

Hybrid5 Irradiation at MAMI

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Belle II PXD Workshop

DESY, Hamburg

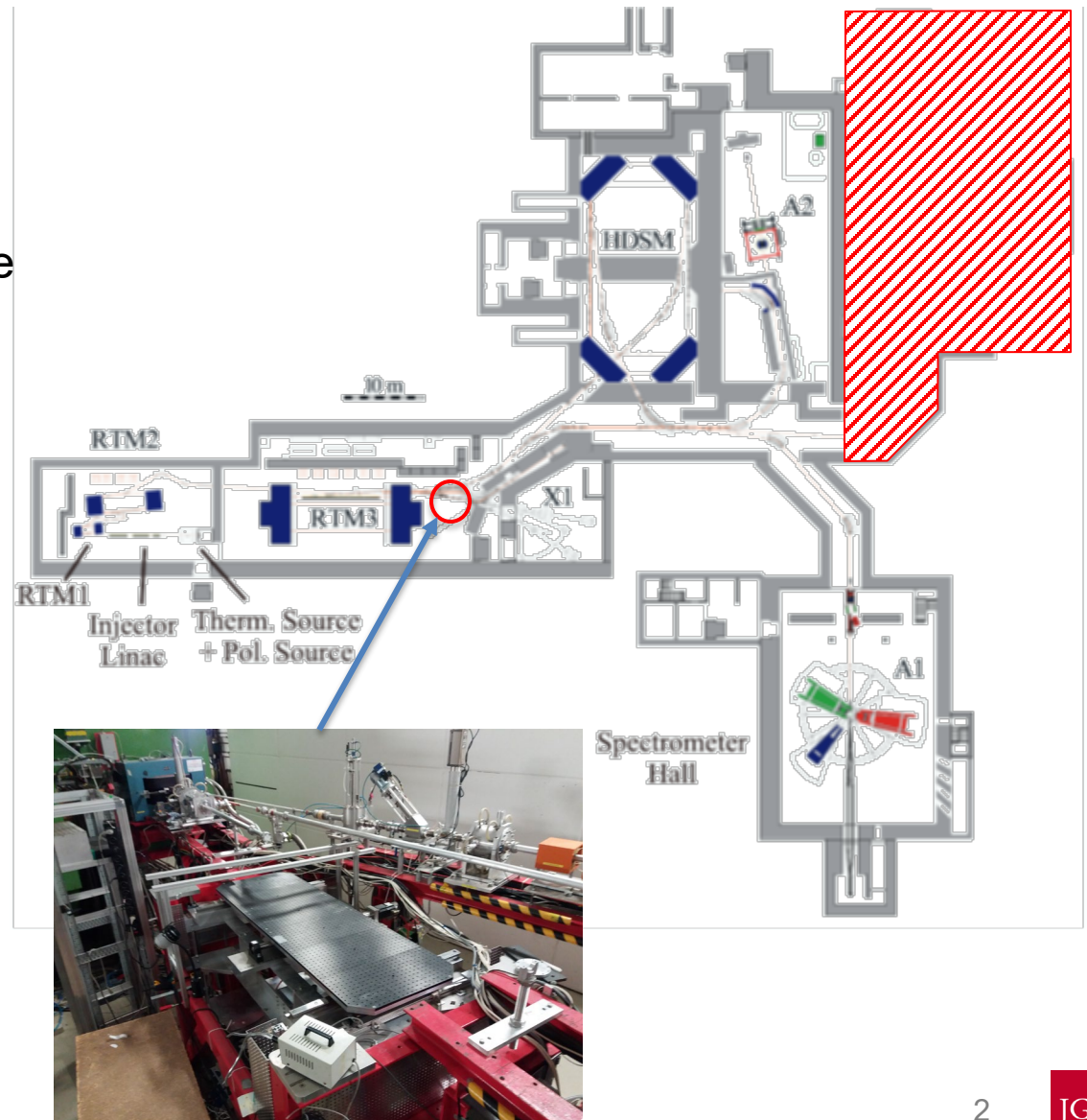
23.-24.9.2019

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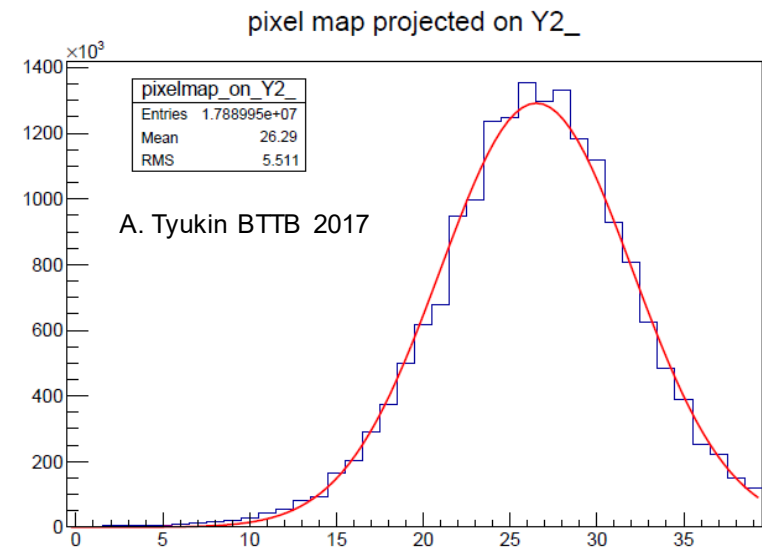
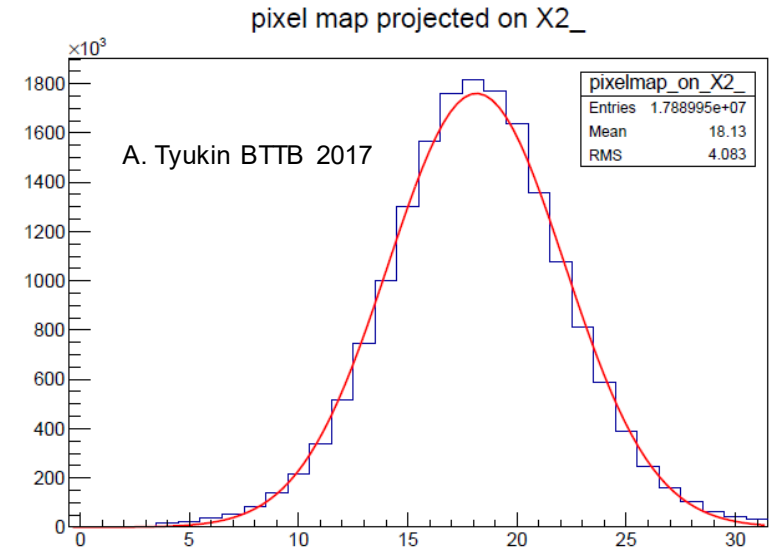
Mainz Microtron (MAMI)

- cw electron beam
 - Polarized/Unpolarized
 - Max. current 100 μA (only A1)
 - Macro pulses ($\sim 20 \mu\text{s}$) possible
- Four stages
 - RTM1 (14 MeV)
 - RTM2 (180 MeV)
 - RTM3 (855 MeV)
 - HDSM (1508 MeV)
- Three beamlines
 - A1 (electron scattering)
 - A2 (real photon scattering)
 - X1 (X-ray sources)



X1 Beamline

- Pencil beam
 - Typical $\varnothing < 1$ mm
- 300 μm aluminium exit window
- MuPix measured beam spot size
 - After 1 m of air
 - RMS_x 0.42 mm (FWHM_x 0.99 mm)
 - RMS_y 0.44 mm (FWHM_y 1.04 mm)
- X-Y table available
 - Remote controlled
 - Vertical range 300 mm
 - Horizontal travel 400 mm
 - Precision ~ 10 μm
- Dosimetry
 - 5-10% accuracy for beam current

