Ab initio symmetry-adapted no-core shell model results for light and medium-mass nuclei

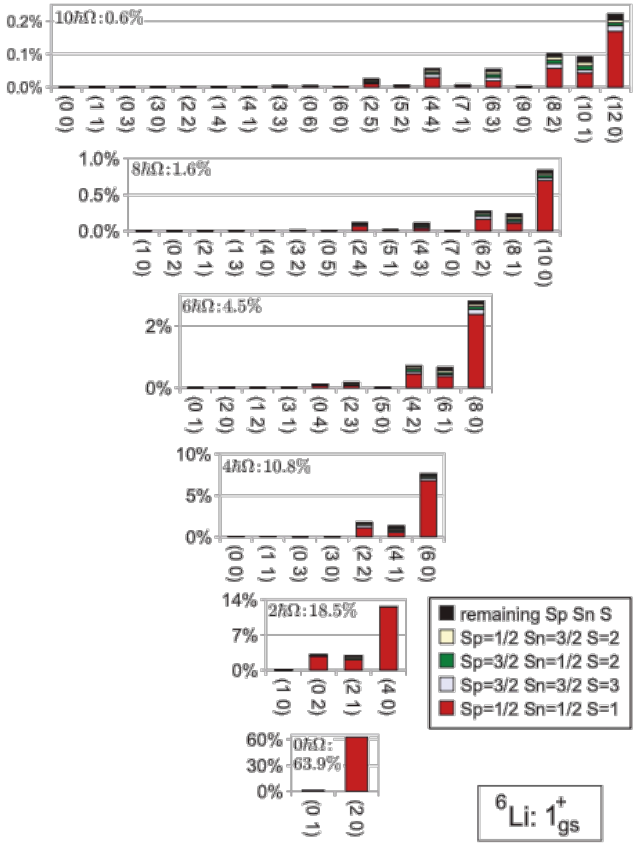
Robert B. Baker[1], T. Dytrych[1,2], K.D. Launey[1], J.P. Draayer[1]

[1]Department of Physics and Astronomy, Louisiana State University, Baton Rouge, LA USA 70803

[2]*Nuclear Physics Institute, 250 68 Řež, Czech Republic*

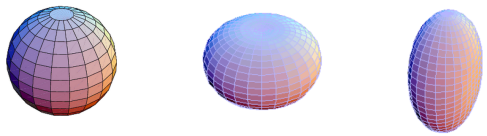
Motivation

Ab initio symmetry-adapted no-core shell model (SA-NCSM)



T. Dytrych, et al., Phys. Rev. Lett. **111** (2013) 252501

Collective basis based on deformation:



(0 0) sphere | (0 μ) oblate | (λ 0) prolate

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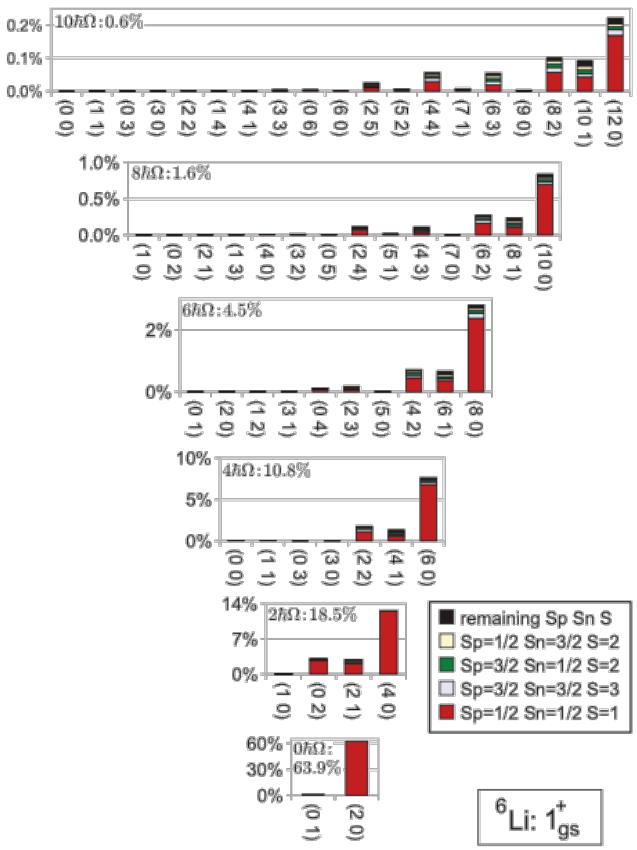

