Group Meeting 06.22

Mechanisms in Proton-Induced Nucleon Removal at ~100 MeV=Nucleon

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Overview

Reduction factor R_s

$$R_s = \frac{\sigma_{exp}}{\sigma_{th}}$$

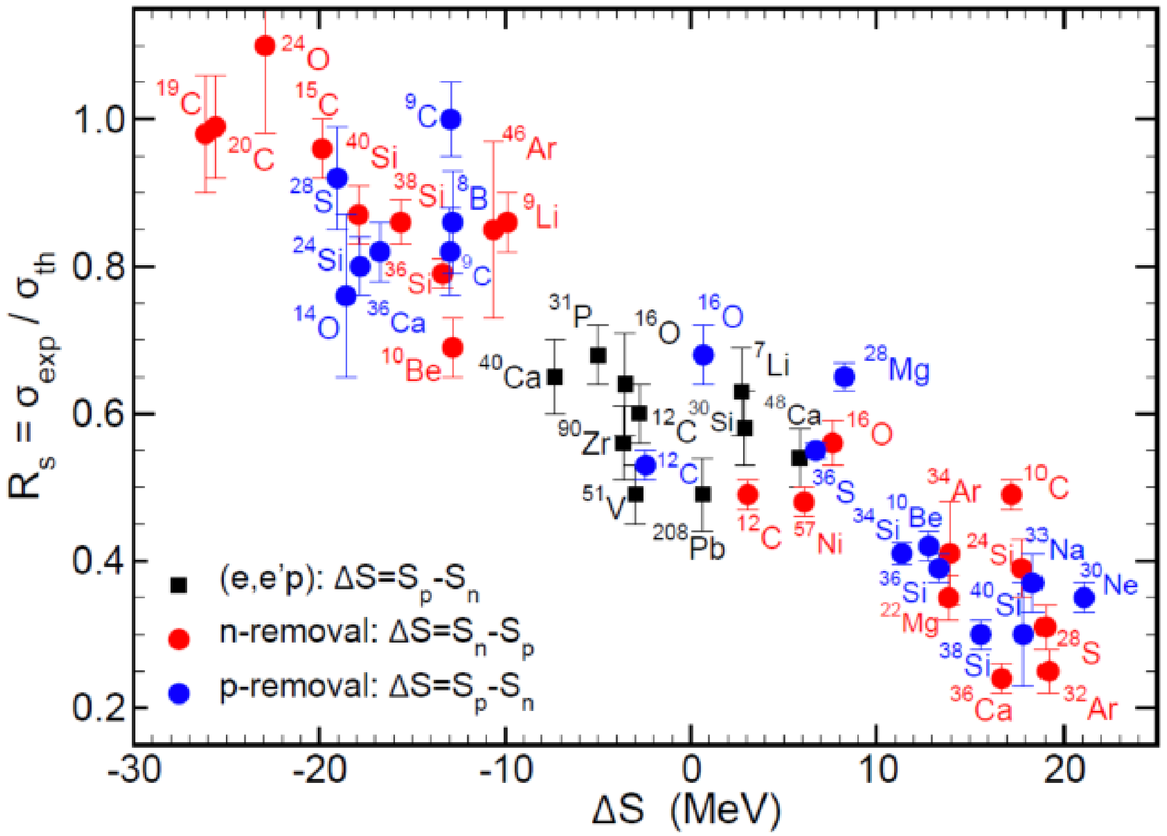
$$\text{Where } \sigma_{th} = \text{SF}\sigma_{sp}\frac{A}{A-1}$$

