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The EclipseTM treatment planning system for microbeam radiotherapy trials at the Australian Synchrotron

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Before clinical trials of synchrotron microbeam radiotherapy (MRT) on humans can occur, a computerised treatment planning system (TPS) to calculate the dose distribution in the patient must be developed and validated. To satisfy this requirement, we use a research licenced version of the EclipseTM TPS from Varian Medical Systems. This research license allows for customised dose calculation algorithms to be integrated with the clinical work-flows in EclipseTM that are typical to modern radiotherapy.

Our treatment planning system is designed for the dynamic MRT modality that has been developed for the Imaging and Medical Beamline. It uses a pencil beam convolution algorithm for dose calculation, and allows for the design of customised conformal masks. For the treatment itself, the white beam is collimated to a 30 mm wide and 1 mm high field which illuminates the MRT collimator, which in turn produces 50 um wide vertical microbeams separated at 400 um center-to-center. The sample and a mask is then dynamically swept through this array of microbeams, producing a dose of radiation in the sample that is conformal to the mask aperture.

Dose calculation considers the sample geometry derived from conventional CT data, custom bolus structures, conformal masks, and multiple fields. Beam configurations and sample stage motions are limited so as to reflect the actual limits on the beamline. We have compared the output from the MRT TPS to measurements on the beamline, and documented our experiences in using it for planning the delivery of known doses to samples.

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