

Properties of the first $1/2^+$ state in ${}^9\text{Be}$ from electron scattering *

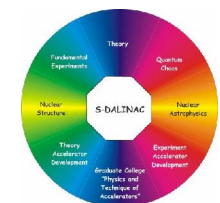


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- Motivation
- Experiments
- Results
- Outlook

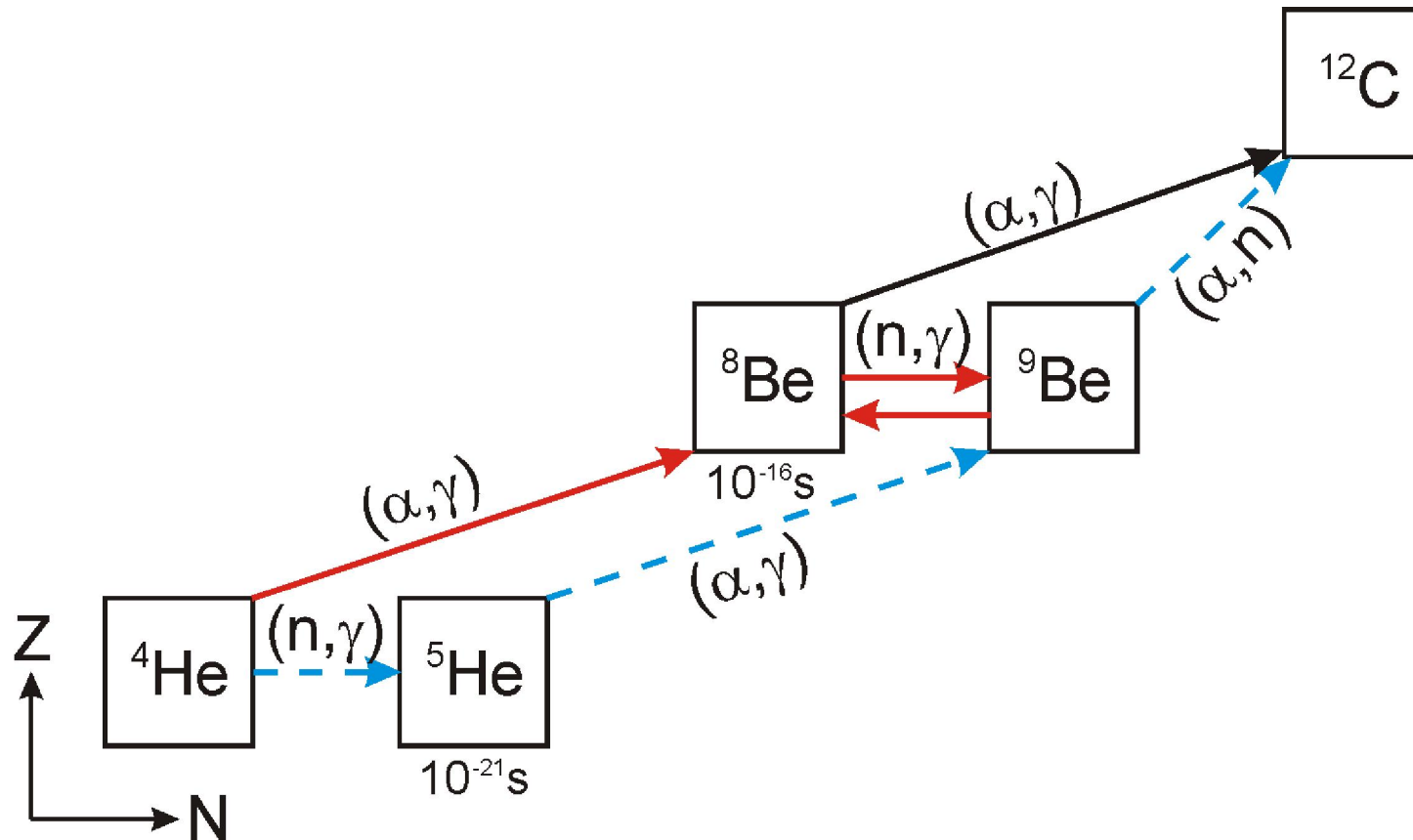
SFB 634



* Supported by the DFG within SFB 634

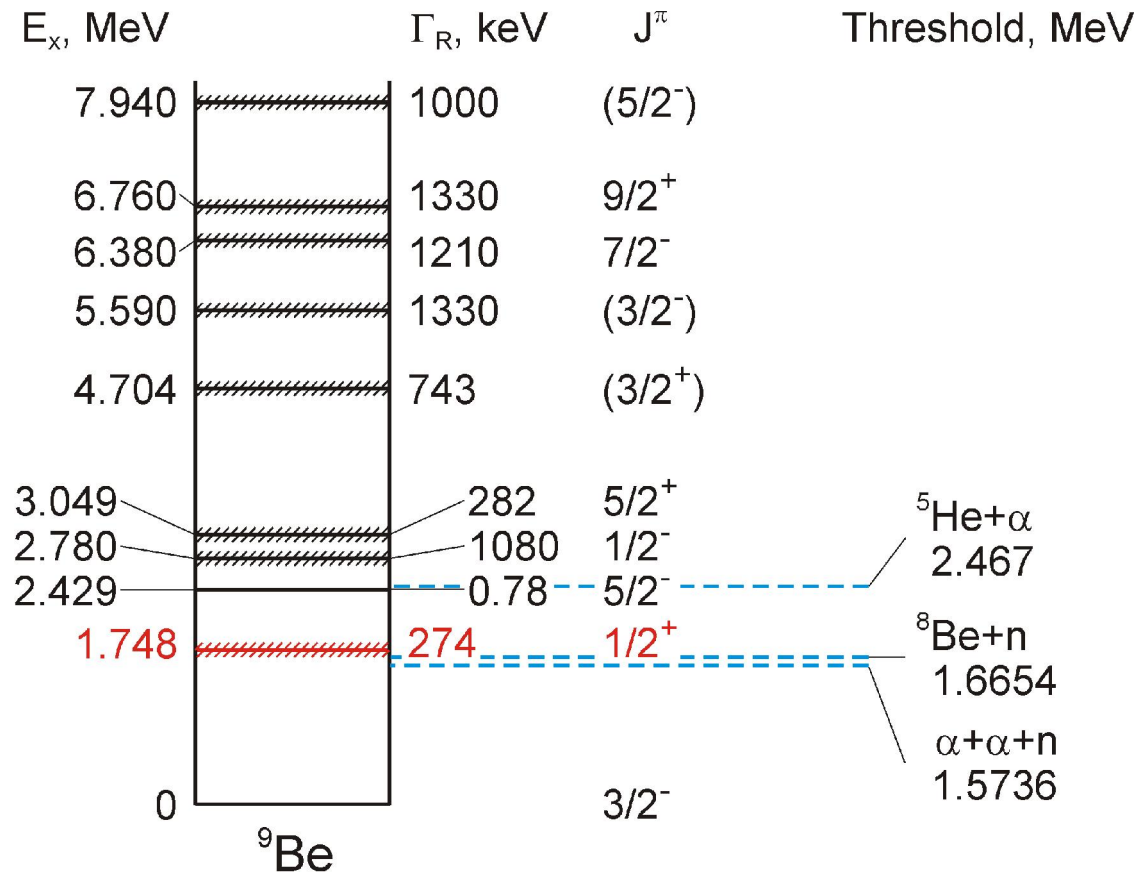
- ${}^9\text{Be}$ is a loosely-bound nuclear system consisting of 2α and a neutron
- ${}^9\text{Be}$ has the lowest neutron threshold ($S_n = 1.665 \text{ MeV}$) of all stable nuclei
 - first excited state lies some tens of keV above S_n
 - all excited states are unstable with respect to neutron decay

Possible role of ${}^9\text{Be}$ in the production of ${}^{12}\text{C}$



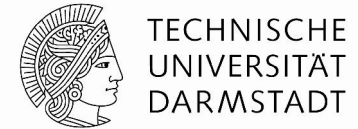
- In r -rich environment (core-collapse supernovae) this reaction path may provide an alternative route for building up the heavy elements and triggering the r -process

