

# Instanton mediated baryon number violation in gauge extended models

Javier Fuentes-Martín



September 8-12, 2014  
Saint-Petersburg State University, Russia



Instituto de Física Corpuscular, Universitat de València - CSIC

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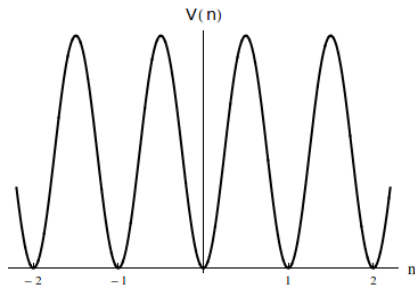
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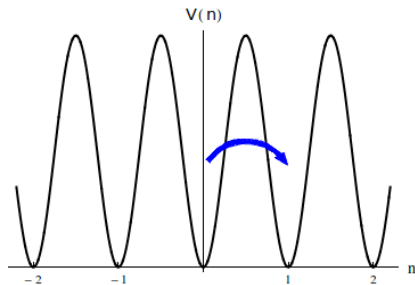
⇒ BNV might be important in new physics models, even if it is not present at the perturbative level.

# Instantons. A brief introduction



[G. 't Hooft, 1976]

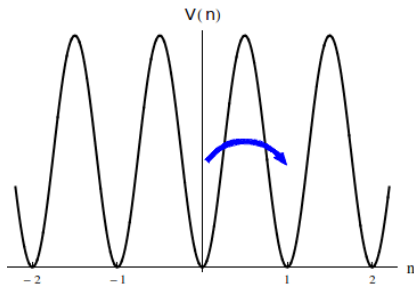
# Instantons. A brief introduction



$$S_{\text{tH}} \propto \int \frac{d^4x d\rho}{\rho^5} (\rho\mu)^{\beta_1} \rho^{6N_f} \prod_{N_f} (qqq\ell)^{N_f} \exp \left[ -\frac{8\pi^2}{g^2} - 2\pi^2 v^2 \rho^2 \right]$$

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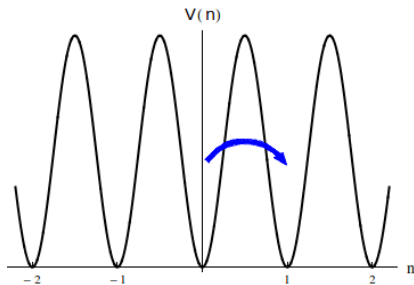
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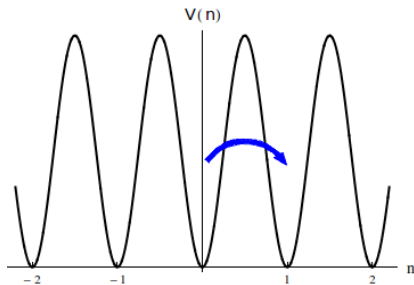
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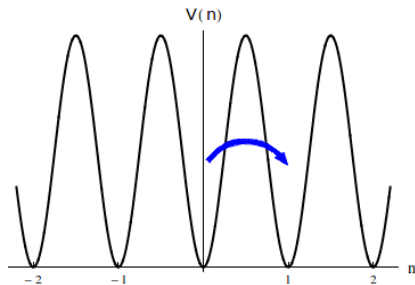


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[I. Affleck, 1981]

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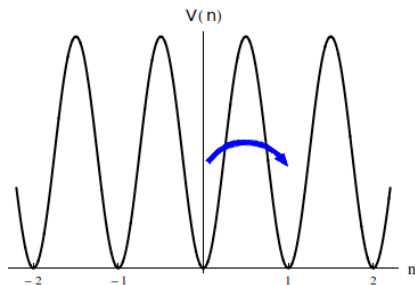


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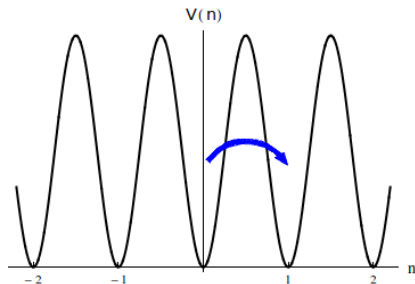
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$$\uparrow$$

