

# Shell effects in fission and quasifission

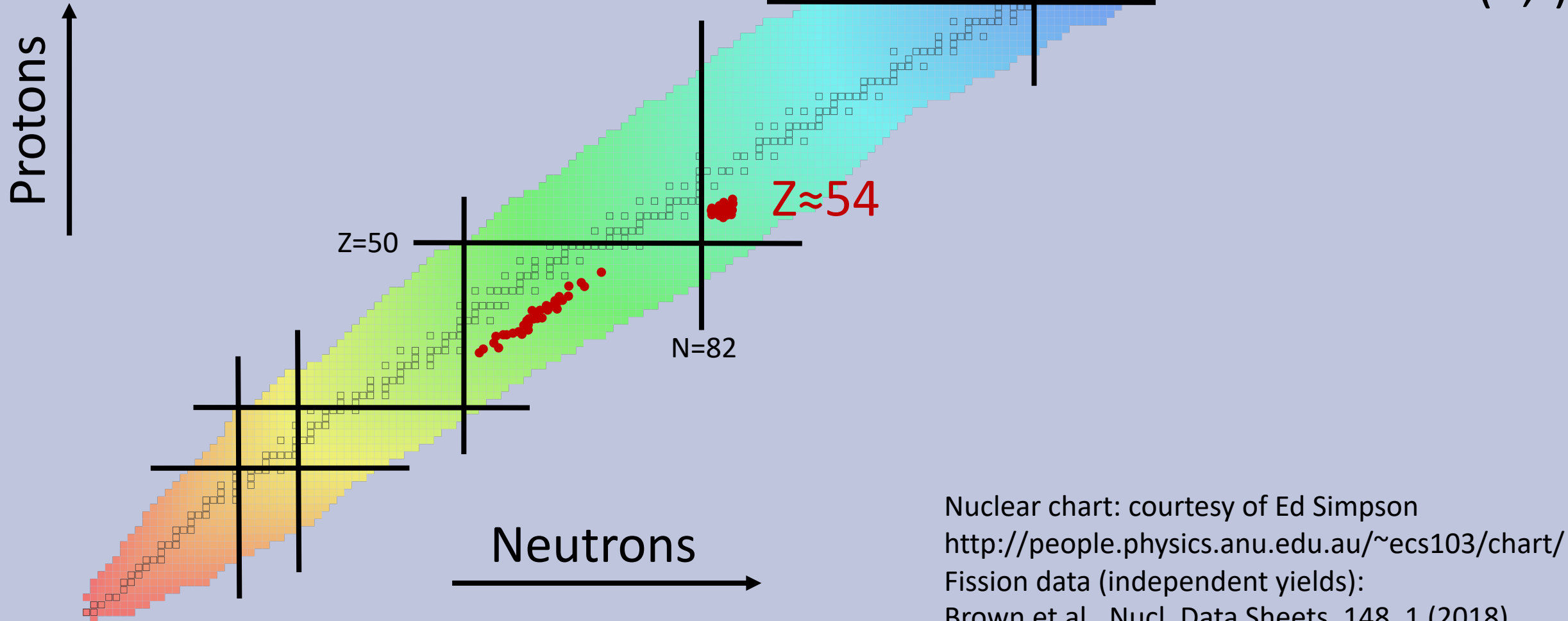
Cedric Simenel

*Australian National University*



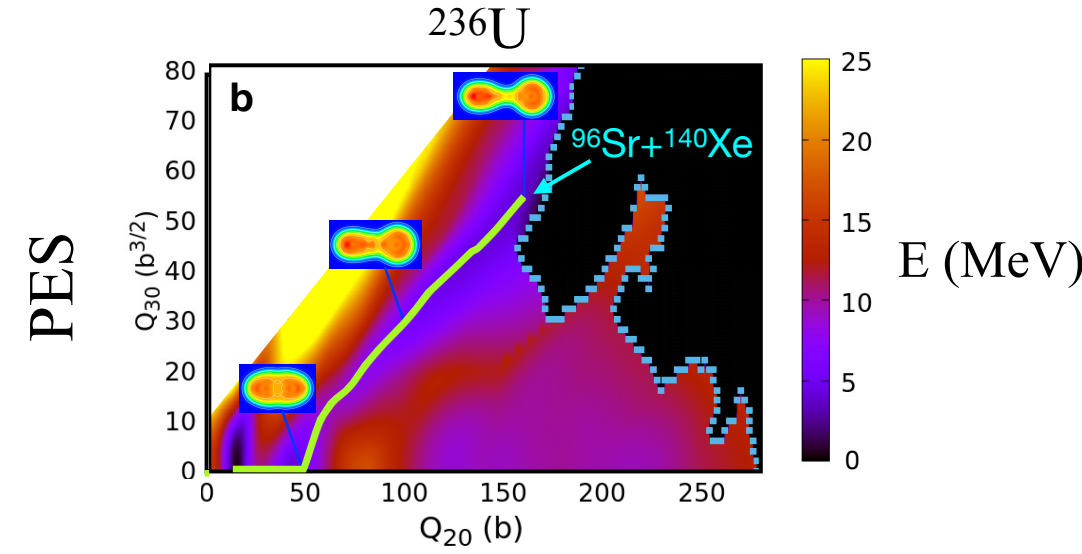
Credit: G. Scamps

# Magic numbers for spherical nuclei



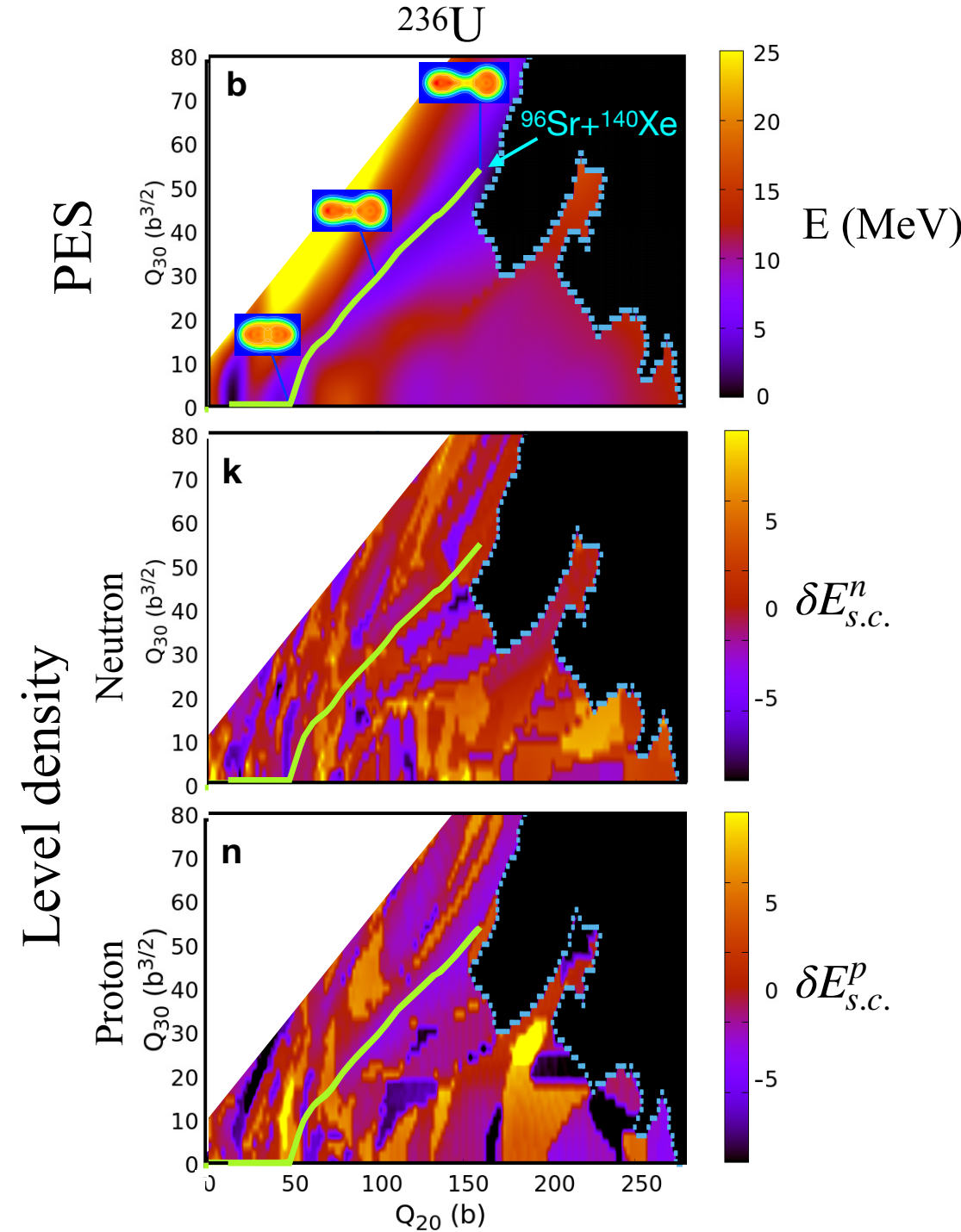
Nuclear chart: courtesy of Ed Simpson  
<http://people.physics.anu.edu.au/~ecs103/chart/>  
Fission data (independent yields):  
Brown et al., Nucl. Data Sheets, 148, 1 (2018)

