

PROBING OF EXOTICS STRUCTURE WITH HADRON AND HEAVY ION COLLISIONS

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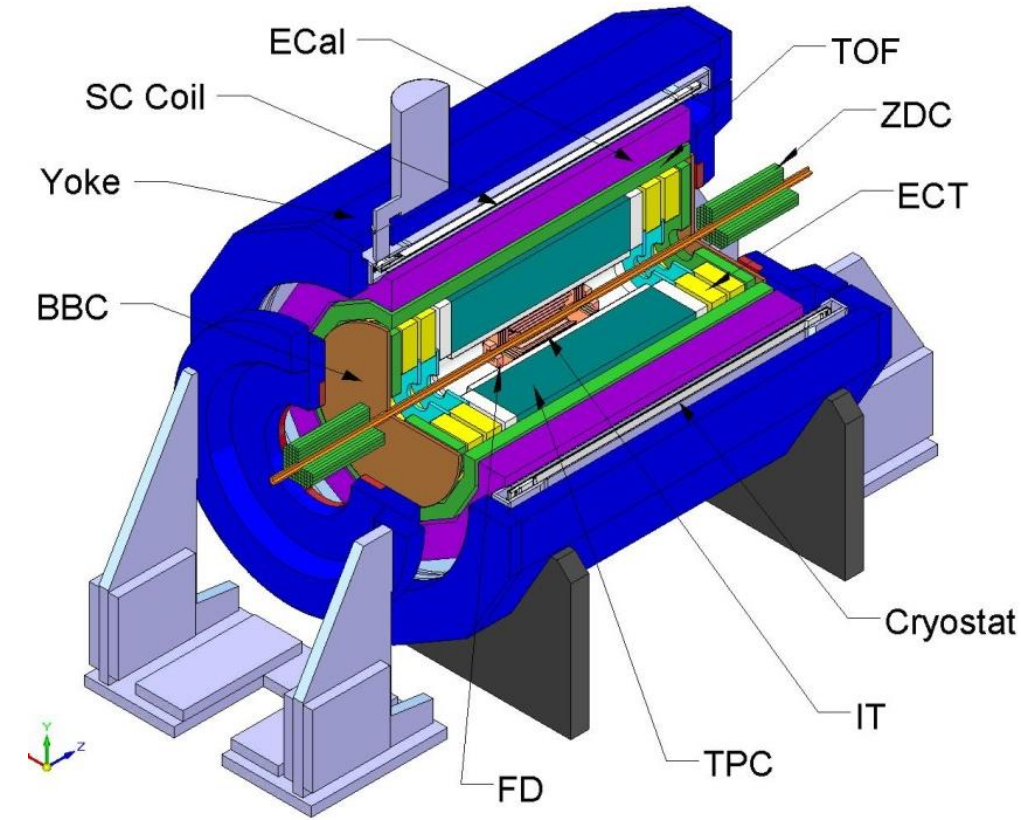
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MPD APPARATUS

Magnet: 0.5 T superconductor
Tracking: TPC, ECT, IT
Particle ID: TOF, ECal, TPC
T₀, Triggering: FFD
Centrality, Event plane: ZDC
Stage 1: TPC, Barrel TOF& ECal, ZDC, FFD
Stage 2: IT + EndCaps (tracker, TOF, ECal)

Detector features:

