# LIGHT ENGINE AND OPTICS FOR HELIUM3D AUTO-STEREOSCOPIC LASER SCANNING DISPLAY

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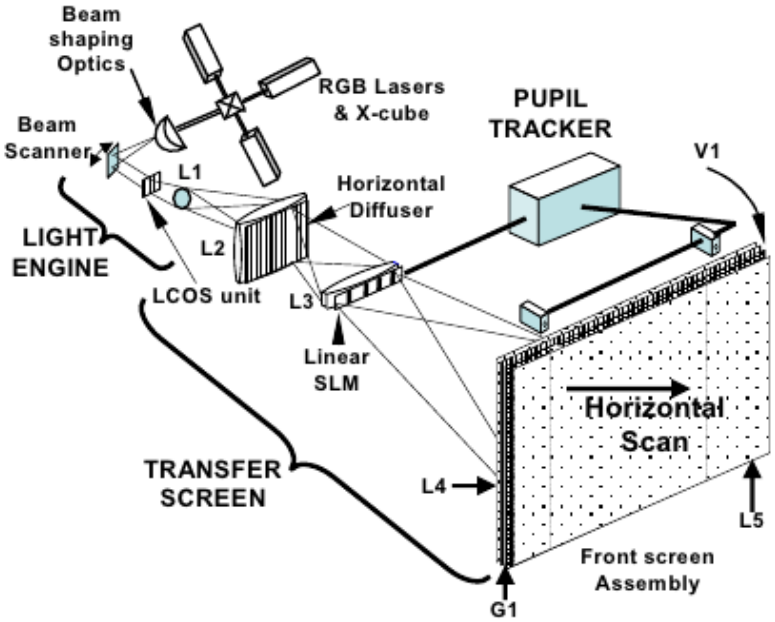
# Introduction

## HELIUM3D

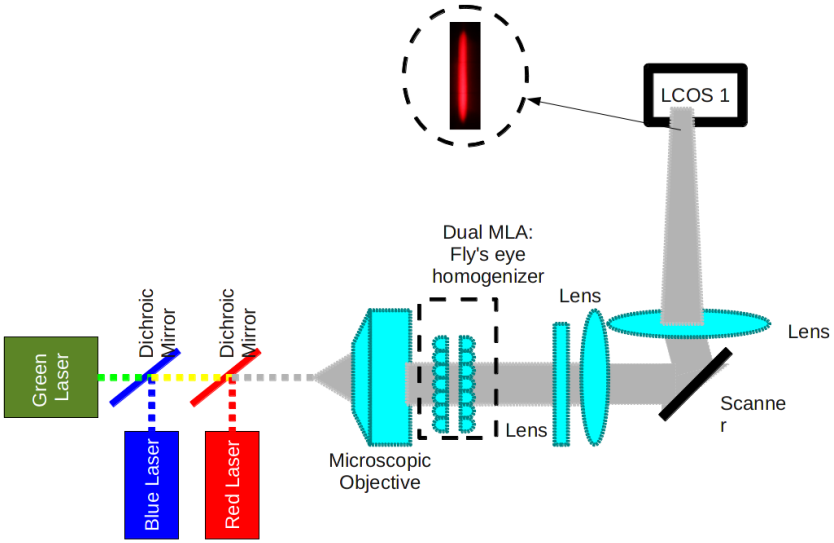

- Glasses-free architecture
- Multi-user support
- High Power Laser based light engine architecture
- Novel light engine design & Implementation
- Special lens design of Transfer Screen
- User Tracking ability