# Shell effects along the fission path



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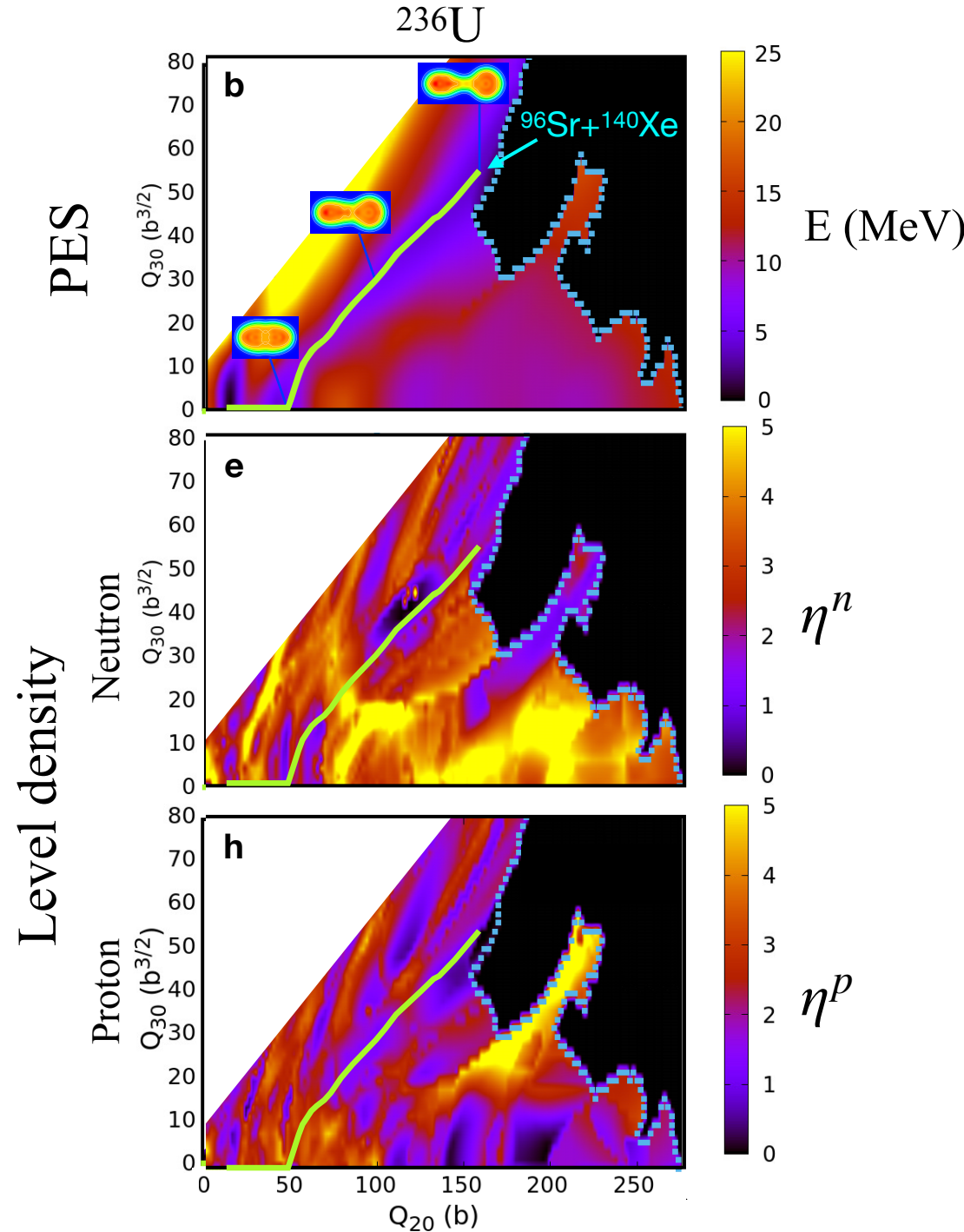
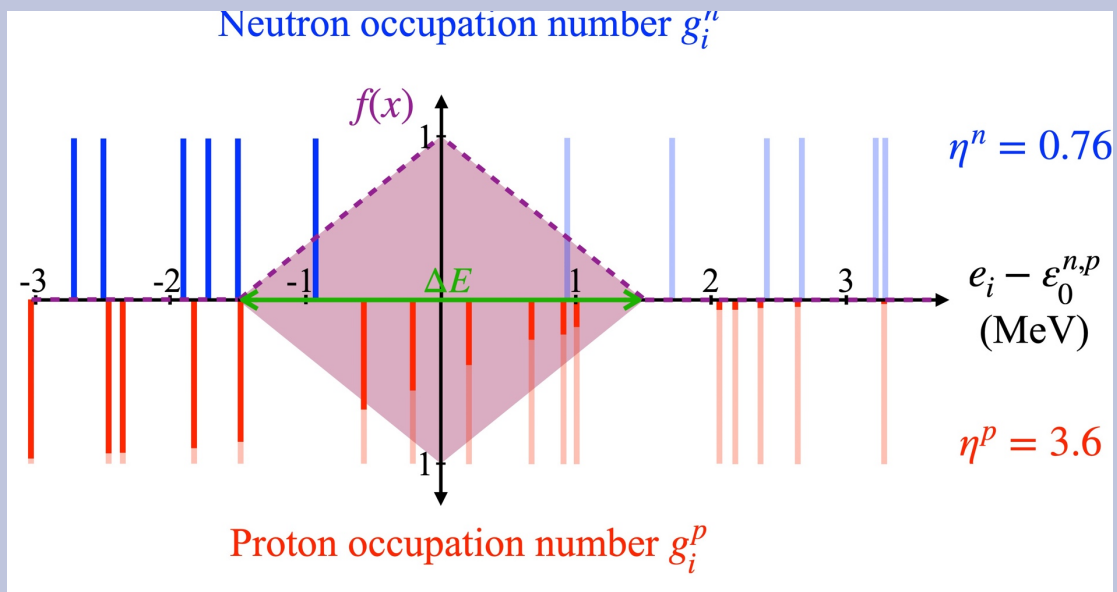
Shell correction energy (Strutinski)



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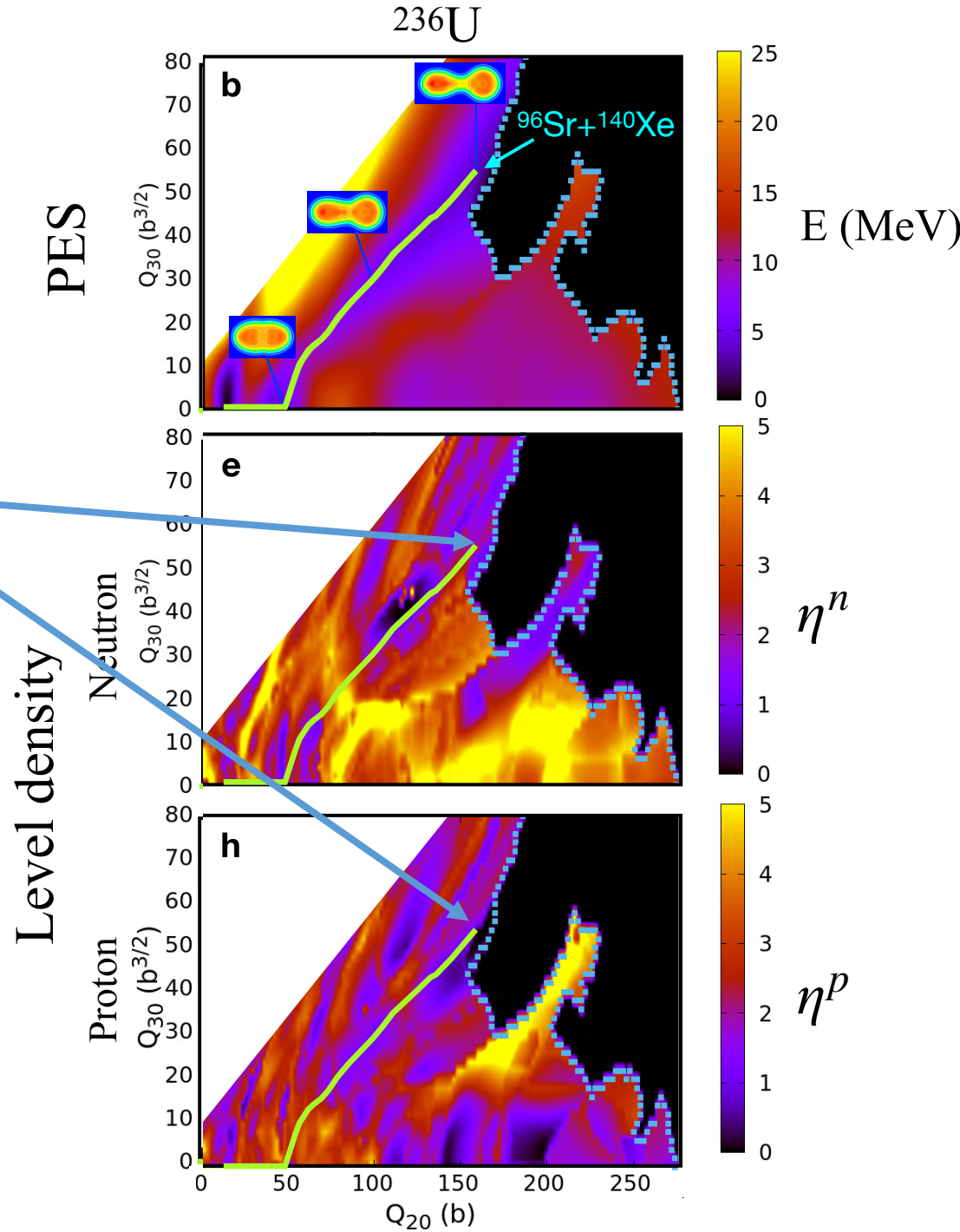
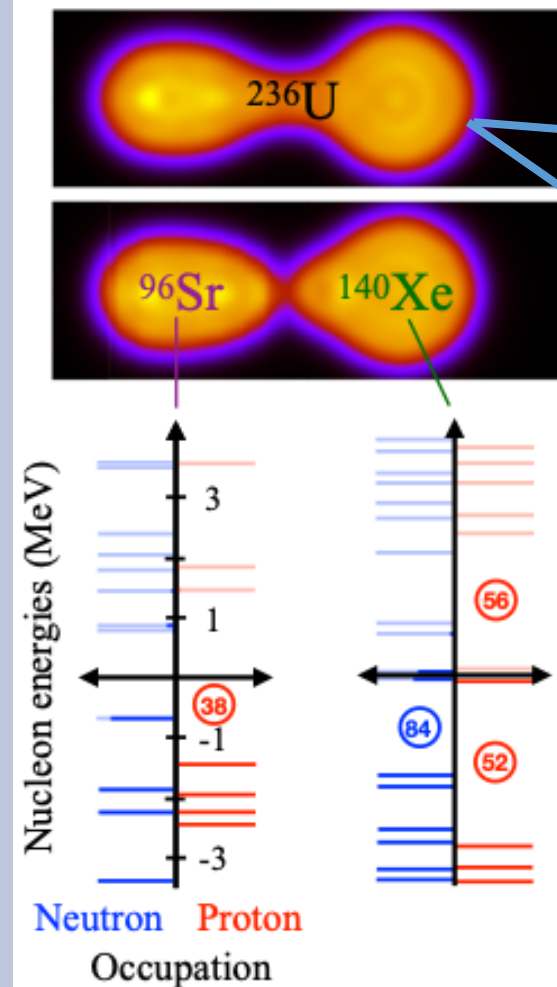
Level density near Fermi surface  $\eta^{n,p} = \sum_i f(e_i - \epsilon_0^{n,p})$



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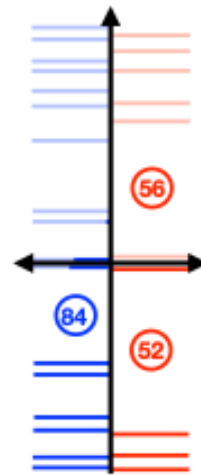
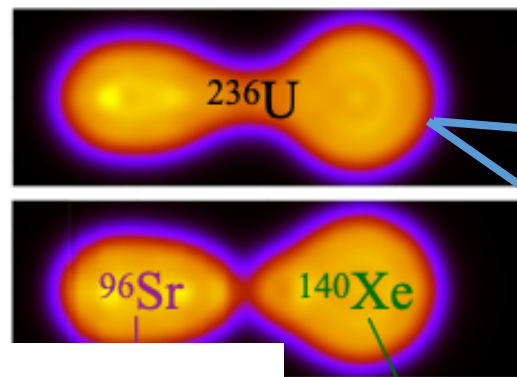
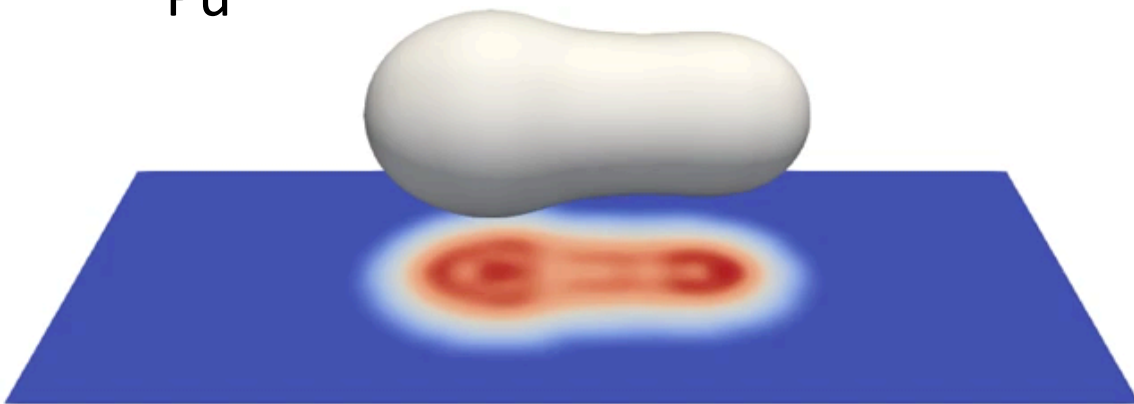
Shell correction energy (Strutinski)

