

Physics Department Seminar

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Surprises in Elementary Physics

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Abstract

One does not associate Elementary Physics with surprises. The science is old and well-trod. But we shall show that a succession of repeated events can lead to a dramatic and unexpected effect. In the present work we consider three examples from school/undergraduate physics. The result is from mechanics and it concerns one dimensional collision leading to an almost 100% efficient energy transfer between disparate masses. The second from optics deals with the rotation of the plane of polarization of light by a succession of suitably rotated polarizers. The third is from calorimetry. A fourth from quantum mechanics wherein repeated interrogation of an unstable state prevents its decay (the Quantum Zeno effect). In each example we examine the role of dissipation and arrive at an optimized arrangement. Our selection of examples is deliberate and it is to suggest that we may seek out many examples from undergraduate physics. This topic, namely the cumulative (and at times dramatic) effect of a sequence of near similar events, is rarely touched upon in textbooks. Its consideration may make the subject matter livelier as well as helps educate students on the role of optimization at an early stage in their career.

[Reference: Vijay A Singh et al. American Journal of Physics Vol. 88, pages 124–130, 2020.]

About the speaker



- **Prof. Vijay Singh** is a visiting Professor at the Center for Excellence in Basic Sciences (CEBS), Mumbai University and the President of the Indian Association of Physics Teachers (IAPT).
- He completed his doctoral degree from the State University of New York (1978).
- He was a Professor of Physics at IIT - Kanpur from 1984 to 2004 and a Professor of Physics at the Homi Bhabha Centre for Science Education, a center of the Tata Institute of Fundamental Research, Mumbai from 2005 to 2015. He was also an Adjunct Professor at CEBS and at IIT Bombay.
- He was the National Coordinator, Science Olympiads and the National Initiative on Undergraduate Science (NIUS) for ten years.
- Under his mentorship a large number of high school students have won gold medals in the Olympiads and a large number of undergraduate students have carried out research projects resulting in several international publications.
- Prof. Singh has worked at several places abroad and has been a visiting faculty at universities in the USA.
- He has over 150 peer-reviewed international scientific publications.
- He was a co-author of the NCERT Physics Textbooks for Higher Secondary School Physics. He was also the chief editor of the Bulletin of the Indian Association of Physics Teachers.
- One of his hobbies is to solve and design problems at school and undergraduate level physics.

All are cordially invited!