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## Examples of public engagement with liquid crystal science

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### ABSTRACT

Public engagement is of increasing importance for scientists in all disciplines. From inspiring the next generation to tackling the under-representation of marginalised groups, public engagement is essential for building an improved and growing scientific landscape. This article outlines some examples of our public engagement activities in liquid crystal science as part of our ongoing EPSRC-funded project, Control of free-surface morphologies in anisotropic liquids.

### KEYWORDS

public engagement;  
outreach; liquid crystals;  
liquid crystal displays

### 1. Introduction

As part of our EPSRC-funded project, Control of free-surface morphologies in anisotropic liquids, our team of theorists at the Universities of Glasgow and Strathclyde and experimentalists at Nottingham Trent University have dived into the nature of nematic liquid crystal flows and free surfaces and their unique controllability. The well-known electric control of nematics in the liquid crystal display industry has led to huge commercial success. As part of our project, we investigate how these well-known avenues for control can be exercised in new settings that move beyond the control of nematic orientation for showcasing the latest Hollywood blockbuster to allow for the control of free surfaces and flow. So far, this work has explored control in nematic rivulet flow [1], Hele-Shaw flow [2], and defect manipulation [3] and examined the properties of static nematic contact lines and free surfaces [4,5].

Often, the most natural part of any project is the fundamental scientific research, but now of increasing importance is the ability to go beyond and explain our work to the public. Discussing research with non-experts is often met with awkward questions: why are you doing this, or what are the applications of this work? In a world where the liquid crystal display is beginning to face competition from new display technologies, answering these questions is becoming more critical. Public engagement allows experts to develop these crucial communicative skills and provide engaging answers to questions like these. This work is vital for inspiring the next generation of scientists and, importantly, providing encouragement and opportunities to underrepresented marginalised groups.

### 2. Examples of public engagement with liquid crystals

Thankfully, liquid crystals make public engagement easy. They provide a playground of exciting and interactive properties that can be used in a range of activities for public engagement. There are a variety of opportunities available to scientists that allow them to engage in many different activities, from local council-organised science festivals, school visits and outreach competitions. Below, we briefly list a selection of the engagement events we have attended as part of our project.

#### 2.1. Glasgow Science Festival, Glasgow, UK, 5th of June 2023

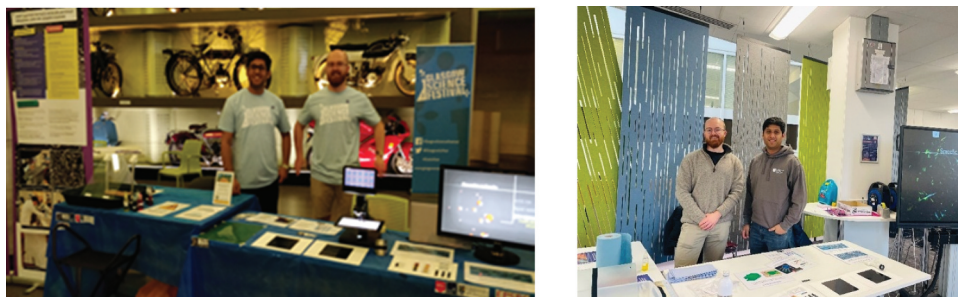
We recently organised a public outreach stall entitled Beyond the Display: The Science of Liquid Crystals at this year's Glasgow Science Festival (shown in Figure 1 (left)). The event took place at the Riverside Museum in Glasgow, where the history of transportation in Glasgow surrounded our stall. We spent the day transporting museum visitors away from the old subway carriages and buses into the world of liquid crystals. Overall, the event was a great success, with around a hundred children, parents, and adults with learning difficulties visiting our stall. The Glasgow Science Festival involved an impressive 68,000 in-person participants.

