# Prof. Bagge's 'Geometric Nucleus'

*This memo was written by Ralf Schauerhammer, an editor of the German-language* Fusion *magazine, March 12, 1988.*

Some weeks ago, I explained the key features of Dr. Moon's "Kepler" nucleus to Prof. Erich Bagge. Although he had doubts about some of the specifics of the construction, he immediately agreed to the basic conception and stated that he is convinced that the atomic nucleus can only be understood "geometrically," and that the "formal" description prevalent today does not explain much. He told me that he had already, 40 years ago, developed a geometric concept of the nucleus.

When Bagge read the paper of Mrs. Goeppert-Mayer on the empirical results of the "magic numbers," he thought that there must be a geometrical explanation for these numbers. He remembers still today, how he got the crucial idea in January 1949, while shaving one morning. (His basic concept is published in *Naturwissenschaften,* Jahrg. 38, S. 473 ff.)

There are two rows of "magic numbers": 2, 6, 14, 28, 50, 82, 126; and 2, 8, 20, 40, 70, 112. They result from the formula:

$$N(N) = \frac{N^3 + 5N}{3}, \quad N = 1,..,7$$

$$G(N) = \frac{N^3 - N}{3}, \quad N = 2,..,7.$$

The series of "magic numbers" usually used is a combination of both; that is, G(2) = 2, G(3) = 8, G(4) = 20, N(4) = 28, N(5) = 50, N(6) = 82, N(7) = 126. The "break," which is responsible for the shift from one series to the other, is usually explained theoretically as a result of the spin-orbital-force between nucleons. Dr. Bagge considers these forces unnecessary and conceptually contradictory.

What is important about these formulae is that they reflect a three-dimensional geometrical structure, which Bagge later explained by "minimal close packings of regular geometric objects." A student of his did experiments by packing regular geometric bodies in a rubberskin, and reproduced exactly the series of the "magic numbers" when he used ellipsoids.

Stuart Lewis/EIRNS

*German nuclear pioneer Erich Bagge (left) and Robert Moon in 1985, in a discussion of the history of nuclear energy, sponsored by the Fusion Energy Foundation. Bagge's unique interpretation of the Darmstadt heavy ion collision experiments was one input into Moon's conception of nuclear structure.*

A two-dimensional example can be constructed with coins and a rubberband. You get 1 for the first "two-dimensional magic number" and 7 for the second one, because 6 fit around the one in the middle, and so on.

I have to take a close look at this work. I believe what Dr. Bagge did, is an application of a three-dimensional "isoperimetric principle" applied to ellipsoids. The "empirical" reason Dr. Bagge gave for the use of ellipsoids is the predominant occurrence of even numbers in nucleons. A deeper reason, however, might be found viewing the process of nucleus-formation from the standpoint of conical functions and their elliptical integrals.

The history of Dr. Bagge's discovery is noteworthy. Immediately after he got the idea, he explained it to Drs. Suess and Jensen, who had passed by on a trip from Copenhagen to Göttingen. They had not worked on the structure of the nucleus previously, but took Bagge's idea and reformulated it in an algebraic version. Then they published it in that form without mentioning Bagge at all!

**Priority Veiled**

The referee of the journal *Naturwissenschaften,* (Haxel) delayed Bagge's note on the subject long enough so that it was published only in the same issue with the article of Jensen and Suess, to veil Bagge's priority. Then Jensen and Suess later got the Nobel Prize for discovering the so-called "shell structure" of the nucleus. Also, in the *Physical Review,* Bagge's idea was published under a totally different name (Gouldsmith on "Electronspin"), and only after Bagge's intervention was a note introduced stating that Bagge had published the "same idea already two years earlier."