Fusion probability and survivability in estimates of heaviest nuclei production

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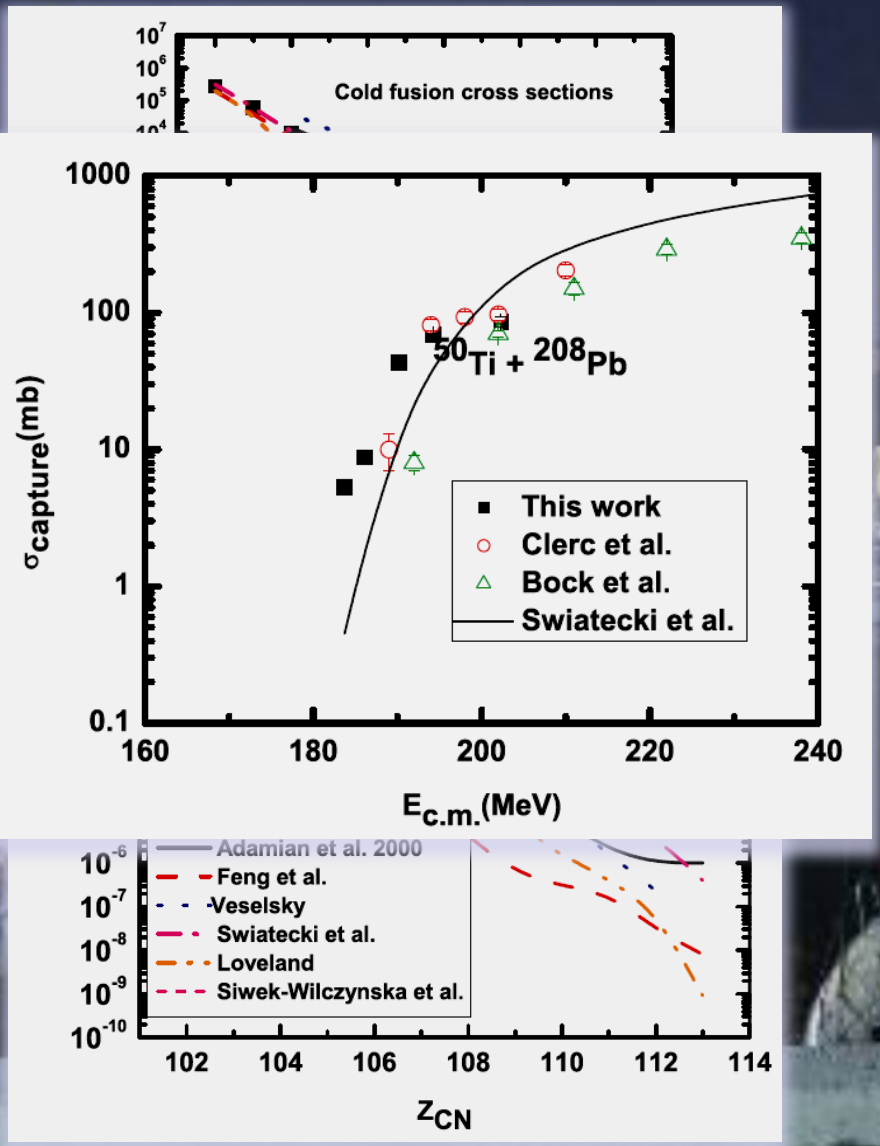
1. P_{fus} and W_{sur} as main values in estimates of the heaviest nuclei production
2. Production of heavy nuclei in the vicinity of a 126 neutron shell in fusion reactions having a different entrance-channel mass asymmetry
3. Macroscopic fission barriers and fusion probabilities in “hot” and “cold” fusion reactions leading to heavy actinides and transactinides
4. Survivability of nuclei close to the SHE region, which are produced in ^{48}Ca induced reactions
5. Summary and conclusion

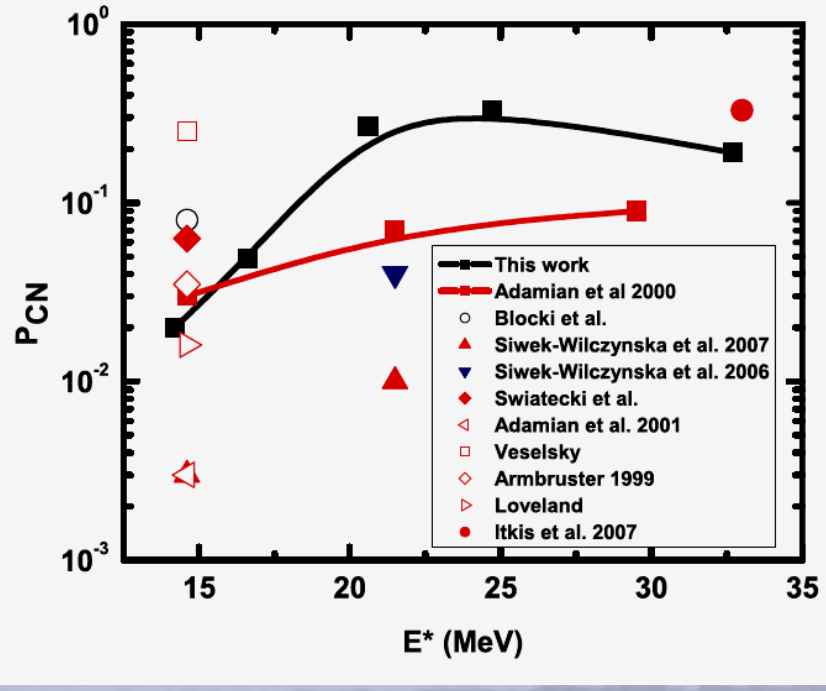
Theoretical and experimental estimates of P_{fus} ($\equiv P_{CN}$)

R. S. NAIK *et al.*, PRC 76, 054604 (2007)



$$\sigma_{\mathrm{EVR}} = \sum_{J=0}^{J_{\max}} \sigma_{\mathrm{capture}}(E_{\mathrm{c.m.}}, J) P_{\mathrm{CN}}(E_{\mathrm{c.m.}}, J) \cdot W_{\mathrm{sur}}$$

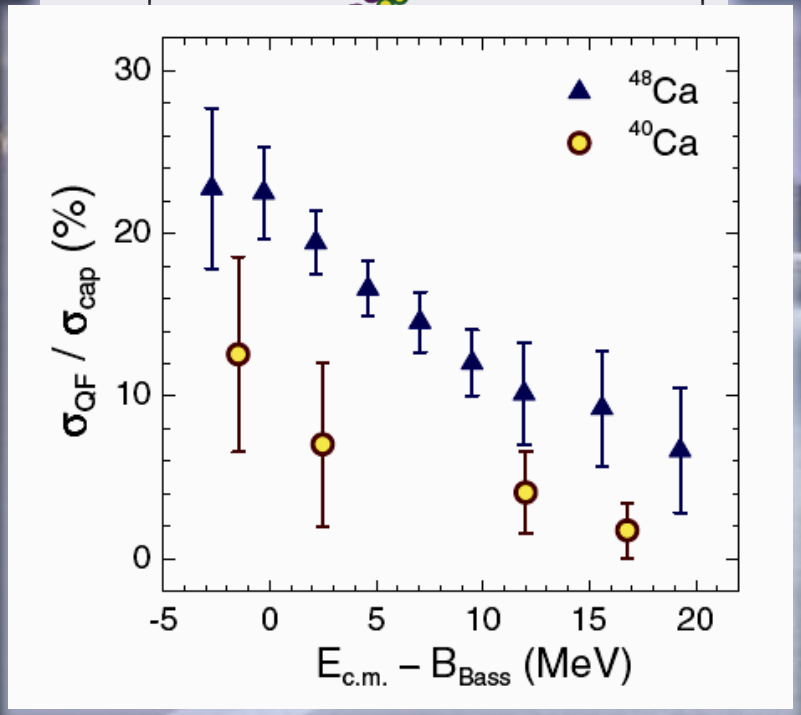
Extraction CN-fission and P_{CN} from the decomposition of fission fragment angular distribution (B.B. Back's approach):



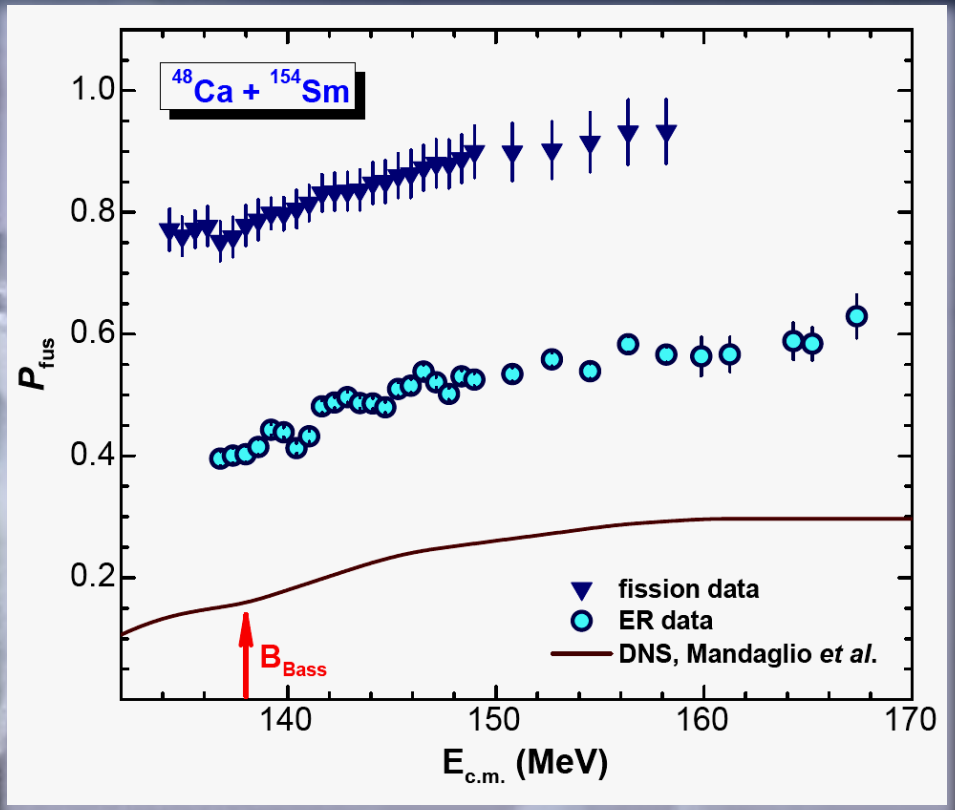
P_{fus} experimentally obtained in reactions leading to less fissile Pb* CN

