

OZI test in vector meson production with the COMPASS experiment

Rutherford Centennial Conference on Nuclear Physics

Johannes Bernhard¹

Institut für Kernphysik Mainz

for the COMPASS collaboration

August 08th 2011



bmb+f - Förderschwerpunkt

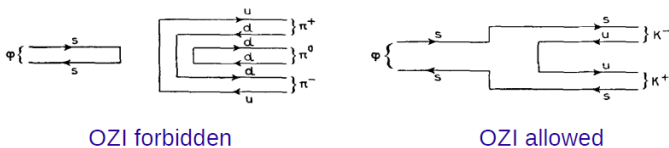
COMPASS

Großgeräte der physikalischen
Grundlagenforschung

¹Contact: johannes.bernhard@cern.ch

Motivation

Okubo-Zweig-Iizuka rule¹: processes with disconnected quark lines suppressed



Calculation² for $\phi(1020)$ to $\omega(782)$ production ratios (A and B non-strange hadrons), not corrected for phase-space:

$$\sigma(AB \rightarrow \phi X) / \sigma(AB \rightarrow \omega X) = 4.2 \cdot 10^{-3}$$

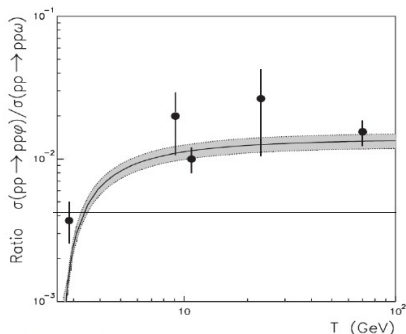
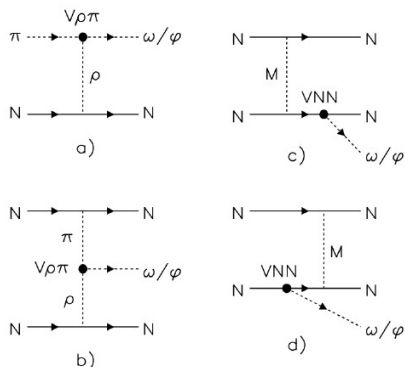
Numerous violations observed, possible explanations:

- reactions on nucleons: strangeness content of the nucleon enhances $s\bar{s}$ production
- intermediate (gluon-rich) states
- differences in production mechanisms

¹S. Okubo, Phys. Lett. 5(1963)165, G. Zweig, CERN report TH-401(1964), J. Iizuka, Prog.Theor.Suppl.38(1966)21

²H.J. Lipkin, Phys. Lett. B 60 (1976) 371

Violations of the OZI rule / COMPASS



No data available for higher energies³

Study at COMPASS:

Compare $\phi(1020) \rightarrow K^+K^-$ to $\omega(782) \rightarrow \pi^+\pi^-\pi^0$ production

