First Studies of 5D Phase-Space Tomography of Electron Beams at ARES

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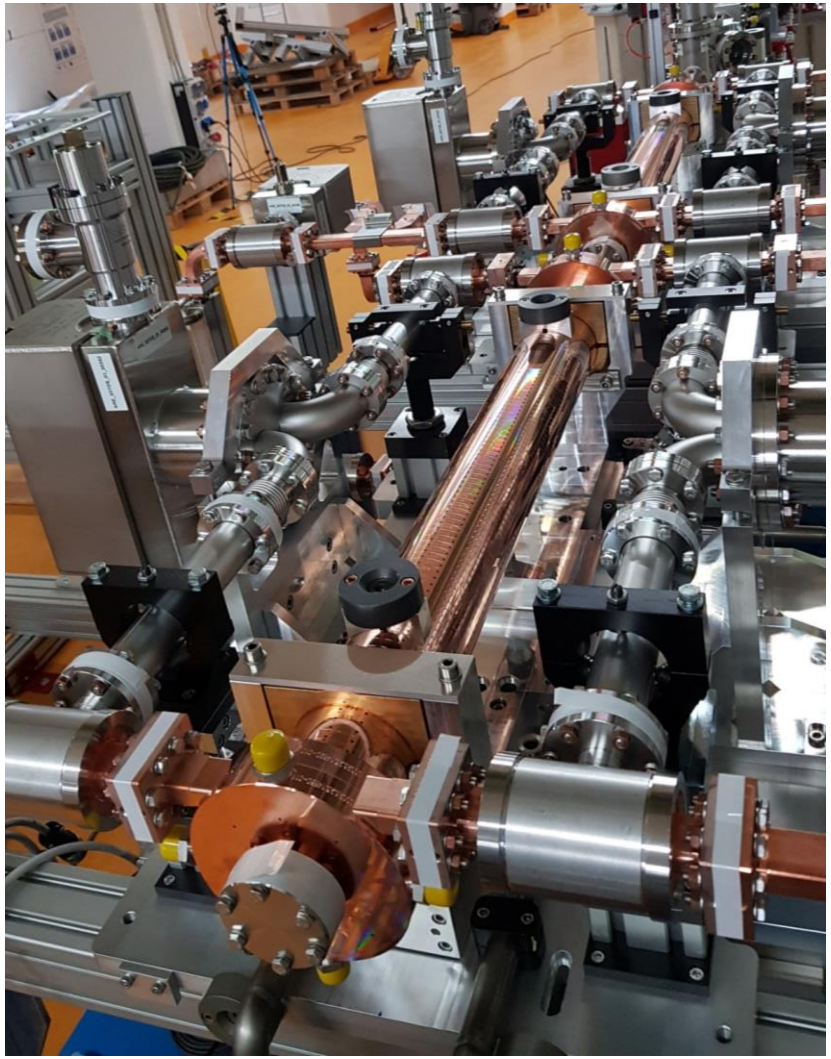
HELMHOLTZ RESEARCH FOR GRAND CHALLENGES

DESY.

Polarizable X-band TDS enables new diagnostics methods



- Designed in **collaboration** between CERN, PSI and DESY [1-3].
- Unique feature: **Variable** streaking angle.
- Two structures are installed at the **ARES** linear accelerator at DESY.
  (see posters **THPOJO01** and **THPOJO02**)

[1] B. Marchetti et al., Sci. Rep., 2021,
[2] P. Craievich et al., Phys. Rev. Accel. Beams, 2020,
[3] A. Grudiev, CLIC-Note-1067, 2016

5D phase-space tomography

Reconstructing the full transverse phase-space of each longitudinal slice

4D transverse tomography [1]

Many transverse phase-space rotations

+

PolariX TDS [2]