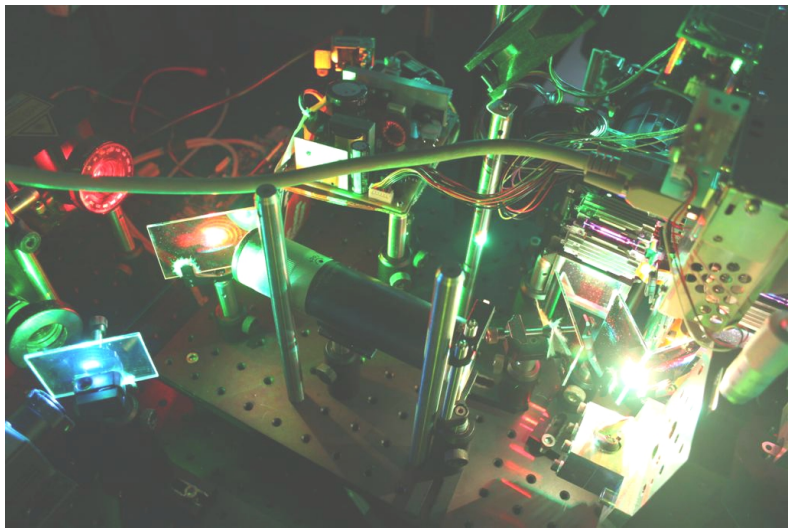

A simplified system-level diagram.

# Prototype I

## Introduction



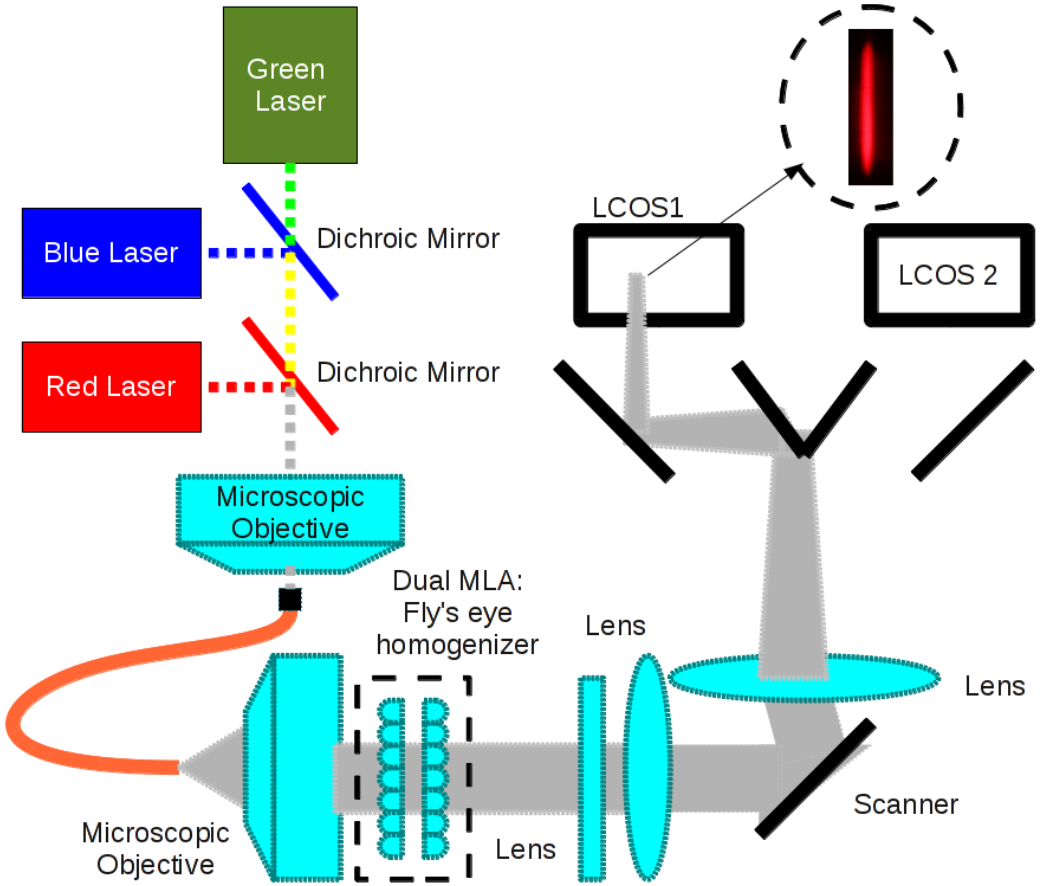

Sketch of the first prototype (top-view).



