Measurement of the Longitudinal $\vec{n}$-$\vec{p}$ Cross Section Differences with 5-20 MeV Polarized Neutrons

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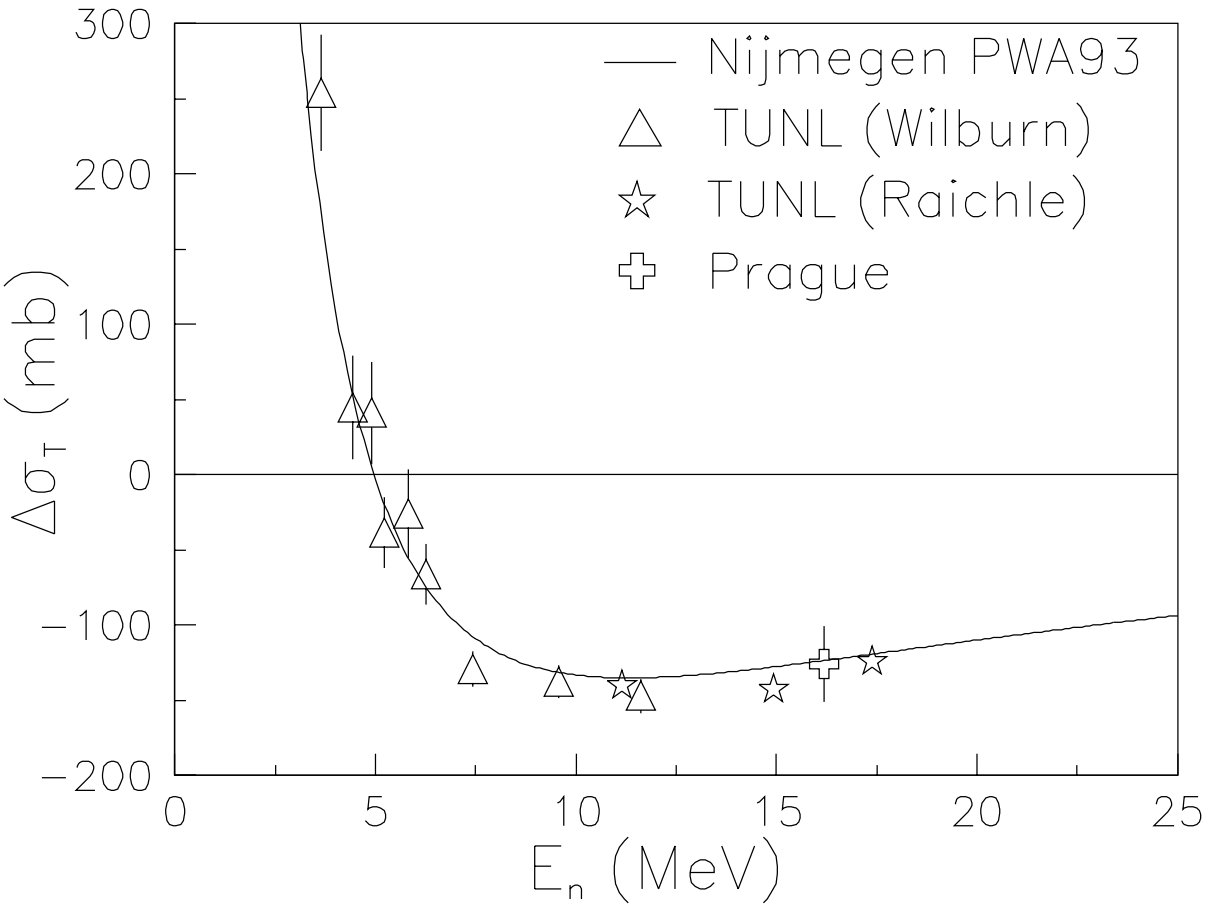
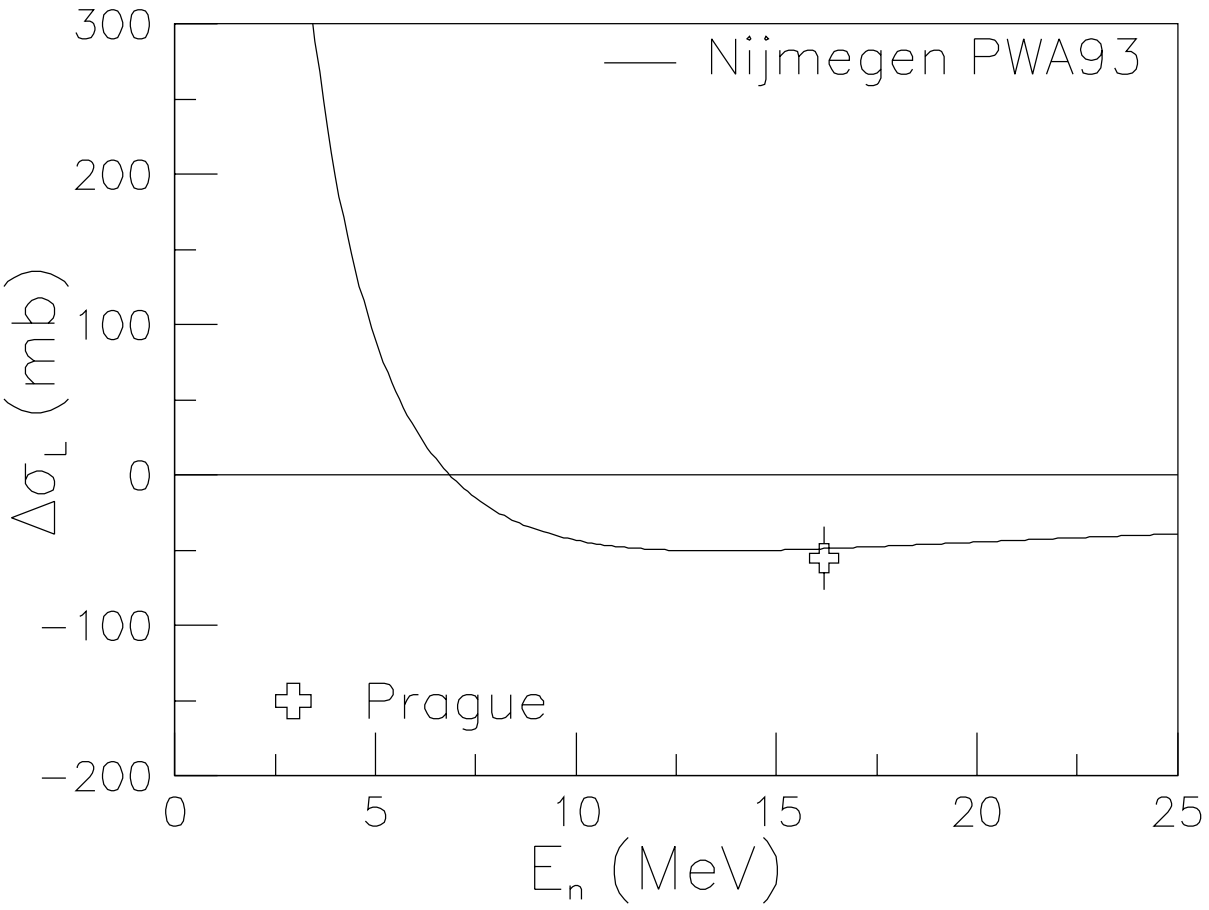
$\Delta\sigma_T$ for $\vec{n}$-$\vec{p}$ interaction