G. N. KNYAZHEVA *et al.*, PRC 76, 054604 (2007)

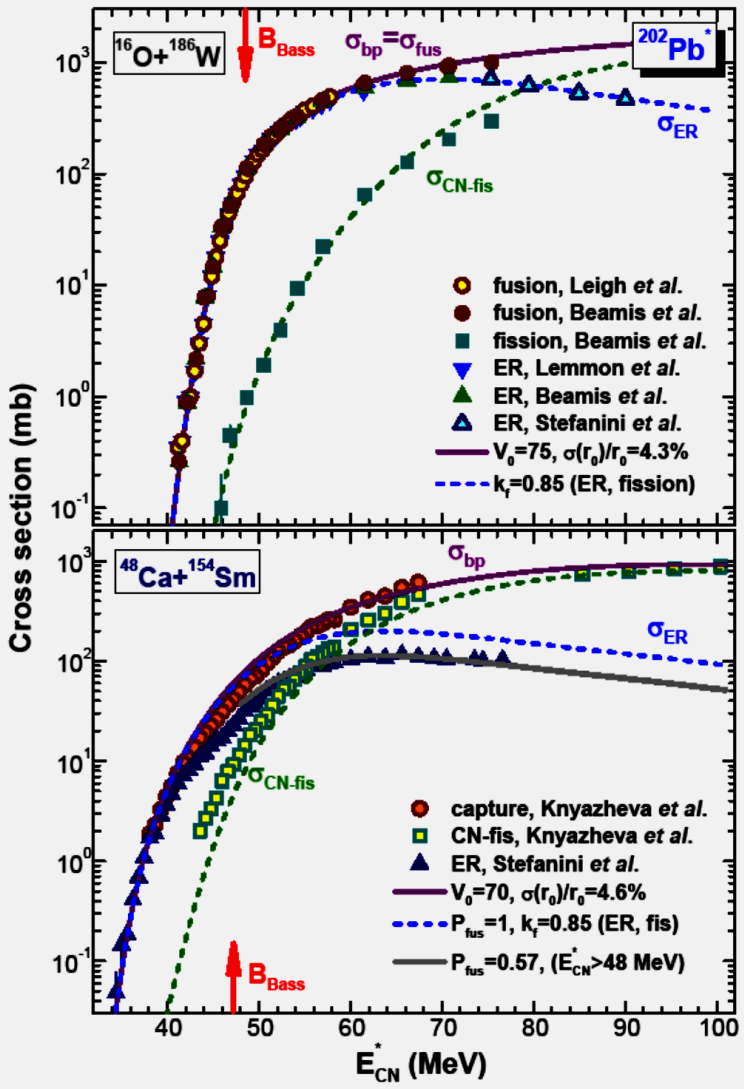
From the decomposition of fission fragment mass, energy and angular distributions

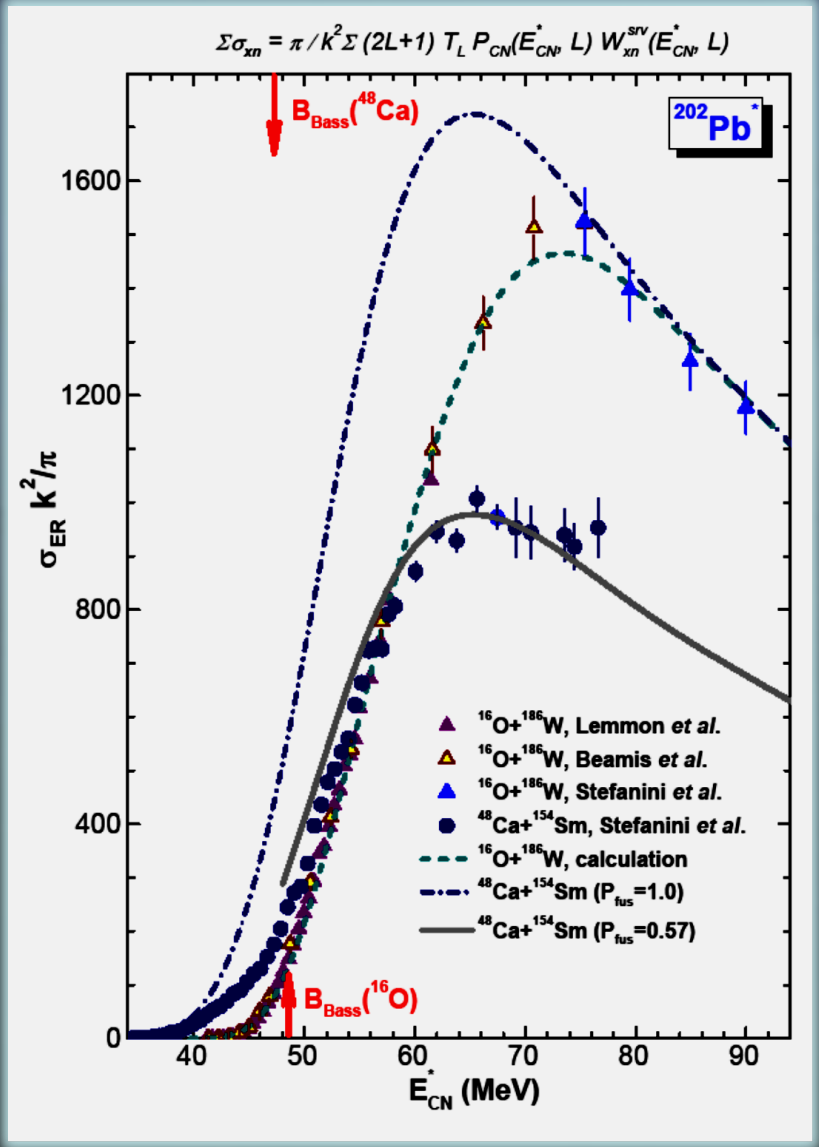


From the comparison of ER production in very asymmetric combination implying no fusion suppression

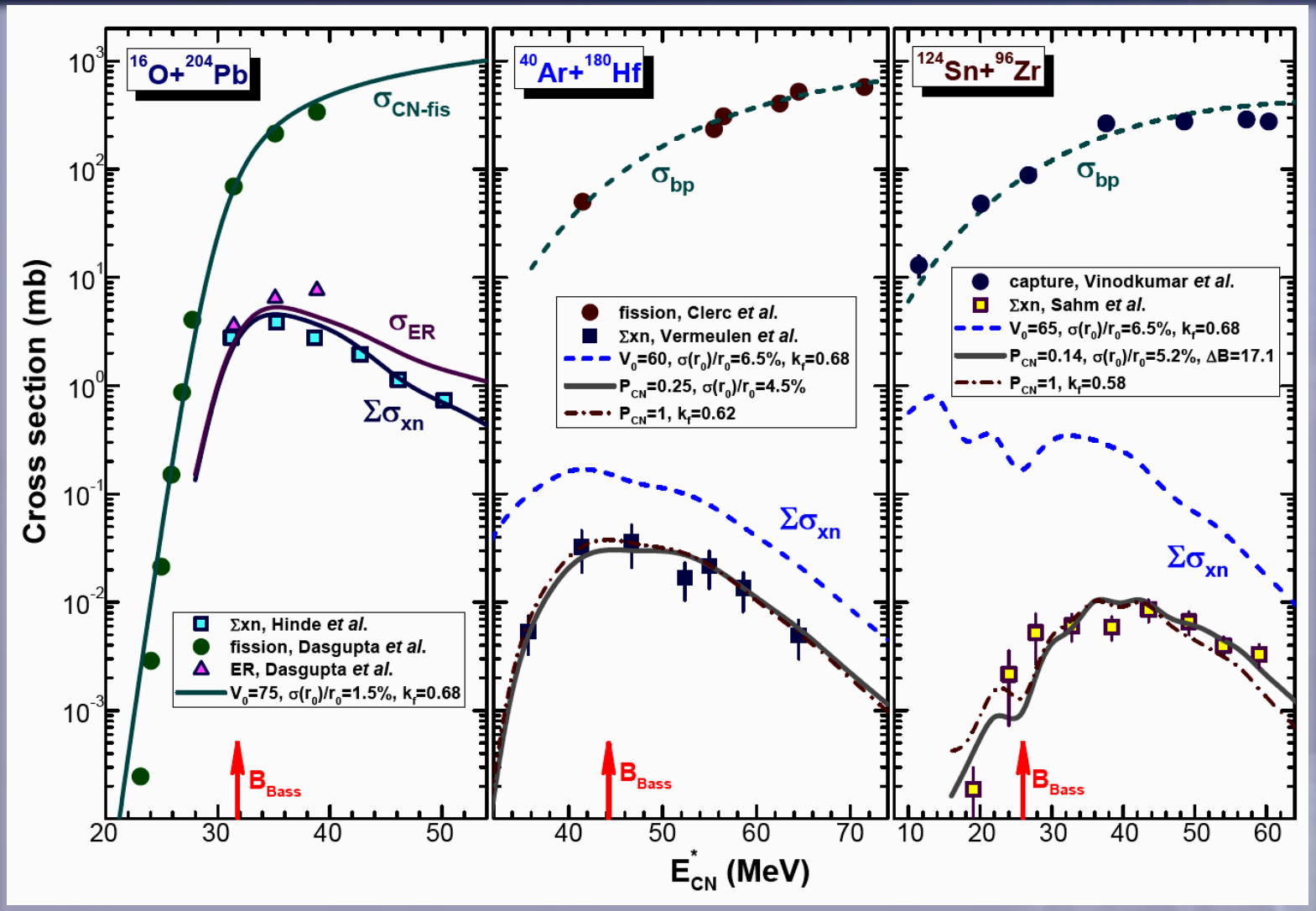


Comparison of the ER production in the $^{16}O+^{186}W$ and $^{48}Ca+^{154}Sm$ combinations leading to the $^{202}Pb^*$ CN

