OZI test in vector meson production with the COMPASS experiment

Rutherford Centennial Conference on Nuclear Physics

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for the COMPASS collaboration

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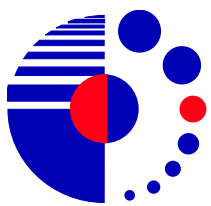

bmb+f - Förderschwerpunkt
COMPASS
Großgeräte der physikalischen Grundlagenforschung

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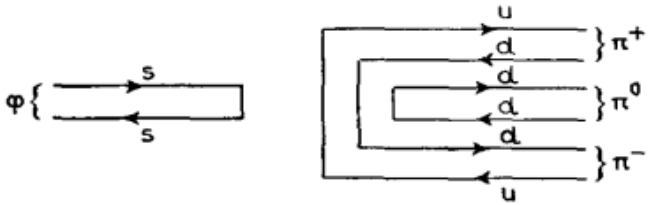
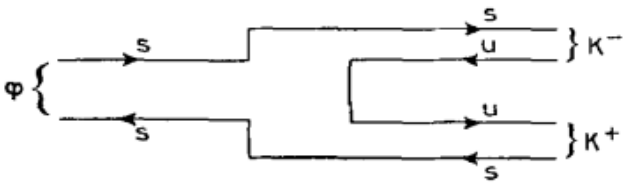
Motivation

Okubo-**Z**weig-**I**izuka rule[1]: processes with disconnected quark lines suppressed



OZI forbidden



OZI allowed

Calculation[2] for $\phi(1020)$ to $\omega(782)$ production ratios (A and B non-strange hadrons), not corrected for phase-space:

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

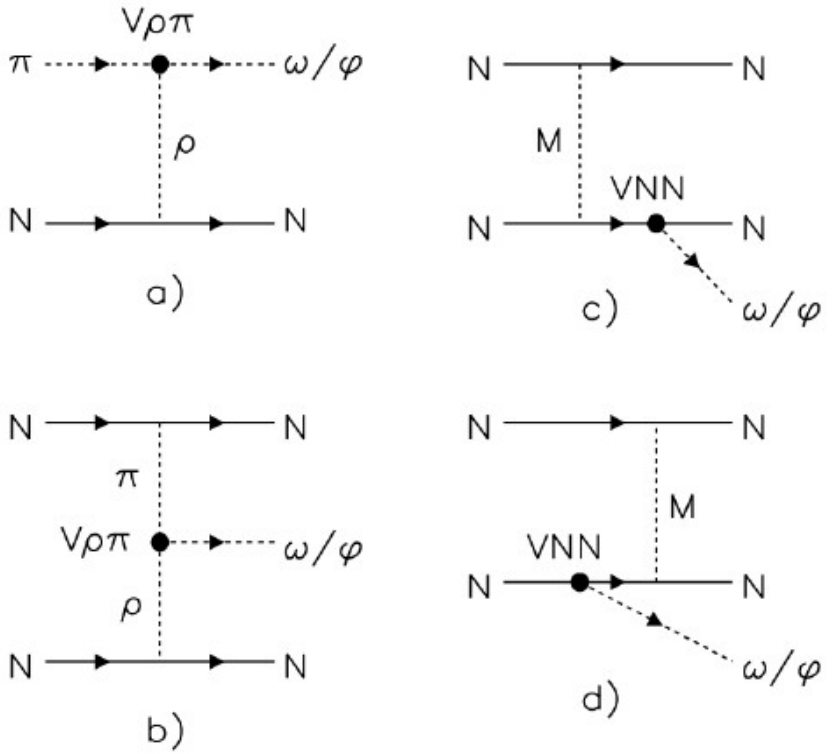
Numerous violations observed, possible explanations:

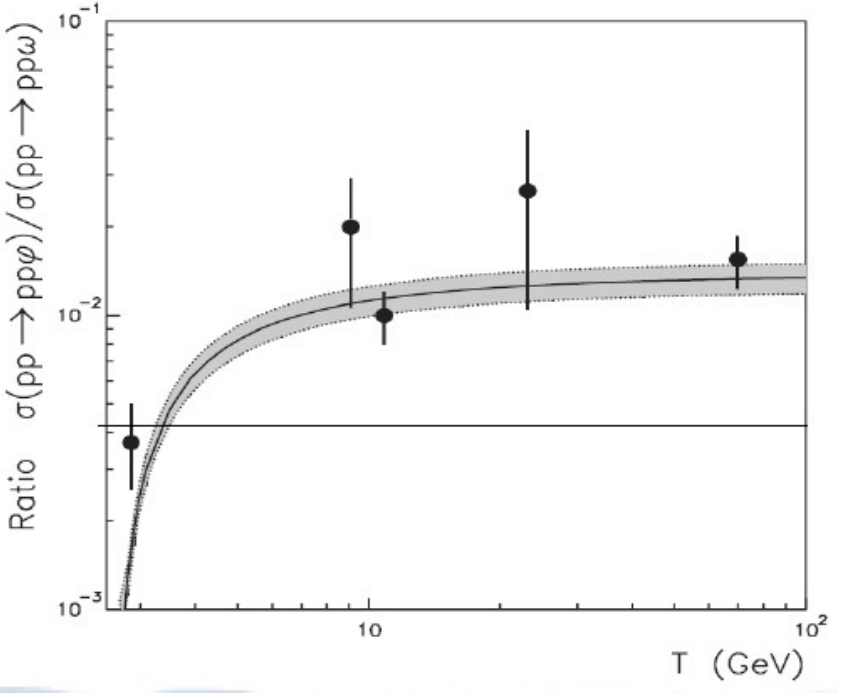
- reactions on nucleons: strangeness content of the nucleon enhances $s\bar{s}$ production
- intermediate (gluon-rich) states
- differences in production mechanisms

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

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

Violations of the OZI rule / COMPASS





No data available for higher energies[3]

Study at COMPASS:

