Abstract Submitted
for the DFD14 Meeting of
The American Physical Society

Modelling Brain Temperature and Cerebral Cooling Methods[1]
STEPHEN BLOWERS, PRASHANT VALLURI, Institute of Materials and Processes, University of Edinburgh, IAN MARSHALL, Neuroimaging Sciences, Centre for Clinical Brain Sciences, University of Edinburgh, PETER ANDREWS, BRIDGET HARRIS, Critical Care Unit, NHS Lothian, Centre for Clinical Brain Sciences, University of Edinburgh, MICHAEL THRIPPLETON, Neuroimaging Sciences, Centre for Clinical Brain Sciences, University of Edinburgh — Direct measurement of cerebral temperature is invasive and impractical meaning treatments for reduction of core brain temperature rely on predictive mathematical models. Current models rely on continuum equations which heavily simplify thermal interactions between blood and tissue. A novel two-phase 3D porous-fluid model is developed to address these limitations. The model solves porous flow equations in 3D along with energy transport equation in both the blood and tissue phases including metabolic generation. By incorporating geometry data extracted from MRI scans, 3D vasculature can be inserted into a porous brain structure to realistically represent blood distribution within the brain. Therefore, thermal transport and convective heat transfer of blood are solved by means of direct numerical simulations. In application, results show that external scalp cooling has a higher impact on both maximum and average core brain temperatures than previously predicted. Additionally, the extent of alternative treatment methods such as pharyngeal cooling and carotid infusion can be investigated using this model.

[1]Acknowledgement: EPSRC DTA

Stephen Blowers
Institute of Materials and Processes, University of Edinburgh

Date submitted: 29 Jul 2014 Electronic form version 1.4