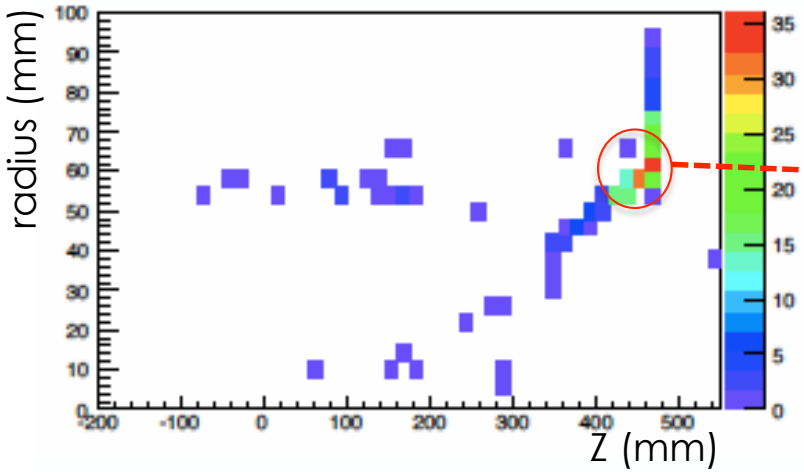
Bckgrnd type	**Touschek**		**Coulomb**		**RBB**	
	LER	HER	LER	HER	LER	HER
Rate per pixel 100 µs	2.10^{-7}	2.10^{-8}	6.10^{-7}	0	2.10^{-8}	3.10^{-8}

