

Complementary project:
A versatile pixel matrix in TPSCo 65 nm for future trackers

Jerome Baudot

- Motivations
- Technical overview
- EOI & Synergies

Motivations for a versatile matrix for trackers

■ Definition

- **Versatile** => fits various projects

- ALICE 3 outer layers
- LHCb Upstream Tracker (MT?)
- Belle II long-term Tracker
- CBM
- FCCee
- (EIC tracker)
- (Calorimetry)

=> range of specifications

- **Tracker** => position res. is not the driver

- Hit rate
- Time stamping
- Low power
- Radiation tolerance
- Trigger
- Data throughput
- Time resolution
- yield

■ Motivations

- Large internat. community interested
=> shared resources
=> strong visibility

- intermediate & long terms applications

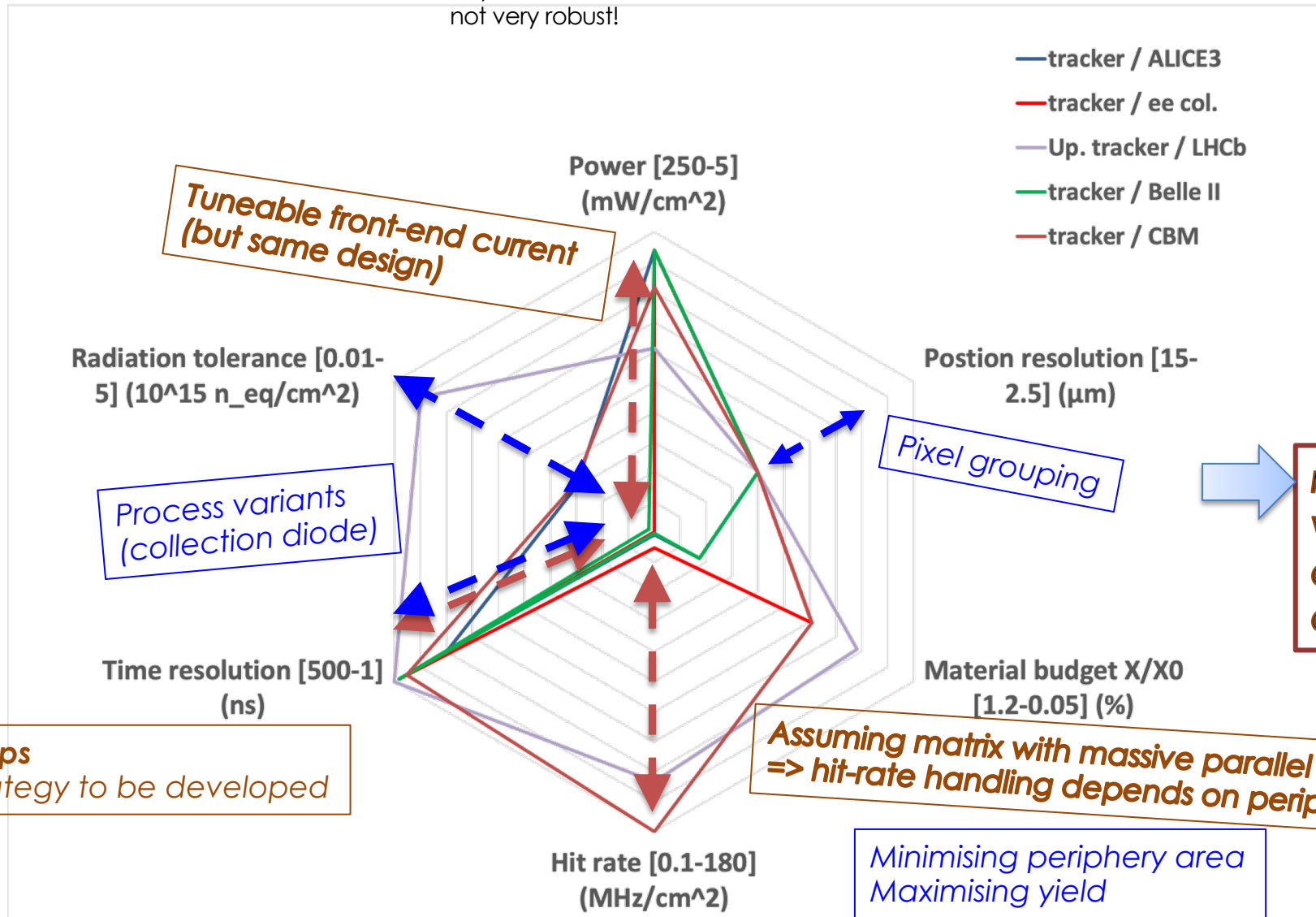
- Key aspects to
“develop the full potential of CMOS MAPS”

