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Excitations, order, and criticality in quantum pyrochlores

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I will present recent work on quantum criticality in the (conducting) pyrochlore iridates in the context of the wide range of exotic phenomena that occur on the pyrochlore lattice, such as Coulombic quantum spin liquids and quantum order-by-disorder. The physics of the highly-unusual super-universal quantum critical point between a non-Fermi liquid and a Weyl semimetal (with Ising-like order) uncovered in a model relevant to the pyrochlore iridates will be discussed in detail. There, the fluctuations in the parent non-Fermi liquid phase compete with the fluctuations due to the coupling to the Ising order parameter. Remarkably, the fluctuations of both origins are of the same order of magnitude and the resulting quantum critical regime belongs to a unique, very large, universality class, genuinely different from those obtained by considering the effects of a single phenomenon. Moreover, the perturbative analysis is controlled, yielding better faith in the theory. The scaling laws and some unusual coefficients of many physical quantities will be discussed, and a scheme to observe the quantum critical point in experiment provided. Further experimental connections, in particular to $Pr_2Ir_2O_7$, where Pr spins are important, will be made.