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Schwarzschild Black Hole from Perturbation Theory to All Orders

Applying the quantum field theoretic perturbiner approach to Einstein gravity, we compute the metric of a Schwarzschild black hole order by order in perturbation theory. Using recursion, this perturbative calculation can be carried out in de Donder gauge to all orders in Newton's constant. The result is a geometric series which is convergent outside a disk of finite radius, and it agrees within its region of convergence with the known de Donder gauge metric of a Schwarzschild black hole. It thus provides a first all-order perturbative computation in Einstein gravity with a matter source. I'll also discuss the generalization to the binary black holes.

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