

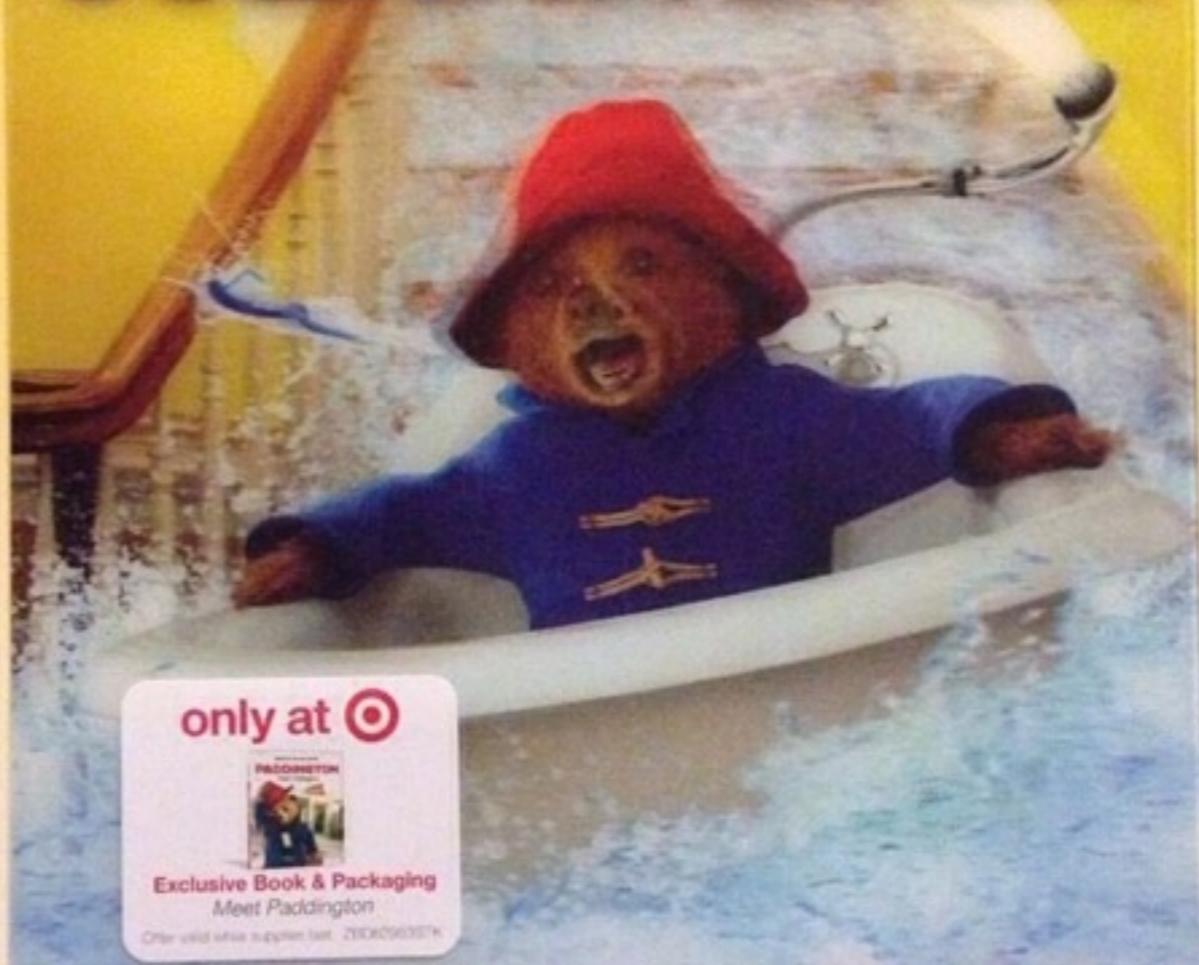
Glasses free: Survey and future prospects

Paul Bourke
UNSW

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Introduction

- Simulated depth perception, largely through stereoscopy has been a standard technique throughout the history of data visualisation. Assisting in the understanding of geometrically complicated data.
- In the rush towards commodity stereoscopy (glasses based) and head mounted displays, it is worth (re)exploring auto stereoscopic technologies.
- There was a autostereoscopic peak in the late 1990s.
A large number of lenticular display products appeared on the market.
- Questions
 - Are there advances that make existing stereoscopic displays more viable, particularly higher resolution panels?
 - Are there any new technologies on the horizon?

Plenoptic function

- Adelson and Bergen developed the concept of the plenoptic function.
- A description of the light passing through a point in space and time.
- For an observer it is a function of position (where the field is being observed) and the direction from which the light approaches this position.

$$P(x, y, z, \theta, \phi, \lambda, t)$$

- Autostereoscopic displays can be rated according to how well they approximate the plenoptic function, typically the degree to which it is being sampled.
- In an ideal display each element would consist of multiple directional emitters, in the synthetic holography world this wavelength and direction vector is referred to as a hogel.

Holography: The most abused word

Turn your Smartphone into a 3D Hologram | 4K - YouTube



<https://www.youtube.com/watch?v=7YWTtCsvgvg>

Aug 1, 2015 - Uploaded by Mrwhosetheboss

This is my tutorial on how to turn your phone into a **Hologram** Projector! ... How To Make DIY **Hologram** for ...

In the news



Jimmy Kimmel Goes Full Hologram Again For CMA Awards Crossover

Deadline - 8 hours ago

Through the miracle of modern **holography**, Kimmel will, for a second consecutive year, host ...

Hologram USA | Hologram Technology | Hologramusa.com

www.hologramusa.com/ ▼

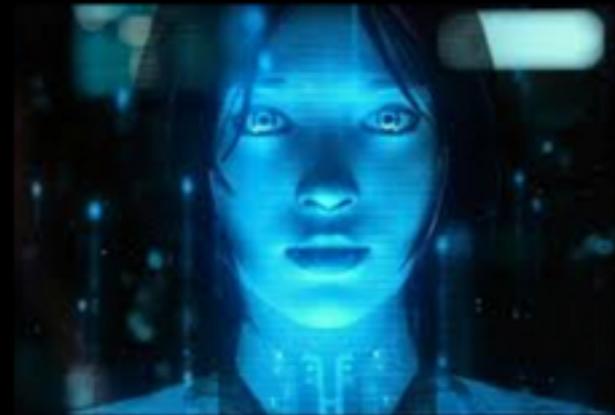
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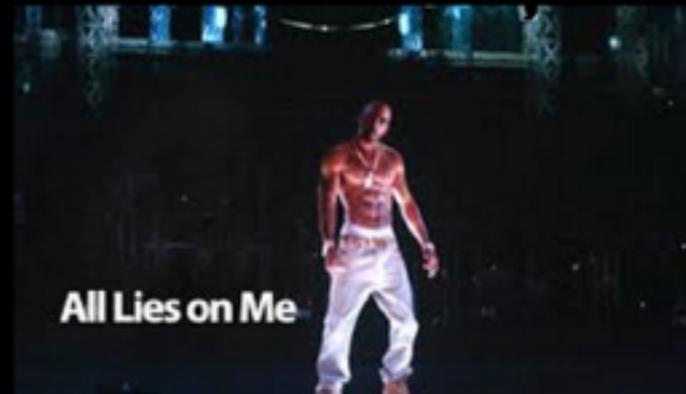
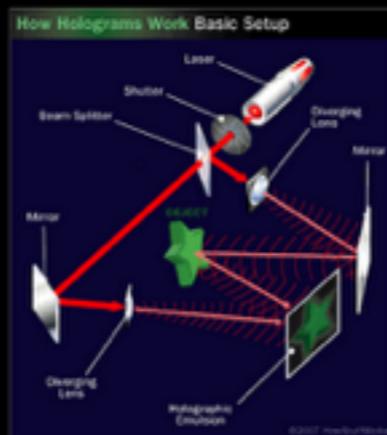
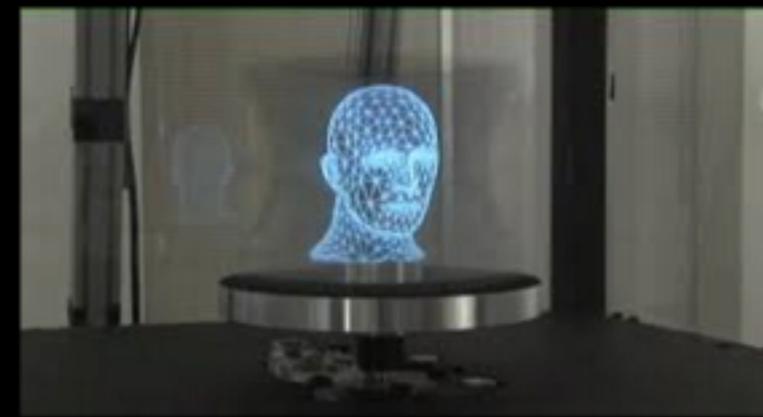
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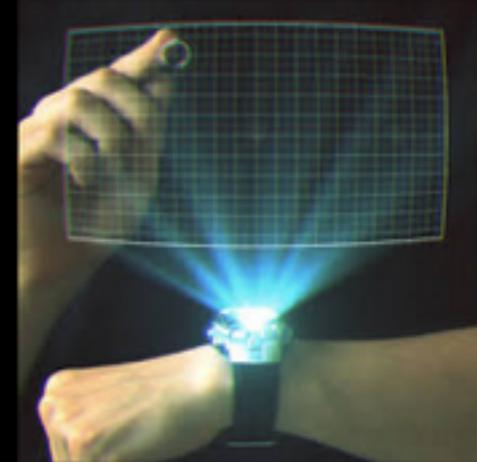
3D
HOLOGRAM
CAMERA
SIMULATOR



