Experimental study of the relative phase between J/ψ production amplitudes

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J/ψ Strong and Electromagnetic Decay Amplitudes

\[ \Gamma_{J/\psi} = 938 \text{ MeV} \rightarrow \rho \Delta \] for all amplitudes short-hand (1)

Points: Par | Inj.err. | \( \Delta \phi \) [°] | \( \Delta \sigma \) [σ] | \( \Delta \sigma_{\text{out}} \) 
--- | --- | --- | --- | ---
5 | 3 | 0.7 | 29.3 | 1.3 | 0.7 \times 10^{-5}
6 | 3 | 0.8 | 26.7 | 1.3 | 0.4 \times 10^{-5}
6 | 3 | 0.8 | 6.1 | 0.9 | 6.1 \times 10^{-5}
12 | 3 | 0.7 | 6.3 | 0.9 | 7.0 \times 10^{-5}
12 | 3 | 0.8 | 5.9 | 0.9 | 7.0 \times 10^{-5}

\[ \sum_{\text{resonant}} \Gamma \] for all amplitudes short-hand (1)

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Investigated Processes

- **Inclusive scenario:** no interference possible
  - The phase is there, but the sum goes to 0
  - Interference \( |f| |g| |f| |g| \)
  - Sum over all final states \( \sum |f| |g| |f| |g| \)
  - Closure approximation \( |f| |g| |f| |g| \)
  - But \( |f| |g| |f| |g| \) orthogonal states

- **Exclusive scenario:** could see interference effects
  - \( \epsilon \cdot \epsilon \rightarrow J/\psi \rightarrow pp, \pi N \)
  - BR \( = 2.17 \times 10^{-4} \)
  - \( \sigma_{\text{out}} \) \( = 11 \text{ pb} \)
  - BR \( = 1.69 \times 10^{-4} \)
  - \( \sigma_{\text{out}} \) \( = 20 \text{ pb} \)
  - BR \( = 5.5 \times 10^{-4} \)
  - \( \sigma_{\text{out}} \) \( = 500 \text{ pb} \)

Energy Points Choice

- \( \Delta \phi \) \( = -90° \)
- \( \Delta \phi \) \( = 90° \)
- \( \Delta \phi \) \( = 180° \)

Expected Achievements

- J/ψ decay amplitude phase: 0° (theory) but 90° (data)
- Required Luminosity collected during run 2012
- Evaluation fit d.o.f.: 3 parameters
- High level analysis in progress

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