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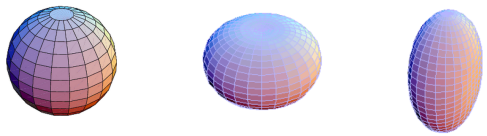

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Nucleus	$(S_p\, S_n\, S)$	Probability (%)	$(\lambda_0\, \mu_0)$	Probability (%)
	Lowest spin		Largest deformation + symplectic excitations	
^{6}Li	$(\frac{1}{2}\ \frac{1}{2}\ 1)$	93.24	(2 0)	93.11
^{8}B	$(\frac{1}{2}\ \frac{1}{2}\ 1)$	85.58	(2 1)	82.32
^{8}Be	(0 0 0)	85.21	(4 0)	85.06
^{12}C	(0 0 0)	55.60	(0 4)	49.03
	[(0 1 1), (1 0 1)]	[29.19]	[(1 2)]	[22.52]
^{16}O	(0 0 0)	78.42	(0 0)	77.33
^{20}Ne	(0 0 0)	79.73	(8 0)	79.30

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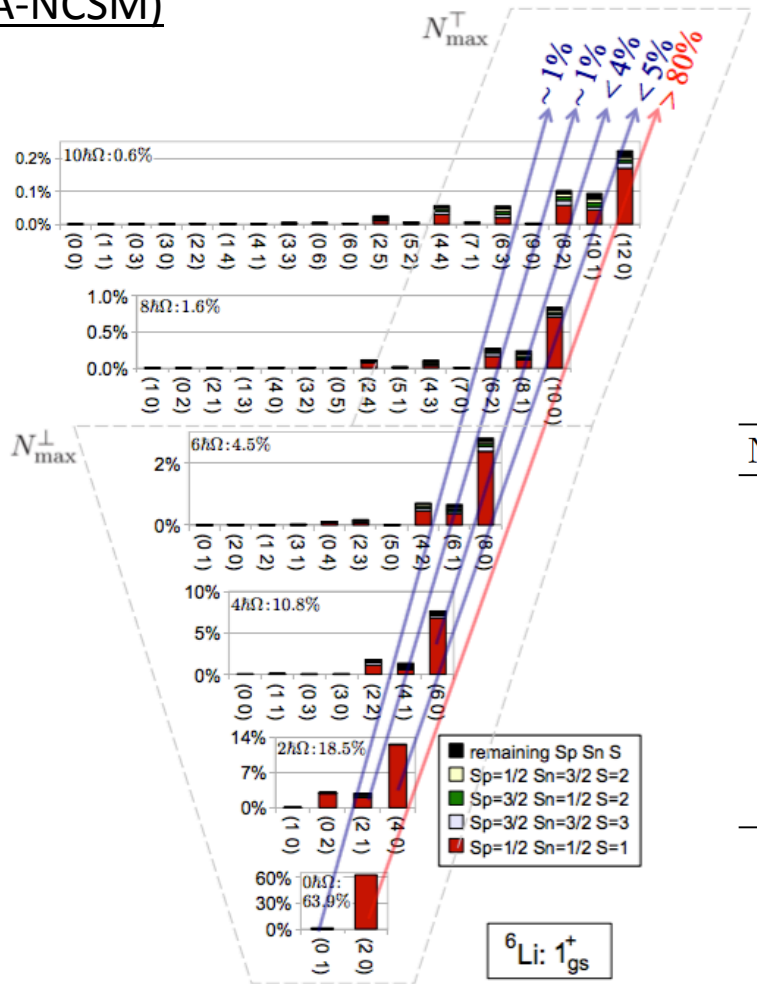