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Octupole (pear) deformed shell effects favour fragments with  $Z=52-56$  protons

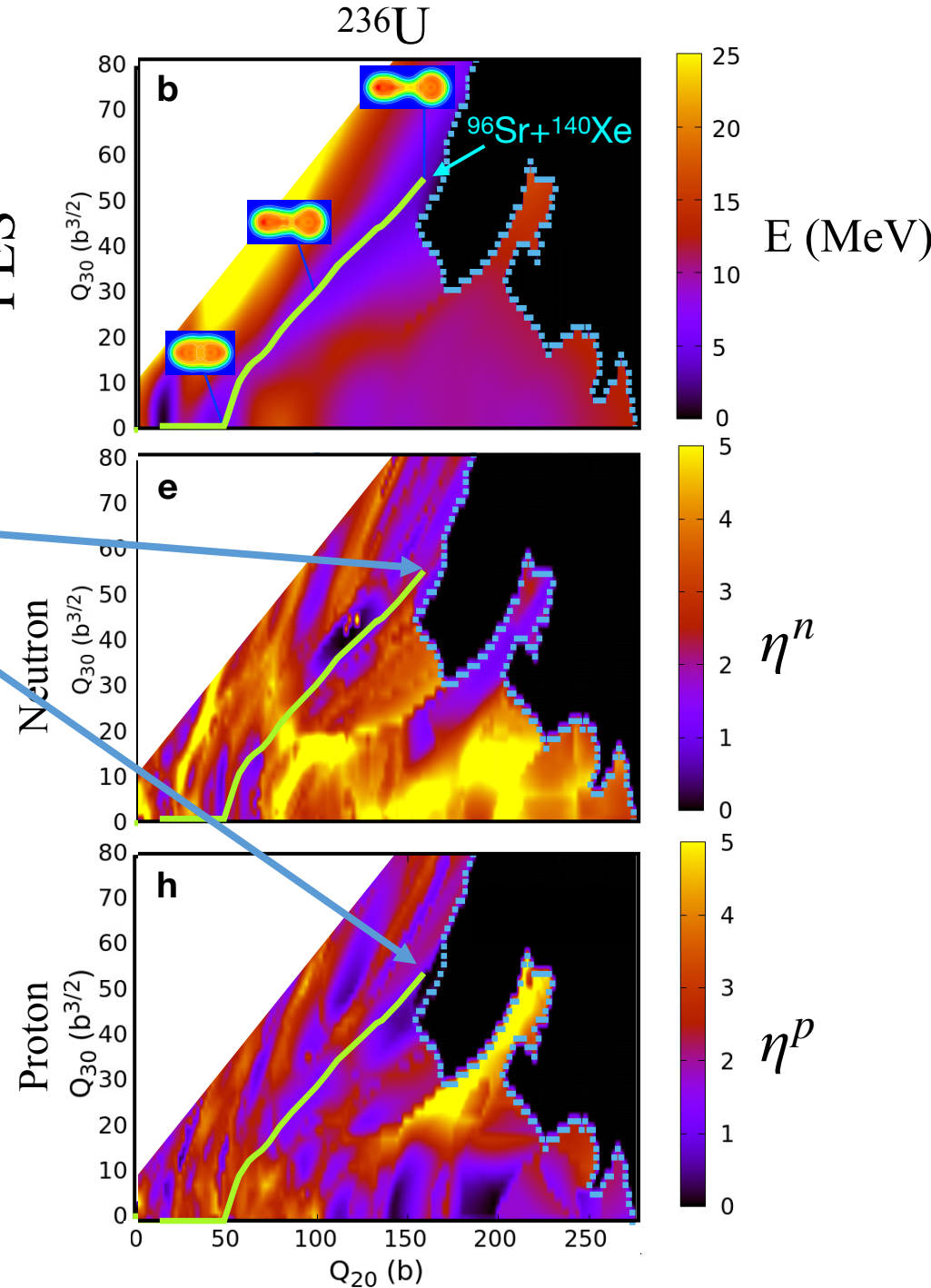
G. Scamps & CS, Nature 2018

$^{240}\text{Pu}$



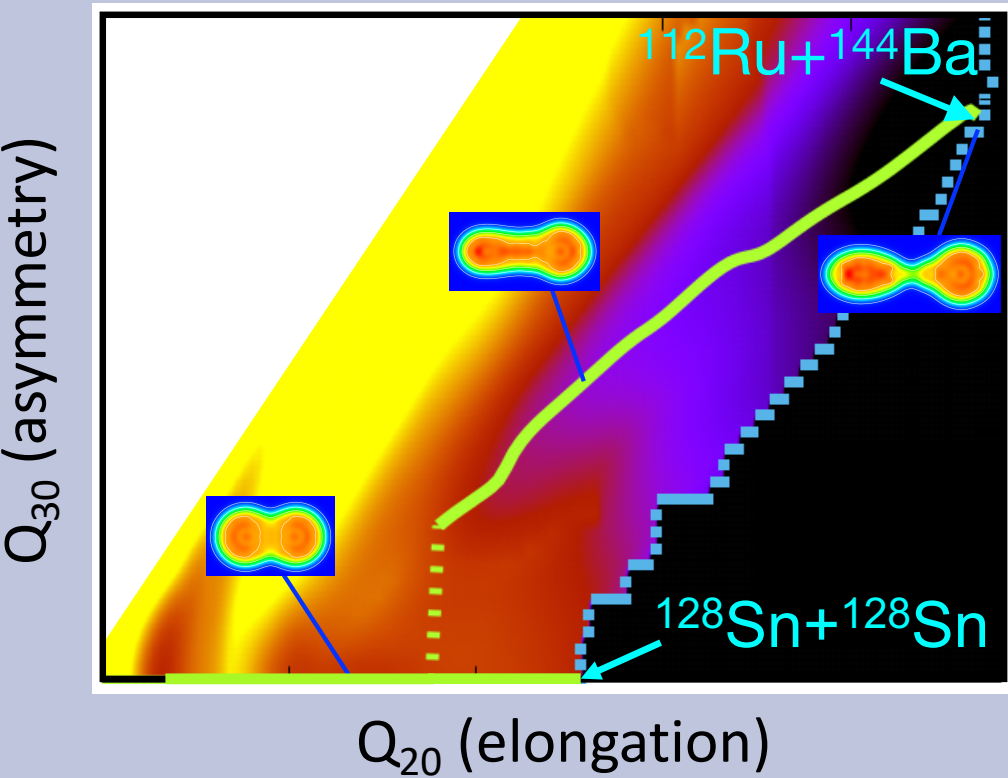
Level density

PES



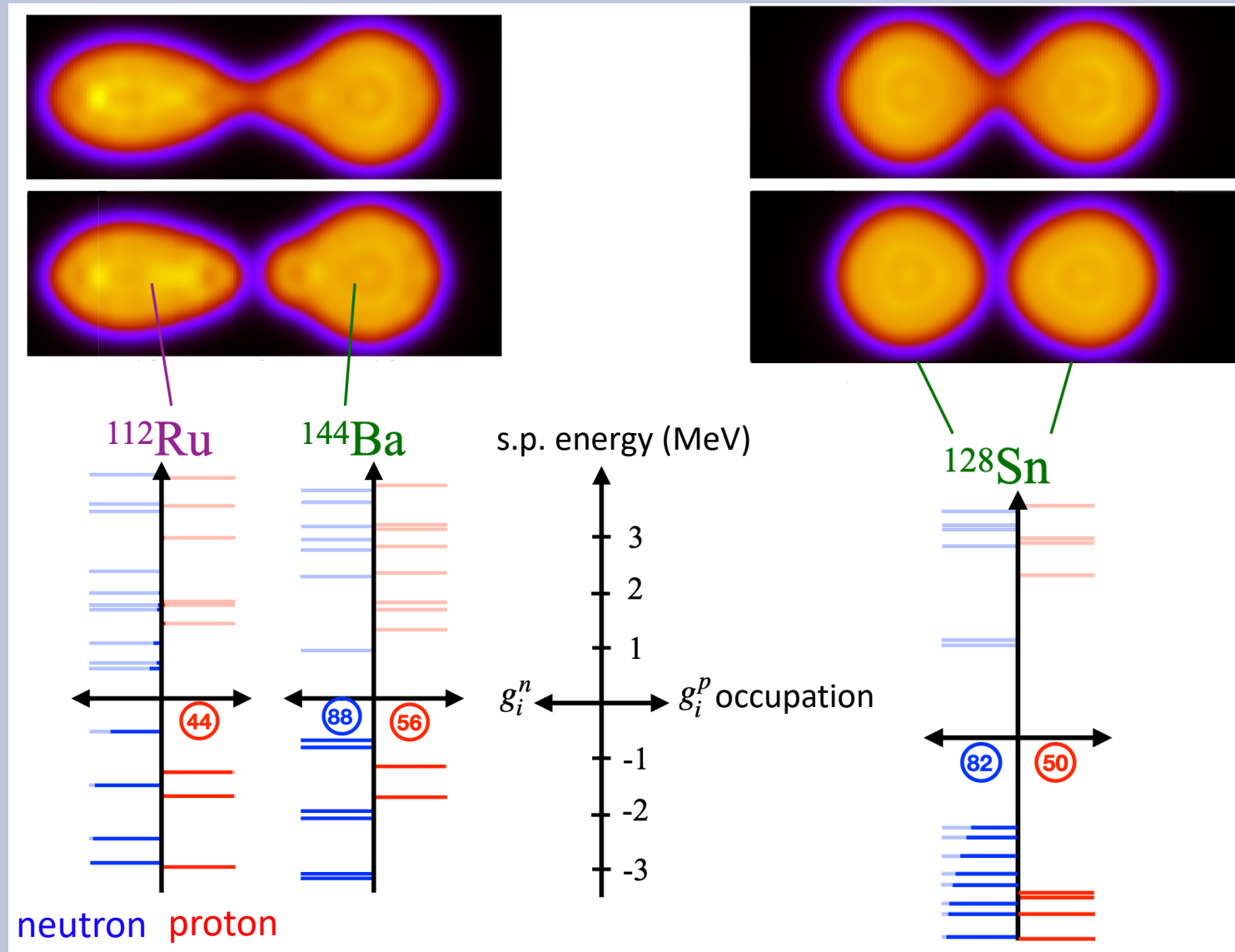
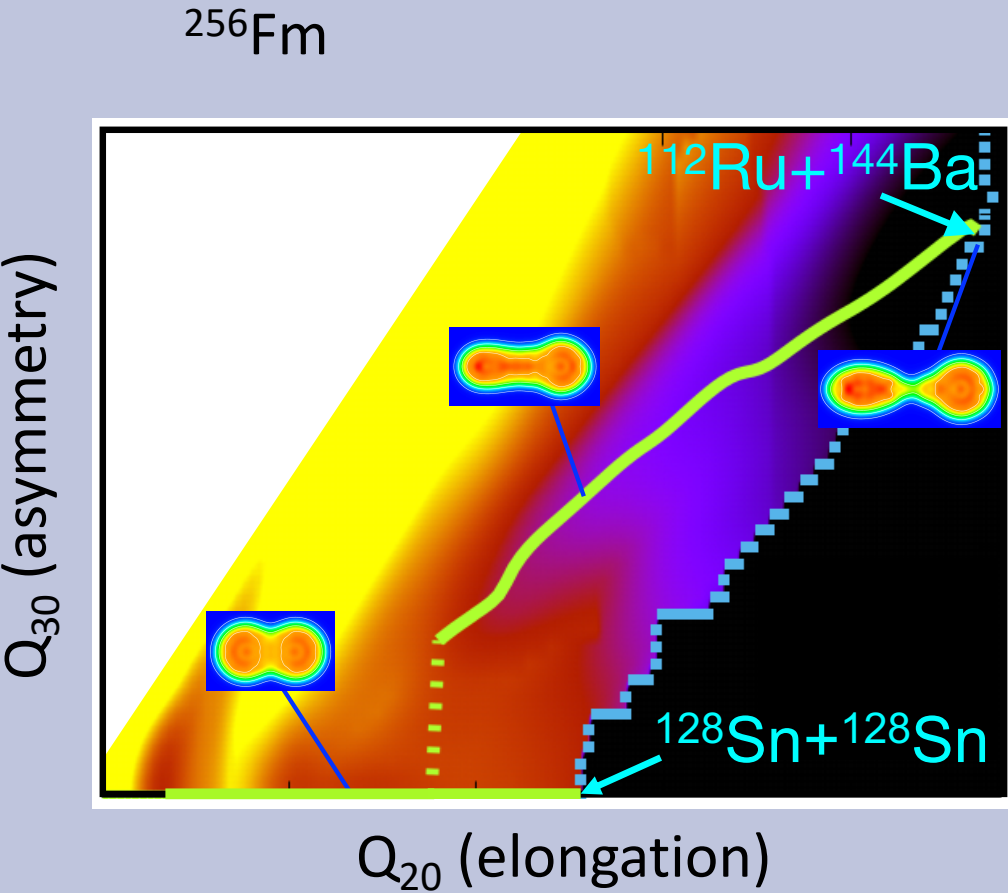
# What about Z=50 and N=82?