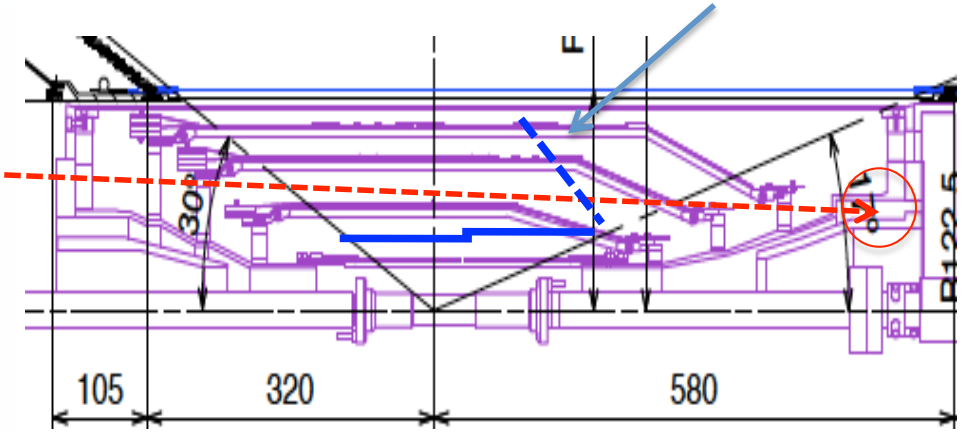
Simulation: background origin

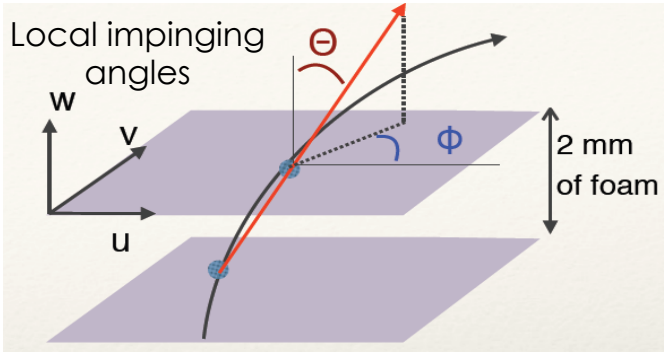
Coulomb LER

This is no hot-spot, rather the area to which PLUME is sensitive

Interest for another PLUME orientation

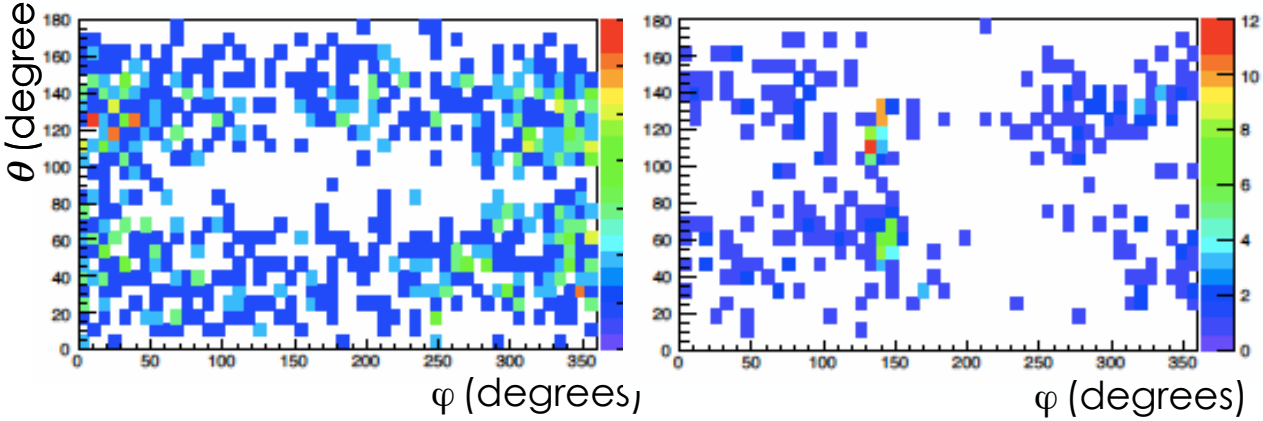






Touschek LER

RBB HER



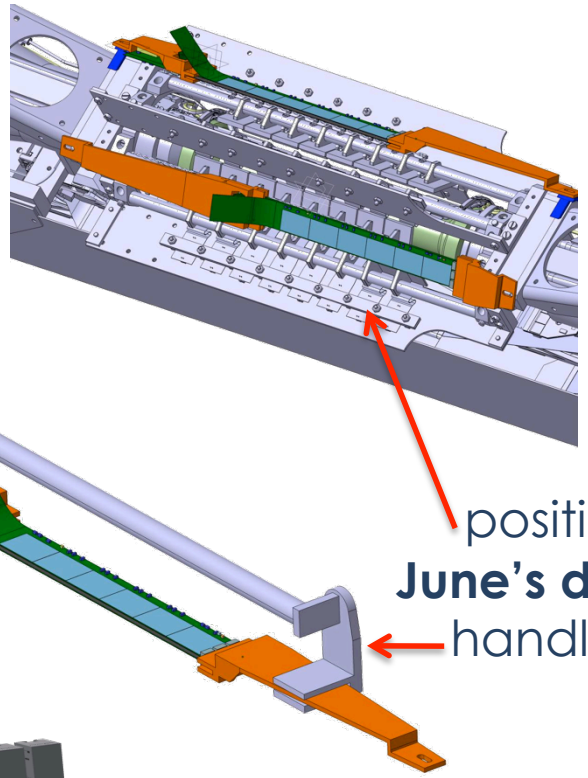