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J.P. Draayer, et al., Prog. Part. Nucl. Phys. **89** (2016) 101

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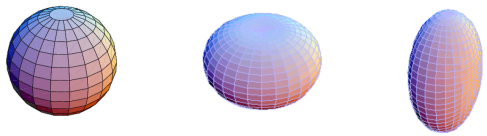

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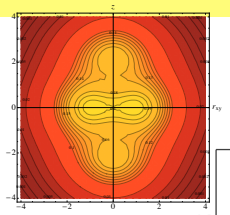
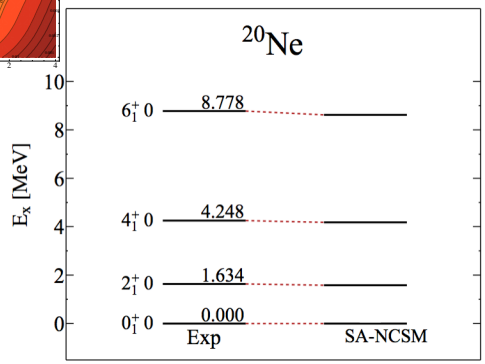
Symplectic symmetry arises naturally from first principles.

SA-NCSM: ^{16}O, ^{20}Ne, and ^{42}Ti





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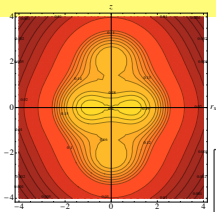

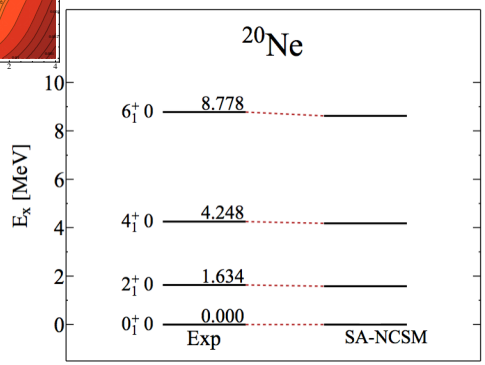

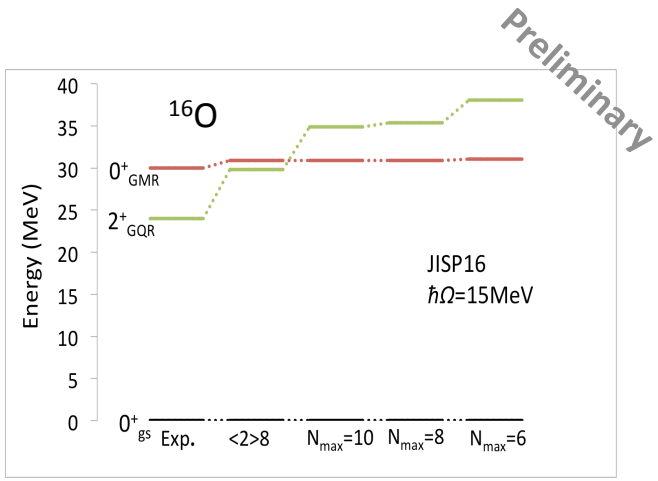

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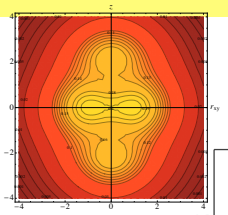