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

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

The COMPASS spectrometer at CERN

190 GeV/c $\pi^{\pm}$/K$^{\pm}$/p beam

2 stage high resolution spectrometer

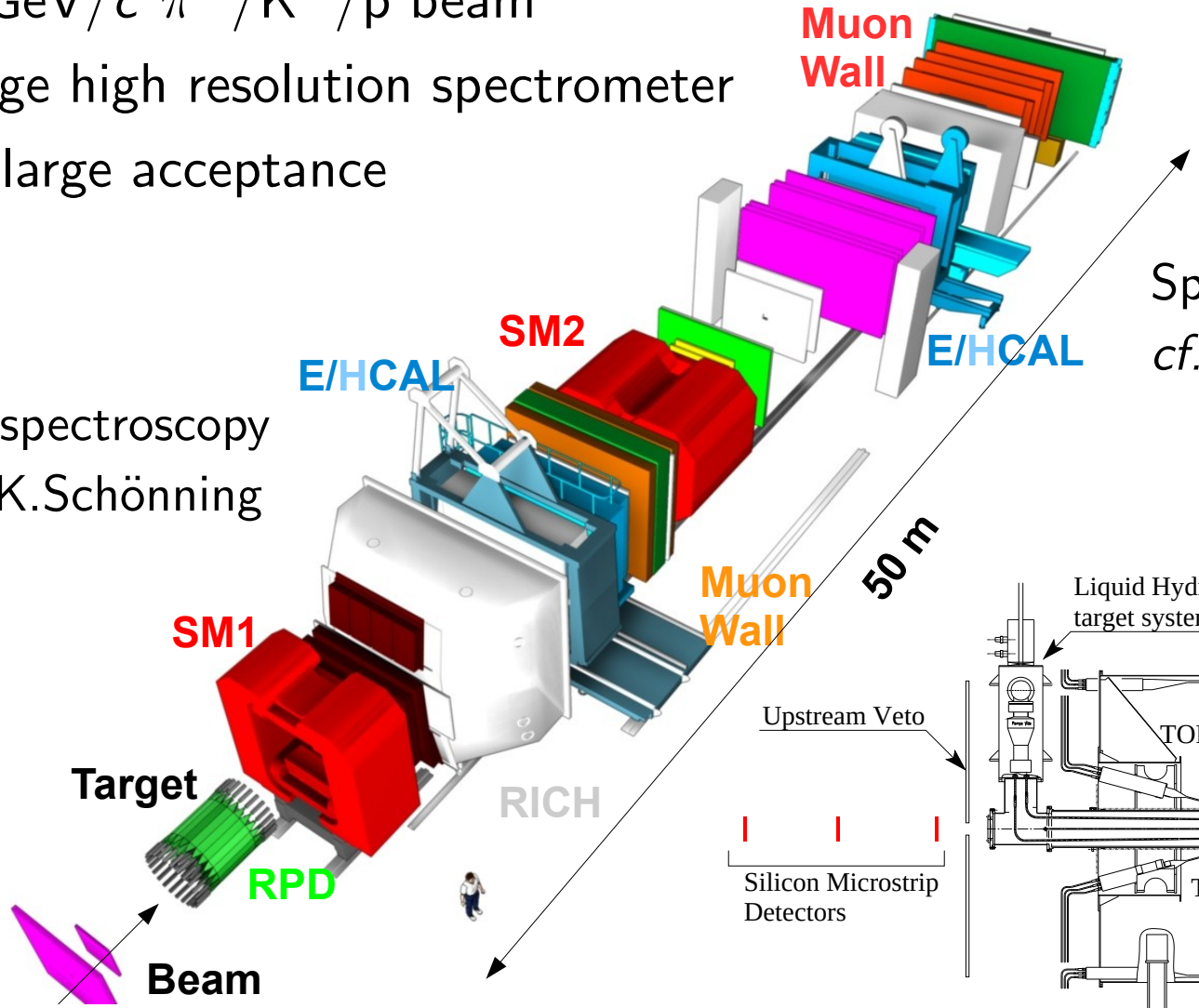
with large acceptance

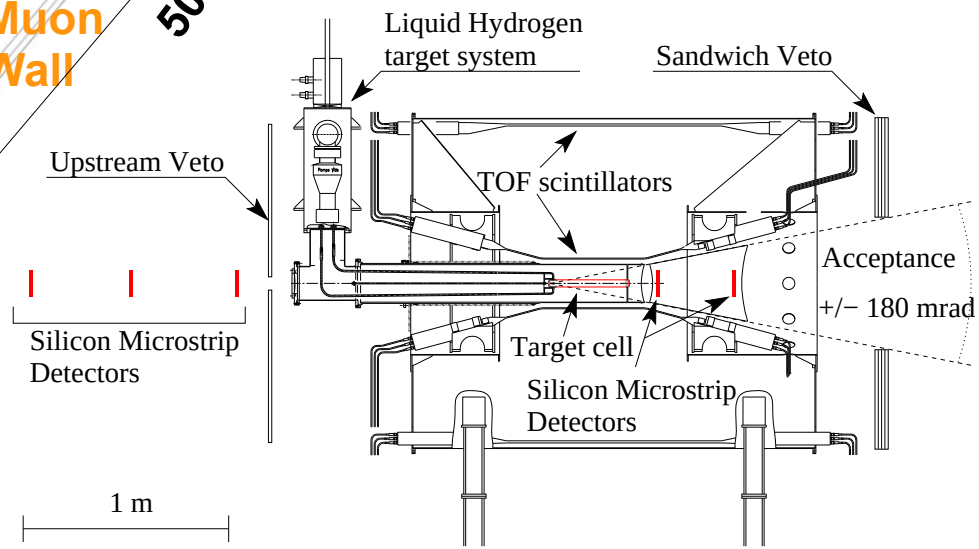
Hadron spectroscopy

cf. talk K.Schönning