$^{256}\text{Fm}$

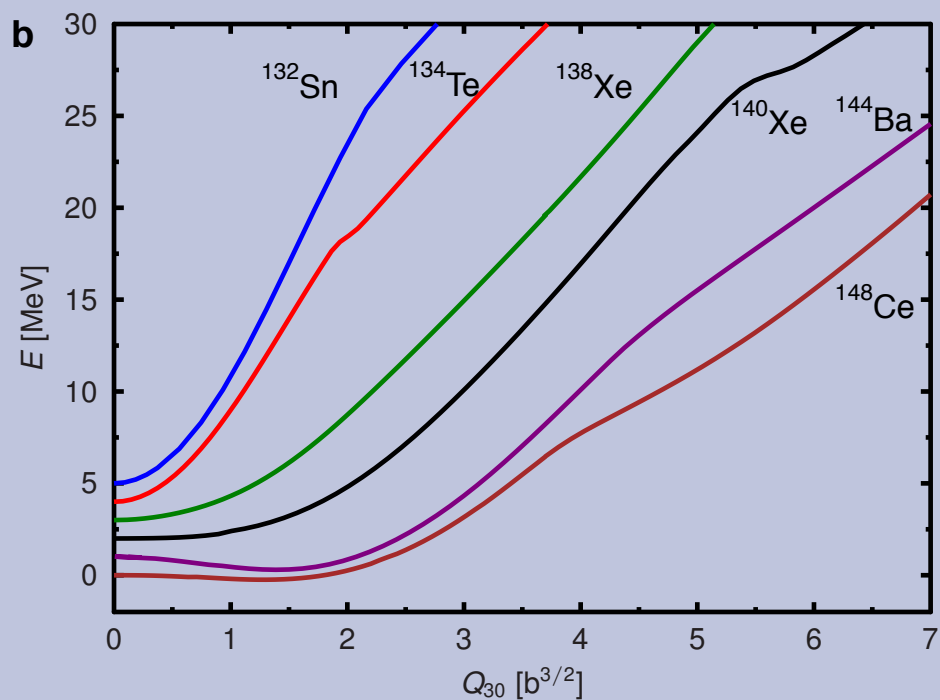




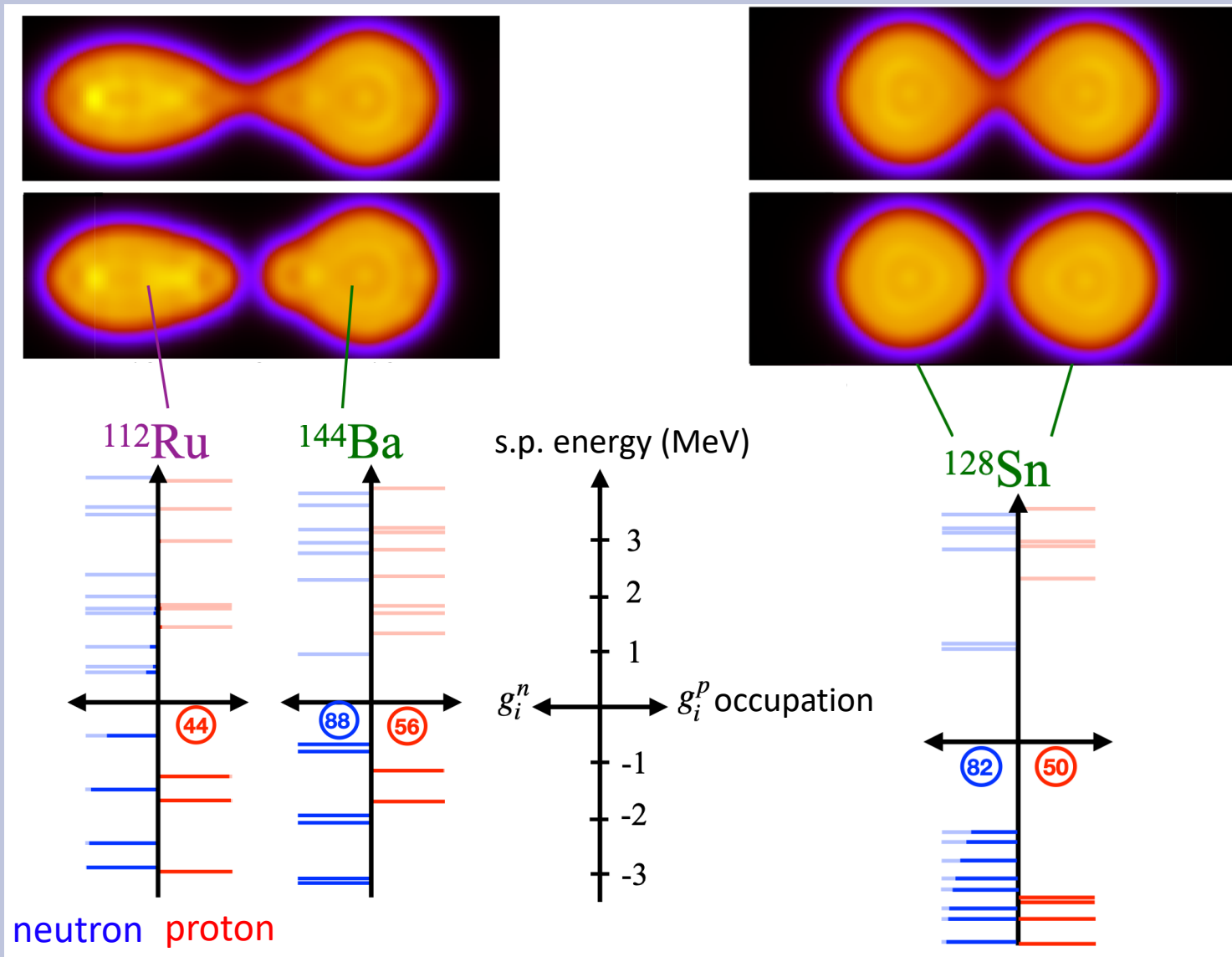
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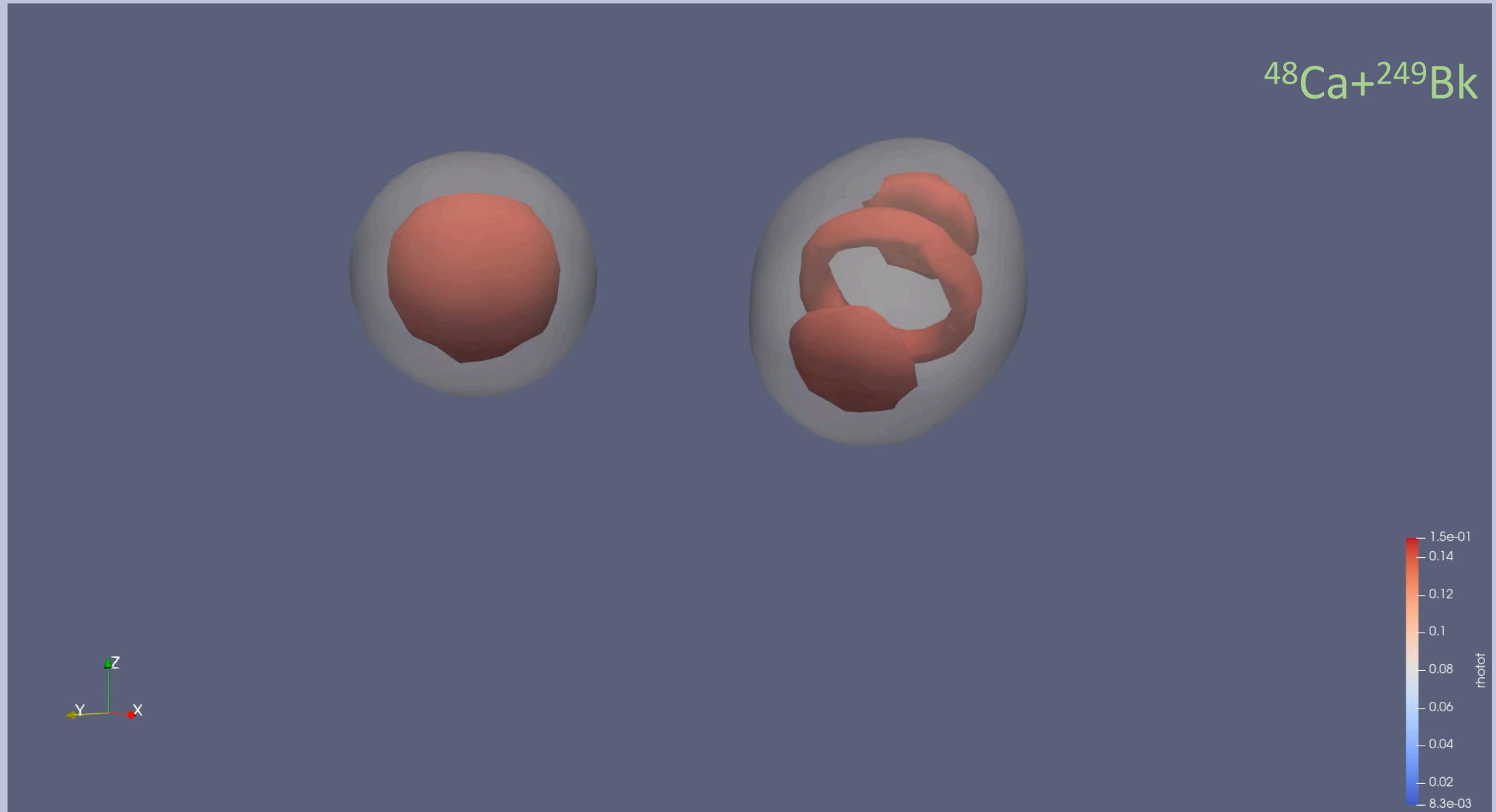
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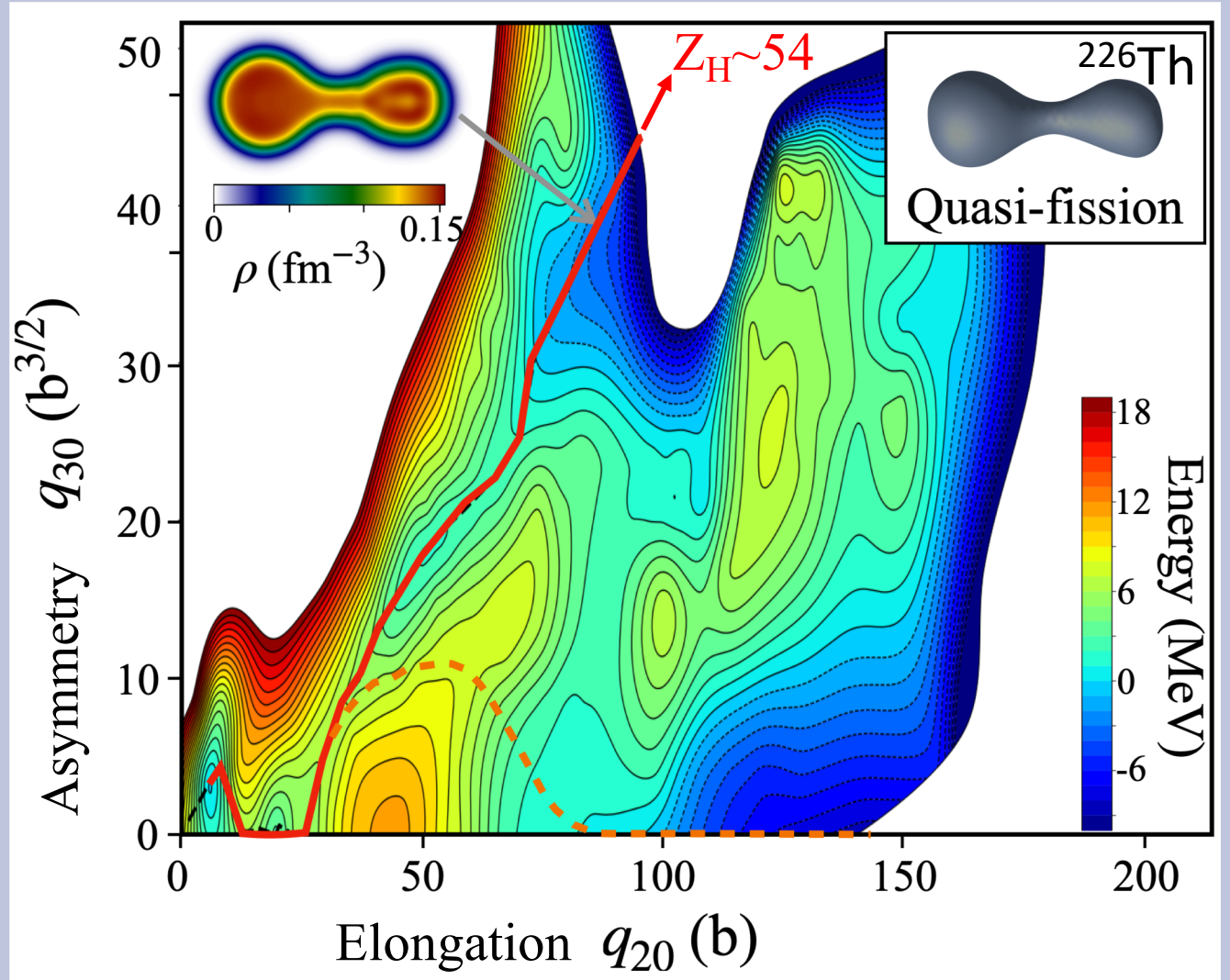
Scamps & CS, Nature 2018



