

Group Meeting 05.09

Investigating neutron transfer in the ${}^6\text{Li}+{}^{124}\text{Sn}$ system

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CRC and CDCC

What is the difference between the CRC and CDCC?

$$\Psi^{(+)}(\xi, \mathbf{R}) = \sum_i^N \phi_i(\xi) \chi_i^{(+)}(\mathbf{R}) + \sum_\nu \phi_\nu^{bin}(\xi) \chi_\nu^{(+)}(\mathbf{R})$$

Bound **Continuum**

continuum components


bin states

bound states

$\phi_i(\xi)$: bound states

$\chi_i^{(+)}(\mathbf{R})$: the relative motion

$\phi_\nu^{bin}(\xi)$: bin states (continuum)



The diagram on the right shows a vertical stack of energy levels. The top portion consists of a blue rectangular area filled with many thin horizontal lines, representing a continuum of states. Below this blue area are three distinct, thick horizontal black lines, representing discrete bound states. A curly brace on the left side of the blue area is labeled 'bin states', and a curly brace on the left side of the black lines is labeled 'bound states'. The text 'continuum components' is positioned above the blue area, and 'bound states' is positioned below the black lines.

CRC and CDCC

Wave function:

$$\Psi^{(+)}(\boldsymbol{\xi}, \mathbf{R}) = \phi_0(\boldsymbol{\xi})\chi_0^{(+)}(\mathbf{R}) + \sum_{\nu} \phi_{\nu}(\boldsymbol{\xi})\chi_{\nu}^{(+)}(\mathbf{R})$$

Initial

Final

Couple equation:

$$[E_i - H_i] \chi_i(\mathbf{R}_i) = \sum_{j \neq i} \langle \phi_i | \mathcal{H} - E | \phi_j \rangle \chi_j(\mathbf{R}_j)$$

CRC

Spectroscopic

${}^6\text{Li} + n \rightarrow {}^7\text{Li}$ factors C^2S

$0p_{1/2}$ _____

0.29

$0p_{3/2}$ _____

0.43

Pickup

$$\Psi^{(+)}(\xi, \mathbf{R}) = \phi_{{}^6\text{Li}}(\xi) \chi_{{}^6\text{Li}+A}^{(+)}(\mathbf{R}) + \sum_{\nu} \phi_{{}^7\text{Li}}(\xi) \chi_{{}^7\text{Li}+B}^{(+)}(\mathbf{R})$$

