

# R-matrix analysis of nuclear-reaction cross-section data



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MEFT project

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# R-matrix theory

$$R_{cc'}(E) = \sum_{\{n\}} \frac{\gamma_{nc}\gamma_{nc'}}{E_n - E}$$

Not only applicable to fusion but all fields involving nuclei and nuclear reactions. Some examples are:

- Overall nuclear analysis;
- Astrophysics;
- Neutron physics.

# Azure2: R-matrix program

Particle Pair Type: Particle, Particle

Light Particle      Heavy Particle

J: 0    +    J: 0    +

Z: 2      Z: 6

M: 4      M: 12

Channel Properties

Excitation Energy [MeV]: 0

Separation Energy [MeV]: 7.167

Channel Radius [fm]: 5.5

Cancel      Accept

Particle Pairs    Levels and Channels    Segments    Experimental Effects    Calculate    Plot

Compound Nucleus Levels

Include?	Fix?	Level Spin	Energy [MeV]
<input checked="" type="checkbox"/>	<input type="checkbox"/>	1-	9.585
<input checked="" type="checkbox"/>	<input type="checkbox"/>	4+	10.356
<input checked="" type="checkbox"/>	<input type="checkbox"/>	0+	11.26
<input checked="" type="checkbox"/>	<input type="checkbox"/>	3-	11.6
<input type="checkbox"/>	<input type="checkbox"/>	2+	15
<input type="checkbox"/>	<input type="checkbox"/>	5-	15
<input type="checkbox"/>	<input type="checkbox"/>	6+	15
<input type="checkbox"/>	<input type="checkbox"/>	7-	15
<input type="checkbox"/>	<input type="checkbox"/>	8+	15

Channels In Selected Level

Fix?	Channel Pair	s
<input type="checkbox"/>	$^{12}\text{C}+\alpha$ [0.000 MeV]	0

Channel Configuration

8    Maximum Orbital Momentum

1    Maximum Gamma Multipolarity

1    Maximum Gamma Multipolarities Per Decay

Channel Details (select from list to view)

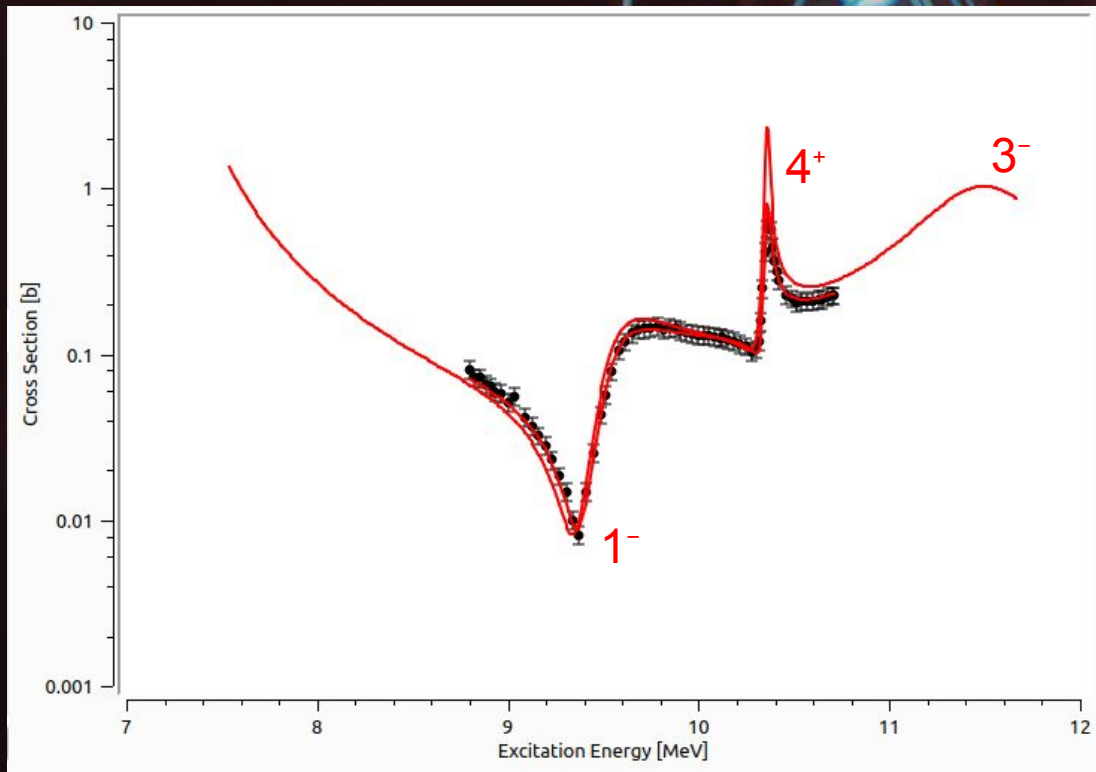
9.585 MeV level with spin 1-  
transitioning via pair key #1  
Channel configuration is  
s = 0, l = 1

Light Particle Spin: 0+  
Light Particle Z: 2  
Light Particle M: 4  
Light Particle G: 0  
Heavy Particle Spin: 0+  
Heavy Particle Z: 6  
Heavy Particle M: 12  
Heavy Particle G: 0  
Excitation Energy: 0  
Separation Energy: 7.167  
Channel Radius: 5.5

Partial Width: 420000 eV

# Azure2: R-matrix program

AZURE2 will reveal to be a great tool for the cross-section analysis and for experiment prediction



# Objectives of current work

- Complement measurements and support the acquisition of new data on nuclear reaction cross-sections useful for IBA.
- Cross-section data analysis from Ion Beam laboratory in CTN.
- We will focus on reactions on  $\theta=115^\circ-135^\circ$  and energies 0.8MeV to 2.3 MeV:
  - ${}^6\text{Li}({}^3\text{He}, p_i){}^8\text{Be}$ ,  ${}^6\text{Li}({}^3\text{He}, d){}^7\text{Be}$ ,  ${}^7\text{Li}({}^3\text{He}, \alpha){}^6\text{Li}$ ,  ${}^7\text{Li}({}^3\text{He}, p_i){}^9\text{Be}$   
 ${}^7\text{Li}({}^3\text{He}, d){}^8\text{Be}$
- Fit to experimental data and use to extrapolate energies and scattering angle unavailable in experimental



Thank you!