# Same shell effects in fission and quasi-fission?



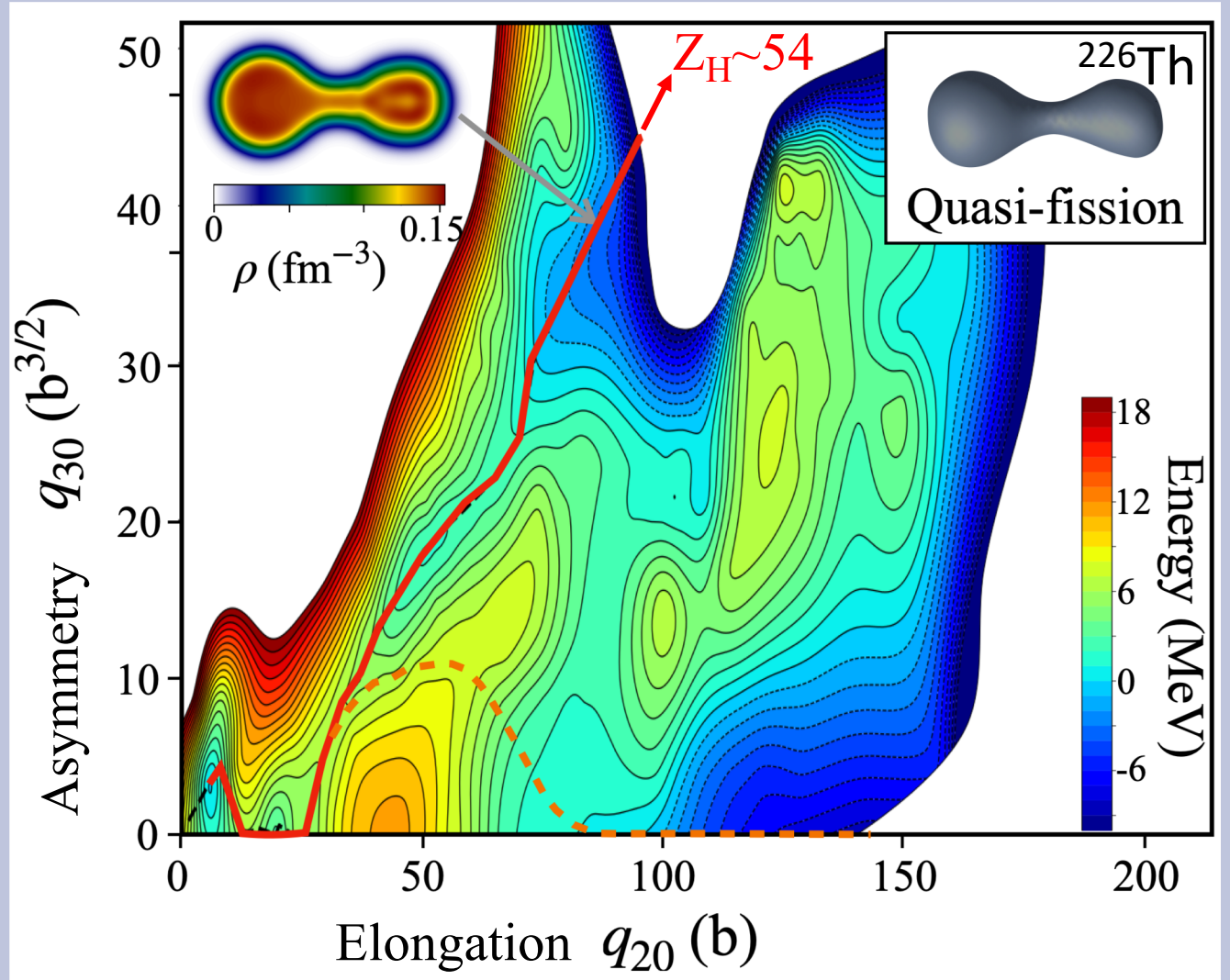
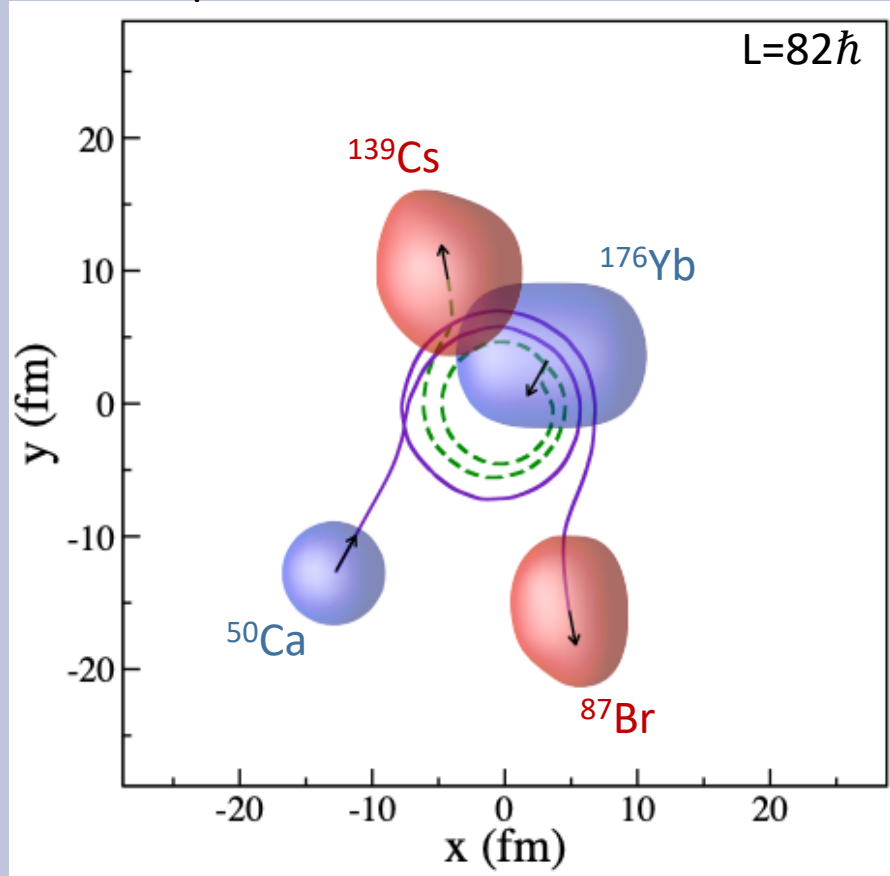
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$^{50}\text{Ca} + ^{176}\text{Yb} (1.1V_B) \rightarrow \text{quasi-fission}$