Strategic development

(technical & scientific statement)

Technical proposal

Pay attention to axis scales, not very robust!



matrix with tuneable front-end and process variants and switchable pixel group

Research goal target

Knowledge from large effort in past years organised by CERN-EP R&D / ALICE-ITS3

RG1
Position
precision



RG3
Readout
architecture
common with
DRD7

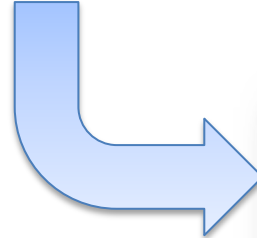
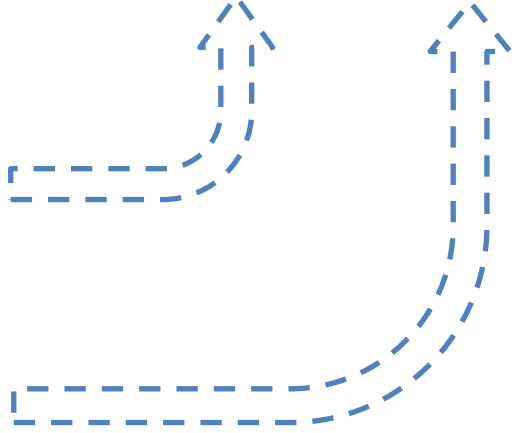


TPSCo (TJ) 65 nm

digital/binary, synchronous/asynchronous
optimised to features of RG1 and RG2 at medium rates
power distribution and control in large size stitched matrix

RG4
Radiation
tolerance

RG2
Timing precision



MS3
establish performance of
readout variants for power
consumption



MS6
handle technical solutions for
Central Tracking (ALICE-3, EIC,
LHCb-2, Belle-3), Timing Layers
(ALICE-3, ATLAS, CMS)
with stitching TPSCo 65 nm

■ EOI ?

- This is a technical proposal rather than a scientific expression of interest
- Target only sensor
- Not an EOI per se / contrary to a complete project for a Vertex detector

=> Potential contribution to another EOI for FCCee tracking

■ Synergies

- With existing detector R&D on ee machine: Belle II
- With integration studies for a FCCee tracker (US, ...)
- With sensor for vertex detector
 - => re-usable front-end (TBC), same matrix architecture, same (programmable) periphery
 - => two variants of 'same' chip
- With even longer term R&D purely on timing and/or intrinsic amplification

Announcement:

Supplementary slides ...