Spin physics

cf. talk C.Schill





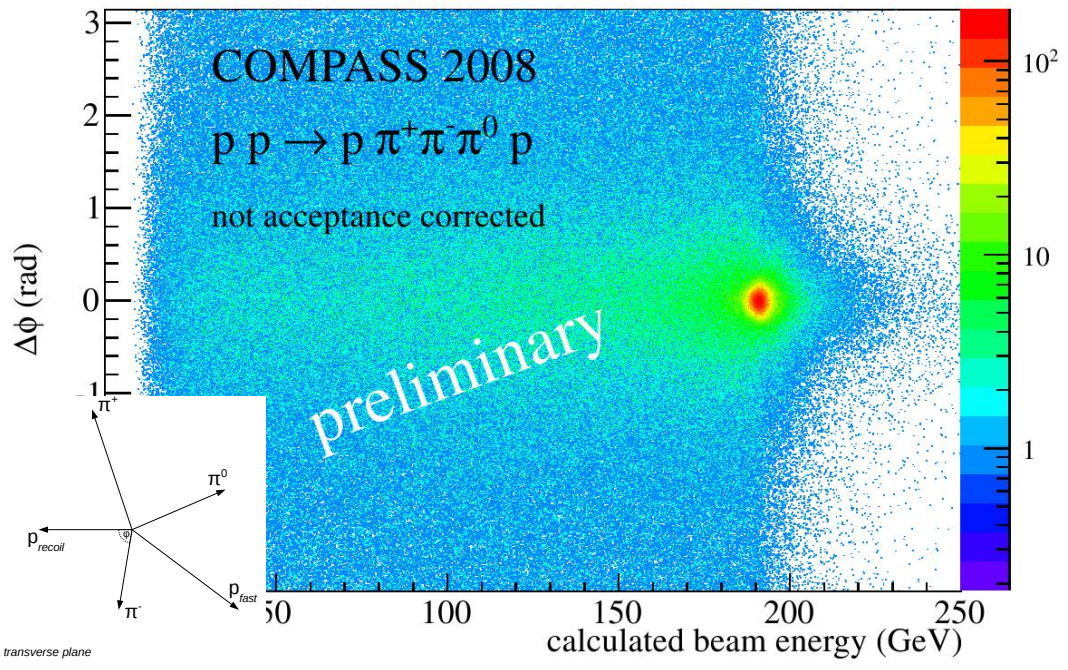
hep-ex/0703049, NIM A 577, 455 (2007)

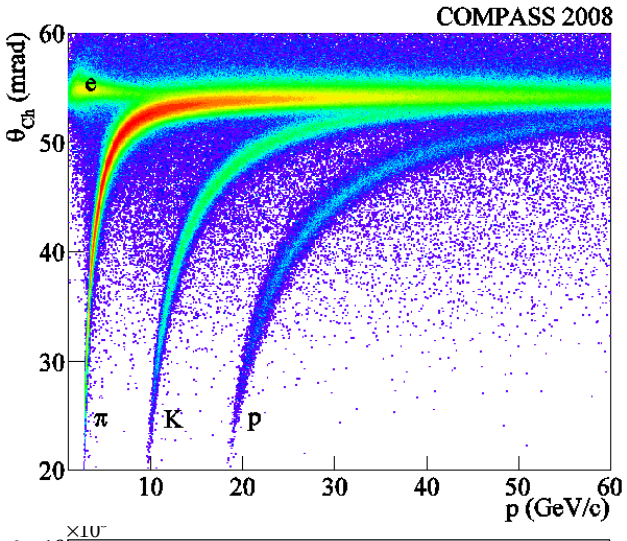
update in preparation

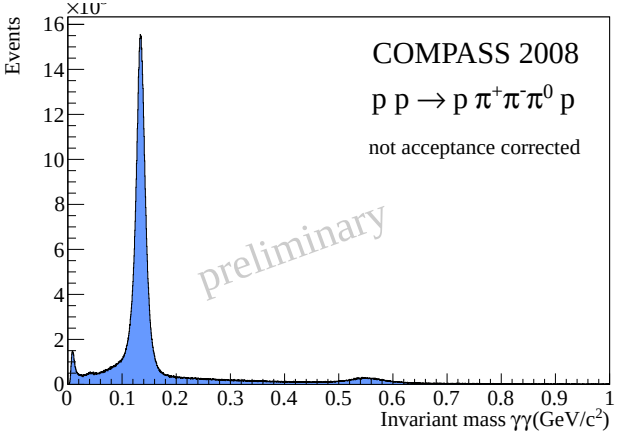
Event selection

Interest in $p\,p \longrightarrow p\,\left(\pi^+\,\pi^-\,\pi^0\right) / \left(K^+\,K^-\right)\,p$ final states

