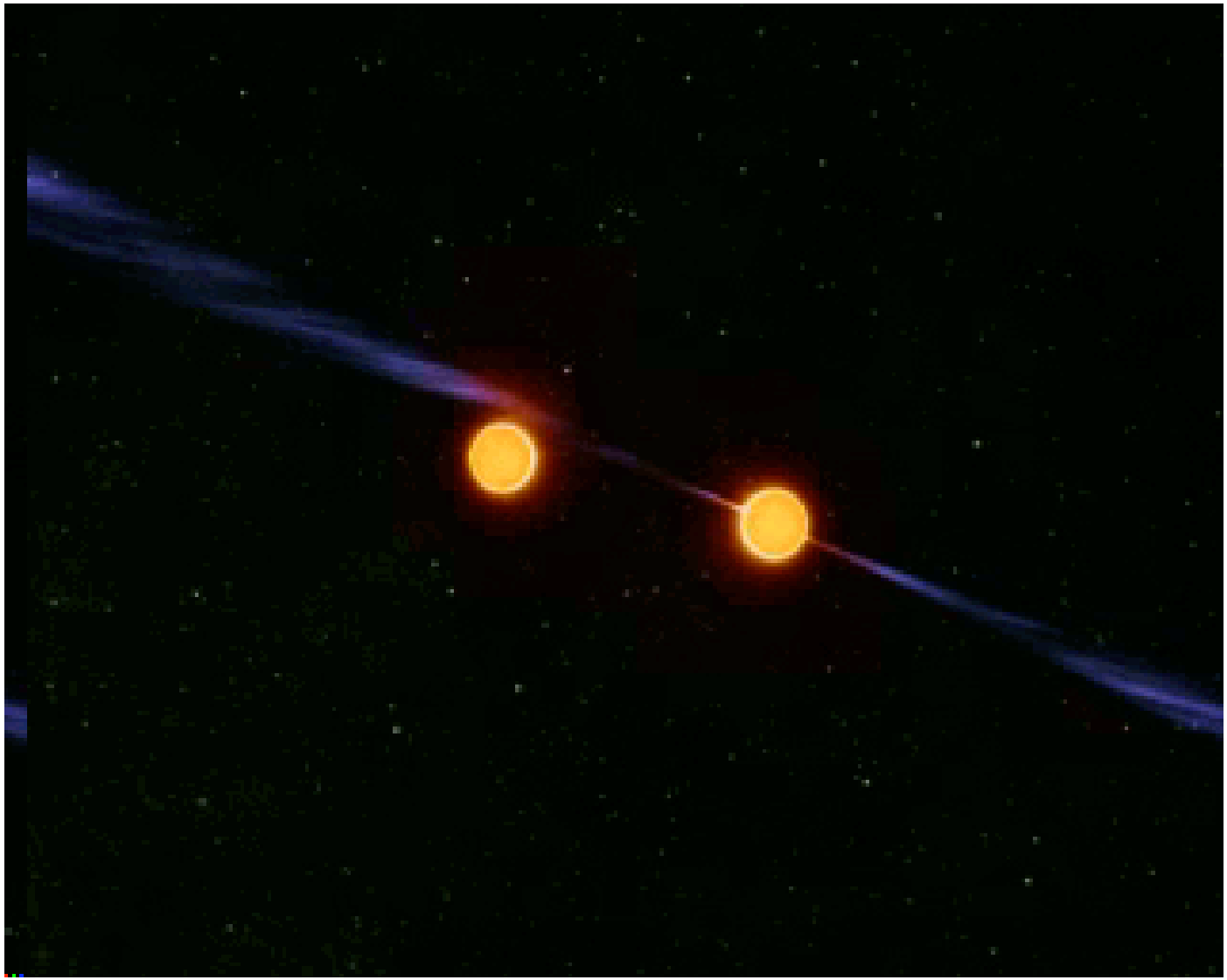
PSR J0737-3039 A&B



Quantum Vacuum Lensing

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Deviation of light rays

Refraction index in magnetized quantum vacuum

$$n_{\parallel(\perp)} = 1 + a_{\parallel(\perp)} B^2$$

With $a_{-} \approx 9\_10^{-24}\ \mathrm{T}^{-2}$ and $a_{-} \approx 5\_10^{-24}\ \mathrm{T}^{-2}$