Spectroscopic

${}^6\text{Li} \rightarrow {}^5\text{Li} + n$ factors C^2S

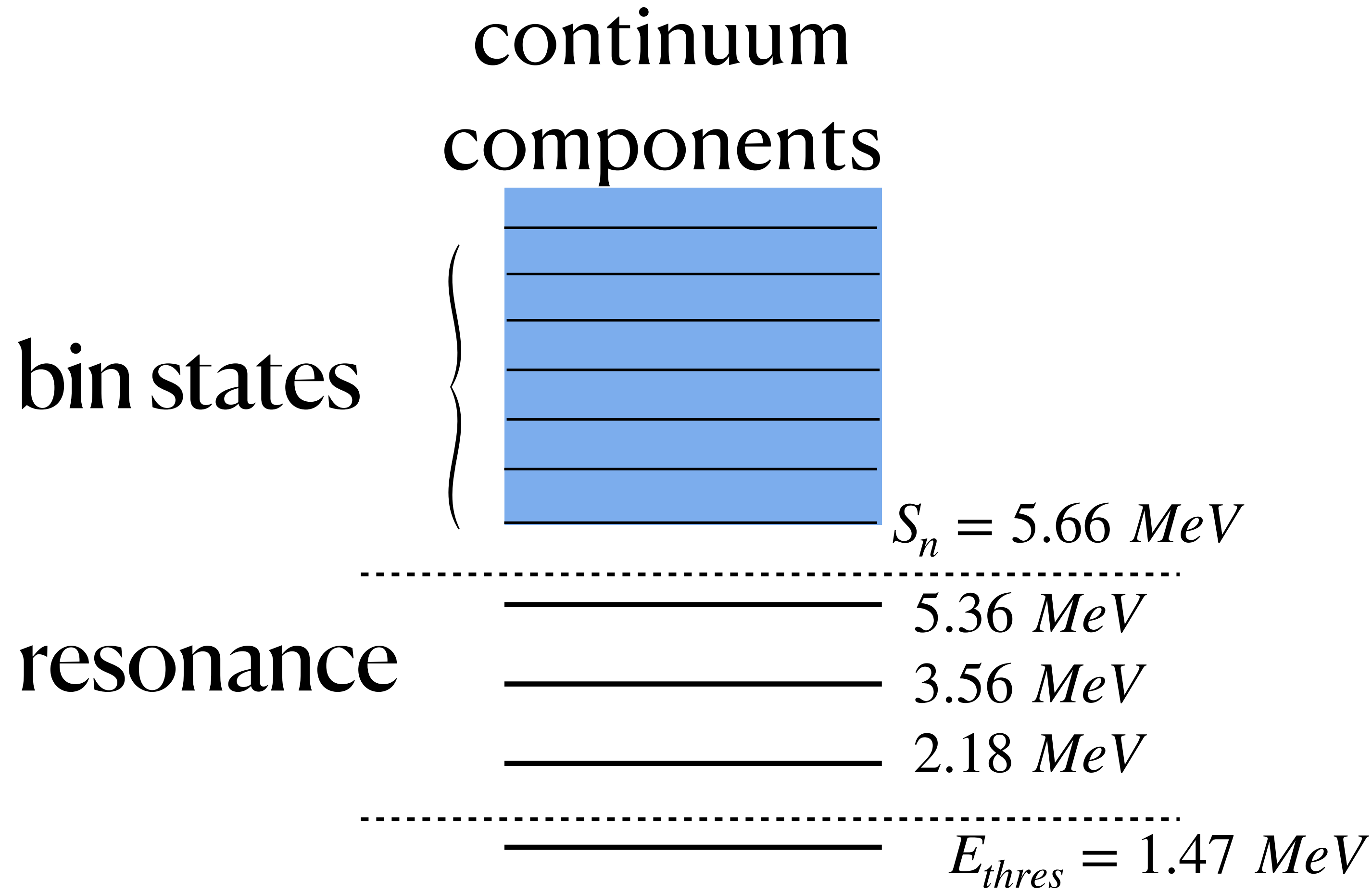
$0p_{3/2}$ _____

1.12

Stripping

$$\Psi^{(+)}(\xi, \mathbf{R}) = \phi_{{}^6\text{Li}}(\xi) \chi_{{}^6\text{Li}+A}^{(+)}(\mathbf{R}) + \sum_{\nu} \phi_{{}^5\text{Li}}(\xi) \chi_{{}^5\text{Li}+B}^{(+)}(\mathbf{R})$$

CDCC



The momentum width of bin

$$k = 0.20 \text{ fm}^{-1}$$



CRC + CDCC

What is the CRC + CDCC?

$$\Psi^{(+)}(\xi, \mathbf{R}) = \sum_i^N \phi_{\alpha+d}(\xi) \chi_{6Li+A}^{(+)}(\mathbf{R}) + \sum_{\nu} \phi_{\alpha+t}(\xi) \chi_{7Li+B}^{(+)}(\mathbf{R})$$

Initial Final

Pickup
Reaction

$\phi_{\alpha+d}(\xi) \chi_{6Li+A}^{(+)}(\mathbf{R})$ and $\phi_{\alpha+t}(\xi) \chi_{7Li+B}^{(+)}(\mathbf{R})$ are gotten from CDCC, which include the continuum states.

CRC + CDCC

$$\Psi^{(+)}(\xi, \mathbf{R}) = \sum_i^N \phi_{\alpha+d}(\xi) \chi_{6Li+A}^{(+)}(\mathbf{R}) + \sum_{\nu} \phi_{\alpha+p}(\xi) \chi_{5Li+B}^{(+)}(\mathbf{R})$$

Initial **Final**

**Stripping
Reaction**

$\phi_{\alpha+d}(\xi) \chi_{6Li+A}^{(+)}(\mathbf{R})$ and $\phi_{\alpha+p}(\xi) \chi_{5Li+B}^{(+)}(\mathbf{R})$ are gotten from CDCC, which include the continuum states.

Sao Paulo Potential

The double folding Sao Paulo potential

$$V_{\text{SPP}}(R) = V_{\text{Fold}}(R)e^{-4v^2/c^2}$$

c light speed v local relative velocity between projectile and target

$$V_{\text{Fold}}(R) = \iint \rho_1(\vec{r}_1) \rho_2(\vec{r}_2) V_0 \delta(\vec{R} - \vec{r}_1 + \vec{r}_2) d\vec{r}_1 d\vec{r}_2$$

where $V_0 = 495 \text{ MeV}$