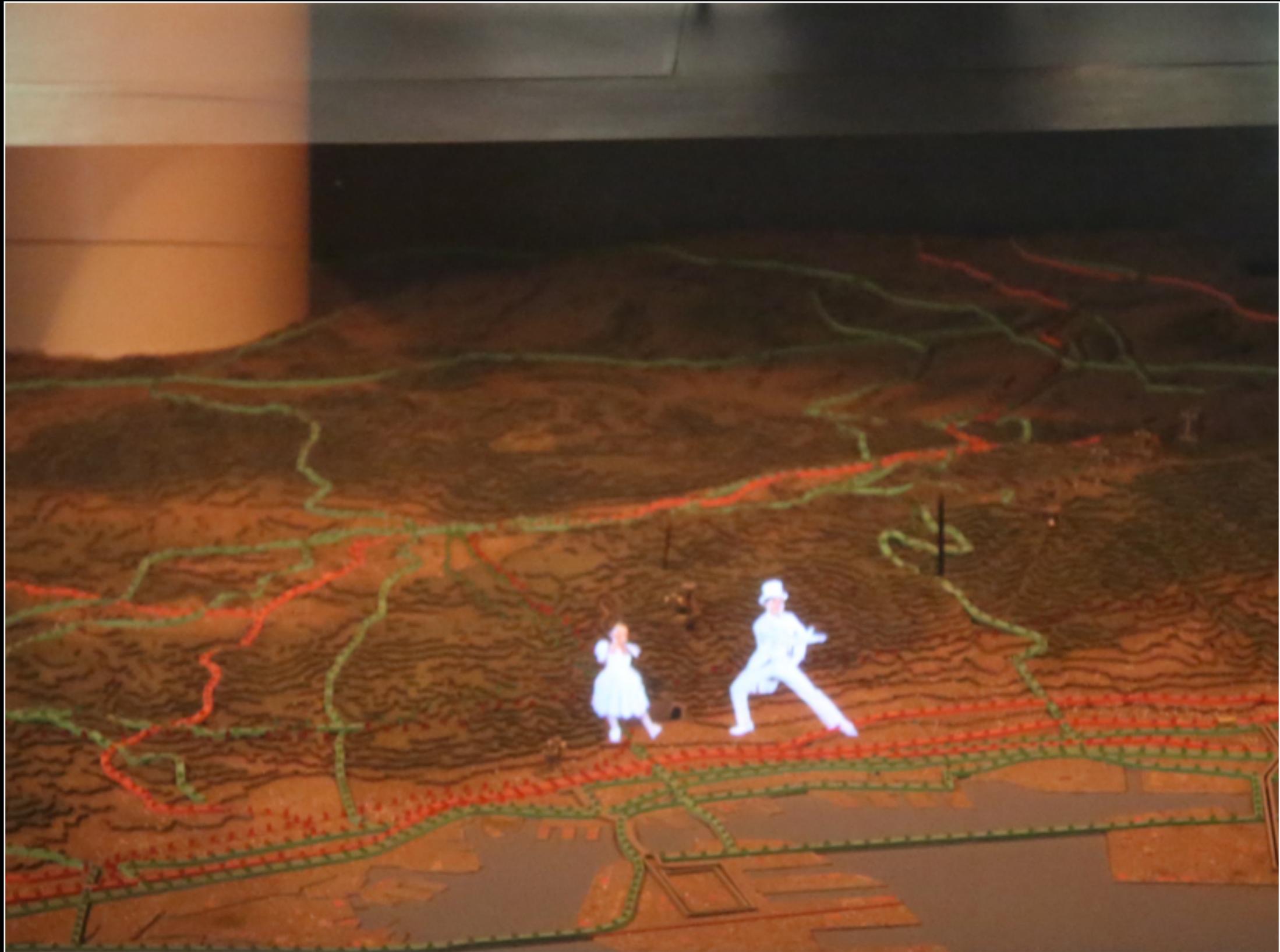


DINO
HOLOGRAM
CAMERA
3D

1280 x 720 - play.google.com



Peppers ghost



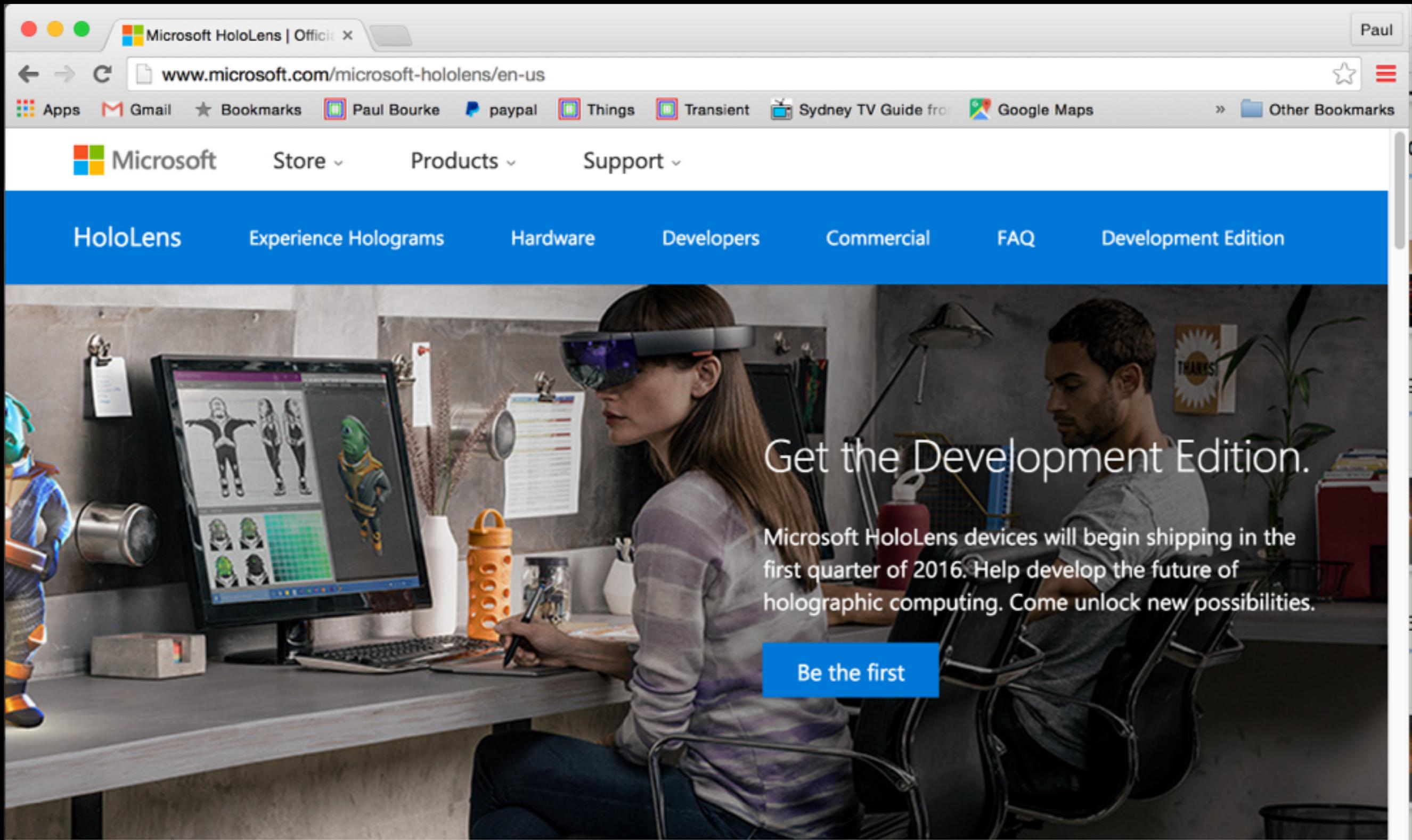


Pan...