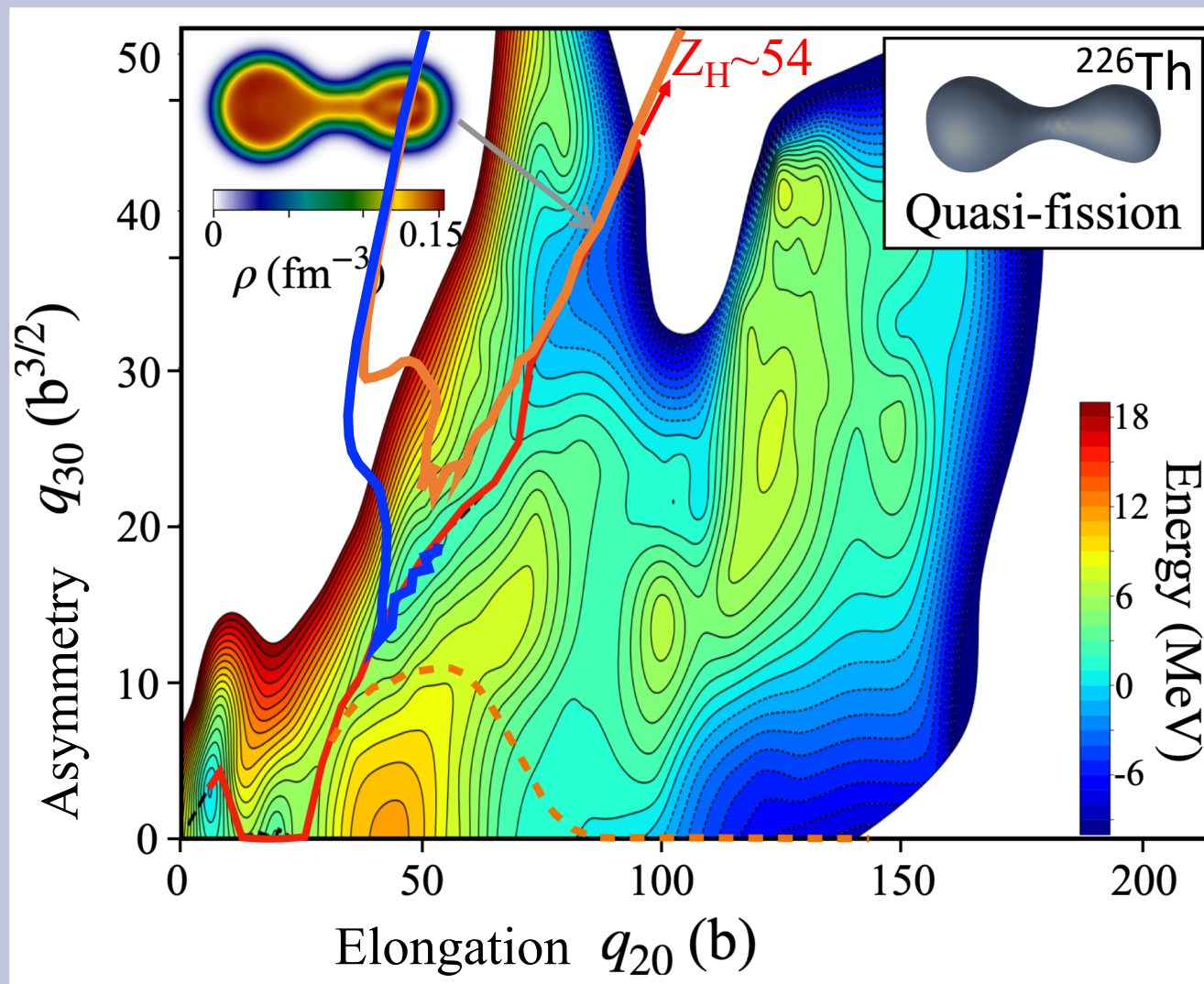
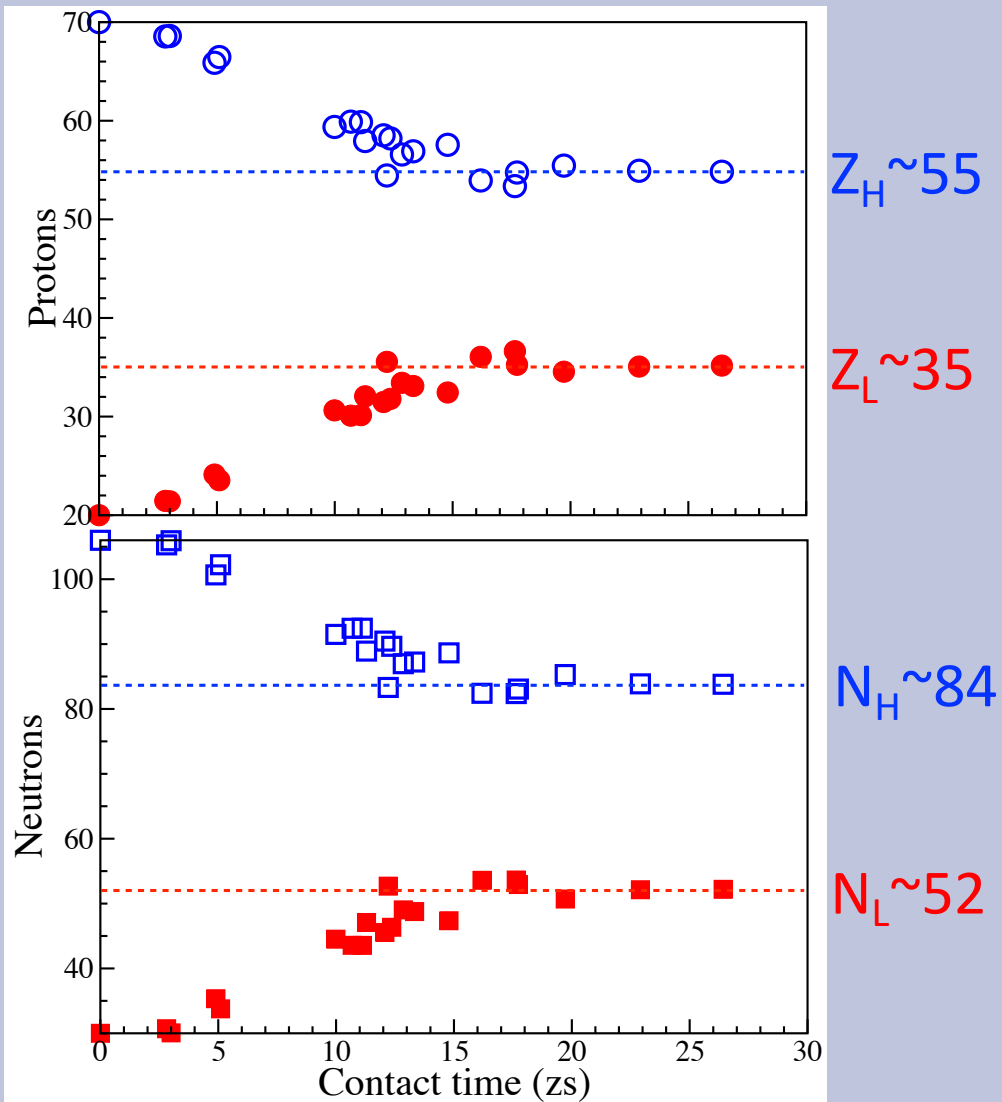
Time-dependent Hartree-Fock



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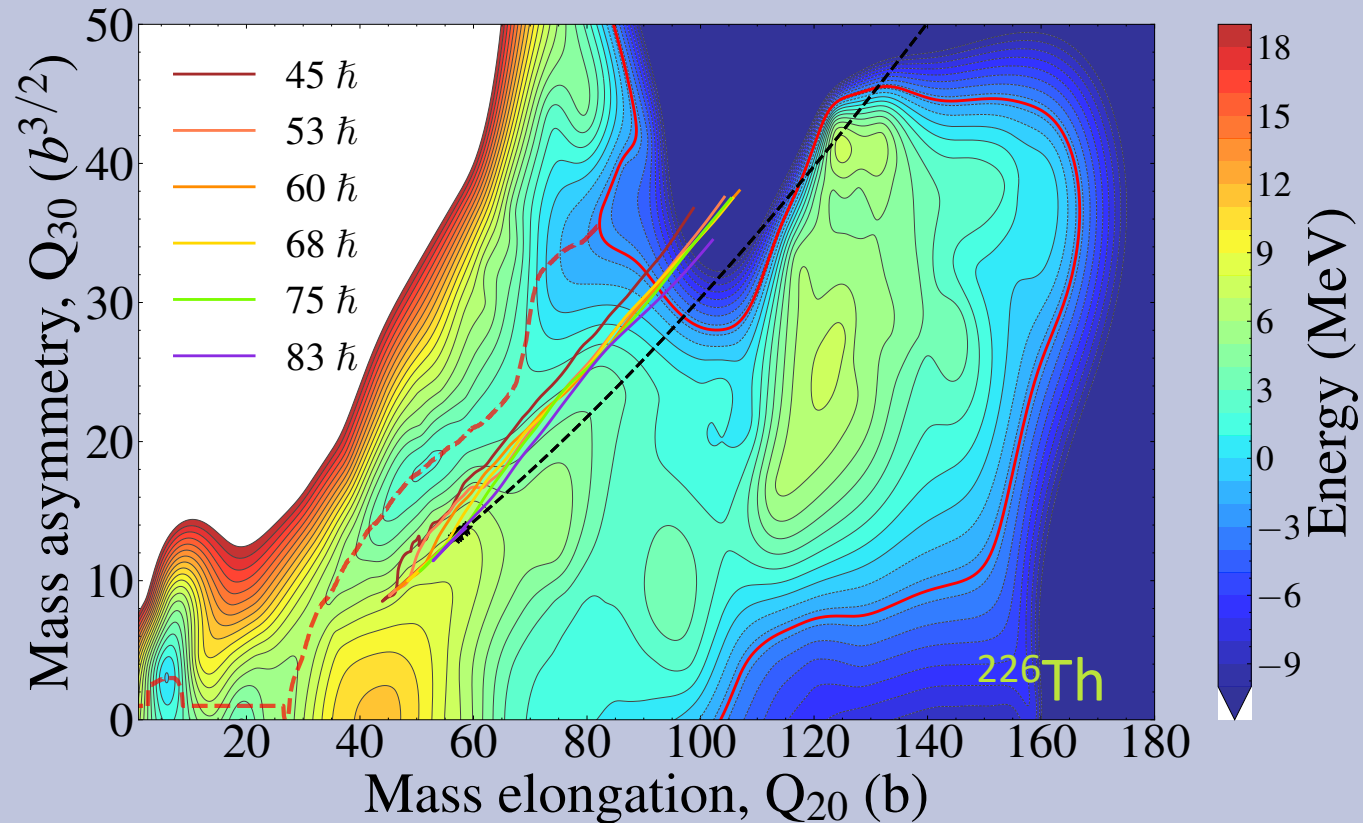
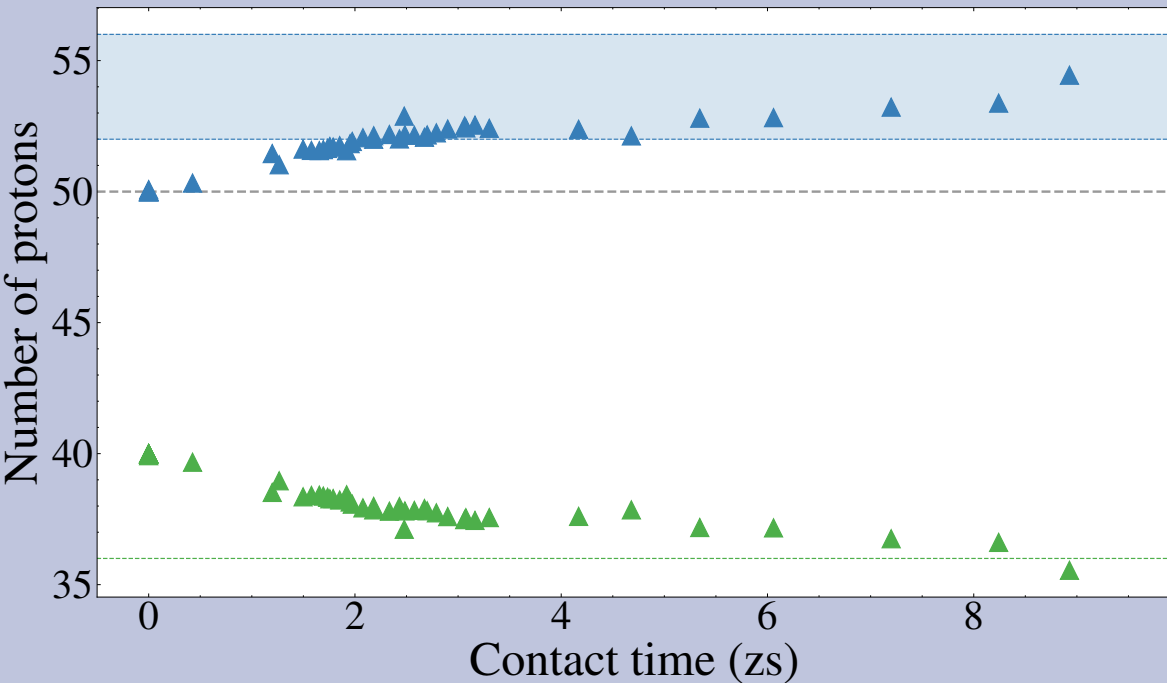
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L=60 L=50

