Solar *pp*-fusion rate and electroweak interactions

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The main source of energy generated in the Sun is a set of exothermic reactions (named the *pp* chain) in which 4 protons are fused into ^{4}He. The first and the slowest reaction of this set is the *pp* fusion, which is a two-nucleon weak reaction that fuses two protons into deuteron (d) and determines the Sun's lifetime ($\tau \sim\ 10^9$ years). However, due to its long lifetime it cannot be measured, so its rate, which is proportional to the matrix element squared of the weak interaction between initial and final nuclear states, has to be estimated from theory only.

In our theoretical work we predict the *pp* fusion by using a method named pion-less Effective Field Theory (πEFT) in which the corresponding coupling constants are fixed from a different weak decay, (named triton β-decay) by using the universality and the consistency of πEFT in the transition between one, two and three nucleon electroweak reactions. In addition, this universality reveals that our prediction for the *pp* fusion rate highly depends on recent new measurements of the neutron half-life.