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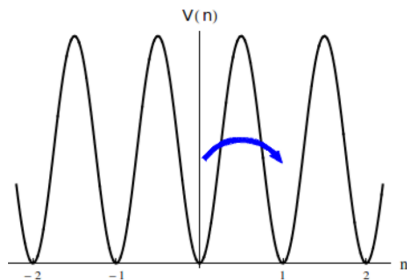


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[J. Fuentes-Martín, J. Portolés, P. Ruíz-Femenía, in preparation]

# Instantons. A brief introduction



SM:  $g \sim 0.64$

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# The Non-Universal $G(221)$ model

$$\mathcal{G} \equiv SU(2)_l \otimes SU(2)_h \otimes U(1)_Y$$

$$q_{Lj} : (2, 1) (1/3)$$

$$u_{Ri} : (1, 1) (4/3)$$

$$l_{Lj} : (2, 1) (-1)$$

$$e_{Ri} : (1, 1) (-2)$$

$$\phi_2 : (1, 2) (1)$$

$$q_{L3} : (1, 2) (1/3)$$

$$d_{Ri} : (1, 1) (-2/3)$$

$$l_{L3} : (1, 2) (-1)$$

$$\phi_1 : (2, 1) (1)$$

$$b : (2, 2)$$

[X. Li and E. Ma, 1981]

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$$b_{ij} \rightarrow \langle b_{ij} \rangle = u/\sqrt{2} \delta_{ij}$$
$$u \sim \text{TeV}$$

$$SU(2)_L \otimes U(1)_Y$$

Symmetry breaking pattern:  $SU(2)_I \otimes SU(2)_h \longrightarrow SU(2)_L$

# The Non-Universal $G(221)$ model

$$g = \frac{g_h g_l}{\sqrt{g_h^2 + g_l^2}} \Rightarrow g_h, g_l > g$$

We assume  $g_h$  is large (but still perturbative) such that  $SU(2)_h$  instantons dominate

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Quarks hadronize:  $\chi PT, R\chi T$   
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## BNV decays

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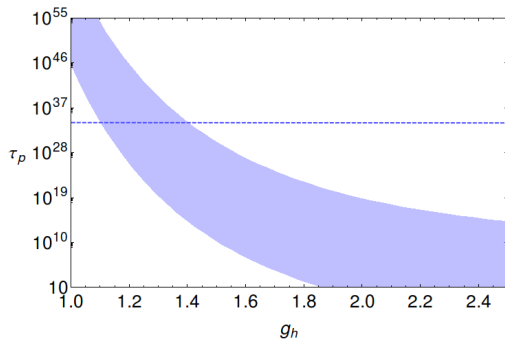
[LHCb Collaboration, 2013]

but...

$$\tau(p \rightarrow e^+\pi^0) < 8.2 \times 10^{33} \text{ yrs}$$

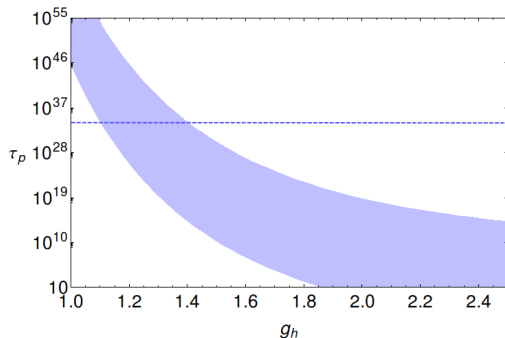
[K.A. Olive et al., 2014]

Proton decay:  $p \rightarrow e\pi^0$



[J. Fuentes-Martín, J. Portolés, P. Ruíz-Femenía, in preparation]

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$$g_h < 1.1 - 1.4$$

[J. Fuentes-Martín, J. Portolés, P. Ruíz-Femenía, in preparation]

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Thank you for your attention!