Gravity with UCN
(non-expert's review)

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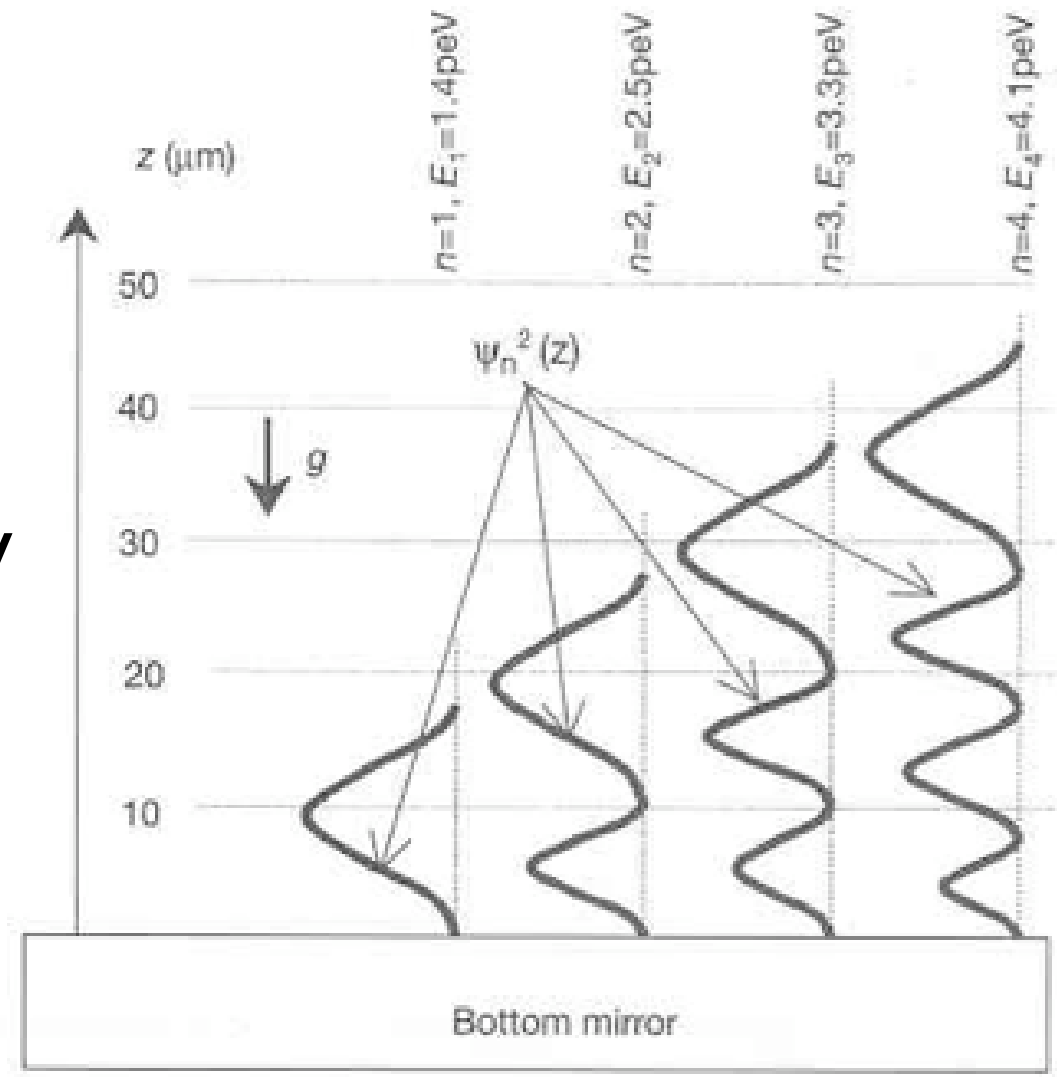
Quantum states of neutrons in gravitational field

