Outline

- Why use demonstrations?
- Timeline of the project
- Achievements so far
- Student focus groups
- Summary
Research indicates that interactive demonstrations can improve student understanding\textsuperscript{1,2}.

For instance in a learning cycle:
\begin{itemize}
  \item The students can be asked to predict the outcome of an demonstration
  \item The demonstration is carried out in the lecture, seminar or tutorial
  \item The students reflect on the outcome and their understanding
\end{itemize}

Provide the opportunity for Assessment for Learning; the lecturer, tutor and student gains insight into understanding and progress

\begin{enumerate}
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- **March 2018**: Stream B proposal "Physics Demonstrations to Create Active Learning" secured funds for a four year project (Y. Andrew, M. Coppins, S Foster, K. Ippolito, V. Tymms)
- **July 2019**: Stefano Vezzoli started as a Strategic Teaching Fellow
- **July-Aug 2019**: two UROP physics students Hans Muneesamy and Dongsung Kim developed and started filming new and existing demonstrations. Project was also opened up to PhD students and RAs
- **Aug 2019**: project secured a small room in Blackett for storage. Cataloguing, filming and buying material continued
- Demonstrations and associated learning cycle questions run for Year 1, 2 and 3&4 physics courses for **2019/20 and 20/21**
- **July-October 2020**: three UROP projects, staff interviews, student focus groups, student surveys
• Over one hundred video clips and ideas recorded, still to be edited, documented and catalogued

• Thirty nine demonstration videos uploaded to a YouTube channel, all catalogued with corresponding documentation:

https://www.youtube.com/playlist?list=PLCZBFu_C1n_uEC2SKLKdo6eLXreAomAwT

• Sixty five demonstrations used in physics outreach work also catalogued and documented
Catalogue of
Physics
Demonstrations

- Thirteen Tabletop Demonstrations for students to do at home
- Thirty five recorded for cataloguing and direct use in online teaching
- Used in ten lecture courses and modules in 2020/21 (all year groups) and online lecture courses and modules in 2021/22

Trials
- Demonstrations on the helpdesks for students to use
- Live streaming to the lecture theatre from a research lab
Example of online lecture use of demonstrations

Classical Mechanics
Lecture 19.1: Rigid Bodies

Autumn Term 2020
Example of online lecture use of demonstration.

Active Learning Demonstrations
Rolling Masses
Evaluation of the Physics Demonstrations

• **Six staff interviews** – transcriptions have been started and completed over the summer

• We plan more interviews with staff who would not use demonstrations in their physics teaching

• **Two student focus groups** – transcriptions have started

• **One student survey** – preliminary results were presented by Stefano at the Education Week

• More student focus groups and surveys planned for the end of this term and next academic year
Student Focus Groups

- Ten students comprise years 1, 2, 3, 4 and PhD

Q1 Are there any particular parts of the core physics programme where hands-on practical experience demonstrations would enhance understanding and enjoyment of learning? Are there any that wouldn't?

‘One aspect is just that it [demonstrations] keeps you interested during the course and the lectures. You’re just more attentive and pay more attention in lectures when there's like something else happening as well. It's not always just chalk on the blackboard, so you stay interested and also it's always nice to see the stuff in real life and not just like read about it in textbooks. So, it's much more interactive and is much more like it's easier to understand a phenomenon when you actually see it happening and not just have someone tell you how it would happen.’

Year 3, Physics Student

‘What's so good about them [demonstrations] is that they both improve learning, but they also incentivise it. In that if you actually make it a concrete, visible thing, it's much more interesting than talking about, you know, abstract phenomena, but you're not sort of, actually witness to.

Year 3, Physics Student
Q2. What are the limitations to Physics Demonstrations in teaching?

'In most cases I think the student needs to have some basic understanding of the underlying theory before they can actually understand what's going on if the demo is done in lectures. Like after you've gone through the necessary theory that you need, in order to understand what's happening, then I don't think that's that much limit as to how it useful it can be'

Year 3 Physics Student

'I think as a starting point there is this reality that demos aren't as conducive for some subjects as they are for others. Like obviously demos in mechanics are probably a lot more feasible but also a lot more accurate, than demos might be for like relativity. When you’re talking about demos you can discuss them both in the sense of actually showing the physics like what we're doing in Fourier or in Thermodynamics or demos that work as an analogy'

Year 3 Physics Student
Summary

- Blended learning has focused on developing resources and successfully applied to two UG courses
- Blended learning approach adapted for Physics ‘Seminars’
- A collection and database of demonstrations for in person and online teaching has been achieved
- Evaluation of active learning techniques (blended learning and demonstrations) has made significant progress using a wide range of methods
- Another year of data collection and two more year of analysis
- Switch to blended and online teaching and learning has required an adjustment to the project and brought up interesting new questions
Example Video for Lecturers to Browse and Use
Q3. In which teaching forums might demonstrations and hands-on practical demonstrations be most effectively employed?

Q4. How might demonstrations be used in a way which is inclusive so as many students as possible will engage with the aspects of active learning that are available to them?