In the beginning . . . there were unitons?

Quantization is the basic fact of life in modern physics. Important properties of elementary particles (electric charge, angular momentum and many more exotic ones) appear only in integral multiples of certain basic units rather than assuming a continuous range of quantities. But the properties associated with the force of gravitation are conspicuously nonquantized as far as anyone knows, and that is a situation that makes physicists unhappy. An important question is whether there is a basic unit of mass as there is a basic unit of electric charge.

Because the (nonrelativistic) equations describing gravitational forces are so similar in form to those describing electric forces, Lloyd Motz of Columbia University decided to attempt to define a "gravitational charge" that would be analogous to electric charge and see whether it could be quantized. He told the recent meeting of the American Physical Society in Washington that he has succeeded. The work predicts the existence of a rather strange basic physical particle that can be used to solve many outstanding mysteries of astrophysics.

According to Motz the quantity that bears the same role in the gravitational equation is not simply mass, as one might think at first, but the square root of the product of mass times Newton's universal gravitational constant. This quantity is what Motz calls gravitational charge.

To quantize it Motz considers its relationship to angular momentum, a well-known quantized phenomenon. He sets up a hypothetical situation in which two bodies are bound in rotational motion, and figures the angular momentum of the system in terms of his gravitational charge. The least possible amount of angular momentum a system can have has to be equal to the basic quantum of angular momentum.

Setting this equal to the expression that comes out of his gravitational figuring, he gets an equation that unites three of the basic constants of physics: the gravitational constant, the speed of light and Planck's constant. There is a kind of mysticism among physicists about these constants. Equations that unite them are often considered to have something profound to say about the basic structure of the universe. Motz works this one for all it will bear.

First he solves the equation for m to seek a basic unit of mass. It yields a figure of about 10^{-5} grams, fantastically large for an elementary unit of mass since it is 10^{19} times the mass of a proton. Nevertheless Motz postulates a particle of this mass. He calls it a uniton.

In the beginning, says Motz, after the big bang, the universe was mostly unitons. Gradually they came together. Since they interact violently by gravitational forces, they lost most of their mass and combined to form much smaller particles. Motz suggests that the whole spectrum of elementary particles can be built up from combinations of unitons. To do this he has to endow them with electric charge, and that comes out to be ⅓ or ⅔ the electron charge, a characteristic that makes them sound similar to the still-elusive quarks.

But some unitons may not have combined and still remain free. If there are as many as one uniton to 10^{17} protons in the present universe, they can solve a number of astrophysical problems. They can provide the necessary but so far unobserved mass to bind the universe together and prevent it from expanding endlessly. Similarly they can provide the missing mass to bind clusters of galaxies together.

If there are unitons on the sun, they can explain the failure to find a flux of neutrinos from the sun.

The gravitational interactions of the unitons would be a good source of gravitational waves. They could explain the fluxes of those waves that Joseph Weber of the University of Maryland has been recording without requiring the destruction of all the visible mass in the center of our galaxy.

Unitons can also explain the energy flux of quasars.

The existence of unitons might also explain the seemingly arbitrary ratios of the strengths of the basic physical forces. Especially curious in this regard is the value of the fine structure constant, 1/137, which is the ratio of the relative strength of the electromagnetic and strong nuclear forces. The number seems absolutely arbitrary, but according to some people's calculations it is precisely the only value that leads to atomic and chemical structures such that intelligent life could evolve. As one prominent physicist puts it: "God made the fine structure constant equal to 1/137 so that we would arise to worship Him." If unitons are real, their existence would relate this and other relations between the natural forces to a more basic level.

Columbia Univ.

Motz: Uniton can solve many riddles.

Critical attitude to Motz's suggestions for the moment appears to be summed up in the words of one listener: "So far this is all playing with numbers." That is not to say that similar numerology has not led to important insights in the past, but Motz's arguments will be more convincing if and when a real uniton is found. Motz suggests that unitons might show up in cloud chambers, and he is now at work on the nature of their interactions with other matter to see how that might be done. □

Saturn may not be so cold after all

In *Intelligent Life in the Universe*, the book he wrote in collaboration with the Russian astronomer I. S. Shklovskii, Carl Sagan tells of a time he was asked to testify for the prosecution in a fraud trial of a flying-saucer cultist. The defendant had claimed he had been visited by inhabitants of Saturn who pointed out to him a special quartz mine in southern California: the quartz cured cancer. Sagan described in detail why it was unlikely Saturn harbored human-like beings. Among the reasons was that earth observations indicated the temperatures in Saturn's atmosphere were several hundred degrees below zero F.

Now three Cornell University colleagues of Sagan have completed a study that, although hardly likely to reverse the quartz-mine promoter's conviction, does show that there are areas in Saturn's atmosphere much warmer and possibly more conducive to life than scientists have previously thought likely.

James J. Condon, David L. Jauncey and Michael J. Yerbury used the 1,000-foot radio telescope at Arecibo, Puerto Rico, to monitor for the first time long wavelength radio waves from the lower levels of Saturn's atmosphere. The temperatures at radio wavelengths of 50 and 100 centimeters turned out to be unusually high—about 240 degrees F. and 520 degrees F. Thus it appears that Saturn, like Jupiter, is not entirely the frozen wasteland it was once thought to be. The report was to be presented at the international meeting of COSPAR (Committee on Space Research) in Madrid this weekend. □