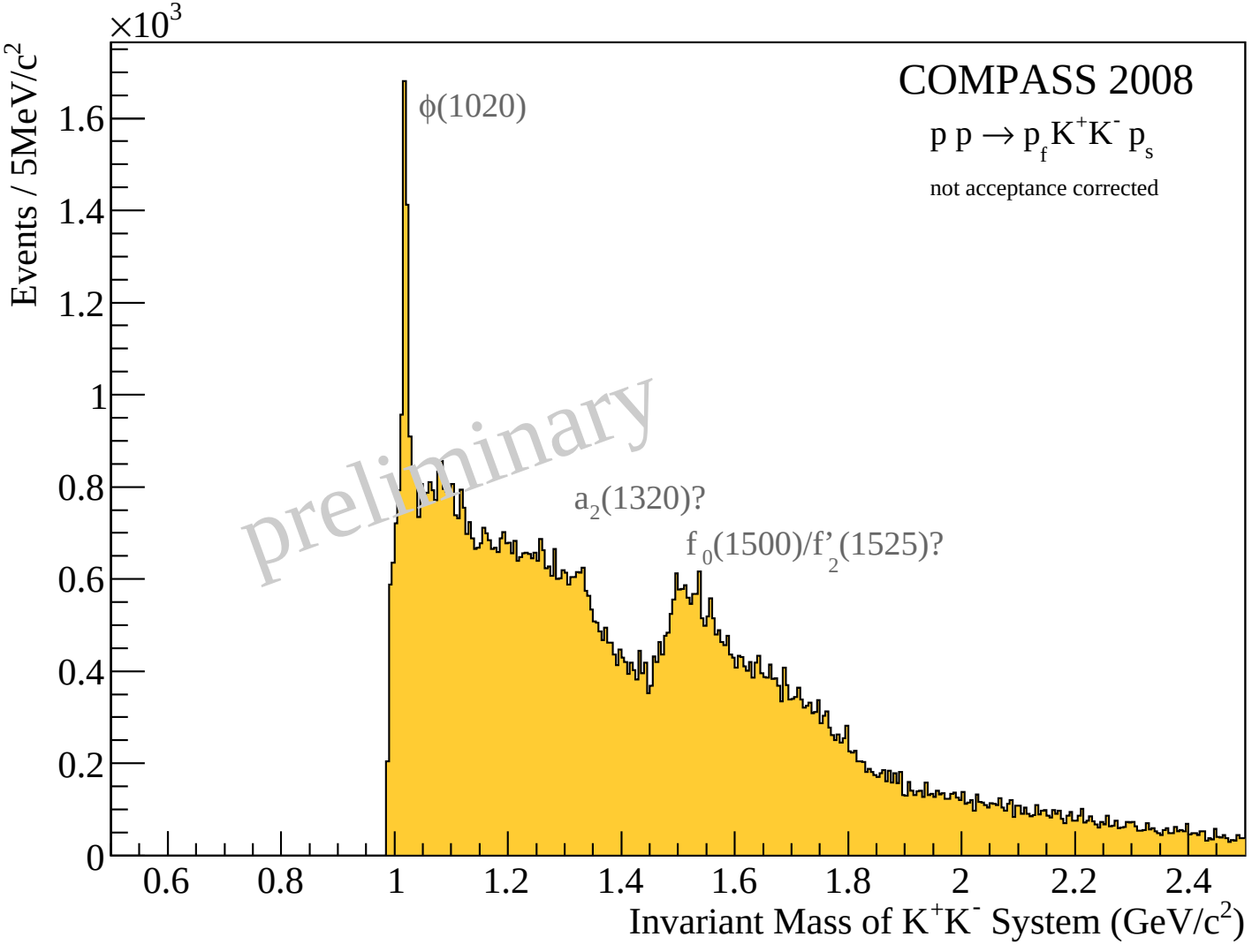
- select event topology (charged tracks, reaction inside target volume, recoil proton etc.)
- ID K^+ with RICH, π^0 with ECALs
- conservation of charge, exclusivity



