SPICE-NIRS Microbeam: Focused vertical system for proton irradiation of a single cell for radiobiological research

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The Single Particle Irradiation system to Cell (SPICE) facility at the National Institute of Radiological Sciences (NIRS) is a focused vertical microbeam system designed to irradiate the nuclei of adhesive mammalian cells with a defined number of 3.4 MeV protons. The approximately 2- μ m diameter proton beam is focused with a magnetic quadrupole triplet lens and traverses the cells contained in dishes from bottom to top. All procedures for irradiation, such as cell image capturing, cell recognition and position calculation, are automated. The most distinctive characteristic of the system is its stability and high throughput; i.e. 3000 cells in a 5 mm x 5 mm area in a single dish can be routinely irradiated by the 2- μ m beam within 15 min (the maximum irradiation speed is 400 cells/min). The number of protons can be set as low as one. A variety of targeting modes such as, multiposition targeting mode for nucleus irradiation and cytoplasm targeting mode are available. SPICE is a joint-use research facility of NIRS and its beam times are distributed for collaborative research.

