

## A UROP perspective by William Parfitt

Summer 2023 (undertaken in the Department of Mechanical Engineering, Tribology Group)

**William** was a year 3 undergraduate at the University of Birmingham in 2022-2023: MSci Physics, Department of Physics and Astronomy.

**UROP title:** Formation of Wrinkling and Hele-Shaw Cells in Liquid Drop Impacts

**Motivation:** Similarly to many undergraduate students looking to expand their understanding and experience with research, I had been looking to undertake some sort of research or work experience during the Summer. However, I came across the UROP programme following a chance meeting with my (soon to be) supervisor at the ICL Great Exhibition Road Festival, where I happily talked to him at length about his research and the work the Tribology group carries out. This eventually led to a discussion, and the organisation, of the UROP which I ended up taking part in. This was a brilliant opportunity for me as it offered an unparalleled opportunity to expand my understanding of fluid dynamics and its use in industry, and gain an insight into how PhDs are carried out and whether I would be interested in doing one myself.

**Preparation and UROP activities:** My supervisor kindly sent me a number of resources which I used to acquaint myself with some of the basics of fluid dynamics and contact effects, and gain a general familiarity with the mathematics behind the core concepts I would be working with. These ranged from very early pieces of research on the subject (J.Thomson, 1855) to more modern lecture series on capillary action and gravity waves, which were very helpful as I had not encountered fluid dynamics as part of my degree at all, and as such it was effectively completely new content to me.

The UROP itself was both interesting and useful. I was involved in imaging and interpreting the effects of a dyed water droplet impacting a bulk liquid, which we used to create a poster to submit to the APS Gallery of Fluid Motion Competition, and assisted in the development of a theoretical model of a transient behaviour in this process, which may potentially result in the brief formation of a curved elastic-walled Hele-Shaw Cell resulting in the production of radial 'jets' of dye from the droplet impact site. As part of this I gained experience working in a laboratory cleanroom, learnt how to properly focus and operate a high-speed camera and the limitations inherent to them which you must work around, and gained an understanding of the basics of video editing software and its use to enhance image clarity. I was given the opportunity to present the work carried out over the course of my UROP to the Tribology group at one of their meetings, which was very useful for practising and refining my presentation skills. In addition to this I was fortunate enough to see some fantastic pieces of work carried out by the rest of the Tribology department and learn more about the research being carried out, through a number of conversations with other members and PhD students.

**Looking forward:** Due to time constraints, I was unfortunately unable to see the development of the Hele-Shaw cell model to its final conclusion. However, I hope that my contributions have made a positive impact and will be put to good use in the future to further the understanding of dynamic fluidic systems. I am also glad that I was able to help with the familiarisation of the new high-speed camera used during the UROP, and have produced some usable research material which can be used in future research if necessary. Finally, I would like to thank my supervisor for all the advice and insight he has given me regarding the field of academia and PhD programmes. I only recently began to consider doing a PhD and so it has been truly invaluable to have these experiences, and has definitely encouraged me to further consider the possibility of applying for PhD opportunities in the coming year.