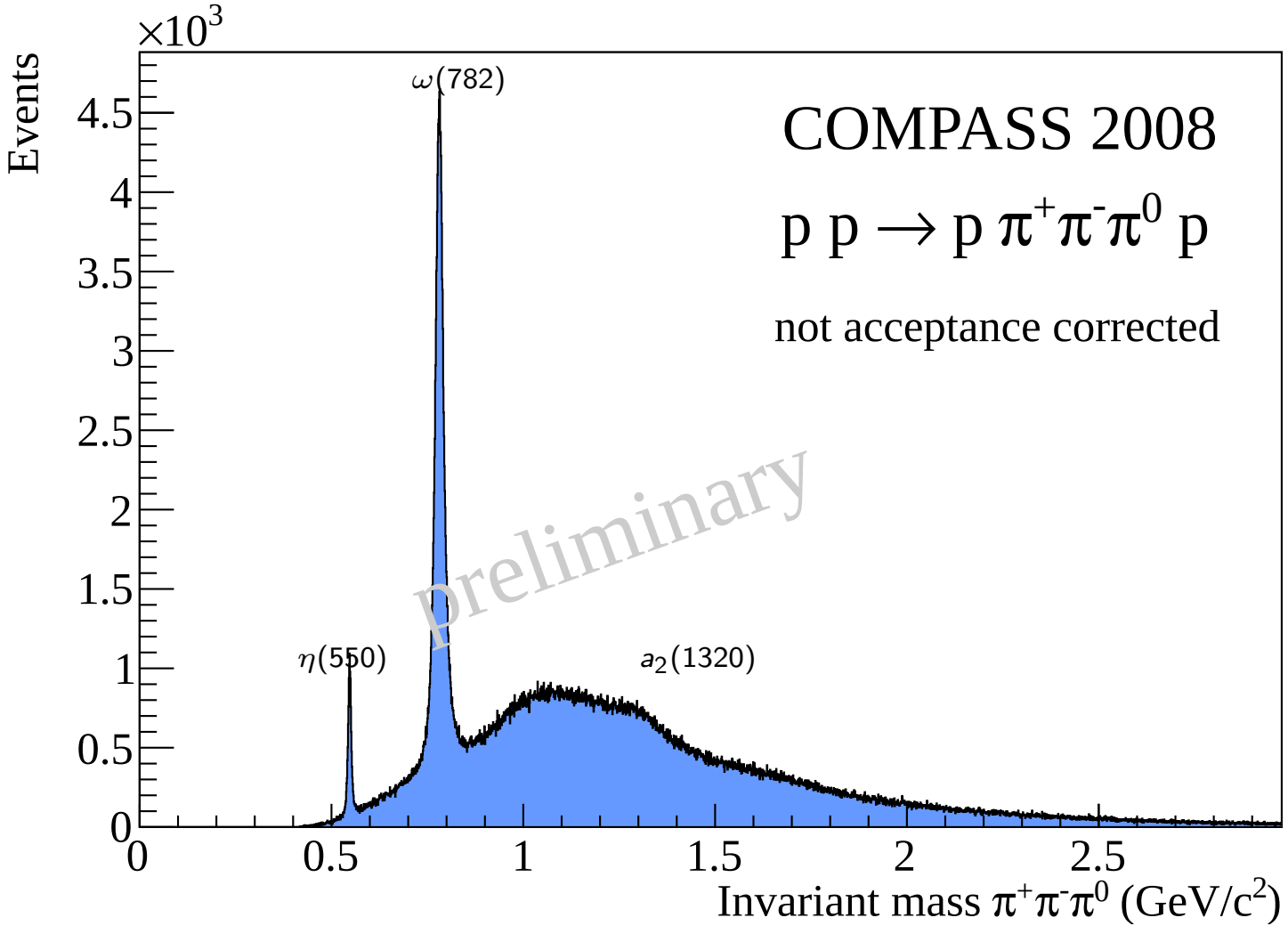




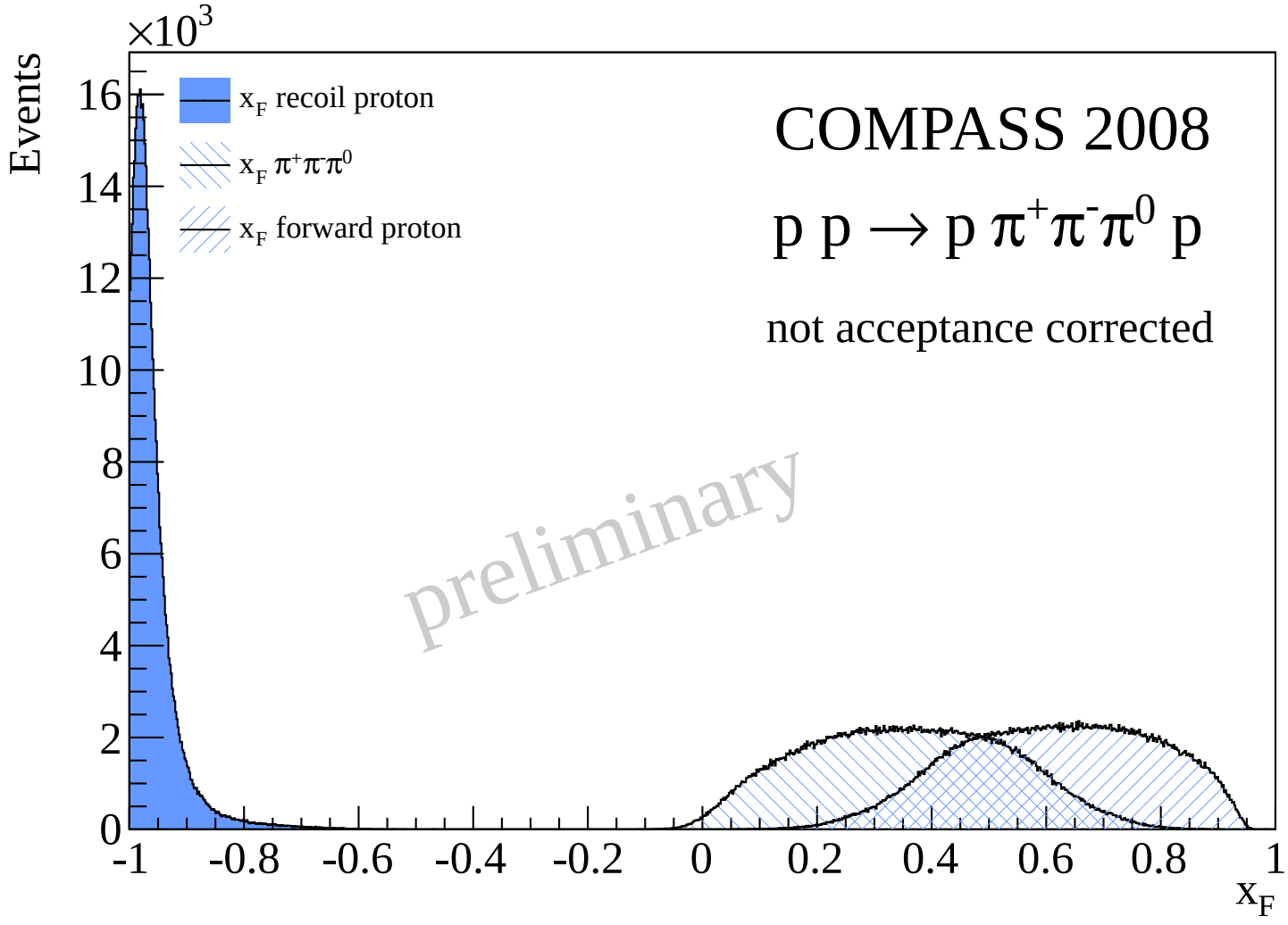
Invariant mass distributions ($K^+ K^-$)



