AN EXAMPLE OF THE CENTRAL STRATEGY

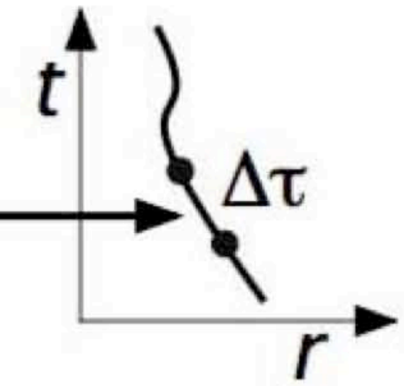
Second edition of *Exploring Black Holes* by Edmund Bertschinger, Edwin F. Taylor, and John Archibald Wheeler

GLOBAL METRIC

A. From our (almost) arbitrary choice of global "map" coordinates ϕ and specially-defined r - - -

B. Einstein's field equations give us the GLOBAL METRIC, the Schwarzschild metric, which tells us the wristwatch time measured between adjacent events along a worldline, from which the

$$d\tau^2 = \left(1 - \frac{2M}{r}\right)dt^2 - \frac{dr^2}{\left(1 - \frac{2M}{r}\right)} - r^2 d\phi^2$$



C. PRINCIPLE OF MAXIMAL AGING helps us derive the

D. map energy E of a free stone, a global constant of motion. Yay! However, map energy E is a mythical beast, a Unicorn, that is NOT directly measurable, because global coordinates are arbitrary. Darn!

$$E_{\text{Boston}} = \frac{E}{\left(1 - \frac{2M}{r}\right)^{1/2}}$$

LOCAL METRIC

E. Curved spacetime is effectively locally flat almost everywhere.

F. From the global metric averaged over a local flat patch, we derive a LOCAL METRIC for an inertial frame: Boston during **this** millisecond.

G. Special relativity is valid in an inertial frame, and coordinates---including time---ARE directly measurable in an inertial frame.

H. From the accumulated transformations, we derive, in the calculus limit, an equation for the "Boston energy" E_{Boston} of the stone measured directly in Boston. Yay!

$$\Delta\tau^2 \approx \left(1 - \frac{2M}{\bar{r}}\right)\Delta t^2 - \frac{\Delta r^2}{\left(1 - \frac{2M}{\bar{r}}\right)} - \bar{r}^2 \Delta\phi^2$$

$$\Delta\tau^2 \approx \Delta t^2_{\text{Boston}} - \Delta y^2_{\text{Boston}} - \Delta x^2_{\text{Boston}}$$