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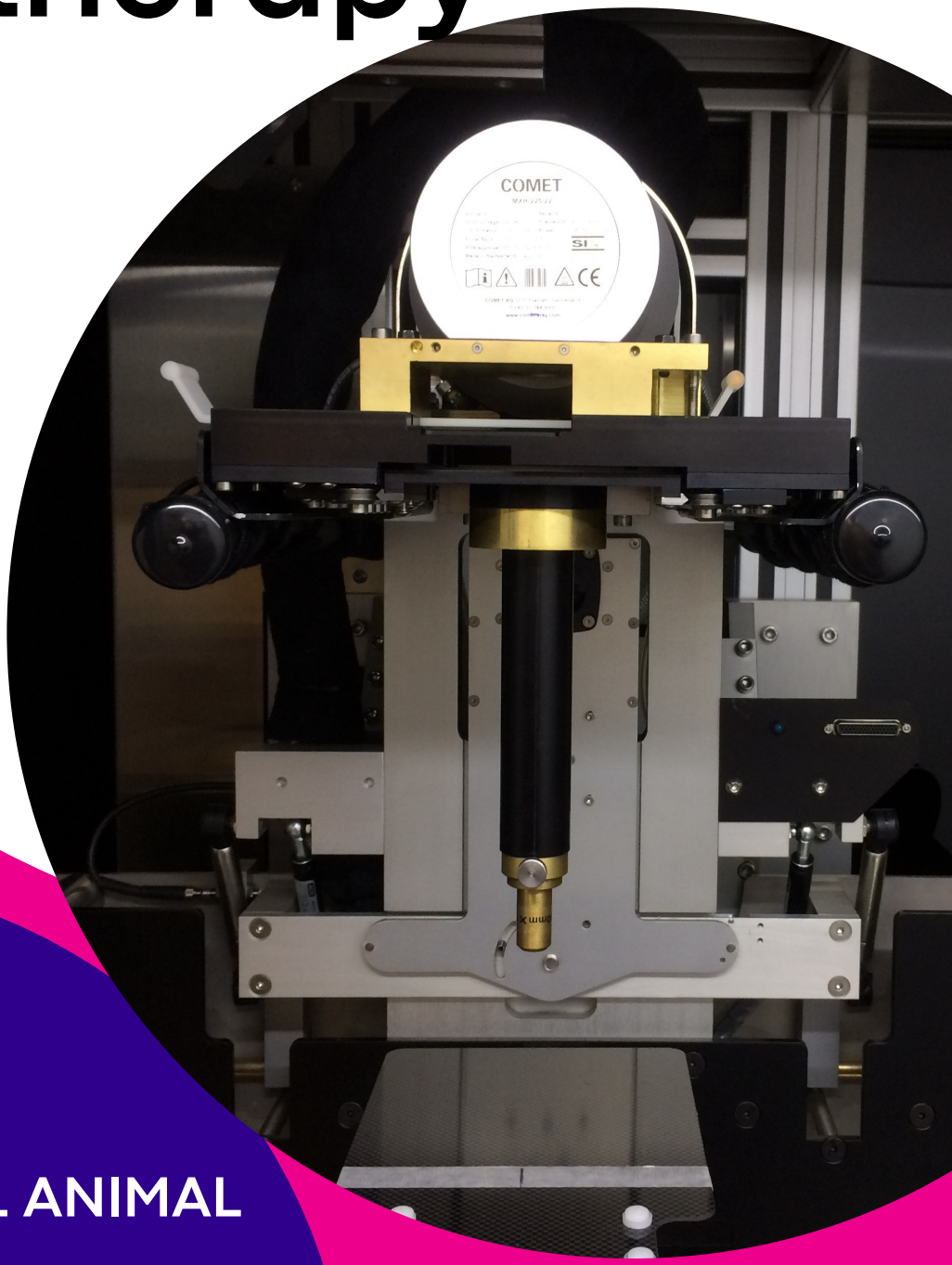
