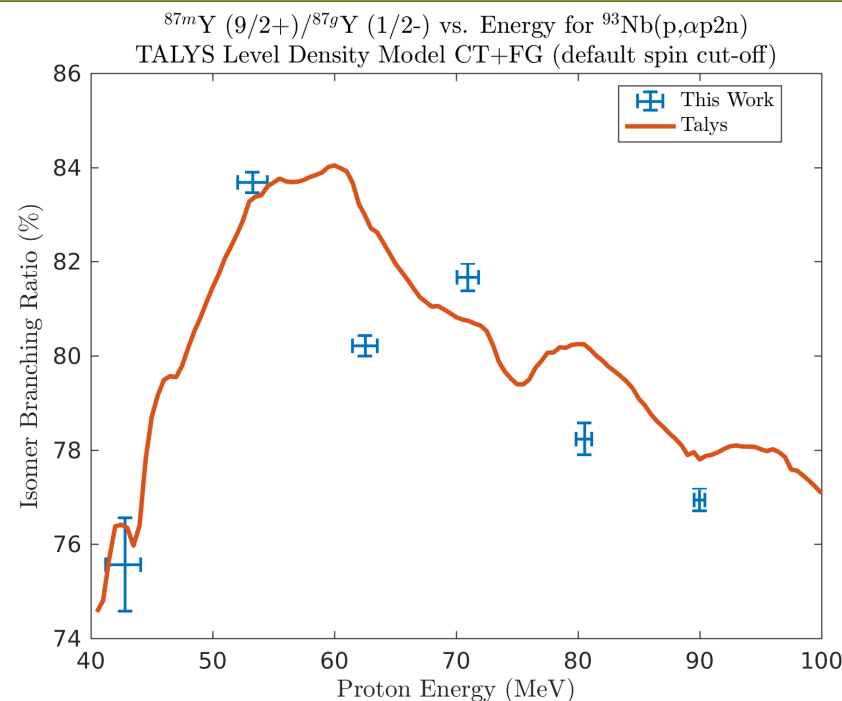
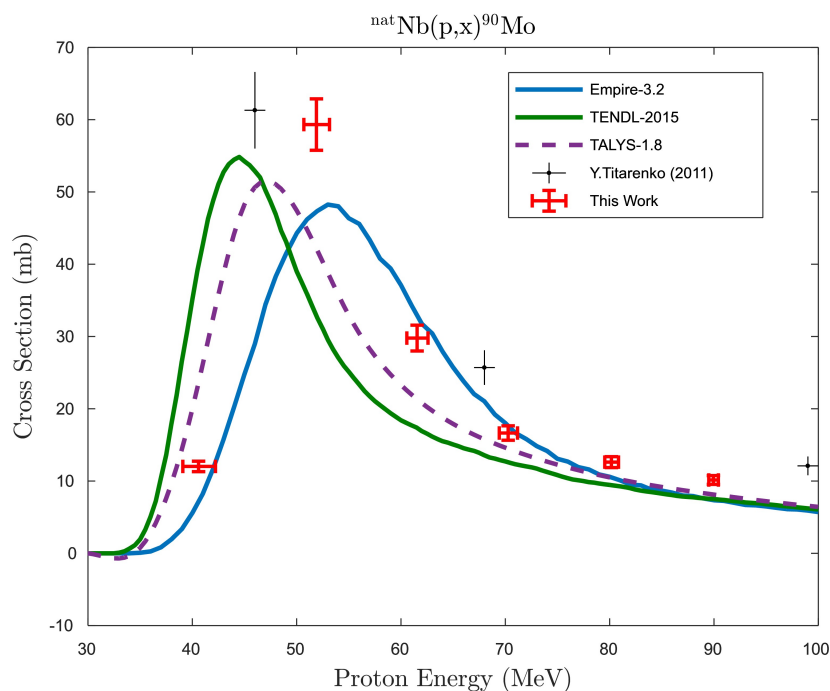


# The USNDP is addressing the need for moderate-energy proton dosimetry standards

- $^{nat}\text{Nb}(p,x)^{90}\text{Mo}$  is a desirable dosimetry standard for  $> 40$  MeV protons.
- Only 1 measurement exists, with 3 points for  $40 \text{ MeV} < E_p < 100 \text{ MeV}^*$ .
- We measured the cross section for  $40 \text{ MeV} < E_p < 90 \text{ MeV}$  at LANSCE-IPF, and have extracted 31 additional cross sections in the process:

