# $\rho$ decay to $\pi^+\pi^-$

Bauer et al., Rev Mod Phys 50 (1978) 261

Salgado, Weygand PhysRep 537 (2014) 1

Shilling, Seyboth, Wolf NP B15 (1970) 397

Ballam et al., PhysRev D5 (1972) 545

Elton Smith

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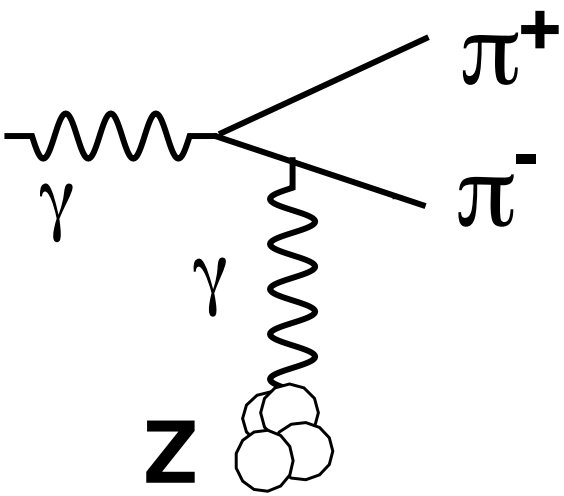
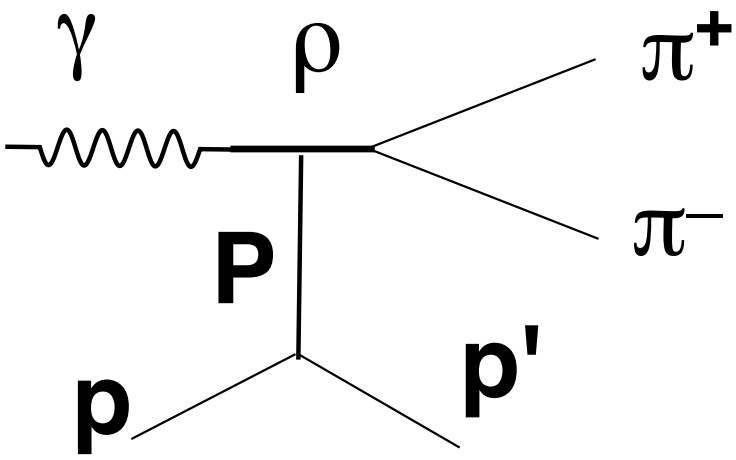
# 2π production




Primakoff production
Sensitive to the
Charged pion polarizability

One of the main backgrounds is ρ production

# Amplitude count

| | | |
|---|---|---|
| P-wave, nucleon | $\lambda_\gamma V_M^{\lambda_{N'}\lambda_N}$ | 24/2 = 12 |
| P-wave, nucleus Z | $\lambda_\gamma V_M^0$ | 6/2 = 3 ? |
| S-wave, nucleus Z | $\lambda_\gamma V_0^0$ | 2/2 = 1 ? |

# Backup Slides

# Angular distributions

Using spin density matrix elements

$$W(\cos\theta,\phi,\Phi)=\frac{3}{4\pi}\left[\tfrac{1}{2}(1-\rho^0_{00})+\tfrac{1}{2}(3\rho^0_{00}-1)\cos^2\theta-\sqrt{2}\,\mathrm{Re}\rho^0_{10}\sin2\theta\cos\phi-\rho^0_{1-1}\sin^2\theta\cos2\phi\right.$$
$$-P_\gamma\cos2\Phi(\rho^1_{11}\sin^2\theta+\rho^1_{00}\cos^2\theta-\sqrt{2}\,\mathrm{Re}\rho^1_{10}\sin2\theta\cos\phi-\rho^1_{1-1}\sin^2\theta\cos2\phi)$$
$$\left.-P_\gamma\sin2\Phi(\sqrt{2}\,\mathrm{Im}\rho^2_{10}\sin2\theta\sin\phi+\mathrm{Im}\rho^2_{1-1}\sin^2\theta\sin2\phi)\right]$$

If it is possible to choose the $z$ axis so that $s$-channel helicity is conserved, $W$ takes a particularly simple form as a function of $\Psi\equiv\Phi-\phi$, namely

$$W(\theta,\Psi)\propto(\sin^2\theta+P_\gamma\sin^2\theta\cos2\Psi). \qquad \text{(D2a)}$$

This results from the relationships

$$\rho^1_{1-1}=-\mathrm{Im}\rho^2_{1-1}=\tfrac{1}{2} \qquad \text{(D2b)}$$

with all other $\rho^\alpha_{ik}=0$ in (D1).

