$\phi\phi$ production at $\sqrt{s}$ = 10 GeV

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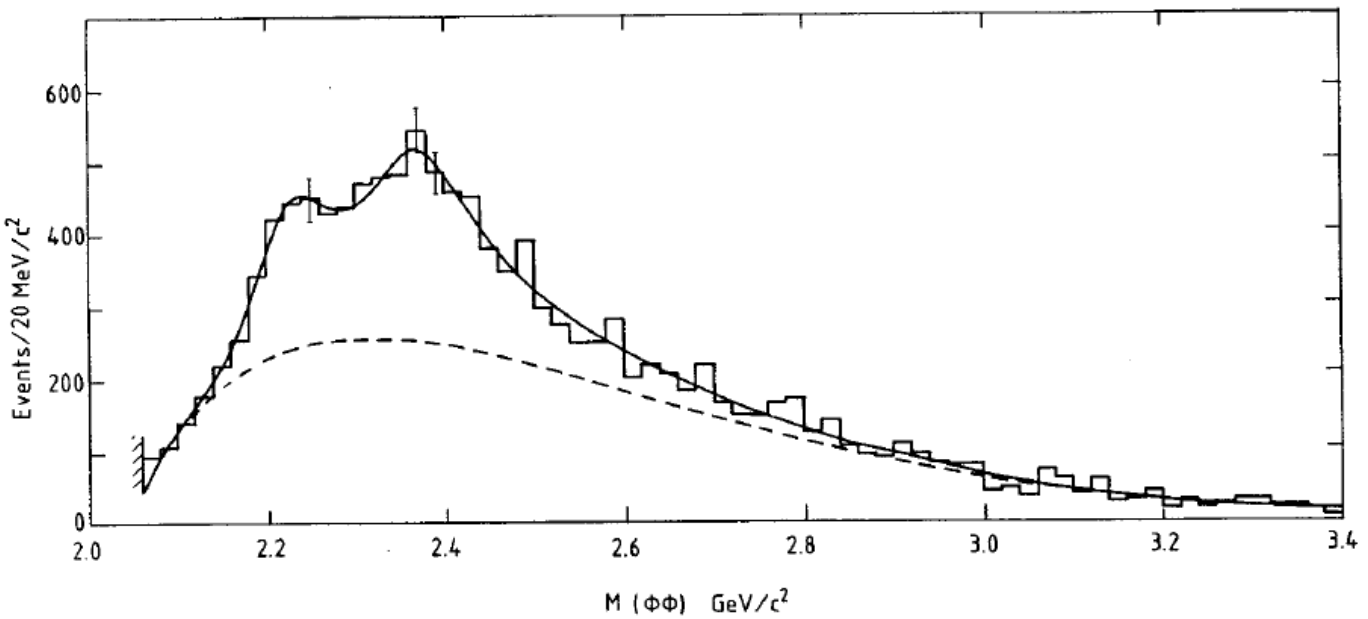
НИТУ МИСиС совместно с НИИЯФ МГУ

- ϕ(ss): M_ϕ = 1 GeV, $\tau \sim 10^{-22}$ s,
- main decay modes: K^+K^- 49%, $K^0_S K^0_L$ 34%, π, ρ 15%
- ss → $\phi\phi$ Okubo-Zweig-Iizuka allowed
- $\eta_c(c\bar{c})$ → $\phi\phi$ Okubo-Zweig-Iizuka suppressed
- Gluonium → $\phi\phi$

