Q&A: JASON Report on High-Frequency Gravitational Waves

On June 17, 2008, a research group called the JASONs, composed of very influential and respected university scientists, were given a briefing on the generation, detection and applications of high-frequency gravitational waves (HFGWs) by representatives of GravWave LLC. The JASON Report (JSR-08-506) was published in October 2008. The Report was widely distributed to the US scientific community and various press organizations reported it. The JASON Report concentrated its criticism on one particular HFGW detector presented by GravWave (the Li-Baker HFGW detector) and found that GravWave incorrectly analyzed it "by an order of magnitude" and that there was no credible application to, for example, communications (involving HFGW generation) and propulsion. The report based its analyses primarily on a well-known theory termed the Gertsenshtein effect.

Q: What is the Gertsenshtein effect?

A: This effect, or rather the inverse of it that the JASONs considered, was first published in 1962. Essentially, it predicts that gravitational waves (GWs) in the presence of a static magnetic field will generate electromagnetic (EM) radiation moving in the same and in the opposite direction of the GWs. The generated EM wave is a second-order effect that generates very little EM radiation. Whether from the framework of classical or quantum theories, the conversion of the a GW to an EM wave will be extremely low. Thus the EM photons in the pure inverse Gertsenshtein effect cannot create a detectable signal.

Q: Is the Li-Baker detector based on the Gertsenshtein effect?

A: No. It is based upon the Li-effect. The Li-Effect includes elements of the Gertsenshtein Effect and, more importantly, elements of Einstein's Theory of General Relativity. It is quite different from the Gertsenshtein Effect since it utilizes a synchro-resonance EM beam (the pure Gertsenshtein Effect utilizes only a static magnetic field) to create a very significant EM signal that propagates not in the direction of the synchro-resonance EM beam and the GW, but perpendicular to both the magnetic field and the GW/EM beam directions. Thus the EM signal created can be sensed in a region relatively free of noise and is capable of detection.

Q: What errors were made in the JASON report?

A: The most serious error was the analysis of the Gertsenshtein Effect as a means for the laboratory generation of high-frequency gravitational waves. None of the many proposals that we know about for the laboratory generation of high-frequency gravitational waves, involves the Gertsenshtein Effect. An additional serious error is the assertion that gravitational waves cannot be utilized as a means for propulsion. A very well known

example of the rocket propulsion effect, which can be produced by gravitational waves, is that of a star undergoing asymmetric octupole collapse, which achieves a net velocity change of 100 to 300 km/s via the anisotropic emission of gravitational waves (Berkenstein, 1973). Additionally, Landau and Lifshitz indicate a change in the gravitational field itself due to the passage of HFGWs. Another serious error is the analyses of the Li-Baker detector under the assumption that it is based upon the Gertsenshtein Effect. As has been stated, the Li-Baker detector is not based on the Gertsenshtein Effect.

Q. Where did the JASON analysts go wrong?

A: The primary failing in their analyses was not to thoroughly study several of the basic peer-reviewed papers by Fangyu Li in order for them to understand the Li-effect. The basic peer-reviewed paper by Li, et al. was given as the JASON Report reference [11], but not thoroughly analyzed in their Report. Their next serious error was not to study the other laboratory high-frequency gravitational wave generators and detectors presented to the JASON group during the GravWave briefing to them on June 17, 2008. They should not have concentrated solely on the Li-Baker detector

Q: Did the JASON analysts utilize the usual approach to scientific inquiry?

A: No. The JASON analysts did not avail themselves of the opportunity, which most scientific investigators do, to consult with presenters during their study. For example, The GravWave presenters could have recommended relevant peer-reviewed HFGW literature and suggested they not waste time studying the Gertsenshtein Effect in detail. As far as we know, the Gertsenshtein Effect has little relevance to useful HFGW detection and no relevance to laboratory HFGW generation.

Q: Do you believe that the organizers of the GravWave briefing to the JASONs had a preconceived agenda to discredit high-frequency gravitational wave research in general and the GravWave LLC research in particular?

A: It is difficult to believe otherwise. Ordinarily, an unbiased analysis of a technical presentation would have involved some consultation with the presenters in order to better define the subject matter. Furthermore, an exclusive focus on only one HFGW detector, to the exclusion of the Birmingham University, INFN Genoa and Japanese HFGW detectors, which the GravWave presenters discussed in their PowerPoint presentation, would be unwarranted in an unbiased analysis, as would be the avoidance of a discussion of other HFGW-generator research presented by GravWave. Only one HFGW detector paper was scrutinized by the JASON authors -- their reference [10]. Although never discussed in the GravWave presentation, the Abstract of that paper did mention the Gertsenshtein Effect, but the first paragraph of the actual paper admonished the reader to review the other literature that clearly showed that the detector was the result of a combination of the Gertsenshtein Effect with synchro-resonance, the Li-effect and not the Gertsenshtein

Effect alone. Their avoidance of analysis of the basic reference [11] in their Report, which covered the Li-effect, was certainly unwarranted in an unbiased Report.

