Introduction

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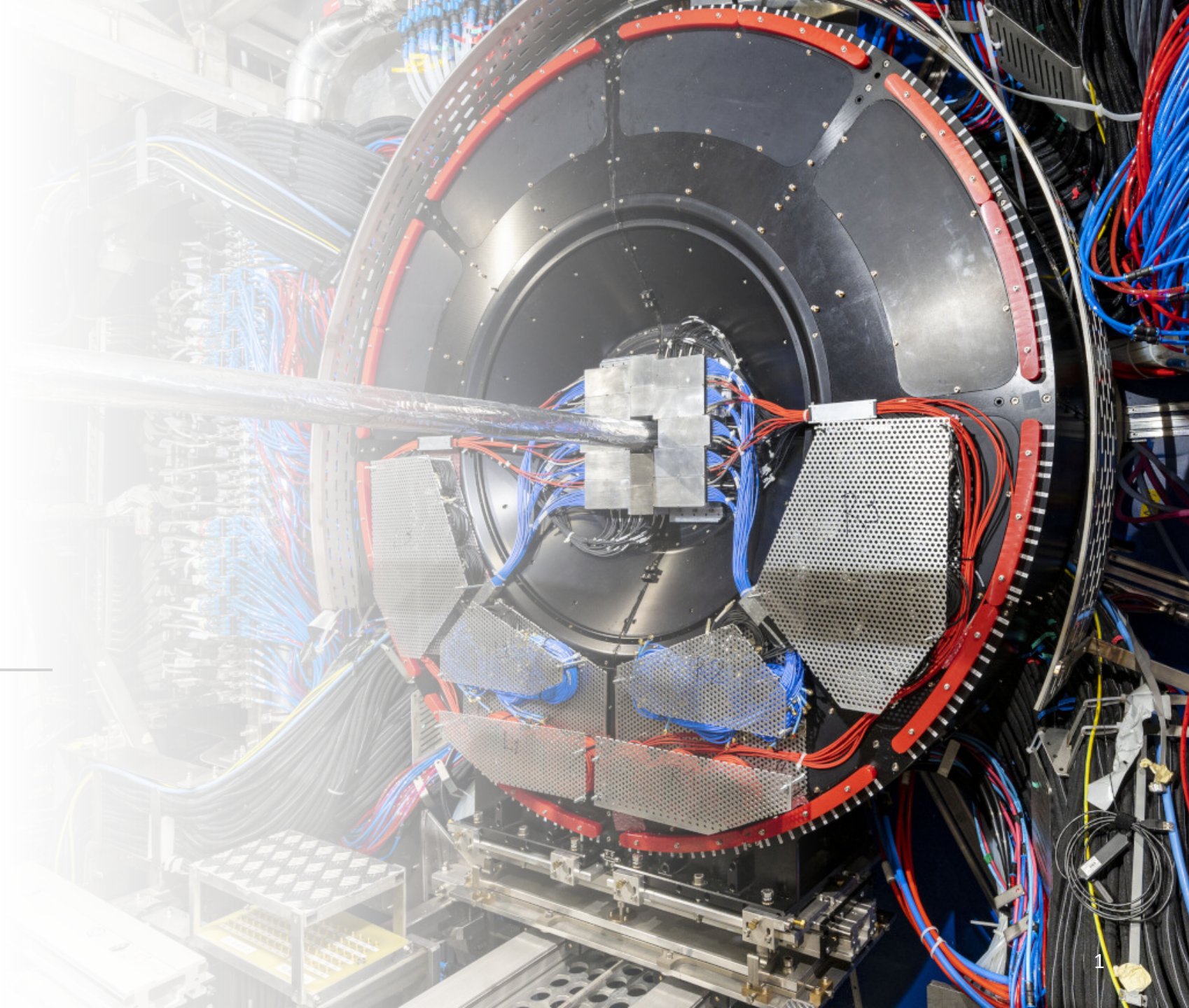
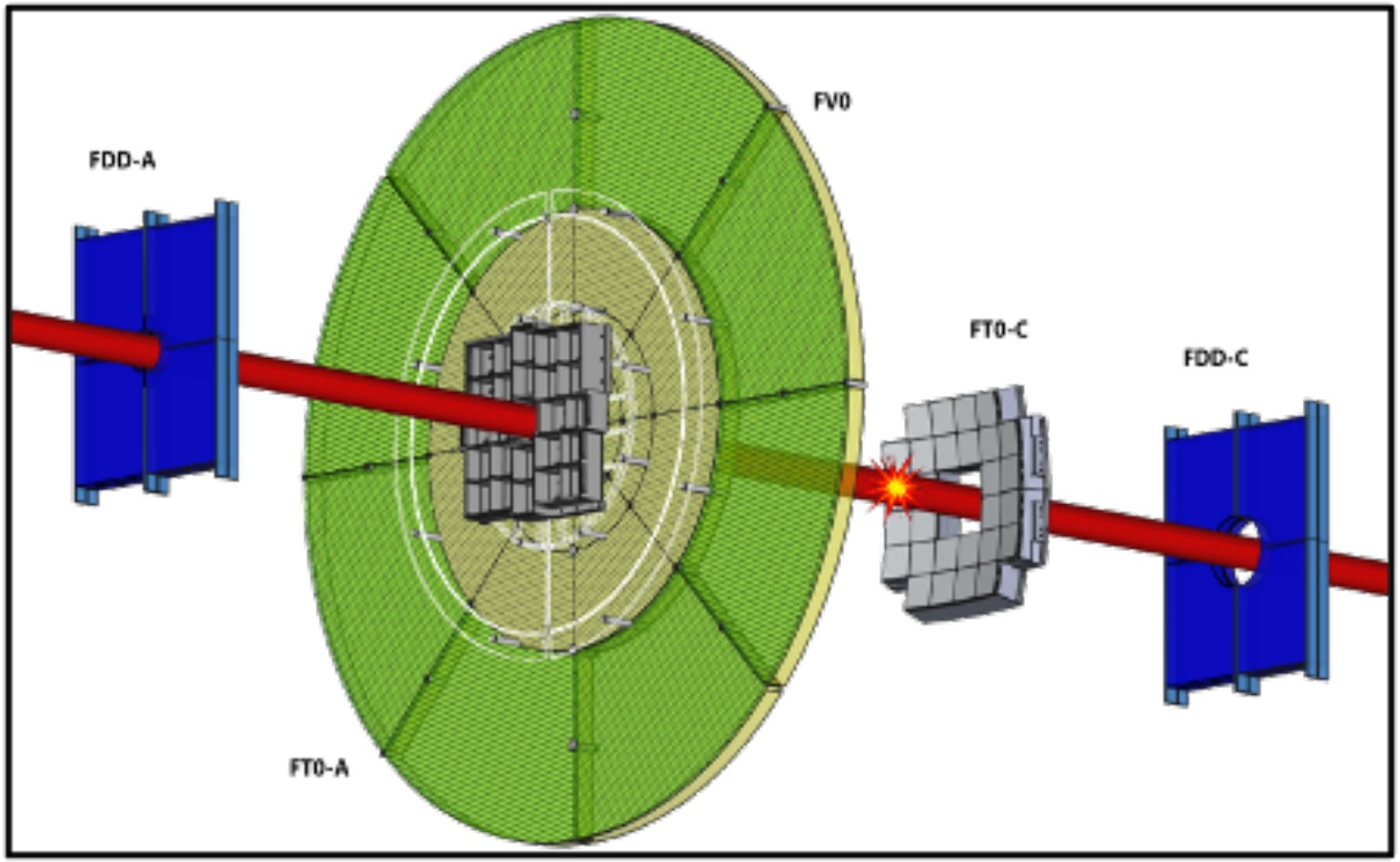