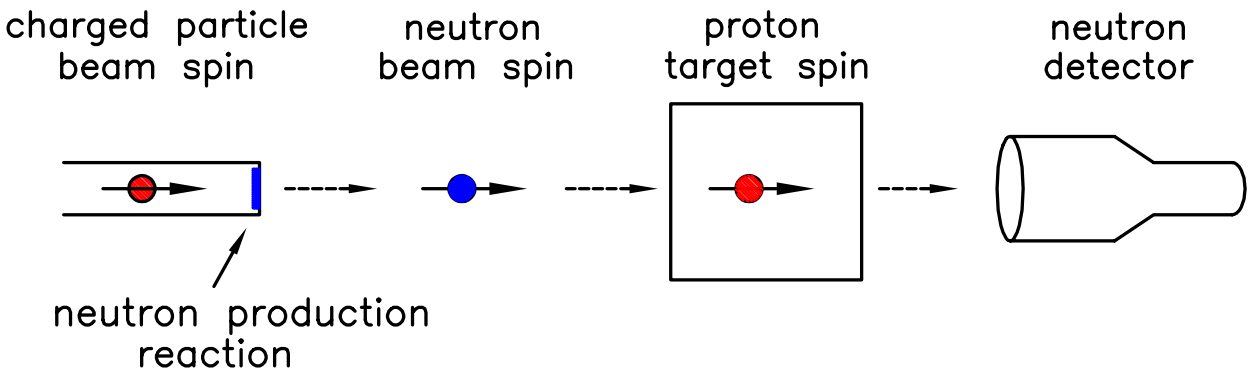


Measurements of $\Delta\sigma_T$ from Wilburn et al. and Raichle et al. at TUNL

$\Delta\sigma_L$ for $\vec{n}$-$\vec{p}$ interaction



Neutron Transmission Measurement



Beam spin direction flipped at 10 Hz

Target spin direction flipped every 4 hours

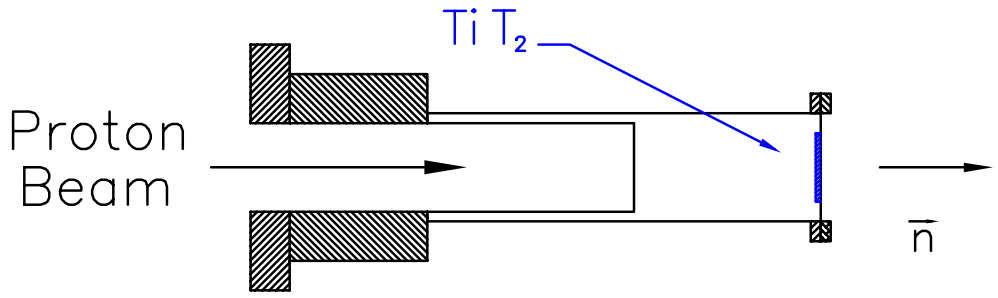
Neutrons are detected at 0°

Neutron Beam Production

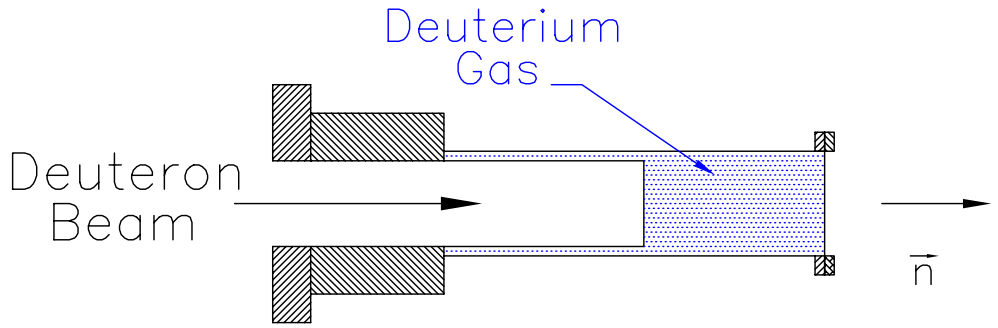
Polarized neutron beam from production reactions:

Proton, Deuteron beam polarization $\approx$ 70% from TUNL polarized ion source

^{3}H$(\vec{p},\vec{n})^3$He used for low energy beams (calibration at 1.5 & 2.7 MeV)

