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From Scattering in Quantum Field Theory to Gravitational Waves in Kerr[1] ALFREDO GUEVARA, Harvard University — Recently a remarkable map between classical black holes and gravitational scattering amplitudes in QFT has been proposed in the Post-Minkowskian framework of GR. Here we extend it by studying low-frequency scattering of massless waves in a Kerr background. The classical amplitudes obtained from the Teukolsky formalism are found to coincide with four-point amplitudes in QFT provided 1) a precise classical limit is implemented on the QFT side, 2) the black hole is modelled as an interacting massive particle with large spin S, 3) the wave is modelled by a massless particle of helicity $h \leq 2$. For h=2 we bootstrap the general form of QFT amplitudes for spin-S particles coupled to gravitons (representing Gravitational Waves). Using the new massive spinor-helicity technique we obtain the partial wave amplitudes and check unitarity of the process. Then, matching to the classical Teukolsky analysis reveals that the corresponding QFT amplitudes are fixed by a novel notion of minimal-coupling, i.e. by imposing a suitable high-energy behaviour. These GW amplitudes exponentiate in the spin parameter, reminiscent of the classical Newman-Janis construction. We use this to derive new results for binary BH emission of GWs. Previous classical results in the eikonal limit are recovered.

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