Bauer RevModPhys 50 (1978) 261

# Choice of α specifies system used

- Angular distribution of π+ is in ρ rest frame
- s-channel helicity is dominant.

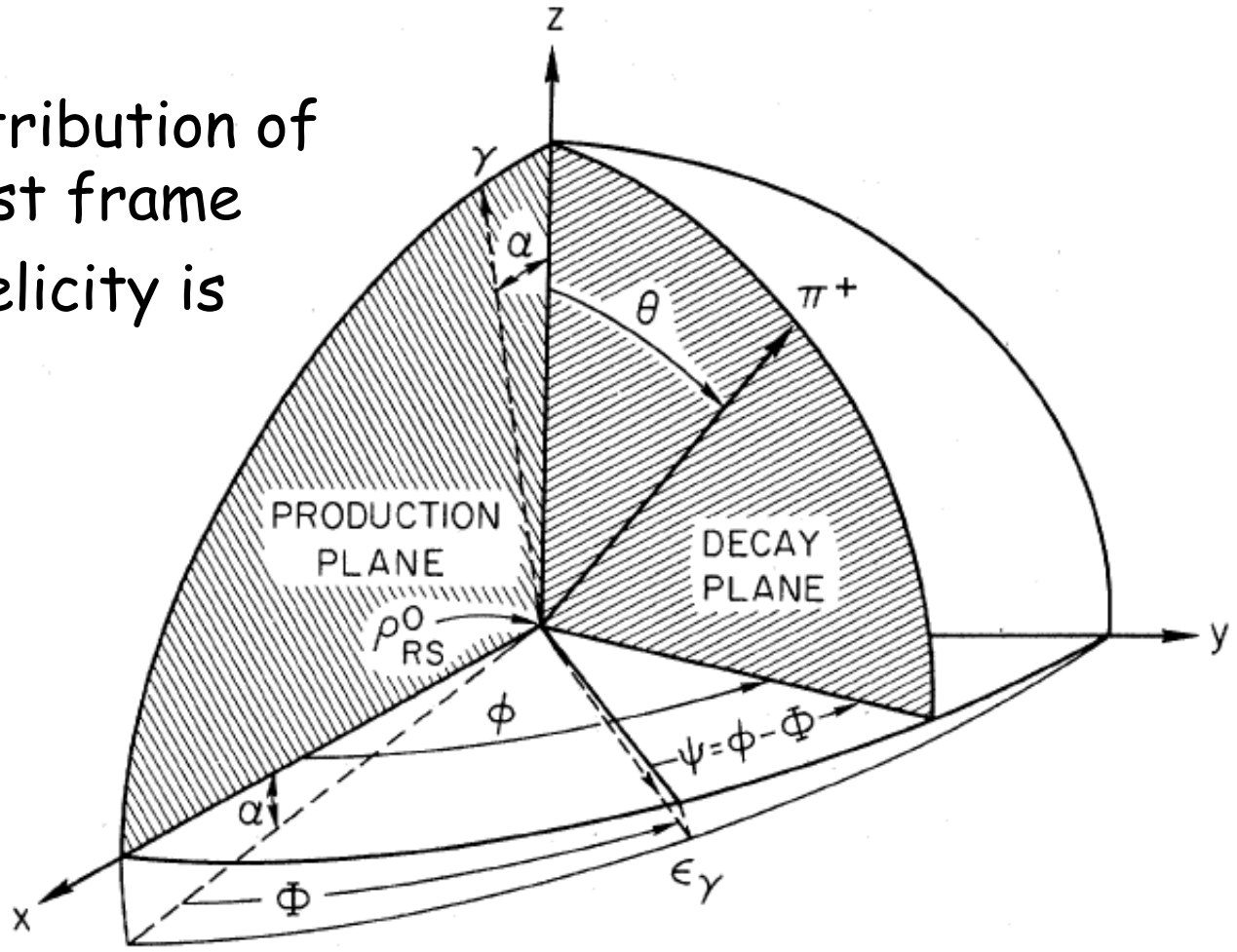



FIG. 12. Angles used in the study of $\rho^0$ decay. The angle $\alpha$ is zero in the Gottfried-Jackson system.