Invited talk at the Physical Sciences Symposium, US-Korea Conference on Science, Technology, and Entrepreneurship (UKC-2003), August 8-10, 2003, Ramo Auditorium, California Institute Of Technology, Pasadena, California, U.S.A.

Relativistic hadron beam cancer treatment*

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Energetic hadron (proton and heavier ion) beams have definite ranges with sharp ionization peaks (Bragg peak) and sharper penumbrae when compared to conventional radiation (photon or electron beams). Hadron beams provide higher degree of conforming the curative dose distributions within the target volumes, while sparing the surrounding healthy tissues and critical organs. Higher dose localization increases the rate of local control of diseases with lower complication rates. Compared to protons (Z=1), heavier nuclei (e.g., Z=6 for carbon nuclei, typical ions used in cancer treatment) ionize more densely upon penetrating living tissue, and exhibit certain biological advantages, which are exploited by clinicians to treat selected types of tumors. The clinical use of relativistic hadron beams for cancer treatment was originally pioneered fifty years ago at Berkeley Lab. Based on the decisive clinical trials at Berkeley, many clinical trials using hadron beams for cancer treatment ensued at various particle accelerator centers, and now constructions of hospital-based dedicated hadron-beam facilities are burgeoning worldwide.

* This work was supported by the Director, Office of Energy Research, Office of Laboratory Policy and Infrastructure Management, of the U.S. Department of Energy under Contract No. DE-AC03-76SF00098.