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Ph.D. Thesis abstract :

A single ion facility has been developed at CENBG for applications in radiobiology at the cellular scale. The development of this set-up was based on the existing nuclear microprobe, which is able to focus protons or alpha particles from 1 to 3 MeV down to one micrometer under vacuum. The main part of this work was dedicated to adapt an irradiation stage on the microbeam line to deliver particles in air with an absolute precision of a few micrometers. A control software, used to drive the overall experiment including the automatic phases of calibration and irradiation, has also been developed. Monte Carlo simulation tools, required for set-up characterisation and enhancement, have been validated at micrometer scale by comparison with experimental data. Experimental validation of the facility, in terms of beam control, spatial resolution and targeting accuracy has been performed. These tests allow to consider the first use of the facility in the frame of radiobiological studies. In the near future, this facility will allow studies of cellular responses to low doses of radiation, including extreme situations like exposure to a single ionising particle. Studies of fundamental cellular mechanisms like signalling, intercellular communication or programmed cell death (apoptosis) will also be possible.