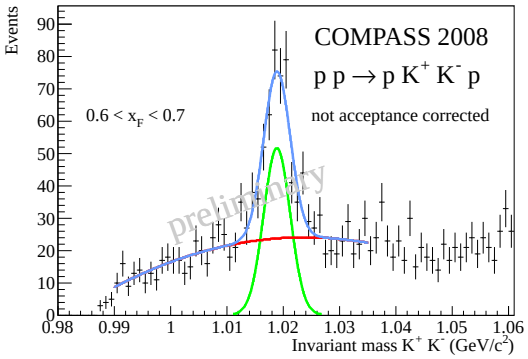
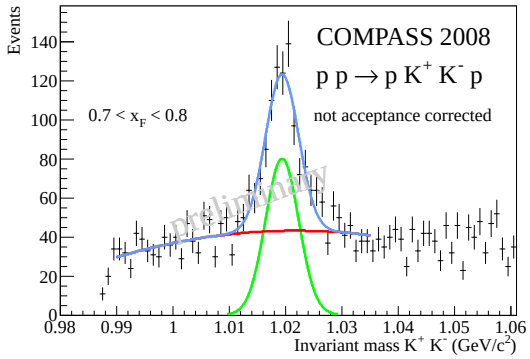
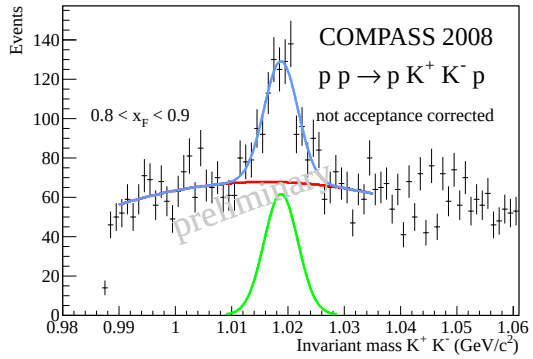
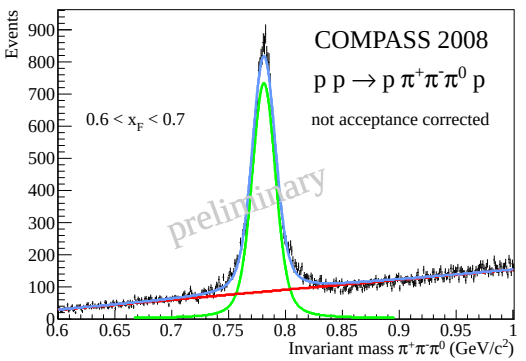
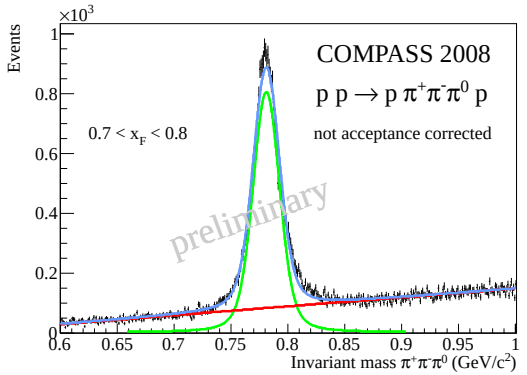
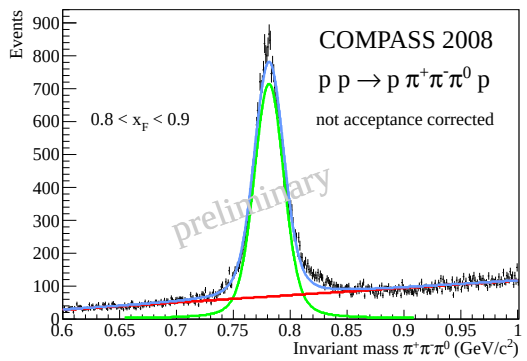
Invariant mass distributions $\left(\pi^+ \pi^- \pi^0\right)$



Reaction Kinematics

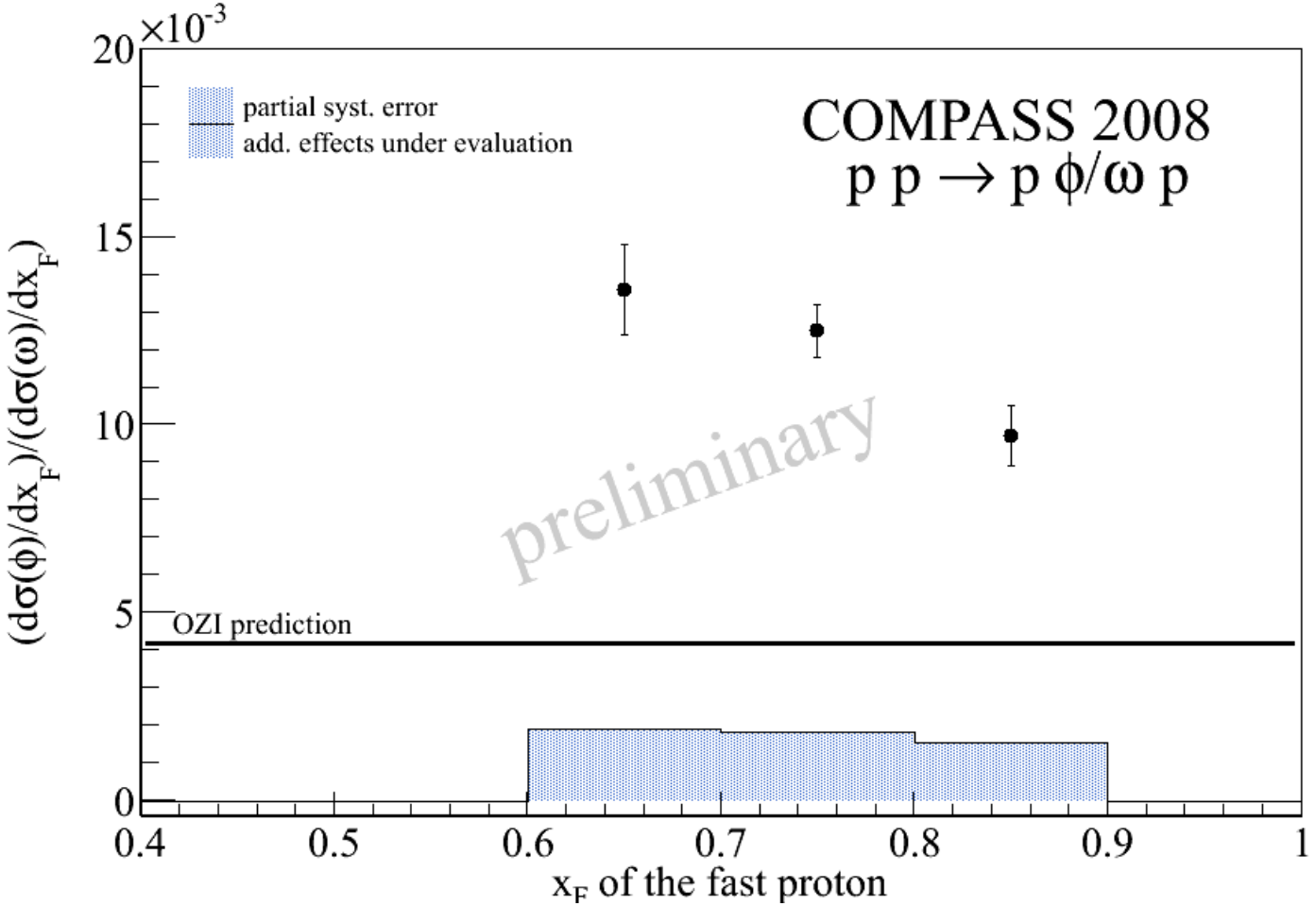


Test OZI violation: Analysis

	$0.6 < x_F < 0.7$	$0.7 < x_F < 0.8$	$0.8 < x_F < 0.9$
ϕ			
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 $R = \dfrac{\text{Number of } \phi}{\text{Number of } \omega}$

