

Foreword

An Invitation to the Conference Participants and Interested Readers

I think you are in for a real treat when you review these papers. This Conference spans a wide breadth of interest in an exciting new topic and includes a tribute to one of the most colorful and intellectual pioneers in this field, Dr. Robert L. Forward. The attendance was international in scope where some nine countries were represented and the discussions and subsequent debates were honest and polite. It was obvious from the onset that the assemblage of individuals was clearly searching for the truth and trying to find answers to very perplexing questions concerning gravitational waves and, more specifically, high-frequency gravitational waves (HFGW).

The genesis of this Conference was unusual. I was involved in a technical discussion with Dr. Ning Li about the magnitude and sensitivity of measuring gravity when she introduced me, via the INTERNET, to Dr. Robert M. L. Baker, Jr. During our initial discussions, it was obvious that Bob was on a mission and that he had a compelling passion for HFGWs. However, during this time I slowly realized that he was also the same individual that wrote a textbook on astrodynamics that I once used when I was in graduate school at the NYU School of Engineering in 1967.

As these discussions continued, I also remembered comments that Ning made regarding the need for gravitational research in this country and that the U.S. has never really had such a conference to address gravity. Bob agreed and funds were fortunately found to undertake this venture. Initially Bob and I considered only having a small group, but then we soon realized that more could be gained by opening up the attendance and including an international audience.

We wanted to treat this subject very seriously with deep respect and we employed scientific principles and standards whenever applicable. Gravity has been around a long time, but our understanding of this phenomenon as well as its synthesis into waves exhibiting various frequencies, had to be given a wide berth of respect. During this process, we asked for and received many abstracts. We reviewed each of these and we both interacted with every author to improve the quality of the presentation and to focus on certain critical issues. I am now in the final stages of reviewing the completed papers and I have to confess that this body of knowledge clearly represents a solid contribution to this scientific field and it is something of very precious intellectual value.

The Conference represents a '*birthing*' process for a new and fascinating technology. We started with a tribute to Bob Forward and the first paper by Bob Baker provided an introduction to the basic terms and standards that were used in this field for those of us, including myself, who was uninitiated or unwashed. With all of us now singing to the same sheet of music, the first session covered HFGW transmitters and receivers. These discussions ranged from hardware to an insightful theoretical analysis concerning Gershtenshtein waves. These are where electromagnetic waves can be converted into gravitational waves. Although the paper focused upon generating gravitational waves, it became obvious in the Q&A that the process could be reversed and the methodology could be used to detect such waves as well. Regarding the pictures presented of hardware, some of these devices were mechanical while others were electrical in nature in order to measure characteristics of gravitational waves. The devices from Spain, China, and Italy were impressive.

Bob Baker had earlier addressed the importance of HFGW by reformulating the equation for gravitational-wave power. Gravitational-wave power was proportional to the change in force

and frequency squared. Unfortunately, there was a multiplier of one over the speed of light raised to the fifth power, which results in a coefficient of about 10^{-52} . That is a really, really small number! This means that the change in force and/or frequencies had to be extremely large to get even the smallest amount of gravitational-wave power. Bob derived an equation that showed that gravitational-wave power is proportional to the square of the time-rate-of-change of acceleration or a “jerk.” He described a very large HFGW generator (500 meters long and 20 meters in diameter) composed of a column of ratcheting or jerking rims. If the timing was right, then a coherent beam of HFGW having a power of 380 KW could be generated. He also described a miniaturized HFGW generator, which could be utilized for hand-held wireless communication that was but a few centimeters in size.

