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Shining a Gluon Beam through Quark-Gluon Plasma

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A holographic calculation of the quenching of a beam of gluons with typical momenta q shining through strongly coupled quark-gluon plasma shows that such a beam is attenuated rapidly over a distance of order q^{1/3} (pi T)^{-4/3} as it propagates at the speed of light, shedding trailing sound waves with momenta of order (pi T). At larger and larger q, the trailing sound wave becomes less and less prominent. The outward-going beam of gluon radiation itself shows no tendency to spread in angle or to shift toward larger wavelengths, even as it is completely attenuated. In this regard, the behavior of the beam of gluons that we analyze is reminiscent of the behavior of jets produced in heavy ion collisions at the LHC that lose a significant fraction of their energy without appreciable change in their angular distribution or their momentum distribution as they plow through the strongly coupled quark-gluon plasma produced in these collisions. However, we know that quark-gluon plasma must be weakly coupled at short enough distance scales. This means that even if jet quenching typically occurs as in a strongly coupled plasma, there should be rare events in which a hard parton is scattered by a larger angle, picking up significant transverse momentum.

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