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Festschrift in Honor of the 80th Birthday of

Dr. Williamson Berry

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This special Issue of the *Journal of Space Exploration* is dedicated to my friend, colleague, and (former) boss at ESA, the eminent

Dr. Williamson (William, Bill) Berry

on the occasion of his 80th birthday (recent picture). As head of the Propulsion and Aerothermodynamics Division at ESTEC for more than twenty-six years, Bill, as one of the leading chemical propulsion experts in Europe, exerted a major influence on European aerospace industry to further his goal in making European rocketry competitive with U.S. and Russian industry. When Bill left ESA in July 1999, he could look back on the Ariane success story, to which ESA in general, and he personally had contributed a major part. Space activities in Europe had changed from humble beginnings into commercial business. In particular, Bill played an active role in the creation of an autonomous, world-class capability in spacecraft propulsion and aerothermodynamics for Europe. However, Bill exerted also a major influence on my career, when he hired me (a physicist) as the head of the aerothermodynamics section in 1988 in his division. Among many other things, we worked together in the early 1990s on the Hermes space-plane, the European version of the U.S. space shuttle. Though Bill was responsible for the European propulsion activities, which means that his view had to be on technically realizable propulsion systems, he was well aware of the severe limits of current propulsion and had a keen vision on the physics of advanced propulsion. I still remember our discussions on *field propulsion*, a term already coined by W. Corliss in 1960, i.e., propulsion without propellant based on hitherto unknown long-range physical fields, which became again a major topic in NASA's *Breakthrough Propulsion Physics* program from 1996-2001.

Because of his outstanding personality and open-mindedness William Berry assembled a long list of friends among his engineering colleagues during his long career in ESA, but I am proud (as a non-engineer) to consider myself friend of Bill who also was a wonderful boss during my time at ESA. In addition to his skillful work in the world of European propulsion, William Berry always saw himself as a contributing citizen both to the larger field of science and humanity, which included, of course, animal world.

When I was asked by the editor in chief of JSE, Prof. T. Musha, to choose a topic of my own for the sixth issue of JSE, I suggested the theme

Spaceflight Perspectives from Novel Concepts of
Spacetime, Gravitation and Symmetries.

Numerous colleagues, both in the academic departments and in the engineering community whom I contacted, approved this title. I am convinced that William Berry would have done the same, but, for obvious reasons, I could not contact him. A dominant theme in Bill's work was the quest to find the ultimate space propulsion technology. Of course, he was well aware that such a technology has to come from novel physics, and not from the refinement of engineering.

It therefore feels very appropriate to me to dedicate this special issue of JSE as Festschrift to William Berry.

At the European Space Agency (ESA) we experienced first-hand the immense technical difficulties and extreme cost to place relatively small payloads into low earth orbit. Space propulsion is still dealing with the technologies developed in the 50s and 60s of the last century, and the vision portrayed by Werner von Braun in his famous article in Collier's magazine in 1952, entitled *Man on the Moon*, did not become a reality. The shuttle era came to an end in 2012, and NASA will not fly a next generation space vehicle any time soon. The problem of propulsion is not the engineering, but it is linked to the underlying physics that remains unchanged since the days of ancient Chinese rockets. It is the physical principle of classical momentum conservation, which stands in the way of producing an efficient, and effective propulsion system. It is the basic physics itself that prevents progress.

Consequently, all contributions to this Festschrift belong to the (speculative) physics of advanced propulsion, energy generation, and gravitation, and report on the progress made since 2001, when the NASA Breakthrough Propulsion Physics program ended. When I contacted the potential contributors, I offered them free choice of topic, but mentioned that all papers will be reviewed, and none of the editors would interfere with the verdict of the reviewers. I feel that the final collection of papers displays an exciting variety, just as William Berry does wish to see!

Recently, the scientific community has been shaken by numerous scandals, where authors published exciting results that eventually had to be retracted, because data had been deliberately manipulated (remember, for instance, the infamous hockey stick curve in climate science, or the large number of articles with falsified measurements in the field of bioscience from authors already considered for a noble prize). Moreover, journals were found to publish articles of questionable quality, i.e., using an insufficient review process. As a consequence, all papers presented in this special issue were thoroughly reviewed. Finally, seven out of eight papers were accepted, three papers were completely rewritten and four papers saw minor modifications. The review process for the paper of my long-time co-author Walter Dröscher and for my own paper was handled by the editor in chief of JSE. I am indebted to these referees, both in Europe and the U.S., who do their work in anonymity, for their patient, but relentless efforts to improve style, readability, clarity, and content of the papers.