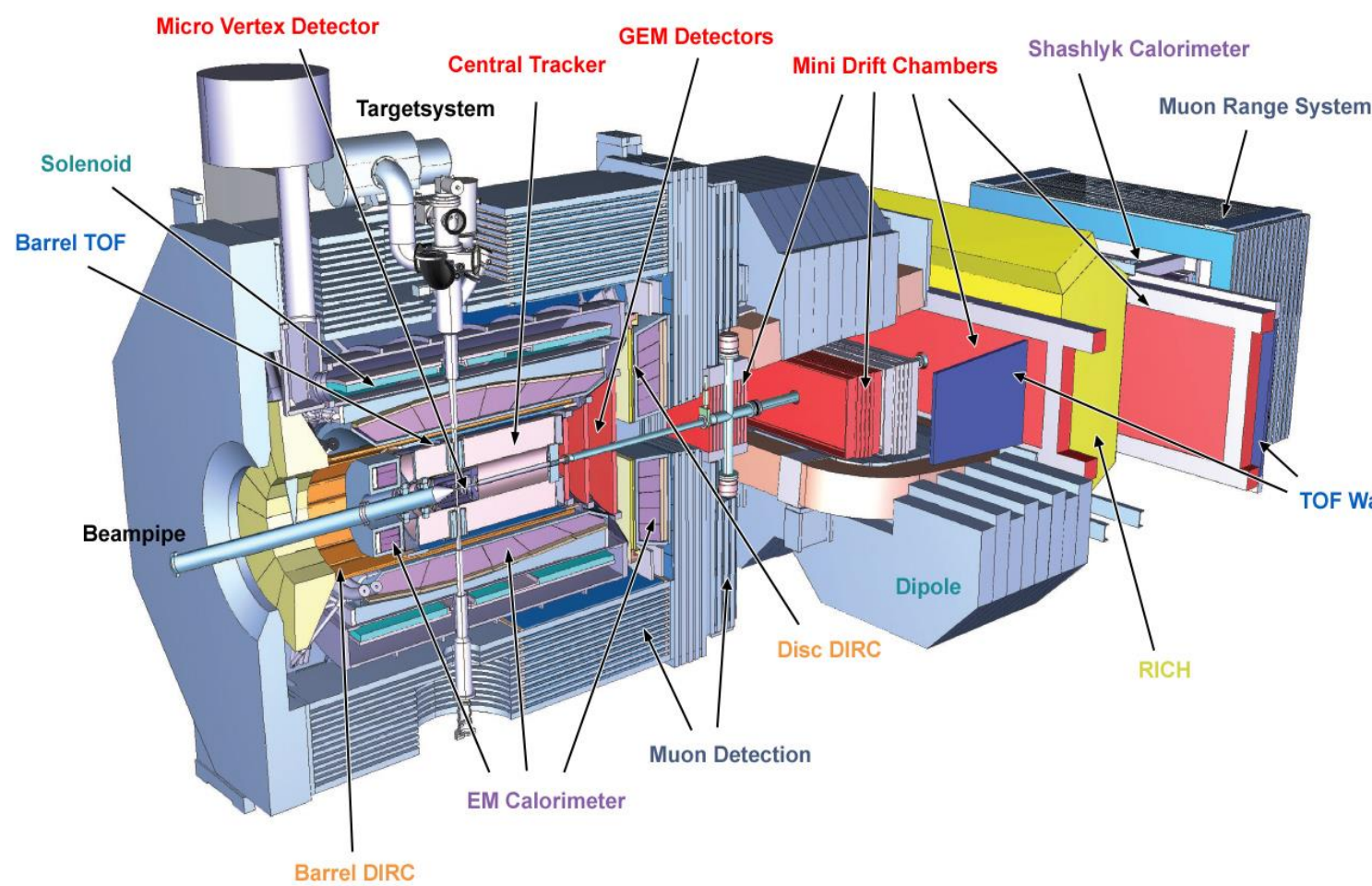
- Minimal dead time, event rate capability up to ~ 6 kHz.
- Hermeticity, homogeneous acceptance: 2π in azimuthal angle.
- Highly efficient 3-D track reconstruction ($|\eta| < 2$), high resolution vertexing.
- Powerful PID: π/K up to 1.5 GeV/c, K/p up to 3 GeV/c, ECal for γ , e^{\pm} .
- Careful event characterization: impact parameter & event plane reconstruction.