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Microsoft HoloLens | Official

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Microsoft HoloLens devices will begin shipping in the first quarter of 2016. Help develop the future of holographic computing. Come unlock new possibilities.

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Barrier strip

- Simplest to explain and there is a straightforward extension to lenticular and requirement of all auto stereoscopic displays.
- Only require two images (has advantages and disadvantages).
- Requires very precise head positioning, or very precise head tracking.
- Suited to print and digital display.



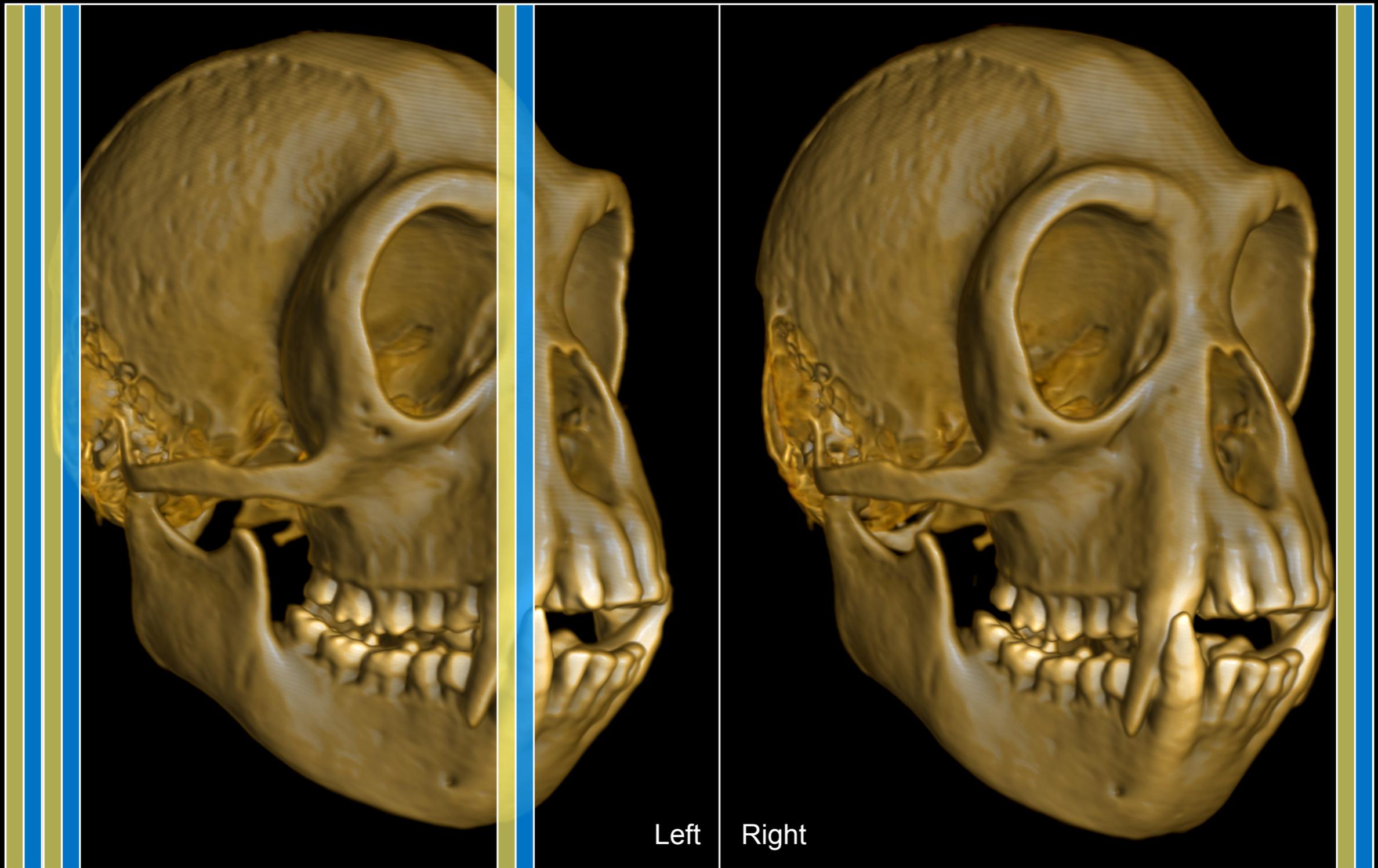
Fujifilm Finepix Real3DW3



Sharp SH25LiS
2002

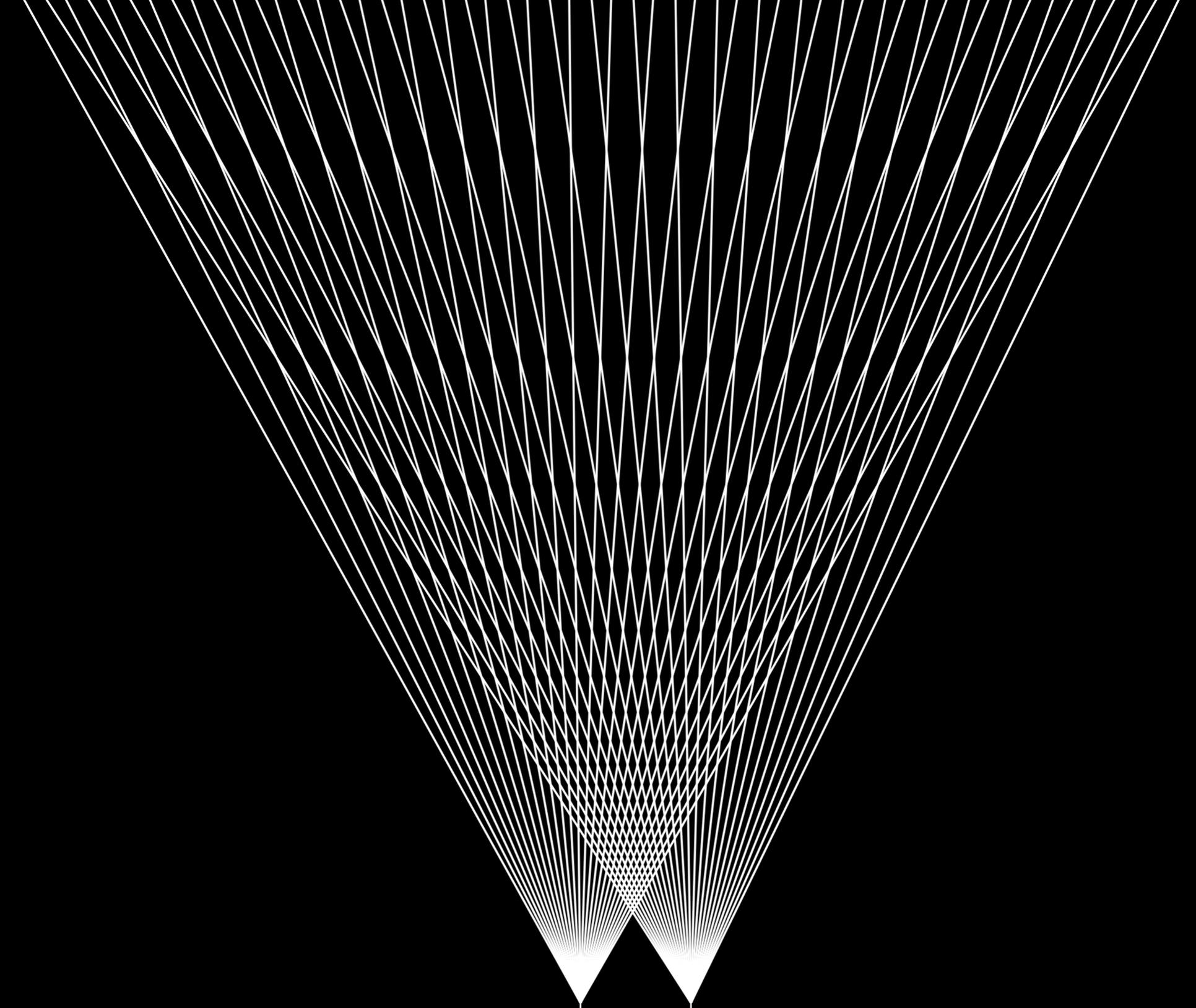
Multiplexed image

Stereo pair



Multiplexed image

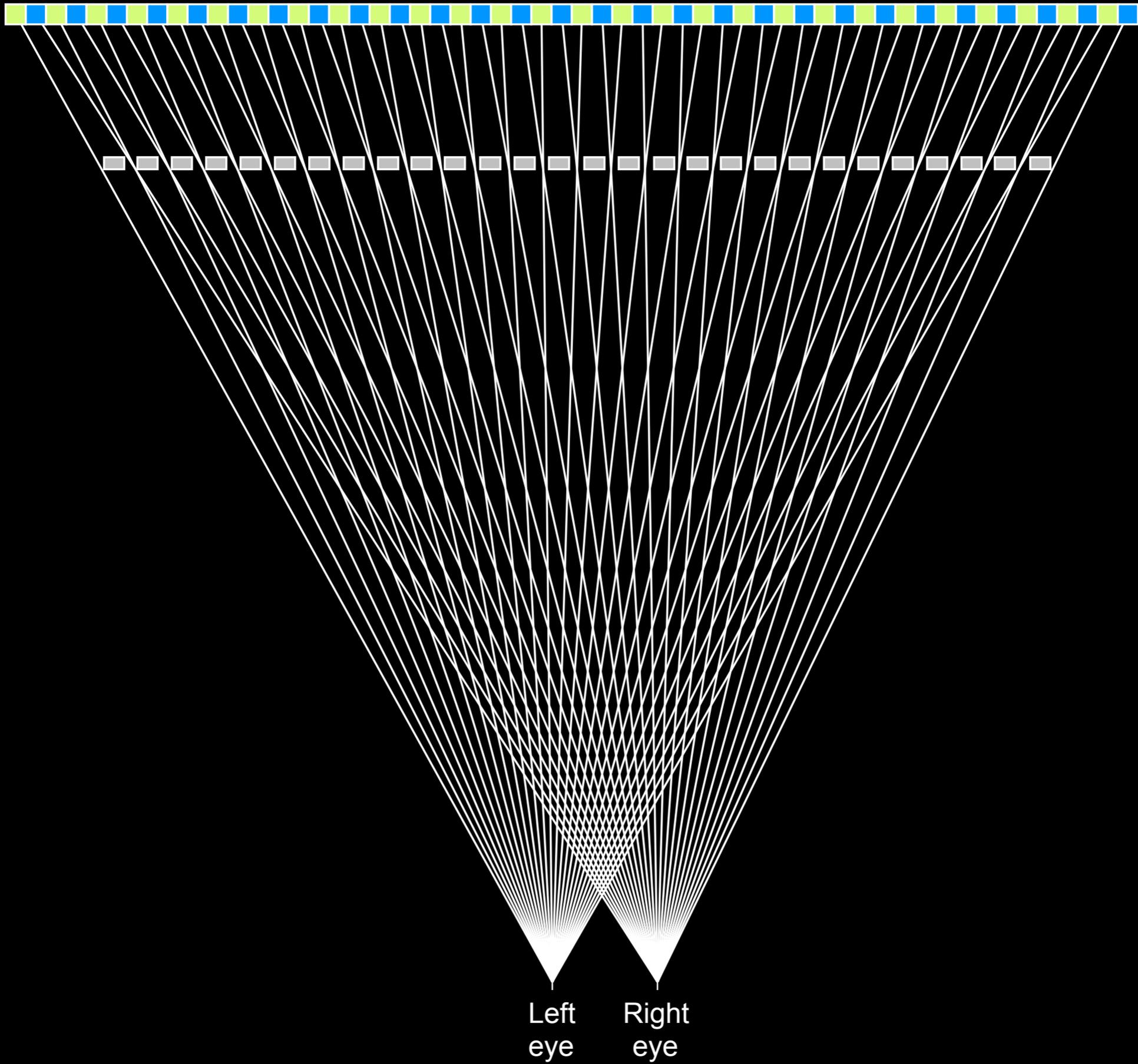
Multiplexed image



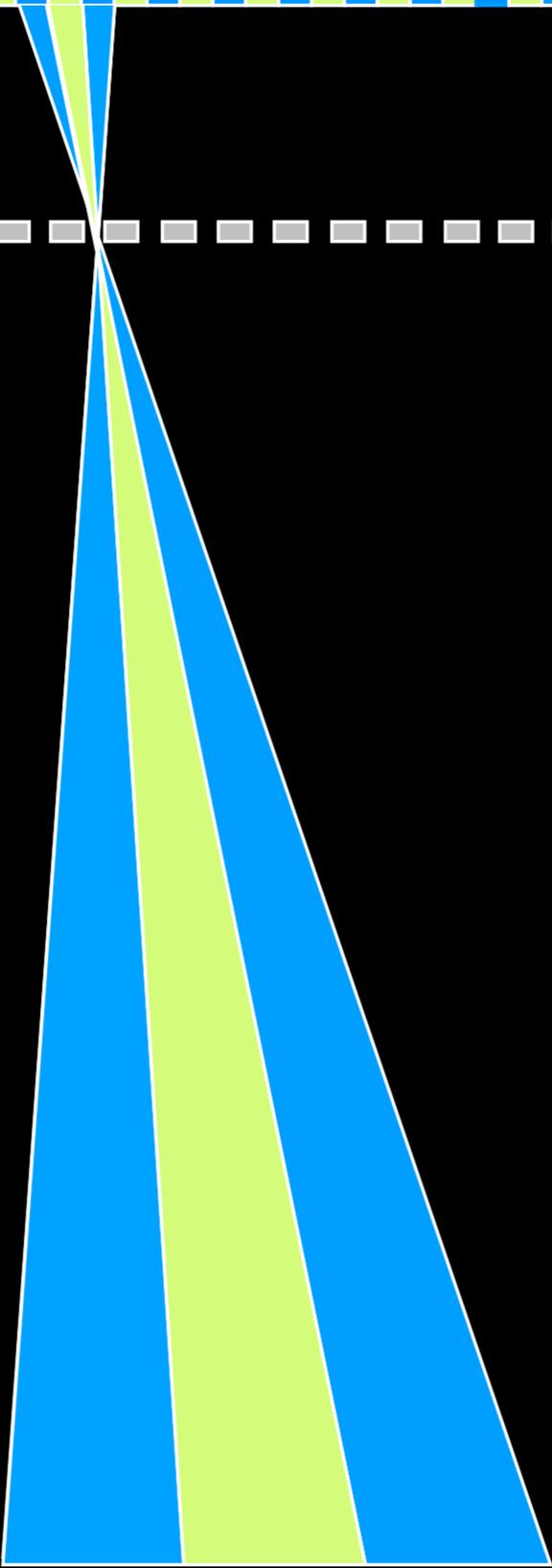
Left
eye

Right
eye

Multiplexed image



Multiplexed image



Left eye Right eye

Example: No-name (Android) tablet

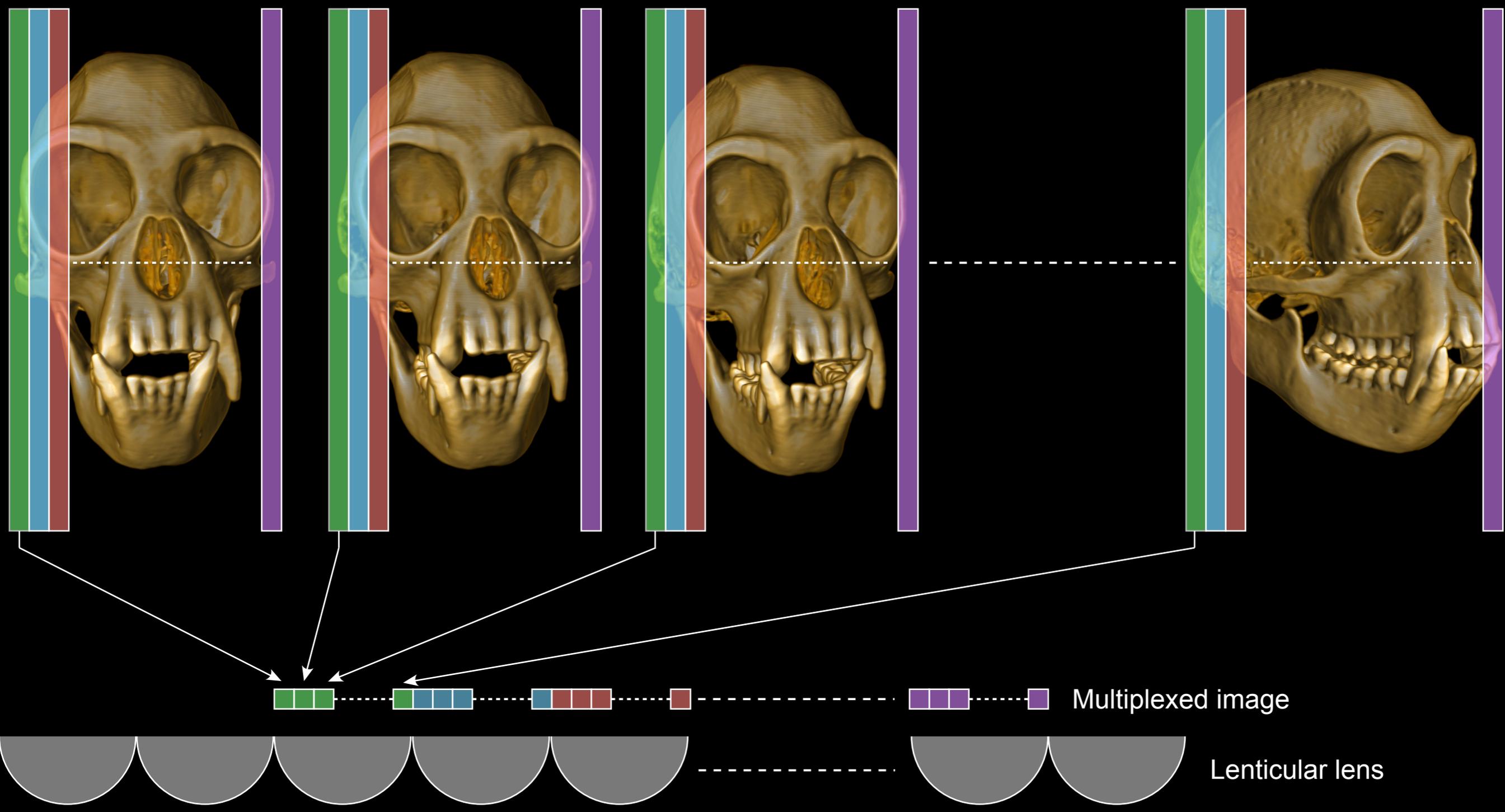
- Based upon a 2600 pixel (horizontal display).
