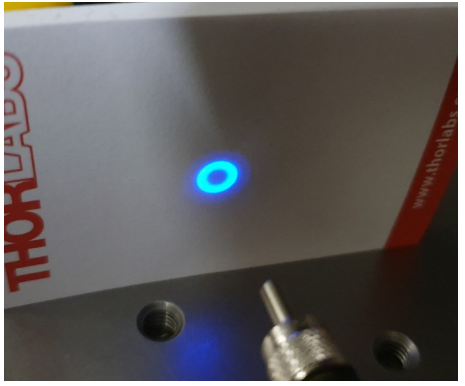
Light source

DarkSide production meeting
25/11-2022

Martin Spangenberg
University of Warwick

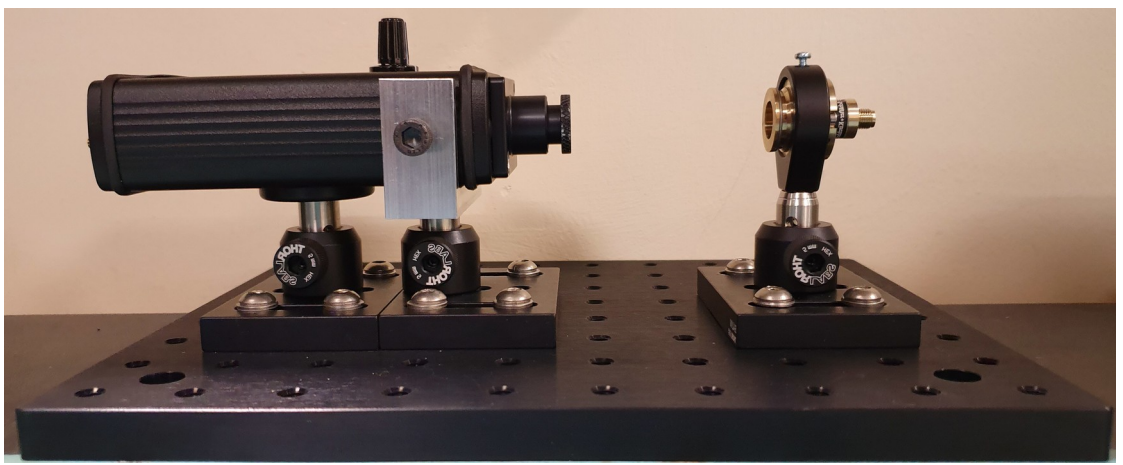
Achieving consistent light output

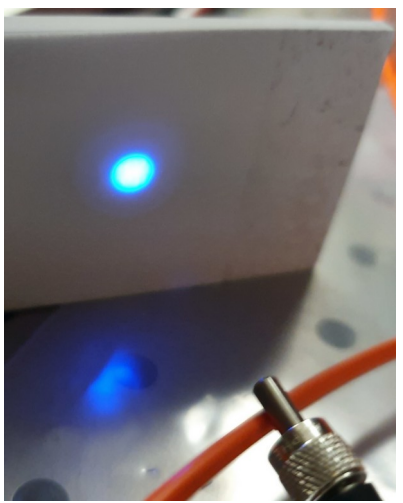
- We use a Photek 405 nm laser going into a fibre coupler, followed by attenuators and splitters
- First attempt used 3D-printed frame to attach coupler in front of laser
  - Fibre coupler designed for narrow collimated light beam
  - Laser has lens with focal spot
  - Produces ring instead of central spot coming out of fibre
- Attenuators (top right) work by adding space btw. fibre end points, i.e. only central light cone is transmitted
  - Attenuation factor very sensitive to light cone shape – not good!



Achieving consistent light output

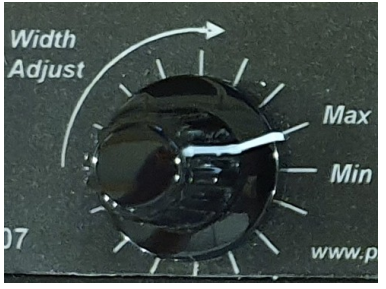
- Increasing distance between laser and coupler achieves better results (approaches collimated beam)
- Setup installed on small aluminium breadboard with optical posts
- Laser rotation fixed with extra clamp
- Fibre output is now a central round spot, and we get consistent attenuation factors





