Science & Technology Facilities Council
ISIS

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Thermal Simulations of Wire Profile Monitors in ISIS Extracted Proton Beamline 1

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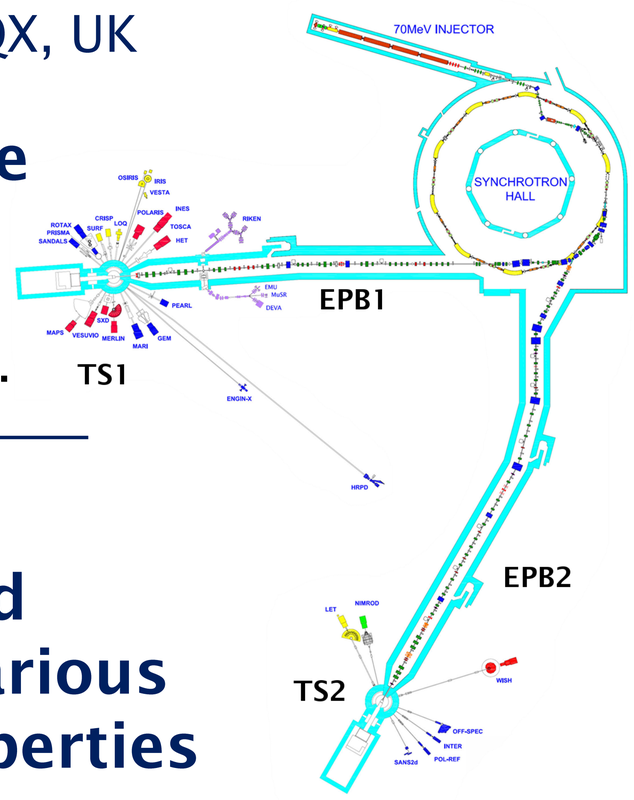
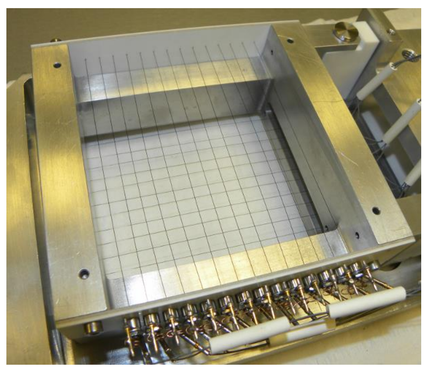
ISIS is a 50 Hz pulsed spallation neutron and muon source

The accelerator consists of a 70 MeV H^- LINAC, an 800 MeV proton synchrotron and two extracted proton beamlines (EPBs). An average beam power of 0.2 MW is delivered to two neutron spallation targets via the EPBs.



Intercepting wire monitors are used at facilities around the world

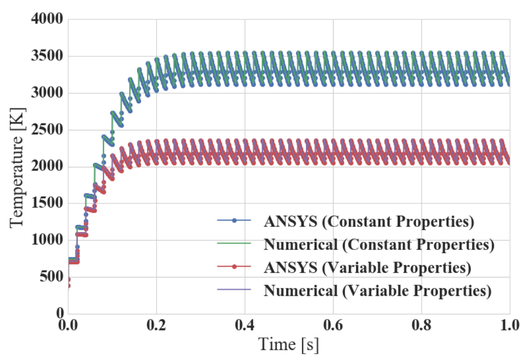
ISIS uses 142 µm diameter silicon carbide coated carbon fibres in wire scanners and grids.
A new monitor would be positioned in EPB1, near TS1; intercepted at 40 Hz.



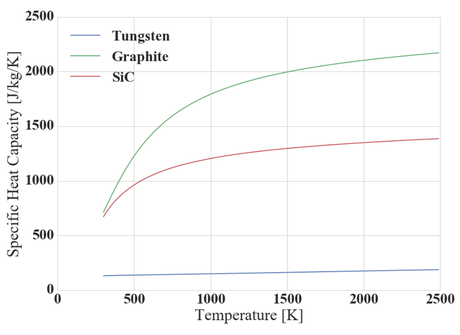
Analysis of heating was performed using ANSYS transient thermal simulations and a numerical simulation in python.

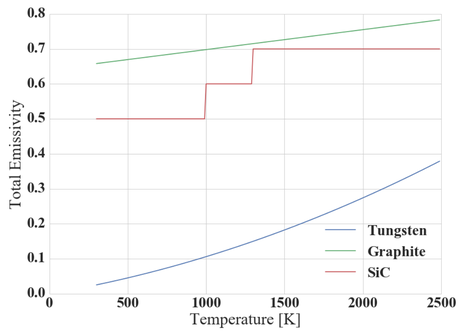
Benchmarking

Numerical code was benchmarked against ANSYS® 15.0 and compared to previously published results from other facilities. The two simulation methods were in agreement.



Material Properties





Assumptions were made for temperature dependent total emissivities and specific heat capacities.

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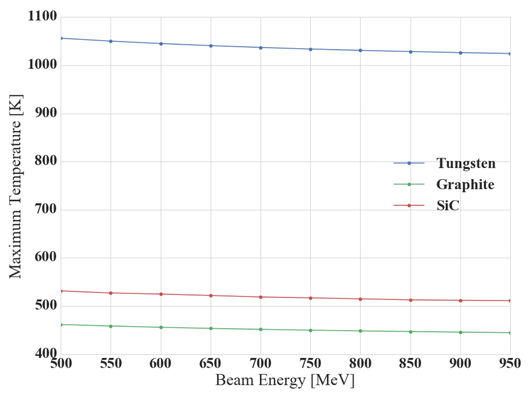
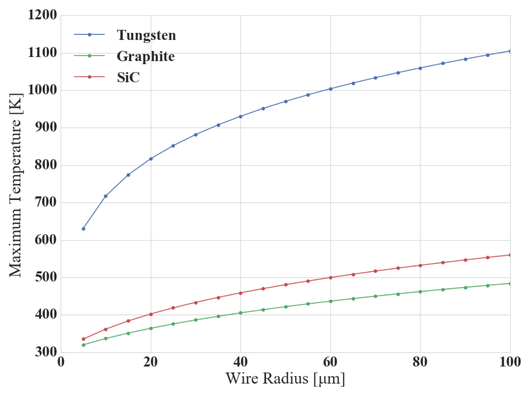
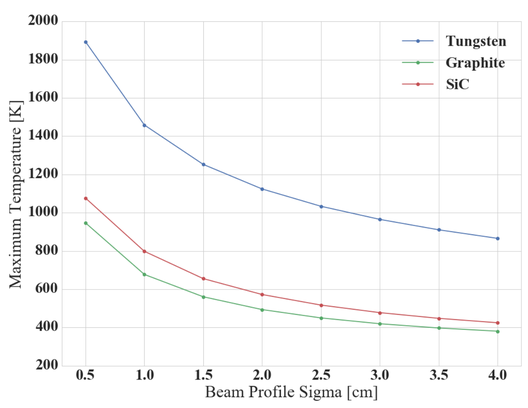
Maximum Simulated Temperature for Various Wire and Beam Properties



Increasing the beam energy slightly reduces the maximum temperature due to a lower stopping power.



Increasing the wire radius slowed the rate of cooling, increasing the maximum temperature.



Decreasing the beam width concentrated the energy deposition and increased the maximum temperature.

Summary & Future

- Temperature dependence of material properties can significantly change expected temperatures.
- No simulations predicted temperatures to reach that necessary to cause wire breaking.
- Contribution to heating from target neutrons was found to be small.
- Future work could look at the contribution to heating from target photons.