#### 2.2. Science in the Park, Nottingham, UK, 11th of March 2023

In the iconic Wollaton Hall in Nottingham, Akhshay and Jacob Aniyan (shown in Figure 2 (left)) provided hands-

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**Figure 1.** Akhshay and Joseph at (left picture) the Glasgow Science Festival and (right picture) the Nottingham Festival of Science and Curiosity.



**Figure 2.** From left to right, Jacob Aniyan and Akhshay (left picture) at the science in the park event at Wollaton Hall, Nottingham and Carl Brown and Thomas Hayward (right picture) at the Curious Rebels at Nottingham Castle.

on demonstrations of our activities to around 2,500 visitors. This family-targeted event included a range of ages and social backgrounds and provided science engagement amongst the rich historical galleries of Wollaton Hall.

### **2.3. Nottingham Festival of Science and Curiosity, Mansfield, UK, 11th of February 2023**

In early 2023, we took our activities to the Science Fun Day in Mansfield as part of the Nottingham Festival of Science and Curiosity (shown in Figure 1 (right)). This event was particularly important because of the location: Mansfield has a low engagement with science, and the importance of public engagement is key to attempting to change this. The event engaged hundreds of participants, mostly children, many of whom took part in our activities.

### **2.4. STEM for Britain, House of Commons, London, UK, 7th of March 2022**

Joseph was selected for the STEM for Britain finals in the category of Mathematical Sciences. STEM for Britain is a yearly competition for young researchers to demonstrate their public engagement skills.

Entrants are tasked with summarising and explaining their research to non-experts, with finalists awarded the opportunity to present their research to Members of Parliament in the House of Commons. There was a fantastic showing of liquid crystal scientists at the event, with Dr Adele Parry (shown in Figure 3),



**Figure 3.** Adele Parry (second from the left) receiving the Henry Cavendish gold medal in physics and the overall Westminster Medal for her work on liquid crystal droplet biosensors at STEM for Britain 2022.

a former PhD student at the University of Leeds, taking the Henry Cavendish Gold Medal in Physics and the overall Westminster Medal for her work on liquid crystal droplet biosensors [6]. This competition runs annually in the UK and is a fantastic opportunity for PhD students and early career researchers to develop their public engagement skills.

Beyond the listed detailed above, our team has also engaged in events in Nottingham, including Physics with NTU at Green's Windmill and Science Centre and Curious Rebels at Nottingham Castle (shown in Figure 2 (right)).

### 3. Our activities

A key part of any successful public engagement event are the activities you demonstrate.

Luckily for us, liquid crystal scientists, liquid crystals are fantastic at demonstrating their unique and fascinating properties. Below is a description of our activities.

#### 3.1. Illuminating the display

A portable microscope, purchased with money provided by the British Liquid Crystal Society (BLCS) outreach fund, was used to demonstrate how a liquid crystal display operates. We examined the display of an old iPad (shown in Figure 4 (left)) and explained to the visitors how the subpixels are controlled through the application of electric fields to the liquid crystal-filled pixels. Visitors were encouraged to focus the microscope on different colours on the iPad screen, observing the immediate and interactive change in the displayed pixels on the microscope.

#### 3.2. Temperature sensing

Chiral nematic thermochromic temperature sensors provide an excellent hands-on and engaging activity. Visitors were shown schematic diagrams (shown in Figure 5 (left)) of the helical structure of a chiral nematic, and the unwinding of the structure with varying temperatures was explained. Children particularly

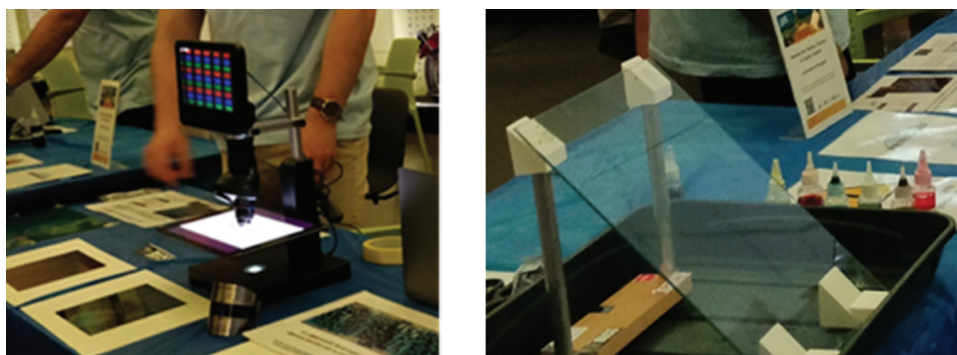


Figure 4. Photographs of (left) a liquid crystal display under a microscope and (right) the droplet race track.

