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Strong Gravomagnetism and Gravitational Solenoids

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In electromagnetism a current along a wire tightly wound on a torus makes a solenoid whose magnetic field is confined within the torus. In Einstein's gravity we give a corresponding solution in which a current of matter moves up on the inside of a toroidal shell and down on the outside, rolling around the torus by the short way. The metric is static outside the torus but stationary inside with the gravomagnetic field confined inside the torus, running around it by the long way. This exact solution of Einstein's equations is found by fitting Bonnor's solution for the metric of a light beam, which gives the required toroidal gravomagnetic field inside the torus, to the general Weyl static external metric in toroidal coordinates, which we develop. We deduce the matter tensor on the torus and find when it obeys the energy conditions. We also give the equipotential shells that generate the simple Bach–Weyl metric externally and find which shells obey the energy conditions.