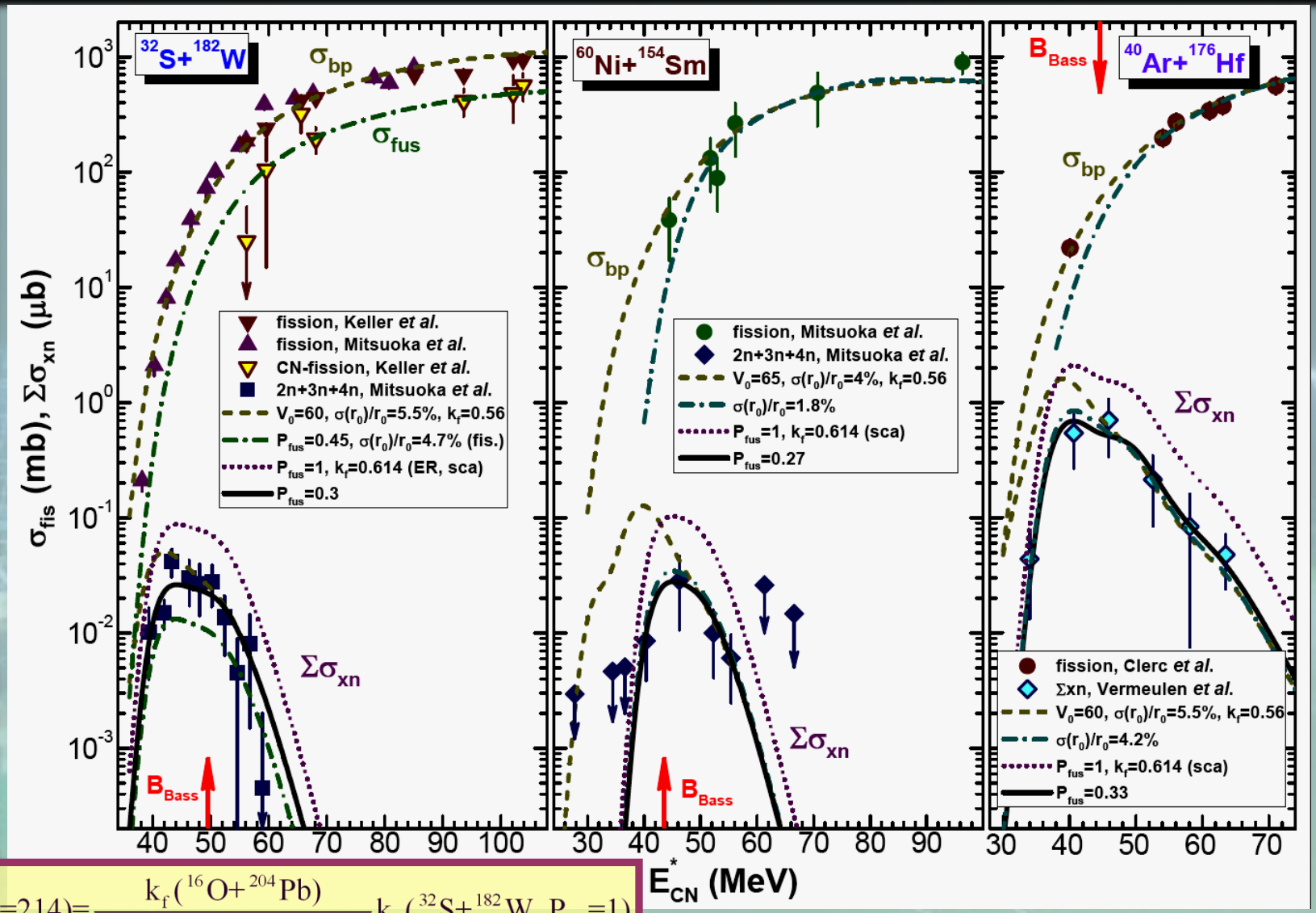




Comparison of the ER production in different combinations leading to the $^{220}Th^{*}$ CN

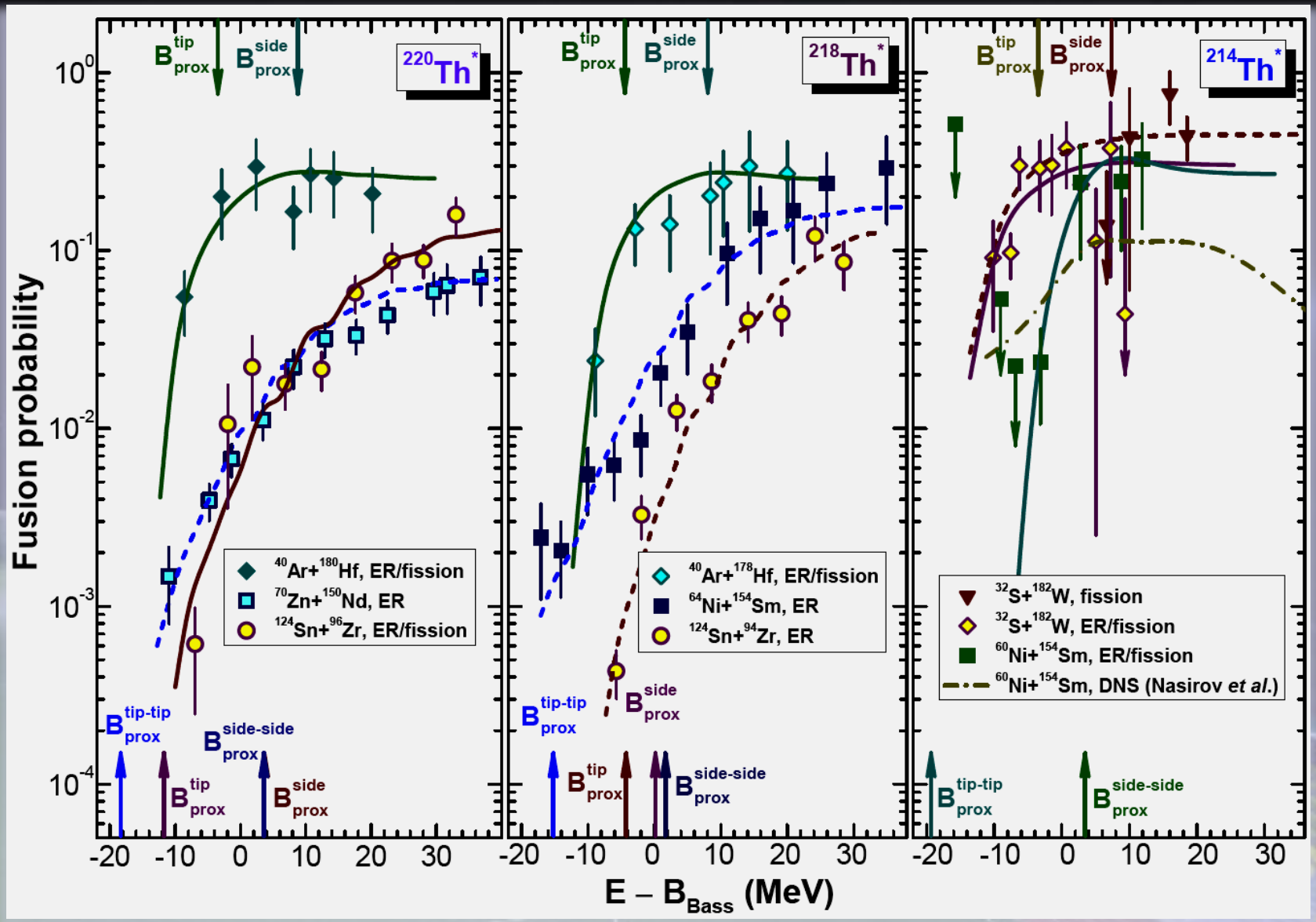


ER production in different combinations leading to the neutron-deficient Th* CN (no ref. combinations, k_f scaling)



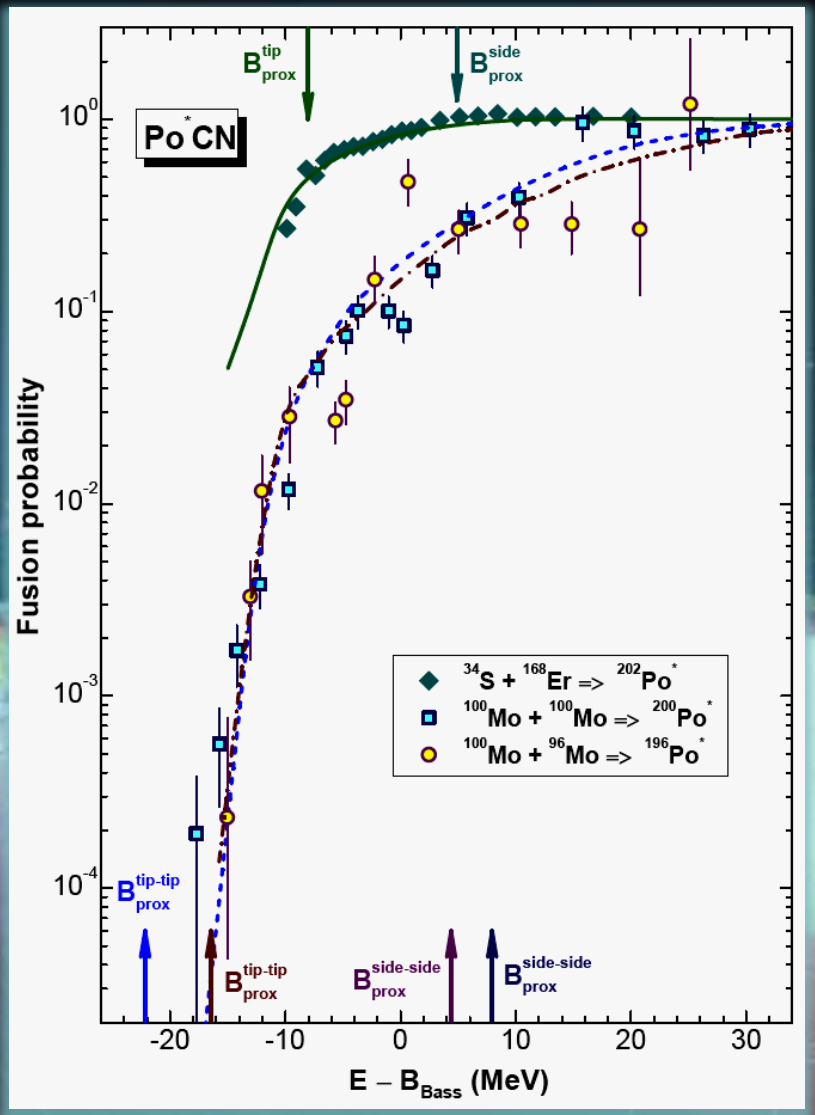
$$k_f(A_{CN}=214)=\frac{k_f(^{16}O+^{204}Pb)}{k_f(^{40}Ar+^{180}Hf,\ P_{fus}=1)}\,k_f(^{32}S+^{182}W,\ P_{fus}=1)$$

