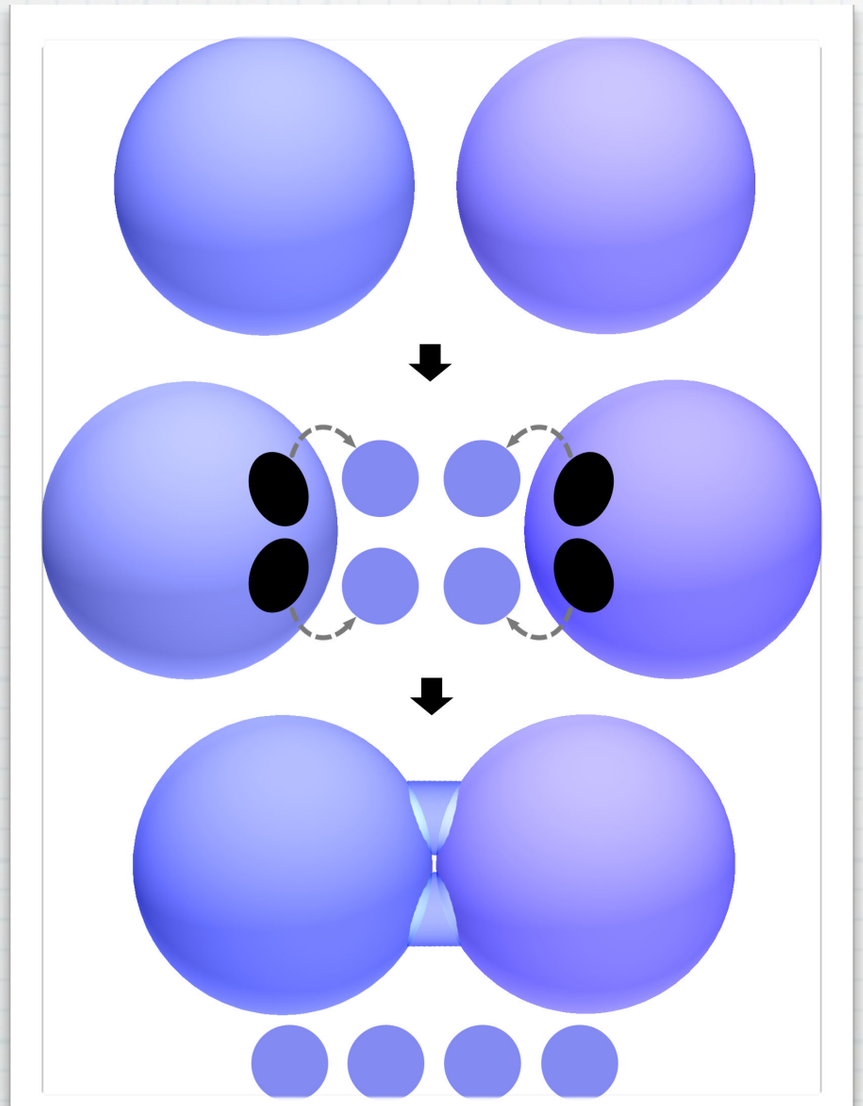
Quantum Boundary Conditions

Giancarlo Garnero

Quantum Boundary Conditions

"Models of Topology Change", 2012 (A. D. Shapere, F. Wilczek, Z. Xiong)



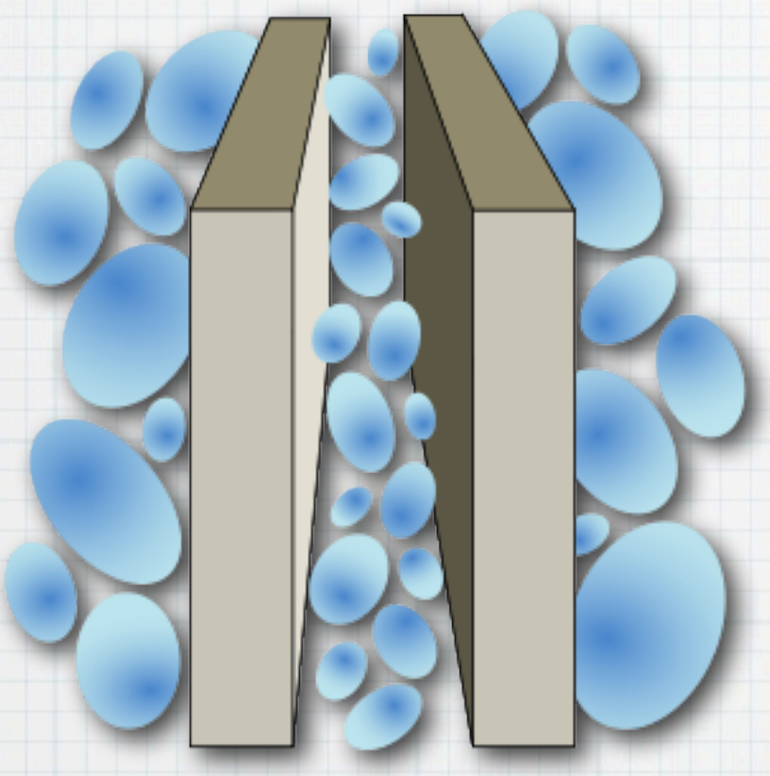
★ **Quantum Gravity: Virtual processes at high energy.**

