Our last statement:
"We note that the attenuation of mirror neutrons in matter is an important consideration in calculating limits for this model".

PRL Comment: As it stands this comment is very open ended and as a non-expert, we have trouble interpreting it. We assume that attenuation would reduce the limits, but don't have a good feeling for the degree. It would be good to provide a bit more context here. How important is this caveat?

Interpretation: why it is open ended? Does PRL think that this attenuation was not included in calculation, or included with uncertainty? Or we did not include it, but should be, and this might change the result and reduce the limit?

Can this be a fix? (Yuri's suggestion)
"We note that the attenuation of mirror neutrons routinely included in our density matrix calculation is induced by the oscillation effect in absorptive matter that additionally can be enhanced when $|V_F + \mu B - \Delta m|$ compensation becomes small. This is an important consideration for the calculation of limits for this model".

No previous oscillations in the vacuum before absorber

$P_{nn} = 7.937 \times 10^{-40}$

Exp(-3500/39)=1.06×10^{-39}

ρ – evolution calculation with averaged vacuum oscillation $\rho(0)$

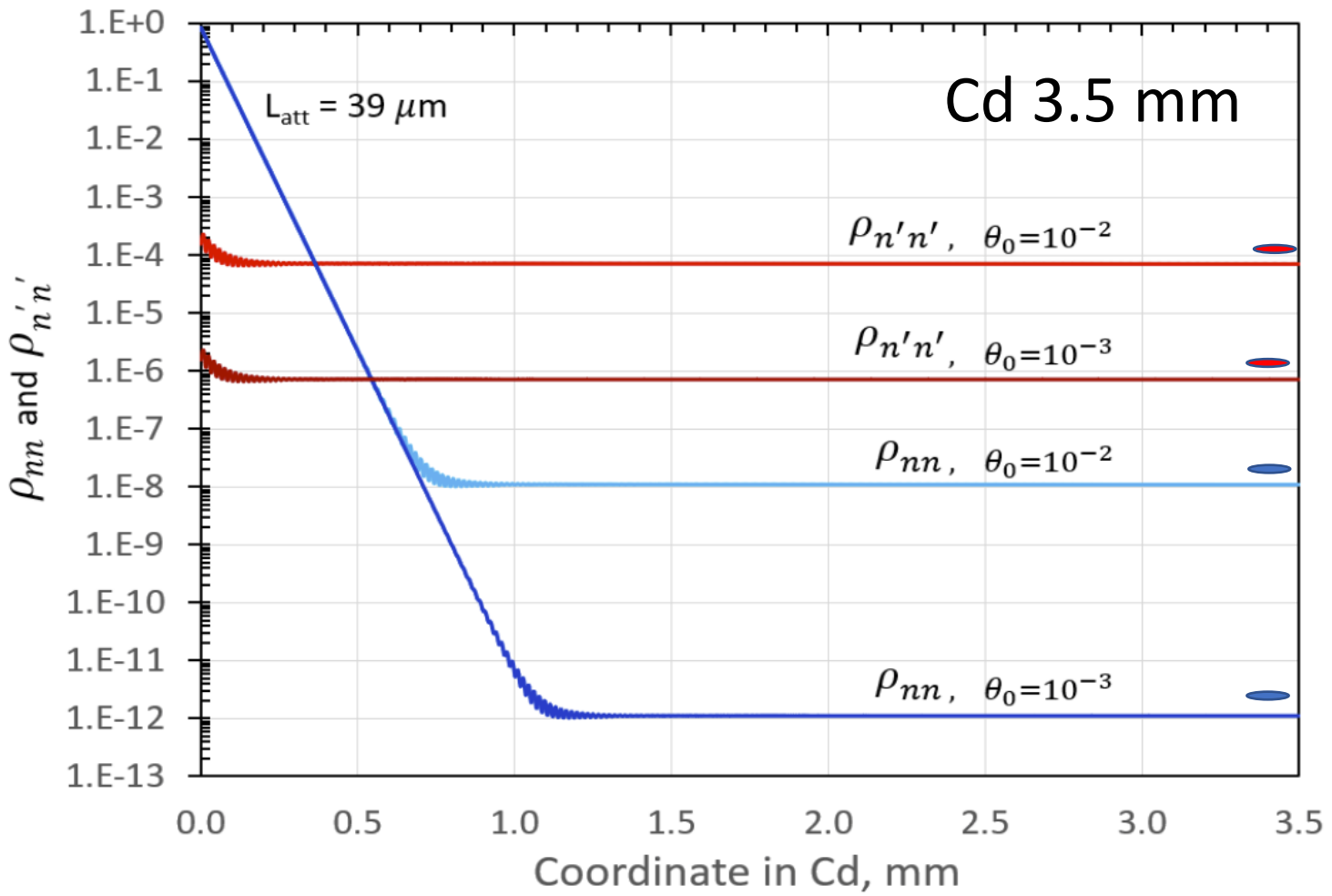
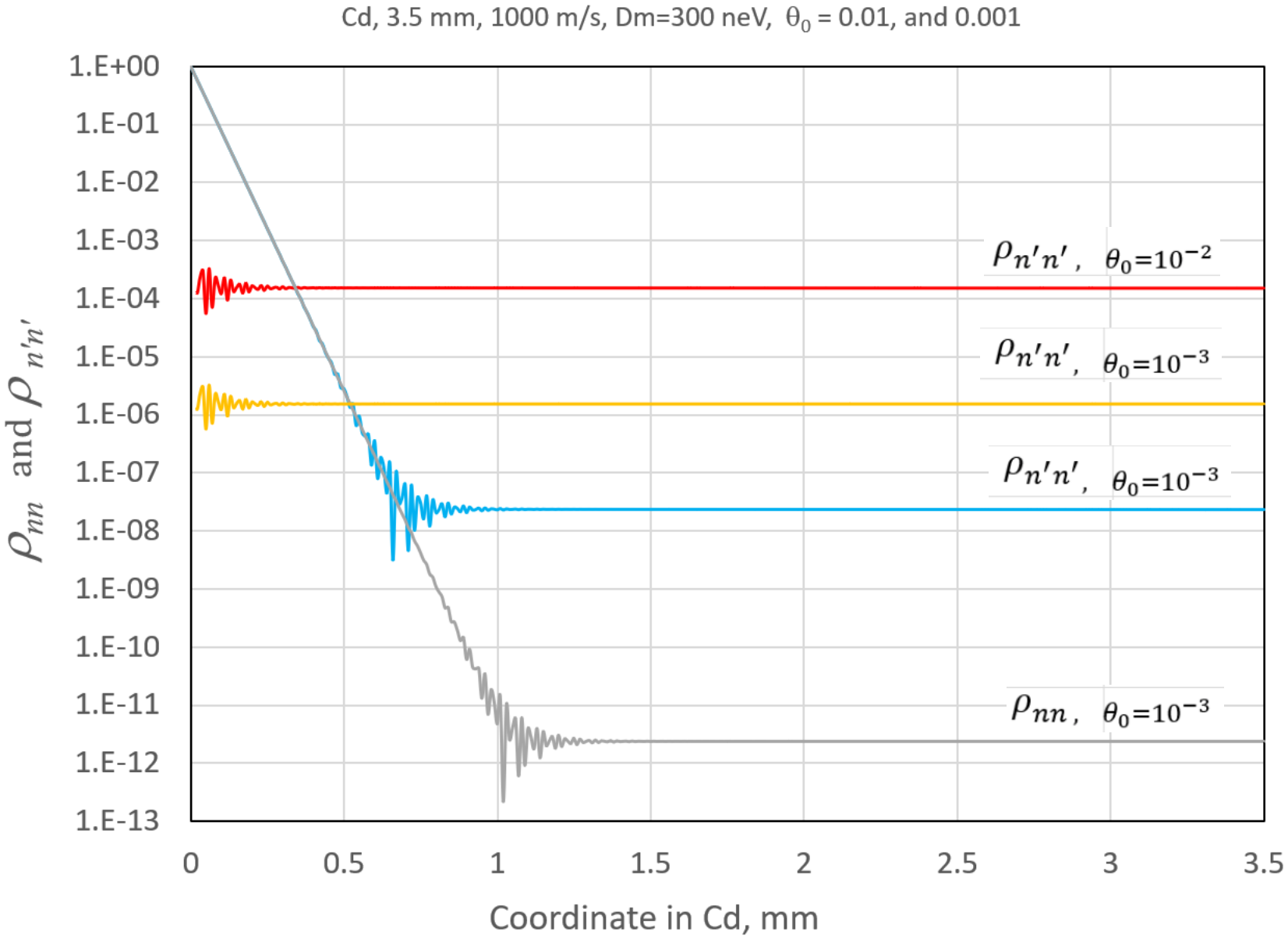
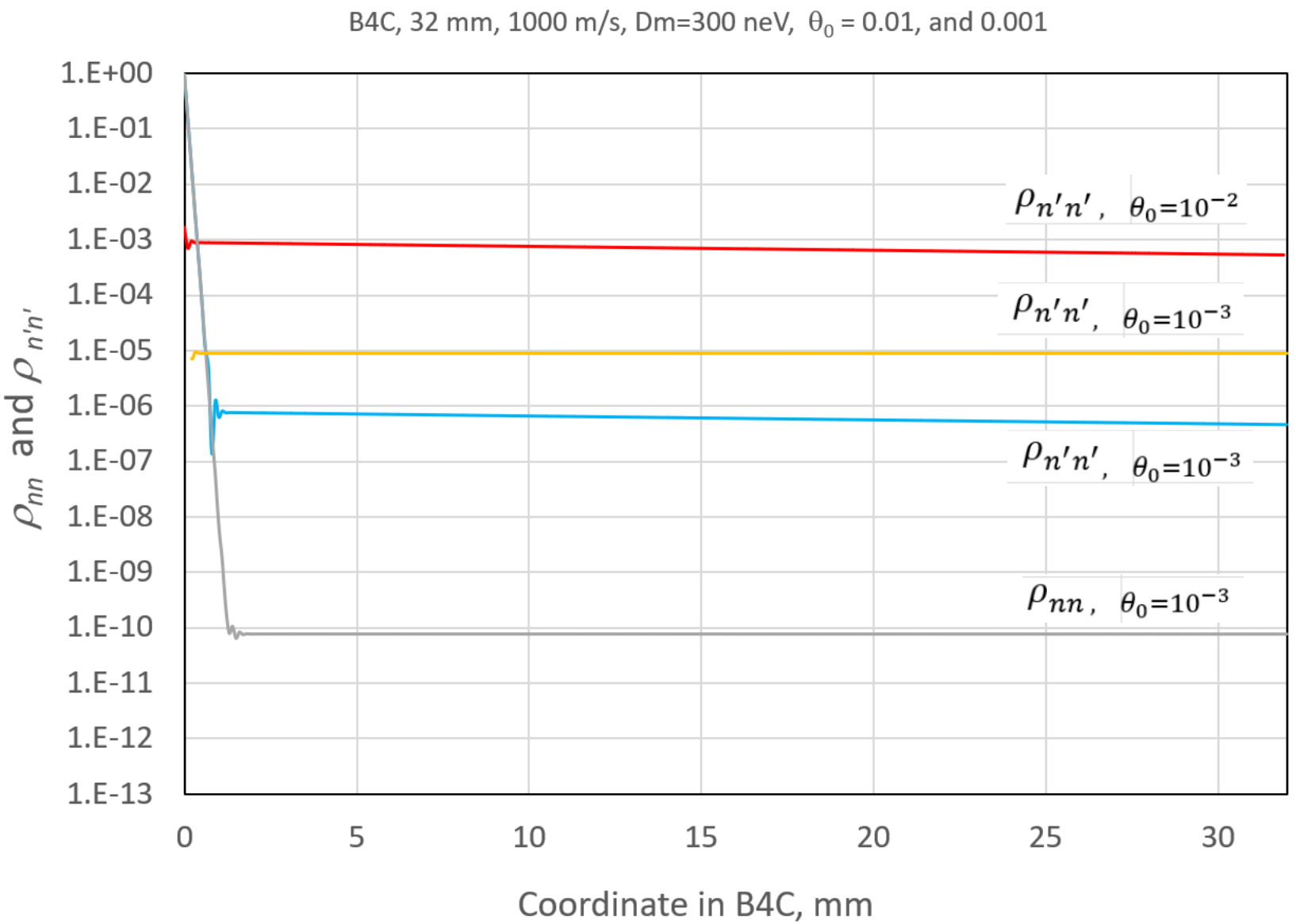