CITATIONS:

Eardley, et al. (2008) "High Frequency Gravitational Waves," JSR-08-506, October, the JASON defense science advisory panel and prepared for the Office of the Director of National Intelligence.

Bekenstein, J. D. (1973), "Gravitational-Radiation Recoil and Runaway Black Holes," *Astrophys. J.* **183,** pp. 657-664.

Landau, L. D. and Lifshitz, E. M. (1975), *The Classical Theory of Fields*, Fourth Revised English Edition, Pergamon Press, section 108, page 349. (Discusses the change in the static gravitational field due to high-frequency gravitational waves)

Baker R. M L, Jr., Stephenson G.V. and Li F.Y. (2008), "Proposed ultra-high sensitivity HFGW Detector," after peer review, accepted for publication in the AIP Space Technology and Applications Int. Forum, Albuquerque, New Mexico **969** 1045-1054, available at http://www.gravwave.com/docs/Proposed%20Ultra High%20Sensitivity%20HFGW%20Detector%2005-15-08.pdf (Reference [10] of the JASON Report SR-08-506 in which first paragraph admonishes the reader to review four previous publications and discusses the synchro-resonant Gaussian beam)

Li, Fangyu, Baker, R. M L, Jr., Zhenyun Fang, Stephenson, G. V. and Zhenya Chen (2008) (Li-Baker Chinese HFGW Detector), "Perturbative Photon Fluxes Generated by High-Frequency Gravitational Waves and Their Physical Effects," *The European Physical Journal C.* **56**, pp. 407-423, http://www.drrobertbaker.com/docs/Li-Baker%206-22-08.pdf (Reference [11] of the JASON Report SR-08-506 and one of the fundamental references concerning the Li-effect)

JASON Report on High-Frequency Gravitational Waves

A Question and Answer Analysis

Q&A: JASON Report on High-Frequency Gravitational Waves

On June 17, 2008, a research group called the JASONs, composed of very influential and respected university scientists, were given a briefing on the generation, detection and applications of high-frequency gravitational waves (HFGWs) by representatives of GravWave LLC. The JASON Report (JSR-08-506) was published in October 2008. The Report was widely distributed to the US scientific community and various press organizations reported it. The JASON Report concentrated its criticism on one particular HFGW detector presented by GravWave (the Li-Baker HFGW detector) and found that GravWave incorrectly analyzed it "by an order of magnitude" and that there was no credible application to, for example, communications (involving both HFGW generation and detection) and propulsion. The report based its analyses primarily on a well-known theory termed the Gertsenshtein effect.

Q: What is the Gertsenshtein effect?

A: This effect, or rather the inverse of it that the JASONs considered, was first published in 1962. Essentially, it predicts that gravitational waves (GWs) in the presence of a static magnetic field will generate electromagnetic (EM) radiation moving in the same and in the opposite direction of the GWs. The generated EM wave is a second-order effect, that is the EM photon flux generated is proportional to the square of the very small gravitational-wave amplitude. Therefore, whether from the framework of classical or quantum theories, the conversion of the a GW to an EM wave will be extremely low. Thus the EM photons in the pure inverse Gertsenshtein effect cannot create a detectable signal. In addition the GW generation process is equally as inefficient and no scientist has suggested its use.

Q: Is the Li-Baker detector based on the Gertsenshtein effect?

A: No. It is based upon the Li-effect. The Li-Effect includes some elements of the Gertsenshtein Effect and, more importantly, elements of Einstein's Theory of General Relativity. It is quite different from the Gertsenshtein Effect since it is 3-dimensinal and utilizes a synchro-resonance EM Gaussian beam (the pure Gertsenshtein Effect utilizes only a static magnetic field and is 2-dimensional) to create a very significant EM signal that propagates not in the direction of the synchro-resonance EM beam and the GW, but perpendicular to both the magnetic field and the GW/ EM beam directions. Thus the EM signal created can be sensed in a region relatively free of noise and is capable of detection. Furthermore the EM signal is proportional to the amplitude of the GW **not** the square a 10^{30} difference!

Q: What errors were made in the JASON report?