COMPLEX NICA



PANDA APPARATUS



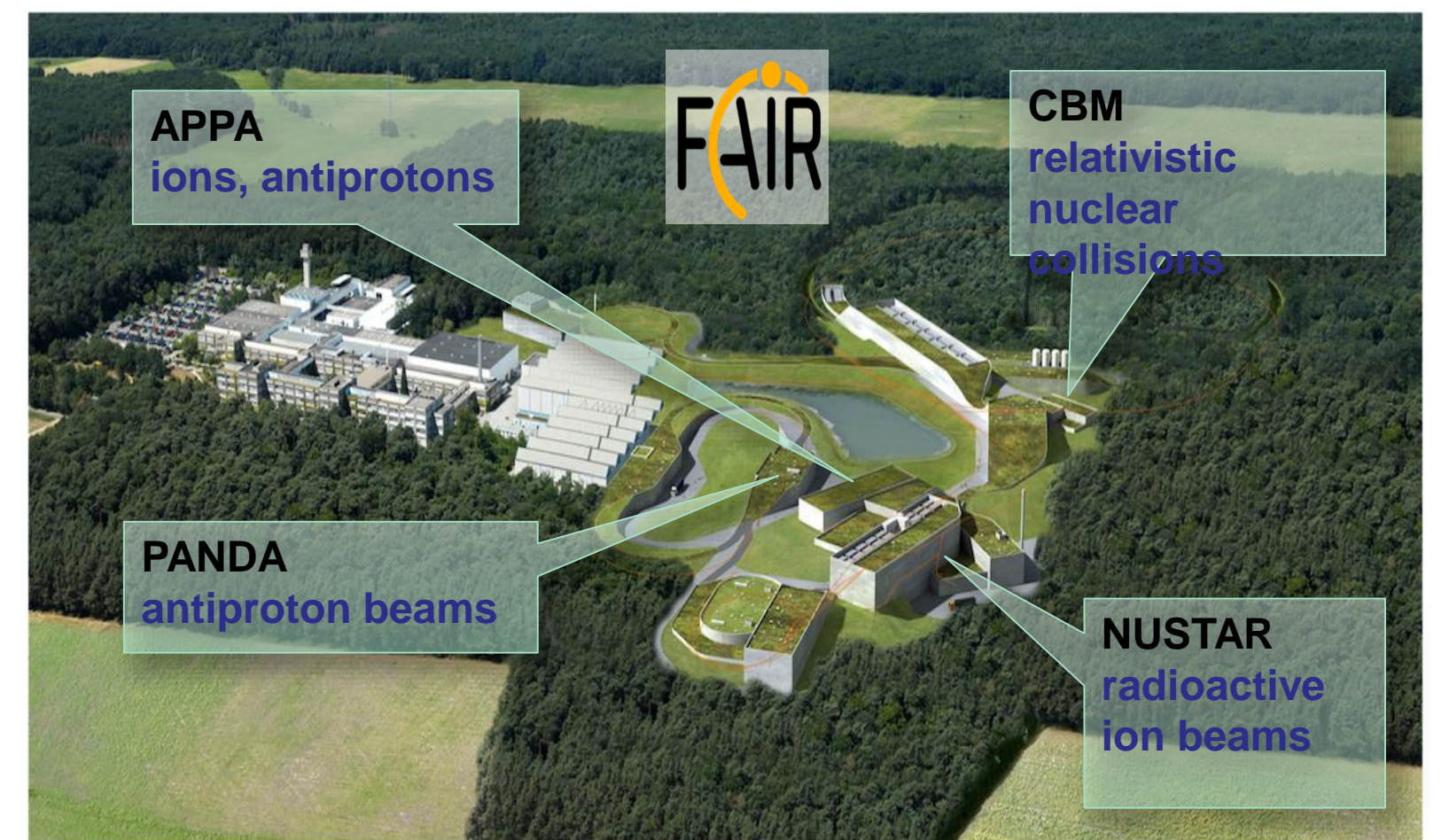
Antiproton production

- Proton Linac 70 MeV
- Accelerate p in SIS18 / 100
- Produce \bar{p} on Cu target
- Collection in CR, fast cooling
- Accumulation in RESR
- Storage and usage in HESR

HESR: Storage ring for \bar{p}

- Injection of \bar{p} at 3.7 GeV/c
- Slow synchrotron (1.5-15 GeV/c)
- Luminosity up to $L \sim 2 \times 10^{32} \text{ cm}^{-2} \text{ s}^{-1}$
- Beam cooling (stochastic & electron)