The Russians possess a characteristic trait that makes you respect their different way of looking at problems and their unique style of thinking. They looked at the gravitational-wave generation problem from a different perspective. Although claiming to have been involved in such investigations since the seventies, they looked at the HFGW-generation equation differently. The variables were now the speed of sound within the media and the strain that the media undergoes during the HFGW-generation process. This approach was far closer to the physicist’s paradigm whereas the previous, jerk approach was more appealing to engineers and applied scientists. Despite these semantic differences, the Russians mentioned earlier research efforts that also looked at mechanical and electrical approaches that, at best, could generate milliwatts of HFGW power. Synthesizing the problem differently, however, the issue was to look at the generation process from an atomic scale point of view. Here, the Russians employed a laser system, involved in thermal fusion reaction investigations, to increase the density of plasma by a thousand-fold. This sudden compression generated more than a watt of gravitational power although, before their program was abandoned at the end of the Cold War, they did not possess an accurate enough instrument to capture the pulse duration or to adequately characterize the actual HFGW power generated. Clearly, this was very interesting research by any *world-class* standard.

The next session covered experiments involving superconductors, most notably efforts by Podkletnov to measure slight changes in gravity possibly related to the generation of HFGW as predicted by Landau and Lifshitz. The findings from several of the presenters suggest that these are extremely difficult experiments to perform. If anything, a scientist would like to repeat someone else’s experiment and replicate the results before accepting the theoretical implications or empirical claims. However, because of the difficulties encountered, some experiments may fall within the realm of not being reproducible, which raises serious concerns on how to honestly judge the merits of such experimental results. Hathaway of Canada demonstrated such uncertainties and, if pictures are worth a thousand words, his pictures spoke volumes. It was difficult enough to manufacture the proper size of a superconducting disk, but add to this the dripping liquid nitrogen or helium gas used to reach proper temperatures, the evaporation, and the sudden formation of sheets of ice created by air condensation. Everything seems to be strongly affected by the cryogenic environment. In fact, it gets so bad that the laboratory looks like a small crevice carved in the midst of an iceberg with wet fog and snow and one simply wonders how you could possibly measure anything let alone stay warm? These individuals in the session discussed all three of Podkletnov’s experiments as well as those of others providing significant insights that examined experimental techniques and overall results. Ning Li ended the session by revealing new findings concerning superconductors claiming that as much as eleven kW of HFGW power could be produced.

The discussion of Podkletnov’s experiment was followed by a session on applications. Several important papers examined the use of HFGW for communications, propulsion, physics as well as imaging. HFGW appears to be a very promising technology and after several detailed

panel sessions, the group more or less felt that applications to communications would offer the most immediate returns. One paper by a Boeing representative accomplished an excellent review of the approaches outlined in the Conference for generating and detecting HFGWs that would be an integral element of a communication system. Another paper outlined a concept for a GASER, or a gravitational analogue of a LASER, which could theoretically generate as much as ten megawatts of HFGW, and it concluded the session. Clearly, we have to open our minds to a new way of thinking to consider how to fabricate these new types of devices that differ from what one would expect when considering using only the conventional wisdom.

The final session discussed astrophysical investigations covering the creation of gravitational waves to several propulsion concepts and a possibility of improving our understanding of planetary gravitational fields. The session ended with a paper that identified the need for considering some gravitational anomalies involving angular momentum carried away by GW.

When all was said and done, I felt that it is a simple fact that those participating in this conference could be proud of what was achieved. I distinctly remember Dr. Grishchuk's comment: "*In my entire life I would have never thought that I would have ever seen a Conference like this one!*" That says it all! We covered a very wide spectrum of issues that crossed disciplines involving engineers, experimentalists, and theoreticians. The papers themselves are extremely impressive and, as far as I am concerned, should be valued as being of journal quality. The amount of intellectual capital resident and expended during the Conference was exceedingly high and I want to thank each contributor for his or her contribution to extending the state-of-the-art.

I have to confess that as you get older, sometimes it is the simple things in life that are the most pleasurable. For me, I find that I really enjoy a challenging and intellectual conversation because it raises so many interesting issues and causes you to grow whether you want to or not. I am very happy to say that we had some of these types of conversations. For example, I remember one briefing that was so convoluted with so many different, exciting and interesting thoughts that I was compelled to extend the briefer's time by an additional twenty minutes. I thought Bob Becker's review of the efforts in this field was quite comprehensive as his paper demonstrates. Moreover, the amount of intellectual capital expended was obvious even during the social hour. After a round of singing of an Italian aria, which was of the same quality as in the Met, I thought that we, as human beings had so much in common. Here, an ex-New Yorker, Bob Becker, who sang, would spend the rest of the evening with a Russian, Valentin Rudenko, discussing Italian and Russian songs and the pronunciation of individual words. This was so unique that I wondered how this could happen except at an *International Gravitational-Wave Conference!* To a large degree, it was a wonderful experience to be in the presence of such talented people and events and I thank all the participants for their shared passion, cooperation, and enthusiasm.