PIXEL EOI 2024

18 - 22 NOV

STRASBOURG
Collège Doctotal Européen

11th International Workshop on Semiconductor Pixel Detectors for Particles and Imaging

High energy and nuclear physics experiments
Astrophysics, biology, medical imaging and photon science applications
Radiation damage and tolerance
Timing with pixels
Monolithic sensors
Sensing materials development
Electronics
Integration in detection modules and structures

Abstract submission until July 5
Registration until September 30

International advisory committee

- Shiva Abbaszadeh, UCSC
- Jerome Baudot, IPHC
- Gabriella Carini, INFN
- Bart Dierckx, Cateste
- Lars Furenlid, University of Arizona
- Claudia Gemme, INFN
- Takaki Hatsu, RIKEN
- Harris Kagan, OSU
- Hans-Günther Moser, MPI
- Leonardo Rossi, INFN
- Walter Snoeyns, CERN
- Yoshinobu Ueno, KEK
- Norbert Wermes, University of Bonn

Local organising committee

- Nicolas Arbor
- Jeremy Andrea
- Magyane Besson
- Jerome Baudot (chair)
- Claude Colledani
- Eric Chabert
- Ziad El Bilal
- Christian Finck
- Christine Ho-Guo
- Miroslav Kischel
- Frédéric Morel
- Serhiy Senyukov
- Marie Vanstalle

cnrs **University of Strasbourg** **IPHC**

<https://indico.in2p3.fr/e/pixel2024>

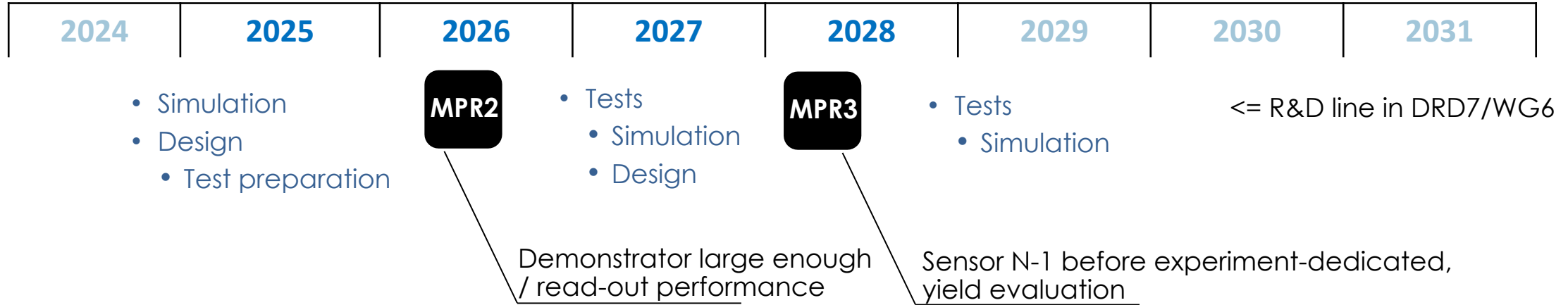
<https://indico.in2p3.fr/e/pixel2024>

Specifications: numbers!

Source: my own mix of LOI, recent talks and private communication

	ALICE3 OT	Belle II trk	CBM <u>trk</u>	LHCb UT	FCCee trk
Position resolution	~10 μm	<15 μm	~10 μm	<10 μm	<10 μm
Pixel pitch (μm)	50	50	~30	50	50
Hit rate (MHz/cm ²)	0.05 to 2	<1	60/180	160	<10
Data rate (Gb/s)			8	20	
Time figure (ns)	100	~1	25	~1 (<25)	20 to 1000
Triggering	no	yes	no	no	?
Power	~20	<50	~50	<100	~20?
TID (kGy)	50	10?	~10	2400	10?
NIEL	10 ¹⁴	10 ¹¹ ?	few 10 ¹⁴	3x10 ¹⁵	10 ¹¹ ?

Timeline & Collaboration



■ Interested groups so far (mostly under discussion)

- France: CPPM, IPHC, IRFU, LPNHE, (IP2I), ...
- Germany: GSI, ...
- Italy: Bergamo/Pavia, Pisa, ...
- Japan: under discussion
- Spain: IFIC, IGFAE, ...
- USA: under discussion
- ...

■ Expected strong synergies

- DRD3-WP1 projects in same techno
 - Position resolution
 - Radiation tolerance
 - Time resolution
- DRD7-WG6 for technology access