Working on mini-vector reconstruction

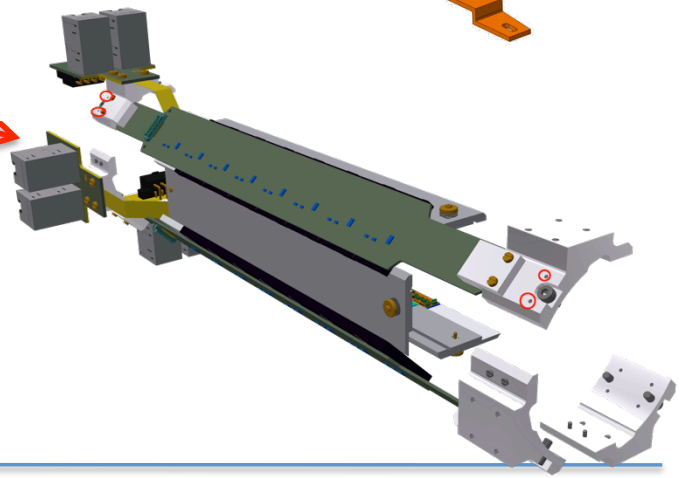
Ladders & mechanical setup

- Assumptions
  - 2 ladders
  - Cables go out on same side

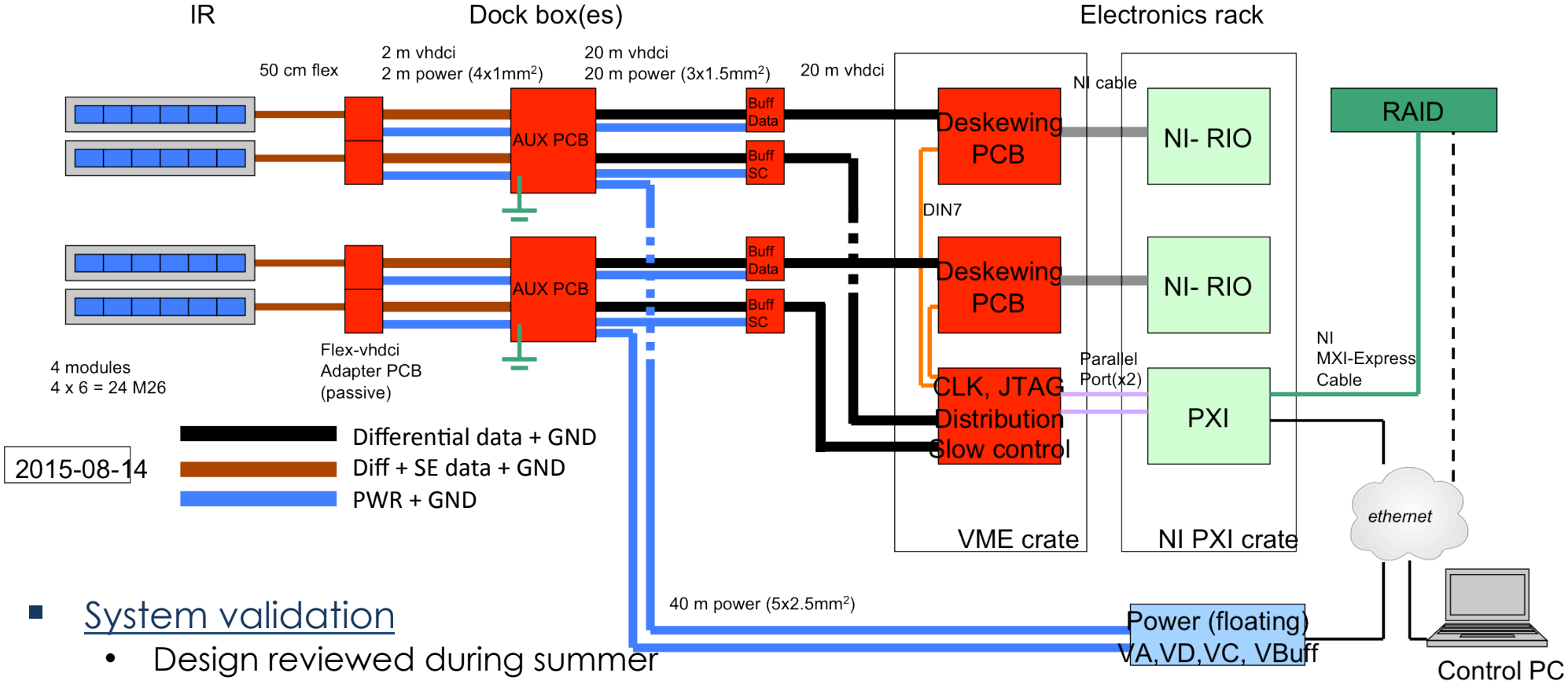
- Ladder production
  - Modules ready, waiting validation tests
  - Ladder assembly resuming in Bristol

