empirically derived by D.R. Long, who published it in the magazine *Nuovo Cimento* in 1980. It has also been referred to in the work of several scientists who used it to account for discrepancies in the measurement of the gravitational constant.

In the upcoming *International Journal of Fusion Energy*, Dr. B.A. Soldano, professor of Physics at Furman University, offers a more fundamental explanation of this discrepancy, which entails a far more revolutionary challenge to accepted physics. He postulates that there is a difference between gravitational and inertial mass which accounts for Fischbach's results, but also accounts for many other so-called paradoxical findings which have been plaguing modern physicists. In his soon-to-be-published *IJFE* article, "The Lagéos Satellite: A 'Laboratory' for Testing General and Special Relativity," he writes:

> For decades, a conflict has raged in physics over the question of the primacy of classical physics inherent in general relativity or of quantum mechanics. At present, physics maintains two parallel paths and occasionally attempts to interrelate these two conflicting disciplines.
>
> We take the position that an answer to the question of primacy already exists. Specifically, we propose to show that classical physics, slightly modified to accommodate a restricted non-equality between inertial and gravitational binding mass, leads to a purely classical explanation of the quantum h. Further, we propose to show that the seeds of a resolution of the above conflict already exist in the framework of both quantum mechanics and general relativity. . . .
>
> In order to obtain accurate enough parameters for resolving a wide array of problems in both general relativity and quantum mechanics, we shall begin by demonstrating that the Lageos satellite constitutes an extremely sensitive "laboratory" for quantifying some of the parameters required by explanations based on nonequivalence in gravitational binding. [A gravitational binding force is the attractive self-energy of a nucleus—ed.]

From this, Dr. Soldano derives a definition of both inertial and gravitational mass. Lageos, NASA's geodynamic satellite, was placed in nearly circular orbit at approximately twice the radius of the Earth at approximately 110° inclination to the Earth's equator. This satellite is well above the Earth's ionosphere and is in a nearly perfect vacuum; nonetheless it is falling at a rate of 1.1 millimeters per day. *According to accepted theory, the satellite should not be falling*. Furthermore, the plane of the satellite is rotating. Both of these otherwise inexplicable results, as well as the Fischbach results, are explained by Soldano's non-equivalence theory.

Interview: Dr. B.A. Soldano

What follows is an interview which the authors conducted with Dr. Soldano on Jan. 17, regarding the relationship between his own work and the postulated "fifth force."

Dr. Soldano has taught physics for 15 years at Furman University. From 1949 to 1971, he was a researcher in chemistry, physics, and engineering at Oak Ridge National Laboratory. For the past two years, he has been a Goddard summer research fellow, under NASA's physics research program.

EIR: Dr. Soldano, can you explain what you mean by the difference between gravitational and inertial mass?
Dr. Soldano: There are only two properties of mass: first, that a given mass will attract all other mass, and that's called *gravitational mass*; and second, that mass resists change in motion, and this resistance to change in motion is called *inertial mass*. Now, these are two different properties of mass, but interestingly, when a substance falls, it can be "inerting" and "gravitating" at the same time.

Since these are two different properties, one would, without being told differently, assume that the values you would associate with inertial and gravitational mass would be different. The fact that—assuming they are in a vacuum—all things appear to fall to the ground with the same acceleration, is indirect proof that the inertial mass and the gravitational mass are one, and identically equal to each other.

EIR: Is this what Galileo showed when he asserted that things of different mass fell to the earth in the same amount of time?
Dr. Soldano: He proved that the inertial mass and the gravitational mass properties, appear to be identically equal to each other—which is contrary to reason, you would have thought. And Einstein, then, took this apparent equality, and he made it a principle—the so-called equivalence principle.

EIR: Can you describe how you came to develop your theory?
Dr. Soldano: About 25 years ago, I concluded that the central difficulty which Einstein had run into when he attempted to unify physics, was the fact that General Relativity could not describe, surprisingly, gravitational energy—of all things. It could handle all other forms of energy, but it couldn't handle gravitational energy. It ran into such problems as apparent violation of conservation of energy at the microscopic level, and it required a special model of the universe in order to fit a series of complications.

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About 25 years ago, I concluded that the central difficulty which Einstein had run into when he attempted to unify physics, was the fact that General Relativity could not describe, surprisingly, gravitational energy—of all things.

ability to quantitatively handle gravitational energy unambiguously, that this was a manifestation of a difficulty in the theory's fundamental assumption. In the gravitational-energy part of energy in general, which is a very small but very important part, the assumption that inertial and gravitational mass were identically equal to each other, was false. This is very important for any unified field theory.

EIR: Can you give us your opinion of Fischbach's communication to *Physical Review Letters*?
Dr. Soldano: The Eötvös experiment measured the acceleration of an object relative to the earth—how it falls. It can be done with pendulums, or by means of bending torsional fibers; but essentially you're looking at the acceleration, how things fall relative to the earth. And contrary to the equivalence principles of Einstein and Galileo, the fact is, they found that in the Eötvös experiment, just by analyzing what he had done 60 years ago, heavier objects (objects that had more nucleons associated with them) would fall just a little bit slower than substances composed of a smaller number of nucleons.

EIR: How come no one has ever commented upon this up until now?
Dr. Soldano: Because the fact that the equivalence principle has almost become "theological." Because Special Relativity depends upon the validity of the equivalence principle; General Relativity depends upon the equivalence principle; the entire foundation of science depends upon the equivalence principle.