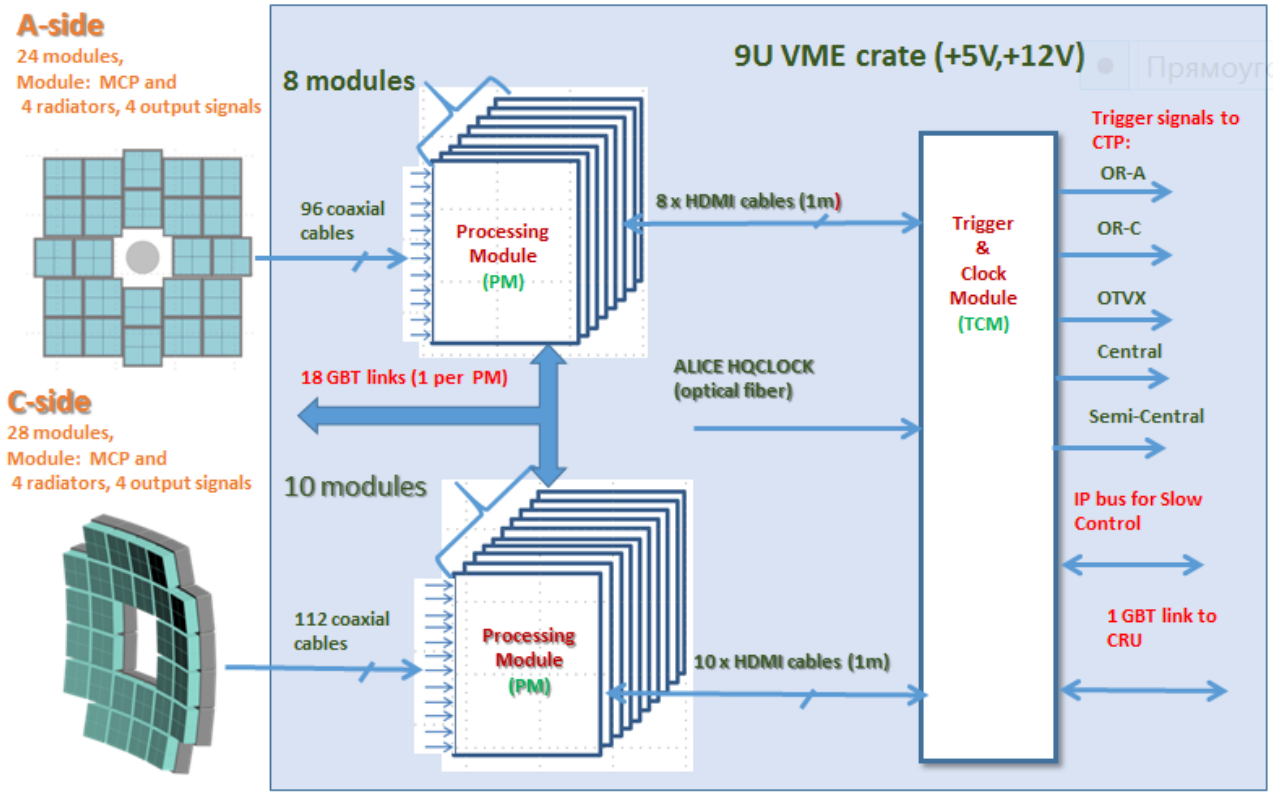
FIT detector



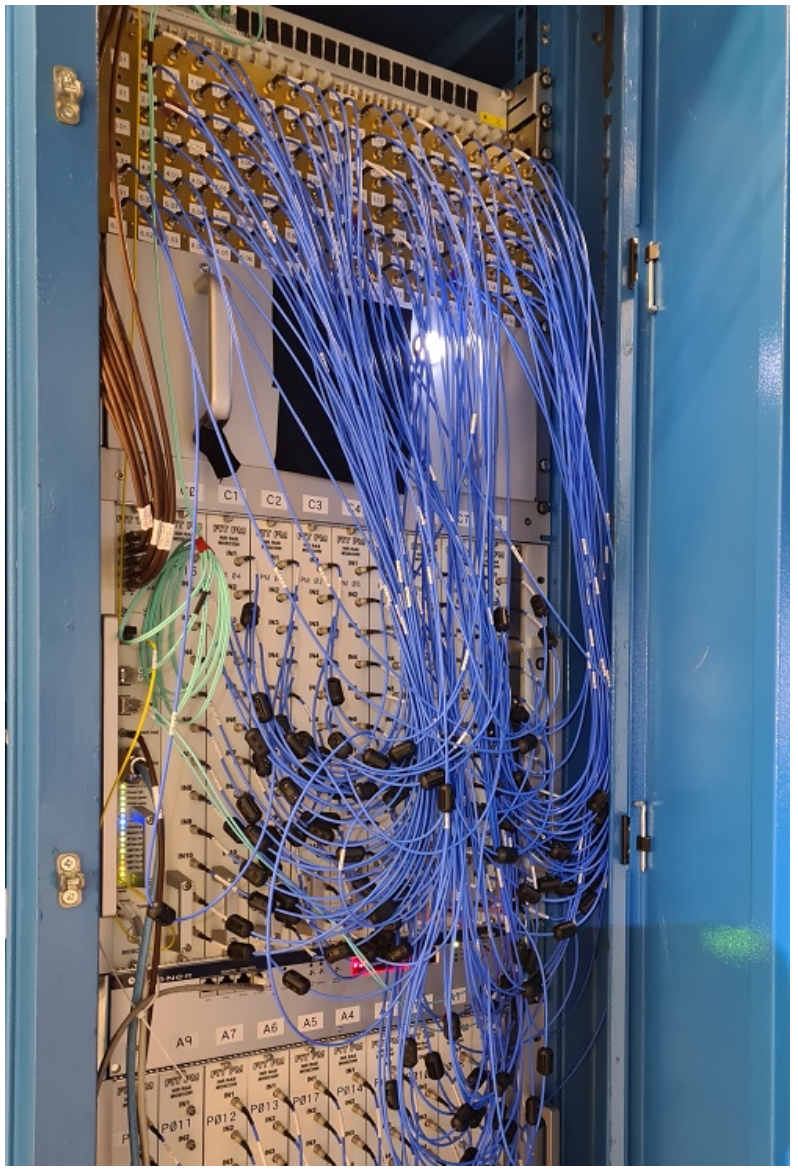
FT0 is a quartz-based Cherenkov detector with the modified Planacon MCP-PMTs readout