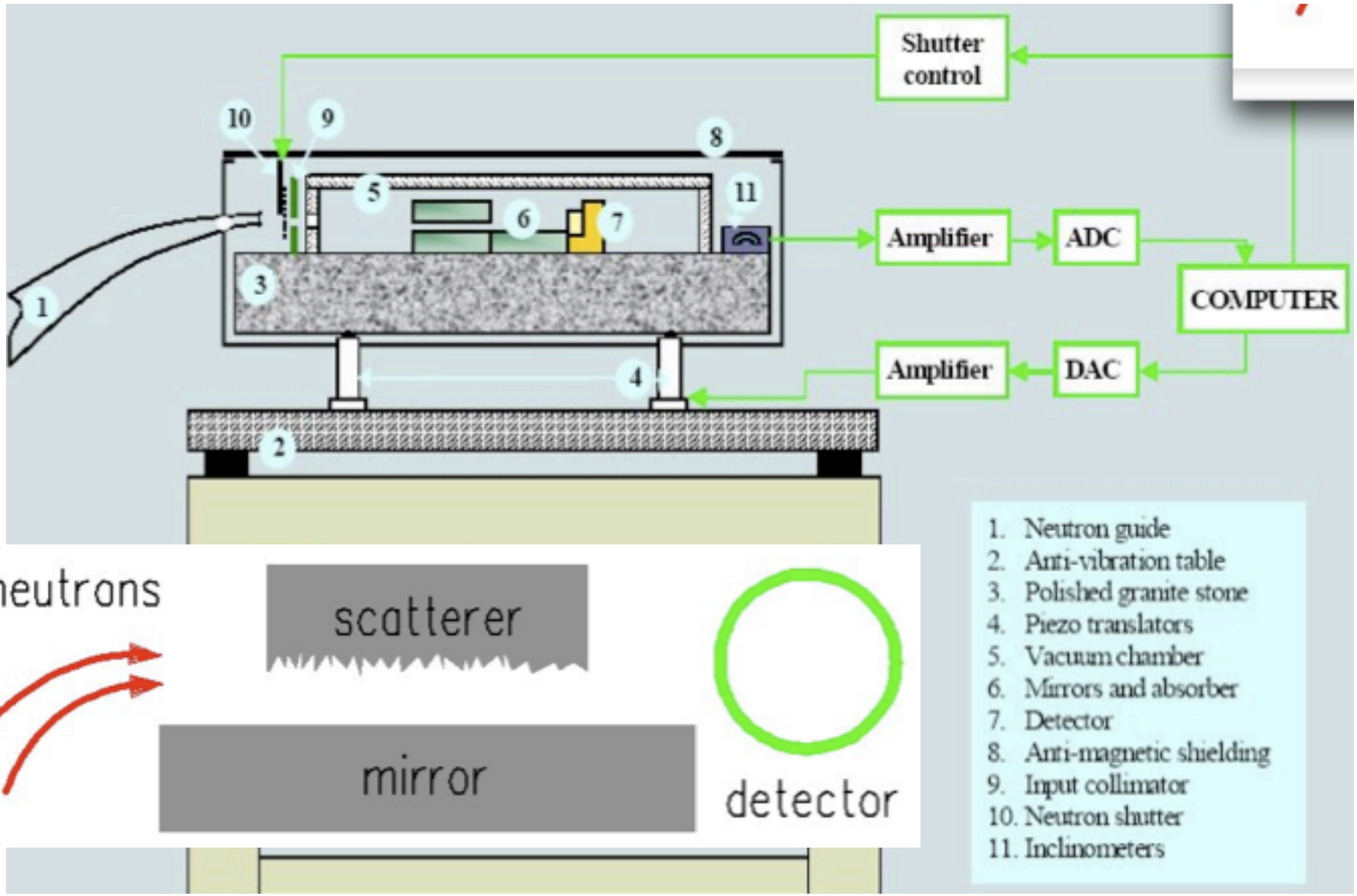
10μm scale

Gravitational potential ~1peV

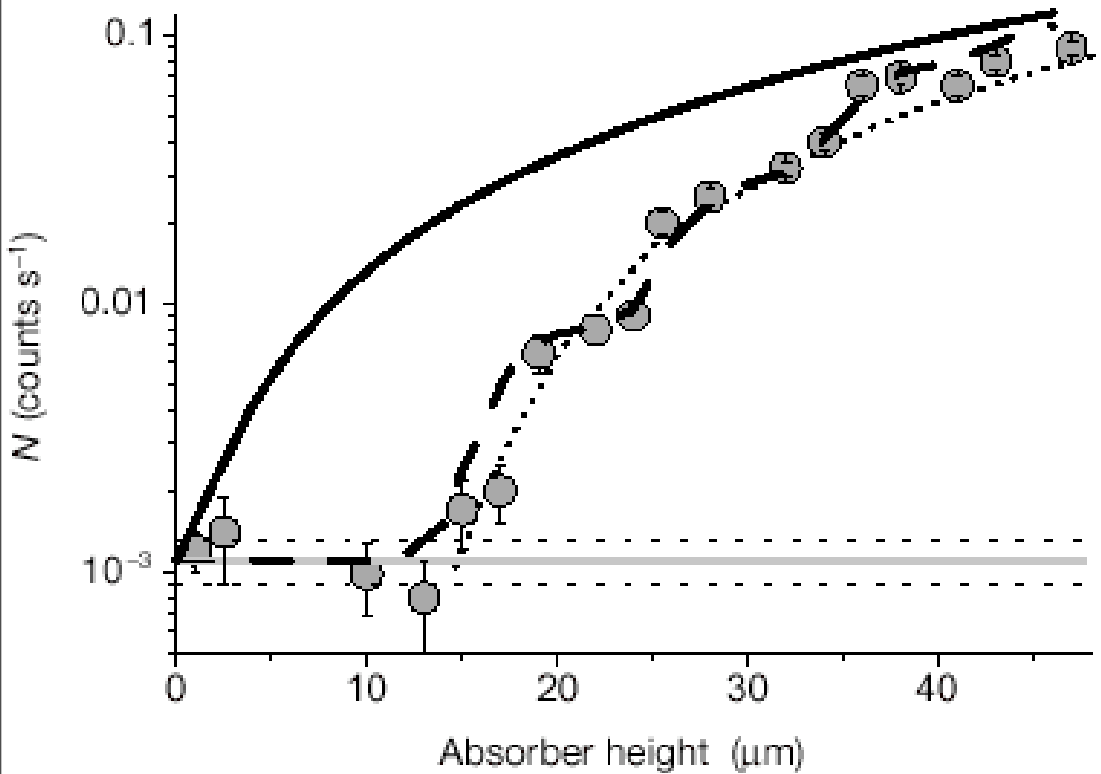
⇒ Compton length ~10μm

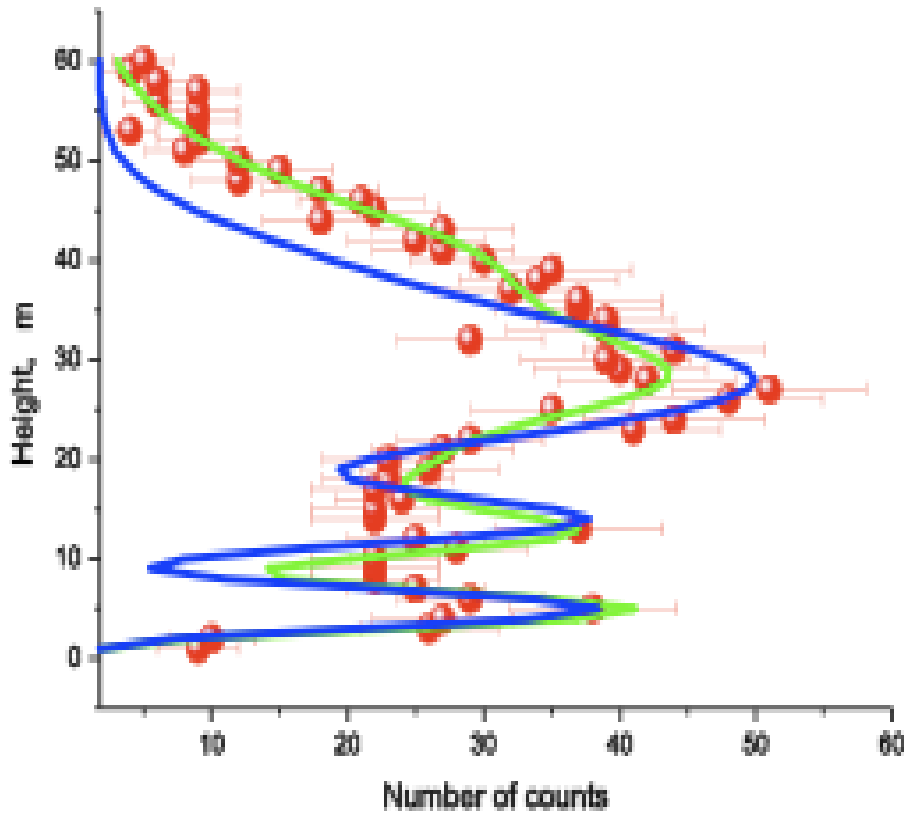


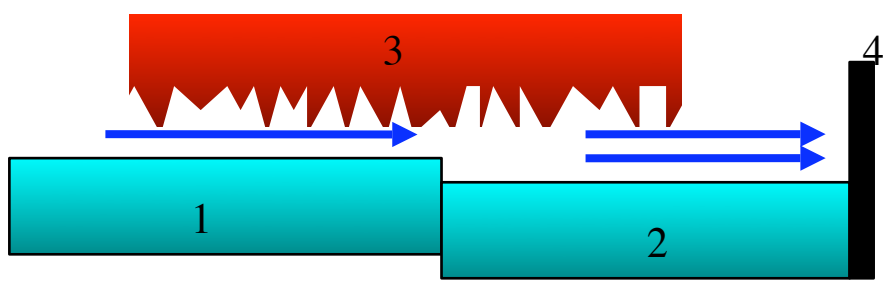
