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Magnetic Monopoles: Scattering Amplitudes, QFT, Group Theory and Topology

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Magnetic monopoles and dyons are unique beasts in the zoo of Quantum Field Theory. The long range interaction between monopoles and electric charges generates an extra electromagnetic angular momentum, fundamentally changing the S-matrix for their scattering.

Though the effective field theory of Dirac monopoles and charges has been known since the ‘70, its Hilbert space has only been explored recently. As matter of fact, the quantum states spanning the charge-monopole Hilbert space are dressed multiparticle states that do not factorize into the tensor product of single-particle states. For charge-monopole states, the electromagnetic dressing is not just the means to get a finite S-matrix, but is also the source of the extra angular momentum in the system. For half-integer charges, this dressing can even alter the quantum statistics of the state, effectively making fermions out of bosons.

In the second half of the talk we present a novel alternative description for a system of monopoles and charges. In this description, spacetime is divided into duality frames separated by duality defects. Each particle sees itself as a charge (rather than a monopole), while seeing the particles in the other frames as monopoles/dyons, similarly to locally-flat coordinate patches in GR. We show how QED+duality defects can reproduce all of the unique features of the charge-monopole system. Finally, we present some long standing open problems in the Quantum Field Theory concerning the famous monopole catalysis of nucleon decay.

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