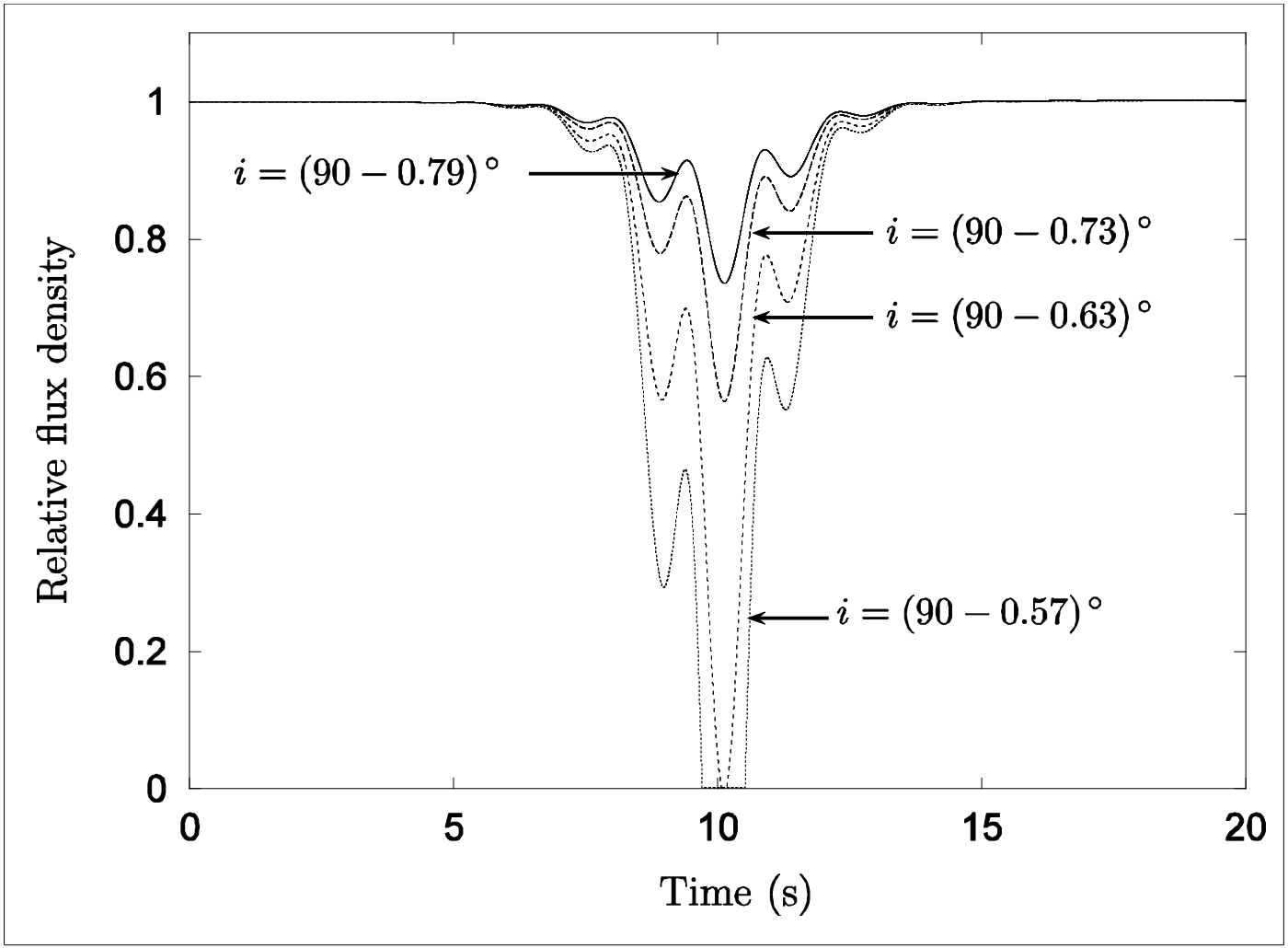
Deviation of light rays

Total angular deflection

$$\theta = \frac{4GM}{\rho c^2} + \frac{5\pi a B_0^2 \rho_0^6}{\rho^6}$$

With $B_0 \approx 10^{8}$ T and $\__0 \approx 10$ km

Relative flux density of pulsar A



Looking for Light Pseudoscalar Bosons in Gamma-Rays from Binary Pulsars

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(Dated: August 2, 2005)