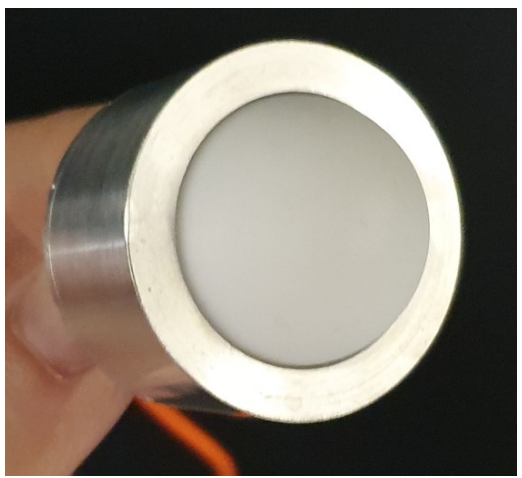
Light source box

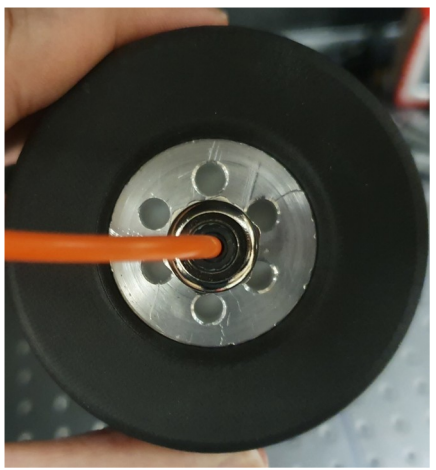
- Light source to be placed in metal box containing:
  - Breadboard with light source and coupler
  - Photodiode detector monitoring output (attached to 99% arm of 99/1 splitter)
  - Fixed + manual variable attenuators
  - 50/50 splitter going to ”LASER OUT” ports
- All inputs/outputs available as feedthroughs
- Output intensity adjustable with:
  - Variable attenuator
  - Knob on laser
- Combined, adjustment spans ~2 orders of magnitude

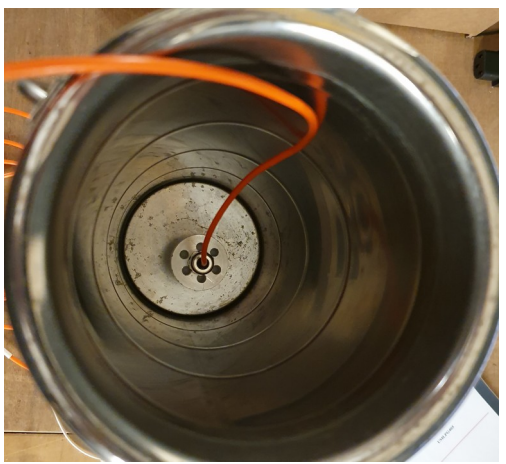


Liquid nitrogen test

- 25mm diameter PTFE diffuser placed inside aluminium enclosure with fibre gland
- Enclosure submerged in LN2 and left overnight to boil off. Repeated twice.
- 2D scans of light output performed
  - Before LN2
  - After 1x LN2
  - After 2x LN2

