**Computational Astrophysics and Multimessenger Astronomy.**

Over recent decades we have witnessed a dramatic rise in the significance of computational approaches in interpreting astronomical observations. Looking deeper into the information age, we can expect to see rapid growth in computational technology and the volume of astronomical data, and greater reliance on computational models for encoding our knowledge of astrophysical systems. The importance of computational modelling in multimessenger astronomy involving gravitational-wave (GW) and electromagnetic (EM) observations provides an example of this.

**An Earth-observing analogy:** Already today, Earth-observing satellite data, together with ground-based data, are fed immediately into a suite of computational models, which effectively encode our best understanding of these Earth systems. A suite of weather simulations is continually repeated, incorporating the most recent data, with results broadly available to the public. Related climate simulations encode knowledge of Earth systems on longer timescales.

**Real-time multimessenger analysis**: In multimessenger time-domain GW+EM astronomy, we look toward a similarly central role for astrophysical simulations. Simulations or their results will be required for real-time processing of detailed time-domain signatures of GW-emitting events. The simulations would include specific predictions for the related time-domain signatures in GW- and various EM-observing bands. We can witness the beginning of this process now. In the last decade, numerical relativity has matured to the point of allowing detailed simulations of systems of merging black holes and/or neutron stars. The specificity of general relativity already provides explicit predictions for the GW signals. Understanding their association with EM counterpart signals will also rely on even more intricate computational models. These computed predictions will drive real-time processing of multimessenger data, guiding prompt follow-up observations with additional instruments.

**Encoding knowledge:** On longer timescales, similar computational models will be continually honed to best represent our knowledge of the underlying astrophysical systems, as well as the overall populations that they sample. At present the capability exists to conduct these simulations, but the full detail of the signals and the breadth of merger parameter space remains incompletely understood and is not yet confronted with observations. For EM observations of strongly gravitating systems, progress requires both richer simulations, and better constraints from observation. Richly physical simulations will provide a crucial connection between the signals carried by various astronomical messengers.

**Guiding new directions:** Simulations will also suggest new phenomena to observe. Numerical relativity simulations of black hole mergers, for example, have predicted strong kicks from asymmetric emission of GWs, predicting a new class of objects -- expelled or off-center massive black holes -- now sought in EM observations. GRMHD simulations may predict EM signatures of black hole mergers. Computational modelling will be essential in assessing the value of future astrophysics data and in raising the new questions that future missions probe.