PROBING OF CHARMONIUM AND EXOTIC MULTIQUARK STATES IN HADRON AND HEAVY ION COLLISIONS

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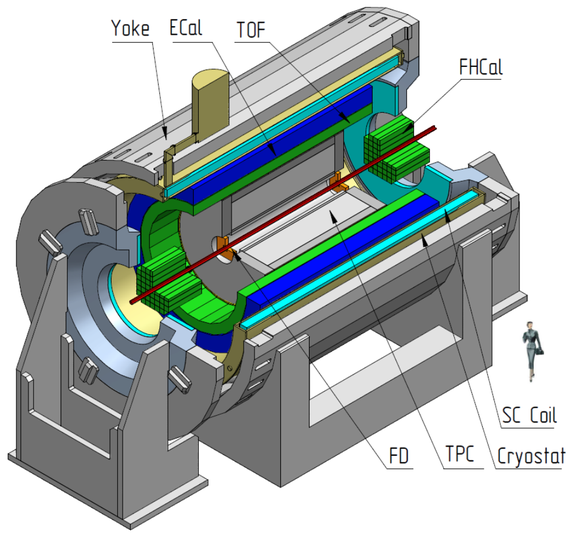
For the MPD Collaboration

MPD APPARATUS

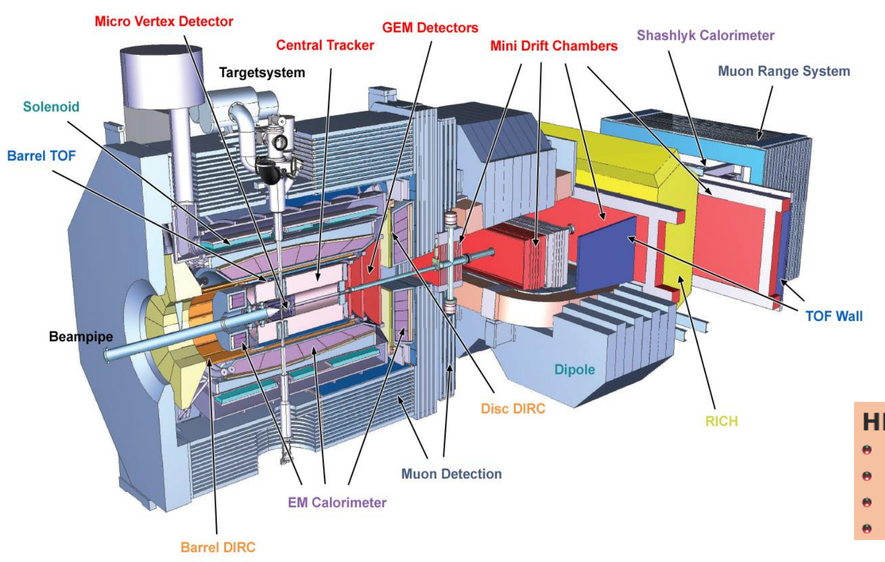
Magnet: 0.5 T superconductor
Tracking: TPC, ECT, IT
Particle ID: TOF, ECal, TPC
T_0, Triggering: FFD
Centrality, Event plane: FHCAL
Stage 1: TPC, Barrel TOF& ECal, FHCAL, FFD
Stage 2: IT + EndCaps (tracker, TOF, ECal)

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 (|η|<2), high resolution vertexing.
- Powerful PID: π/K up to 1.5 GeV/c, K/p up to 3 GeV/c, ECal for γ, $e^{+/-}$.
- Careful event characterization: impact parameter & event plane reconstruction.