- Uses a front LCD layer to act as the barrier, so can be used as a normal 2D panel at full resolution.
- This is at one end of the scale, highest resolution but only a single view position.



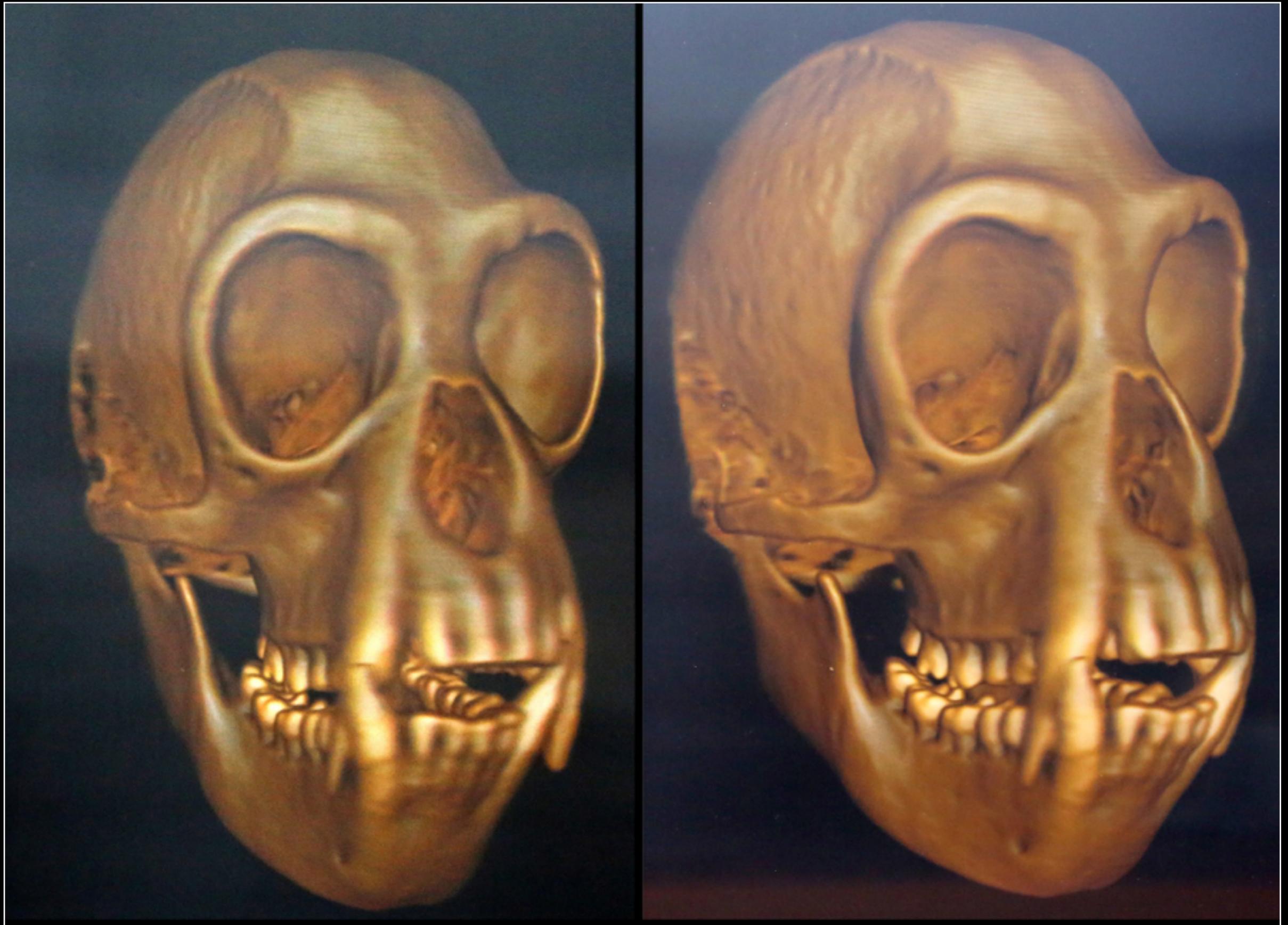
Lenticular

- Replace barrier strip with a lens array, elements called “lenticules”.
- Possible to create precise low cost lens strips.
- Suited to both print and digital displays.
- Number of images depends on the resolution of the underlying media. Typically 8-16 for displays, 30-50 for print.
- Images captured along a linear track, any pair is a stereo pair.
- Will benefit from increased display resolution.



