

This Week's Citation Classic

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Goulding F S, Landis D A, Cerny J & Pehl R H. A new particle identifier technique for $Z=1$ and $Z=2$ particles in the energy range > 10 MeV. *Nucl. Instr. Methods* **31**:111, 1964. [Lawrence Radiation Lab., Univ. California, Berkeley, CA]

This paper described the first use of the power law Range v Energy relationship for identifying nuclear particles. Signals from a $\Delta E E$ detector telescope were combined using the logarithmic voltage v current relationship in semiconductor junctions to produce an output representative of the type of particle. [The SC® indicates that this paper has been cited over 225 times since 1964.]

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"Like many new techniques the invention of the new particle identifier method at the Lawrence Berkeley Laboratory was stimulated by the need to solve a growing problem. The complexity of products produced in nuclear reactions in the new generation of cyclotrons and Tandem Van de Graaff machines could not be resolved by the earlier methods. B. Harvey pointed out this problem and the identifier resulted directly from his interest. The success of the method can be judged by the fact that more than 20 new isotopes have been discovered using it. Work on the stability of neutronrich nuclei using the identifier resulted directly in the E.O. Lawrence Award being given to J. Cerny.

"The paper also marked a significant philosophical breakthrough for the instrumentation group (F.S. Goulding and D.A. Landis) in at least one nuclear laboratory. Instrumentation for nuclear science had previously largely been developed by amateur electronic 'experts' whose real forte was experimental nuclear physics. They were remarkably late in using transistors and semiconductor devices. Two of the authors of the paper (F.S.G. and D.A.L.) were involved in making the transition to modern circuits in nuclear

science and the success of the identifier established the credibility of the new approach.

"Success of the method was due to the combination of modern electronics with the realization of the value of using the approximate power law range-energy relationship $R = A E^\alpha$ (where $\alpha \approx 1.78$) rather than the more exact Bethe-Bloch relationship. This simplified the electronics and, more important, extended the range of energies and isotopes that could be accommodated while at the same time eliminating the critical experimental adjustments required by earlier (multiplier) identifier methods. The power of the basic method is illustrated by the fact that it is still used in almost all particle identification work even when computer signal processing is employed rather than the analog techniques used in this paper. Even though the coefficient α of the power law changes substantially for heavy ions, a modified version permitting α to change is used in heavy ion physics, the present forefront area of nuclear science. The immediate recognition of the work is illustrated by its publication in two journals by demand.¹

"The new identifier led to very rapid developments in studies of nuclear reactions and within a few months very low yield reactions were being studied (e.g., production of ^3He). Work on these reactions led to invention of the multiplier-detector telescope for such studies.² This new identifier was already in use before publication of the original work. The multiplier-detector telescope led to a wide range of experimental programs—for example, in studies of the isotopic composition of high-energy ions in space.³

"It is gratifying to feel that one's work remains useful for almost two decades. Among the deluge of papers appearing today it is evident that few contain such simple and satisfying ideas. Unfortunately for the young scientist, history grows with time and new ideas become more difficult to find in an established scientific area."

1. **Goulding F S, Landis D A, Cerny J, III & Pehl R H.** A new particle identifier technique for $Z = 1$ and $Z = 2$ particles in the energy range > 10 MeV. *IEEE Trans. Nucl. Sci.* **NS11**:388-98, 1964.
2. **Goulding F S, Landis D A, Cerny J & Pehl R H.** An improved particle identifier for studies of low yield nuclear reactions. *IEEE Trans. Nucl. Sci.* **NS13**:514-26, 1966.
3. **Griener D E.** A versatile, high-resolution particle identifier theory. *Nucl. Instrum. Methods* **103**:291-308, 1972.