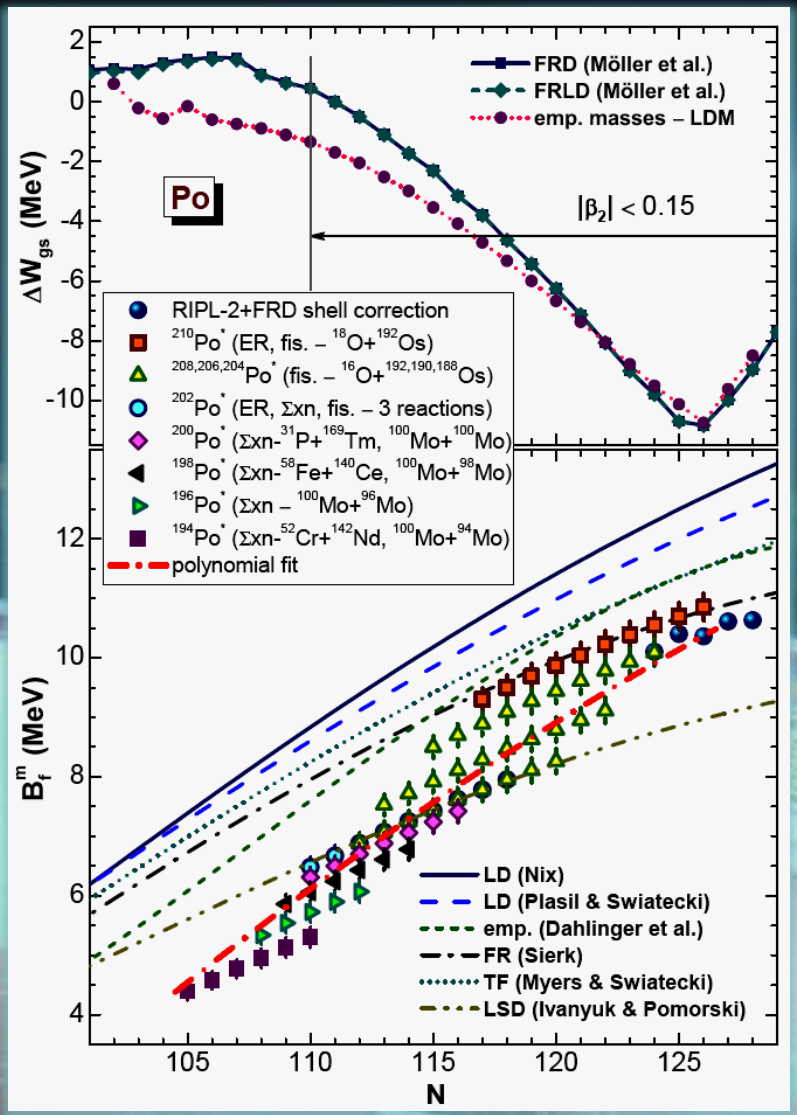
Fusion probability in different combinations leading to Th* CN



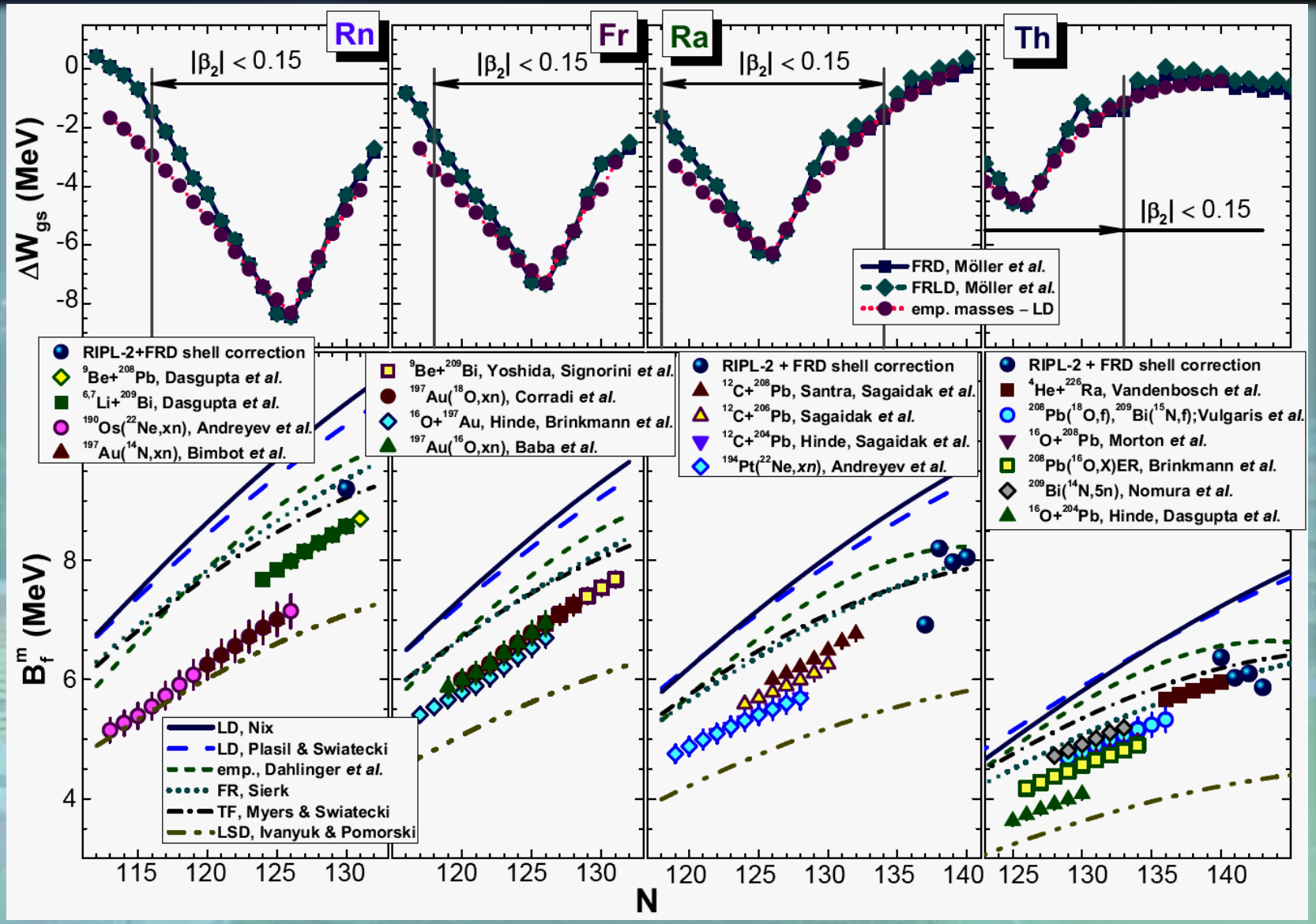
Fusion probability and fission barriers in reactions leading to Po* CN