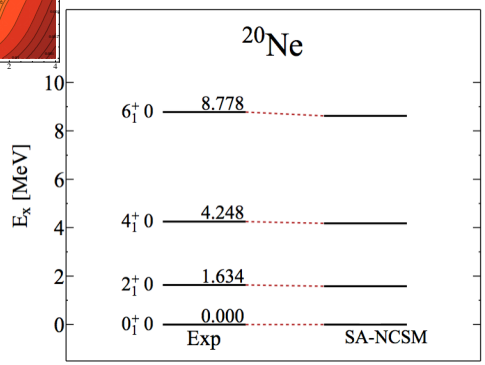

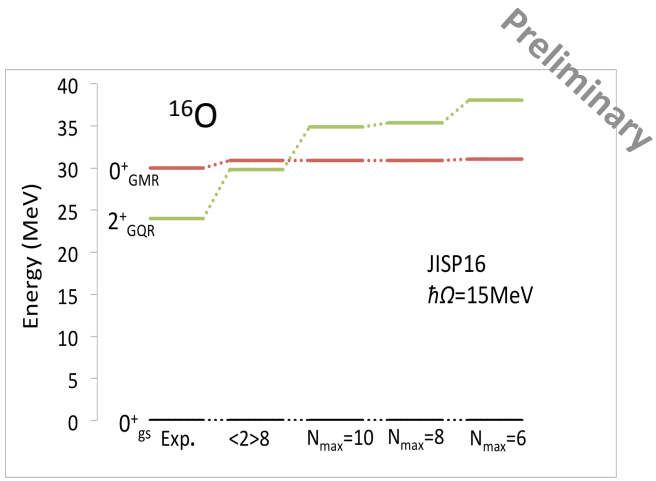

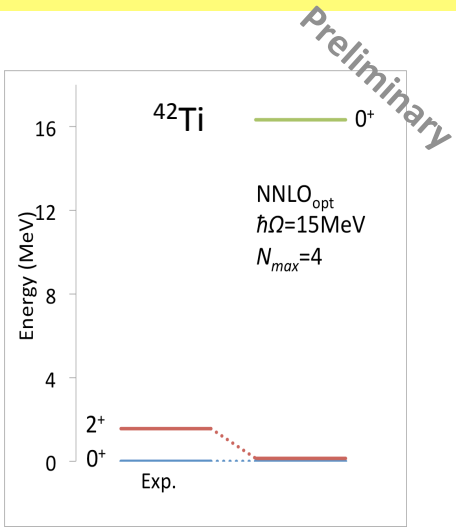

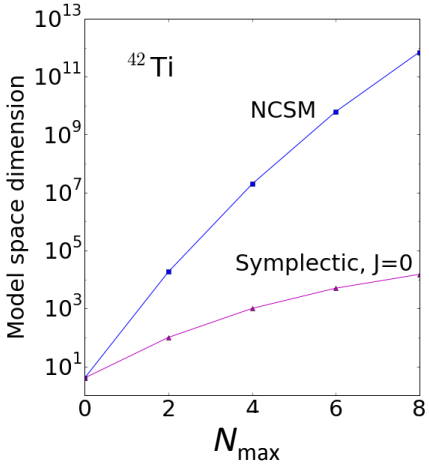

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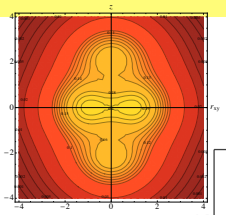
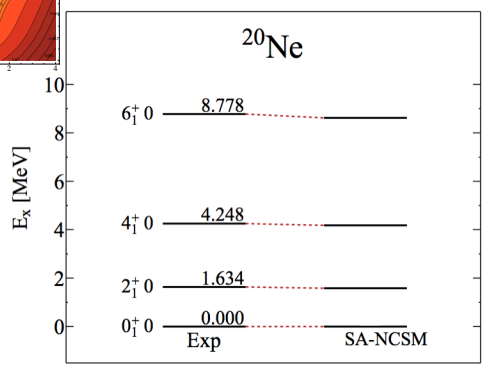
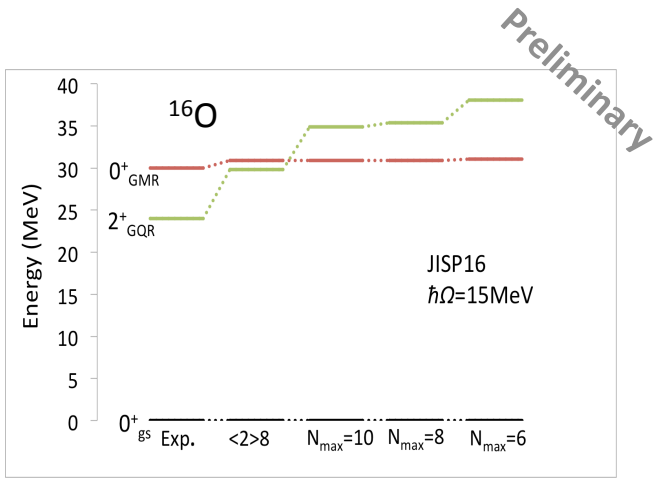
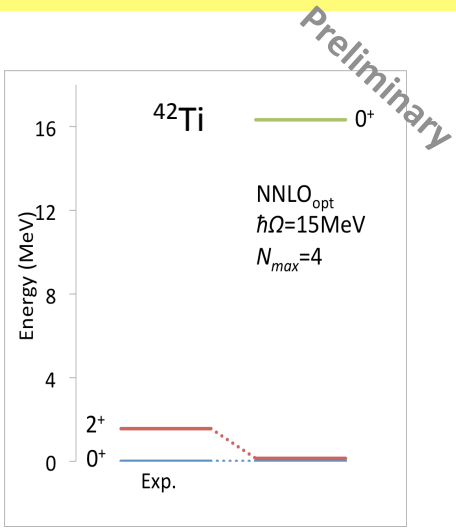
