BRAND: Search for BSM physics at TeV scale by exploring the transverse polarization of electrons emitted in neutron decay


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Measurement of the angular correlations in the decay of polarized cold neutrons with full kinematic reconstruction of events

\[ \frac{d^3\Gamma}{d\Omega_{\text{e}}d\Omega_{\text{p}}d\Omega_{\text{v}}} \sim 1 + a_1 \frac{q}{E_{\text{e}}} + b_1 \frac{m_e}{E_{\text{e}}} + \left( \frac{1}{J} \right) \left[ A \frac{p}{E_{\text{e}}} + B \frac{q}{E_{\text{e}}} + D \frac{p}{E_{\text{e}}} \times \frac{q}{E_{\text{e}}} \right] \]

Components foreseen in Standard Model

If \( J = 0 \) → access to coefficients \( X (= H, L, N, R, S, U, V) \), which are linear combination of BSM - scalar and tensor couplings:

\[ X = X_{SM} + X_{EM} + c_{R, S} Re(S) + c_{R, T} Re(T) + c_{I, S} Im(S) + c_{I, T} Im(T) \]

Significant improvement of constrains on \( Re(S), Re(T), Im(S), Im(T) \) if precision of \( H, L, N, R, S, U, V \) measurement: \( 5 \times 10^{-4} \) → impact on constrains of leptoquark exchange model, R-parity violating MSSM and parameters of EFT.

Experimental Setup

For reconstruction of decay kinematics: electron 4-momentum, proton 4-momentum and electron transverse polarization to be measured

Detection of electrons:
- track reconstruction in MWDC
- energy measurement in plastic scintillator
- transverse polarization measurement via Mott scattering

Detection of protons:
- acceleration in electric field (-25 kV)
- conversion into bunch of electrons in LiF foil
- energy information from hit position and ToF in plastic scintillator

One sector (1/6) of BRAND ultimate setup

Light readout principle of proton detector

Experimental Issues

Prototipe of MWDC (BRAND-0)