Working Group 4

Time-resolved Diagnostics

12th workshop on longitudinal electron bunch diagnostics, Karlsruhe, 12th – 14th Jun. 2023

MATTER AND TECHNOLOGIES

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Electron bunches

facility	bunch charges	bunch lengths	repetition rates	single-shot resolution
FLUTE	1pC…1nC	few fs…1ps	10Hz , single-bunch	
ARES	100fC…20pC	few fs		~1fs
CLARA	5pC…250pC	50fs	100Hz, single-bunch	<10fs
EuXFEL/FLASH	20pC…500pC (1nC) design 250pC	10fs…500fs (1ps)	4.5MHz / 10Hz burst mode	<5fs
KARA	100pC…1nC	few ps	2.7MHz, single-bunch 11MHz, single-bunch (in the booster)	
MAXiv	10pC…200pC design 100pC	1fs…100fs	10Hz…100Hz, single-bunch or double-bunch (100ns separation)	<5fs

Laser-based detection

- Central wavelength
  1560nm +/- 20nm
  1560nm +/- 50nm
  1310nm
  800nm +/-30nm
- Pulse width
  100fs…<1ps
- Pulse energy few 10pJ

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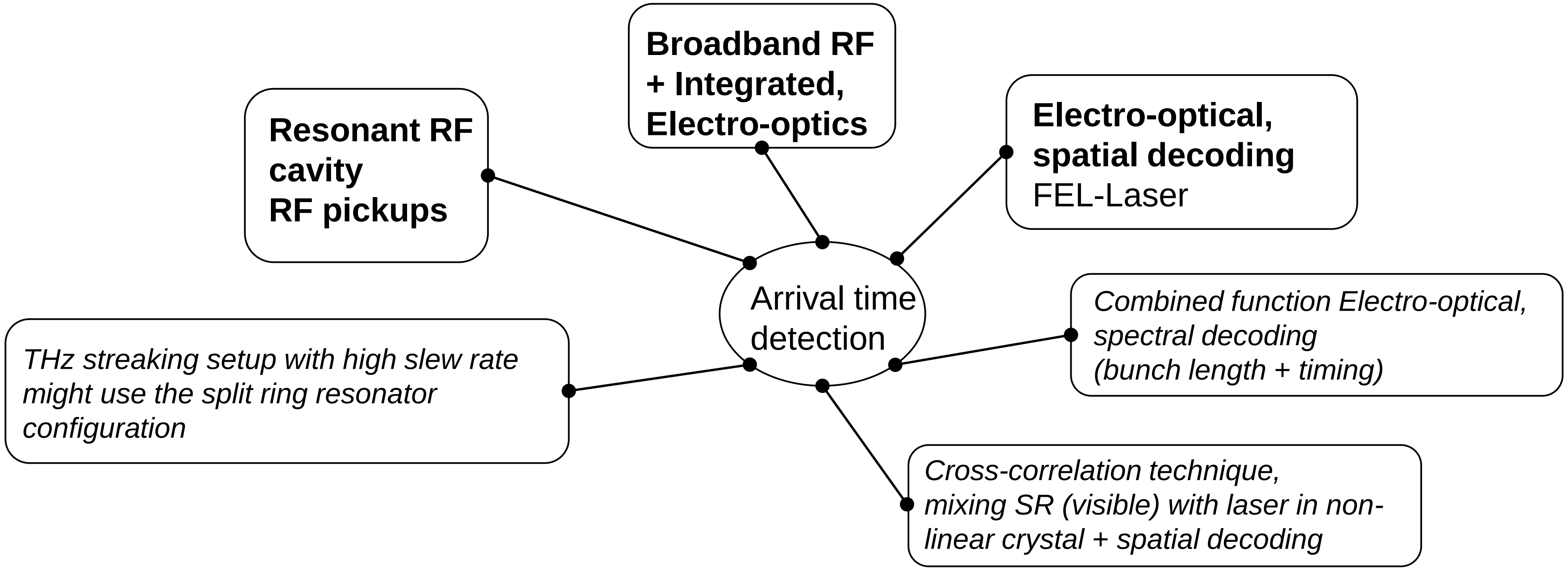

Idea

combine RF resonant cavity and resonant EOM

- Resonant frequencies
  (RF SC cavity, optical resonator)
  10GHz…50GHz
- Would fit to low rep.rate cw machines, single bunch down to fC?

Novel Electro-optics devices

- Thin-film LiNbO3 MZM structure w/o metallic electrodes,
  bring close to Coulomb Field of beam?
  @1560nm
  balanced configuration

Read-out Electronics for resonant approach

- Direct sampling
- Mixing / Down conversion
  - IQ detection scheme,
  - Limitations on achievable resolution ?
    (e.g. at 100pC)

Different approaches to consider :

- A type of BOM-PD for detecting phase drift between RF and a laser reference
  - Achievable resolution and requirements on input RF power?

Read-out for broad-band approach

- Single channel, MZM at quadrature point

Different approaches to consider :

- Balanced photodiode configuration
  - Remove influence of laser RIN
- Coherent detection scheme
  - With carrier suppression + IQ detection
  - Challenges: broadband design in RF & optical