Publications 1978-1999

- A. Etkin et al (Brookhaven), Observation of Double phi Meson Production in pi- p Interactions, Phys. Rev. Lett. 40 (1978) 22
- C. Daum et al (ACCMOR Coll), Observation of Double ϕϕ Meson Production in 100-{GeV} and 175-{GeV} π−π− Be Interactions Phys.Lett.B 104 (1981) 246-250
- T.F. Davenport et al, Observation of Double phi Meson Production in 400-GeV/c Proton - Nucleon Interactions, Phys. Rev. D33 (1986) 2519
- T.A. Armstrong et al (WA76 Coll), Observation of Double ϕϕ Meson Production in the Central Region for the Reaction pp−>p(K+K−K+K−)p at 300 GeV/c, Phys.Lett.B 166 (1986) 245
- P.S.L. Booth et al (WA76 Coll), A High Statistics Study of the ϕϕ Mass Spectrum, Nucl. Phys. B 273 (1986) 677
- P.S.L. Booth et al (WA76 Coll), Angular Correlations in the ϕϕ System and Evidence for Hadronic ηc Production, Nucl. Phys. B273 (1986) 689
- T. Aleev et al (EXCHARM Coll),The double Phi-meson production investigation on the Serpukhov accelerator, JINR Rapid Commun. 1-93 (1999) 14



$\phi\phi$ invariant mass distribution taken from P.S.L. Booth et al (WA76 Coll). Two BW propagators with masses 2200 MeV and 2400 MeV and widths 130 MeV and 200 MeV used for fitting of 13K «true» $\phi\phi$ (2K+2K-) events produced in π Be at 85 GeV. The corresponding σ(X)*Br(X→$\phi\phi$) were 7.5 and 3.8 μb/Be. At the NICA integrated luminosity 10^{35} cm^{-2} the crs $\sigma = 100$ nb gives 10^4 events.

Вопросы в связи с генератором PYTHIA 8

Double counting of soft/hard processes

SoftQCD: all = on

(1) Overlaps with low energy QCD. How to separate soft/hard QCD contributions

(2) Multiparton processes yield

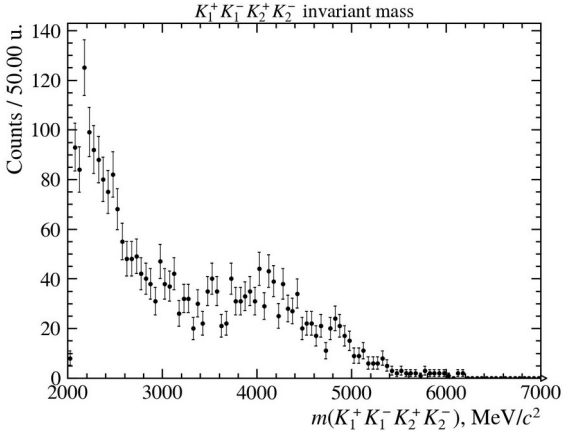
Hard QCD: qq,gg→ss = on

(1) How to separate main s-quark contribution (OZI allowed)

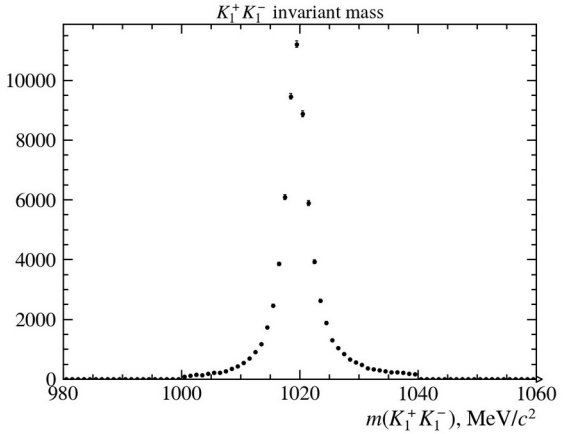
(2) What is the stability of the s-quark PDF at low energy