In my concluding remarks, I would like to thank Bob Baker and his charming wife Bonnie for their efforts. I owe Bob a large debt of thanks for helping me turn our dreams into a concrete reality. He literally put the Conference together with speakers and authoring or co-authoring no less than five papers himself, reviewed abstracts, and helped set up the arrangements at Mitre after pulling together an interesting and challenging program. On a personal note, I value our friendship and one could not find a more honest individual who showed me how we should do certain things. I also owe a debt of thanks to the people at Mitre, especially Ms. Pam Harbourne, Gretchen and the rest of her staff. Pam, as Bob is, were both Godsend to me.

In what follows, you will find an agenda, a tribute to Dr. Robert Lull Forward, the papers, author resumes, a brief summary of some of the key remarks made following each paper as well as the panel sessions, a bibliography of key HFGW references, a mailing list to facilitate networking and, of course, some of the actual presentations. In our treatment of the papers, we tried very hard to keep the paper intact to follow the author's true intentions. There may have been problems adjusting formats for consistency throughout all of the papers in the conference and some figures or pictures may be out of place. Moreover, the Chinese version of WORD apparently allows you to have superscripts upon superscripts. We may not be able to reproduce these terms exactly as the author wishes. Also some software variants for equations may have equal signs that now appear as a box. These changes were not intentional and we sincerely apologize to any author where this may have occurred.

Finally, we were very disappointed when some authors were not able to provide a final version of their paper. Our objective was to look at this field and examine it truthfully from all aspects. We did this as honest engineers, scientists, and physicists searching to solve some of the most important mysteries since man first gazed at the stars. We did not do this for our egos or accolades. Without these missing papers, we can not substantiate some of the claims that were made or examine the logic, analysis, or experimental technique that was used to provide some very unusual final results. Moreover, without these papers our views in this set of Proceedings, may appear to the outside observer to be slightly skewed. This was and is not our intention. We did, however, include an additional paper provided by an attendee to make up for some of these shortfalls and we appreciate this as well as all of the contributions that helped make this Conference an advance to the state-of-the-art. Only through such unselfish contributions can be better learn and understand complicated science and technology.

Evenso, I think that you will still agree with me that these Proceedings will make very interesting reading and I would recommend continuing this worthwhile tradition started by having similar Conferences in the future with an *'International'* flavor. This Conference has been an unusual *'birthing'* process that has yielded very positive results. Furthermore, HFGW can easily become one of those new and exciting technical disciplines that easily can challenge mankind's imagination and point technology into new and exciting directions.....

Finally, for the critic or those that may have felt that we covered too much ground or we were out of our technical depth, I would like to offer a remark that I made. This was when I was asked to review a technical paper written by a person that had to reside in the damp darkness and deepest depth of a prison in Illinois. The individual liked the remark so much that he inserted it directly into the final version of his paper. These words are still very appropriate here and goes something like this:

"Where does it say that we are allowed to see the face of God let alone think that we, with all of our limitations, can dare comprehend the infinite? We place ourselves and mankind on unfamiliar ground in a forbidden country. If these mysteries can be revealed, they will be done so in God's own time, place and choosing. We have no other option but to hope, think and wait. It is a shame that we cannot look into the future, but all we can do is wait."

Somehow these words are very prophetic, still true and timeless. It is, however, our responsibility as simple human beings to make things happen. I think we gladly did this with this Conference and maybe, just maybe, we gave God a little shove to get a small glimpse to reveal some more of his marvelous mysteries and hidden treasures....

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