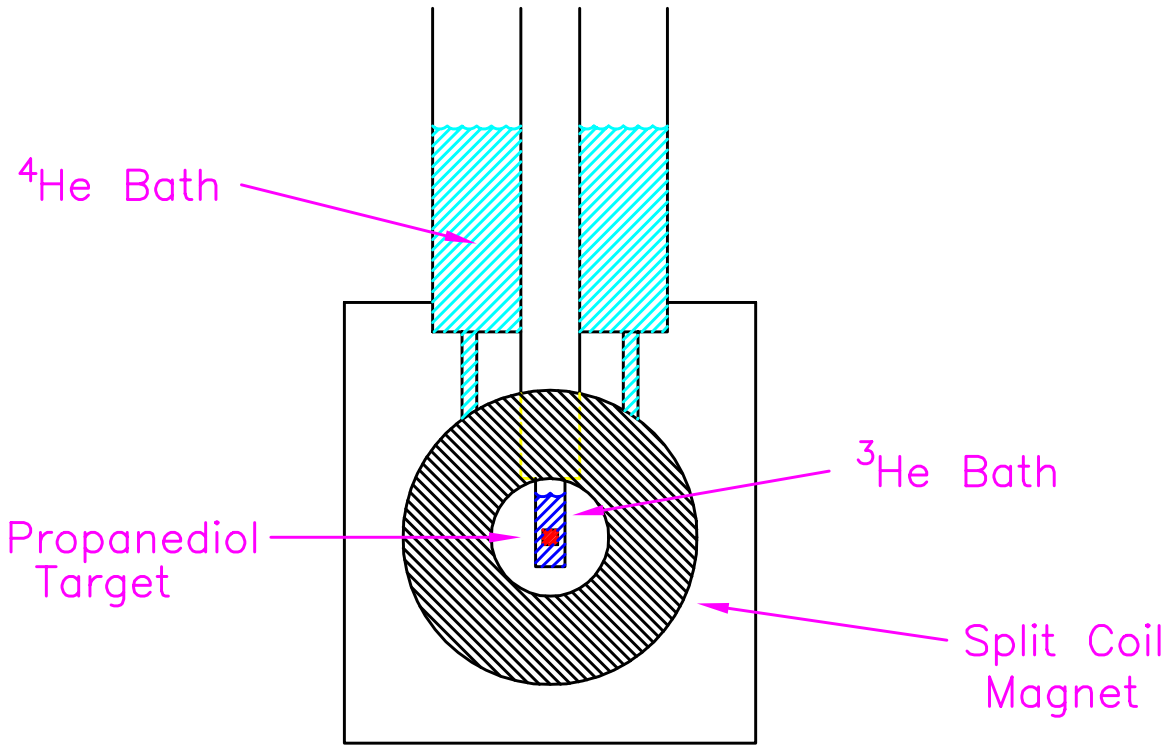


^{2}H$(\vec{d},\vec{n})^3$He used for high energy beams (5, 7, 11, 15, 17 & 20 MeV)



Dynamically Polarized Proton Target

- polarized to $\approx 65\%$ with thickness 0.06 b^{-1}
- polarization continuously monitored
- polarization quickly reversible ($\approx$ 30 min)



Measuring $\Delta\sigma_L$ requires a polarized beam and polarized target.

$$\Delta\sigma_L = \frac{-2\,\epsilon}{P_n P_t x}$$

where

- ϵ is the transmission asymmetry.

$$\epsilon = \frac{N_+ - N_-}{N_+ + N_-}$$

- P_n is the beam polarization.