FV0 and FDD are made of EJ-204 plastic scintillators with the fine-mesh PMT (Hamamatsu R5924-70 and H8409-70)

FIT FEE

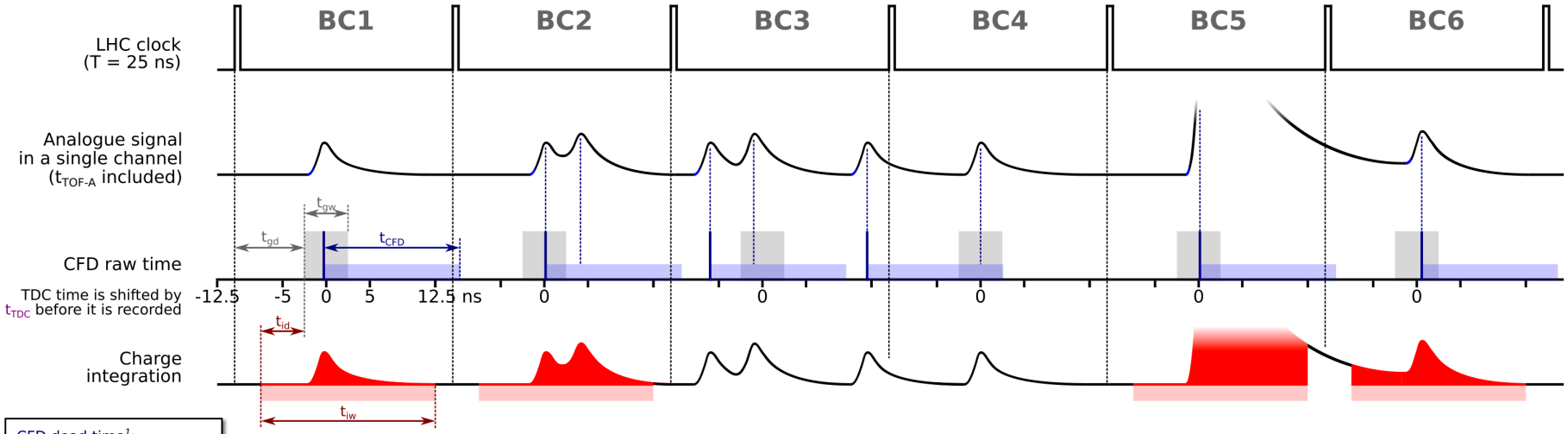


Designed and produced by INR/Moscow



- Designed for FT0 and adapted for FV0 and FDD detectors
- FT0 and FV0 trigger signals to CTP in 425 ns
- FT0 time resolution < 20 ps
- Large dynamic range required (up to 600 particles/ch expected)