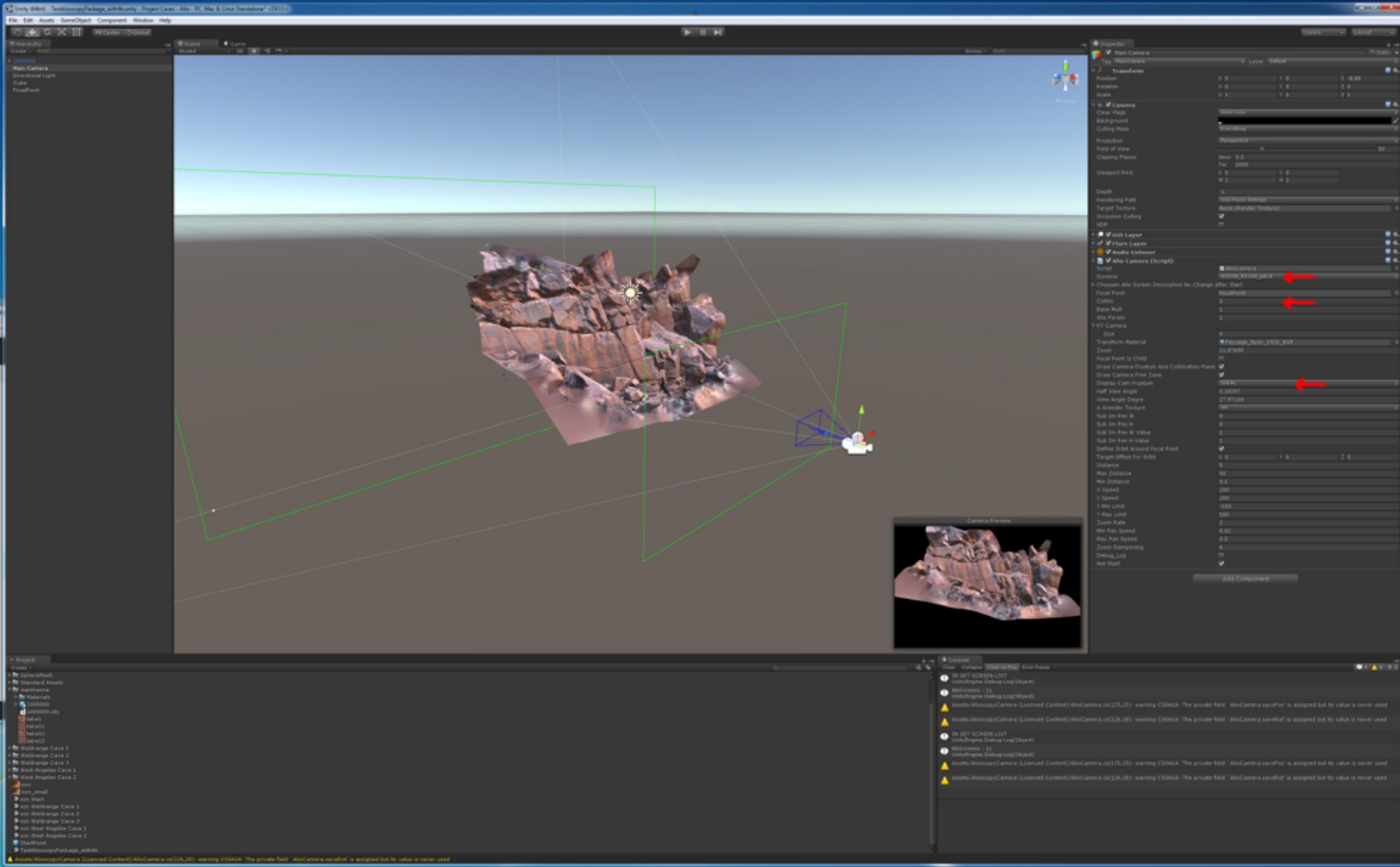


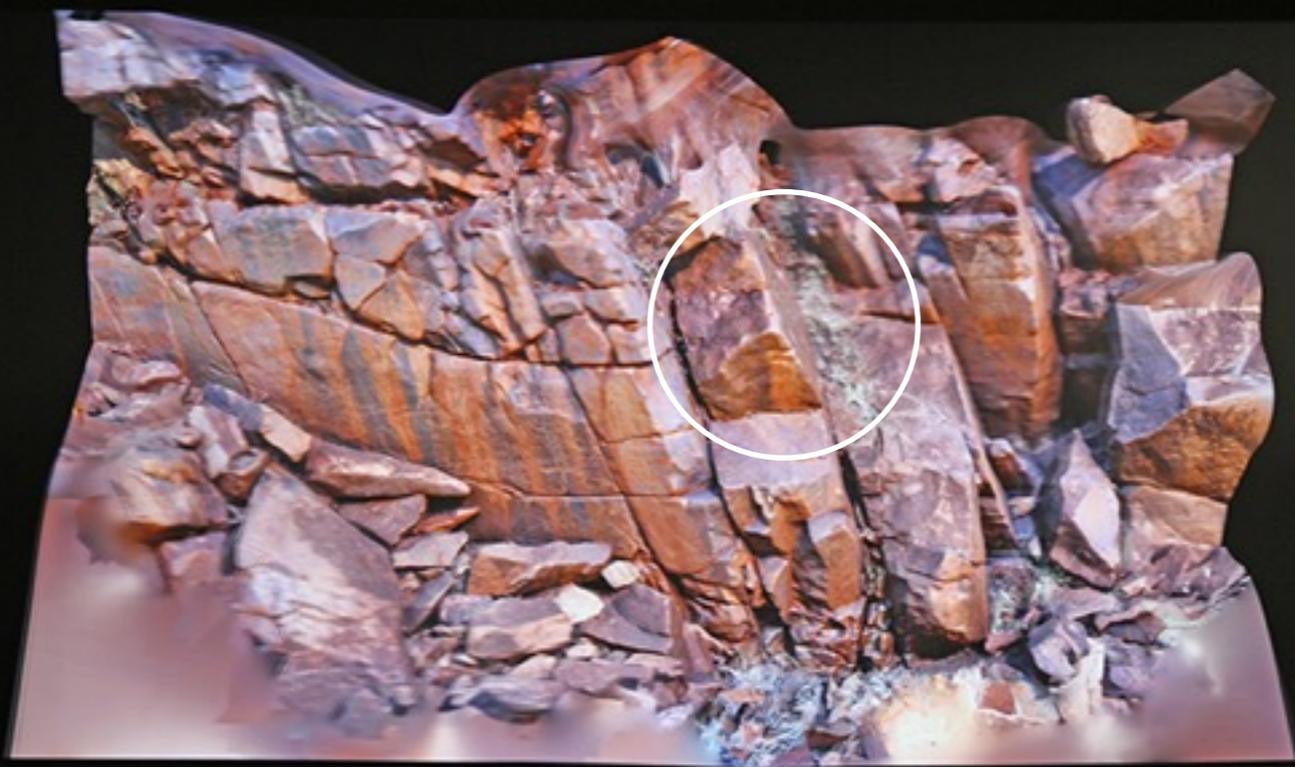
Lenticular prints



Example: Alioscopy 4K

- Alioscopy released a version of their product early in 2015.
- Based upon a 4K panel.
- Supports up to 8 images.
- Lenticular screen is layered on front and exposed, could get damaged.
- Note that effective resolution is not $1/N$ due to a slanted lenticular array with respect to the LCD elements.
(Berkel, Parker, Franklin, "Multiview 3D LCD," Proc. SPIE 2653, 32 (1996))





Comments

- Great improvement over previous HD resolution versions.
- Depth budget is still very low and thus not suited to VR applications.
- Viewer still needs to be located too far from the display.

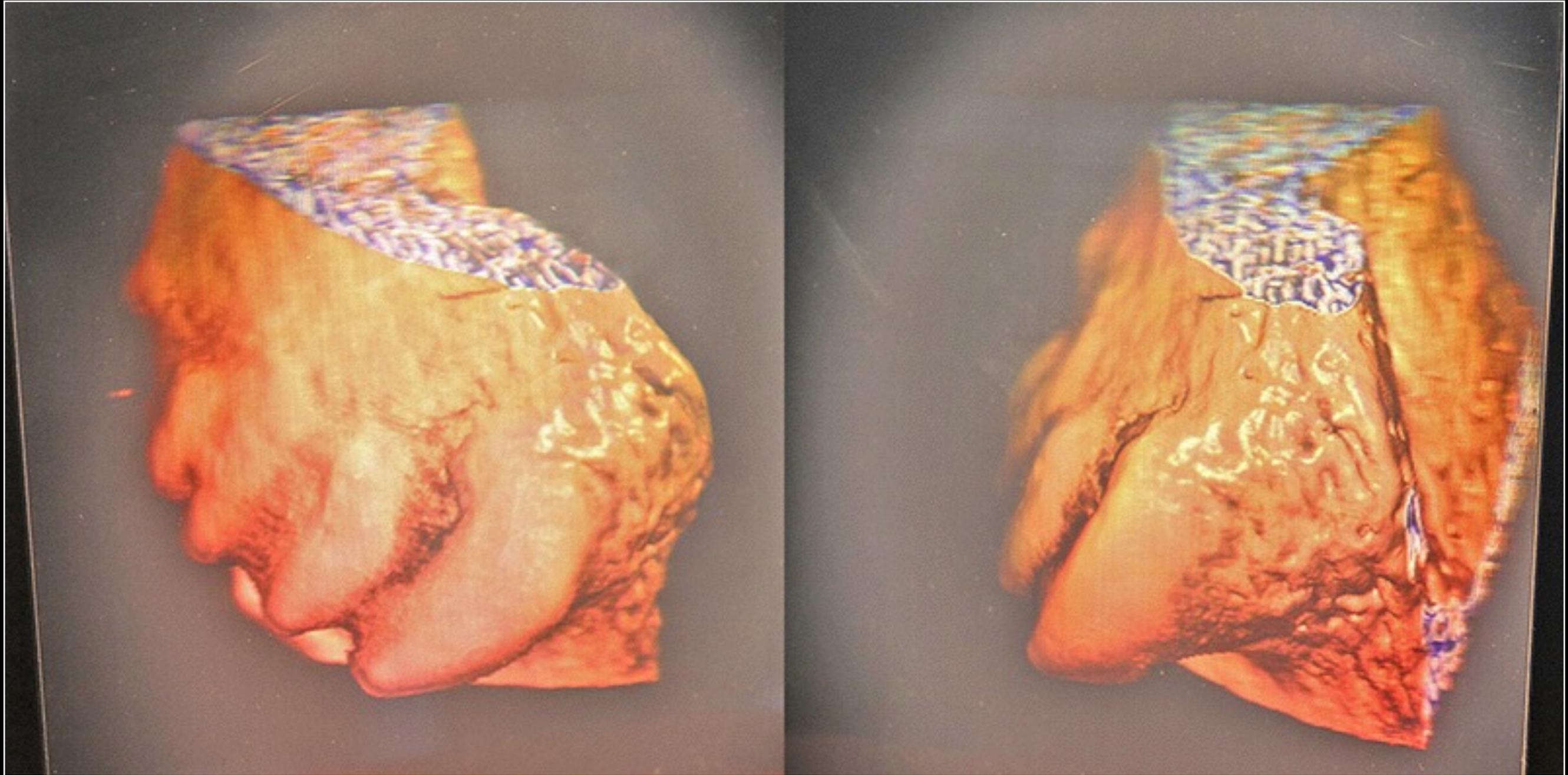
Solution requires either

- variable spaced lenticules
 - variable spaced LCD elements (not possible as based upon existing panel) and market too small.
- Effective resolution still relatively low despite being based upon a 4K panel. Not aware of any 8K version in development.