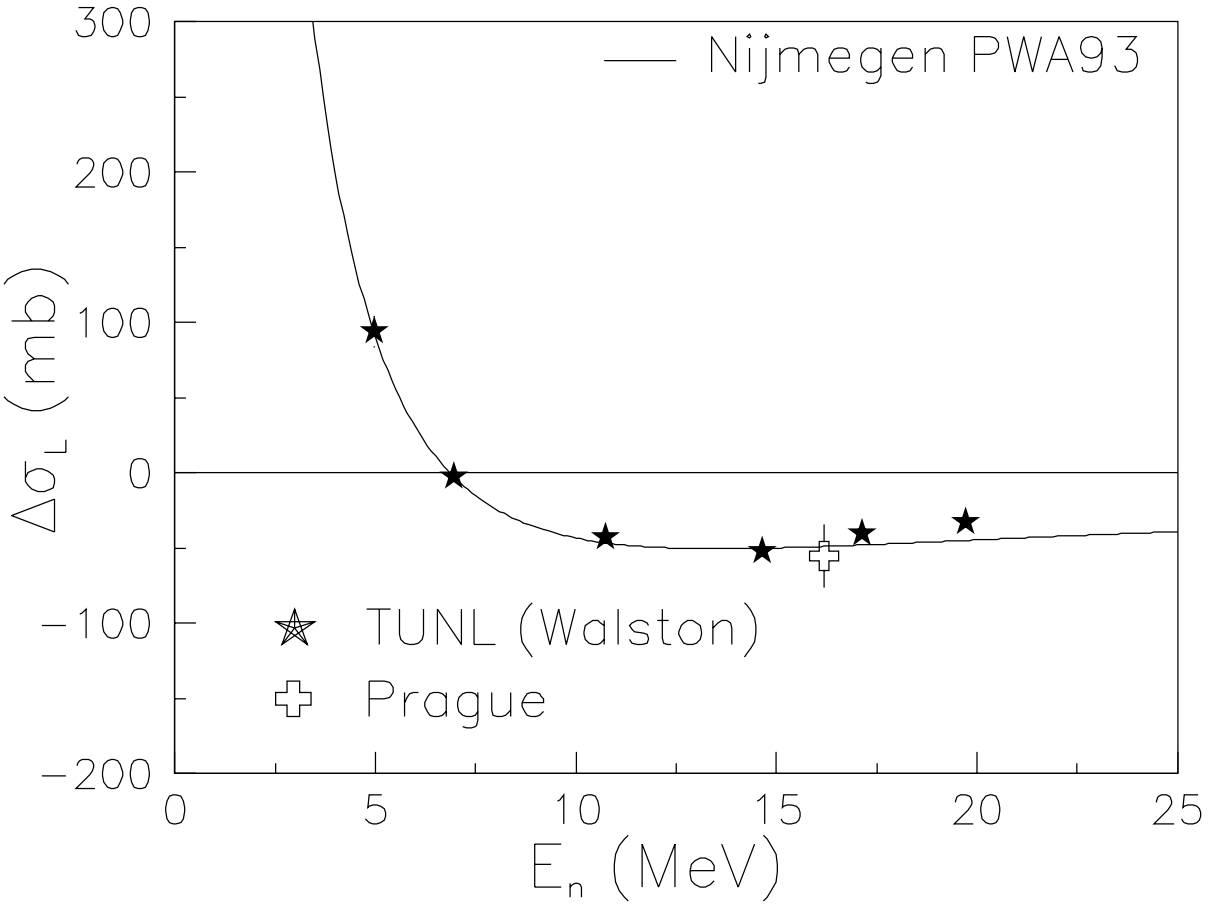
- P_t is the target polarization.

- x is the target thickness.

P_t and x are determined:

- absolutely through transmission measurements
  - requires precise knowledge of spin-spin interaction (low energies)
  - requires reliable and precise value of polarization transfer coefficient
- monitored through NMR measurements
  - requires calibration by measuring static polarization ($\approx$ 0.5%)
  - samples different volume of target material

$\Delta\sigma_L$ for $\vec{n}$-$\vec{p}$ interaction



Energy (MeV)	$\Delta\sigma_L$
5.0	94.0 ± 10.8
7.0	-2.0 ± 1.8
10.7	-42.2 ± 5.9
14.7	-51.5 ± 4.6
17.1	-39.9 ± 6.6
19.7	-32.8 ± 7.2

Summary

- Description of $\Delta\sigma_L$
- Description of transmission measurement
- Description of polarized proton target
- Measurement of $\Delta\sigma_L$

Next Presentation

- Extract ϵ_1 from $\Delta\sigma_T$ and $\Delta\sigma_L$