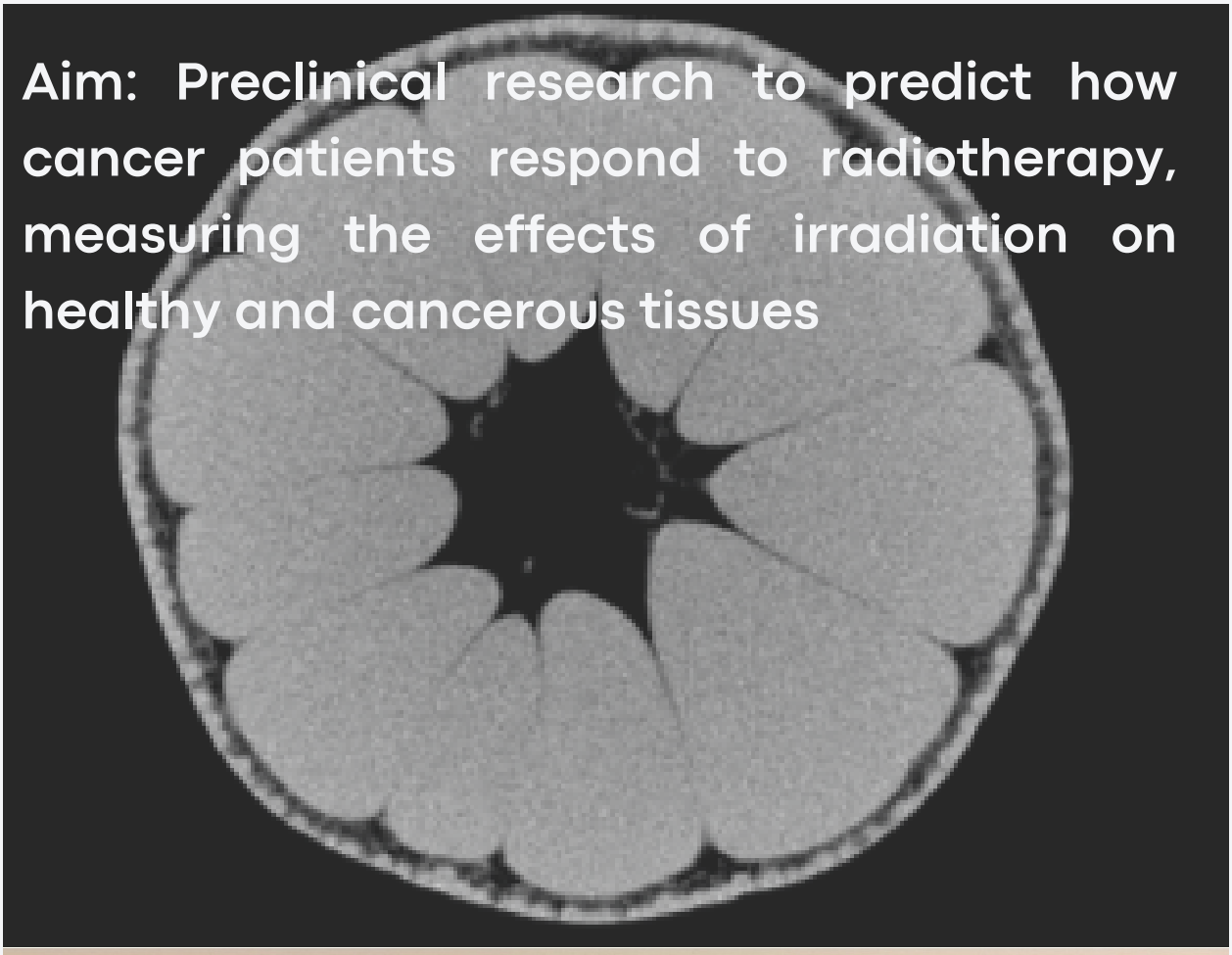
Pre-clinical Radiotherapy