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

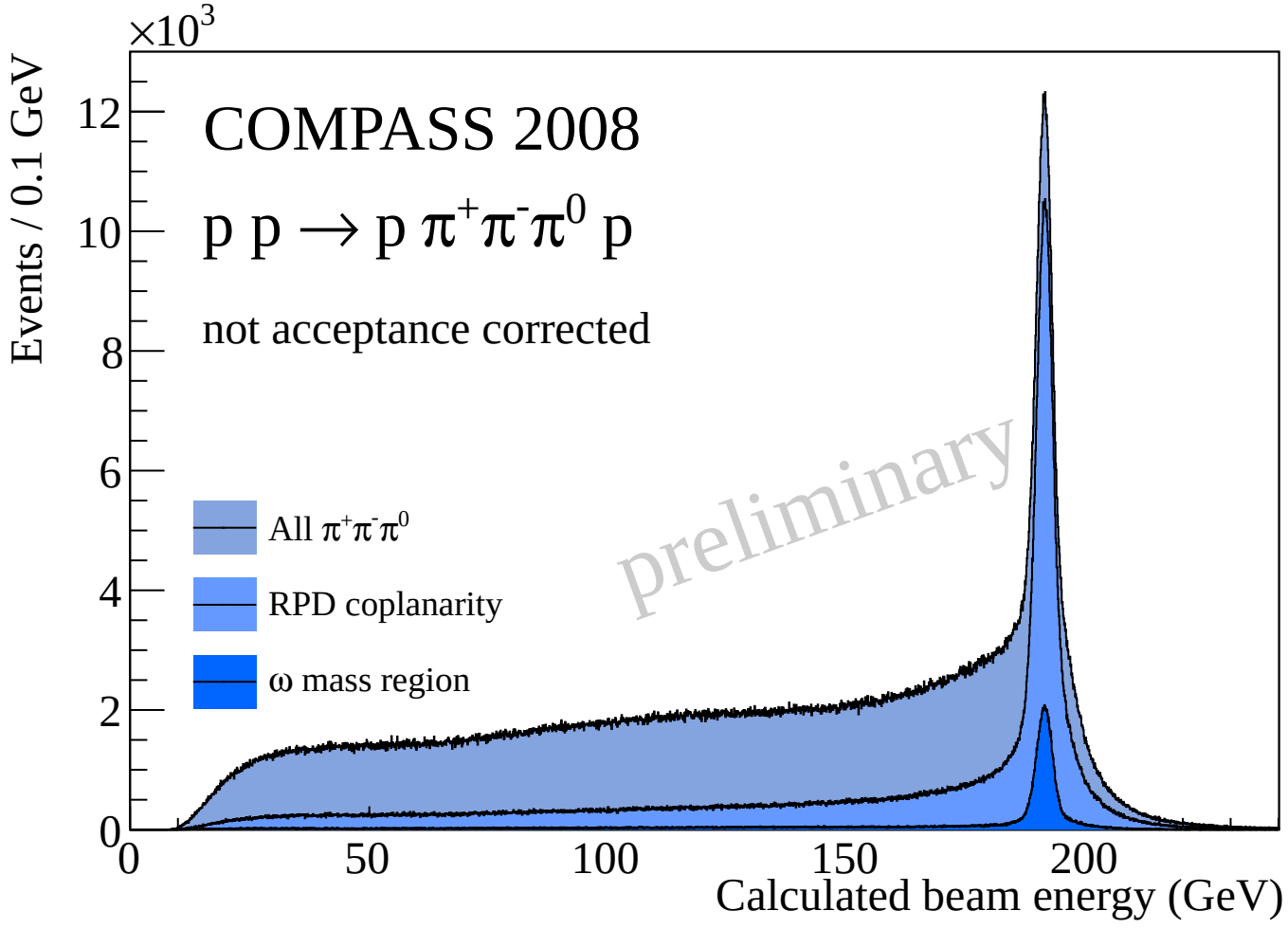
- proton beam data allows for differential studies
- data sample 2 orders of magnitude larger compared to former experiments

Ongoing studies:

