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Calorimetry for Synchrotron radiation

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Calorimetry is the most accurate method of quantifying the x-ray flux and dose in the synchrotron beam lines for medical and research applications. In calorimetry, the radiation dose absorbed results in raising the temperature of the absorbing medium which is measured accurately. Several absorbing media have been tried but graphite with relatively low specific heat and zero heat defect has been the chosen medium for calorimetry. Graphite calorimeters are dose-rate independent and hence can be used over wide dynamic range of intense synchrotron x-ray beams. They are energy-independent and hence are ideally suited to measure the total energy fluence over the entire low energy photon spectrum compared to diodes, films etc. The temperature rise due to the absorbed dose is high (of the order of several milli-kelvins) resulting in simple read-out instrumentation.
The design criteria of the ARPANSA graphite calorimeter which was successfully used to measure the high dose-rates (~2500 Gy/sec) in Hutch1B and (~50 Gy/sec) in Hutch 3B at the Australian Synchrotron is presented in this talk. The need for absorbed dose to water is realised through Monte Carlo calculations of the conversion factor from the graphite absorbed dose measured by the calorimeter. The talk also includes the different calorimeters used earlier internationally for photon fluence measurements different from the unique application of the ARPANSA calorimeter for the IMBL measurements.

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Summary

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