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QCD-Gravity double-copy in the Regge regime via shockwave collisions

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We present new results for gravitational wave radiation in ultrarelativistic collisions of black holes which are described as Aichelburg-Sexl shockwaves. We demonstrate that the effective "Lipatov" vertex governing graviton radiation is a mathematical double copy of the corresponding effective gluon emission vertex in heavy-ion collisions [1]. We also show that propagators in the gravitational shockwave background are double copies of the corresponding propagators in the gluon shockwave background [2]. The existence of these double-copy relations suggest that CGC-based techniques that describe the energy evolution of gluon radiation in QCD can similarly be applied to study the gravitational wave radiation spectrum in close black hole encounters [4].

[1] H. Raj and R. Venugopalan, "Universal features of 2⟶N scattering in QCD and gravity from shockwave collisions,"Phys. Rev. D 109, no.4, 044064 (2024) [arXiv:2311.03463 [hep-th]].
[2] H. Raj and R. Venugopalan, "QCD-gravity double-copy in the Regge regime: Shock wave propagators," Phys. Rev. D 110, no.5, 056010 (2024) [arXiv:2406.10483 [hep-th]].
[3] H. Raj and R. Venugopalan, "Gravitational wave double copy of radiation from gluon shockwave collisions," Phys. Lett. B 853, 138669 (2024) [arXiv:2312.03507 [hep-th]].
[4] H. Raj, A. M. Stasto and R. Venugopalan, in progress

Author: RAJ, Himanshu (Stony Brook University)

Presenter: RAJ, Himanshu (Stony Brook University)

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