REDUCTION OF QUANTUM NOISE IN GRAVITATIONAL WAVE DETECTORS

[1]Anmol Bansal, [2]Vijayta, [3]Kuldeep Chand,

[1]Student, [2]student, [3]Associate professor in Physics department

[1]Department of physics, [1]The ICFAI University Baddi, Himachal Pradesh, India

Abstract: However, the current generation of Gravitational wave observatories has some of the most sensitive detector devices on the earth but still lacks in proper detection of gravitational waves. So this paper provides the new idea to enhance the detecting ability of signals by available detectors. This can be achieved by quelling quantum noise. Hence this paper mainly focuses on making the quantum noises aphonic with the application of nanotechnology. This can be done by fabricating sensors from graphene. This should definitely quench the undesirable noises and further increase the sensitivity of present gravitational wave detectors.

***Keywords*: graphene, quantum noise, quelling, LIGO**.

I. Introduction

At present there are four gravitational wave detectors are in operation namely Laser Interferometer Gravitational-Wave Observatory (LIGO) (Hanford), Laser Interferometer Gravitational-Wave Observatory (LIGO) (Livingston), GEO600 interferometer and VIRGO interferometer. KAGRA interferometer is under construction and one more Laser Interferometer Gravitational-Wave Observatory (India) is under planning process. After the discovery of gravitational waves(11th February 2016) it has been announced that there can be no more doubt because scientist have detected the merging of two neutron stars a 130 million years away which was the first ever detection by in spiraling of neutron stars.

Now the point is what gravitational waves exactly are? It's nothing but just like as if we throw a stone in pond very small curves or we can say ripples are produced , similarly in space when any mass accelerates around another body or rotates around itself , pulsating perturbations/ fluctuations are generated in the fabric of space time . And these perturbations travel away from the accelerating mass with the speed of light. These ripples are gravitational waves. These gravitational waves are travelling continuously and passing through number of stellar bodies including earth. So it is necessary to detect them with greater precision. There are many gravitational wave detectors present on earth like: LIGO, VIRGO, and GEO which are performing their duty 24*7 but are not able to detect them with much accuracy. Hence, there is need to upgrade them with new technologies.

II. Objective

During the detection of gravitational waves there is number of quantum noises arise which hinders the clear and proper detection of waves. So, the purpose of this paper is to fabricate the sensors which mute the quantum noise from gravitational reduce the quantum noises in gravitational wave detectors with the application of nanotechnology.

III. Why detection?

The detection of gravitational waves is necessary as it will unveil various mysteries related to space, gravitation and astrophysics. The proper detection of these waves results in the answering of number of outstanding questions such as, about the prediction of correct theory of gravity, matter behavior under intense densities and pressures, abundance of stellar-mass black holes, results of massive star collapses and a lot more.

IV. Challenges in Detection

There are number of challenges occurring in the way of detection of gravitational waves.

Radiation pressure noise: The "dual nature" of light i.e. particle and wave at the same time makes the things more tangled to understand. Quantum mechanically, the radiation pressure noise due to the fluctuations in the positions of mirrors in the

interferometer. This quantum radiation pressure noise strict the ability of relative gravitational wave detector to gauge the strain of passing gravitational waves precisely.

Thermal noise: Another one is the fluctuations in mechanical systems which are a limiting noise source in current gravitational wave detectors. The coatings of optical cavities results into the fluctuations in optical measurement and hence it produces noise.

Another one is quantum noise although it can be done by squeezing the light source which is known as "Squeeze state generation". So, the problem is that making enough squeezing and the preserving that squeezed state. Also the combination of squeezing and noise reduction sensors will give brilliant results. All of the world's large gravitational wave interferometers have shown unexplained noise at low frequencies between 10 Hz and 30 Hz.

V. Noise reduction sensors

A sensor is a device which senses or detects the event like temperature, pressure, light, heat etc., and further it responds with an output, usually an electrical, mechanical or optical signal. The household mercury thermometer is a simple example of a sensor. Sensors from graphene is a natural combination, as graphene's large surface-to-volume ratio, unique optical properties, excellent electrical conductivity, high carrier mobility and density, high thermal conductivity and many other attributes can be greatly beneficial for sensor functions. Graphene will enable sensors that are smaller and lighter - providing endless design possibilities. They will also be more sensitive and able to detect smaller changes in matter, work more quickly and eventually even be less expensive than traditional sensors.

As graphene has number of amazing properties such as electrical, optical and the most vital is saturable absorption which will provide wide range of potential applications in ultrafast photonics. Hence, this article is about the idea for sensors from graphene which will sense the quantum noise and absorb that noise at the same time.

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VII. Conclusion

As the quantum noise is the dominant noise source in the LIGO detector (and all other gravitational wave detectors), the sensors from graphene will reduce the quantum noise. Hence, it will be named as "*Noise Reduction Graphene Sensors*". These noise reduction sensors will be solution to the various challenges occurring in the way of detection of these waves. The generation of these noise reduction graphene sensors will lead to a greater increase in the sensitivity of the present and future gravitational wave detectors. Hence it will help in the disclosing of the mysteries of space and gravitational wave astronomy.

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