Figure 1. Evolution of (n, n') system in a 3.5 mm Cd absorber for $\Delta m = 300$ neV, $\theta_0 = 10^{-2}$ and 10^{-3}, and for velocity $v = 1000$ m/s. The averaged density matrix at the entrance of the Cd absorber after passing 3 m in air is used as an initial condition. Magnetic field is $B = 0$. Neutron components ρ_{nn} are shown in light/dark blue and mirror neutron component $\rho_{n'n'}$ in light/dark red colors.

Analytical solution (Zurab) with $\Psi(0) = (1\,,0)^T$

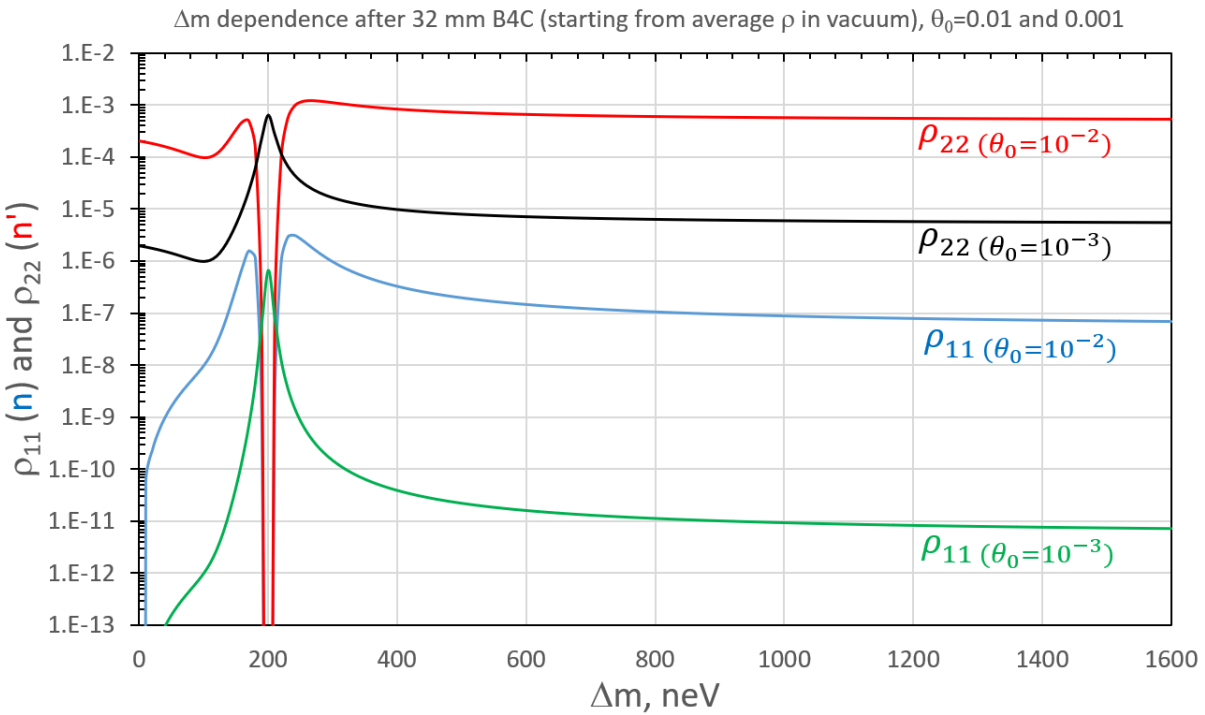


Analytical solution (Zurab)