Detector setup



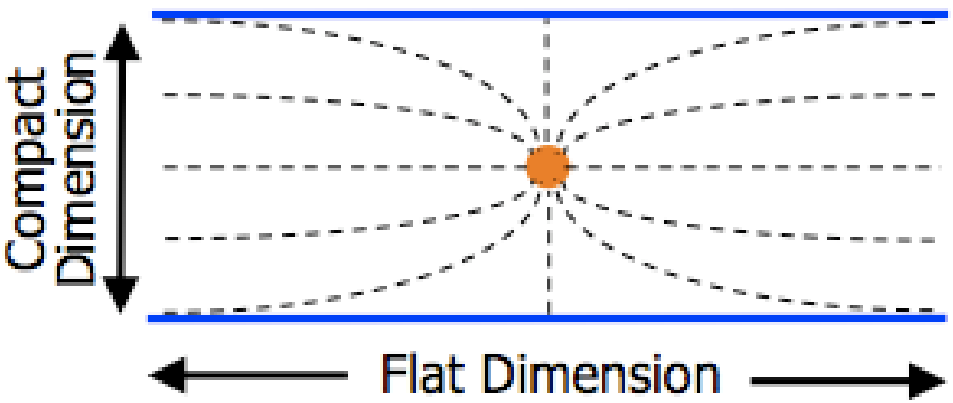
Results


0.1
0.01
10^{-3}
N (counts s^{-1})
0
10
20
30
40
Absorber height (μm)


Height, m
0
10
20
30
40
50
60
Number of counts


3
4