Low power laser set combined using dichroic mirrors and projected into two LCoS units using mirrors.

# Prototype II

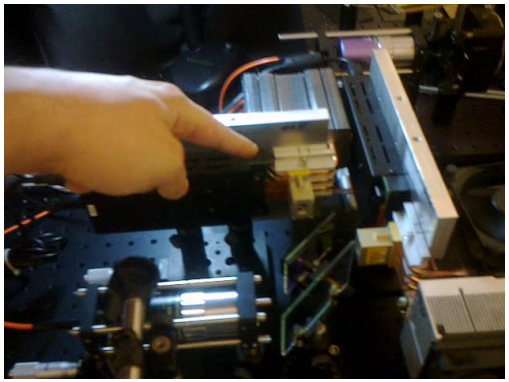
## Introduction



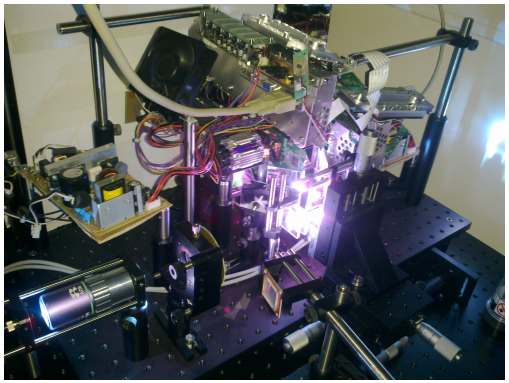

Optical design of the prototype II (top-view).

# Prototype II

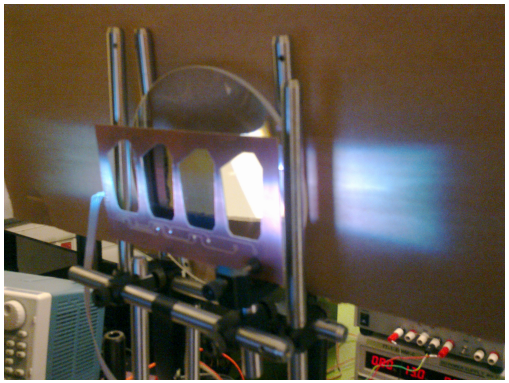
## What is new?



High power multi-emitter laser set combined using dichroic mirrors with fibre coupling.



Beam Shaping Optics.

