Ab initio calculation of the ^{3}He$(\alpha,\gamma)^7$Be astrophysical S factor

Mack C. Atkinson

LLNL-PRES-841578

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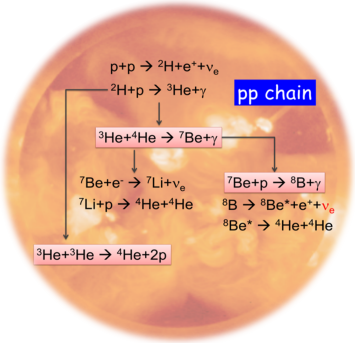
$^3\mathrm{He}(\alpha,\gamma)^7\mathrm{Be}$ important for solar-model predictions



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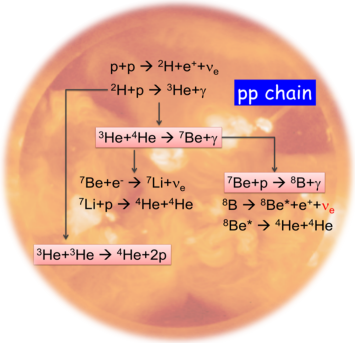

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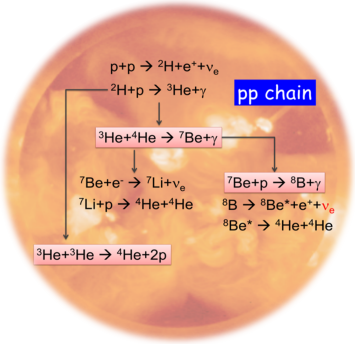

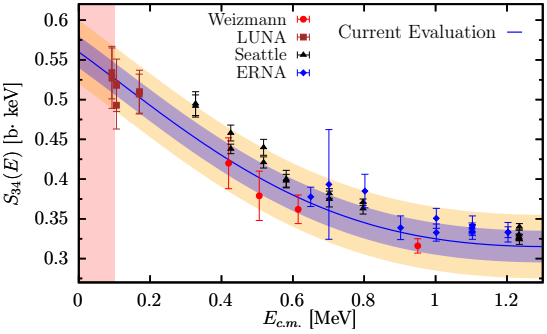

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Adelberger *et al.*, Rev Mod Phys **83** 195 (2011)

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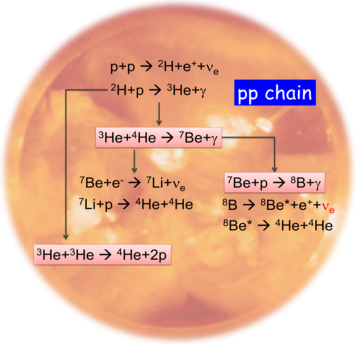

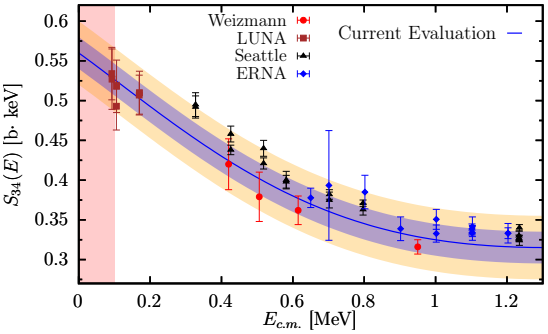

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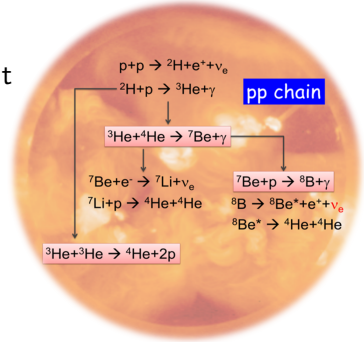