★ Violent fluctuations of the space-time texture.

★ Topology change ⇔ modification of the b.c. in a Hilbert space.

★ A quantum mechanical view on topology fluctuations could provide info on the space-time texture.

Quantum Boundary Conditions

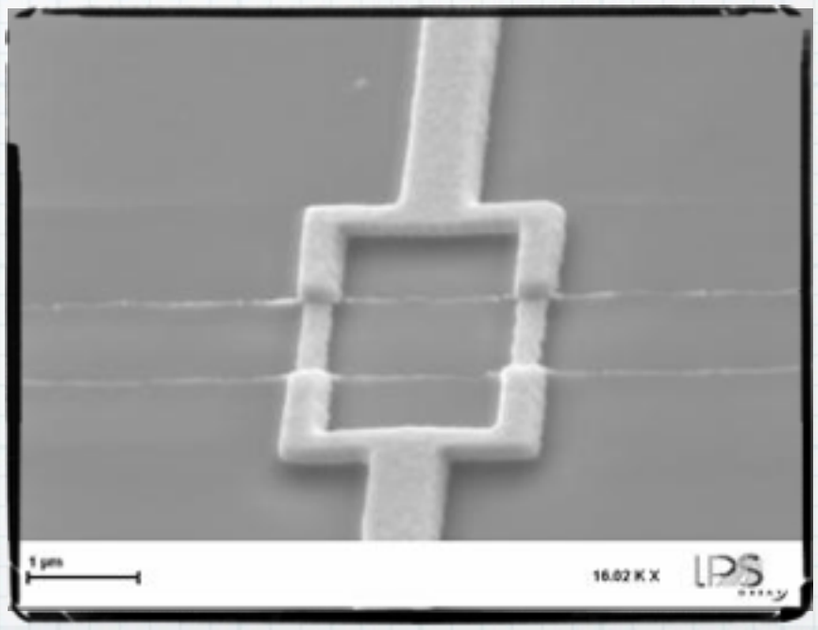


★ vacuum energy depends on the distance between plates

★ dynamical Casimir effect

★ photon generation

C. M. Wilson et al, Phys. Rev. Lett 105, (2010)



★ SQUID + tuning of the junction.

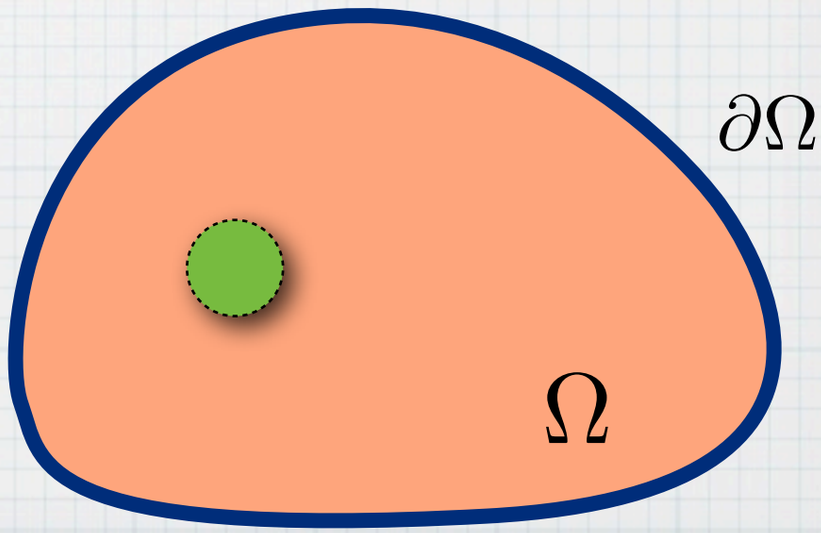
★ Josephson junction : it assigns a phase to the wavefunction.