- Setup currently under revision
  - Latest (Sept.) FANGS+CLAWS drawings
  - Latest PLUME assembly design





System (16 Mpix) architecture



- System validation
  - Design reviewed during summer
  - Data path fully tested over real length with deskewing and current boards
- Construction status
  - All final boards entering schematic
  - Cables partially collected
  - Power supplies to be purchased
- Latest change
  - Aux board splitted in 2
  - Rad-hard regulators in dock-space
  - All rad-soft components 15 m away (Belle II top)

Task list (mid-term)

- Simulations
  - Analyze all background types
  - Study new geometry (tilted ladder)
  - Study impact of degraded efficiency (induced by high radiation level)
  - Implementation of reconstruction algorithms in dedicated framework

  ➡ Master + PhD thesis position opening in March 2016 (non French candidate encouraged)

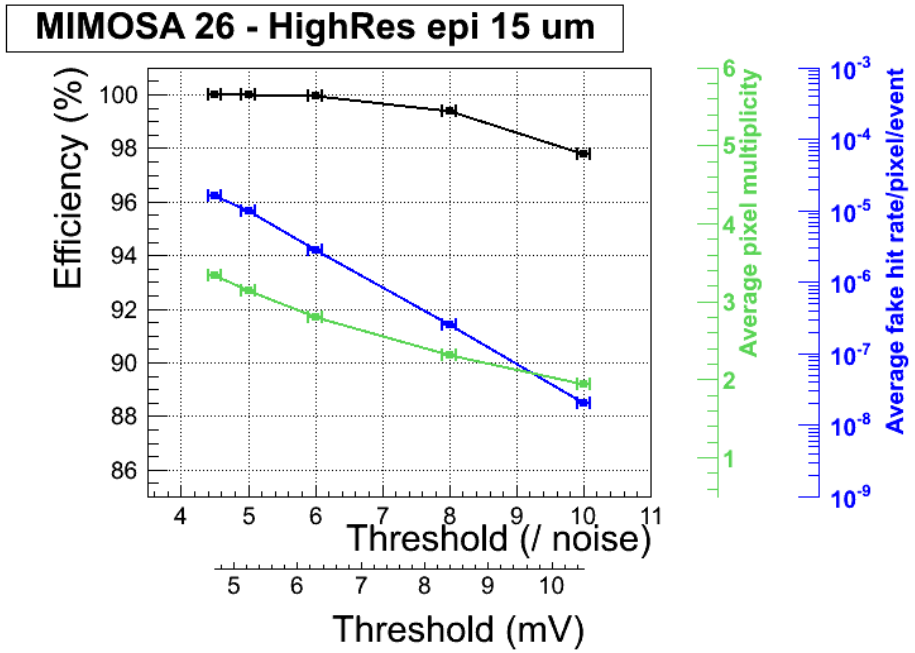
- Hardware
  - Finalize mechanical setup ➙ last(?) check at next B2GM
  - Cooling simulation (slowly) getting ready
  - Schematic & Production of various boards

- Target
  - Full system readiness by late summer 2016

Backups

Comments on counting

- Occupancy ~ fake rate
  - Not a real issue: 2 ways out
  - Increase discriminator threshold
    - det. efficiency ≈ 95 %
    - fake rate ≈ 10^{-9} / pixel
  - Cut clusters with less than 2 pixels
    - det. efficiency ≈ 90 %
    - fake rate ≈ 10^{-11} /pixel



