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Why is Physics Important to Cancer Research?

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Cancer is increasingly described as a "disease of the genes", and while the genome (in fact all of the omes) are important information molecules that drive aspects of the initiation and progression of cancer, they are far from the whole story. Cancer is an extraordinarily complex system (in fact a complex of systems) that occurs in three-dimensional space, across multiple scales and often over extended periods of time. The most challenging issues that plague the cancer field such as metastasis, cellular heterogeneity and resistance to therapy are in large part more rationally explained in the context of the physics of these systems vs. genomics. For example, the biology of metastasis has been studied extensively for decades with little progress. Metastatic disease depends on cells acquiring (or expressing innate information) new properties that enable and sustain their ability to migrate to distant sites. Developing a fundamental understanding of key cancer processes ranging from metastasis to immunotherapeutic responses requires that physicists (and mathematicians and engineers) be integrated into a new generation of cancer research period! The presentation will focus on those areas where physics is essential and the hows and whos of achieving the integration required.