R. N. SAGAIDAK & A. N. ANDREYEV, PRC 79, 054613 (2009)

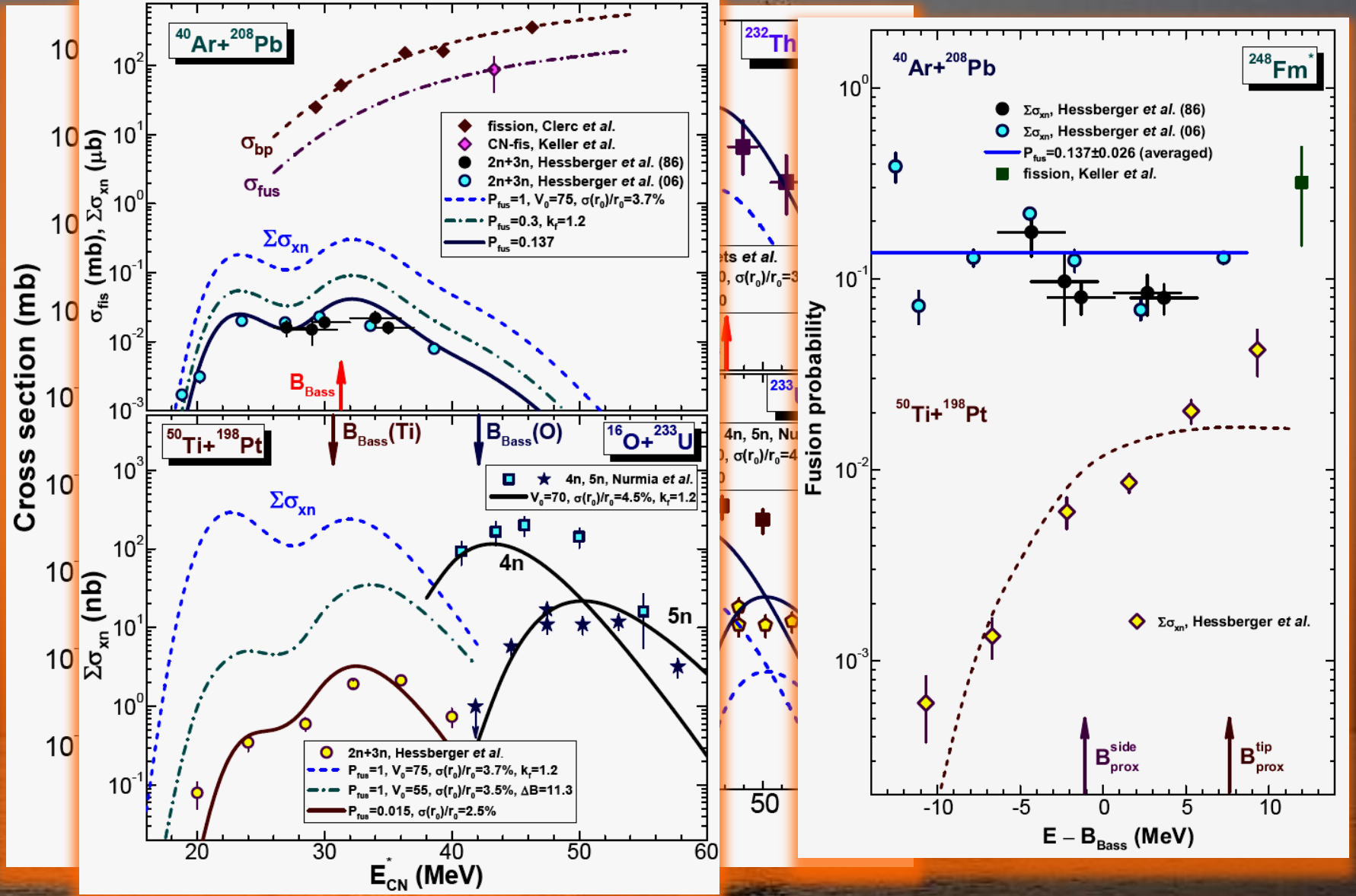




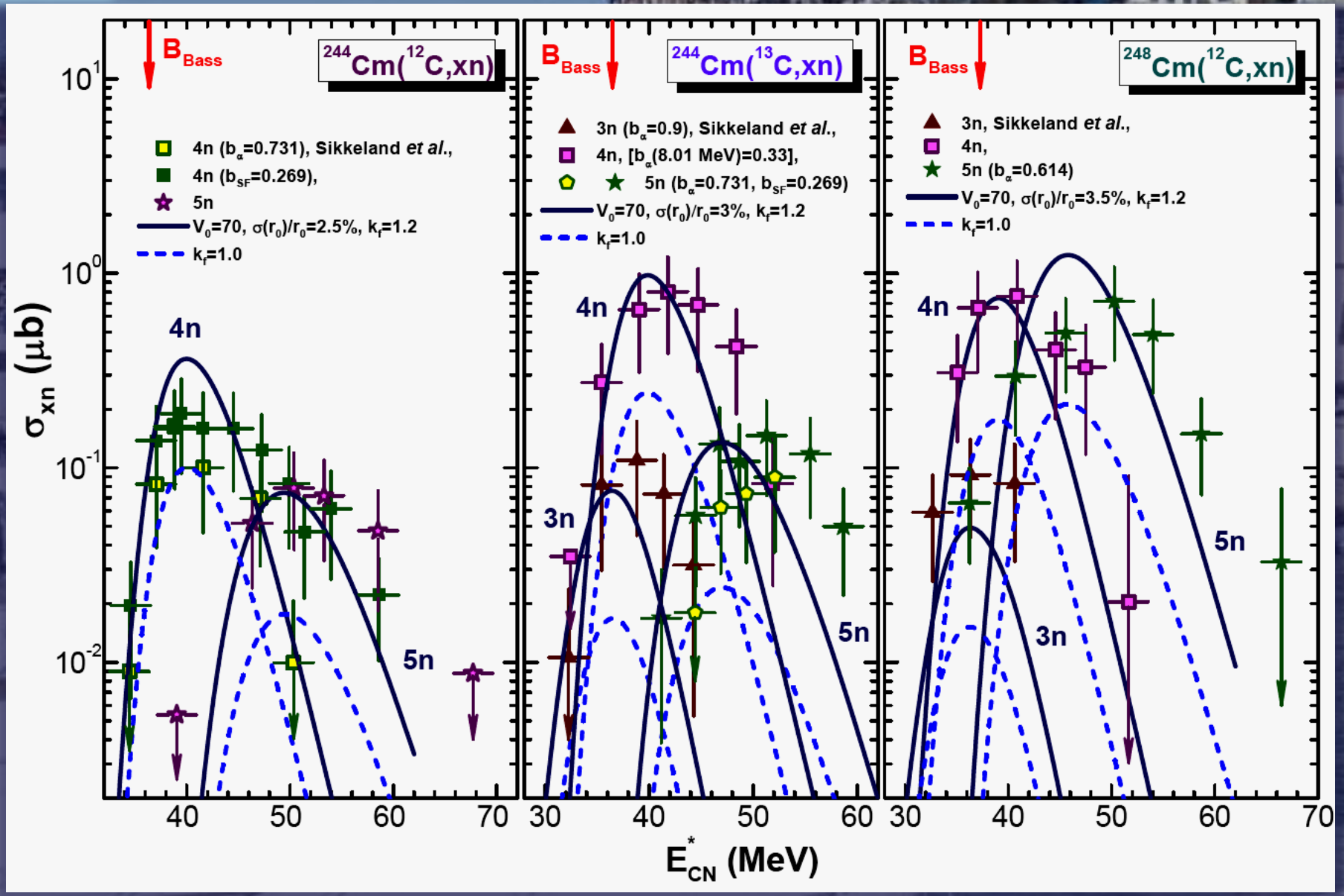
Macroscopic fission barriers for Rn, Ra, Fr and Th nuclei



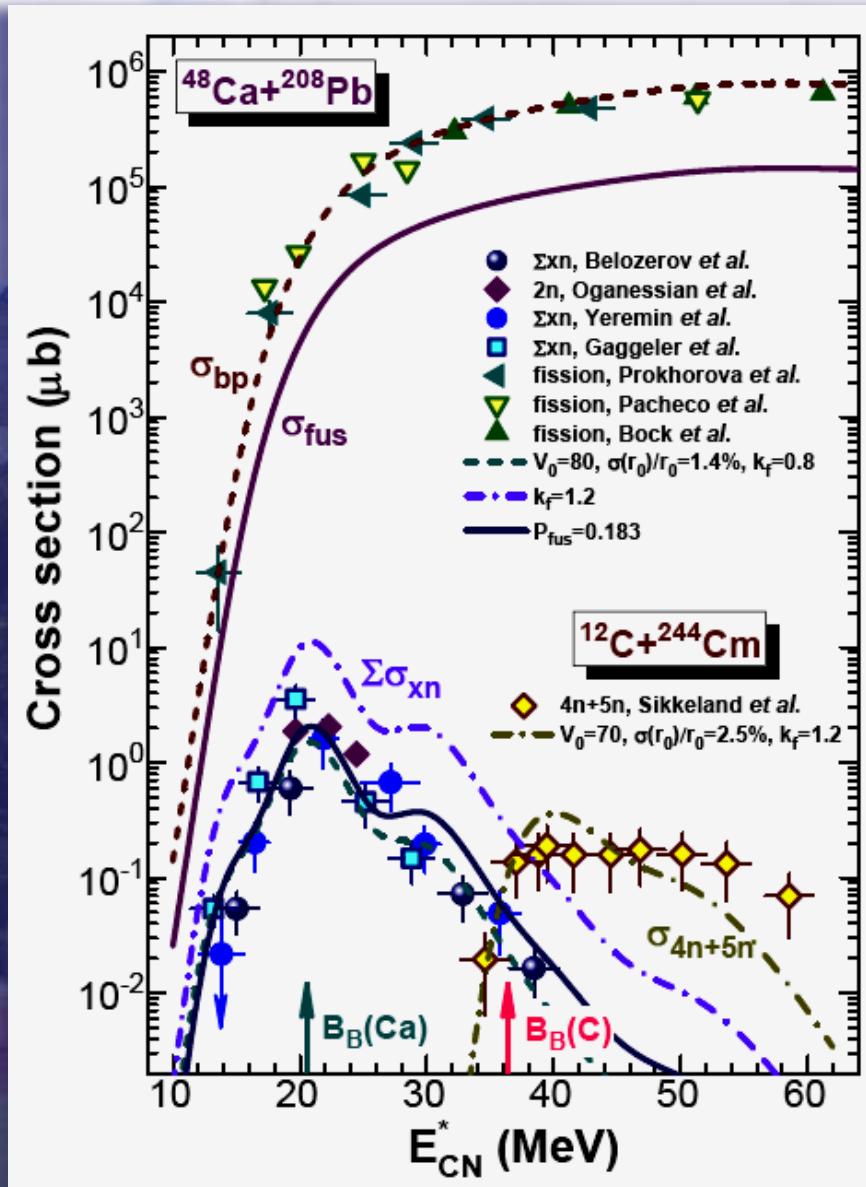
Production of Fm nuclei in reactions with a different entrance channel mass-asymmetry