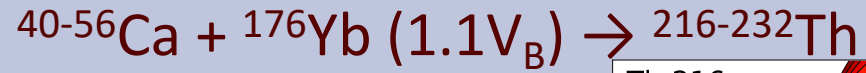


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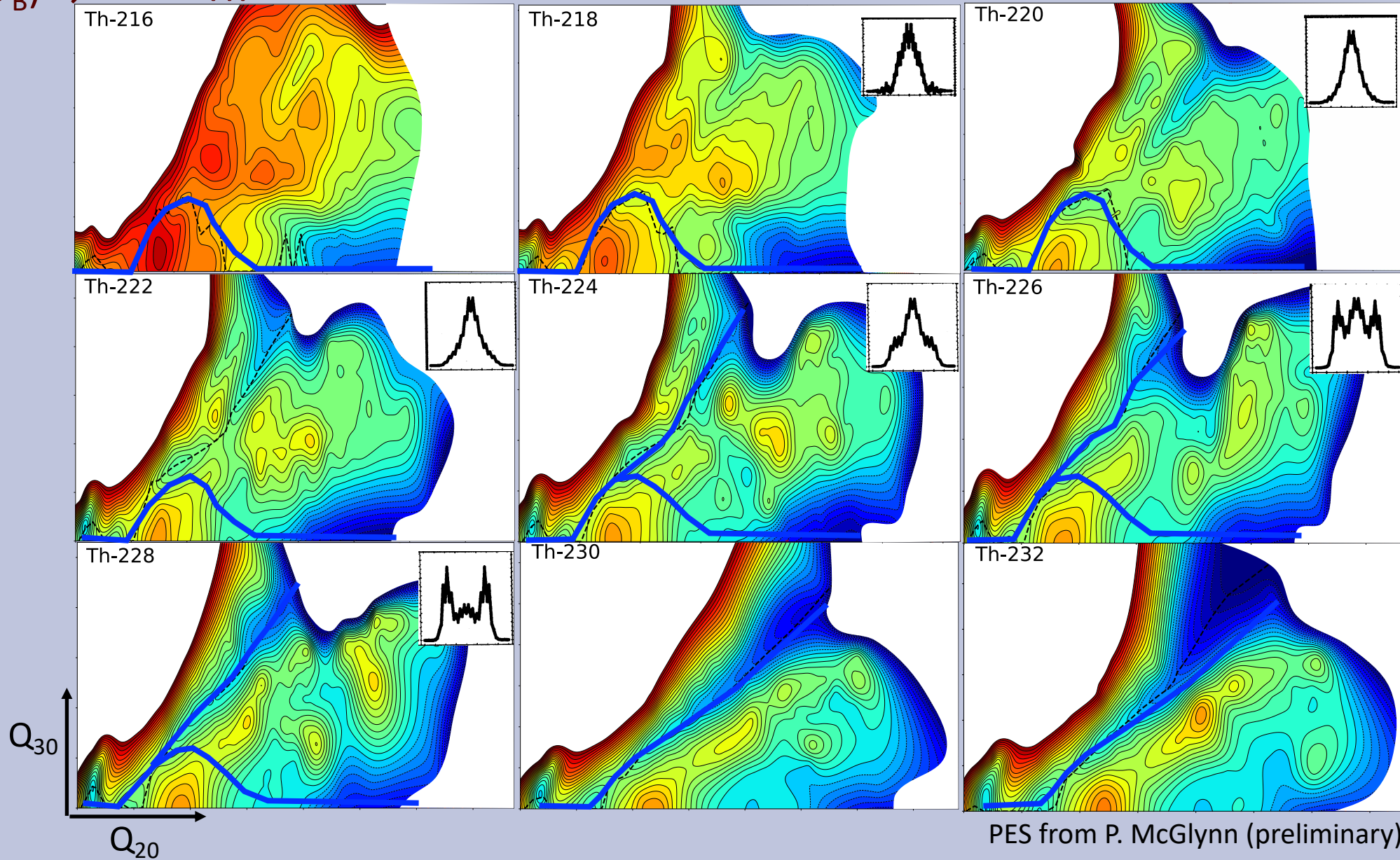
$^{96}\text{Zr} + ^{130}\text{Sn} (1.1V_B) \rightarrow \text{quasi-fission}$



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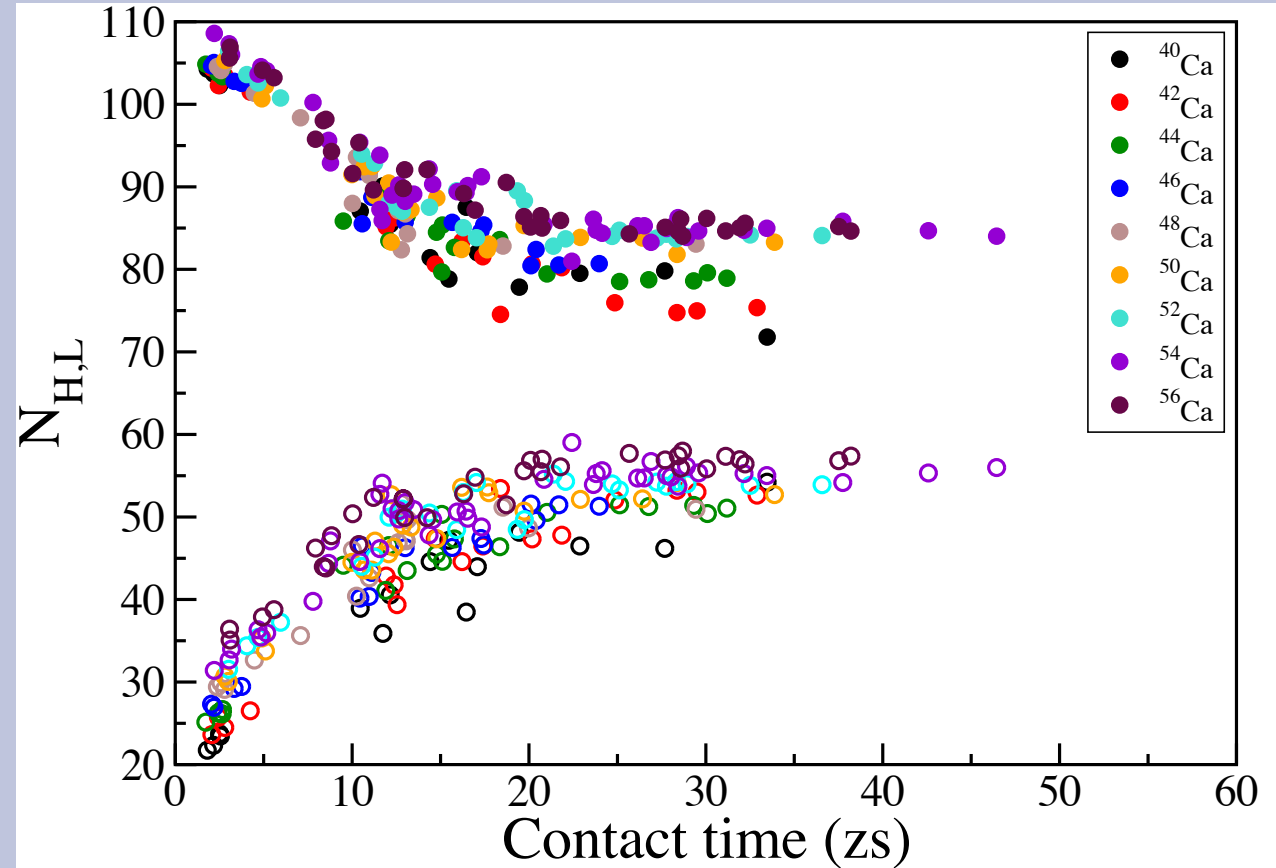
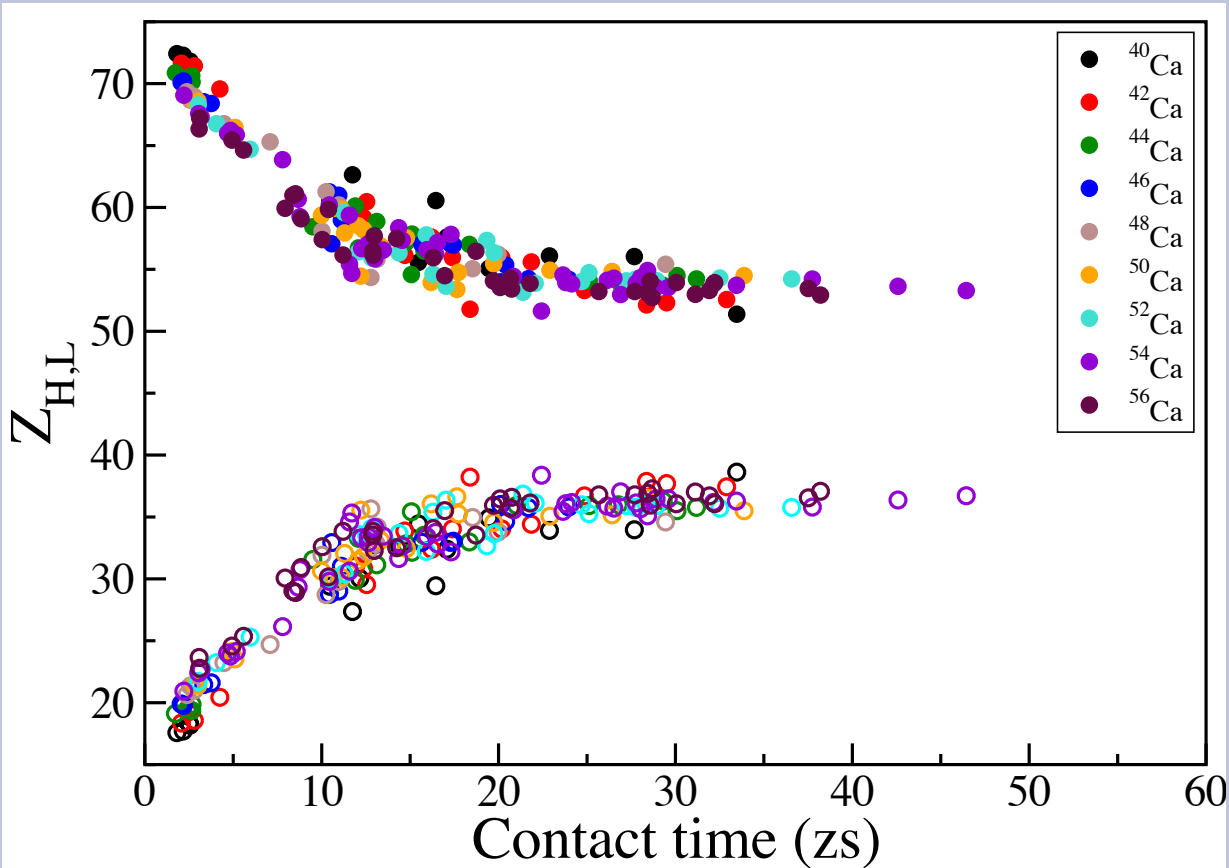
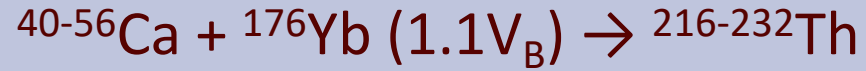
Data: Schmidt et al NPA 2000



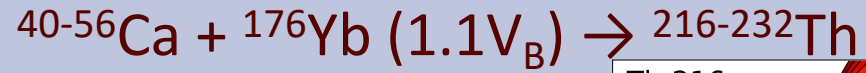
PES from P. McGlynn (preliminary)