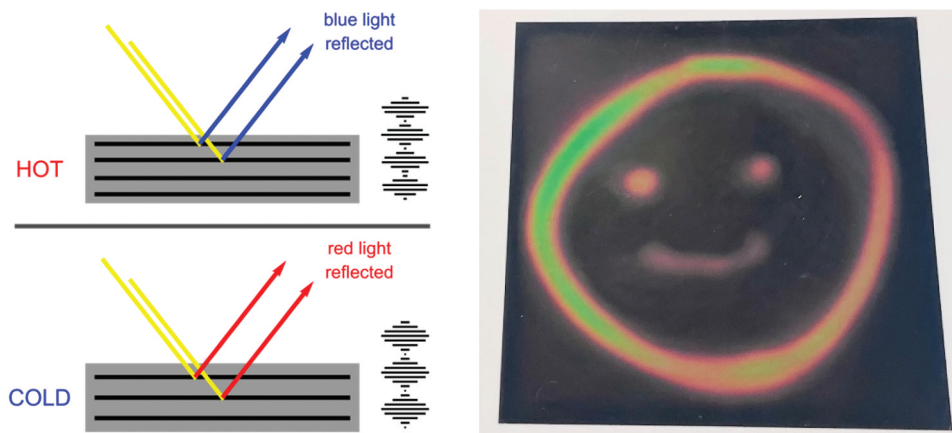


Figure 5. A (left) schematic diagram of a chiral nematic thermochromic sensor and a (right) photograph of a chiral nematic thermochromic sensor.

enjoyed this activity, with some even competing against their siblings, friends, and parents to see whose hands were warm enough to write their name or draw a smiley face on our largest sensors (shown in [Figure 5](#) (right)). Many visitors recognised these thermochromic temperature sensors and were pleased to learn about how they work. One particularly rewarding part of this activity was enabled by the money provided by the BLCS outreach funding, which allowed us to give away free samples to children.

### 3.3. Droplet racing

In this activity, we moved away from the well-demonstrated liquid crystal science to introduce participants to the basics of our research on nematic rivulets. We created a droplet racing track by treating one-half of a glass surface with hydrophobic silica nanoparticles whilst leaving the other half untreated to retain its hydrophilic nature (shown in [Figure 4](#) (right)). The setup was used to demonstrate how liquids form droplets and rivulets on an inclined surface and how their behaviour varies under different flow speeds and surface properties. We conveyed this science by inviting visitors to participate in exciting droplet races. Both children and adults enjoyed choosing sides before dispensing droplets or rivulets of coloured water onto their selected side. The liquid dispensed on the hydrophobic side quickly bounced to the finish line as droplets, while the liquid on the uncoated hydrophilic side turned into a slow-moving rivulet and promptly lost the race. After the droplet race, we discussed how the hydrophobic coating changes the fluid behaviour. Finally, we linked this activity to our work on nematic rivulets, where the interaction of surface properties and fluid flow becomes even more critical. These explanations were greatly aided by a poster-sized version of our outreach article published with *Futurum* last year [7].

## 4. Conclusions

Public engagement with liquid crystal science is an achievable and rewarding activity that researchers should make a key priority. There are a variety of ways scientists can go about finding ways to support their outreach activities, from learned society funding to outreach grants. Please feel free to get in touch with us if you would like to know more about preparing these activities or would like to use any of our resources.

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