We present the exact quantum calculations of the photon-axion production in the recently discovered double neutron star system J0737-3039. Light pseudoscalar bosons (LPBs) oscillate into photons in the presence of strong magnetic fields. In the context of this neutron star binary system, this phenomenon attenuates the light beam emitted by one of the pulsars, when the light ray goes through the magnetosphere of the companion pulsar. We show that such an effect is observable in the gamma-ray band since the binary pulsar is seen almost edge-on, depending on the values of the LPB mass and on the strenght of its two-photon coupling. Our results are surprising in that they show a very sharp and significant (up to 40%) transition rate in the gamma-ray ($>$ tens of MeV) domain. We also show that the effect in question provides a cross-check to the very recent PVLAS result on the existence of a new LPB. The observations can be performed by the upcoming NASA GLAST mission.

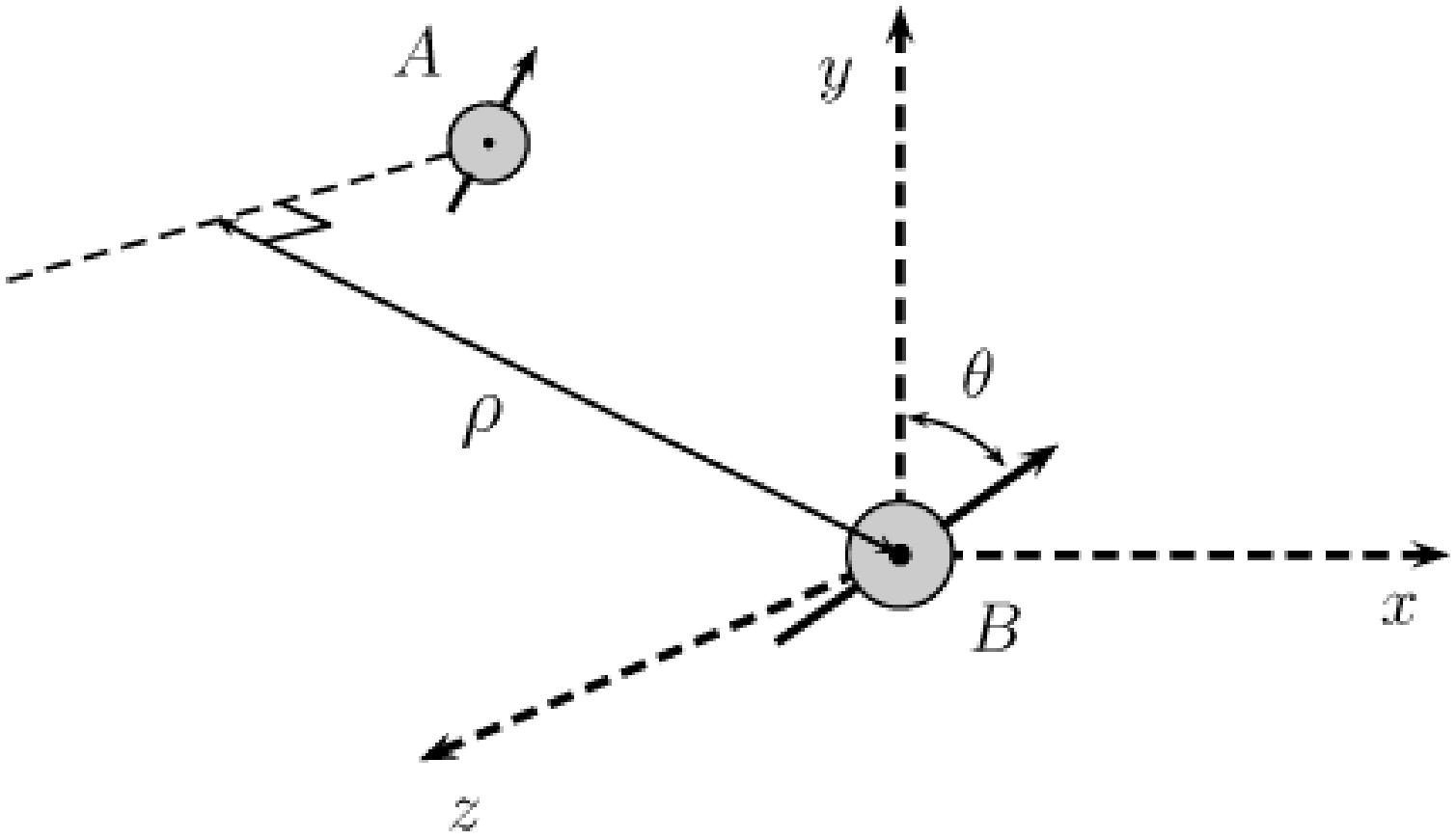

FIG. 1: Geometry of the model neutron star binary system

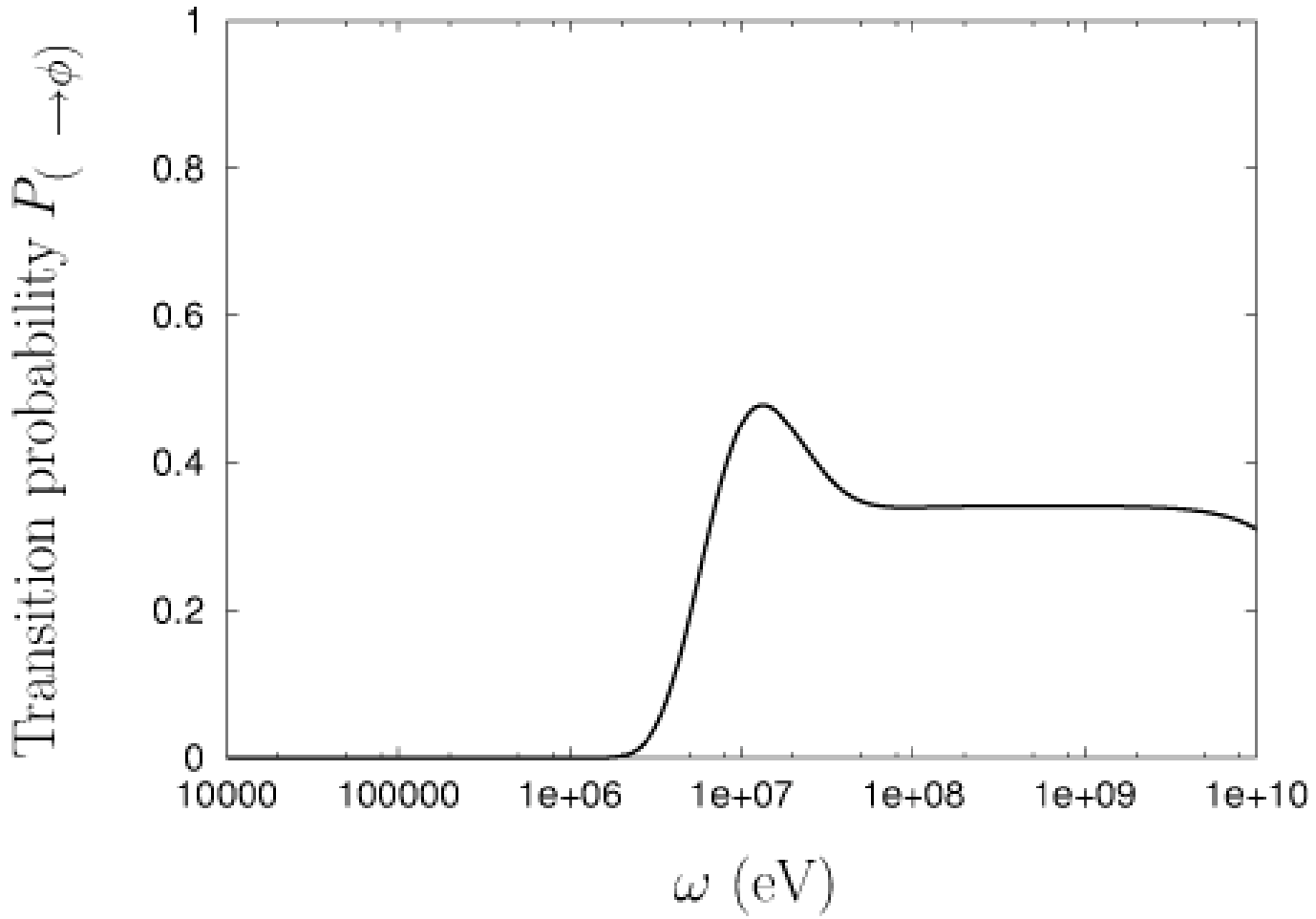

FIG. 2: Transition probability versus photon energy for a trajectory of the light beam with an impact parameter $\rho = 4 \cdot 10^3$ km.