³ A. Sibirtsev and W. Cassing, Eur.Phys.J.A7(2000)407

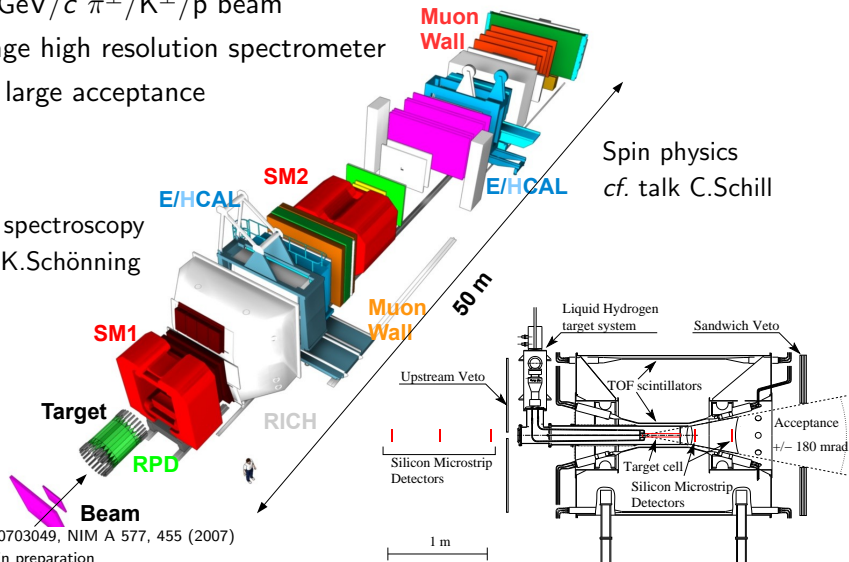
The COMPASS spectrometer at CERN

190 GeV/c π^\pm /K $^\pm$ /p beam

2 stage high resolution spectrometer
with large acceptance

Hadron spectroscopy
cf. talk K.Schönning

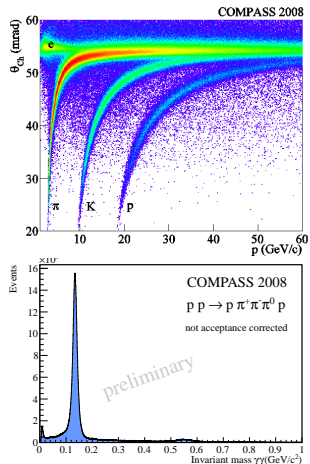
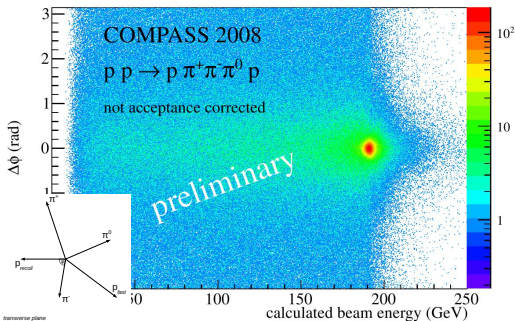
Spin physics
cf. talk C.Schill



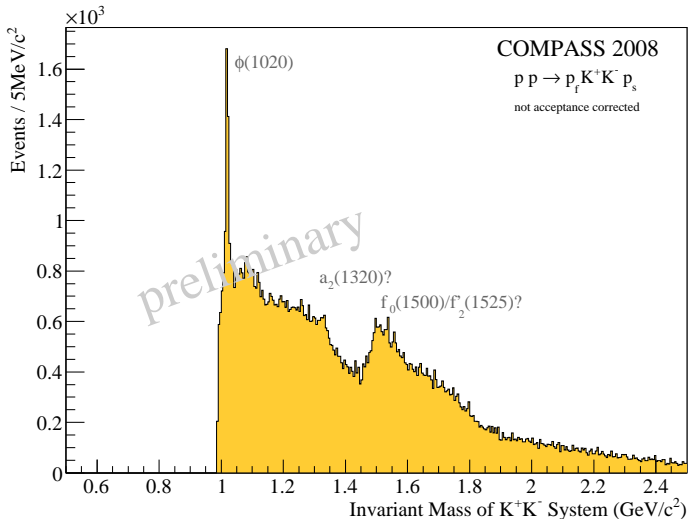
Event selection

Interest in $p p \rightarrow p (\pi^+ \pi^- \pi^0) / (K^+ K^-) p$ final states

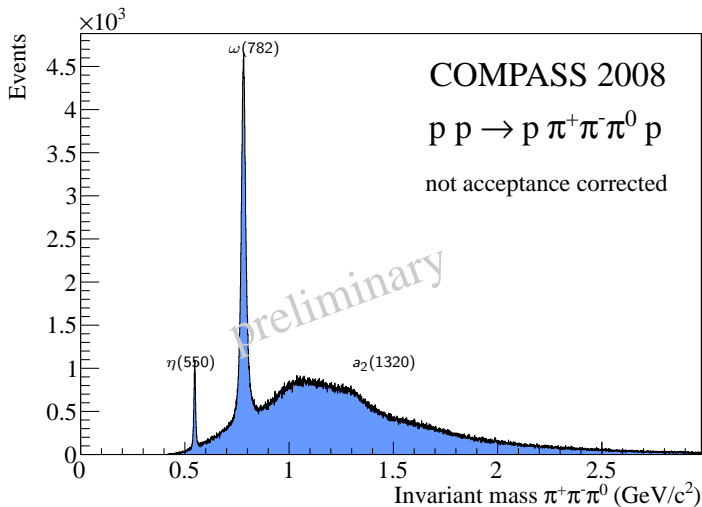
- select event topology (charged tracks, reaction inside target volume, recoil proton etc.)
- ID K^+ with RICH, π^0 with ECALs
- conservation of charge, exclusivity