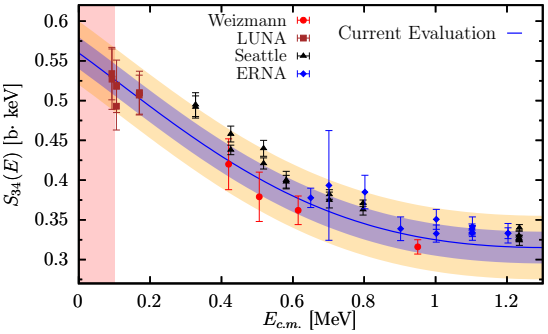

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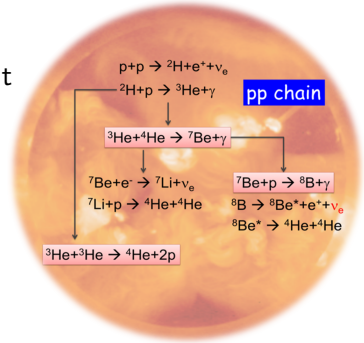
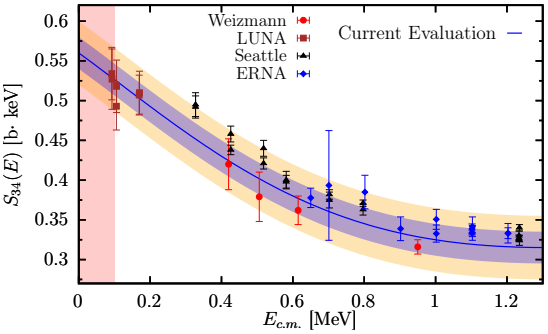
- Current evaluations depend on both theory and experiment
- Ideally, theory will accurately predict $S_{34}(0)$





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Current evaluation:

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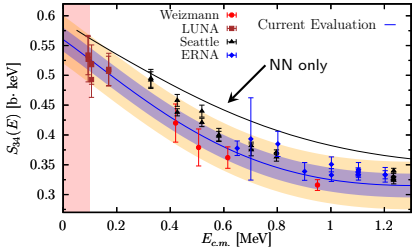

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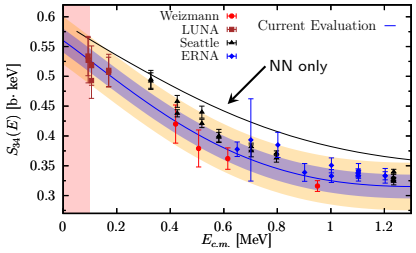

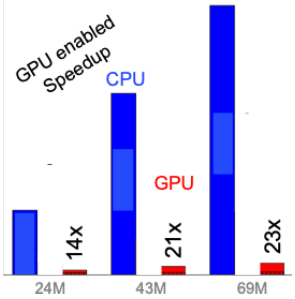

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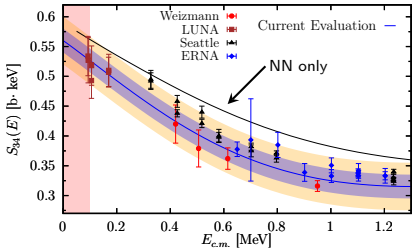

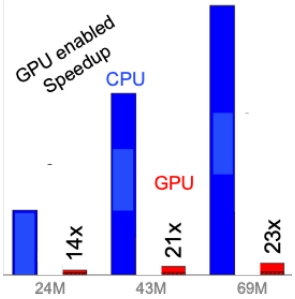

- GPU speedup $\implies$ NNN forces are now included

The *ab initio* method: from NCSM to NCSMC

$$\left\langle \Psi_{bs}\left({}^{7}\mathrm{Be}\right) \middle| \hat{\mathcal{M}}_{\mathrm{EM}} \middle| \Psi_{sc}\left({}^{3}\mathrm{He}+\alpha\right) \right\rangle$$

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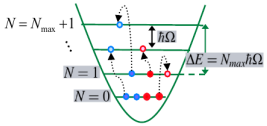

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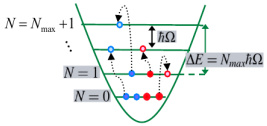

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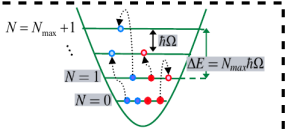

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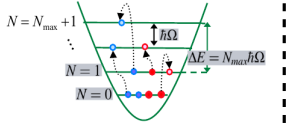

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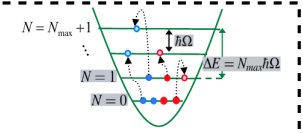

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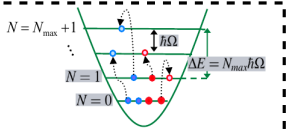

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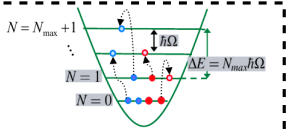

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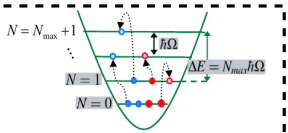

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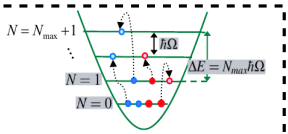