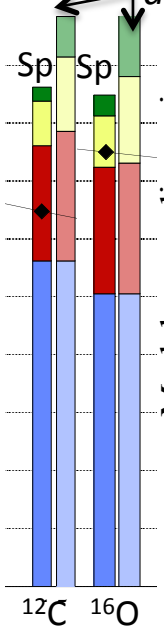


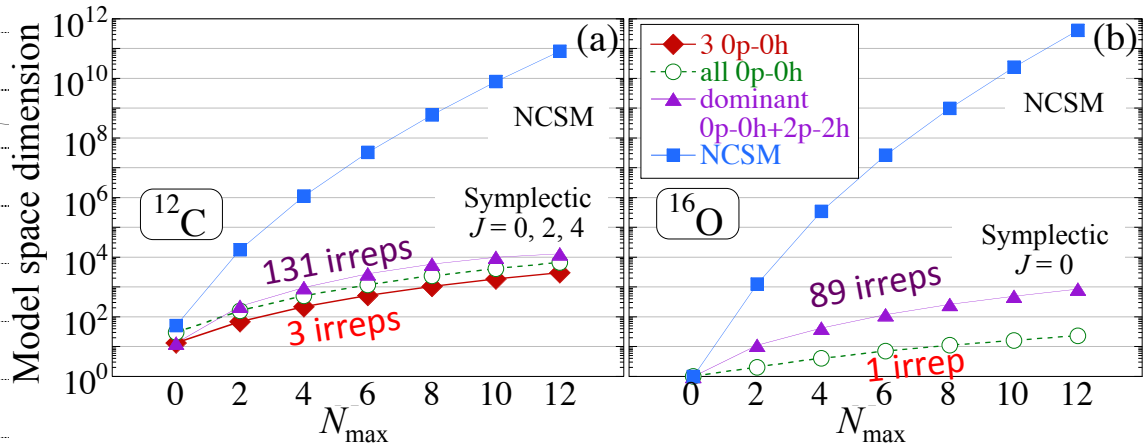






ab initio wave functions





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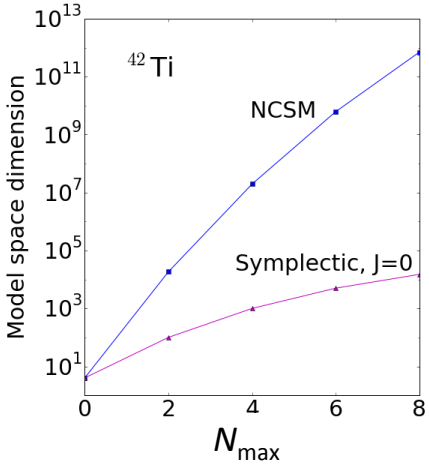

A few symplectic irreps capture a major portion of the physics;
for *ab initio* studies, several hundred symplectic irreps may be needed.