21 Oct 92

Hi Ge: -

Here is an interesting application of polarization tomography:

Suppose the space-time metric is written

$$\gamma_{\mu \nu} = g_{\mu \nu} + h_{\mu \nu}$$

where $g = \left(\begin{array}{cccc} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & -1 & 0 \\ 0 & 0 & 0 & -1 \end{array}\right)$ and $|| h || \ll || g ||$

e.g. "almost flat space-time!". Then if $\phi = -\frac{1}{2} h_{00}$, then the equation for a tangent, $\hat{x}$ (a 3-vector), to a light ray is:

$$\frac{d}{dt} \hat{x} = \hat{x} \times (\hat{x} \times \nabla \phi)$$


But compare with Menke & Abbott's formula for the tangent to an acoustic ray (MTA 8.7.11)

$$\frac{d}{ds} \hat{x} = \hat{x} \times [\hat{x} \times (-c \nabla c^{-1})]$$

hence light rays act as acoustic rays with

$$c \nabla c^{-1} = \nabla \phi = \nabla \frac{1}{2} h_{00}$$

Hence the existing polarization tomography method can be used in Astronomy, to study the curvature of space-time.