Hard QCD component can be generated by CompHEP with PYTHIA interace

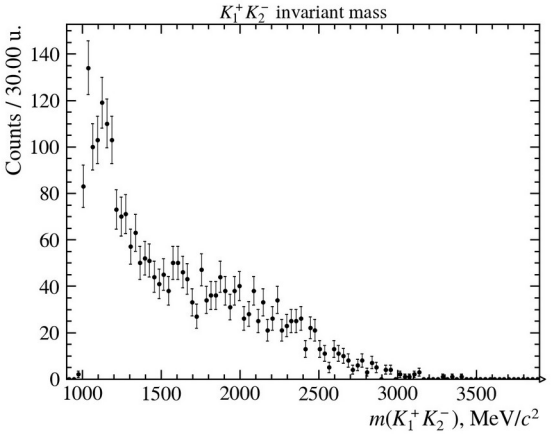
Invariant mass spectra



4-particle invariant mass



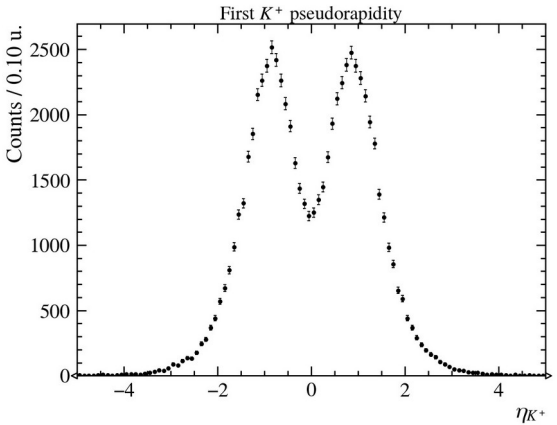
Correct kaon pair mass



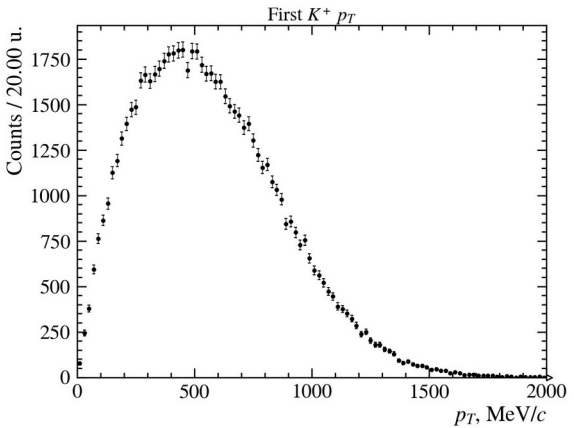
Incorrect kaon pair mass
(kaons from different φ)

- Distributions were generated with PYTHIA8
  - Processes used: HARDQCD:gg2qqbar, HARDQCD:qqbar2qqbarNew
- Signal event filter requirement: exactly 2 positive and 2 negative charged kaons
- Beam specifications: 10 GeV proton beams (unpolarized)

