Close to threshold
\( \eta' \) meson production
in proton-proton collisions
at COSY-11

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on behalf of COSY-11 Collaboration

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Motivation

- $\eta'$ production cross-sections
- pp FSI
- N$\eta'$ interaction
- $\eta'$ mesic nuclei
COSY-11 setup

- cluster target
- drift chambers
- scintillators
Principle of measurement

\[ p \ p \rightarrow p \ p \eta' \]

Determination of the total width of the \( \eta' \) meson

Detector system upgrade

![Graph showing counts vs. beam momentum (p_{beam} [GeV/c])](image1)

![Image of detector component](image2)

![Image of light emission](image3)
Detector system upgrade

![Diagram of detector system upgrade](image)

- Cluster beam dump
- Pressure measurement point
- Diagnosis unit
- Cluster
- Proton beam
- Nozzle \( \phi 16 \mu \text{m} \)
- \( \text{H}_2 \) target beam

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Luminosity determination

Comparison with differential cross-section for elastically scattered pp from EDDA collaboration
Luminosity determination

Comparison with differential cross-section for elastically scattered pp from EDDA collaboration
Luminosity determination

- Q = 1.4 MeV
- Q = 1.7 MeV
- Q = 2.8 MeV
- Q = 4.8 MeV

EDDA
COSY-11
pp → pp
Background subtraction

Q = 0.8 MeV data
Q = 4.8 MeV data shifted and normalized to Q = 0.8 MeV data
η' counting

Q=0.8 MeV

shifted and normalized 2nd order polynomial fit to data for another Q
$\eta'$ counting

$Q=1.4$ MeV

shifted and normalized 2nd order polynomial fit to data for another Q
$\eta'$ counting

$Q=1.7$ MeV

![Graphs showing data and fitted curves with labels: DATA, MC, shifted and normalized 2nd order polynomial fit to data for another Q.](image)

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η' counting

Q=2.8 MeV

shifted and normalized 2nd order polynomial fit to data for another Q
η' counting

Q=4.8 MeV

DATA
MC

shifted and normalized 2nd order polynomial fit to data for another Q
Result

DATA

COSY-11

SPESIII

DISTO

THEORY

pp-FSI parametrized as:

inverse of the squared Jost function

inverse of the squared Jost function,
full Q range

Niskanen-Goldberger-Watson model

## Summary

<table>
<thead>
<tr>
<th>$Q$ [MeV]</th>
<th>$\sigma(pp \rightarrow p p\eta')$ [nb]</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.76 ± 0.10</td>
<td>1.38 ± 0.08 ± 0.17</td>
</tr>
<tr>
<td>1.35 ± 0.10</td>
<td>3.82 ± 0.19 ± 0.47</td>
</tr>
<tr>
<td>1.66 ± 0.10</td>
<td>4.97 ± 0.28 ± 0.61</td>
</tr>
<tr>
<td>2.84 ± 0.10</td>
<td>11.41 ± 0.40 ± 1.39</td>
</tr>
<tr>
<td>4.78 ± 0.10</td>
<td>17.58 ± 0.64 ± 2.15</td>
</tr>
</tbody>
</table>

$\text{Re}(a_{p\eta'}) = 0.00 \pm 0.43^{\text{stat}} \text{ fm}$ (syst. err. negligible)

$\text{Im}(a_{p\eta'}) = 0.37^{+0.02}_{-0.11}^{\text{stat}} +0.38^{\text{sys}} -0.05^{\text{sys}} \text{ fm}$
Thank you
Danke
Grazie
Merci
Dziękuję
ありがとう