σ_{exp} : Experimental cross section

σ_{th} : Theoretical prediction

SF: Spectroscopic factors

σ_{sp}: Single particle state



Overview

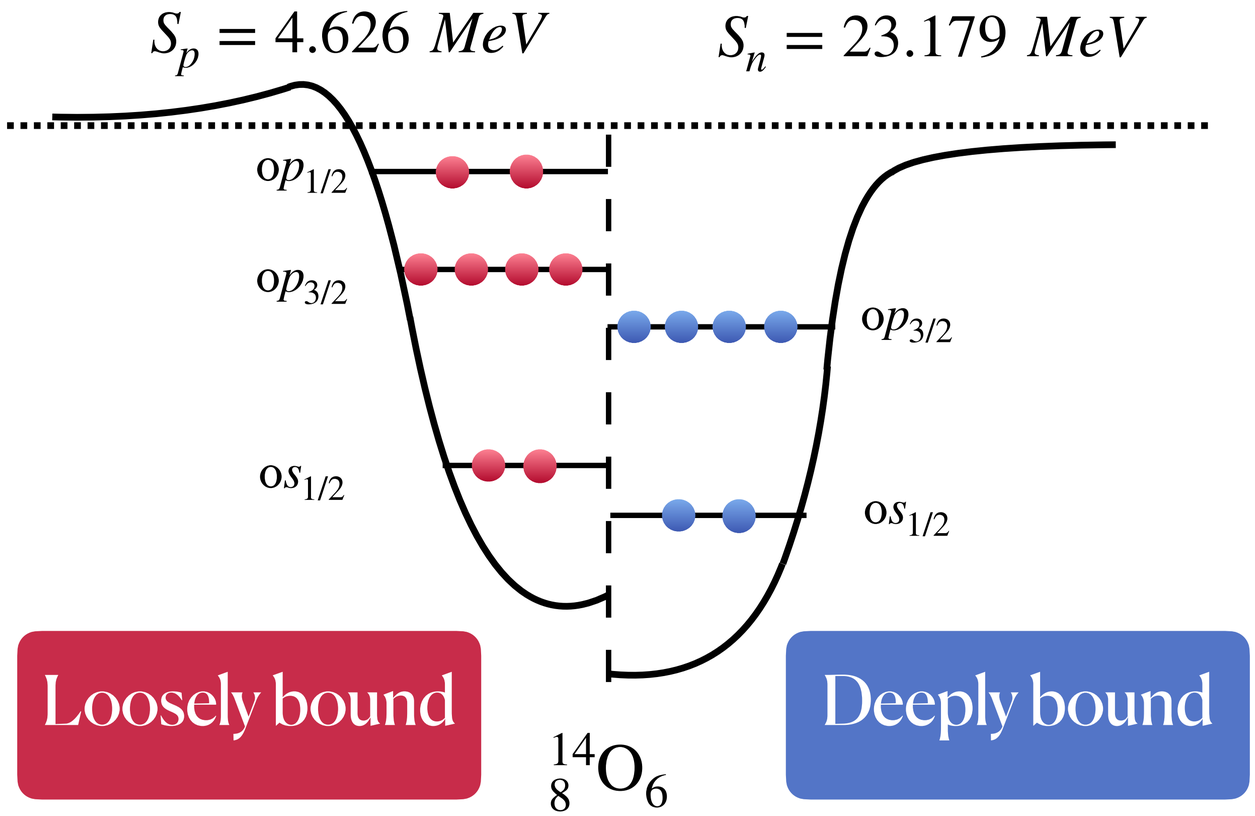
Single-proton-removal reaction

$$p + {}^{14}\mathrm{O} \rightarrow {}^{13}\mathrm{N} + p + p$$

Single-neutron-removal reaction

$$p + {}^{14}\mathrm{O} \rightarrow {}^{13}\mathrm{O} + n + p$$

$$p + {}^{14}\mathrm{O} \rightarrow {}^{13}\mathrm{O} + d$$



DWIA and QTC

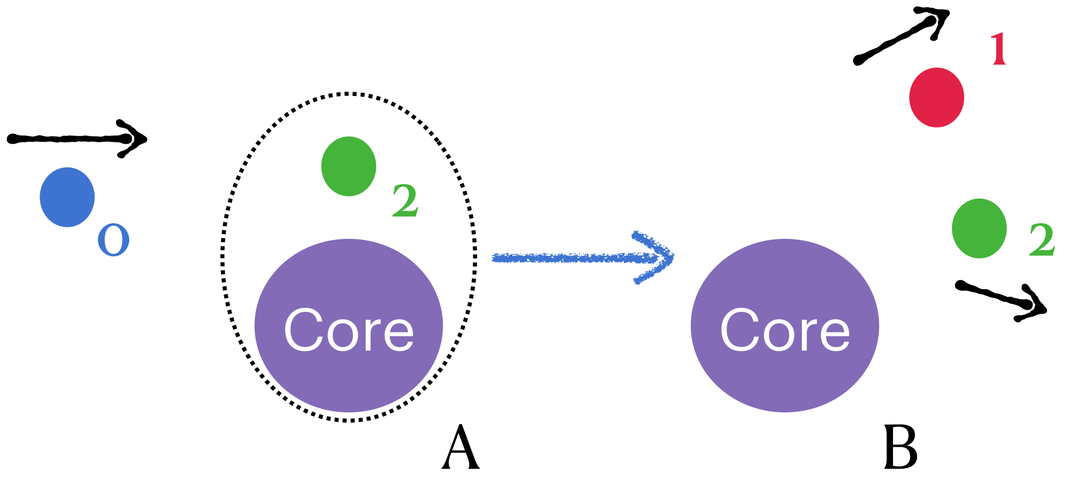
The T-matrix of DWIA can be written in,

$$T^{nljm}_{\boldsymbol{K}_0\boldsymbol{K}_1\boldsymbol{K}_2} = \left\langle \chi^{(-)}_{1,\boldsymbol{K}_1}\chi^{(-)}_{2,\boldsymbol{K}_2} \left| t_{pn} \right| \chi^{(+)}_{0,\boldsymbol{K}_0}\varphi^{nljm} \right\rangle$$

Distorted wave function of particle 1

Distorted wave function of particle 2