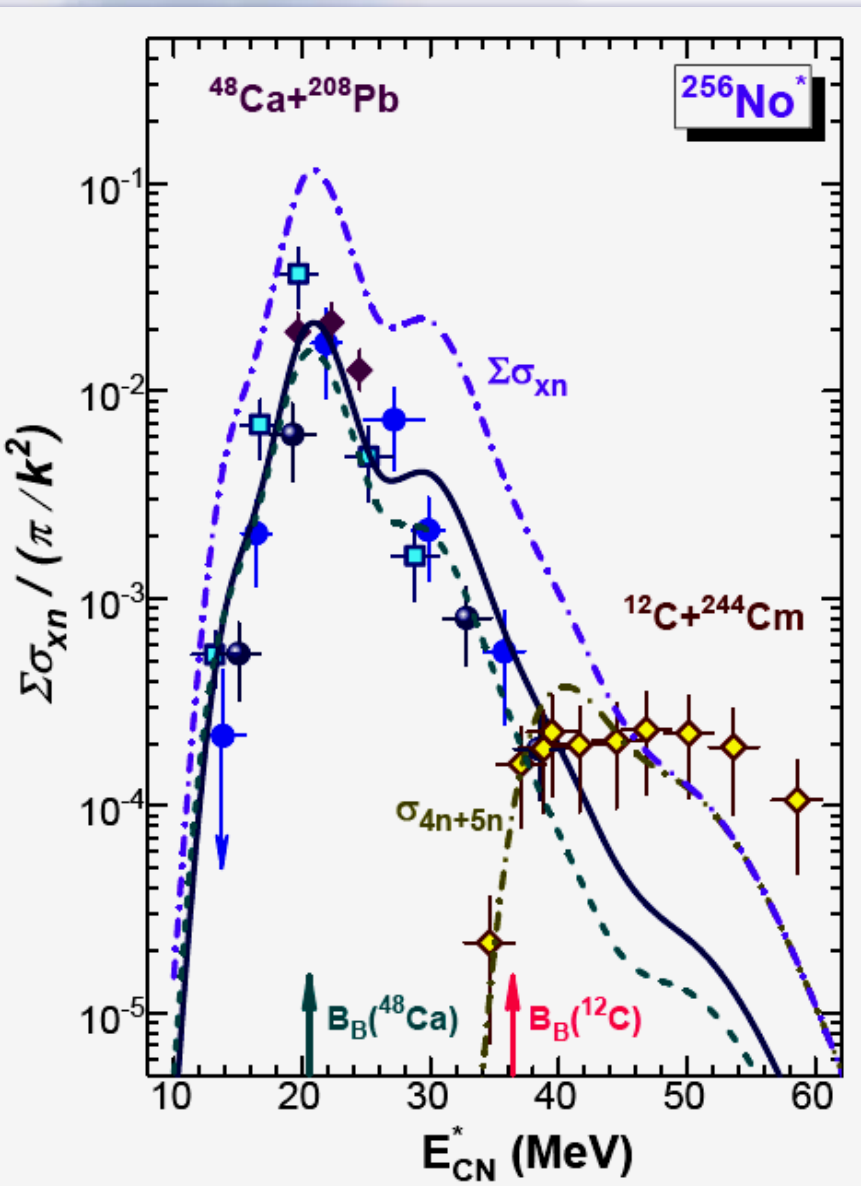


Production of No nuclei in very asymmetric hot fusion reactions

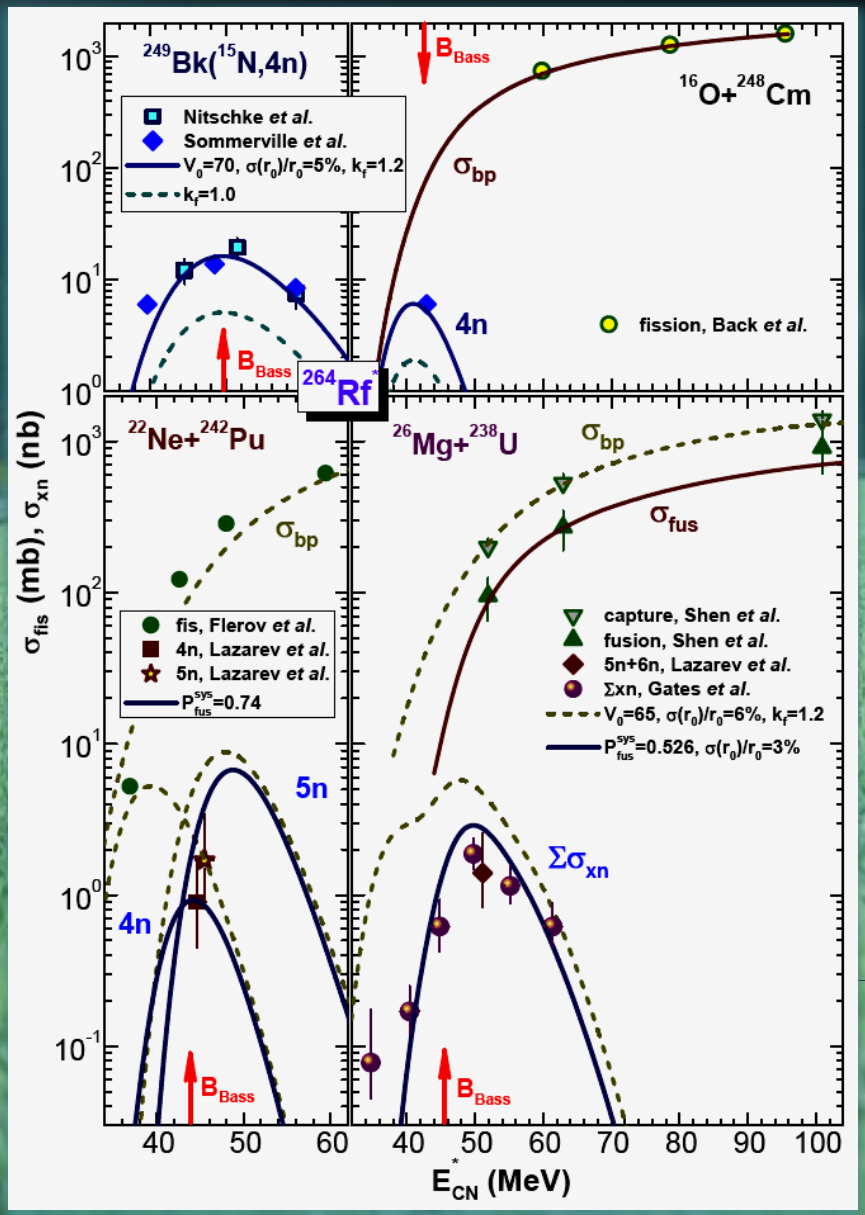


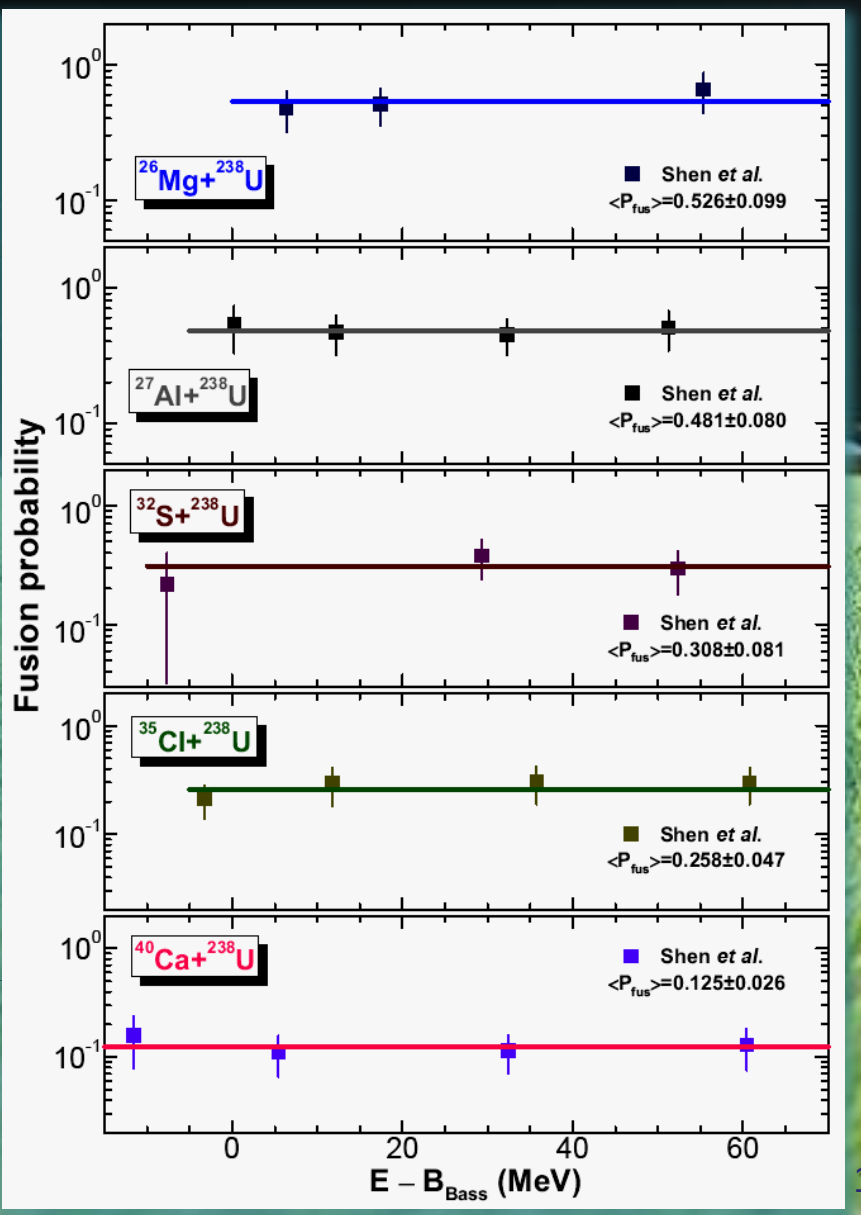
Production of No nuclei in the $^{48}Ca+^{208}Pb$ reaction





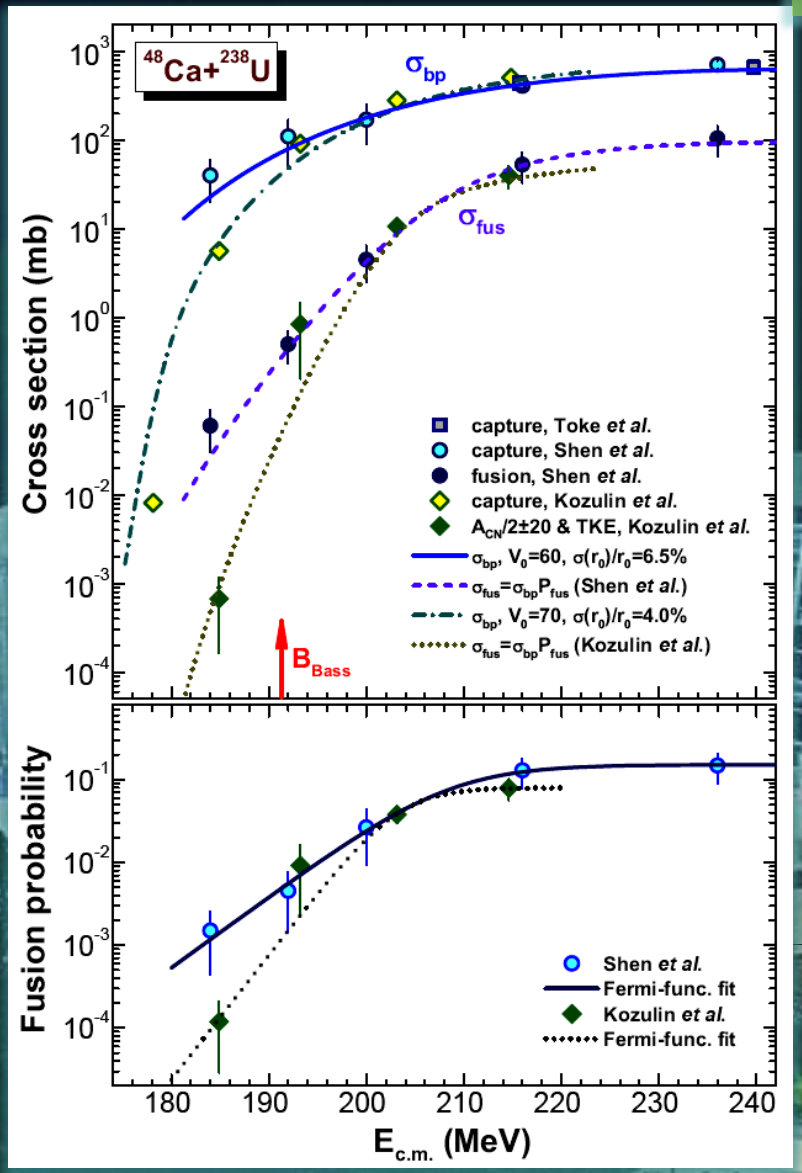
Production of Rf and P_{fus} derived from fission data obtained in hot fusion reactions

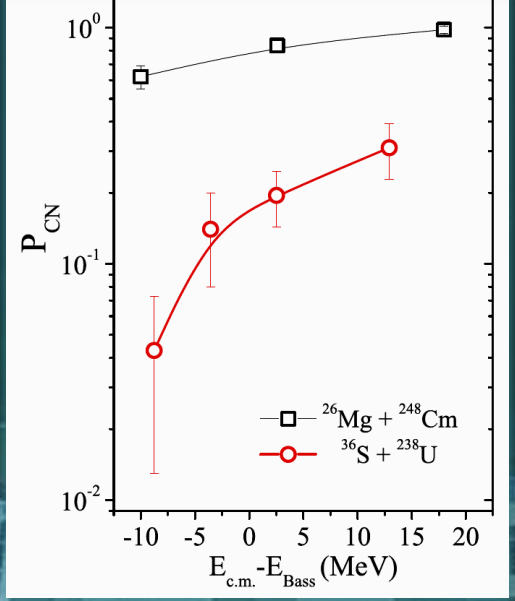


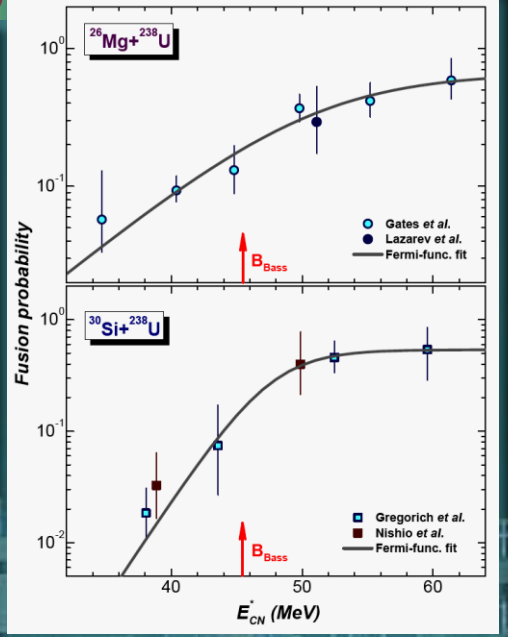


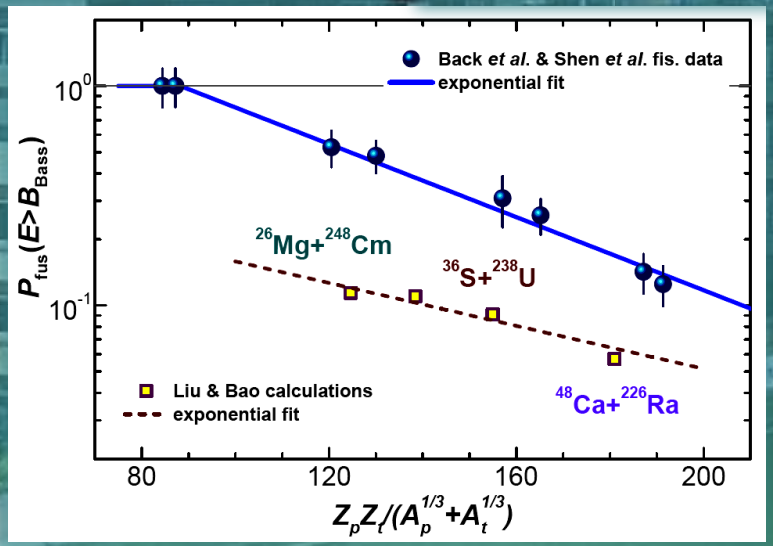
Energy dependence of P_{fus} derived from fission (ER) data and P_{fus} systematics

