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Phenomenology of fundamental spinons

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In condensed matter physics, the theory of spin–charge separation dates back to the 1950 paper of Tomonaga [1], but experimental confirmation required almost a half century [2-4]. Here we consider the possibility of a similar phenomenon —inspired in part by the reality of Higgs bosons [5,6] and therefore of at least one Higgs condensate —which would potentially be observable in Run 2 of the LHC. The qualitative phenomenology is simple: These fundamental spinons would carry only angular momentum (as spin 1/2 particles) plus energy and momentum, with no charge of any kind, so they must be detected as e.g. missing transverse momentum. They could be produced in virtual processes, such as the decay of virtual Z bosons, or real processes, such as emission from W bosons, but always involving vector bosons in the presence of a Higgs condensate. Their masses are undetermined by the theory (just as was the mass of the observed Higgs), but the mass of a spinon pair must exceed the mass of a Z boson, since the decay of real Z bosons is completely explained by Standard Model particles. Here we will make no attempt to justify the theory from which the prediction of these spinons emerges [7] (which has many compelling features but requires the introduction of a very large number of novel ideas). The important fact is that the theory does lead to this prediction of new particles which are in principle observable in the foreseeable future, as well as various other predictions —since it cannot even be formulated without supersymmetry, SO(N) grand unification, or vanishing of the usual cosmological constant, and since the simplest version of the theory leads to a self-coupling of the Higgs field whose unrenormalized value is nearly zero. Since the spinons proposed here are closely related to the Higgs, it may be worthwhile to establish historical context: After the electron was discovered in 1897, and the photon was introduced by Einstein in 1905, the richness of behavior associated with spin 1/2 fermions and spin 1 gauge bosons emerged slowly during the following decades. More than a century later, the third kind of Standard Model particle, with spin 0, has finally been discovered, and one should not be completely surprised if some of its implications are yet to be determined.

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Oral or Poster Presentation

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