XSTRAHL SMALL ANIMAL RADIATION RESEARCH PLATFORM (SARRP)

Image-guided irradiator with microbeam targeting



Small Animal Radiation Research Platform

The SARRP irradiator provides CT imaging combined with adaptive radiation delivery:

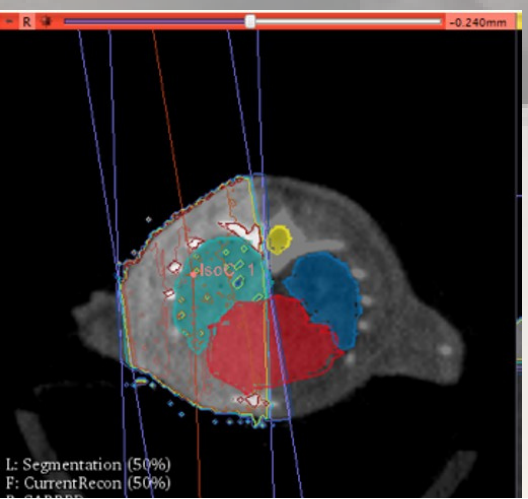
·With the imaging system, it is possible to take cone-beam CT images of small animals with rapid reconstruction (under 1 minute) and high definition

·The images are used for treatment planning using bespoke Muriplan software

·During treatments, X-ray targeting of specific internal regions can be made by using collimated beams of 1-10mm width. The beam angle can be moved through a full 360- degrees of rotation around the specimen

.The treatment platforms, and 3D-printed mouse beds, are fully adjustable to facilitate accurate targeting·

·The x-ray beam quality can be refined using interchangeable filters; aluminium for imaging, and copper for treatment



·Dosimetry is fully traceable to UK primary standard (National Physical Laboratory, Teddington)

Imaging and Software

The CT image is reconstructed from X-ray projections taken through the specimen as it rotates through 360 degrees. This generates a 3D image dataset that can be viewed in the treatment planning software (Muriplan), as sequential slices through the axial, sagittal and coronal planes of view.

Muriplan is used both to visualise the CT and to target and define treatment volumes. It allows for rapid tissue segmentation, anatomical targeting, and coregistration with other imaging modalities.

Unique plan creation for each animal allows precise targeting of X-rays to the required region. The defined X-ray dose is calculated for the target depth and isodose maps are generated to visualise the percentage dose to adjacent tissues. To quantify dose, organ contouring can be used to create accurate dose-volume histograms.

