Gravitational Field of a Thin Shell with Fictitious Oscillations

Hou Y. Yau, FDNL Research, 119 Poplar Avenue, San Bruno CA 94066,

hyau@fdnresearch.us

We study the gravitational field of an infinitesimally thin spherical shell with fictitious oscillations in the radial directions. The system is spherically symmetric with no oscillations in other directions. Analogous to introducing a fictitious force to describe gravity, we use the fictitious oscillations to explain the gravitational effects outside a thin shell. These fictitious radial oscillations are not physical vibrations of matter. They are considered as geometrical properties of spacetime that can affect the temporal and spatial measurements by an observer. Their total energies are conserved as typical for spherically symmetric simple harmonic oscillating systems. According to Noether's theorem, the system has a time translational symmetry. The components of the metric tensor on the time-like hypersurface derived from the fictitious oscillations are constant over time. By studying the effects of the fictitious oscillations on an observer's measurements, we show that the metric derived is equivalent to that for a timelike hypersurface with constant mass *M*. The external spacetime is static and satisfies the Schwarzschild solution for the gravitational field of a spherically symmetric mass. According to Birkhoff's theorem, this thin shell can be contracted to infinitesimal radius while the external spacetime is unaffected as long as the equivalent mass *M* of the shell remains constant. As a result, the spacetime structure generated by the infinitesimal

radius shell with fictitious oscillations can mimic the gravitational field of a point mass in relativity.