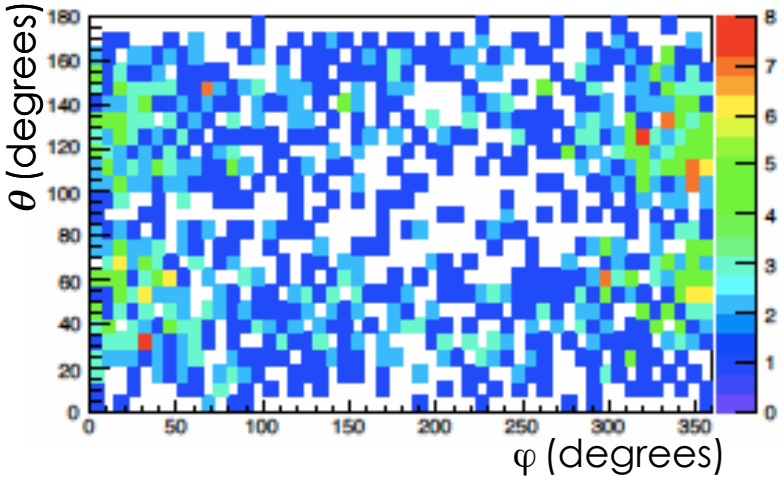
- Max. occupancy MIMOSA-26
  - Driven by internal memory size
  - 3.10^{-4} / pixel
  - → safety factor of 500

- Injection background
  - 10 revolutions within 100 µs frame
  - Single bunch would need to be 50 noisier than standard one to saturate PLUME

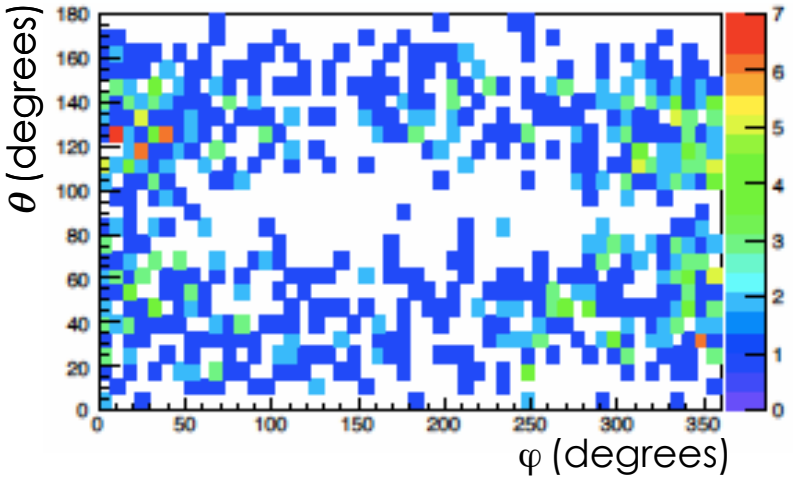
- Synchrotron photons
  - Needs factor 500 wrt other bckgrnd to saturate PLUME
  - CLAWS screens "most" of it

