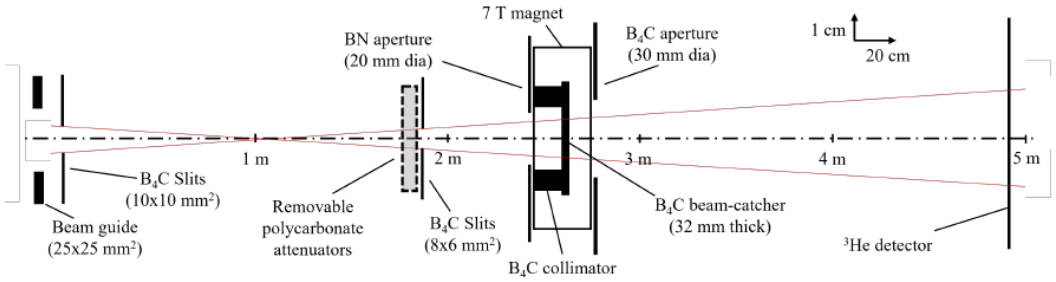
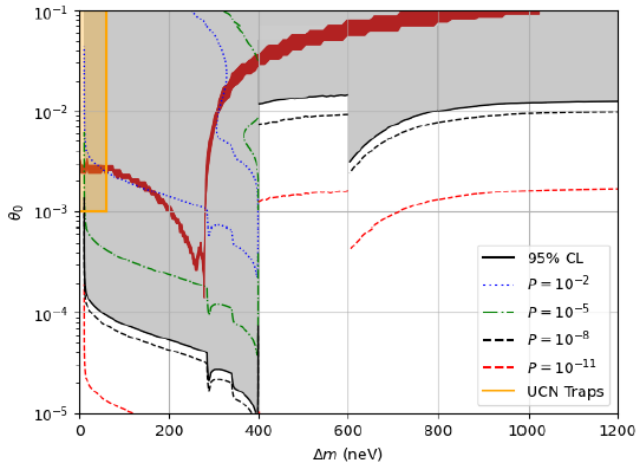
ORNL experiment

Broussard et al. arXiv:2111.05543

Testing this scenario via $n \to n' \to n$ in strong magn. fields

Difference of neutron counts between $B = 0$ and $B = 5$ T





For $\Delta m \gg 1$ μeV initial state in the beam is not n but the light eigenstate $n_1 = cn - sn'$ (heavier n_2 cannot be bounced by the walls of guide)

From $H = \begin{pmatrix} m_n & \epsilon \\ \epsilon & m_{n'} \end{pmatrix}$ follow two levels of energy: $E_{1,2} = \frac{m_n + m_{n'}}{2} \pm \sqrt{\left(\frac{m_n - m_{n'}}{2}\right)^2 + \epsilon^2}$

For large $\Delta m \gg \epsilon$ $E_{1,2} = \overline{m} \pm \frac{|\Delta m|}{2}$ Berezhiani is talking about $\Delta m \cong 1\mu eV = 1000\, neV = 10^{-6}\, eV$

He compare this with Fermi potential of the neutron guide (say, pure Ni $V_F(Ni) = 252\, neV$)

In the guide the transversal velocity of the neutron $T_n = T_\parallel + T_\perp$ is reflected if it is less than V_F

$T_\perp < V_F$ or $v_\perp < \sqrt{\frac{2V_f}{m_\pm}} = 6.95\,\frac{\mathrm{m}}{\mathrm{s}}$ for Ni In reflection $\theta_{max} < \frac{v_\perp}{v_{tot}} = \frac{6.95}{1000} \cong 0.4°$

typical n-velocity
in cold beam

For $\Delta m = 10^{-6}\, eV$ $v_\perp(m_\pm) = v_\perp(m) \cdot \left(1 \pm \frac{\Delta m}{2m}\right) = v_\perp(m) \cdot (1 \pm 5 \times 10^{-16})$

So, both eigenstates n_1 and n_2 will be successfully reflected, unlike stated by Berezhiani