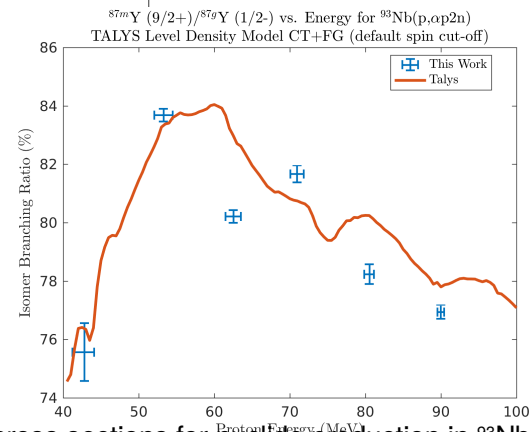
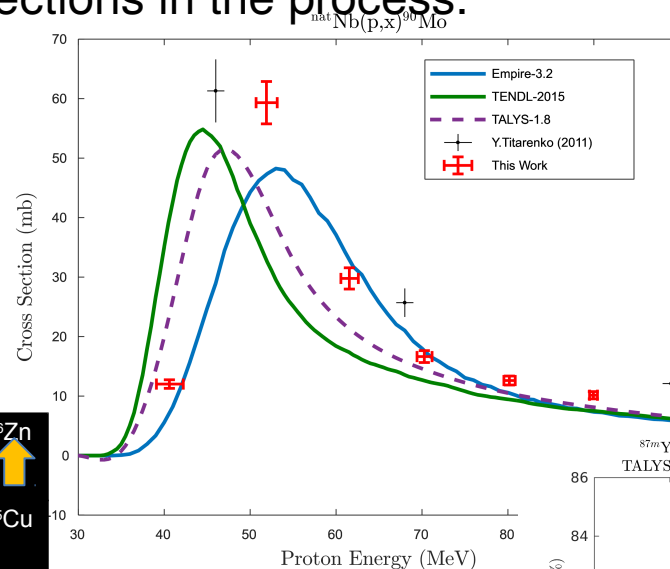
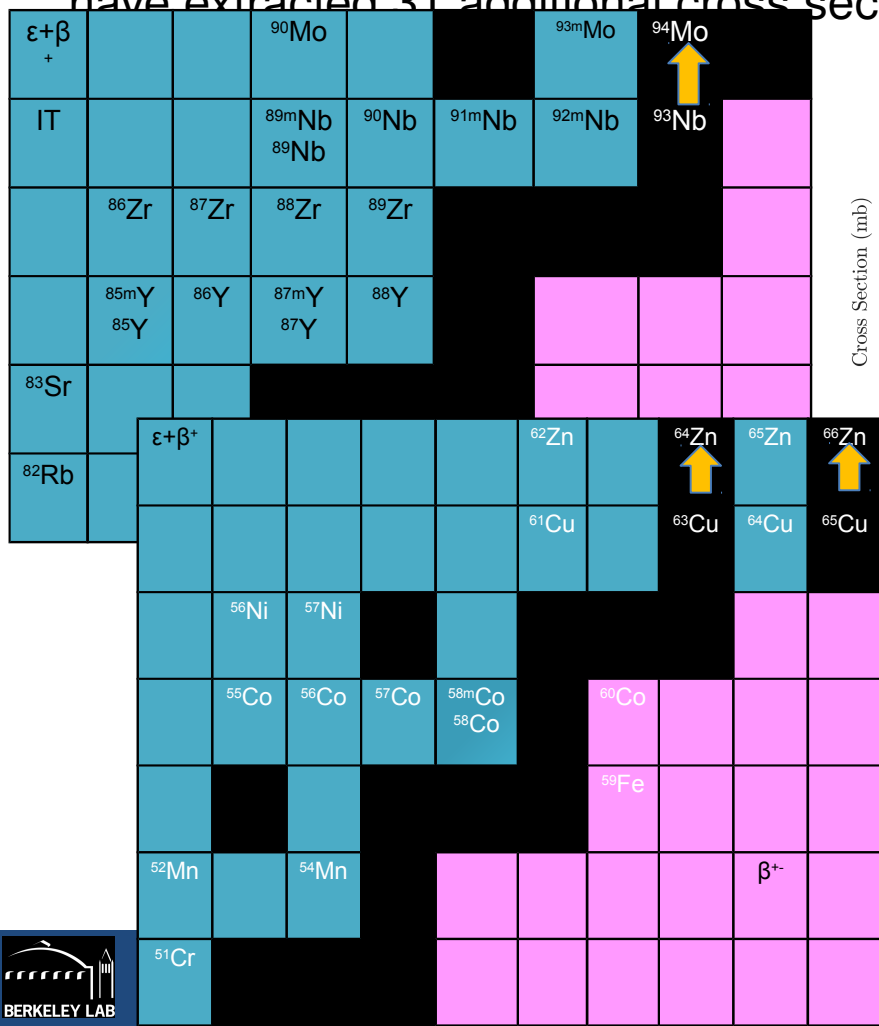
- $^{nat}\text{Nb}(p,x)$ :  $^{82}\text{Rb}$ ,  $^{83}\text{Sr}$ ,  $^{85m}\text{Y}$ ,  $^{85}\text{Y}$ ,  $^{86}\text{Y}$ ,  $^{86}\text{Zr}$ ,  $^{87}\text{Zr}$ ,  $^{87m}\text{Y}$ ,  $^{87}\text{Y}$ ,  $^{88}\text{Y}$ ,  $^{88}\text{Zr}$ ,  $^{89m}\text{Nb}$ ,  $^{89}\text{Nb}$ ,  $^{89}\text{Zr}$ ,  $^{90}\text{Mo}$ ,  $^{90}\text{Nb}$ ,  $^{91m}\text{Nb}$ ,  $^{92m}\text{Nb}$ ,  $^{93m}\text{Mo}$
- $^{nat}\text{Cu}(p,x)$ :  $^{51}\text{Cr}$ ,  $^{52g}\text{Mn}$ ,  $^{54}\text{Mn}$ ,  $^{55}\text{Co}$ ,  $^{56}\text{Co}$ ,  $^{56}\text{Ni}$ ,  $^{57}\text{Co}$ ,  $^{57}\text{Ni}$ ,  $^{58m}\text{Co}$ ,  $^{58g}\text{Co}$ ,  $^{59}\text{Fe}$ ,  $^{60}\text{Co}$ ,  $^{61}\text{Cu}$ ,  $^{62}\text{Zn}$ ,  $^{64}\text{Cu}$ ,  $^{65}\text{Zn}$



\* Measurement and simulation of the cross sections for nuclide production in  $^{93}\text{Nb}$  and  $^{nat}\text{Ni}$  targets irradiated with 0.04- to 2.6-GeV protons » Yu.E. Titarenko (2011)

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# Measurements @ LANL – Nb(p,x)