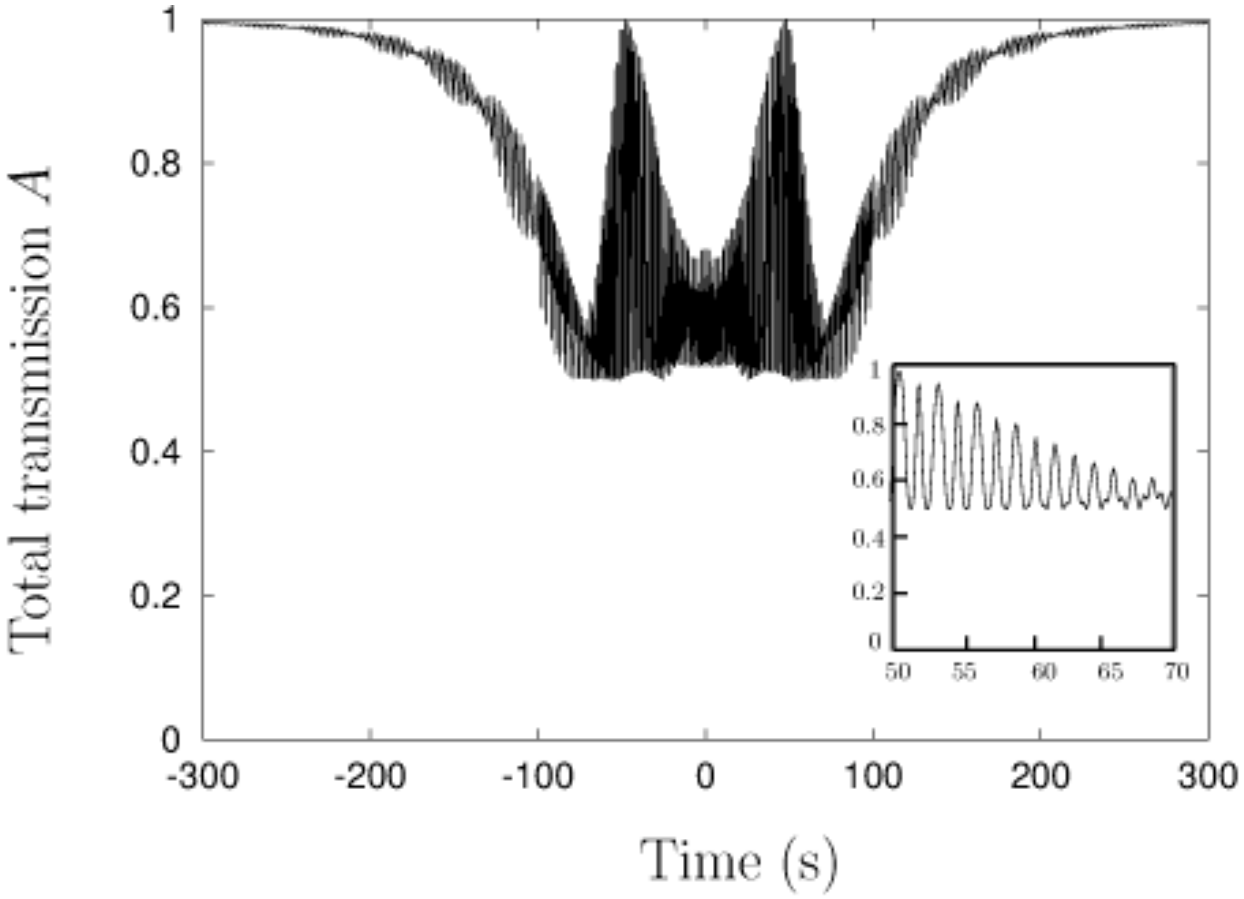

FIG. 3: Total transmisson of the gamma photon beam emmitted by pulsar A versus time. Inset shows the modulation mainly due to the rotation of the magnetic dipole moment of pulsar B.