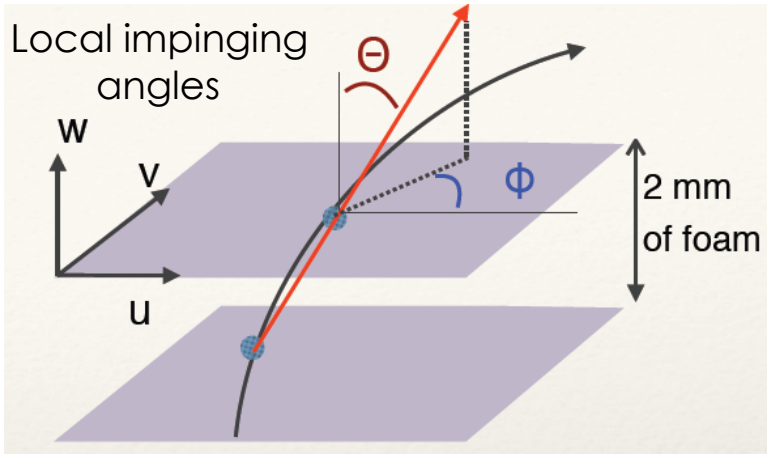
Background Impinging angles

Coulomb LER

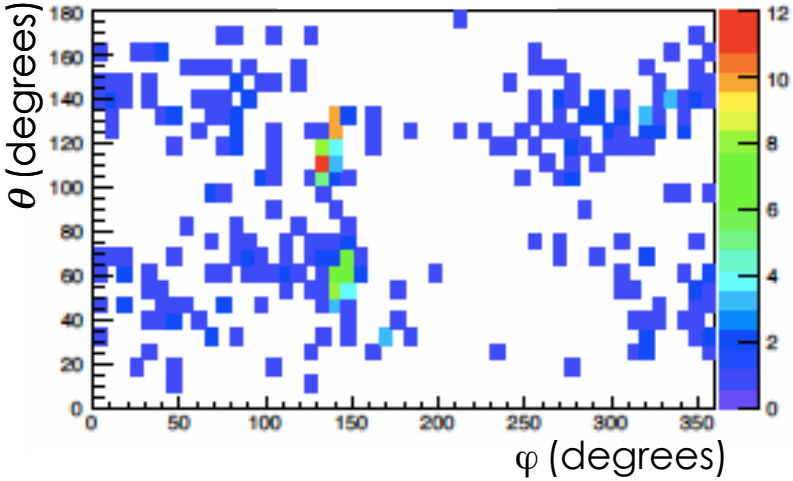


Touschek LER



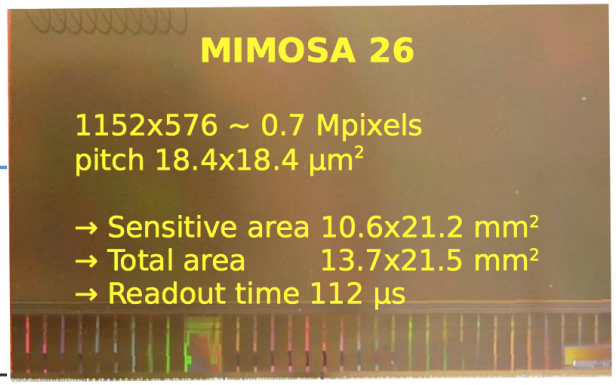


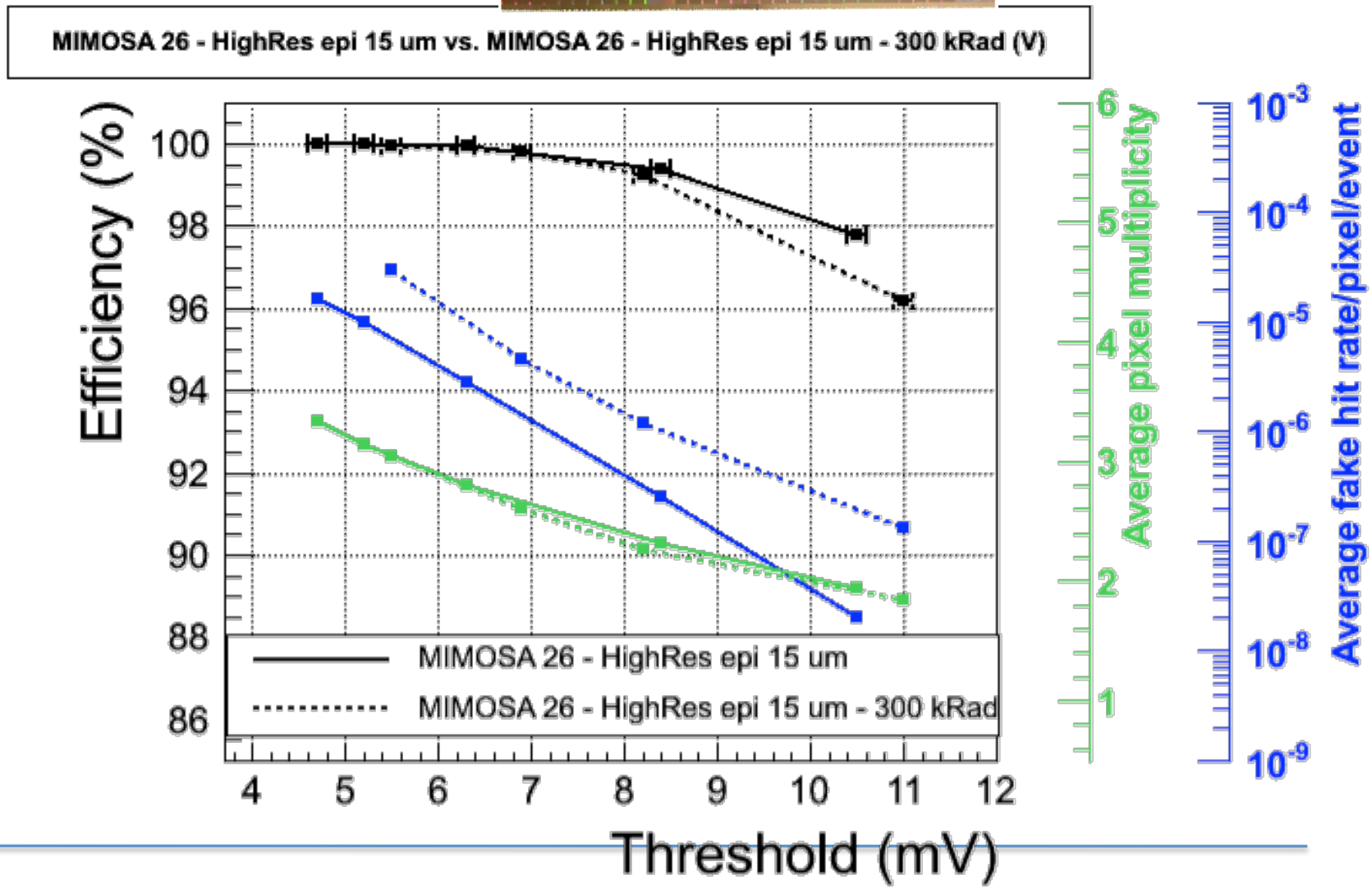
RBB HER