★ Varying the magnetic field you obtain different b.c.

Paauw, Fedorov, Harmans, Mooij, PRL 102, (2009)
Cosmelli,et al., New J. Phys. 11, (2009)

Quantum Boundary Conditions

- ★ QBC: effective description of confined systems.
- ★ Observables in QM: self adjoint operators
- ★ QBC and self adjoint operators
- ★ QBC and different physical realizations



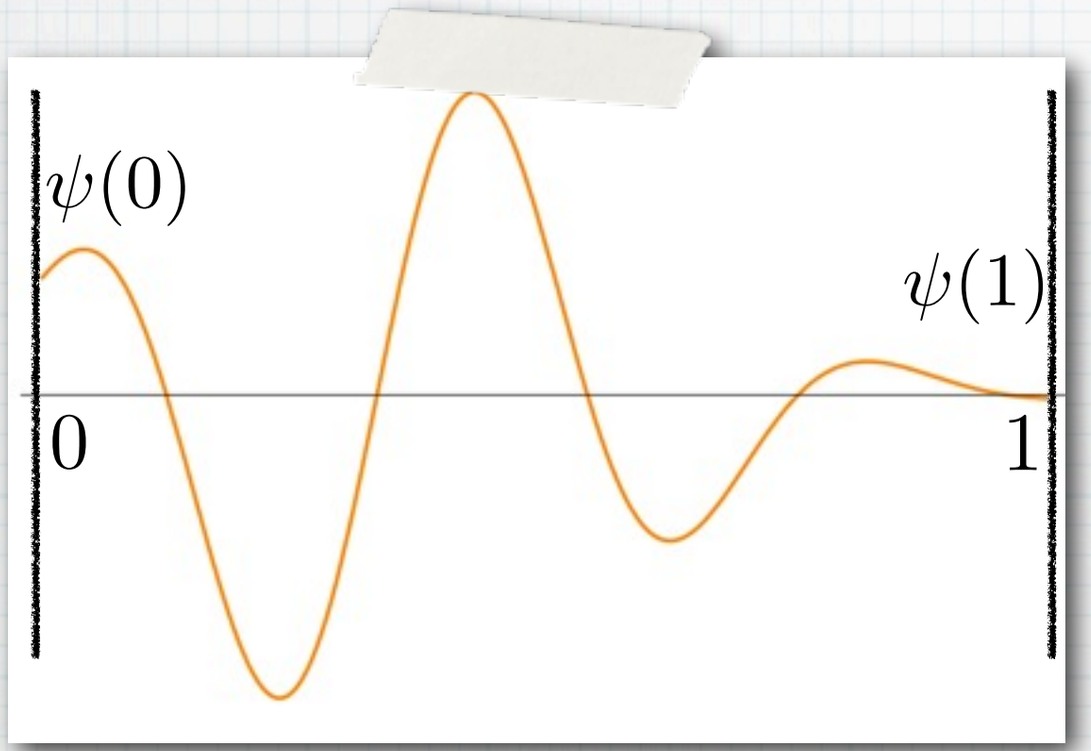
Quantum Boundary Conditions

Different Boundary Conditions

Self-adjoint Hamiltonian

Different Physical Systems

Quantum Boundary Conditions



$$H = \frac{p^2}{2m} = -\frac{\hbar^2}{2m}\frac{d^2}{dx^2}$$

$$i\,(I+U)\begin{pmatrix}\psi(0)\\ \psi(1)\end{pmatrix} = (I-U)\begin{pmatrix}-\psi'(0)\\ \psi'(1)\end{pmatrix}$$

$U = \mathbb{I},$	$\psi(0) = 0 = \psi(1),$	Dirichlet;
$U = -\mathbb{I},$	$\psi'(0) = 0 = \psi'(1),$	Neumann;
$U = -\sigma_1,$	$\psi(0) = \psi(1)\,,\ \psi'(0) = \psi'(1),$	periodic;
$U = \sigma_1,$	$\psi(0) = -\psi(1)\,,\ \psi'(0) = -\psi'(1),$	antiperiodic,

Buon Natale!