COMPLEX NICA

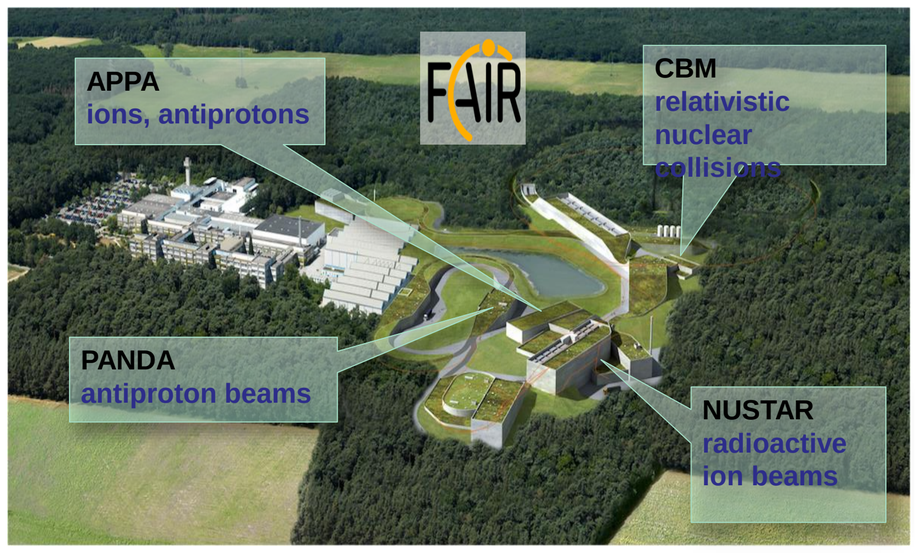
PANDA APPARATUS



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~ 2×10^{32} $cm^{-2}s^{-1}$
- Beam cooling (stochastic & electron)

COMPLEX FAIR



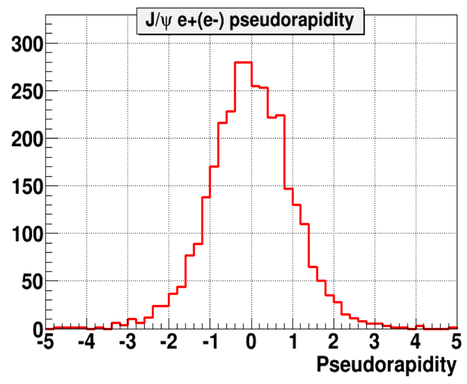
SOFTWARE

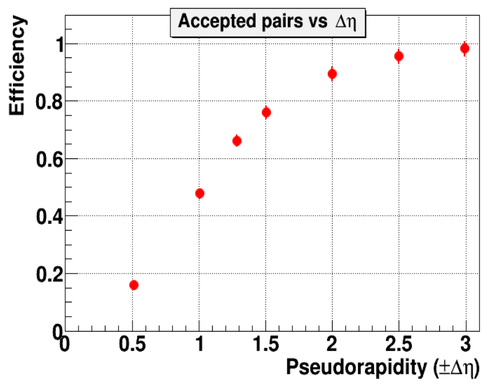
1. MpdRoot as a framework
2. Pythia8, UrQMD3.3 generators
3. MpdRoot Geant3 transport
4. MpdRoot TPC Kalman filter – based track and vertex reconstruction

RUNNING CONDITIONS

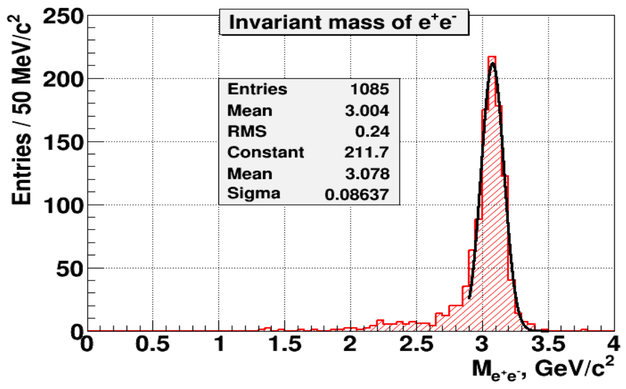
1. p+p at $\sqrt{s}$ = 25 GeV
2. Luminosity L = 10^{29} $cm^{-2}c^{-1}$
3. Running time 10 weeks: integrated luminosity L_{int} = 604.8 nb^{-1}
4. Decay channel $J/\Psi \rightarrow e^+e^-$ (branching ratio ~6%)
5. X-section $\sigma_{J/\Psi}$ from Pythia8 equals 108.7 nb
6. Statistics: $N_{J/\Psi} = L_{int}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

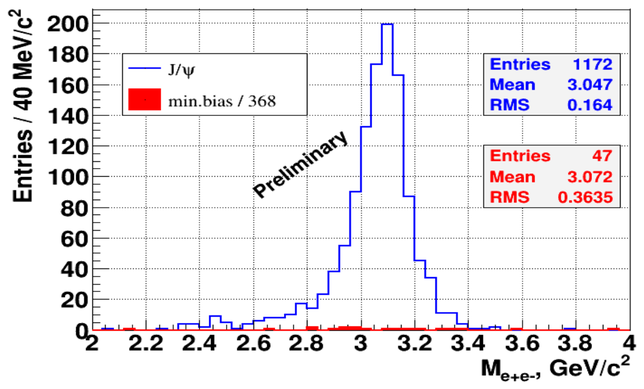
MPD DETECTOR ACCEPTANCE FOR e^+e^- FROM J/Ψ