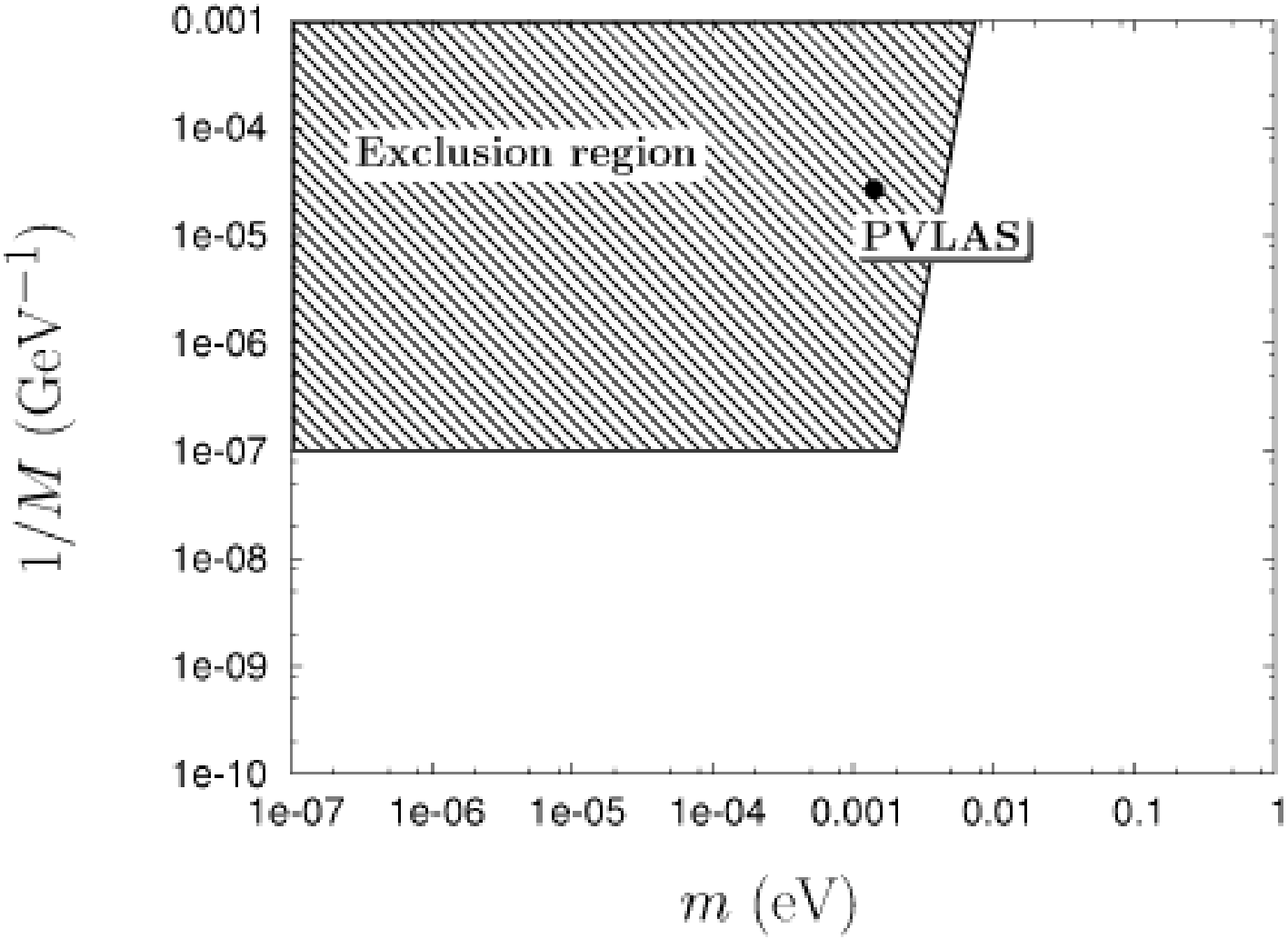

FIG. 4: Exclusion region in the case that the existence of the attenuation is excluded at 10 % level.