All of the authors have been in the field long enough to be widely known from their publications, but of course, there is no guarantee that the novel ideas discussed in these papers actually reflect physical reality. If they do, a revolution will occur both in science and technology, but it may well be that our ideas turn out to be wrong. If, in hindsight, some or all of the ideas presented here, appear incorrect, the reader should be assured that, at least, we were acting as honest fools, which is scientifically legitimate as was stated by the well known physicist Richard P. Feynman.

The last paper, accessible for the intelligent layman, by C. Daigle, summarizes from a design perspective the ensuing revolutionary technological aspects that could follow from this novel physics.

In this special issue we are presenting to the scientific community the state of theoretical and experimental research concerning the latest results in the emerging field of physics for novel gravity-like fields that might represent a new paradigm shift regarding the very nature of gravitation, including the evaluation of recent experiments that might have measured extreme gravitomagnetic fields outside general relativity.

Therefore, the motivation to further exploring the mysterious nature of gravitation is understandable, aiming beyond Newtonian (Einsteinian) gravity. Gravitation has maintained the interest of researchers at every stage in the history of physics, and it became Einstein's quest to unify gravitation with the other forces since 1916. Hence, it should be no surprise that new theoretical attempts along with experimental work are presented in this special issue to continue where Einstein was forced to leave off.

The quantization of the gravitational field has been unsuccessful, despite great efforts in this direction. The problem may be that the number of fundamental forces is not known, in other words, there is a belief that only four forces exist (strong, weak, electromagnetic, and gravitational force). Perhaps gravity is of a more subtle nature than Newtonian gravity, and an interaction between gravity and electromagnetism might exist?

New gravitational experiments have been published since 2006, and geometrical theories from the 1950s have gained prominence (for instance, by Finzi, Heim, Wheeler). They have been extended and combined with concepts of modern physics, trying to explain novel experimental results for extreme gravitomagnetic and gravity-like fields. For instance, in his monograph on *Quantum Field Theory*, M. Kaku presents a calculation of the Coleman-Weinberg potential that might be employed to calculate the coupling strength for extreme gravitomagnetic fields. More recently, as pointed out by A. Zee in *Quantum Field Theory in a Nutshell*, gravity might be the square of two spin 1 fields (it should be noted that particles of spin 1 can be described by Yang-Mills fields), an idea that also might be applicable in the explanation of the experiments on extreme gravitomagnetic fields. These and other exciting ideas are presented to the reader, shedding new light on the nature of gravity as well as the number and type of fundamental forces that should exist in Nature.

As Einstein felt, the most important objective of any theory is to comprise as few and basic elements as possible without contradicting physical experience in conjunction with practical applications. For example, a relationship between the physical phenomena of electromagnetism and gravitation might exist at cryogenic temperatures. Any novel theory must be verifiable by laboratory experiments or astronomical observations.

Performing gravitational experiments is not an easy endeavor since highly sensitive devices have to be produced and utilized at cryogenic temperatures, often at liquid Helium temperature. Even if experimental findings or theories eventually cannot be verified, one should not denounce the serious experimenter or theorist for failure, since the history of science has shown that every step forward is a complicated venture, needless to say that all programs for novel theoretical models initially contain many unclear points. But this is true even for established theories. Gravitational experiments are notoriously difficult as can be seen from the fact that the physics of gravitational wave astronomy, despite the early efforts of J. Weber starting out in 1969, is still not an established fact.

As was pointed out by theoretical physicist Richard P. Feynman, there occur numerous strange phenomena in the complex situations of solid-state physics. He prophetically foresaw an enormous number of technical applications that could arise from such physics. Might it be possible that a combination of low temperature and solid state physics could lead to strange phenomena and, this is the most important point, to a large number of technical applications, but this time in the field of gravitational engineering?

Finally, in order for science to progress, both theorists and experimenters have to be willing to leave the save (funding issues) and (sometimes) sacred ground of established physical theory and dare to propose speculative novel ideas. If a blind alley is met, the courage to reverse one's direction of research is required. In particular, the speaking silence of the Large Hadron Collider at Geneva is at odds with all of the so-called advanced physical theories beyond the standard model of particle physics. Instead, if ideas of novel gravitational fields at cryogenic temperatures turn out to be true, the new scientific age of gravitational engineering might have begun.

Whether or not this special issue of JSE, which can be considered a sequel of the recent book on *Gravity-Superconductor Interactions: Theory and Experiment, G. Modanese, G. A. Roberson (eds.), Bentham Publishers 2012,* is revealing novel scientific facts, or even stands for a paradigm shift in science, remains undecided at present. New experiments, hopefully as suggested in this special issue, need to be carried out in order to prove the existence of gravity-like fields outside Newtonian gravity. Nevertheless, I am convinced that the articles presented here contain a large amount of exciting material that will be of substantial benefit to those readers willing to leave the trodden path of science and to accept the challenge.

Subtle is the Lord…Albert Einstein

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