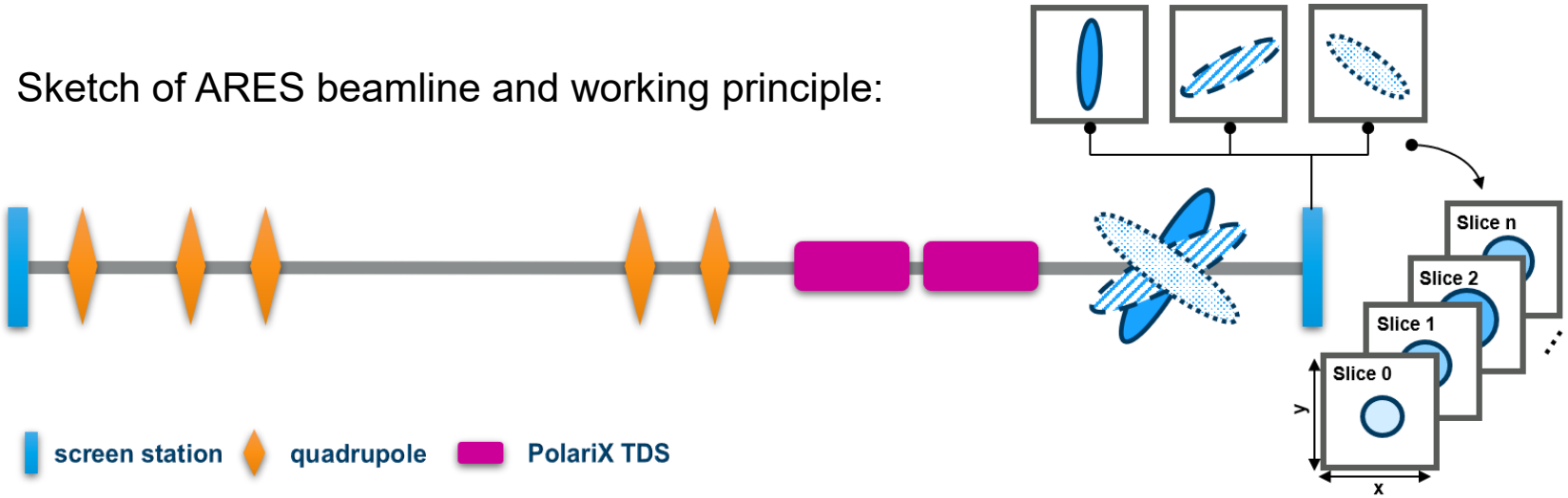
Many streaking angles

→

Full 5D (x, x', y, y', t) reconstruction.

Logitudinally-sliced 4D transverse tomography

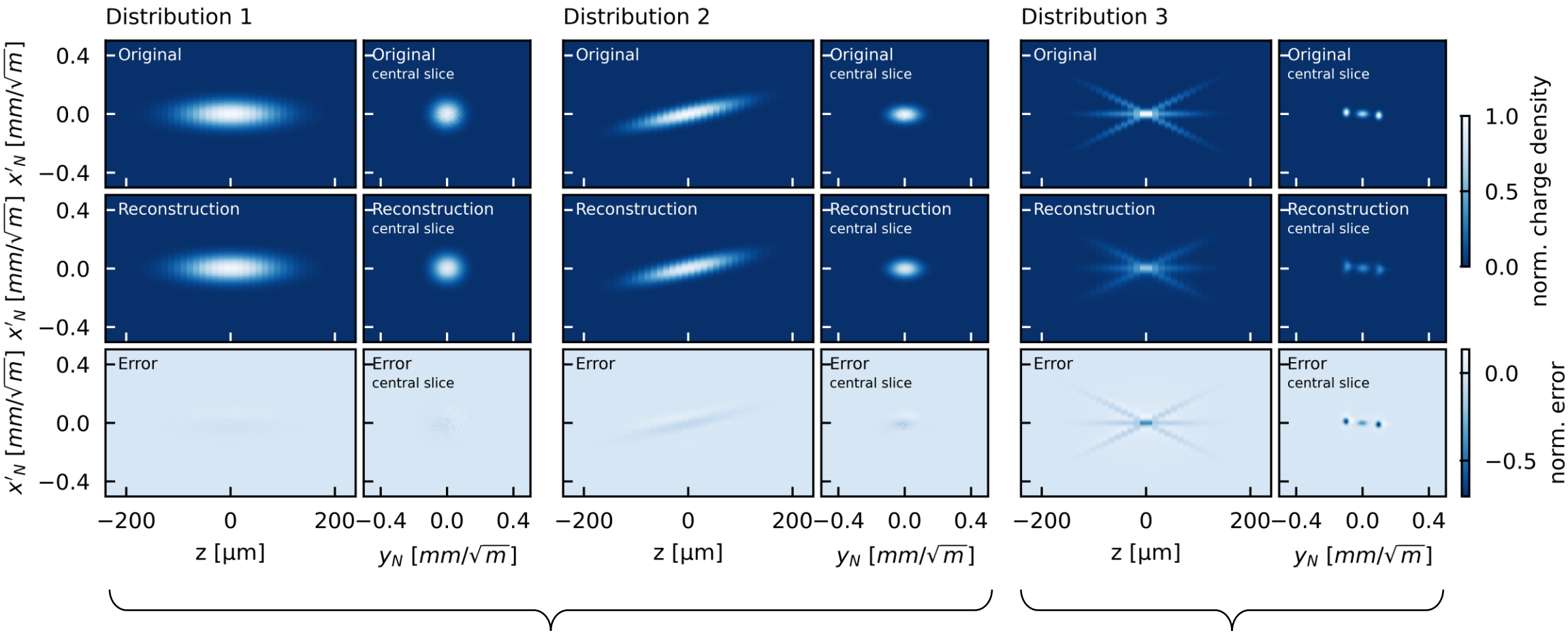
Sketch of ARES beamline and working principle:



[1] K. Hock and A. Wolski, Nucl. Instrum. Methods Phys. Res. Sect. A, 2013, [2] B. Marchetti et al., Sci. Rep., 2021

Successful 5D reconstruction of different bunches

Proof-of-principle simulation studies with artificial distributions



Beam parameters reconstructed with $\lesssim$ 6% discrepancies.

Successful reconstruction of complex features.

Looking forward to see you at my poster

MOPORI10

- 5D (x, x', y, y', t) phase-space tomography method
  - Combines **quadrupole-based** transverse phase-space with the **variable streaking** angle of a **PolariX** TDS.
- Enables to:
  - Detect **correlations** and other **features** in the distribution,
  - **Optimize** and **improve** the beam quality,
  - Perform detailed **simulation** studies.
- Proof-of-principle simulations:
  - **Beam parameters** and **correlations** are accurately reconstructed (discrepancies $\lesssim 6\%$) for Gaussian distributions.
  - Successful reconstruction of **complex phase spaces**.