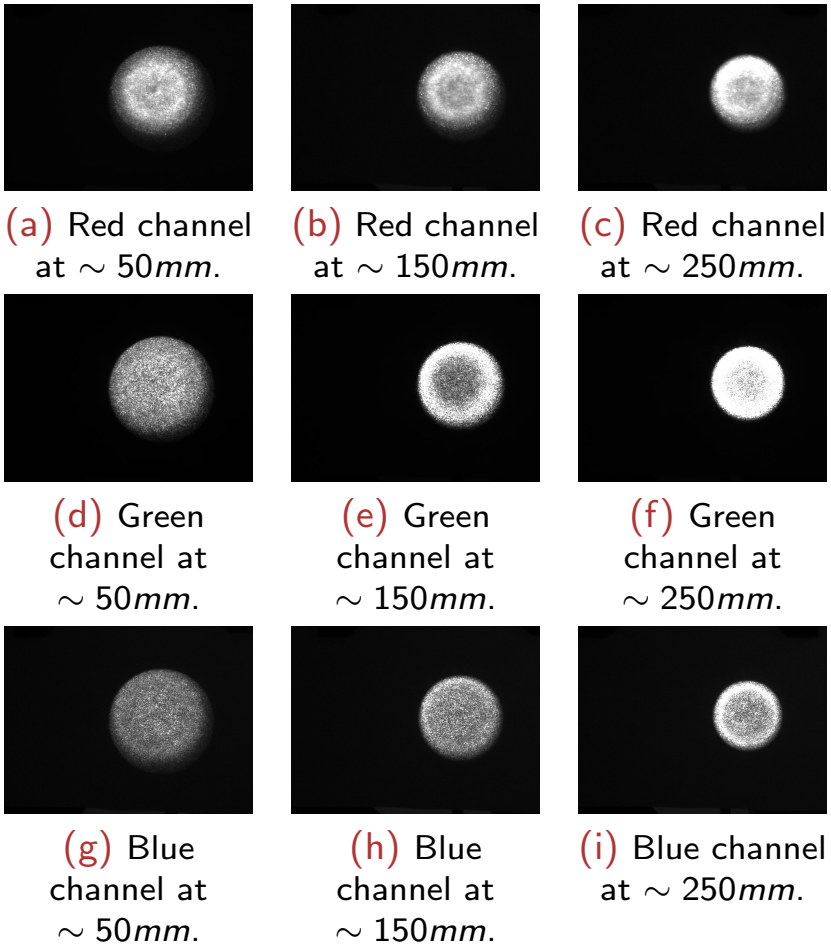


Improved Shutter Glasses implementation.

New transfer screen (Gabor Superlens).

# Prototype II

## Vibrating the fibre for speckle reduction

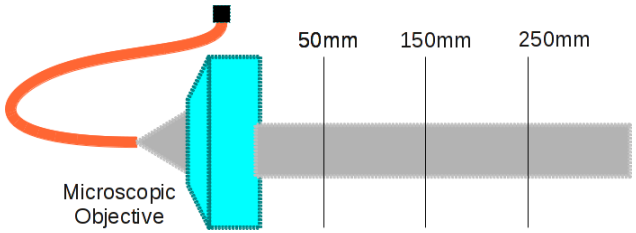


(a) Red channel at $\sim 50mm$. (b) Red channel at $\sim 150mm$. (c) Red channel at $\sim 250mm$.

(d) Green channel at $\sim 50mm$. (e) Green channel at $\sim 150mm$. (f) Green channel at $\sim 250mm$.

(g) Blue channel at $\sim 50mm$. (h) Blue channel at $\sim 150mm$. (i) Blue channel at $\sim 250mm$.

Output of the fibre coupling for different channels. Verifies the need of homogenization

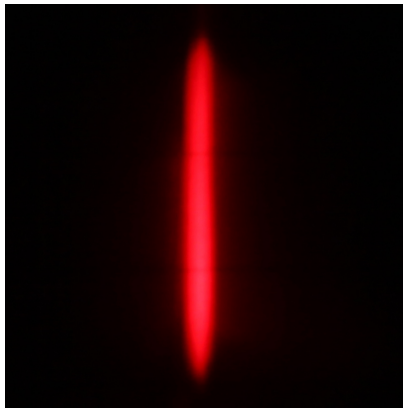



Sketch of the experiment (top-view).

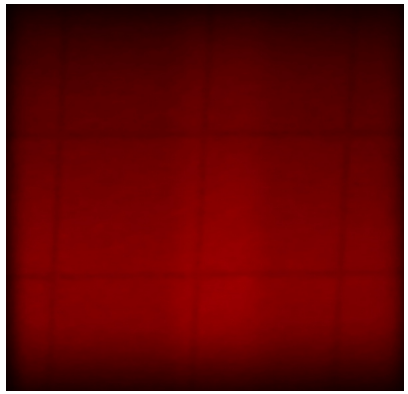
fibrevideo

# Prototype II

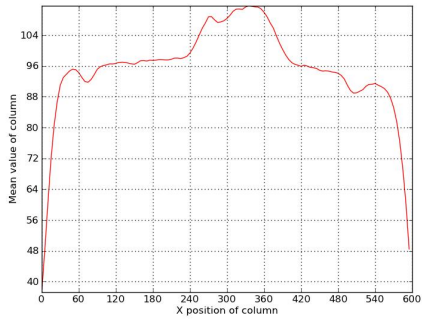
## Output of the beam shaping optics after fly's eye homogenizer and focusing with a cylindrical lens



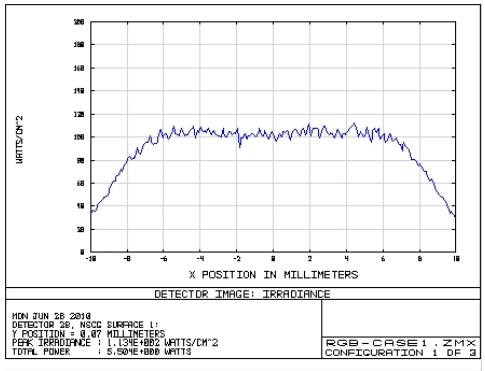
(a) A single line at LCoS plane.