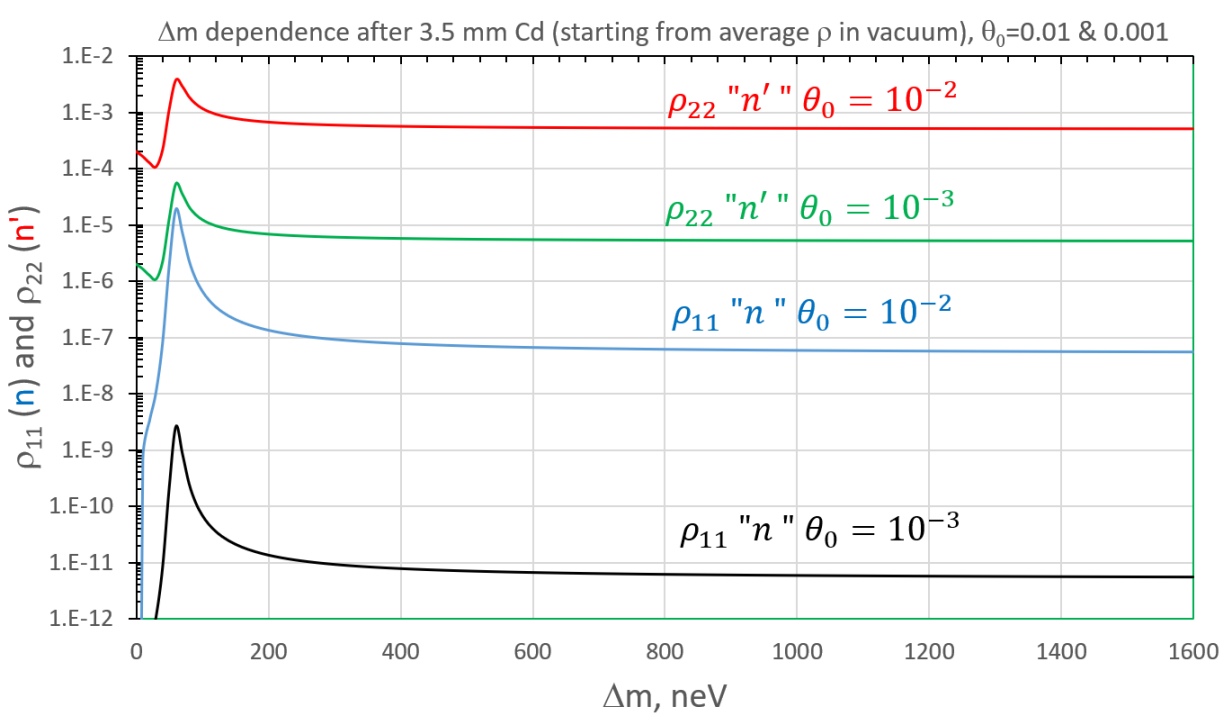


$V_F = \Delta m$ possible resonance inside the absorber

B4C absorber 32 mm



Cd absorber 3.5 mm



Where is absorption resonance in Cd?