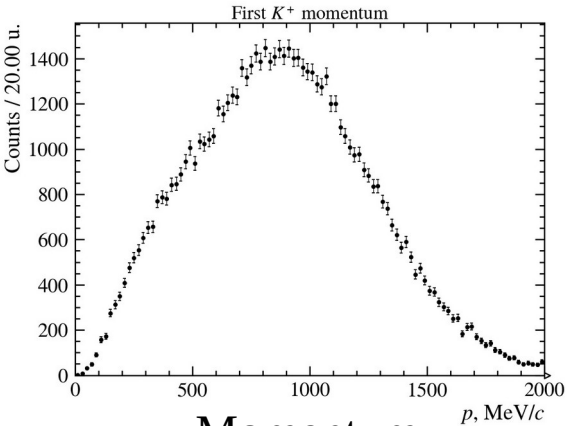
Kinematic distributions



Pseudorapidity

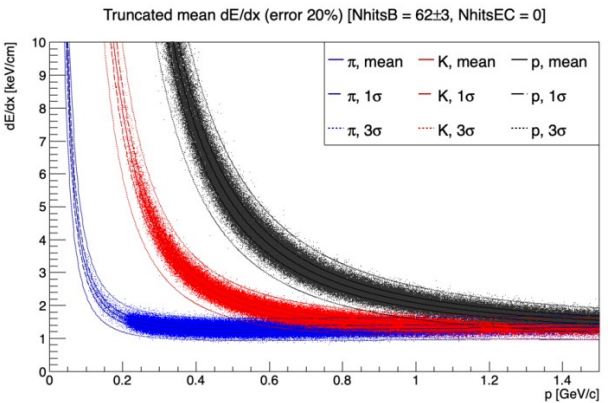


Transverse momentum



Momentum

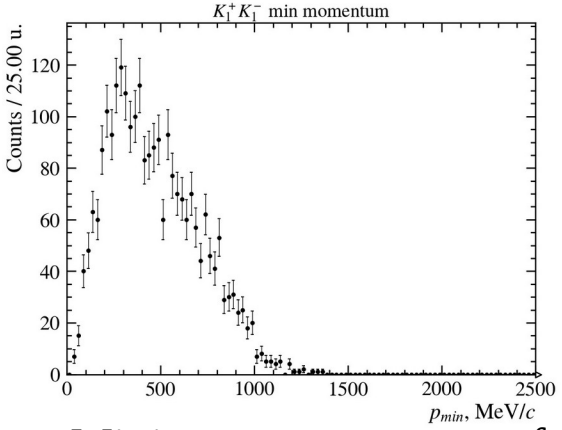
- Similar distributions for all 4 kaons
- Significant number of kaons outside Phase-I PID system range



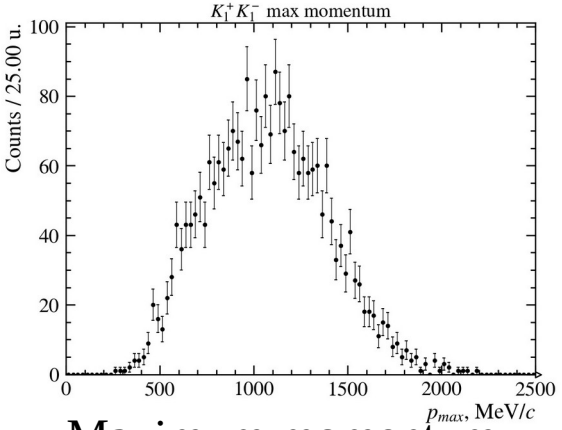
Straw Tracker PID feasibility ranges

Considered background & next steps

- Different kaon final states
  - KKKK
  - φKK
- π-K misID
  - Minimum & maximum momentum could be exploited
  - Low charged multiplicity allows for exploring all track combinations



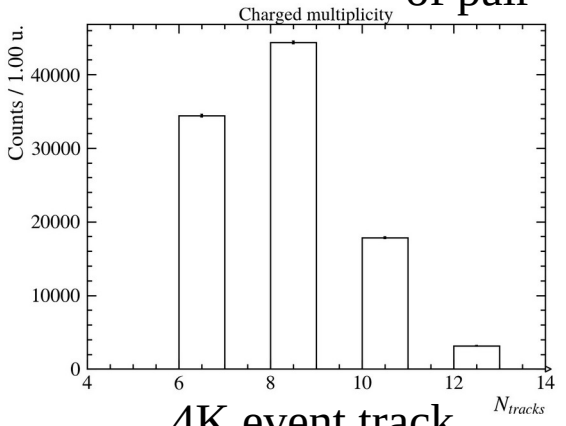
Minimum momentum of pair



Maximum momentum of pair

NEXT STEPS

- Full detector simulation and reconstruction
- with SPDROOT
- Selection enhancements with minbias events



4K event track multiplicity

ϕ decay in hadronic matter

- D. Cabrera, M.J. Vicente, Mass shift and decay width of the ϕ in nuclear matter using chiral effective lagrangian, arXiv:0205075[nucl-th]
- R. Kumar, A. Kumar, ϕ meson mass and decay width in strange hadronic matter, arXiv:2005.05133[hep-ph]
- Chiral perturbative theory approach to ϕKK interaction. In the asymmetric strange hadronic matter, the study of the mesons can be relevant for the compressed strange baryonic matter and experimental observables such as dilepton spectra which can result from the experiments.

$\phi\phi$ double production channel with a large cross-section and good signal separation capabilities from the background, demonstrates promising physics potential and allows reliable monitoring of possible manifestations of exotic states.