➡ Can PLUME reconstruct these distribution ?

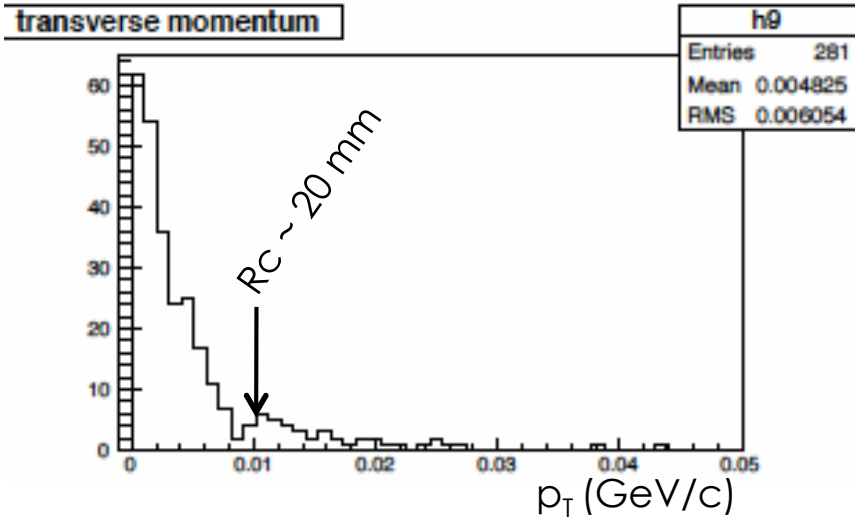
MIMOSA-26


MIMOSA 26
1152x576 ~ 0.7 Mpixels
pitch 18.4x18.4 µm²
→ Sensitive area 10.6x21.2 mm²
→ Total area 13.7x21.5 mm²
→ Readout time 112 µs