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

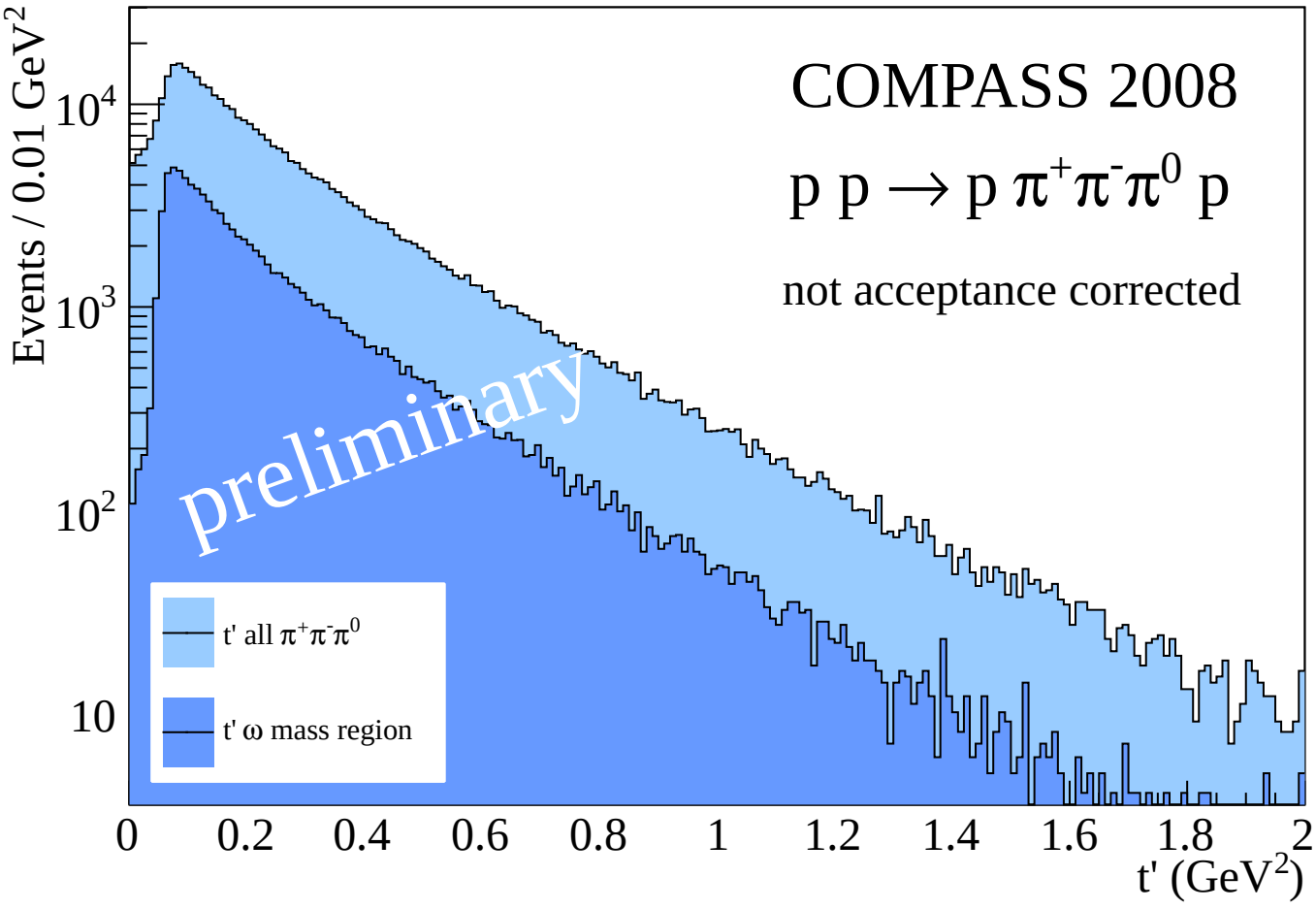
Spares

Exclusivity



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

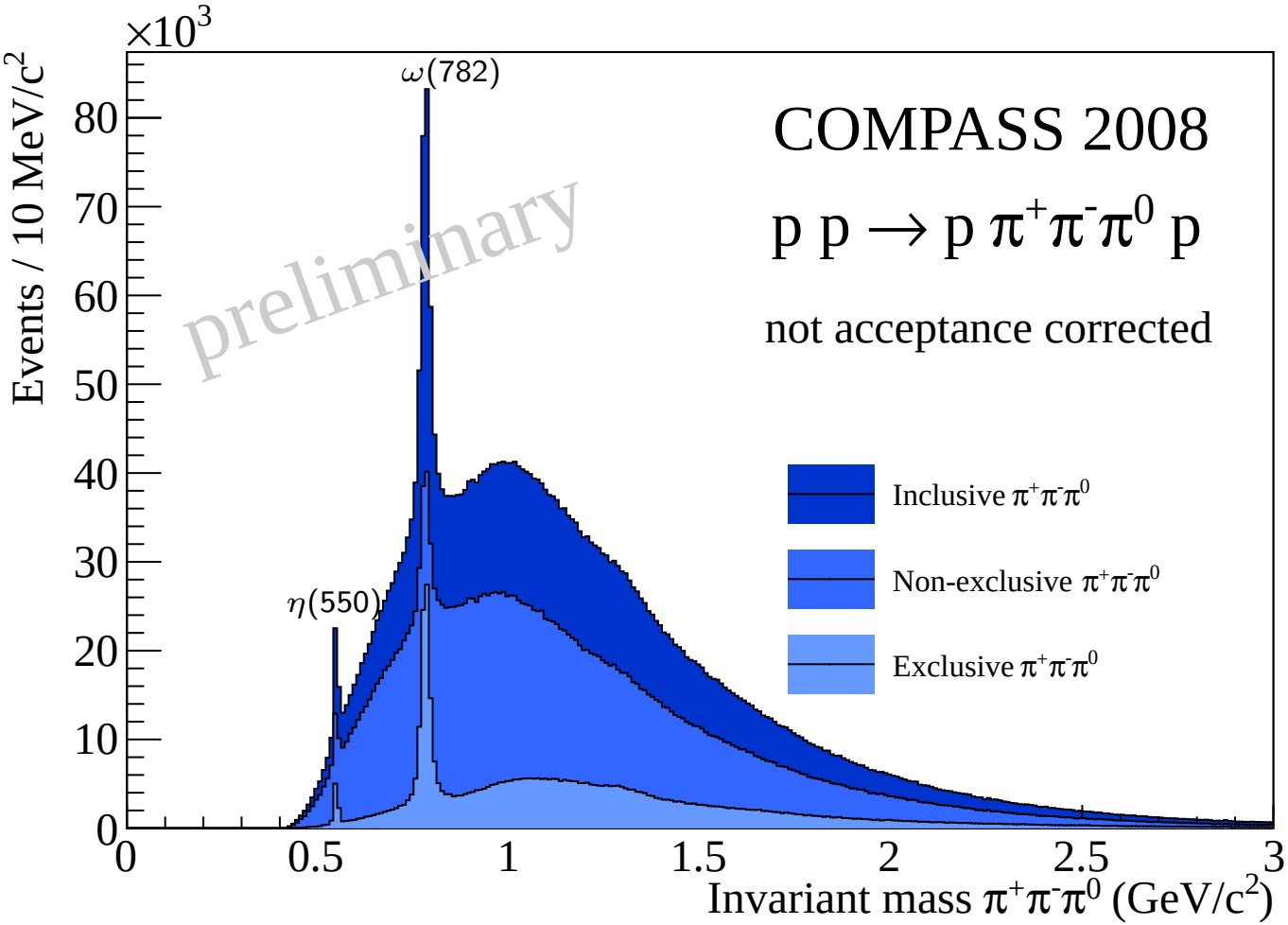
Production mechanism



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

Background

Composition 2008 data sample: exclusive vs. non-exclusive



Important for background studies