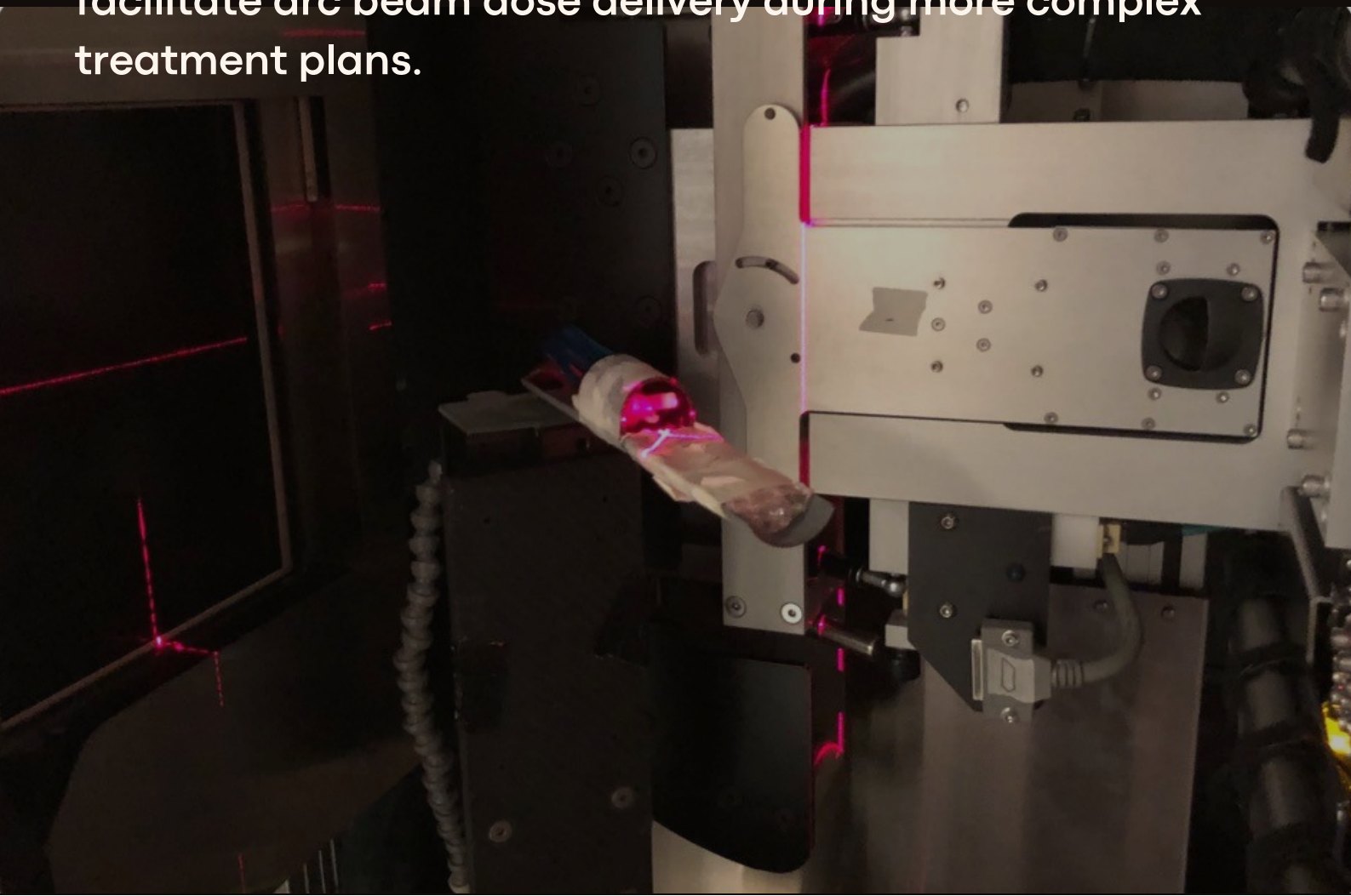
This visualisation of dose distribution and the availability of different beam geometries enables radiation treatment to be planned in a clinically-relevant manner.

Robotic specimen stage

· The SARRP includes a robotically controlled specimen stage. Following target acquisition, the movement of the stage is automatically coordinated to position the animal at the correct distance from the X-ray source, with the target region centred in the collimated beam.

. Positioning is determined through X- lateral, Y- longitudinal and Z-vertical axes. Co-axial lasers are used to confirm the accuracy of targeting.

· Stage rotation through 360 degrees is required during CT imaging, additionally, stage rotation can be used to facilitate arc beam dose delivery during more complex treatment plans.