$J^\pi = 1/2^+$ state at threshold



- The photodisintegration cross section at low energies is given by the properties of $1/2^+$ resonance
- Strongly asymmetric line shape

Parameters of the first $J^\pi = 1/2^+$ state in ${}^9\text{Be}$



	(γ, n)	(e, e')		Reanalysis of [2]
	[1]	[2]	[3]	by Barker [4]
$E_R, \text{ MeV}$	1.75(1)	1.684(7)	1.68(15)	1.7316
$\Gamma_R, \text{ keV}$	283(42)	217(10)	200(20)	280
$B(E1)\uparrow, \text{ e}^2\text{fm}^2$	0.0535(35)	0.027(2)	0.034(3)	0.0685

[1] H. Utsunomiya et al., Phys. Rev. C63 (2001) 018801

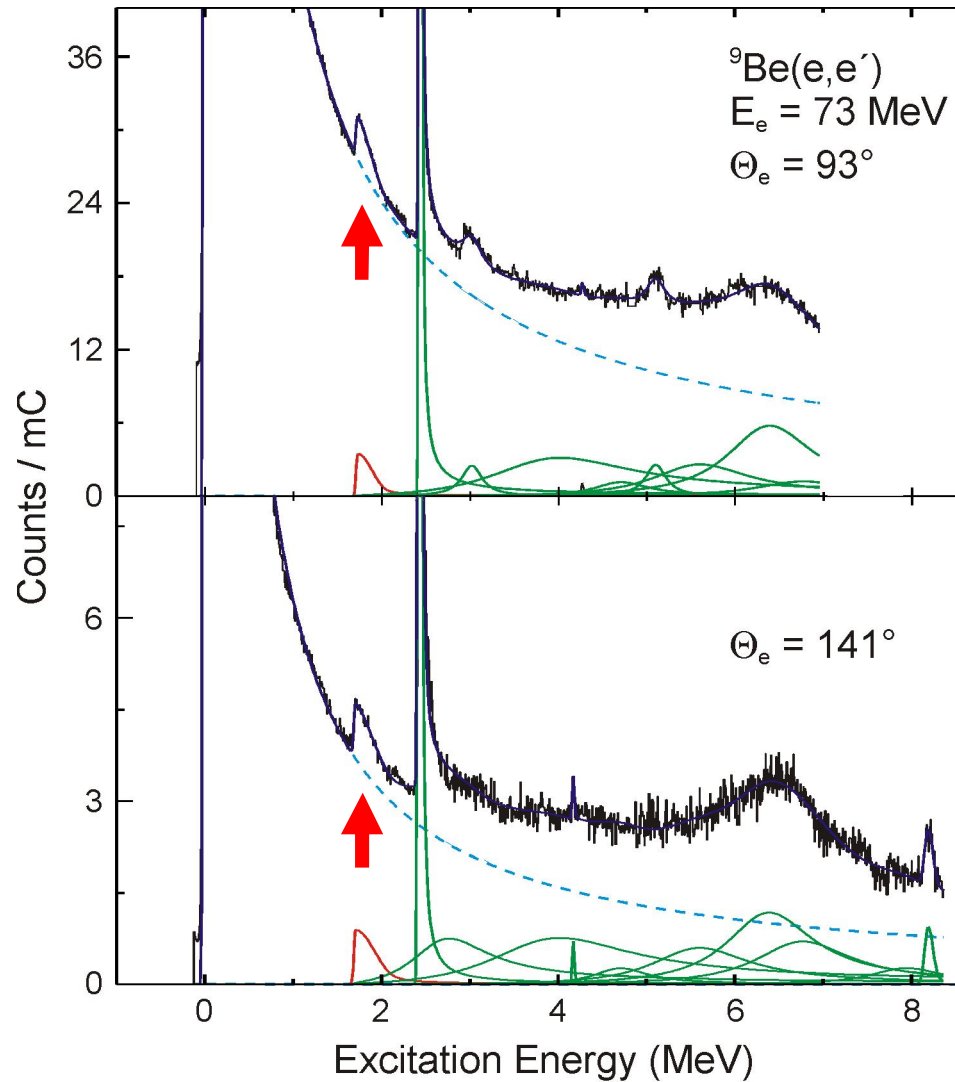
[2] G. K uchler et al., Z. Phys. A326 (1987) 447