Answer: at still larger θ_0 (see below)

Initial state: average density matrix $\rho(0)$ in vacuum

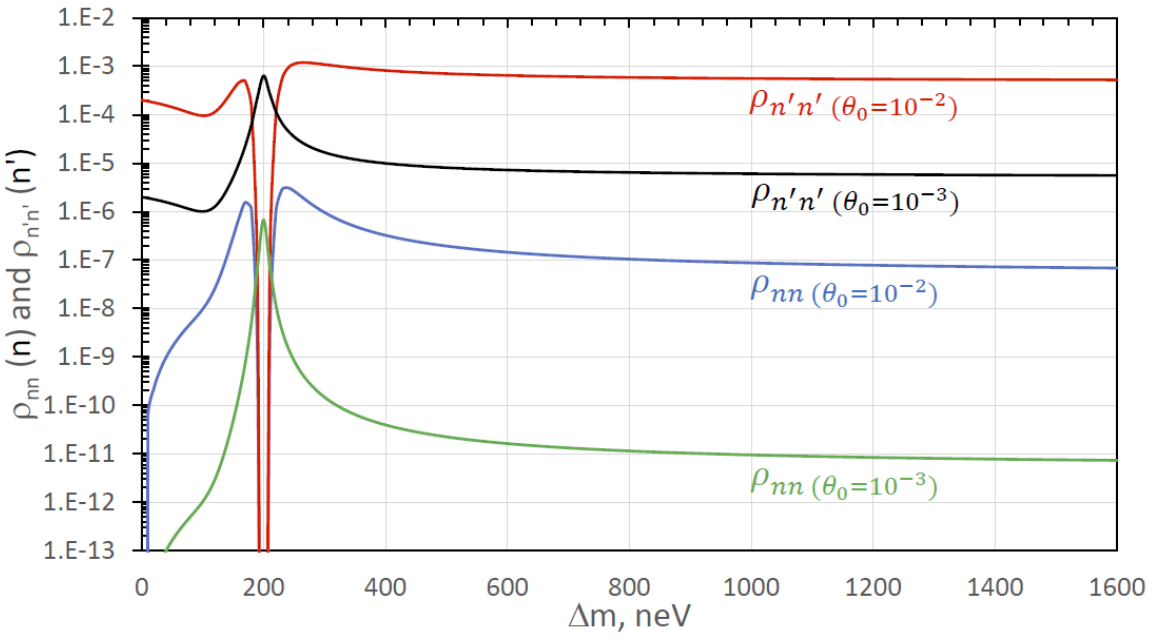
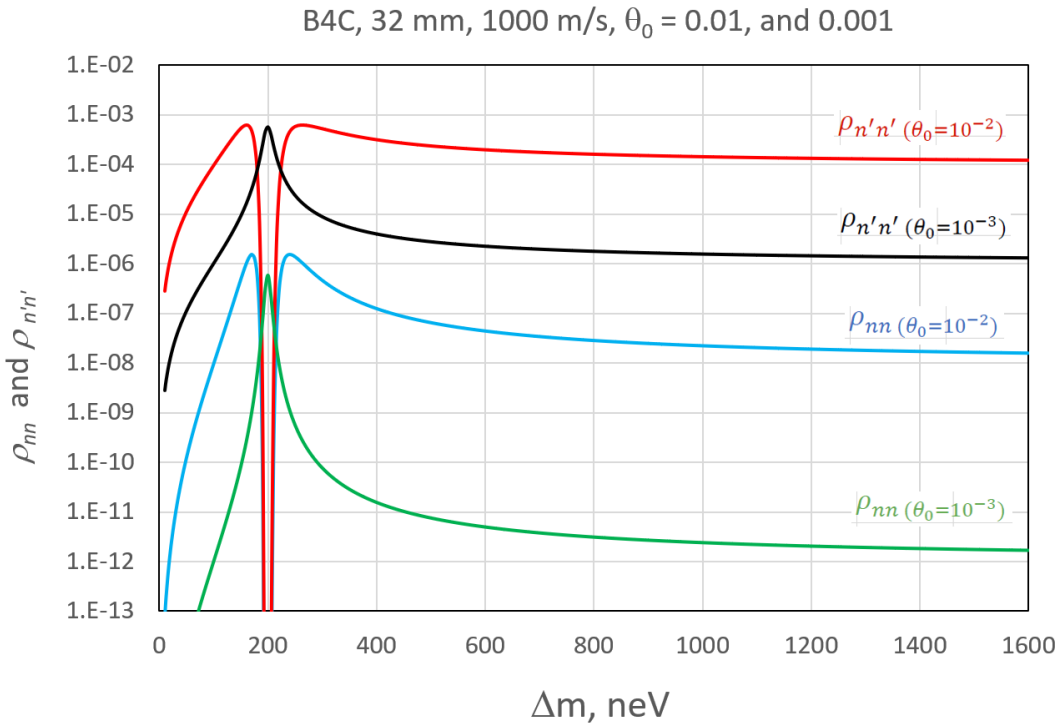


