Unified Boundary Conditions and Casimir Forces for Fields with Arbitrary Spin

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The electromagnetic Casimir effect is well-known and has been extensively studied for the last half-century. This attractive force between parallel plates arises from the imposition of boundary conditions upon the fluctuating spin-1 photon field, so a natural further question is whether fields of different spin can cause similar forces when confined in the same way, as illustrated in Fig. 1.
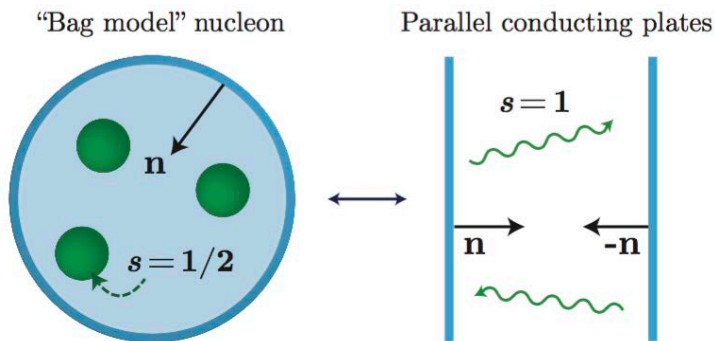

Figure 1: Illustration of the main idea of our work. The vectors *n* are the normal vectors to the surfaces that confine the spin-*s* fields.

However, up until now it has not been clear what the appropriate boundary conditions for physically-confined spinor fields may be. Here we present work that generalises the physically well-motivated electromagnetic boundary conditions to fields of arbitrary spin, thus arriving at physically reasonable boundary conditions [1] and Casimir forces for a selection of interesting fields [2]. For example, the so-called `bag model' boundary conditions from nuclear physics and standard electromagnetic perfect reflector boundary conditions emerge from our generalised boundary condition as special cases, as do the linearised gravity boundary conditions suggested in a remarkable recent proposal [3] concerning possible measurement of gravitonic Casimir forces.

[1] A. Stokes and R. Bennett, New J. Phys. 17 073012 (2015)
[2] A. Stokes and R. Bennett, Ann. Phys NY 360 246 (2015)
[3] James Q. Quach, Phys. Rev. Lett. 114 081104 (2015)