FIT PM design limitations



CFD dead time[1]:
t_{CFD} = 15..16 ns

Gate width:
A: t_{gw} = 5 ns

Gate delay[2]:
A: t_{gd} ≅ 7.5 ns
C: t_{gd} ≅ -0.1 ns

Integration window width:
t_{iw} = 19..20 ns

Integration window delay[2]:
t_{id} = -3.5 ns

TDC time shift:
$t_{TDC} = t_{gd} + t_{gw} / 2$

Time-of-flight
A: t_{TOF} ≅ 10 ns
C: t_{TOF} ≅ 2.4 ns

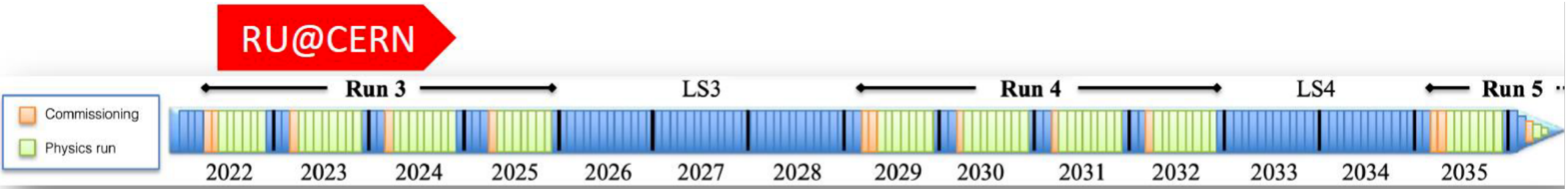
BC1	BC2	BC3	BC4	BC5	BC6
Single hit at the interaction time CFD is triggered by sufficiently steep leading edge CFD time is within ± 2.5 ns gate, so the charge integration is triggered **Time and charge is recorded**	Two hits within the CFD dead time, second hit comes from background CFD records only time of the first hit Charge from both hits is integrated Reconstructed multi-plicity contains back-ground contamination **Time and charge is recorded**	Three hits: initial 2 are within CFD dead time, first and third hit comes from background CFD is triggered by the first pulse, but integra-tor does not start because the pulse is outside of ± 2.5 ns gate The second pulse is lost - neither its time nor charge is recorded The third pulse triggers CFD, but not integrator **2 time values are recorded and pile-up flag is set**	Single hit after background hit, that occured late in the previous BC Otherwise valid hit is lost, because the CFD was still busy processing previous background hit **No data is recorded**	Many hits Collected charge is slightly underestimated because tail is lost Timiing may be inaccurate if CFD was saturated **Time and charge is recorded**	Single hit after high-charge event Signal level has not dropped to the base level, because of the tail of preceeding hit CFD triggers, but time is slightly shifted and charge contains a portion of tail from the previous BC **Time and charge is recorded**

[1] *Dead time may depend on channel*
[2] *Delays are adjustable individually for each channel via PM registers*

Current status:

- CFD dead time (~ 16 ns)
- Narrow time gate to trigger charge integration
- Only 300 particle / channel dynamic range
- High frequency noise affecting FV0 and FDD time distributions for small signals

FIT FEE upgrade proposal



Adaptation of mezzanine boards for FV0 and FDD. Noise removal and better FEE dynamics (INR / Moscow)