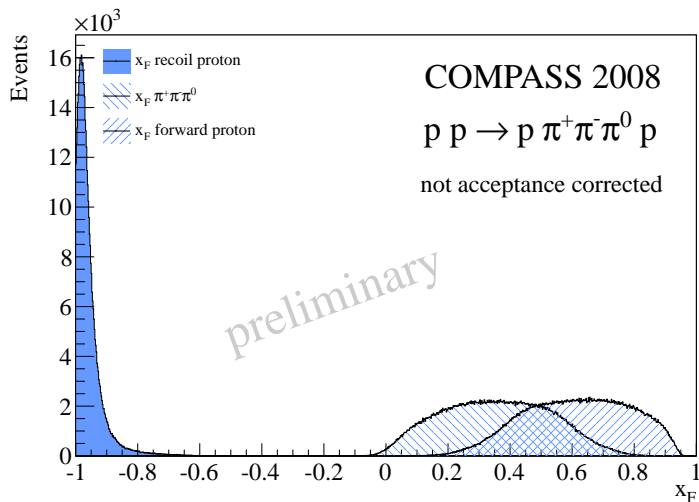
Invariant mass distributions ($K^+ K^-$)



Invariant mass distributions ($\pi^+ \pi^- \pi^0$)

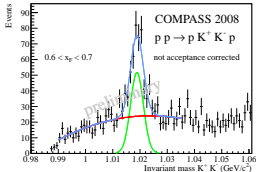


Reaction Kinematics

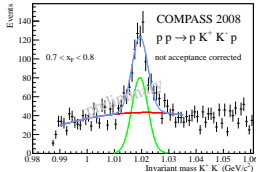


Test OZI violation: Analysis

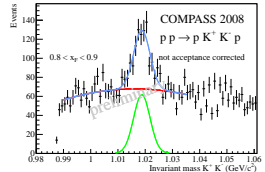
$0.6 < x_F < 0.7$



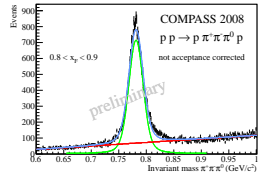
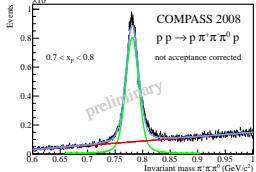
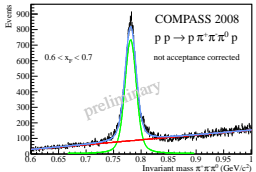
$0.7 < x_F < 0.8$



$0.8 < x_F < 0.9$

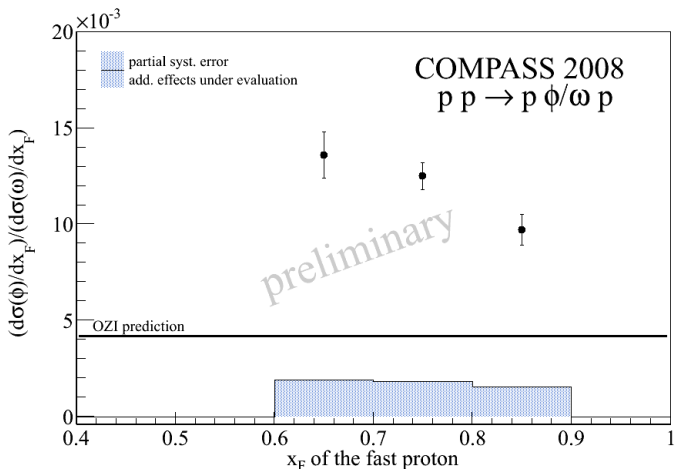


ω



- ① fit invariant mass distributions with Breit-Wigner folded with Gaussian plus polynomial background in x_F bins \Rightarrow yields
- ② correct for acceptance and branching \Rightarrow corrected yields
- ③ calculate $R = \frac{\text{Number of } \phi}{\text{Number of } \omega}$