A: The most serious error was their analysis of the Gertsenshtein Effect as a means for the laboratory generation or detection of high-frequency gravitational waves. **None of the many proposals that we know about, for the laboratory generation or detection of high-frequency gravitational waves, involves the Gertsenshtein Effect.** An additional serious error is the assertion that gravitational waves cannot be utilized as a means for propulsion. A very well known example of the rocket propulsion effect, which can be produced by gravitational waves, is that of a star undergoing asymmetric octupole collapse, which achieves a net velocity change of 100 to 300 km/s via the anisotropic emission of gravitational waves (Berkenstein, 1973). Additionally, Landau and Lifshitz indicate a change in the gravitational field itself due to the passage of HFGWs. Yet another serious error is the analyses of the Li-Baker detector under the assumption that it is based upon the Gertsenshtein Effect. As has been stated, the Li-Baker detector **is not based on the Gertsenshtein Effect.**

Q. Where did the JASON analysts go wrong?

A: The primary failing in their analyses was not to thoroughly study several of the basic peer-reviewed papers by Fangyu Li (references in the last slide) in order for them to understand the Li-effect. The basic peer-reviewed paper by Li, et al. was given as the JASON Report reference [11], but not thoroughly analyzed in their Report. Their next serious error was not to study the other laboratory high-frequency gravitational wave generators and detectors (under development by the British, Italians and Japanese) presented to the JASON group during the GravWave briefing to them on June 17, 2008. They should not have concentrated solely on the Li-Baker detector.

Q: Did the JASON analysts utilize the usual approach to scientific inquiry?

A: No. The JASON analysts did not avail themselves of the opportunity, which most scientific investigators do, to consult with presenters during their study. For example, the GravWave presenters could have recommended relevant peer-reviewed HFGW literature and suggested they not waste time studying the Gertsenshtein Effect in detail. As far as we know, the Gertsenshtein Effect has little relevance to useful HFGW detection and no relevance at all to laboratory HFGW generation.

Q: Do you believe that the organizers of the GravWave briefing to the JASONs had a preconceived agenda to discredit high-frequency gravitational wave research in general and the GravWave LLC research in particular?

A: It is difficult to believe otherwise. Ordinarily, an unbiased analysis of a technical presentation would have involved some consultation with the presenters in order to better define the subject matter. Furthermore, an exclusive focus on only one HFGW detector, to the exclusion of the Birmingham University, INFN Genoa and Japanese HFGW detectors, which the GravWave presenters discussed in their PowerPoint presentation, would be unwarranted in an unbiased analysis, as would be the avoidance of a discussion of other HFGW-generator research presented by GravWave. Only one HFGW detector paper was scrutinized by the JASON authors -- their reference [10]. Although never discussed in the GravWave presentation, the Abstract of that paper did mention the Gertsenshtein Effect, but the first paragraph of the actual paper admonished the reader to review the other literature that clearly showed that the detector was the result of a combination of the Gertsenshtein Effect with synchro-resonance, the Li-effect, and not the Gertsenshtein Effect alone. Their avoidance of analysis of the basic reference [11] in their Report, which covered the Li-effect, was certainly unwarranted in an unbiased Report.

CITATIONS:

Eardley, et al. (2008) "High Frequency Gravitational Waves," JSR-08-506, October, the JASON defense science advisory panel and prepared for the Office of the Director of National Intelligence.

Bekenstein, J. D. (1973), "Gravitational-Radiation Recoil and Runaway Black Holes," *Astrophys. J.* Volume **183,** pp. 657-664.

Landau, L. D. and Lifshitz, E. M. (1975), *The Classical Theory of Fields*, Fourth Revised English Edition, Pergamon Press, section 108, page 349. (Discusses the change in the static gravitational field due to high-frequency gravitational waves)

Robert M. L. Baker, Jr. (2006), "Novel formulation of the quadrupole equation for potential stellar gravitational-wave power estimation," *Astronomische Nachrichten.* Volume **327**, No. 7, pp. 710-713.

Fang-Yu Li, Meng-Xi Tang, Jun Luo, and Yi-Chuan Li (2000), "Electrodynamical response of a high energy photon flux to a gravitational wave," *Physical Review D,* Volume **62**, July 21, pp. 044018-1 to 044018 -9.

Fang-Yu Li, Meng-Xi Tang, and Dong-Ping Shi, (2003), "Electromagnetic response of a Gaussian beam to high-frequency relic gravitational waves in quintessential inflationary models," *Physical Review D* Volume **67**, pp. 104006-1 to -17.

Fangyu Li, Robert M L Baker, Jr., Zhenyun Fang, Gary V. Stephenson and Zhenya Chen (2008) (Li-Baker Chinese HFGW Detector), "Perturbative Photon Fluxes Generated by High-Frequency Gravitational Waves and Their Physical Effects," *The European Physical Journal C.* Volume **56**, pp. 407-423