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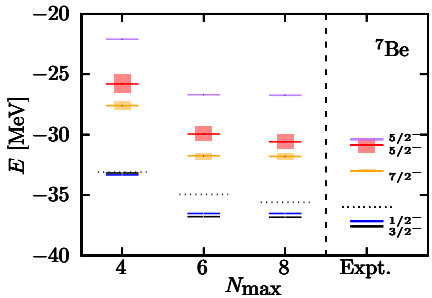

NN-N3LO+3NInl

$\hbar\Omega = 20$ MeV

$\lambda_{\mathrm{SRG}} = 2.0$ fm^{-1}

D.R. Entem and R. Machleidt, PRC **68**, 041001 (2003)
P. Navratil, Few Body Systems **41**, 117 (2007)

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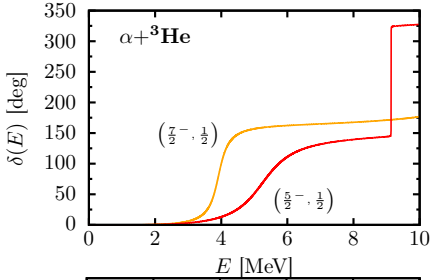

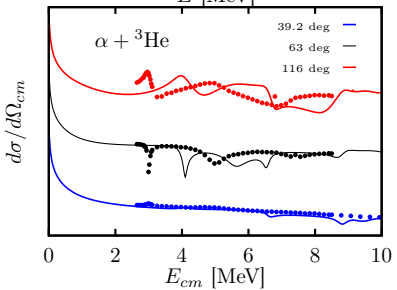

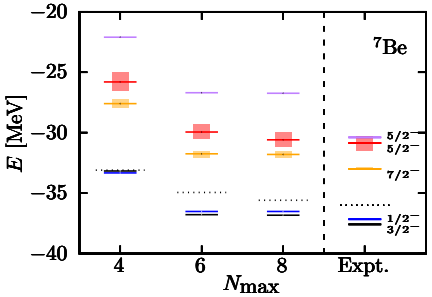

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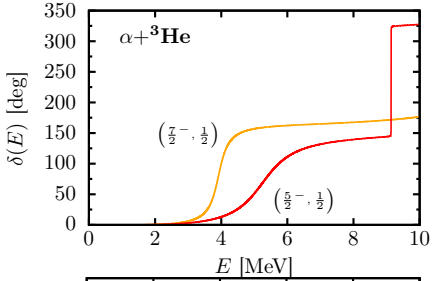

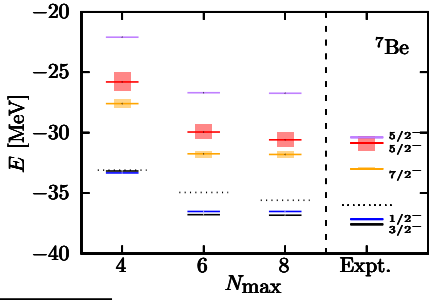

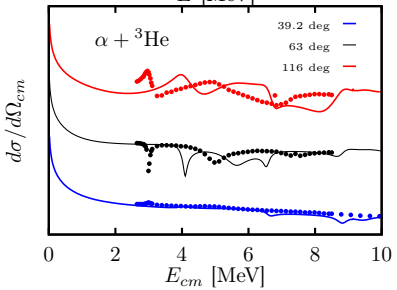

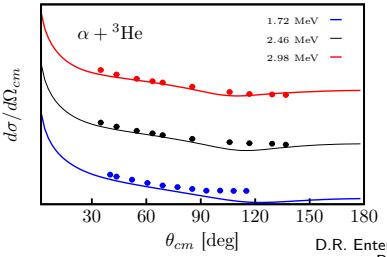

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Results are promising but convergence needs to be explored

$$^{3}\mathrm{He} + \alpha \rightarrow {}^{7}\mathrm{Be} + \gamma$$

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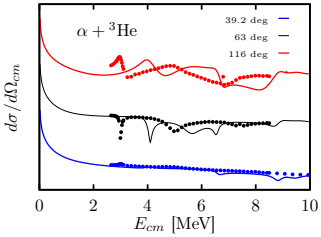

$$^3\mathrm{He} + \alpha \rightarrow {}^7\mathrm{Be} + \gamma$$

NN-N3LO+3Nlnl

$\hbar\Omega = 20$ MeV

$\lambda_{\mathrm{SRG}} = 2.0$ fm^{-1}

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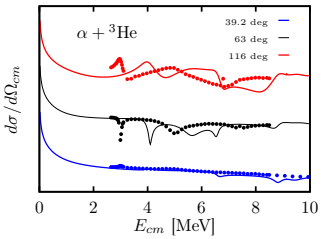