Mid-term

Redesign FEE for FV0 and FDD before nominal luminosity in 2025

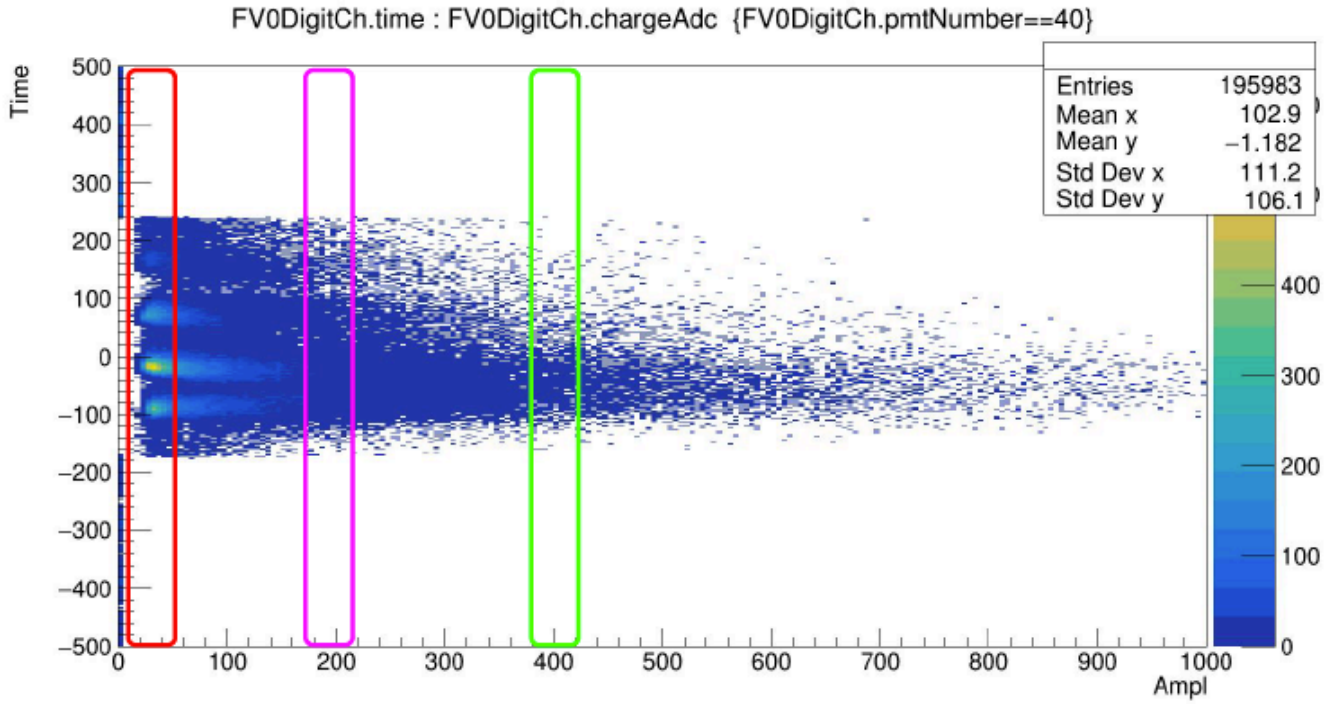
Long-term (end of Run 4)

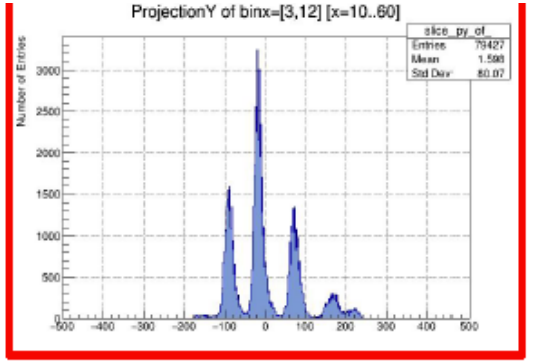
New electronics with better properties and higier flexibility

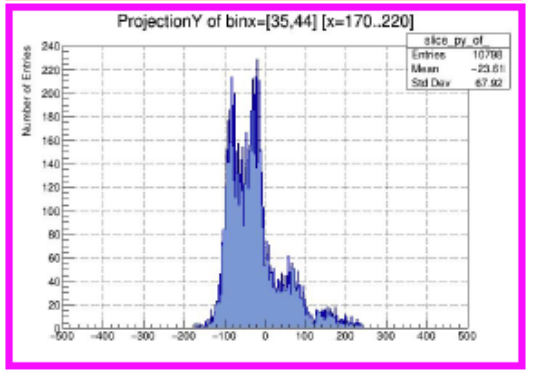
- CERN will terminate cooperation with Russian Federation institutions in 2024
- **ALICE management ask ALICE-PL consortium to make middle- and long-term FEE upgrades**

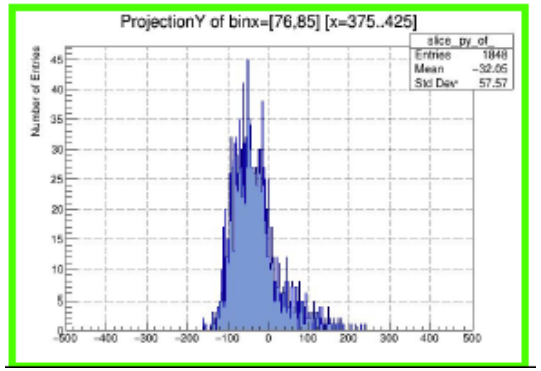
Backup

FV0 - time distributions









- Multiple peaks visible for small charges
  - ~1 ns spacing between peaks
- Hardware problem, FEE for FV0 and FDD will be redesigned

Short term upgrade - new FV0 PM mezzanine

INR/Moscow