Distorted wave function of particle 0



In the formula of DWIA, the transfer reaction is not taken into consideration.

DWIA and QTC

The T-matrix of QTC can be written in,

$$T_{if}^{3b}(\alpha) = \sqrt{S_{\alpha,\ell,j}} \left\langle \Psi_f^{3b(-)} \middle| V_{pN} + U_{pB} - U_{pA} \middle| \varphi_{BA}^{\alpha} \chi_{pA}^{(+)} \right\rangle$$

where φ_{BA}^{α} is the overlap wave function between the wave functions of target A and core B, and 3-body wave function can be replaced by CDCC wave function,

$$\Psi_f^{3b(-)} \approx \Psi_f^{\mathrm{CDCC}} = \sum_{n,j,\pi} \phi_n^{j\pi}\left(k_n, \vec{r}\,'\right) \chi_{n,j,\pi}\left(\vec{K}_n, \vec{R}\,'\right)$$

Single-proton-removal

Direct reaction

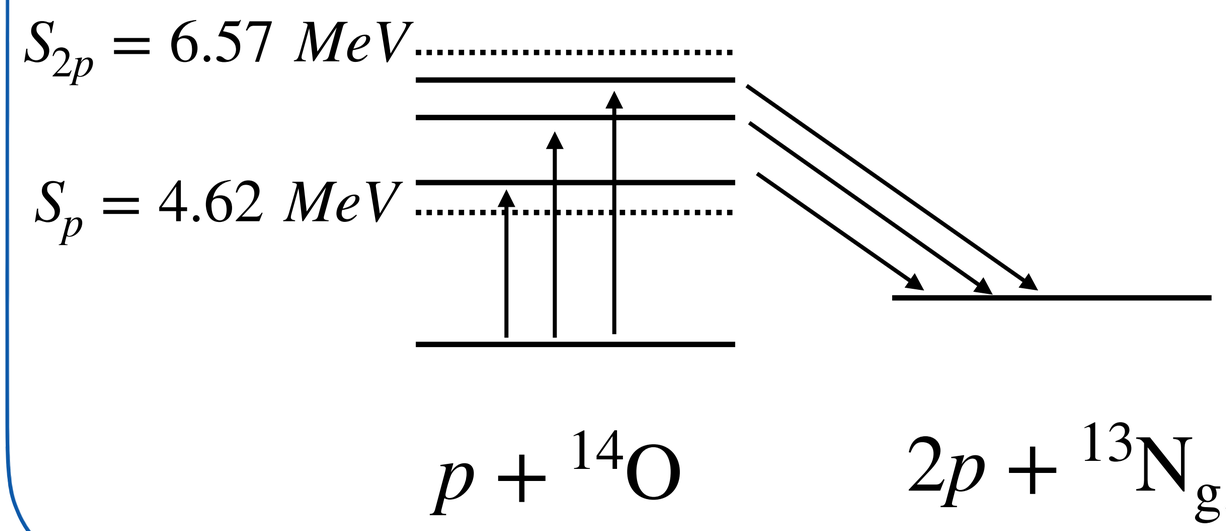
$$p + {}^{14}\mathrm{O} \rightarrow {}^{13}\mathrm{N} + p + p$$

Calculated by DWIA and QTC, respectably.