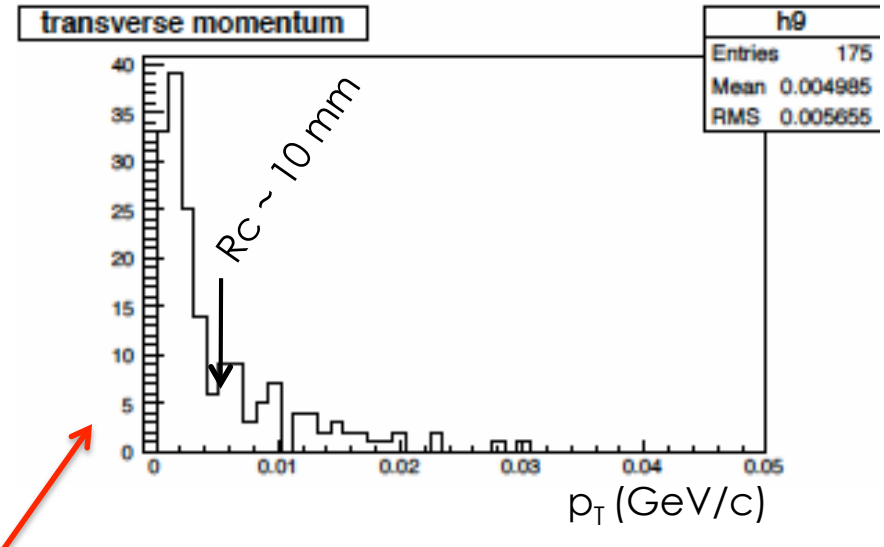

MIMOSA 26 - HighRes epi 15 um vs. MIMOSA 26 - HighRes epi 15 um - 300 kRad (V)
Efficiency (%)
100
98
96
94
92
90
88
86
4
5
6
7
8
9
10
11
12
Threshold (mV)
MIMOSA 26 - HighRes epi 15 um
MIMOSA 26 - HighRes epi 15 um - 300 kRad
Average pixel multiplicity
1
2
3
4
5
6
Average fake hit rate/pixel/event
10-3
10-4
10-5
10-6
10-7
10-8
10-9

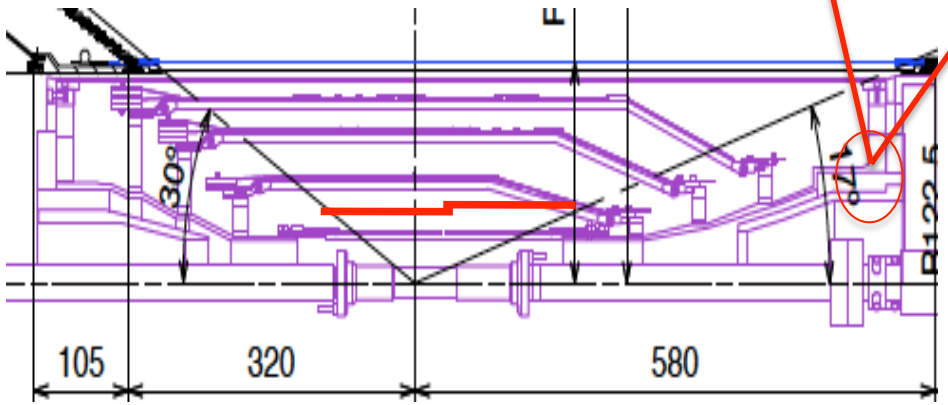
Background pT & Curling Radius

Coulomb LER



Touschek LER





RBB HER