Investigation of the Neutron-induced Deuteron Breakup Process

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• Fundamental Forces
• Strong Force
• Theoretical Models
• Experimental Setup
• Future Plans for the Experiment
# The Four Fundamental Forces

<table>
<thead>
<tr>
<th>Force</th>
<th>Relative Strength</th>
<th>Range</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strong Nuclear</td>
<td>1</td>
<td>$10^{-15}$ m</td>
<td>Holds nuclei together</td>
</tr>
<tr>
<td>Electromagnetic</td>
<td>1/137</td>
<td>Infinite</td>
<td>Holds atoms together</td>
</tr>
<tr>
<td>Weak Nuclear</td>
<td>1/10,000</td>
<td>$10^{-16}$ m</td>
<td>Radioactive decay</td>
</tr>
<tr>
<td>Gravity</td>
<td>$10^{-38}$</td>
<td>Infinite</td>
<td>Holds Solar system together</td>
</tr>
</tbody>
</table>
Strong Force

Two-Nucleon Force

Three-Nucleon Force
Cross Section

\[ N_d = \sigma N_{inc} N_t d\Omega \]
Neutron-Deuteron Breakup
N-d Breakup Cross-Sections

- $E_{\text{lab}} = 65$ MeV
- $E_{\text{lab}} = 135$ MeV
- $E_{\text{lab}} = 200$ MeV

Theta vs Theta diagrams for different lab energies.
Obtaining a Neutron Beam
WNR FACILITY
Fission Chamber

http://en.wikipedia.org/wiki/Nuclear_fission
Liquid Deuterium Target
Wire Chambers

Legend:
- Cathode wires
- Anode wires
- Wire Chamber
- Filled with Argon Gas
\[ t_1 = \Delta t_1 + \Delta t_0 + \frac{\Delta x}{v} \]

\[ t_2 = \Delta t_2 + \Delta t_0 + \frac{\Delta x}{v} \]

\[ t_1 - t_2 = \Delta t_1 - \Delta t_2 \]

\[ t_1 + t_2 = \Delta t_1 + \Delta t_2 + 2\Delta t_0 + 2\frac{\Delta x}{v} \]
Future Plans

• Analyze data
• Statistics
• $^3\text{He}(n,2p)2n$