COMPLEX FAIR



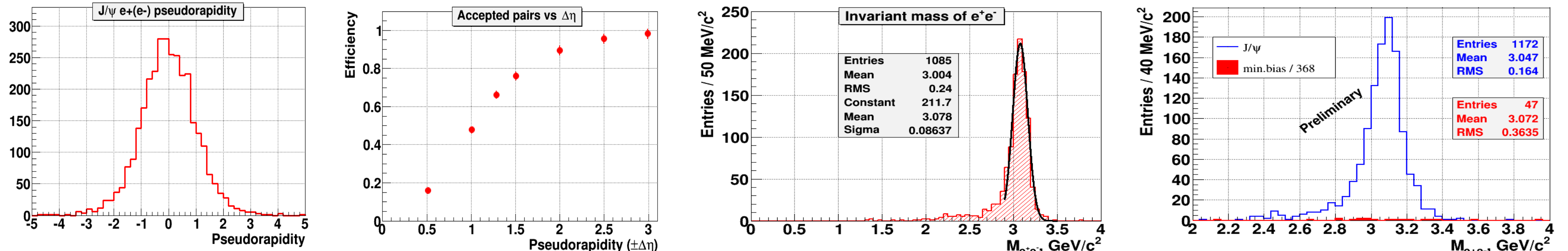
SOFTWARE

- MpdRoot as a framework
- Pythia8, UrQMD3.3 generators
- MpdRoot Geant3 transport
- MpdRoot TPC Kalman filter – based track and vertex reconstruction

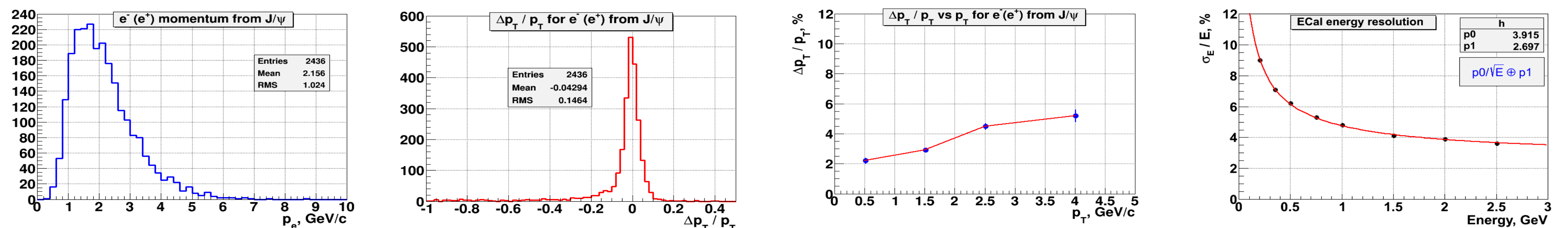
RUNNING CONDITIONS

- $p+p$ at $\sqrt{s} = 25 \text{ GeV}$
- Luminosity $L = 10^{29} \text{ cm}^{-2} \text{ s}^{-1}$
- Running time 10 weeks: integrated luminosity $L_{\text{int}} = 604.8 \text{ nb}^{-1}$
- Decay channel $J/\psi \rightarrow e^+e^-$ (branching ratio ~6%)
- X-section $\sigma_{J/\psi}$ from Pythia8 equals 108.7 nb
- Statistics: $N_{J/\psi} = L_{\text{int}} \cdot \sigma_{J/\psi} \cdot \text{Br}_{J/\psi \rightarrow e^+e^-} \cdot \text{Eff}_{\Delta\eta=1.5} = 604.8 \cdot 108.7 \cdot 0.06 \cdot 0.8 = 3156$

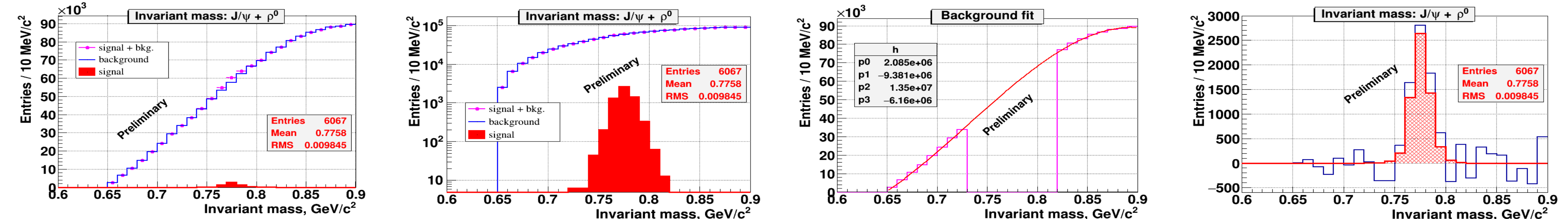
DETECTOR ACCEPTANCE FOR e^+e^- FROM J/ψ & INVARIANT MASS OF e^+e^-