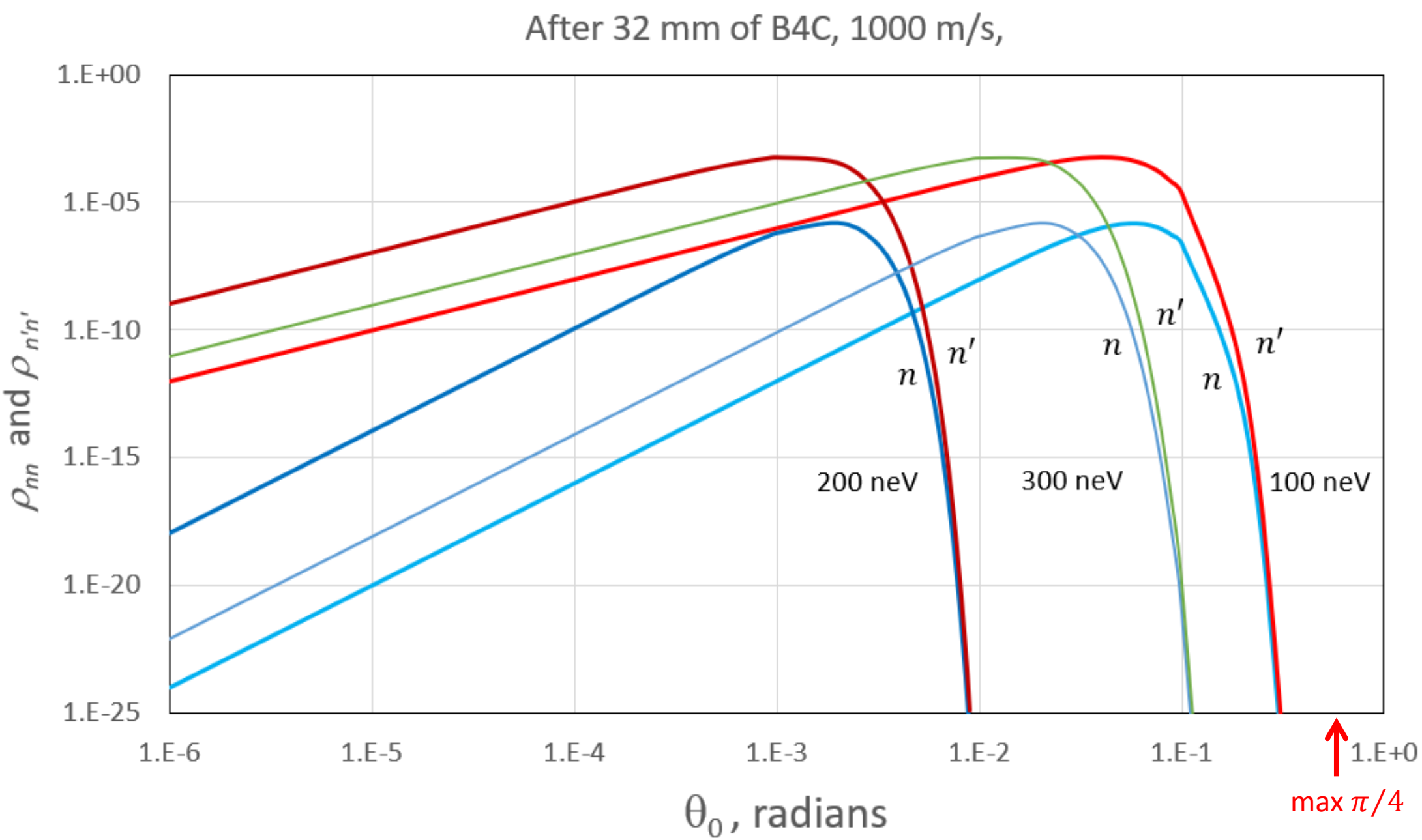
Figure 2. Δm dependence of probability ρ_{nn} and $\rho_{n'n'}$ for two values of angles $\theta_0 = 0.01$ and 0.001 after the neutron passes through the 32 mm B_4C absorber starting from the average density matrix in a vacuum. The value for the magnetic field $B = 0$.