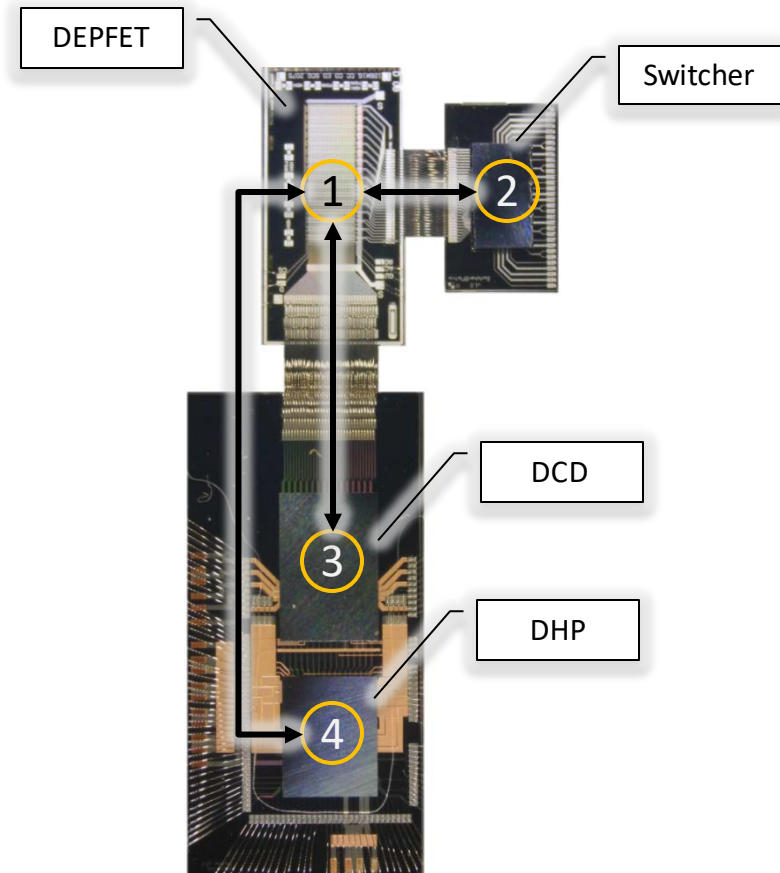


Radiation Dose Rate Estimate

- Estimated dose rate during SuperKEKB beam loss (**I. Peric**)
 - $3 \text{ Rad}/40 \mu\text{s} \Rightarrow \dot{D} = 1.2 \cdot 10^{13} \frac{\text{MeV}}{\text{g}\cdot\text{s}}$
- Stopping power for 855 MeV-electrons in Si (NIST)
 - $40.11 \text{ MeV}\cdot\text{cm}^2/\text{g}$
- Required electron density
 - $3 (1.25) \cdot 10^9 \text{ e}/\text{s mm}^2 \Rightarrow 4.8 (2) \cdot 10^{-10} \text{ A}/\text{mm}^2$
- Beam spot diameter 1 mm
 - $I = 4.8 (2) \cdot 10^{-10} \frac{\text{A}}{\text{mm}^2} \cdot 0.79 \text{ mm}^2 = 380 (160) \text{ pA}$
- Safety margin ~ 100
 - $I_{\text{max}} = 38 (16) \text{ nA}$

