0.3 - Module and assignment specifics

Course details: Unit director: Dr Andrei Sarua (a.sarua@bristol.ac.uk) Technical support: Tom Kennedy (Tom.Kennedy@bristol.ac.uk)

Lab opening hours: 10:00-13:00 14:00-17:00 First lab date: 22/01/2026 Last lab date: 26/02/2026

Assessment details: Lab book submission due date: 12:30 16/03/2026 Lab report submission due date: 12:30 16/03/2026 Assessed on: - In lab attendance/performance - lab book - final report Marking criteria: - Knowledge & understanding - Intellectual skills - Research & scientific practices - Professional & life skills

Lab details: Mab group: C (Thursday labs) Lab partner: Scarlett Kitchener (up24667@bristol.ac.uk) Lab experiment: Ising model Supervisor: Dr Francesco Turci (f.turci@bristol.ac.uk)

Guidance on lab book: Digital lab book using onenote; should be continuous diary over project; make sure to copy any handwritten notes into the lab book. Needs to be submitted as exported PDF.

Guidance on final report: Final report is scientific letter style paper using provided LaTex template. 4 pages total (inc everything, inc references/appendix). Best "example" of style to write in will be published scientific articles in area of study.

Lab handbook experiment description ([?]): The Ising model represents a simplified magnet in which each atom has a spin, which can only take one of two values, 'up' and 'down'. Historically, it played a fundamental role in the theory of phase transitions in statistical physics, since it goes from a non-magnetic state at high temperature to a magnetic state at low temperatures, below the Curie temperature Tc. But there are many surprises, and the model and its close relatives are still central to modern physics. For example, the 2016 Nobel prize was awarded to Kosterlitz and Thouless for the theory of phase transitions in the related XY model (where the spin is still fixed in size, but can have any direction in the x-y plane). The Ising model is discrete and so is particularly suited for investigation by computers. In this laboratory we shall investigate the thermodynamics of the Ising model using the Metropolis Monte- Carlo method. Using this approach, we shall investigate the Ising model in zero, one and two dimensions, seeing how the statistical state changes as temperature and magnetic field are varied. In particular, we will use the Metropolis method to investigate the 'critical exponents' in the two-dimensional model, which represent how the magnetization, energy, entropy, heat capacity, etc., change near to the Curie temperature Tc. Optionally, the role of the lattice geometry, dimensionality, and similar models, such as Potts and XY could also be explored. This laboratory is specific to theoretical physics students, and introduces concepts, which will be fundamental in the later, e.g., 4th year Phase Transitions course.