Density matrix evolution

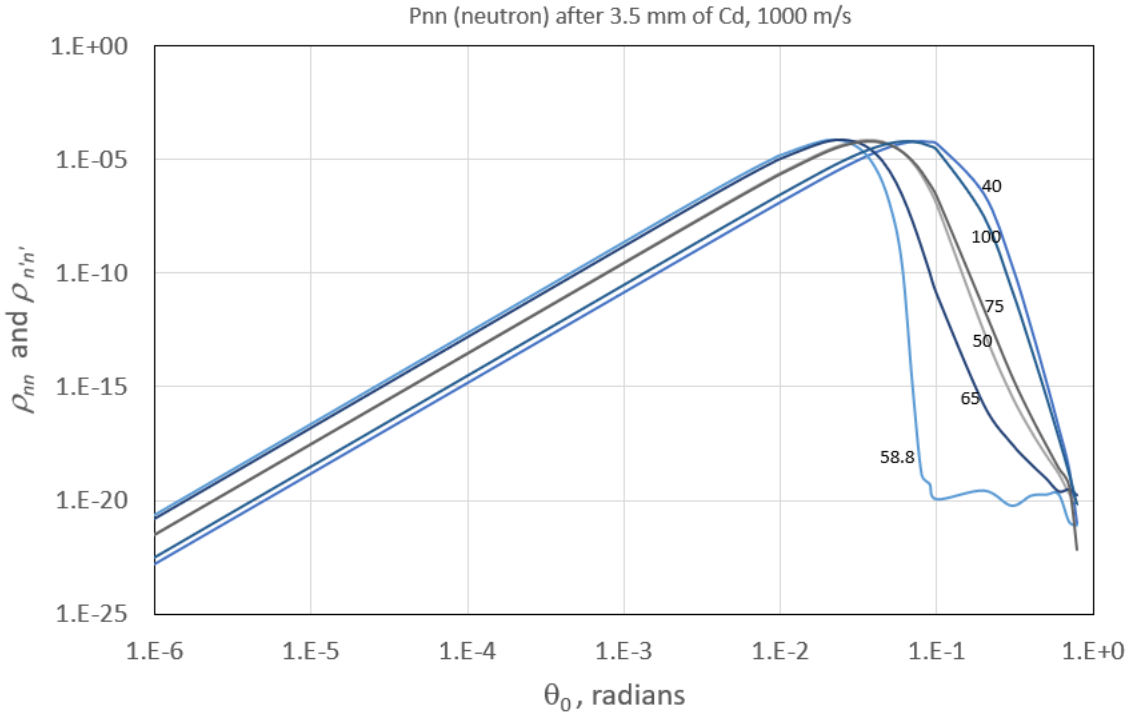
Initial state $\Psi(0) = (1,0)^T$

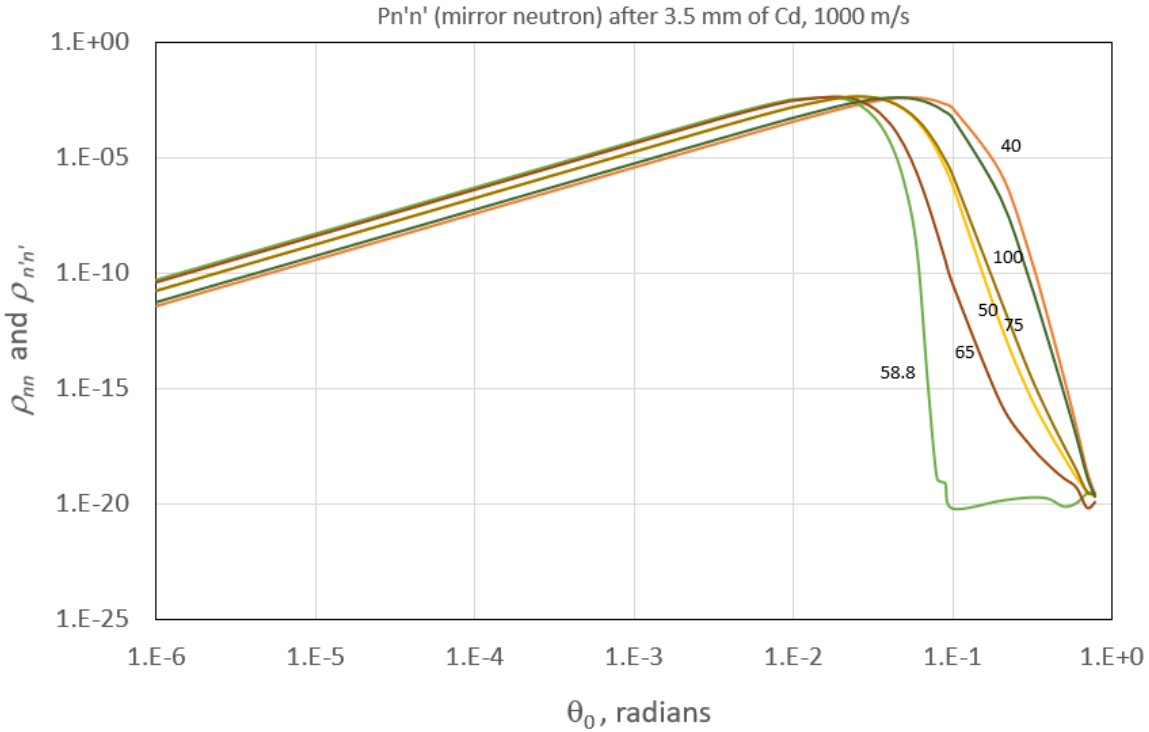


Analytical solution (Zurab)


After 32 mm of B4C, 1000 m/s,
1.E+00
1.E-05
1.E-10
1.E-15
1.E-20
1.E-25
ρ_{nn} and $\rho_{n'n'}$
1.E-6
1.E-5
1.E-4
1.E-3
1.E-2
1.E-1
1.E+0
θ_0, radians
max $\pi/4$
n
n'
200 neV
300 neV
100 neV

3.5 mm Cd , 1000 m/s





Plan of the paper on the GP-SANS Beam characterization

April 26, 2022. Zoom n-n'

1. Short introduction, motivation – search for rare oscillation processes
2. The cold source and bended transport channel and GP-SANS scheme with names terms nomenclature.
3. Initial design of Herb Mook (spectrum, divergence, intensity)
4. Brightness of the source MCNP (Franz-Erik-postdoc) and McStas of transport channel (Lisa?) at two points: (a) before velocity selector z=0 m and (b) at the position of sample z≅17 m.
5. Plots from Lisa's McStas at points (a) and (b) with divergence, X-Y beam profile, spectrum, intensity.
6. Measurements of spectrum by TOF: chopper (at sample) + TOF (with the detector at 20 m)
7. Beam divergence measurements (?) at (a) and (b)
8. Intensity measurements by 3 methods:
   8.1 Lowel's monitor (needs spectrum)
   8.2 With PMMA attenuators (measurements with broad spectrum)
   8.3 With gold foil activation (re-measurement, spectrum needed)
9. Conclusion, summary

Study of different absorbers

1. Review all absorber candidates for $V = U - iW$
2. Calculate attenuation vs depth for neutrons (no oscillations)
3. Chose thickness for probability <10^{-40}
4. Include $V = U - iW \pm \mu B$ absorption resonance
5. How attenuation changes in the presence of oscillation with ϵ (nn') mixing
6. Can this be a method of detection of n-n'-n -regeneration in absorber?
7. What limit on ϵ (nn') can be set?