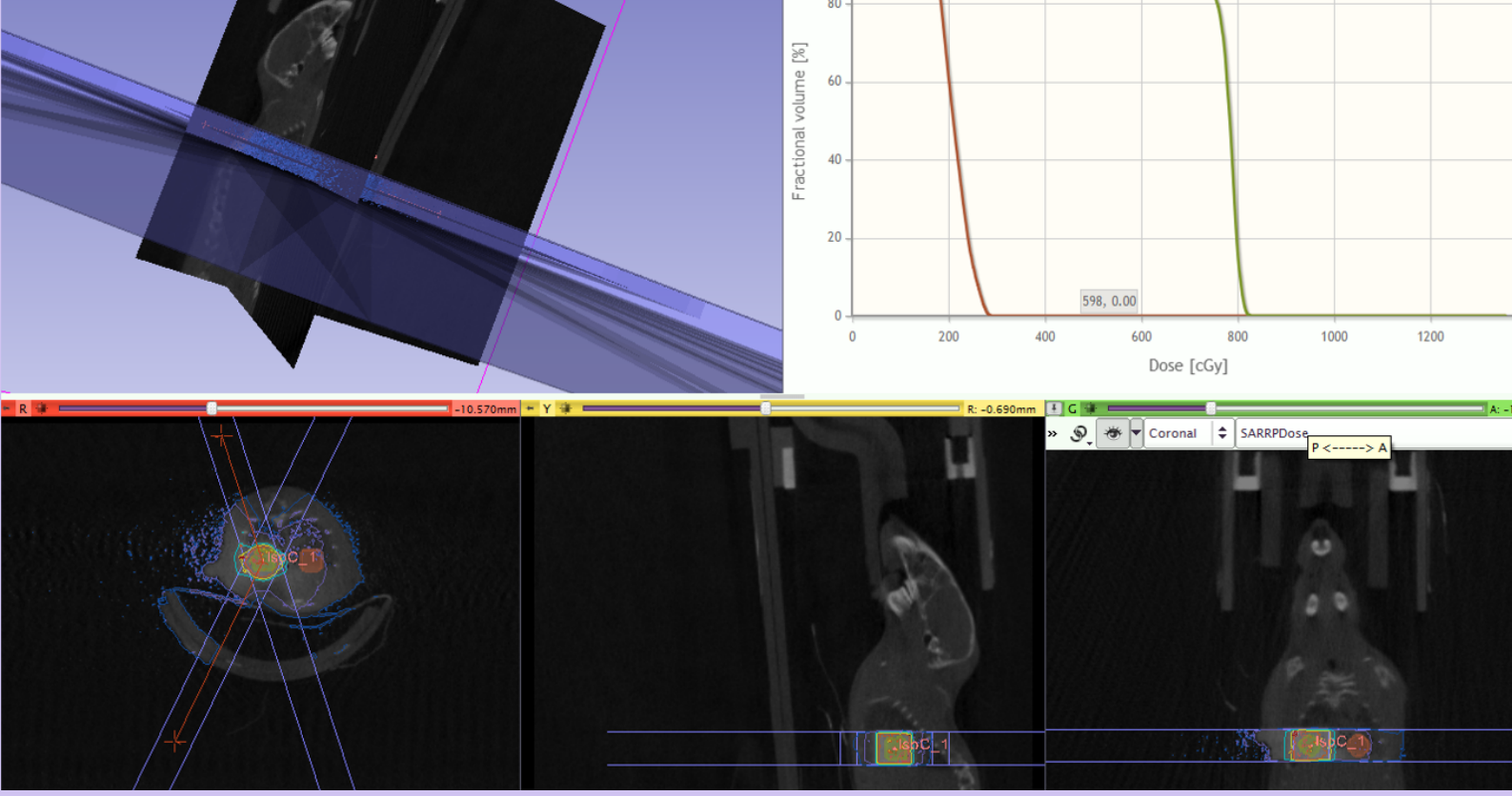


Fixed and variable collimators

Beam collimators restrict the path of the X-ray, narrowing the beam for radiation targeting.

- A remotely-operated variable collimator enables the beam to be dynamically adjusted between large field (up to 30mm x 70mm) and smaller focal irradiations (minimum 3x3 mm)

- For standard irradiations, interchangeable fixed brass collimators of 0.5mm to 10mm width provide ease of use for microbeam targeting



Respiratory-Gated Irradiation

Gating systems are used to overcome the problem of organ movement during X-ray treatment.

- Fibre-optic motion detection and synchronised opening of a shuttered X-ray beam allows respiratory-gated radiation delivery to orthotopic tumours in the lung or abdomen

- An integrated ion chamber ensures accurate real-time measurement of the dose during treatment

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