Synthetic (light field) holograms

- Based upon film resolution recording of “hogels”, generally recorded with photopolymers. Realtime based upon micro-mirror arrays.
- Pioneered by Geola, USA representation is Zebra print.
- Typically create >1000 renders as an approximation to the light field.
- Possible to create parallax in two dimensions for images that can be viewed from all directions.
- Unlike true holograms where colour fidelity is difficult, these are full colour.
- Supply images from a render process, or the model for the supplier to render.
- Expensive, ~\$1000 for A4 size. Been that way for over 6 years.

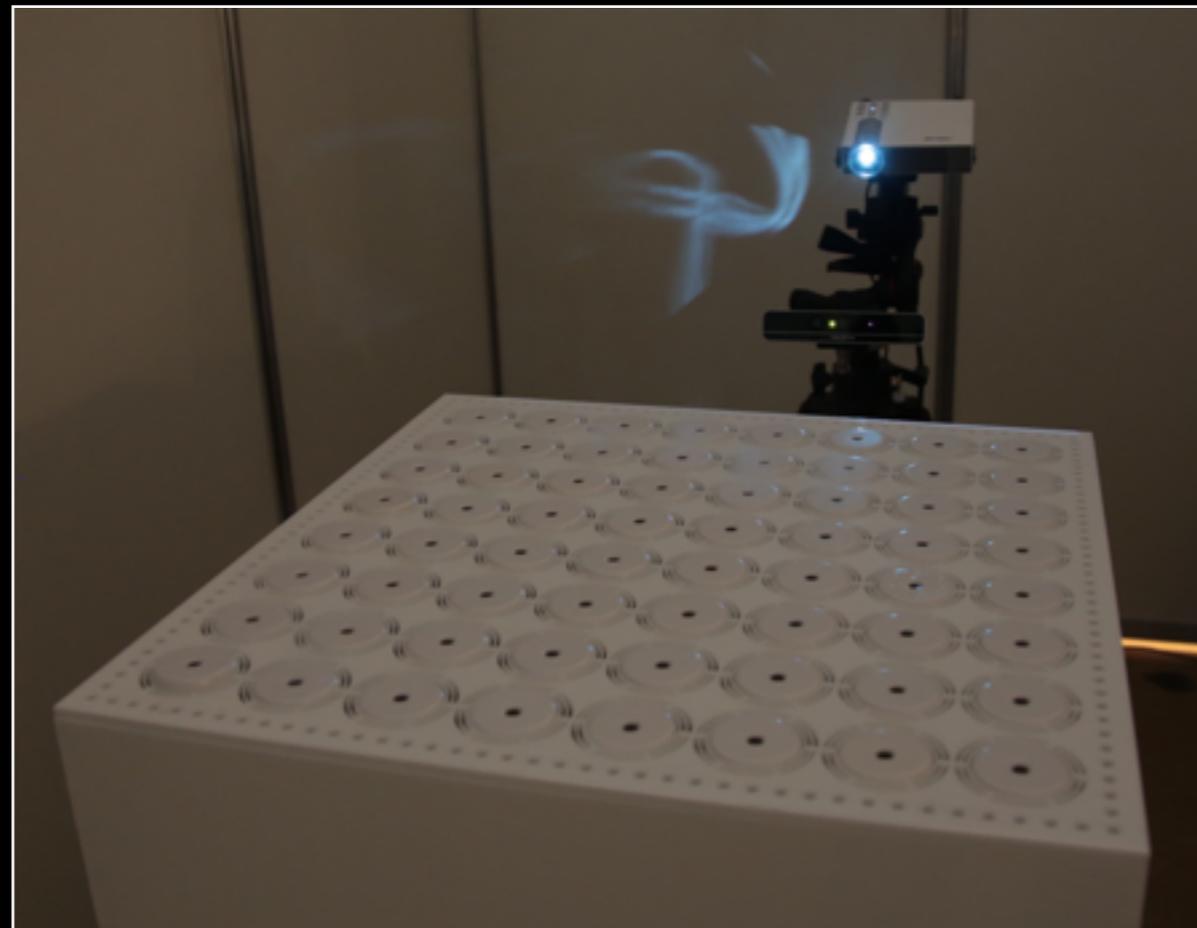
Example: Geola



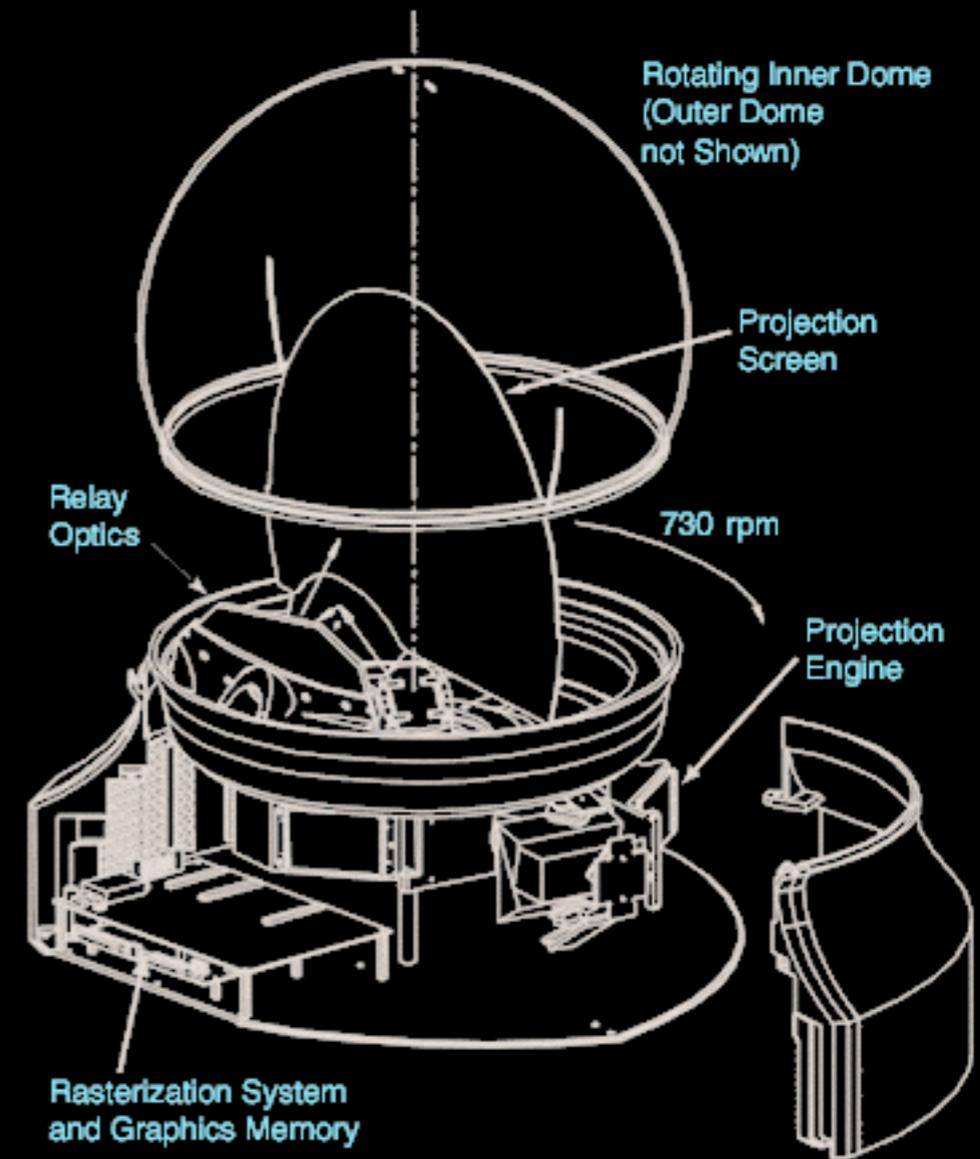
