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This Week's Citation Classic

Ericson T. The statistical model and nuclear level densities. Advan. Phys. 9:425-511, 1960. [Dept. Physics and Lab. Nuclear Science, MIT, Cambridge, MA]

Nuclear reactions have an important component due to the formation of an equilibrium system from which statistical emission occurs nearly independent of the formation similar to evaporation. The logical consequences of the assumption of independence are analyzed with the prediction of new phenomena. [The SCI® indicates that this paper has been cited over 420 times since 1961.]

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"In 1959, shortly after having passed my thesis on nuclear level, densities and statistical reactions at Lund, Sweden, and on my way to MIT for a year as a fresh post doc, I received a letter from (now) Sir Brian Flowers inviting me to write a review for his journal.

"This was an extraordinary opportunity and a tremendous challenge for a young physicist. I did not for a moment intend to make this a routine review. At the time statistical and evaporation models were considered old-fashioned crude approximations, after having dominated thinking on nuclear reactions in the 30s and 40s. The whole picture was plain suspect in view of all the evidence for fast diffraction like processes. I disagreed, for I was very impressed by several recent experiments, in particular those on (p,á) reactions by N. Lassen in Copenhagen. Nobody had taken the model really seriously and analyzed all its implications to the end to see what the predictions really were. That is what I set out to do.

"This program developed smoothly at first. It was indeed possible to bind all together logically in a nearly classical picture with a considerable number of smaller new results, physical pictures, and elaborations, but basically without injection of anything radical. It was turning out just as planned. And then I got stuck, desperately stuck, on the crucial step which throws out all interference terms and makes the statistical model classical by a random phase assumption. I could not for my life see how it could happen, but it was manifest to everybody else. After weeks it finally dawned on me that I was right. There were a number of new phenomena in the model with an enormous fine structure which was extremely sensitive to the detailed dynamics. It would not show up in normal global experiments, but here was a strong test of the model.

"When this was pointed out it became extremely controversial. A companion paper was first rejected by Physical Review Letters.[1] An unconfirmed story tells that the editors finally accepted it with great hesitation. A number of referees had argued for rejection. However, half of them did so for reasons of triviality, while the other half did so on the grounds of incorrect conclusion.

"The predicted phenomena are now well established and are referred to as 'Ericson fluctuations.' Specialized books often give the topic a separate chapter. When re viewed six years after the initial paper over 100 papers had been published about it.[2] The corresponding effect has also been found in acoustics.

"This is of course a major reason why the paper has been cited so much, particularly in the early years. Nowadays the effect is usually cited by its name and no further reference. The remainder of the article contains in addition much material not easily or not at all found elsewhere. It has become a standard reference on nuclear level densities, evaporation of complex particles, and on statistical angular distributions for people in nuclear physics, nuclear chemistry, and their applications. The article has been required PhD reading for nuclear physicists at various places."

1. Ericson T E O. Fluctuations of nuclear cross sections in the "continuum" region. Phys. Rev. Lett. 5:430-1. l960.
2. Ericson T & Mayer-Kuckuk T. Fluctuations in nuclear reactions. Annu. Rev. Nucl. Sci. 16:183-206. 1966. [Translated in Usp. Fiz. Nauk SSSR 92:271, 1967.]