[3] J. P. Glickman et al., Phys. Rev. C43 (1991) 1740

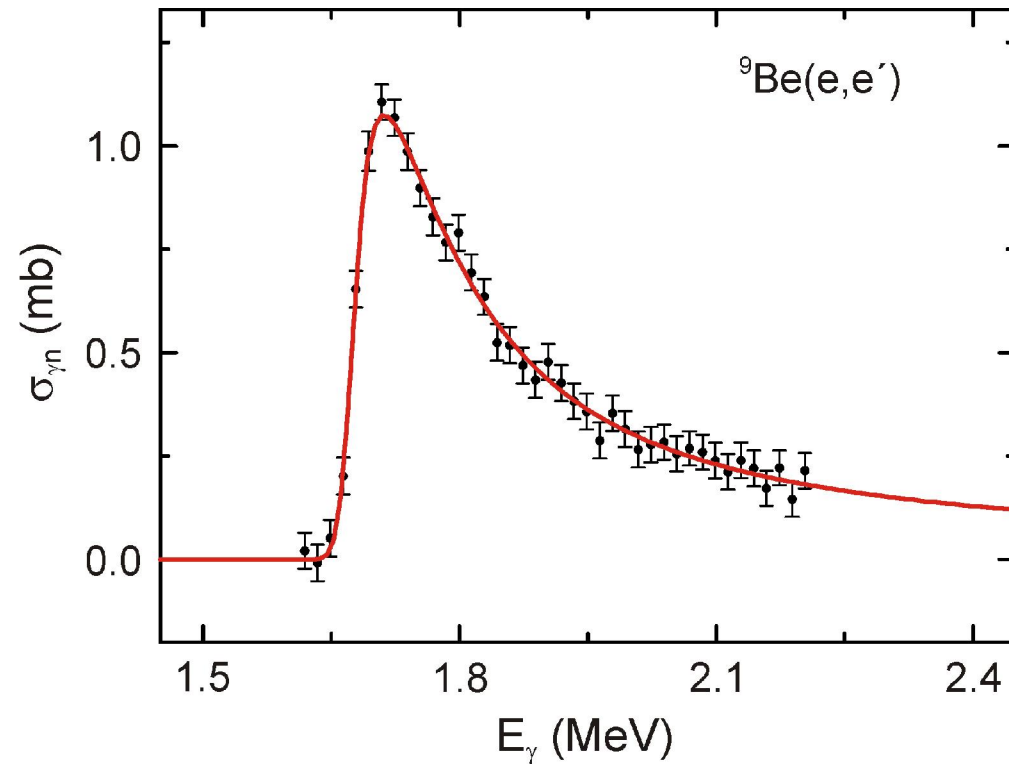
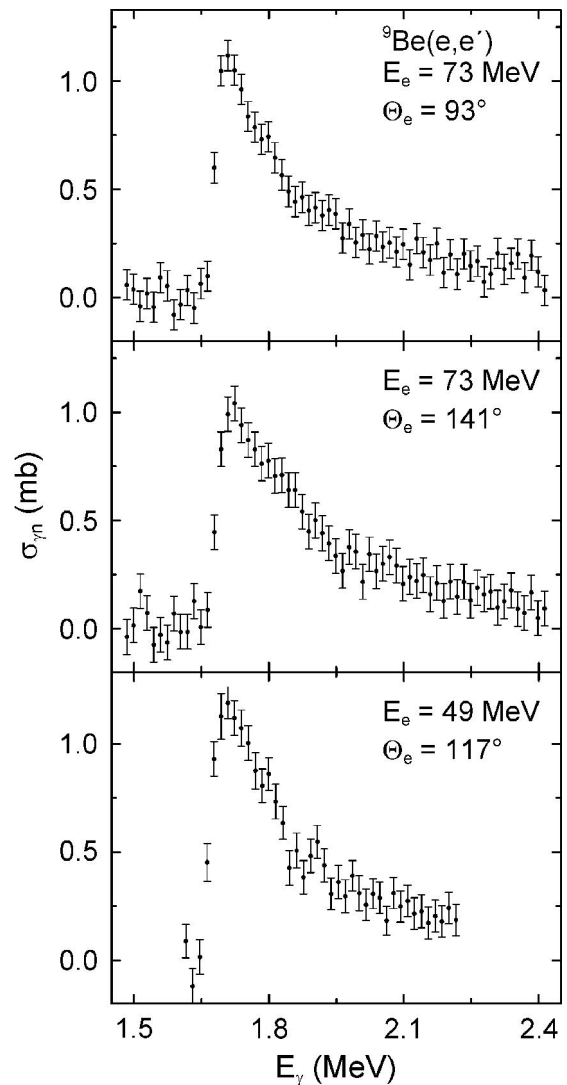
[4] F. C. Barker, Aust. J. Phys. 53 (2000) 247