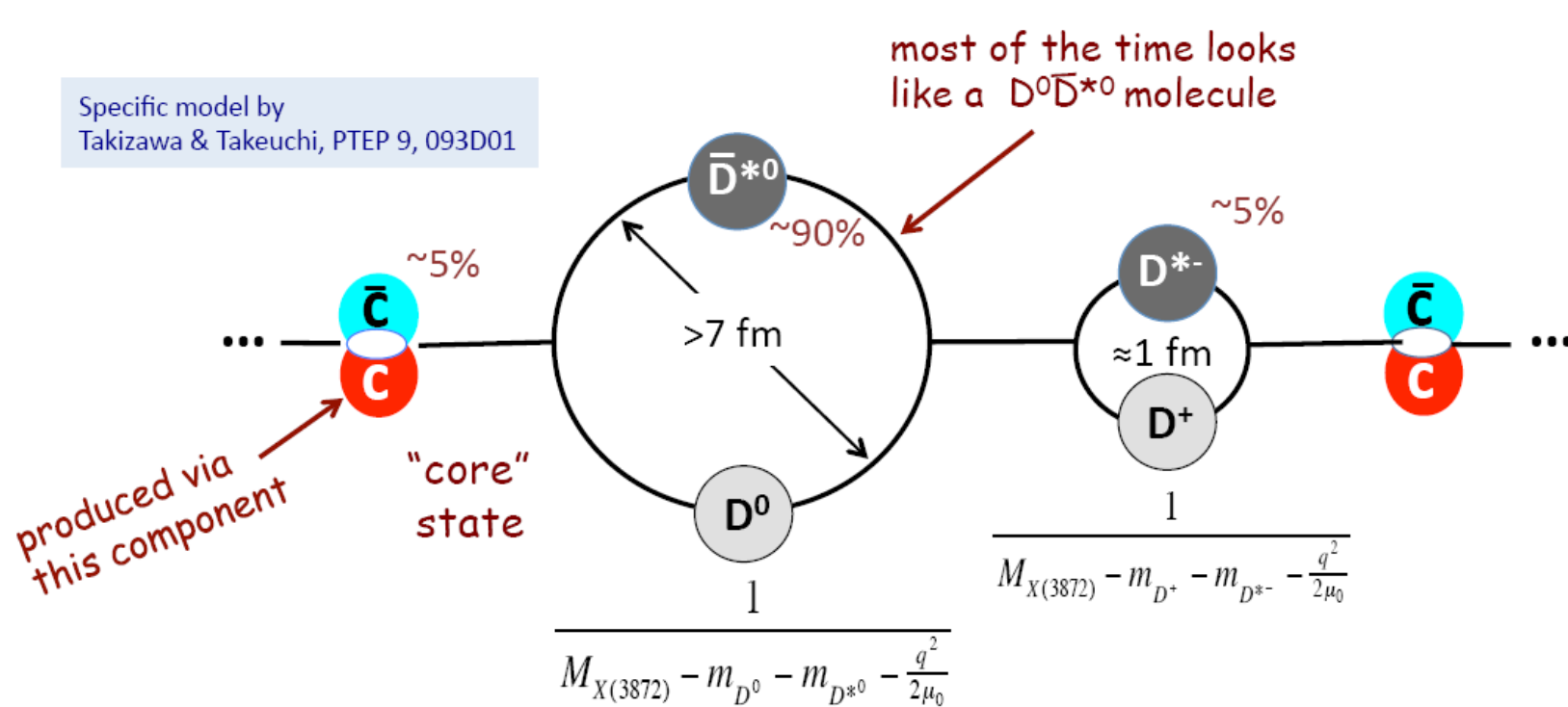
MOMENTUM RESOLUTION FOR e^+e^- FOR J/ψ



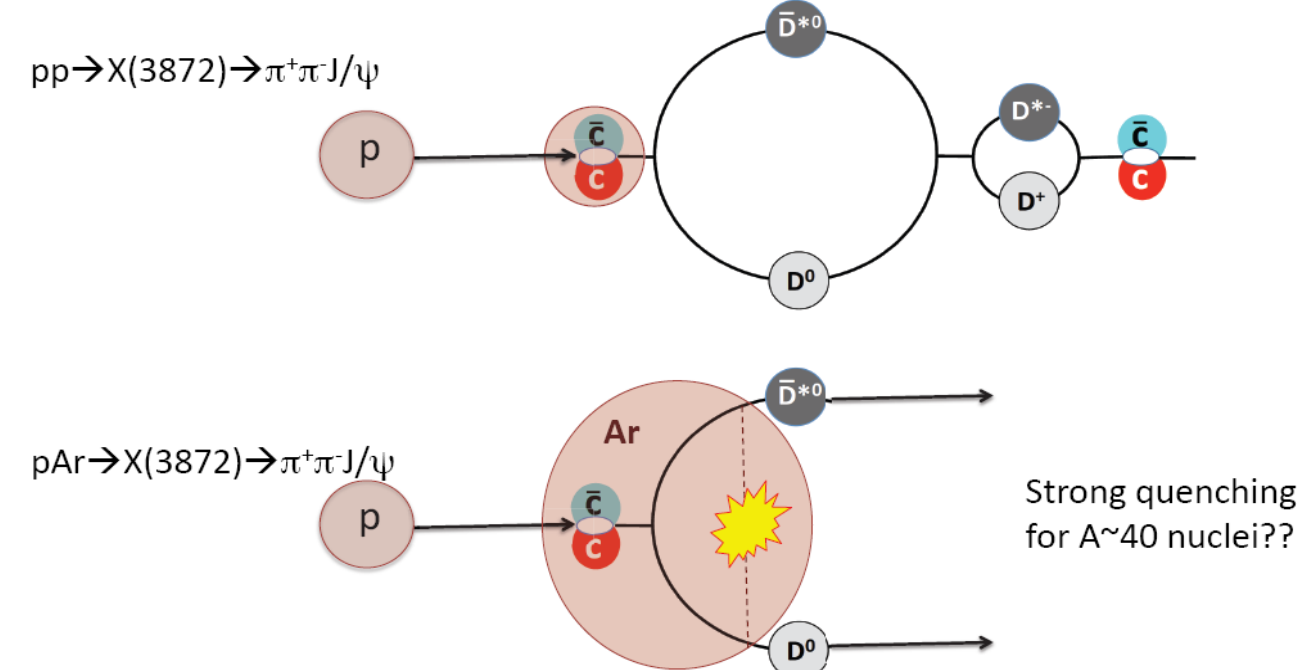
$X(3872) \rightarrow J/\psi + p^0$ USING MASS COMBINATION $M_{e^+e^-\pi^+\pi^-} - M_{e^+e^-}$ (1000 EVENTS AT $L = 10^{31} \text{ cm}^{-2} \text{ s}^{-1} \Rightarrow 95 \text{ DAYS}$; 31600 EVENTS AT $L = 10^{32} \text{ cm}^{-2} \text{ s}^{-1} \Rightarrow 10 \text{ MONTHS}$)



$X(3872)$ REPRESENTS PROBABLY A MIXTURE OF $D\bar{D}^*$ AND $C\bar{C}^*$ CORE



NEAR THRESHOLD PRODUCTION VIA pp & pA



Use NICA, a new $pp/pA/AA$ collider at JINR (Dubna)?

PROPOSAL

"Probing of $X(3872)$ meson structure with near threshold pp and pA collisions"

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SUMMARY

- These experiments could provide good opportunities for the reconstruction and identification of charged and neutral particles.
- They can obtain some valuable information on the charm production in $pp/\bar{p}p$, pp & pA collisions.
- Measurements of charmonium-like states can be considered as one of the "pillars" of physics program.