1
2

Extra dimension



$$\phi(x) = \phi(x + 2\pi kR), \quad k = 0, 1, 2 \cdots$$

$$M(G_{KK}) = \sqrt{P_x^2} = 2\pi k/R$$

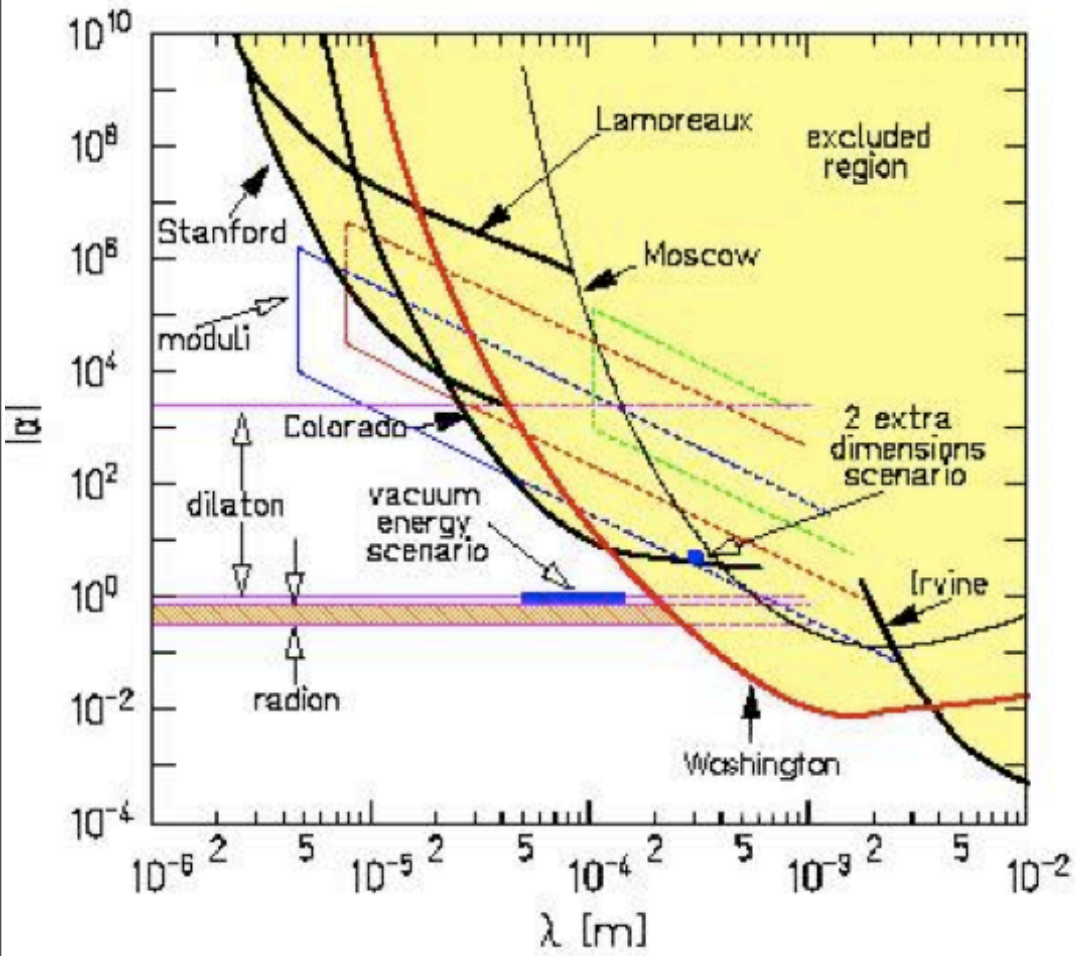
$$F = G_3 \frac{m_1 m_2}{R^2} \qquad r > r_0$$

