Understanding COMPASS data on $\pi^- + p \to \eta^{(\prime)}\pi^- + p$ in the double-Regge region

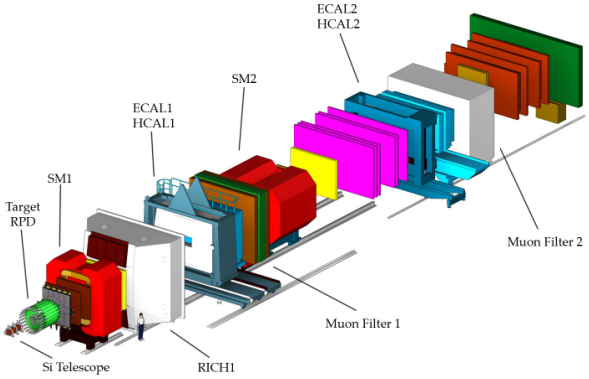
Hadron 2025

Henri Pekeler
on behalf of the COMPASS collaboration

March 29, 2025

The COMPASS experiment

- **CO**mmon **M**uon **P**roton **A**pparatus for **S**tructure and **S**pectroscopy
- Many different physics programs from 1997-2022



Reaction – 190 GeV beam energy

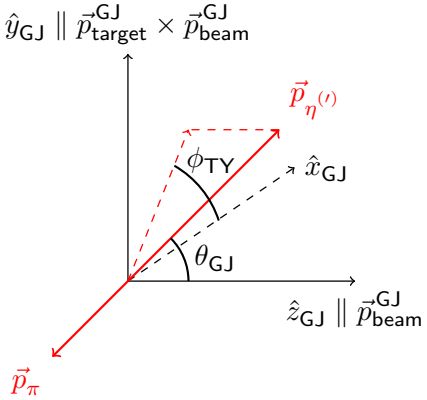
$$\underbrace{\pi^-}_{\text{beam}} + \underbrace{p}_{\text{target}} \to \eta^{(\prime)} + \pi^- + \underbrace{p}_{\text{recoil}}$$

The Gottfried-Jackson frame

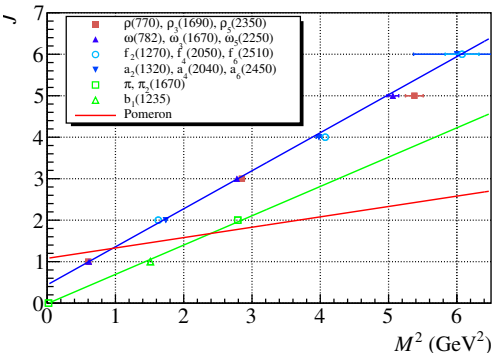
- Rest frame of $\eta^{(\prime)}\pi^-$
- $\vec{p}^{\,\text{GJ}}_{\text{beam}}$ defines z-axis
- y-axis is defined by $\vec{p}^{\,\text{GJ}}_{\text{target}} \times \vec{p}^{\,\text{GJ}}_{\text{beam}}$

Dominating processes

- Resonance production
- Double-Regge exchange



Chew-Frautschi plot

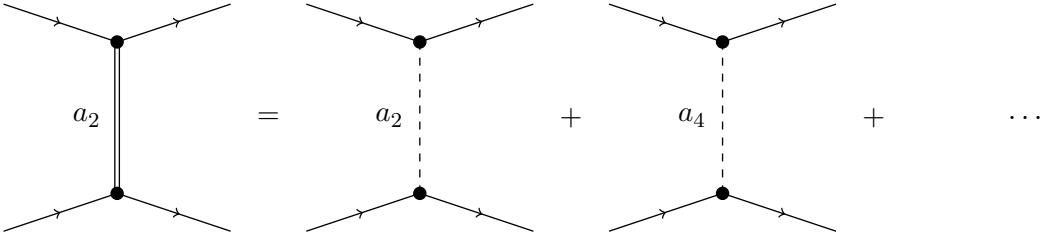


[Ketzer et al., 2020, Prog. Part. Nucl. Phys., 113]

- Resonances with same isospin, intrinsic spin and parity fall on a straight line in M^2 vs J
- This resummation is called a Regge trajectory
- Pomeron: Introduced to obtain an asymptotically constant total cross section

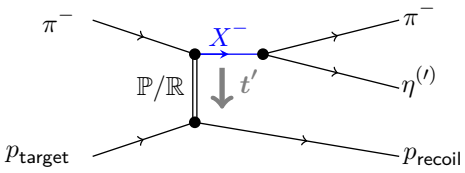
$$\alpha_{a_2}(t) = 0.53 + 0.90t$$
$$\alpha_{f_2}(t) = 0.47 + 0.89t$$
$$\alpha_{\mathbb{P}}(t) = 1.08 + 0.25t$$

Regge theory – a_2 trajectory



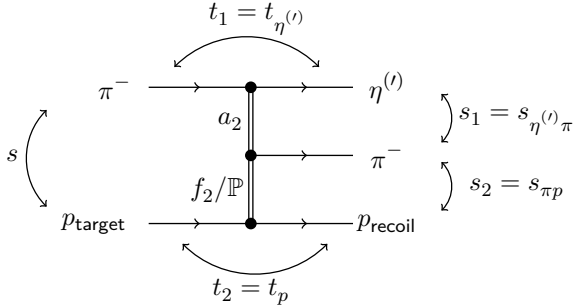
Dominating processes in the $\eta^{(\prime)}\pi^-$ final state

Resonance production



Dominating in the lower mass region

Double-Regge exchange
Forward



Dominating in the higher mass region