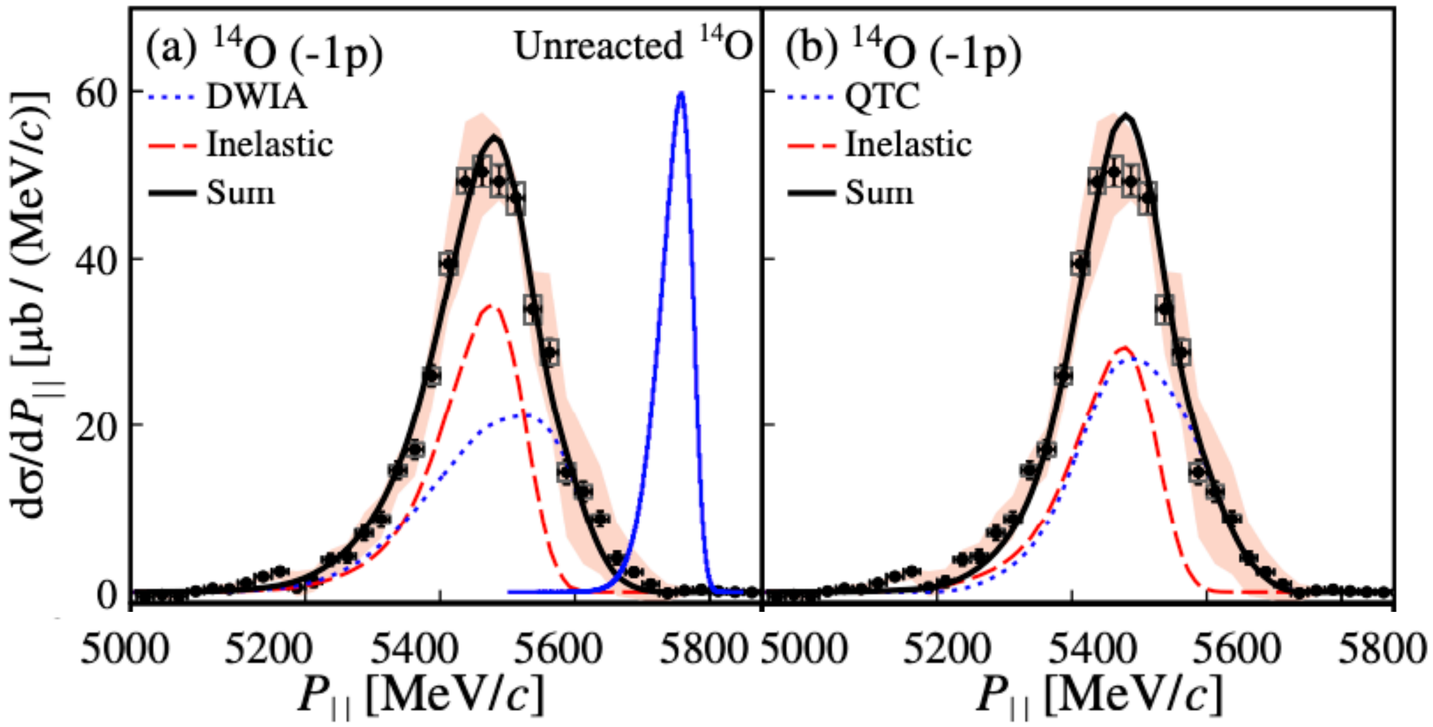
Inelastic

$$p + {}^{14}\mathrm{O} \rightarrow {}^{14}\mathrm{O}^{*} + p$$

$$ {}^{14}\mathrm{O}^{*} \rightarrow {}^{13}\mathrm{N}_{\mathrm{g.s.}} + p$$



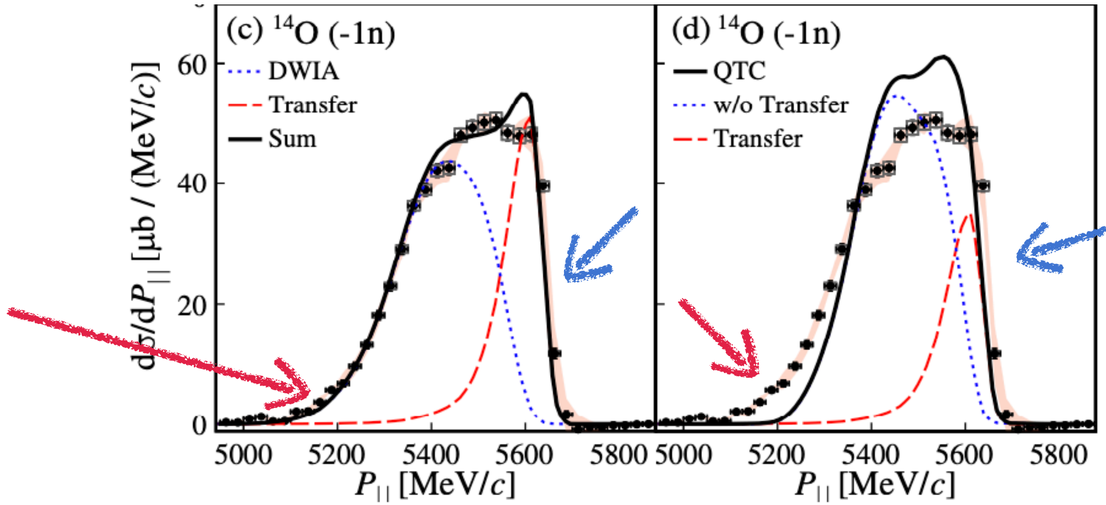
Single-proton-removal



(p, p') and $(p,2p)$ mainly contribute to the loosely bound proton removal.

Single-neutron-removal

A tail



A sharp edge

Knock out

$p + {}^{14}\mathrm{O} \rightarrow {}^{13}\mathrm{O} + p + n$

Calculated by DWIA and QTC, respectably.

Transfer