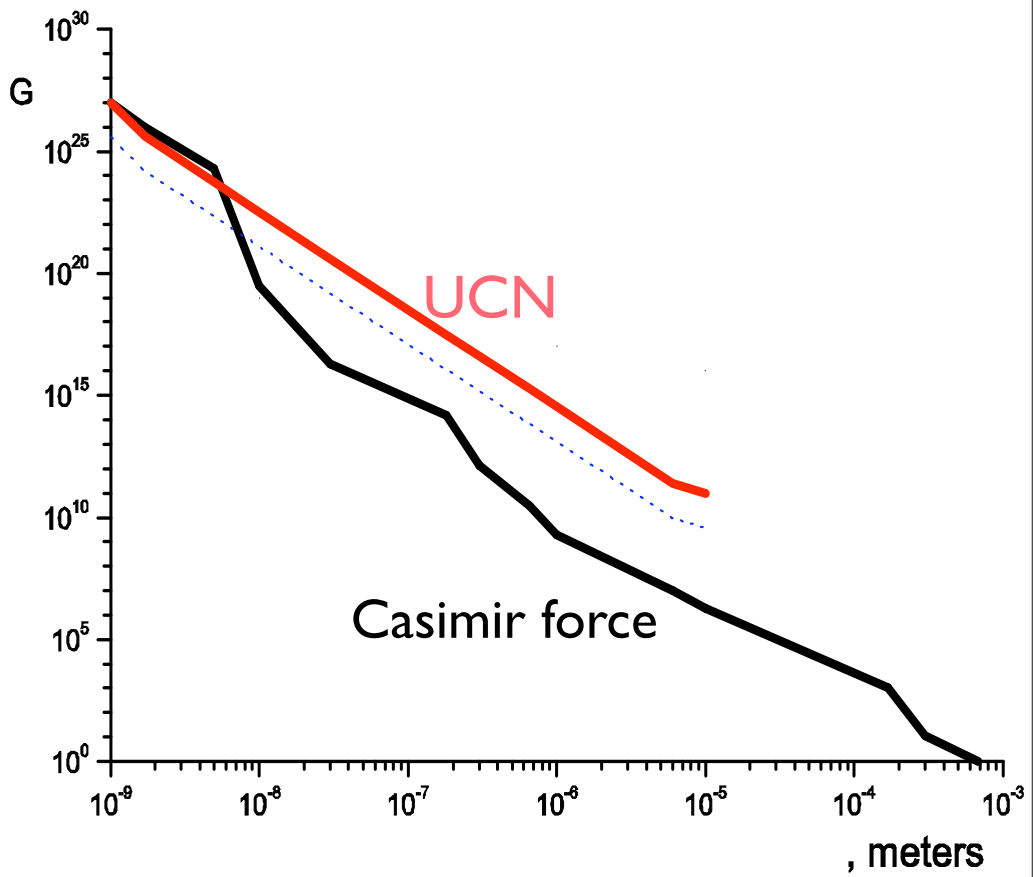
$$F = G_{3+n} \frac{m_1 m_2}{R^{n+2}} \qquad r < r_0$$

$$\phi(r) = -G_4 \int d^3 r \frac{\rho(\vec{r})}{|\vec{r} - \vec{r}'|} \left(1 + \alpha e^{-\frac{|\vec{r} - \vec{r}'|}{\lambda}}\right)$$