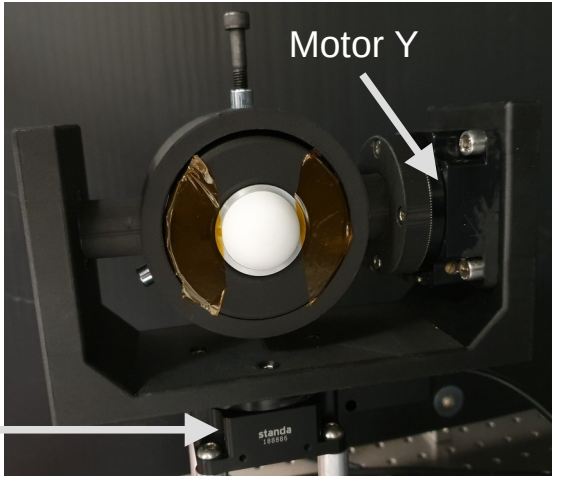


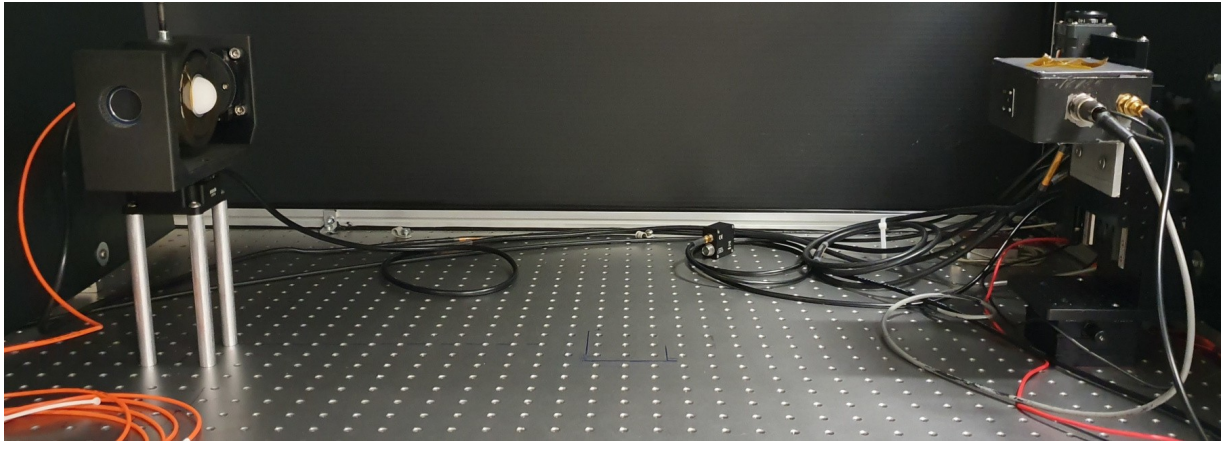


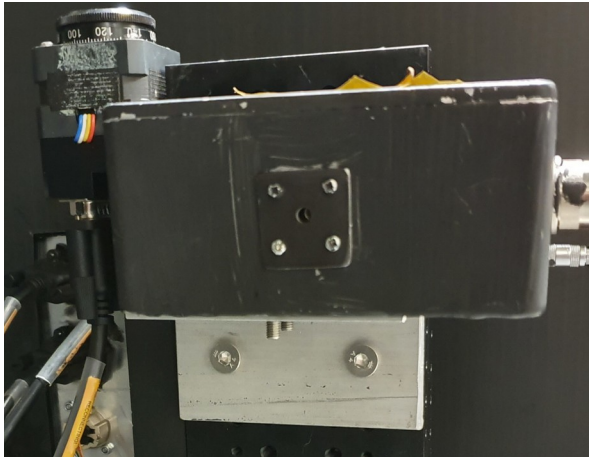


Liquid nitrogen test

- Diffuser placed in dark box and tested after each cooldown
- 2D scan performed with dual rotation stages (motor X and Y)
- Light output measured with PMT at ~700mm

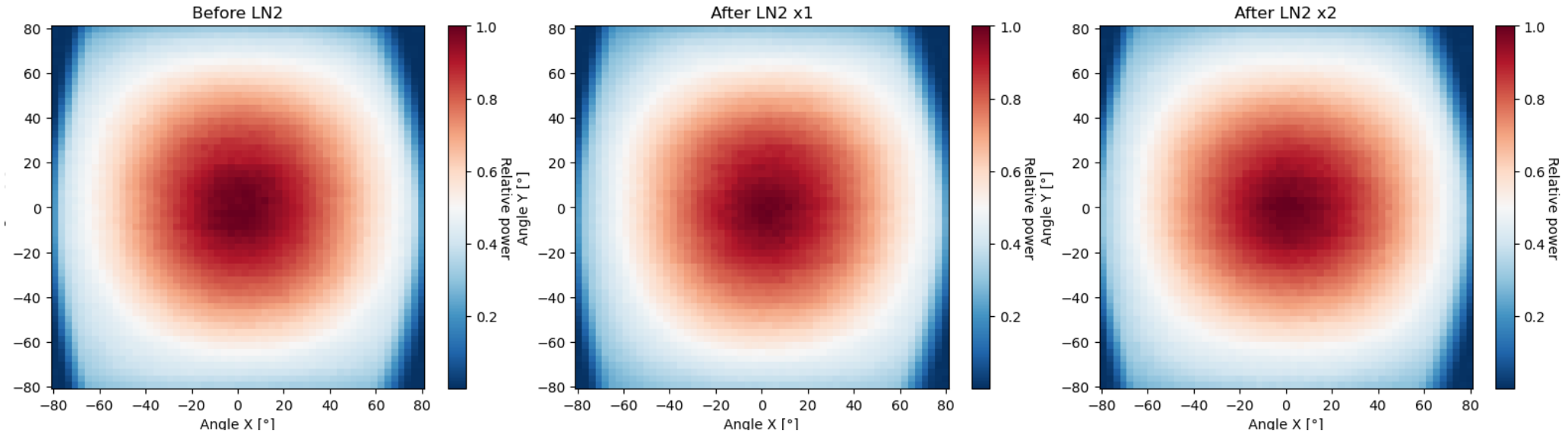






2D heat maps

- Plots normalised to point with highest intensity in each scan



1D profile

- Profile plot of angle X = 0°
- Shape of diffuser light output stays the same
- Overall light output seems to trend downward with number of thermal cycles
  - Change in PTFE opacity?
  - Fibre position changes wrt. back of diffuser?
- Not a problem:
  Can easily adjust light output with laser attenuators after multiple cooldowns