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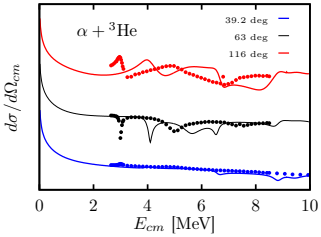

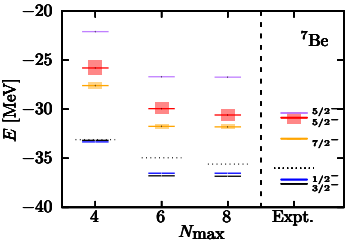

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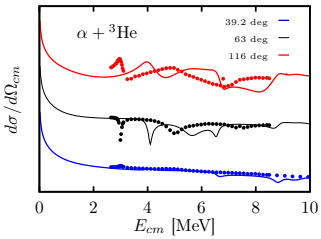

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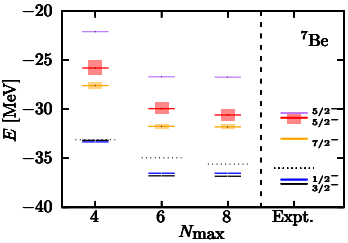

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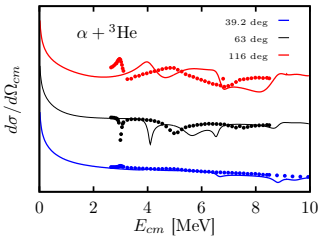

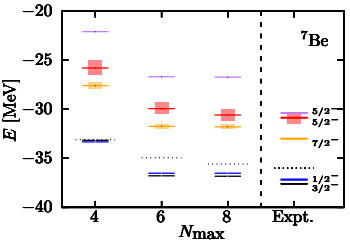

$^3\mathrm{He} + \alpha \rightarrow {}^7\mathrm{Be} + \gamma$

NN-N3LO+3NInl
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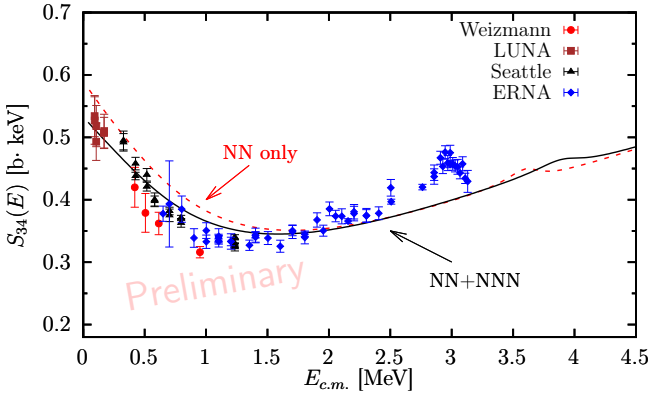
$\lambda_{\mathrm{SRG}} = 2.0$ fm^{-1}



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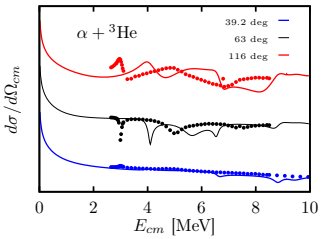

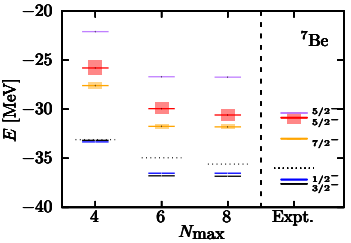

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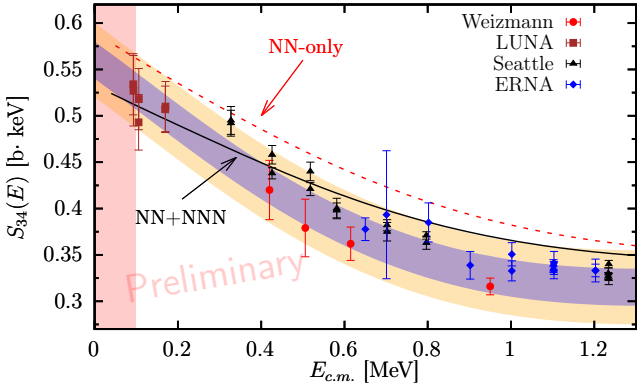

Thanks

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(TRIUMF)