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Application of conservation laws in electron-positron annihilation

BIJAYA ARYAL, University of Minnesota-Rochester — Electron-positron annihilation and creation of gamma rays involve various conservation principles. The least possible number of gamma rays produced in an annihilation event for low energy case can be generally explained using energy and momentum conservation. For this purpose, we choose a convenient frame of reference in which the system has zero linear momentum just before the annihilation event occurs. A learning activity was designed to help introductory level physics students understand and apply some of these conservation principles in the context of electron-positron annihilation. This study presents the students' spontaneous application of prior learning resources while explaining the annihilation process and predicting the least possible number of gamma rays produced in an annihilation event. Qualitative and quantitative data were gathered from students' interviews and written responses from several semesters. Data analysis has revealed students' use of macroscopic analogies during these applications. Moreover, this study has shown that analogical mechanical models seemed to improve student performance. However, a majority of the students using such models provided incorrect reasoning in their explanations.

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