Gravitational Spiral Waves

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Abstract: ***Waves propagate in Universe either in longitudinal or transverse form co-axially. Waves cannot travel successfully in these forms as Universe is not homogeneous in respect to medium. So, waves change its form of propagating and take the spiral form. Such form of gravitational waves travel with carrying energy more successfully. So, we need to think in this context and should revise wave's energy equations.***

Keywords: Gravitational waves, Spiral wave, longitudinal waves, Transverse waves

1. Introduction

The theory of gravitational waves was initiated by A. Einstein (1917, 1919) in two papers on the approximate wave like solutions of his empty space field equations. Subsequently, Einstein and Rosen (1937) investigated plane and cylindrical gravitational waves and Rosen came to the conclusion that there were no exact plane wave metrics filling all space-time.

Unfortunately, plane gravitational waves do not exhibit their plainness in so clear a way as plane electro-magnetic waves do, and the published plane wave solutions have received from criticism. Our interest in plane waves derives not , of course, from the expectation that such waves might exist in nature and so we think about spiral GW's in nature, but from the presumption that at great distance from a finite source of gravitational waves, these waves must appear to be approximate plane.

Observation of gravitational radiation from black holes and neutron star transform our view of the Universe. The new topic of gravitational wave astronomy will be initiated with detection by recently commissioned gravitational wave detectors. Observation of neutron star binaries PSR 1913+16 and, more recently, PSR 0737-3039, tell us that gravitational waves exist and carry energy. This discovery is a considerable advance beyond the earlier phenomenology of quasi-static space-time in general relativity.

2. Spiral GW's Wave Equation

Here, we assume the shape of gravitational wave which carries more intensive energy by receiving compression and rarefaction. We are trying to search such an unconditional equation whose configuration could interpret the better physical situation.

The Equation of Spiral waves as

$W= Ae^{k\Psi}$ ..... (2.1)

Where, W= GW's, A=Amplitude, Ψ= Angle of contingence of curvature of equiangular spiral, k=Desirable constants depending on medium of surrounding.

The Energy Equation with higher amplitude should give

$E= he^{\lambda\nu}$ ---------- (2.2)

where, h= Plank's constant, $\nu = frequency\ of\ waves\ and\ \lambda$= constants of the medium.

The amplitude of spiral waves depends upon the receiving energy per unit of time

$A= \frac{E}{T}$ ---------- (2.3)

Combining equations (2.1) and (2.2) with the help of (2.3) , We should have

$W= \frac{E}{T} e^{k\Psi}$

$=\frac{he^{\lambda\nu}}{T} e^{k\Psi} =\frac{h}{T} e^{(\lambda\nu+k\Psi)}$ ---------- (2.4)

For, the same medium, k=λ,so,

$W= \frac{h}{T} e^{k(\psi+\nu)}$ ---------- (2.5)

This is our wave energy equation.

3. Discussion and Results

We discuss possible role of gravitational waves background in investigation of the early universe. The universe is expanding, galaxies and quasars flying apart at velocities proportional to their distances,

V=HR . Where H= 50-150 km/sec MPC (Hubble parameter)

A gravitational wave changes the distance between the points. In the actual distance between two test particles dl, which is measured by light, is defined by the equation,

$dl^2 = -\eta_0\ dx^i dx^j$ - h(dy^2-dz^2) -2h dy dz ---------- (3.1)

Here, $dl^2= \eta_0\ dx^i dx^j$ is the initial distance between them. The variation in the initial distance, which existed before the action of the gravitational wave is described by the equation

$dl= \frac{1}{2}$ h $(dy/dL)^2$ - $(dz/dL)^2$dL - $\frac{1}{2}$ h (dy/dL)(dz/dL) ----------(3.2)

4. Generation of Spiral Gravitational Waves

We need to calculate the energy emitted in the form of gravitational radiation by a system when energy momentum tensor can be expressed as a Fourier integral

$T_{\lambda\nu}$ (x,t) = $\int_o^\infty dw T_{\lambda\nu}$(x, w) $e^{-i\omega t}$+c.c ---------- (4.1)

Here "+c.c" means plus the complex conjugate of the preceding term.

5. Curvature Produced by Spiral Waves

We have assumed that the background metric satisfies the vacuum Einstein equations to linear order but now it is possible to view the full action principle for the background with a wave field $h_{\mu\vartheta}$ on it and to let the wave energy affect the background curvature. This means that the background will actually solve, in a self consistent way, the equation.

$G_{\alpha\beta}[g_{\mu\vartheta}] = 8\pi T^{GW}_{\alpha\beta}\ [g_{\mu\vartheta}+h_{\mu\vartheta}]$ ---------- (5.1)

This does not contradict the vanishing of the first variation of the action, which we needed to the use above, because now we have an Einstein tensor that is of quadratic order in $h_{\mu\vartheta}$, contributing a term of cubic order to the first variation of the action, which is of the same order as other terms neglected.

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Author Profile

Dr. Pradeep Kumar received M.Sc degree from B.U Muzaffarpur (Bihar) , Ph.D from B.R.A. Bihar university, Muzaffarpur (Bihar) , took two U.G.C. project on the topic 'Parameterized Post Newtonian Formalism: Gravitation and Application' and 'Super Energy Of Gravitational Waves' in 2001-03 and 2012-2013 respectively , worked on 'Black Hole Energy As Rotational Energy', Visited TIFR, Mumbai and IUCAA , Pune for the Scientific project, presently posted as an associate professor and head of the department of mathematics in M.S College, Motihari, under B.R.A. Bihar university, Muzaffarpur, Bihar, India.