- Resonance parameters from different experiments and analyses are not in mutual agreement

Deconvolution of the spectrum

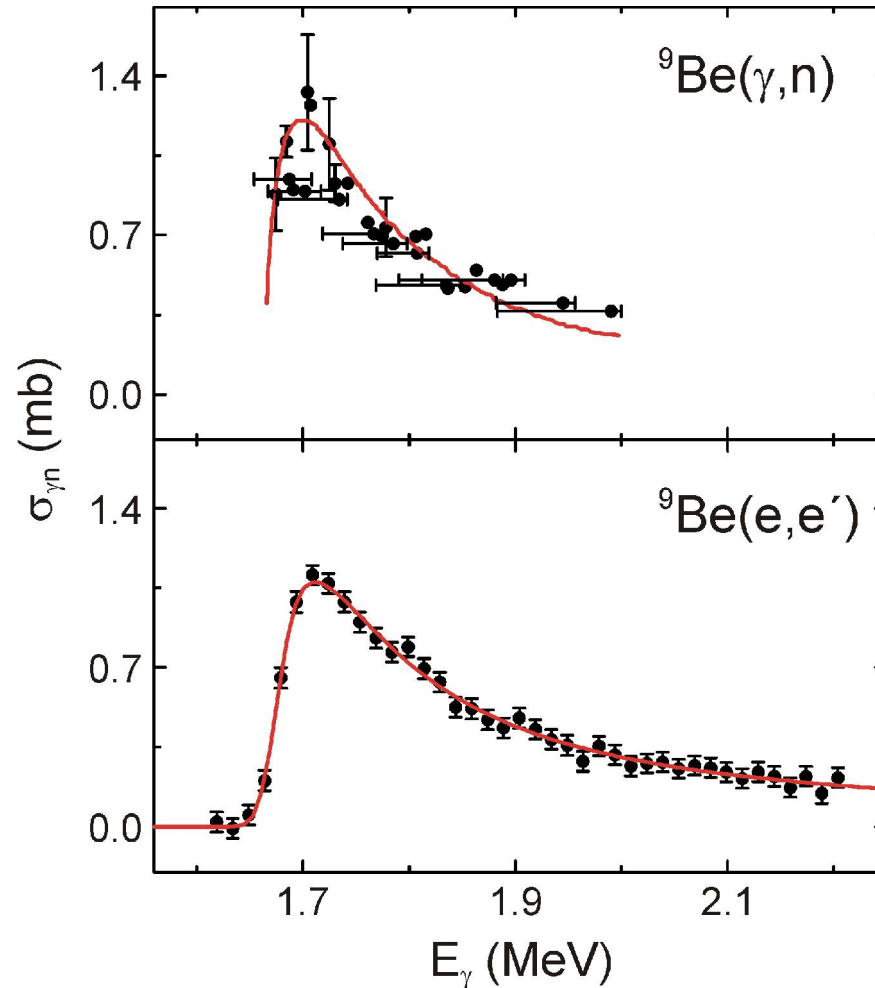


${}^9\text{Be}(\gamma, n)$ extracted from ${}^9\text{Be}(e, e')$



$$E_R = 1.737(10) \text{ MeV}$$
$$\Gamma_R = 275(14) \text{ keV}$$

Comparison: ${}^9\text{Be}(\gamma, n)$ and ${}^9\text{Be}(e, e')$



H. Utsonomiya et al.,
PRC 63, 018801

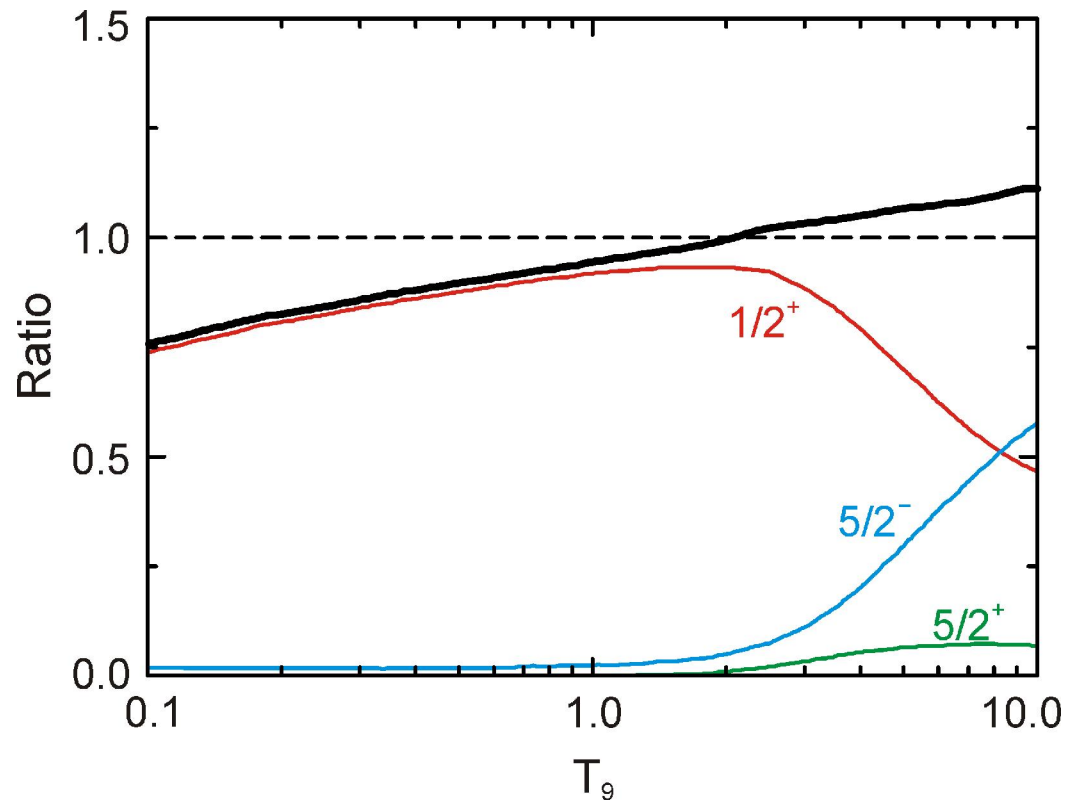
$E_R = 1.750(10)$ MeV
 $\Gamma_R = 283(42)$ keV

Present

$E_R = 1.737(10)$ MeV
 $\Gamma_R = 275(14)$ keV

● Resonance parameters agree well

Reaction rate of $\alpha n \rightarrow {}^9\text{Be}$



1999 compilation:
C. Angulo et al.,
NPA 656 (1999) 3

- Deviation ranges from -25% to +11% from adopted values
- For $T_9 = 0.1 - 3$ the $1/2^+$ resonance determines exclusively ${}^4\text{He}(\alpha, \gamma){}^8\text{Be}(n, \gamma){}^9\text{Be}$ chain

- Role of direct capture
- Structure of the first $1/2^+$ state in ${}^9\text{Be}$
- NCSM and FMD calculations