# $^{25}$O - Beyond the Neutron Dripline *

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The R3B-collaboration has studied proton knock-out reactions from the very neutron-rich isotope $^{26}$F populating neutron-unbound states in $^{25}$O [1, 2]. The incoming $^{26}$F ions have been identified on a event-by-event basis. For the outgoing reaction products the four-momenta ($P_i = (E_i/c, \vec{p}_i)$) have been measured and those have been combined to reconstruct the invariant mass.

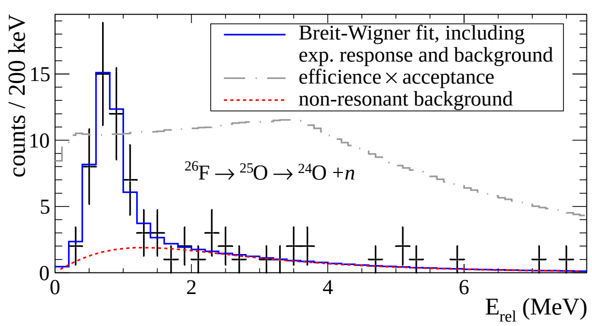


Figure 1: Relative-energy spectrum of the $^{24}$O+$n$ system. The blue solid line shows a Breit-Wigner fit to the data, which includes the experimental response and a non resonant background (red dotted curve). The grey dashed-dotted histogram indicates the experimental response to a white spectrum.

The resulting $^{24}$O+$n$ relative-energy spectrum as shown in Fig. 1 exhibits a peak at around 700 keV. This peak corresponds to the ground-state of $^{25}$O. The resonance position $E_r$ and width $\Gamma$ were determined in the following way. A Breit-Wigner line shape in the one-level approximation as given in [3] has been used:

$$f(E; E_r, \Gamma) = \frac{\Gamma}{(E_r + \Delta - E)^2 + 1/4 \cdot \Gamma^2} . \qquad (1)$$

The resonance shift $\Delta$ has been set to zero, the width $\Gamma$ is given by the reduced width $\gamma$ and the penetration factor $P_l$; $\Gamma = 2P_l(E;R) \cdot \gamma^2$. For the angular momentum $l = 2$ is used, since the additional neutron of $^{25}$O compared to $^{24}$O is most likely in the $0d_{3/2}$ - shell. A channel radius $R$ of 4 fm has been choosen.

This distribution has been convoluted with the experimental response as shown in Fig. 2. A non-resonant background has been modeled with:

$$f(E) = a \times \mathrm{erf}(b \cdot E) \times e^{c \cdot E} , \qquad (2)$$

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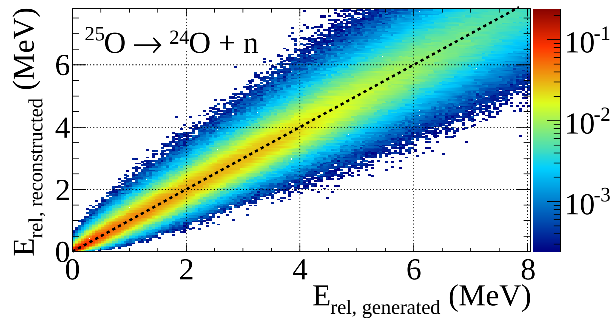


Figure 2: Simulated experimental response for detection of a $^{24}$O+$n$ decay from the (unbound) isotope $^{25}$O. The x-axis depicts the relative energy used as input for the simulation while the y-axis shows the reconstructed relative energy $E_{rel}$ reflecting the measured values.

where 'erf' is the error-function and the paramters $a$, $b$ and $c$ have been varied freely. The sum of convoluted Breit Wigner and background was used to fit the experimental data. The $\chi^2$ minimization was done using a $\chi^2$ based on the Poisson likelihood [4]. The results are as follows:

$$E_r = 725^{+54}_{-29} \text{ keV},$$

$$\Gamma = 20^{+60}_{-20} \text{ keV}.$$

The result on the resonance position (width) is in agreement with the result from [5] within 1-$\sigma$ (2-$\sigma$). Our result is within (1-$\sigma$) in agreement with a single-particle width calculated for a pure $d$-state character ($\Gamma_{s.p.} \approx 65$) keV.

## References

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