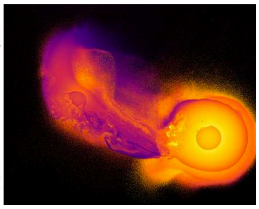
Durham University
SPH SIG
UK FLUIDS NETWORK



Meeting 5 Report – Durham University

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The fifth UK Fluids Network Smoothed Particle Hydrodynamics (SPH) Special Interest Group (SIG) was hosted by Durham Universities Department of Physics at the Ogden Centre for Theoretical Physics on the 28th and 29th of November 2019.

This meeting aimed to celebrate together *grand* outputs from the astrophysics and engineering SPH communities and was split over two days. Day 1 saw some significant achievements by SIG members from the astrophysics side, while day 2 concentrated on engineering aspects. A significant aim of this meeting was to allow two key communities that develop SPH for different purposes to come together and share best practice, reasons for developments and challenges.

SPH SIG at the Ogden Centre, Durham

The following organisations were represented by SIG members and those from industrial backgrounds: Durham University; Edinburgh University; EPFL (Switzerland); Ghent University (Belgium); HMU Design Ltd.; Leiden University (Netherlands); Liverpool John Moores University; Sheffield University; St. Andrews University; The University of Hertfordshire; The University of Manchester; UKRI-STFC

1.0 Presentations

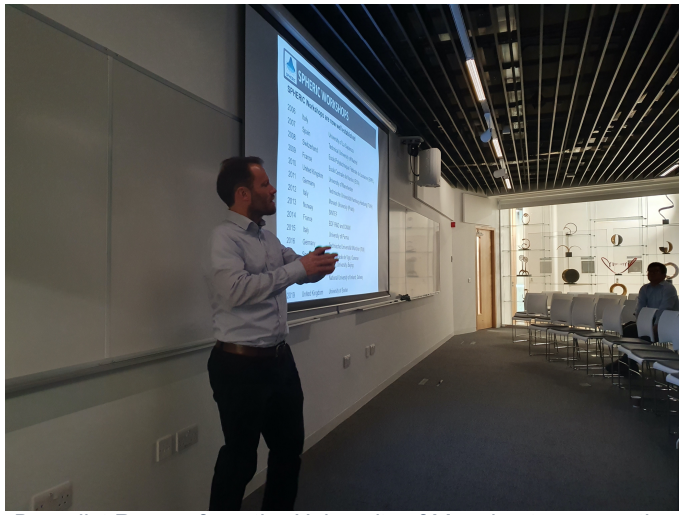
Day 1

1. **Stephen Longshaw (UKRI-STFC):** Welcome and SIG Overview
2. **Matthieu Schaller (Durham University):** Simulating Galaxy Formation with SPH: Method, Success and Challenges
3. **James Wurster (St. Andrews University):** Non-ideal Magnetohydrodynamics (MHD)
4. **Joshua Borrow (Durham University):** Handling 100 Billion Particles: An SPH Scheme for Cosmological Simulations
5. **Jacob Kegerreis (Durham University):** When Worlds (Literally) Collide
6. **Bert Vandenbroucke (St. Andrews University):** Meshless Finite Volume Schemes: Greatest Hits for the Future?

Day 2

1. **Konstantinos Georgoulas (Edinburgh University):** Using SPH to Model How Corals Apply the Goldilocks Principle to Engineer their Habitat
2. **Georgios Fourtakas (Manchester University):** Major Advances in SPH
3. **Tom De Vuyst (Hertfordshire University):** SPH Modelling of High Strain Rate Failure of Metals
4. **Benedict Rogers (Manchester University):** The SPHERIC Community
5. **Masy Green (Imperial College London):** Smoothed Particle Hydrodynamics Simulations of Three-Dimensional Sloshing in Tanks

Jacob Kegerreis from Durham University presenting his work on colliding worlds using SPH on day 1



Benedict Rogers from the University of Manchester presenting the creation, growth and current state of the international SPH community SPHERIC on day 2

2.0 Meeting Overview

This meeting, the last funded by the UK Fluids Network directly, was designed to allow the two primary SPH communities, engineering and astrophysics, to come together, share best practice and highlight the key outcomes enabled by SPH. Effectively a celebration of the method to date.

The first day saw a collection of some of the key outputs from the UK's astrophysics SPH community, with the second focussing on engineering. While the topics presented were very divers,e a clear thread of recent developments of the SPH method became evident, with the astrophysics SPH solutions tending towards extreme high-performance solutions and huge simulation sizes while the

engineering approaches focussed on methodological rigour such as convergence studies and ensuring numerical stability.

The meeting made it clear that both communities have much to share with each other, with the potential for combining efforts to better develop the SPH method for both, despite the significant differences in its application.

A good discussion was had regarding the future of the SPH SIG following the end of UK Fluids Network funding in January 2020. It was agreed that a new steering committee would be formed from those who organised the first 5 meetings.

A specific goal of this meeting was to encourage more social interaction between different SPH communities, as such the first day was finished with a number of social activities, including a meal. This was well attended and well received with lively conversation about the first days presentations.

3.0 SPH SIG Future

An important outcome of this meeting was to allow the SPH SIG to discuss how it can take itself forward into 2020 and beyond without access to specific UKFN funding.

The topic and ideas were introduced at the start of day 1 and then a chaired discussion was held at the end of day 2. In short it was agreed that a new committee would be formed from the current SPH SIG leadership (Stephen Longshaw from UKRI-STFC and Benedict Rogers from The University of Manchester) along with the 4 organisers of past UKFN sponsored meetings (Steven Lind from the University of Manchester; Thomas Rendall from the University of Bristol; Tom De Vuyst from The University of Hertfordshire and Richard Bower from Durham University). The committee will initially meet in the first quarter of 2020 with the goal of organising the sixth SPH SIG meeting in the UK before the end of the year. The goal henceforth will then be to organise at least 1 meeting per year with each committee member taking responsibility. The committee will be open to change as and when required with additions/changes proposed to the SIG membership beforehand.

It was acknowledged that having no clear funding for SIG events will increase organisational complexity. However, it was also agreed that a new model whereby SIG members will include funding for SPH SIG meetings in any appropriate (primarily EPSRC) proposal in the future will be adopted, along with requesting funding from other sources such as industrial partners sponsorship. Where no funding can be found in a year then a nominal fee will be charged for attendance (no more than £100 based on events run between 2017 and 2019), though this is not the preferred option.

Finally, it was agreed that the SPH SIG will retain its UK focus so as not to replicate efforts of established communities like SPHERIC and will continue to focus on community bridging as this is seen as a key achievement of the UKFN sponsored SIG meetings.