Test OZI violation: Result



N.B.: Included only systematics from fit and ECAL reconstruction, additional effects are still under investigation

Outlook and Conclusions

Preliminary results from 2008 proton campaign (one week):

OZI violation of a factor 3 at 190 GeV beam energy

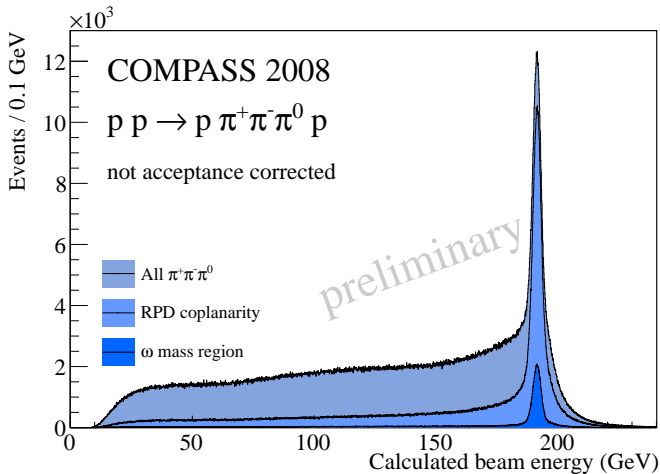
- proton beam data allows for differential studies
- data sample 2 orders of magnitude larger compared to former experiments

Ongoing studies:

- further systematic studies
- improved background estimation (include possible coherent background)
- measurement of ω/ϕ spin alignment via Gottfried-Jackson angles
⇒ production mechanisms

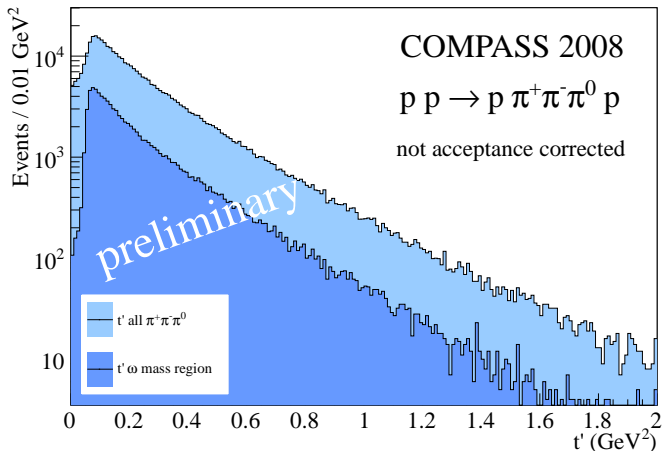
Spares

Exclusivity



Selection of exclusive events: energy balance $191 \text{ GeV} \pm 6 \text{ GeV}$

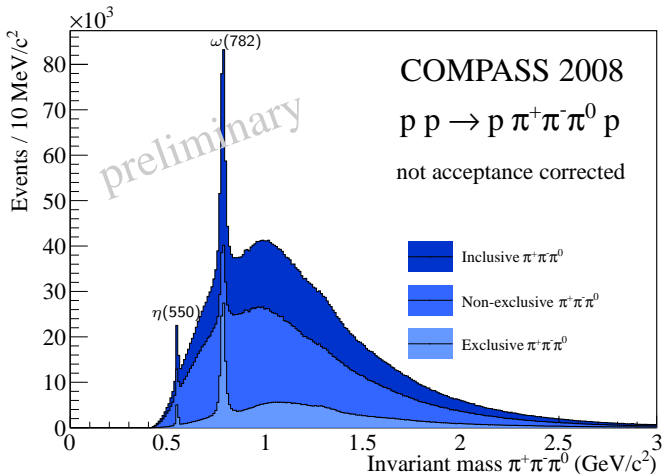
Production mechanism



Ongoing: binning the ratio $R = \frac{\text{Number of } \phi \text{ in } t}{\text{Number of } \omega}$

Background

Composition 2008 data sample: exclusive vs. non-exclusive



Important for background studies