I.M. ITKIS *et al.*, PRC 83, 064613 (2011)

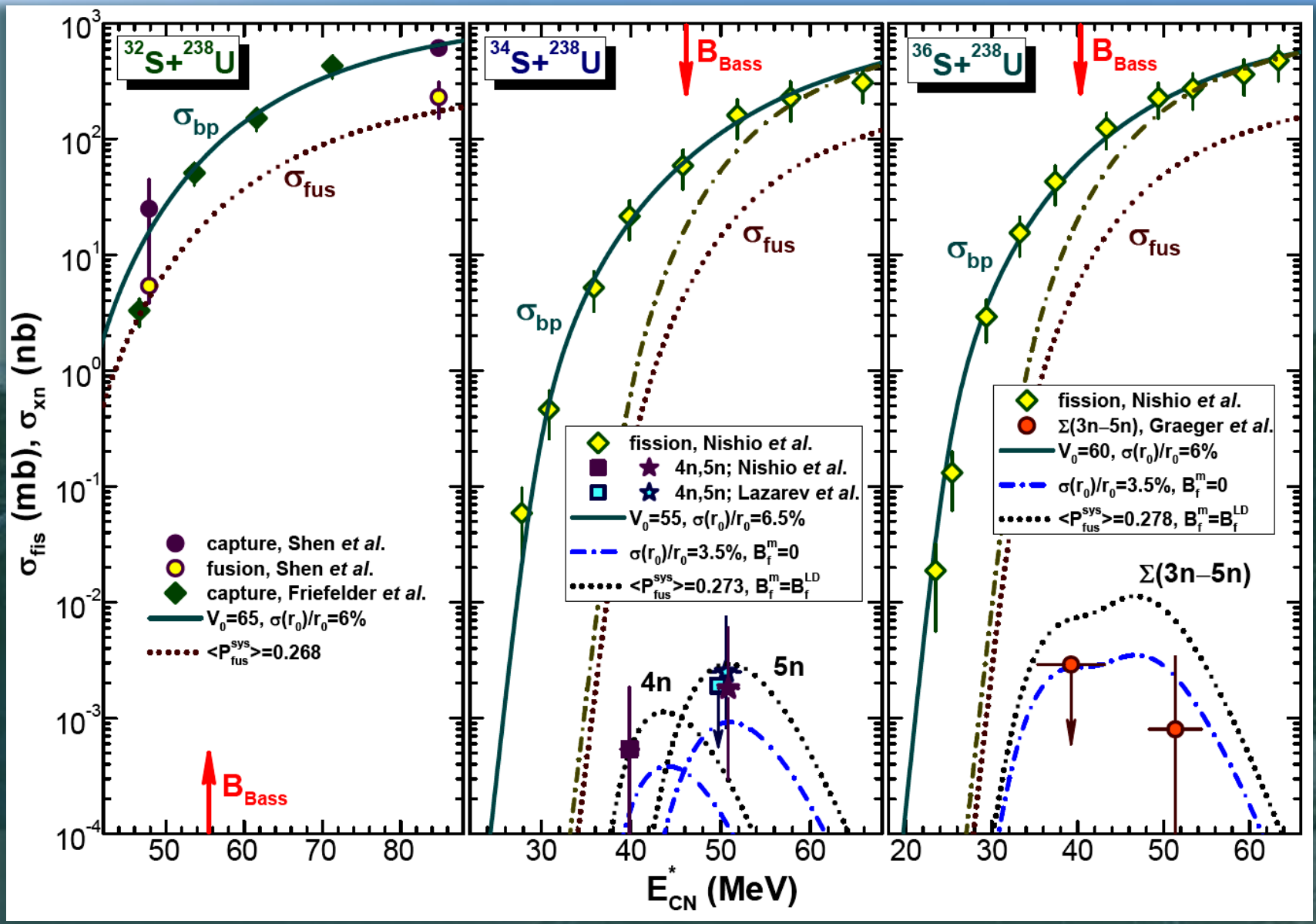




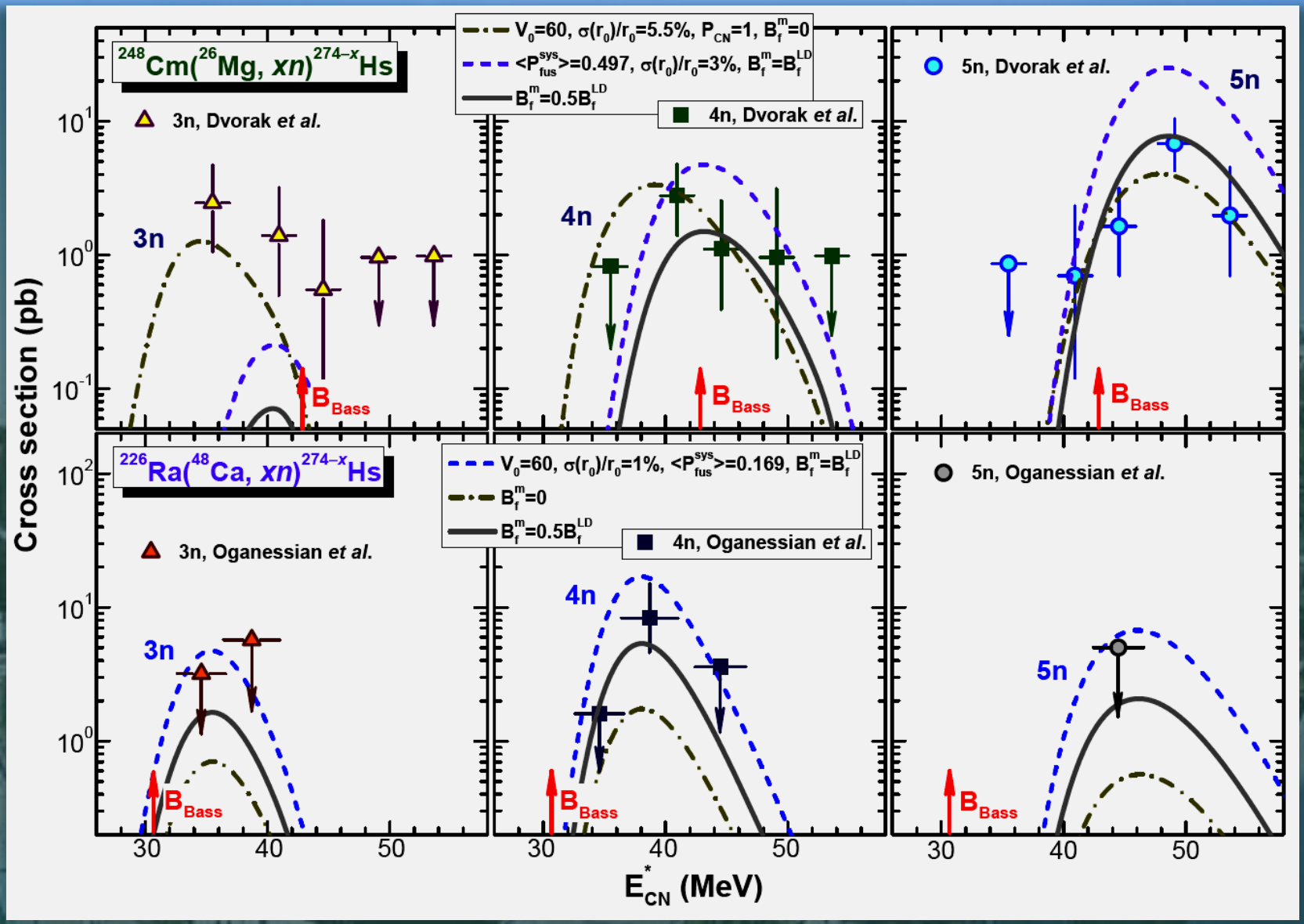




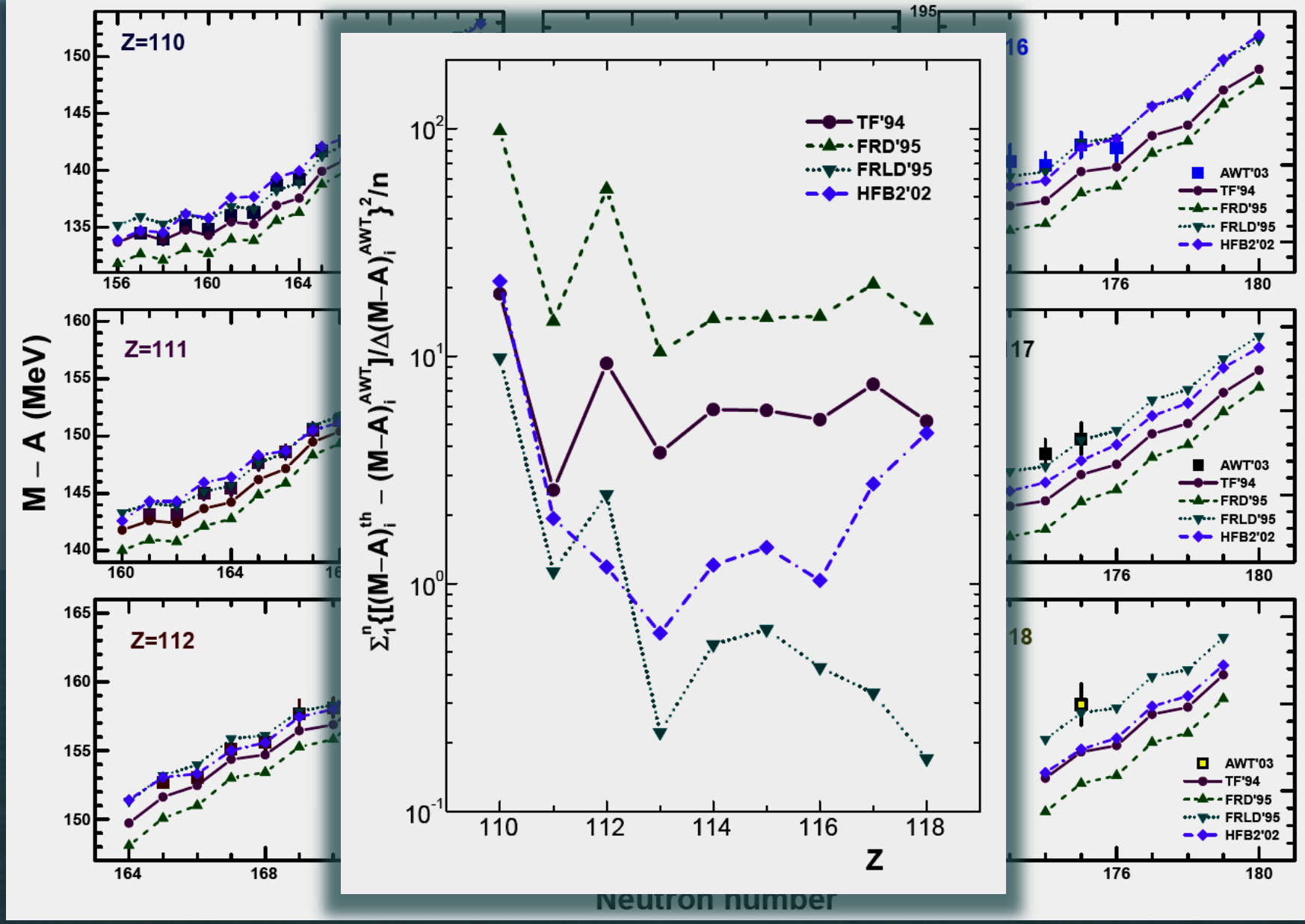
Hs production in S+^{238}U fusion reactions