(b) Scanned light on a piece of paper at the LCoS plane with saw-tooth scanner drive input.




(c) The light density distribution in X-axis of Figure b.

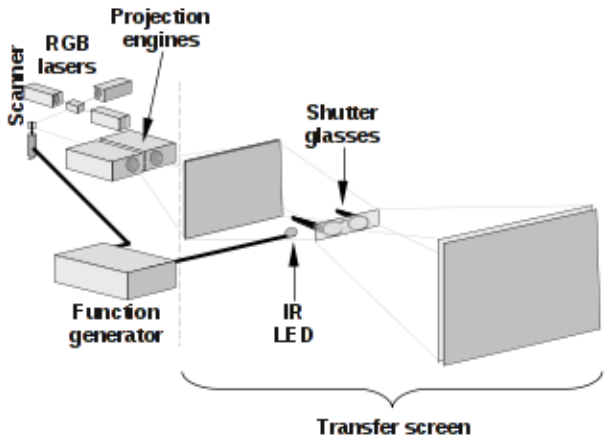



(d) The light density distribution in Y-axis of Figure b.

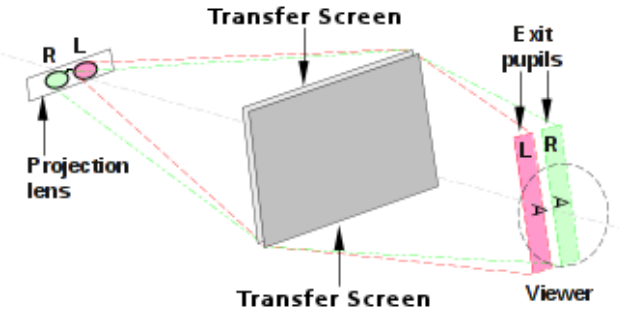
Light density distribution at the LCoS plane with and without scanning.

# Transfer Screen

## Shutter glasses approach




Schematic diagram showing the shutter glasses used to control the light directions from the front screen.




Exit pupil formation with Fresnel lens and vertical diffuser.

Outputs:

- pyusbir is developed during the development phase.
- A shutter glass is built with two pairs.

Used transfer screens:

- Fresnel Lens + Vertical Diffuser
- Gabor Superlens

# Transfer Screen

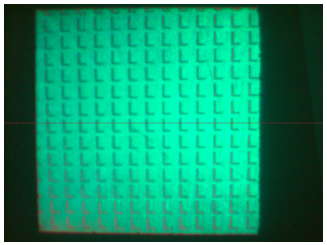
## Dynamic Exit Pupil Formation

part2

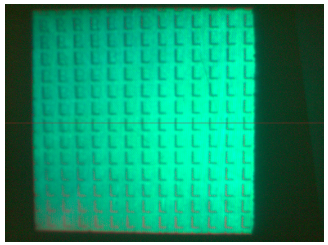
Illustration that shows how dynamic exit pupil is formed.

# Prototype II

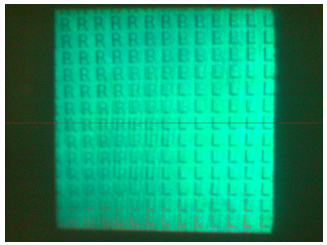
## What happens at viewing zone?