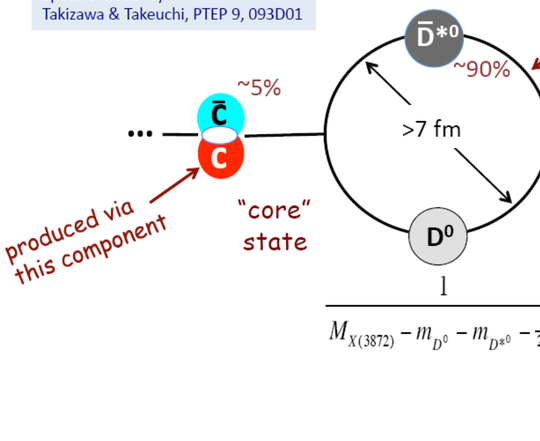


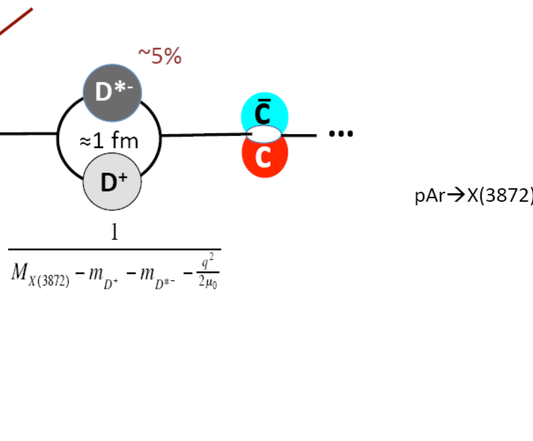
INVARIANT MASS DISTRIBUTION FOR e^+e^- COMBINATION



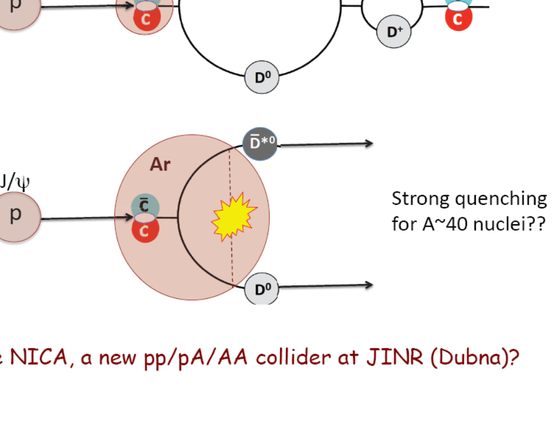


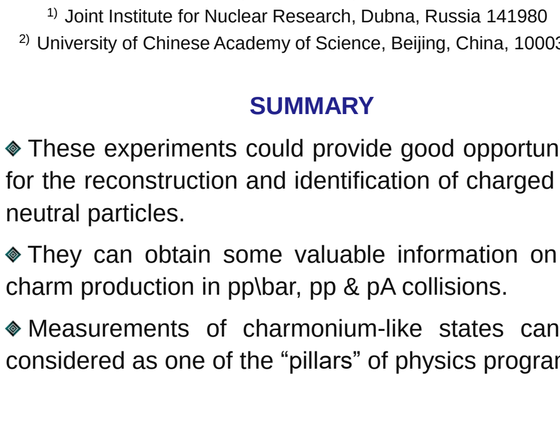
MOMENTUM DISTRIBUTION FOR e^+e^- FROM J/Ψ IN MPD DETECTOR





MPD DETECTOR MOMENTUM RESOLUTION FOR e^+e^- FROM J/Ψ IN TPC (LEFT) AND ECAL (RIGHT)





X(3872) → J/Ψ + ρ^0 USING MASS COMBINATION $Me^+e^-\pi^+\pi^-$ - Me^+e^- (1000 EVENTS AT L = 10^{31} $cm^{-2}s^{-1}$ => 95 DAYS; 31600 EVENTS AT L = 10^{32} $cm^{-2}s^{-1}$ => 10 MONTHS)

X(3872) REPRESENTS PROBABLY A MIXTURE OF DD*\bar AND CC\bar CORE

$$\frac{1}{M_{X(3872)} - m_{D^0} - m_{D^{*0}} - \frac{q^2}{2\mu_0}} \qquad \frac{1}{M_{X(3872)} - m_{D^+} - m_{D^{*-}} - \frac{q^2}{2\mu_0}}$$

NEAR THRESHOLD PRODUCTION VIA pp & pA AT NICA

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, pp & pA collisions.

◈ Measurements of charmonium-like states can be considered as one of the "pillars" of physics program.