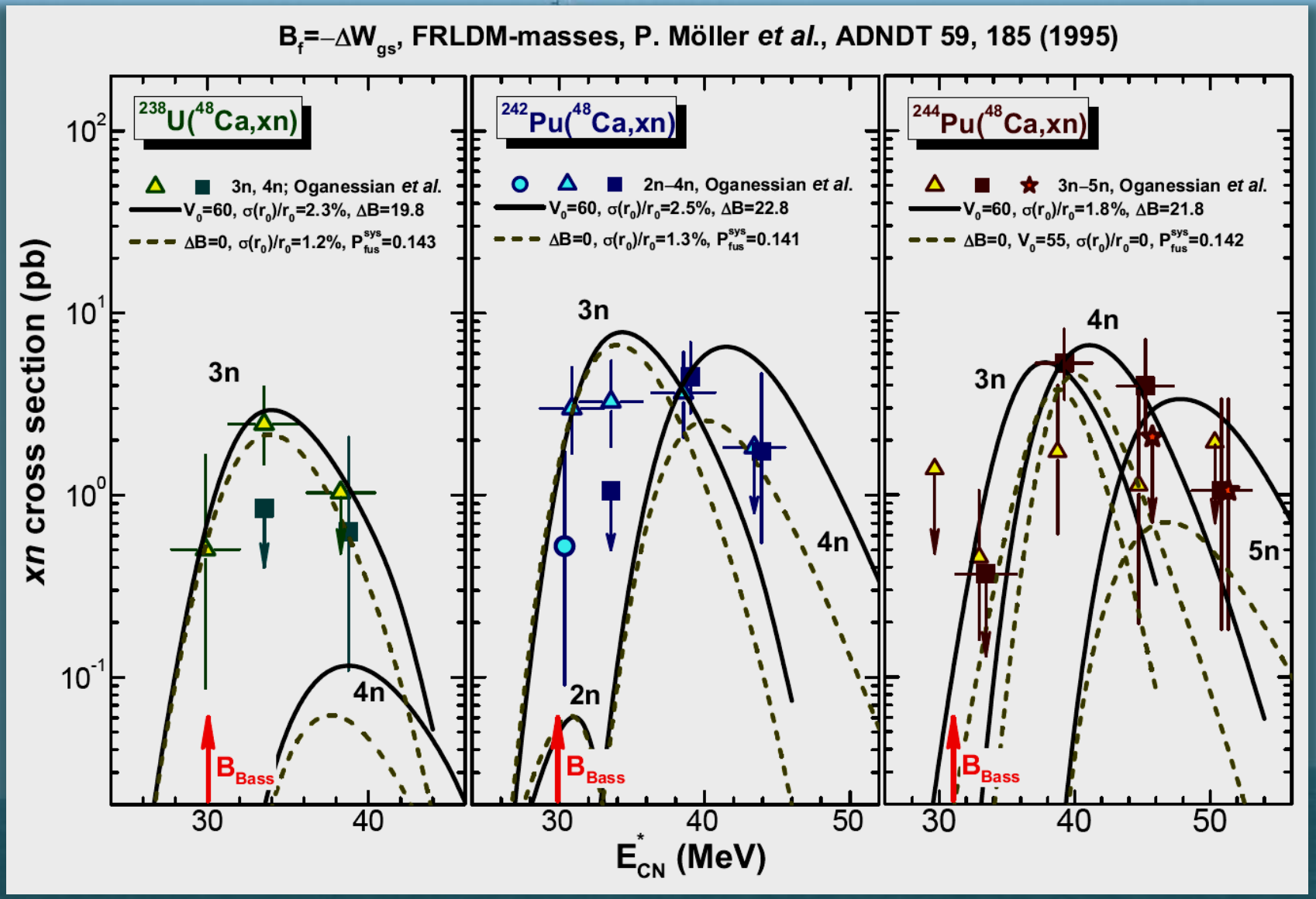
Hs production in the $^{26}Mg+^{248}Cm$ and $^{48}Ca+^{226}Ra$ fusion reactions



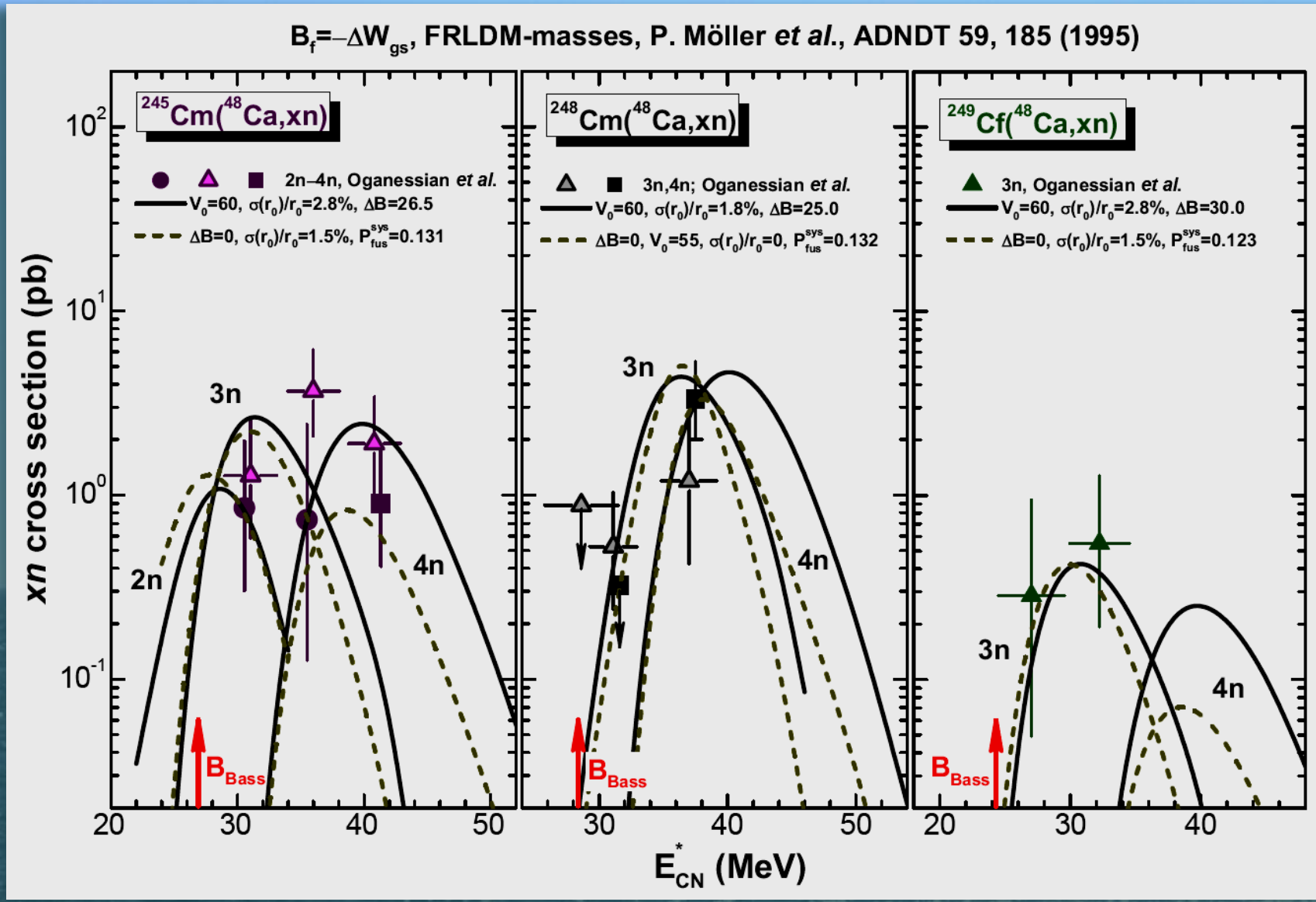
Fission barriers for the heaviest nuclei



Production cross sections for Z=112, 114 nuclei in ^{48}Ca induced reactions



Production cross sections for Z=116, 118 nuclei in ^{48}Ca induced reactions



Summary and conclusion

- **Being critical and correlating values in the estimates of ER cross sections, fusion probability and survivability in CN-reactions leading to heavy and heaviest nuclei were considered using the potential barrier passing model for capture and statistical model (SM) for the CN de-excitation.**

- **The survivability of heavy nuclei produced in the vicinity of a 126 neutron shell in very asymmetric projectile-target combinations can be reproduced with reduced values of the liquid-drop (LD) component of fission barriers in the framework of SM. The obtained survivability can be used in the empirical estimates of the fusion probability for more symmetric reactions.**

- **Production of heavy nuclei from Fm to Rf in very asymmetric "hot" fusion reactions can be reproduced with the 20% increase in the LD component of fission barriers using a similar approach with SM. The corresponding estimates of the fusion probability for more symmetric "cold" fusion reactions are differed from those predicted by theories.**

- **Production of the heaviest nuclei with Z>104 in "hot" fusion reactions induced by massive projectiles can be reproduced with the fusion probabilities obtained from fission data and with some reduction in the LD component of fission barriers (for Hs nuclei). Data analysis implies a disappearance of the macroscopic (LD) component for nuclei with Z>108.**

- **Estimates of atomic masses and shell corrections are mainly responsible for the description of the heaviest nuclei production in reactions induced by ^{48}Ca and heavier projectiles, bearing in mind the absence of the macroscopic component in the fission barriers for these nuclei.**


Thank you for
your attention