EIR: Why hasn't the equivalence principle been challenged before? At the time when Eťvös did his experiment, why do you think that there wasn't any question raised about the discrepancy which was found?
Dr. Soldano: At the time, the experiment was considered so much more accurate and sensitive than anything up to that time, that they thought that this was a remarkable extension of the principle. And a whole body of literature has arisen—a massive amount—that always refers to the experiment and its modern variants as proof of the validity of the equivalence principle. And then one starts to construct theories like special and general, which depend upon that single-minded assumption.

EIR: What was the analytic technique the Fischbach group used?
Dr. Soldano: Just curve-fitting, and using modern error-analysis and graphical techniques, they just went back and re-examined the data, and found, lo and behold, that the conclusion of the null hypothesis—that there is no difference between inertial and gravitational mass—really doesn't seem to hold up. The data actually fit the pattern, that the more nucleons (that is protons and neutrons, the mass number) you have in any pair of atoms which you are comparing, the less will acceleration occur. A fancy name for nucleon, which Fischbach and his group like, is "hypercharge"; that gives you the idea, you're able to introduce quantum considerations, like strangeness; but in the Eötvös experiments, you're dealing with non-strange material, and nucleon number and hypercharge amount to the same thing.

EIR: Can you expand on the fact that what is actually being compared are not densities as such, but mass number?
Dr. Soldano: It's not densities which you're comparing, but the number of nucleons, the number of protons and neutrons associated with the nuclei. If you could densify something, by some means, by compressing it, it would not

Dr. B. A. Soldano

necessarily be the case that it had the same mass number as something else which had an equal mass density. The mass number is called hypercharge in modern quantum physics.

EIR: Can you describe your objection to the so-called fifth force?

Dr. Soldano: They evoke a fifth force, hypercharge force, which is repulsive. It will (they say), tend to repel the earth as a substance falls, so that the substance won't fall as fast. This, I submit, is an attempt to save Special and General Relativity theory, which both depend fundamentally on the equivalence principle—the equality of inertial and gravitational mass.

They went to an equation which has been evolving over the last 10-15 years, in which the general premise is that the Newtonian gravitational constant indeed is not quite a constant. There is a Newtonian gravitational constant at infinite extension from some reference frame, which has a larger value than the gravitational constant which you find when you make measurements in a laboratory. We're talking about a small difference, but it's real, it's measurable, it's come out of a lot of geophysical measurements: that the Newtonian gravitational constant really has a slight variation in it.

They say that a hypercharge effect can account for this disparity between the gravitational constant at infinity, and a local gravitational constant. They say that these empirical constants, the constants of the equation, produce the new fifth force they're talking about. They think they've avoided the central question, but the equation they use already betrays them.

General Relativity is based upon strict equivalence, and in General Relativity, the Newtonian gravitational constant must remain constant under all conditions. General Relativity based upon the equivalence principle, requires that the Newtonian gravitational constant remain an absolute constant; it can't vary. But here they're using an equation, based upon experimental data, that shows the constant varies! And they say the hypercharge explains it! Well, obviously, whatever the hypercharge is doing, it's inconsistent with General Relativity.

EIR: How does this relate to your own theory?

Dr. Soldano: The equation they're using to fit their data, is easily calculable according to my theory. In fact, the equation is actually referenced in the paper of mine which you are publishing [in *IJFE*—ed.], and I am sending you an appendix which deals directly with Fischbach's conclusions. There are a lot of arguments which I go into.

EIR: Can you explain this for a popular audience?

Dr. Soldano: I can make it very simple. I can derive the empirical constants which Fischbach uses from my formula for the non-equivalence in gravitational binding. I take the body of information that's in their paper, and show how to derive what they call the hypercharge from my formula. This hypercharge is only one manifestation of non-equivalence in gravitational binding.

EIR: So, according to the work which you've done, in which you state the non-equivalence of inertial and gravitational energy, you can make your work cohere with the values which they found empirically?

Dr. Soldano: Absolutely. I can derive them theoretically. A fifth force tends to localize this difficulty being encountered by the Establishment. Non-equivalence in gravitational binding clearly shows that this effect appears at every level of physics. We handle the strong interaction, we handle electromagnetic force, we handle the weak force, and we handle gravitation. Because non-equivalence in gravitational binding *can't* be restricted; it appears at every level of interaction in science.

EIR: Do you want to make a statement about what you consider to be the philosophical implications of your theory, that there is a non-equivalence in gravitational and inertial energy?

Dr. Soldano: In my opinion, the weakest of the weak of all interactions, non-equivalence in gravitational binding, will provide the key to uniting all four levels of interaction in science. And more importantly, it will provide an answer to the fundamental dilemma that's faced all of science for the last 70 years, namely: Does Planck's Constant, on which the modern revolution in physics has been based, have priority over classical physics?

That is the central question. And, from a non-equivalence standpoint, the answer is, non-equivalence in gravitational binding strongly indicates that classical physics, when modified by this non-equivalence idea, leads to a unit of action which mirrors all of the characteristics of the quantum itself. So that, in principle, non-equivalence says classical theory ultimately has precedence over the dominant physics today, which is quantum mechanics. Today, quantum mechanicians think that you start with Planck's Constant, and from it you can derive the world. Non-equivalence says, you start with classical physics; once you introduce non-equivalence in gravitational binding, you can arrive at the quantum itself—which is the fundamental question of modern science.

Dr. Moon is the editor-in-chief of the International Journal of Fusion Energy *and professor emeritus at the University of Chicago. He is a veteran of the Manhattan Project. Carol White is science and technology editor of* EIR *and editor-in-chief of* Fusion *magazine.*