$p + {}^{14}\mathrm{O} \rightarrow {}^{13}\mathrm{O} + d$

Calculated by DWBA and QTC, respectably.

Reduction factor

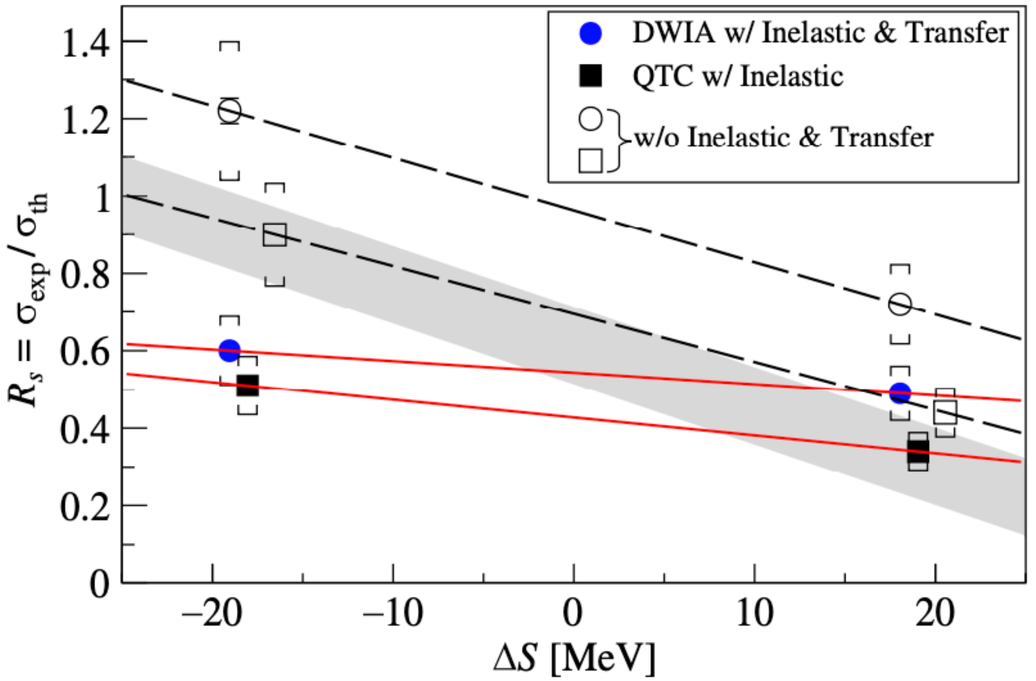


FIG. 3. R_s as a function of ΔS from the present work (blue dots and black squares) compared to the trend extracted from Be or C induced nucleon-removal cross sections analyzed with the eikonal model [19–21] (gray shaded region). The square brackets indicate the total systematic uncertainties. Red solid and black dashed lines are shown to guide the eyes.