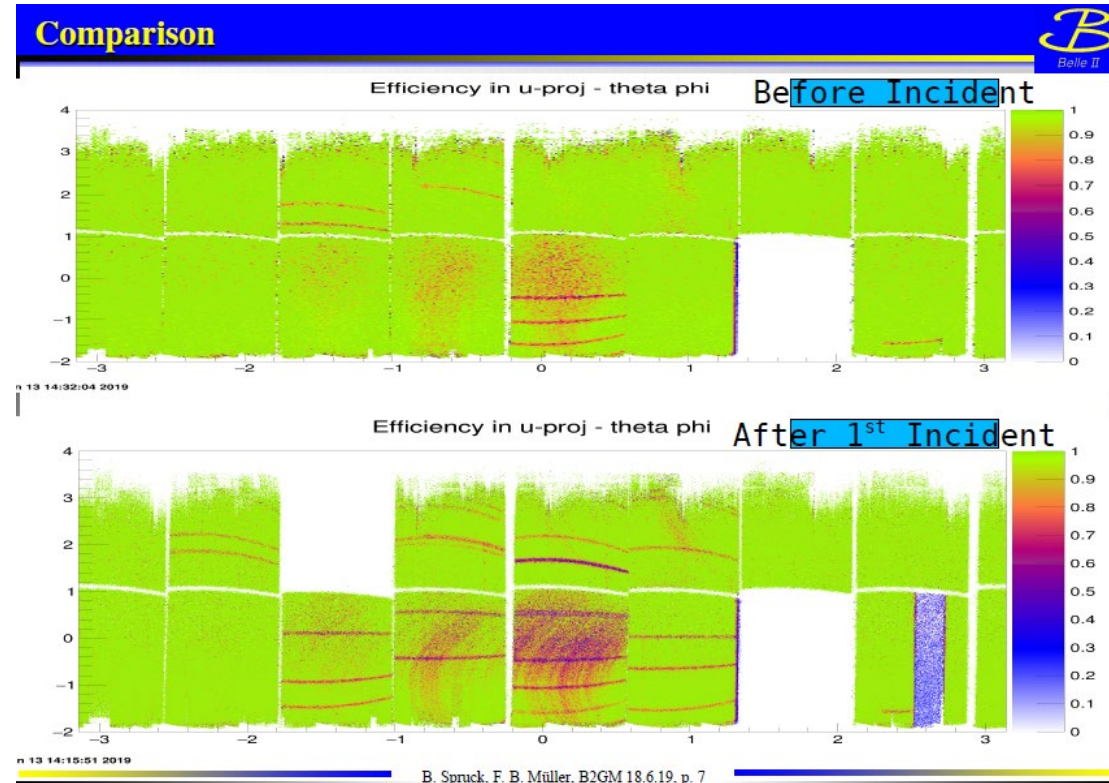
Irradiation Sequence

- Four areas
 - Subareas?
- Need to return to sensor?
 - Beam halo limited
- 10 minutes per step
- Intensity steps
 - a) Fixed steps
 - 1 nA-steps
 - 390 (170) minutes
 - b) Increasing steps
 - 380 (160) pA steps until 10-fold dose rate
 - 1 nA steps until 100-fold dose rate
 - 440 (240) minutes



Open Issues

- System Experts on site?
 - DAQ, Sensor, etc.
- Setup infrastructure requirements?
 - Power supplies, cooling, etc.
- Map beam spot
- How many Hybrid5 boards to irradiate?
- Key measurement quantities?
 - Only missing gates?
- Detailed Schedule



Tentative Schedule (26.11.-02.12.19)

	Mon 25.11.	Tue 26.11.	Wed 27.11.	Thu 28.11.	Fri 29.11.	Sat 30.11.	Sun 01.12.	Mon 02.12.
Beam available								
MuPix (?)								
Testing								
Setup								
Data Taking								

Needs to be agreed with MuPix group!

- Confluence page
<https://confluence.desy.de/pages/viewpage.action?pageId=135759358>
- Google Spreadsheet
https://docs.google.com/spreadsheets/d/1soWpCqXZfPW6_dGjwNlawINfgn6ZaIQjF67tCxLWH3A/edit#gid=1657638876
- How to reach the Institute <https://www.blogs.uni-mainz.de/fb08-nuclear-physics/general-information/maps-and-directions/>