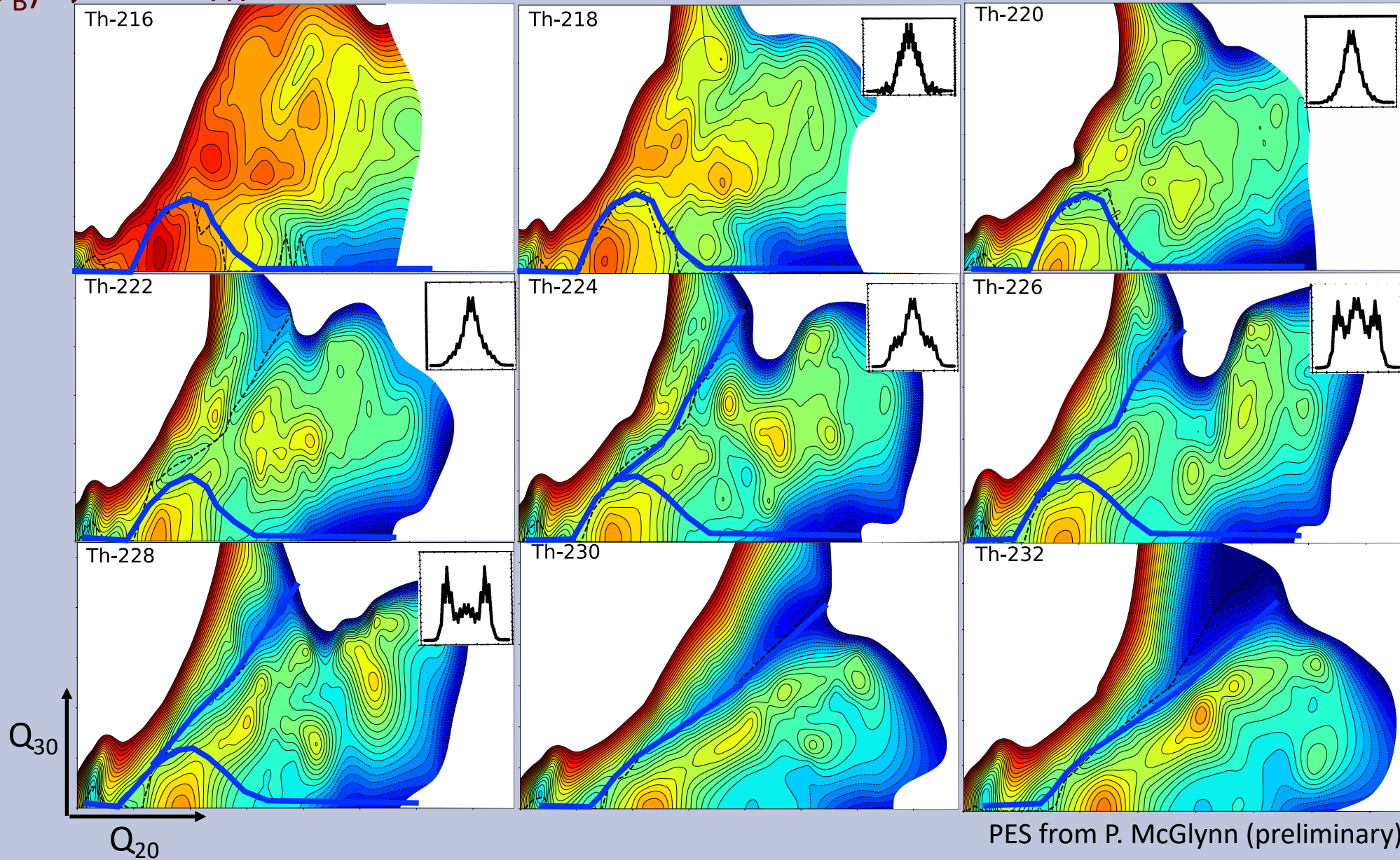
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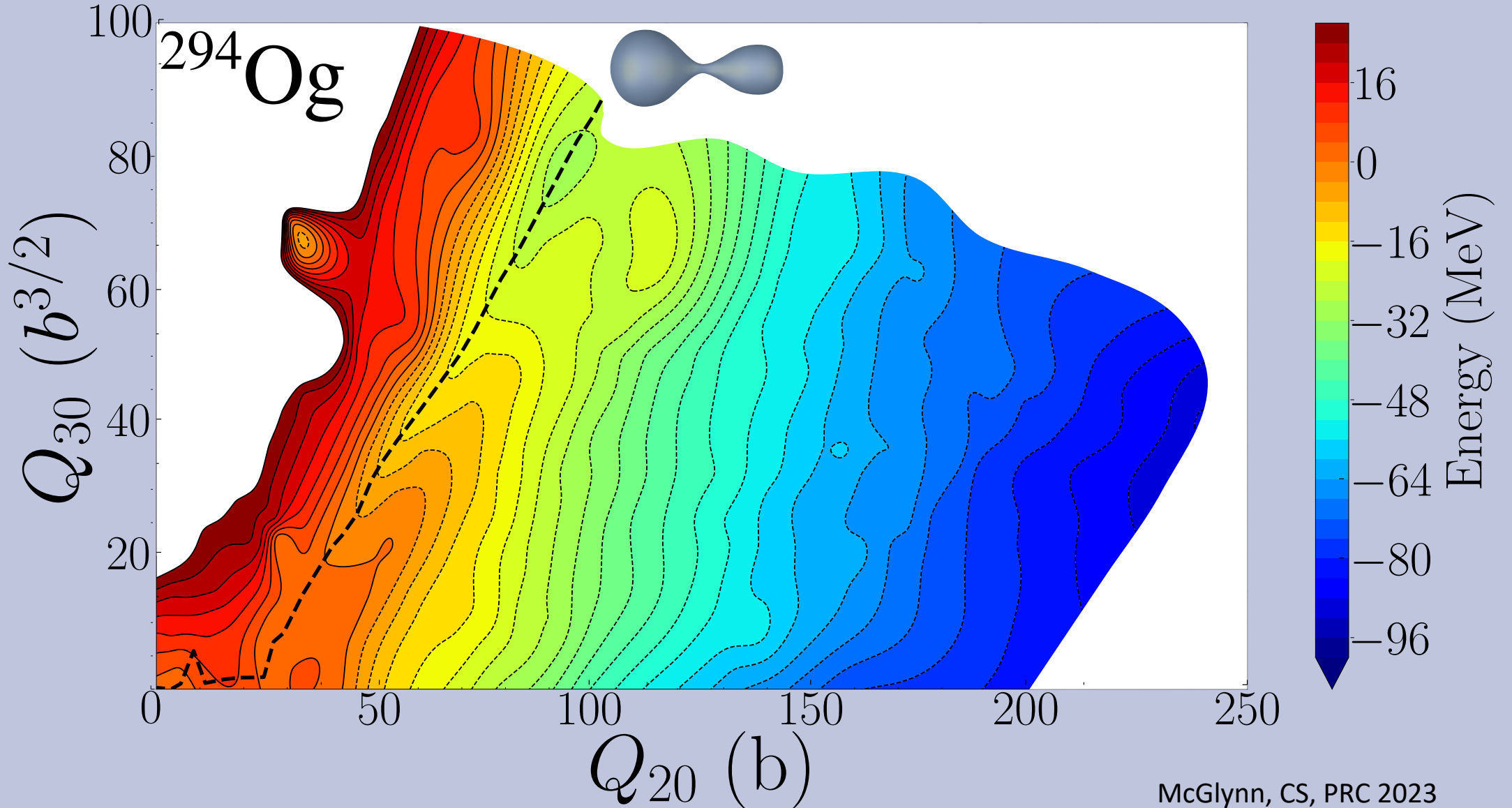


Data: Schmidt et al NPA 2000

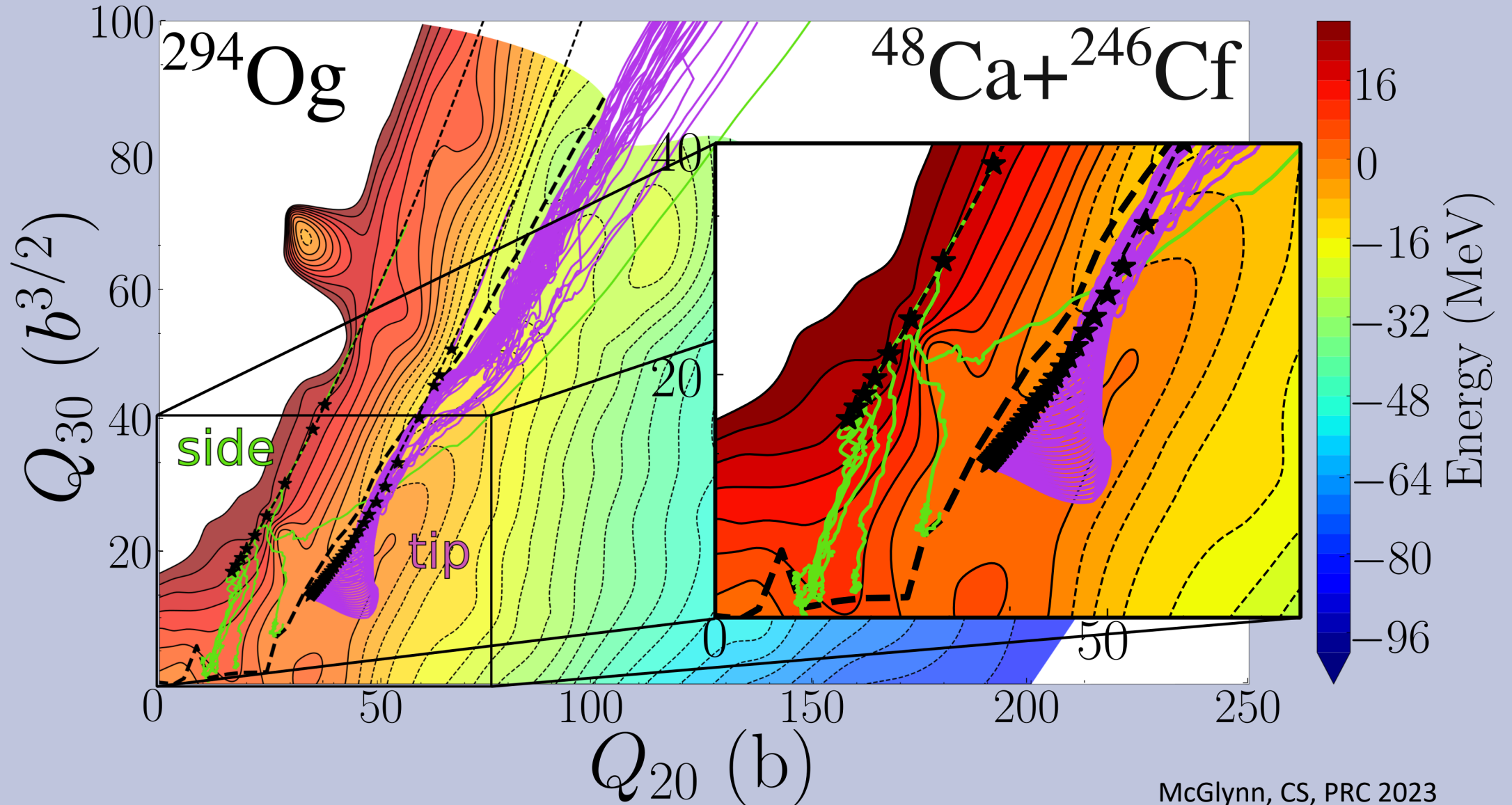


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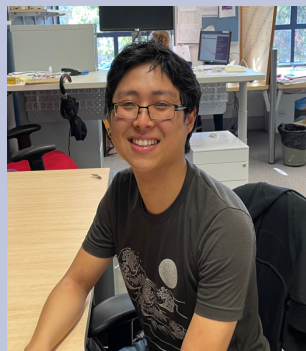
# Same shell effects in fission and quasi-fission?



# Collaborators



Bernard



Lau



Scamps



McGlynn



Lee



Godbey



Umar