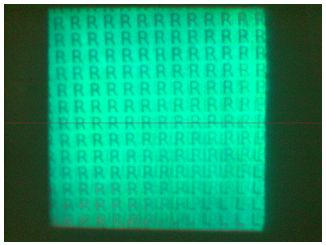
(a) −5cm



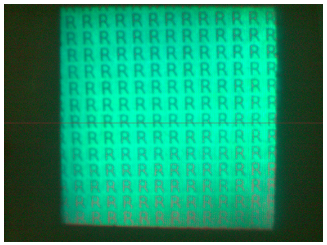
(b) −3cm



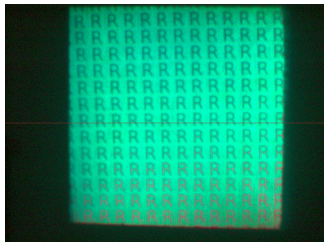
(c) −1cm



(d) 1cm

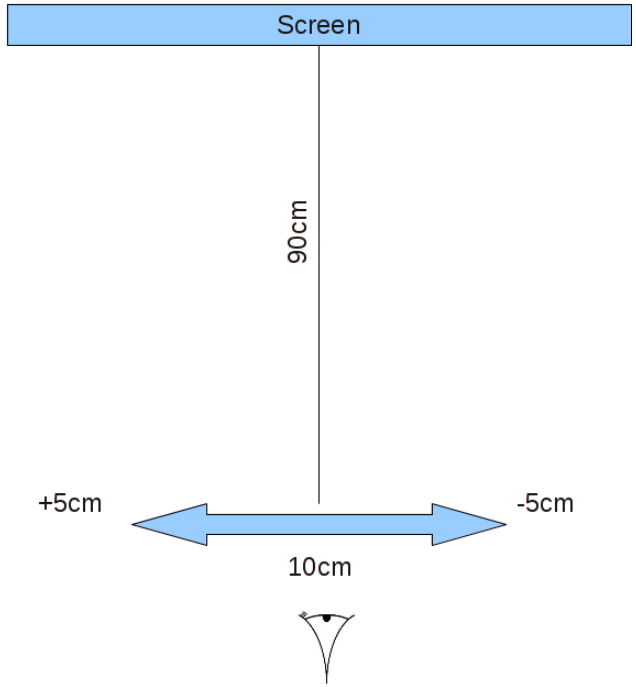


(e) 3cm



(f) 5cm

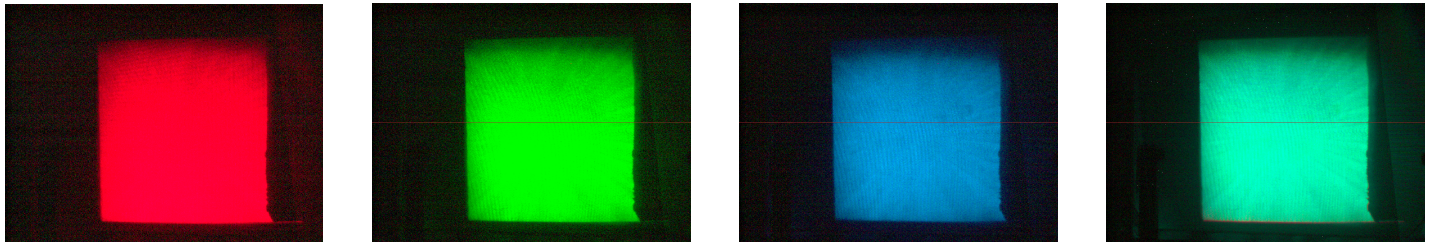
Different views at 90cm distance from the screen (Sphere optics PM-1000).




Sketch of the experiment (top-view).

# Prototype II

## What happens at viewing zone?



(a) (b) (c) (d)

Different views at viewing zone at 120cm distance from the screen.

- Brightness $15 \sim 20 Cd/m^2$
- Viewable in a low level illuminated environment.

# Final system

## Prototype II in action

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Second prototype in action.

# Conclusion

## Summary & Future Work

What is achieved?

- Glasses-free architecture
- Single-user support
- High Power Laser based light engine architecture
- Special lens design of Transfer Screen
- Novel light engine design & Implementation
- Successful User-trials

Future work?

- With the new SLM & user-tracker, multi-user support will be in place.

Thank you very much for paying attention, Questions?

HELIUM3D Web site: `http://www.cse.dmu.ac.uk/~heliumusr/`