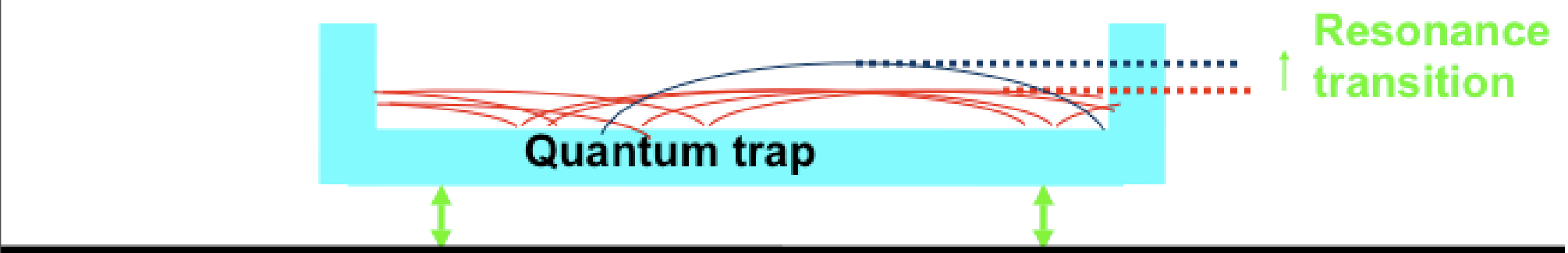
(Yukawa potential)

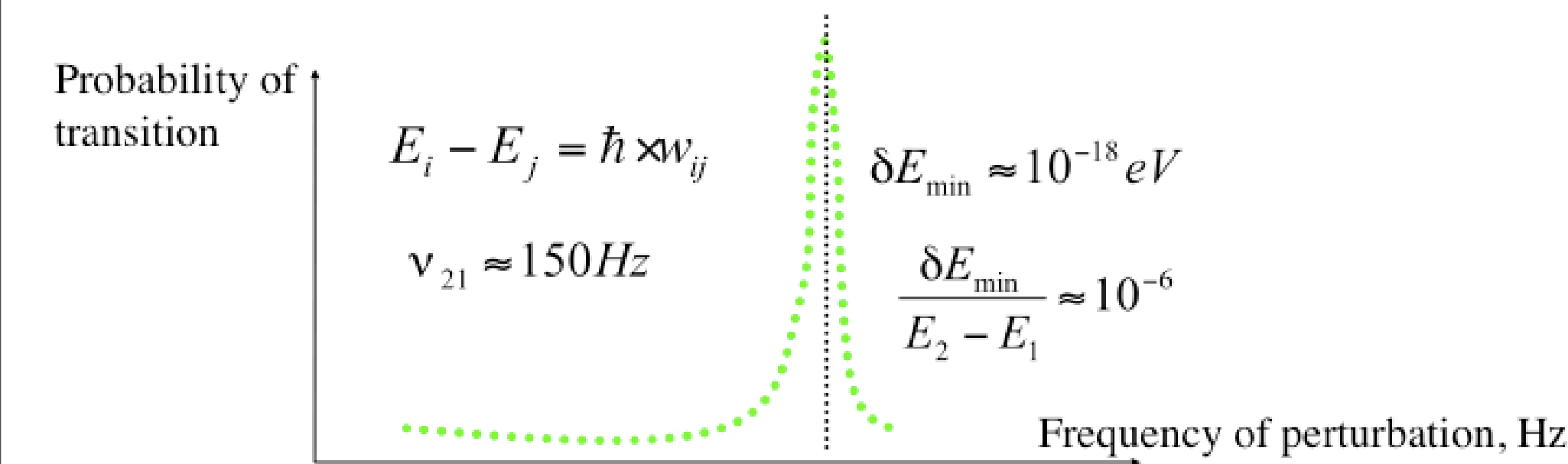
Limit on new new force





Resonance transition between states (GRANIT project)





Improvements with high intensity UCN

- Precision measurement of wave function shape
- Precision measurement of state gap using resonance transition technique
- Search for additional states below the ground state caused by new force?