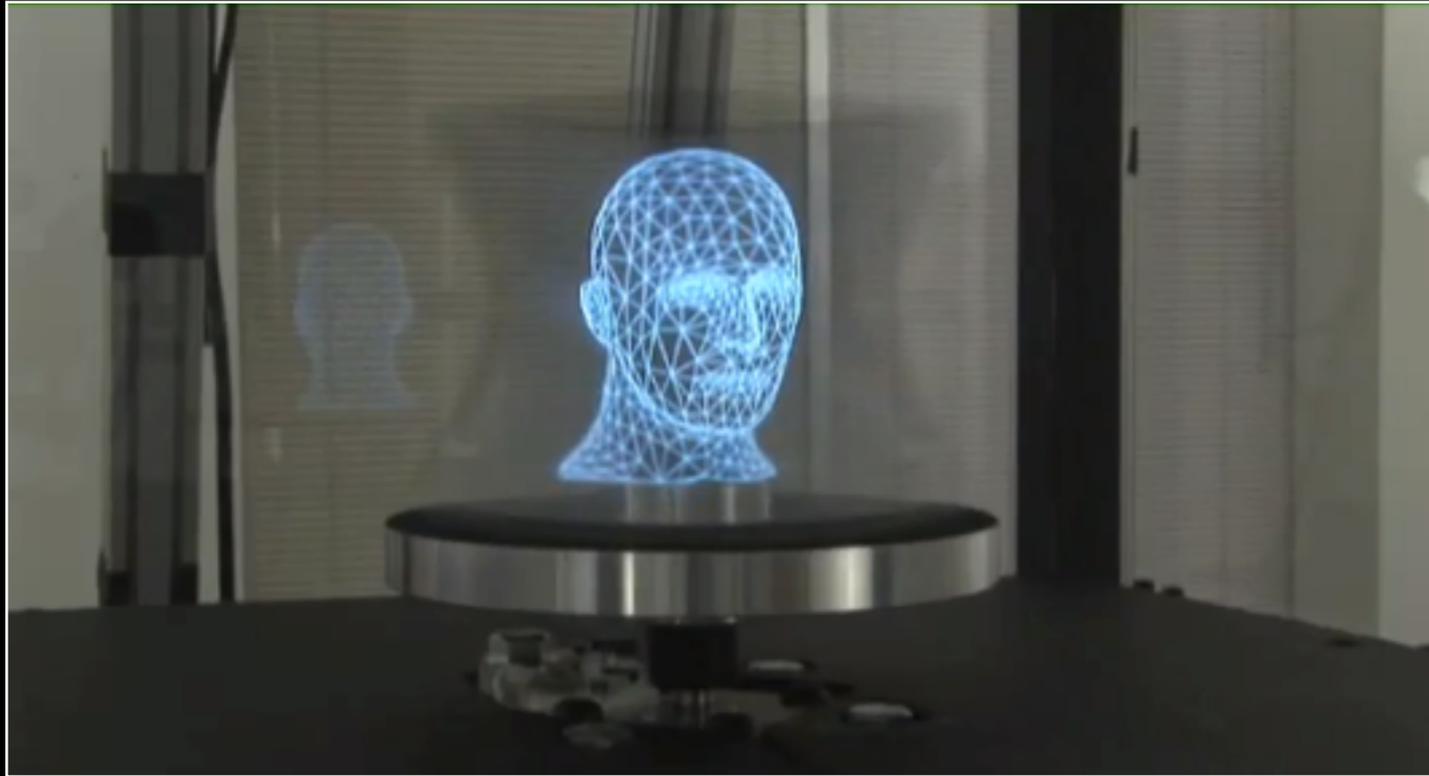
Summary

	Barrier strip tablet	Lenticular 4K panel	Lenticular print	Synthetic hologram
Contributing images	2	5 - 8	~40	~1000 (x1000)
Viewing distance (mm)	~400	~2000	500+	~800
Viewing angle (degrees)	Narrow precise position	± 5	± 15	Widest ± 45
Dimensions (width, mm)	~120	~700	~500	~400
Controlled lighting	No	No	No	Yes
Dynamic/realtime	Yes	Yes	No	Difficult
Perceived resolution	High	Modest	Good	Modest
Depth budget	Limited	Limited	Good	Good
Photography capable	Yes	Yes	Yes	Challenging
Video capable	Yes	Yes	No	No
Cost (Approximate)	\$300	\$15,000	\$300	~1,500

Fog/smoke projection



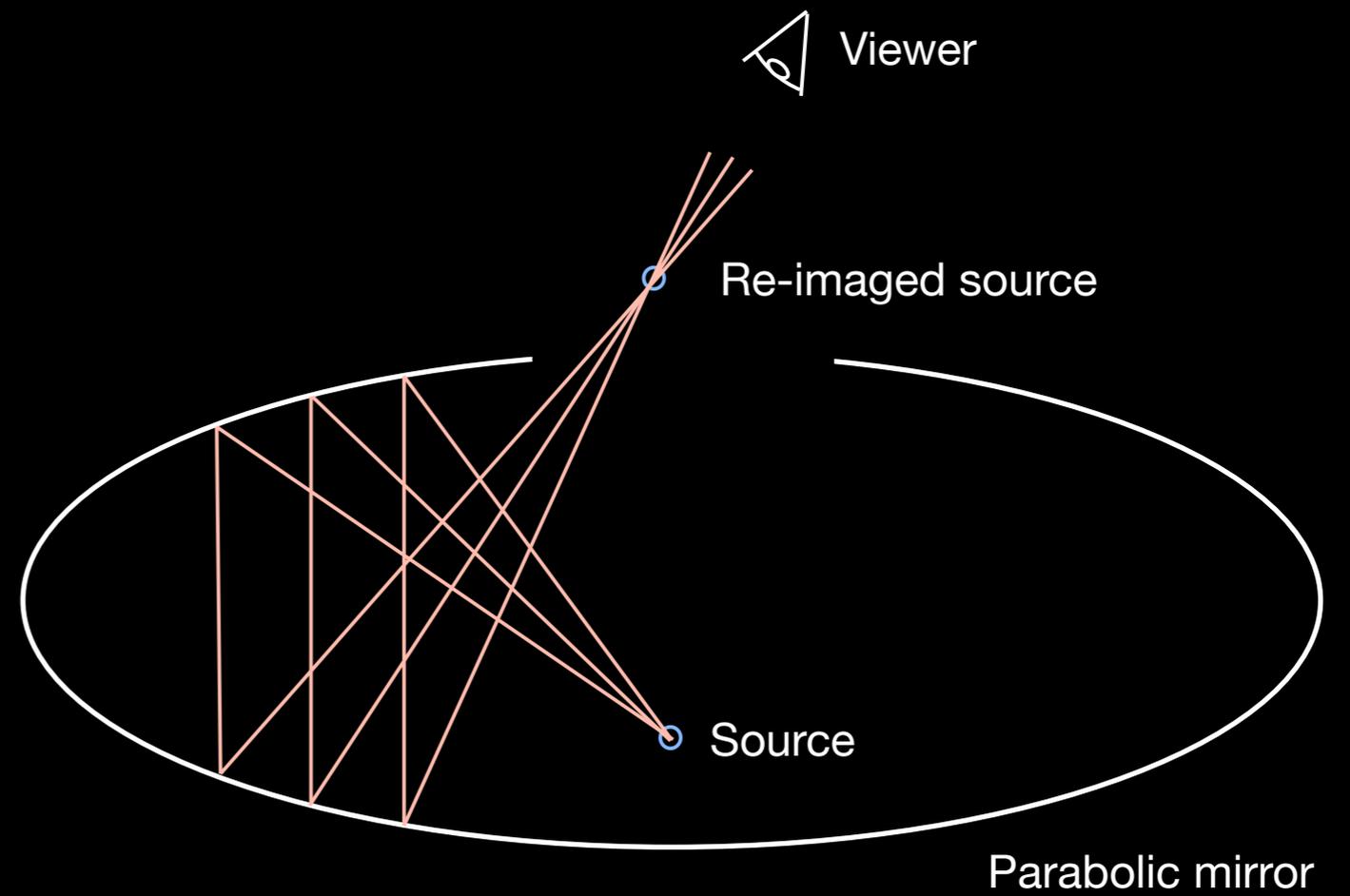
Spinning mirrors



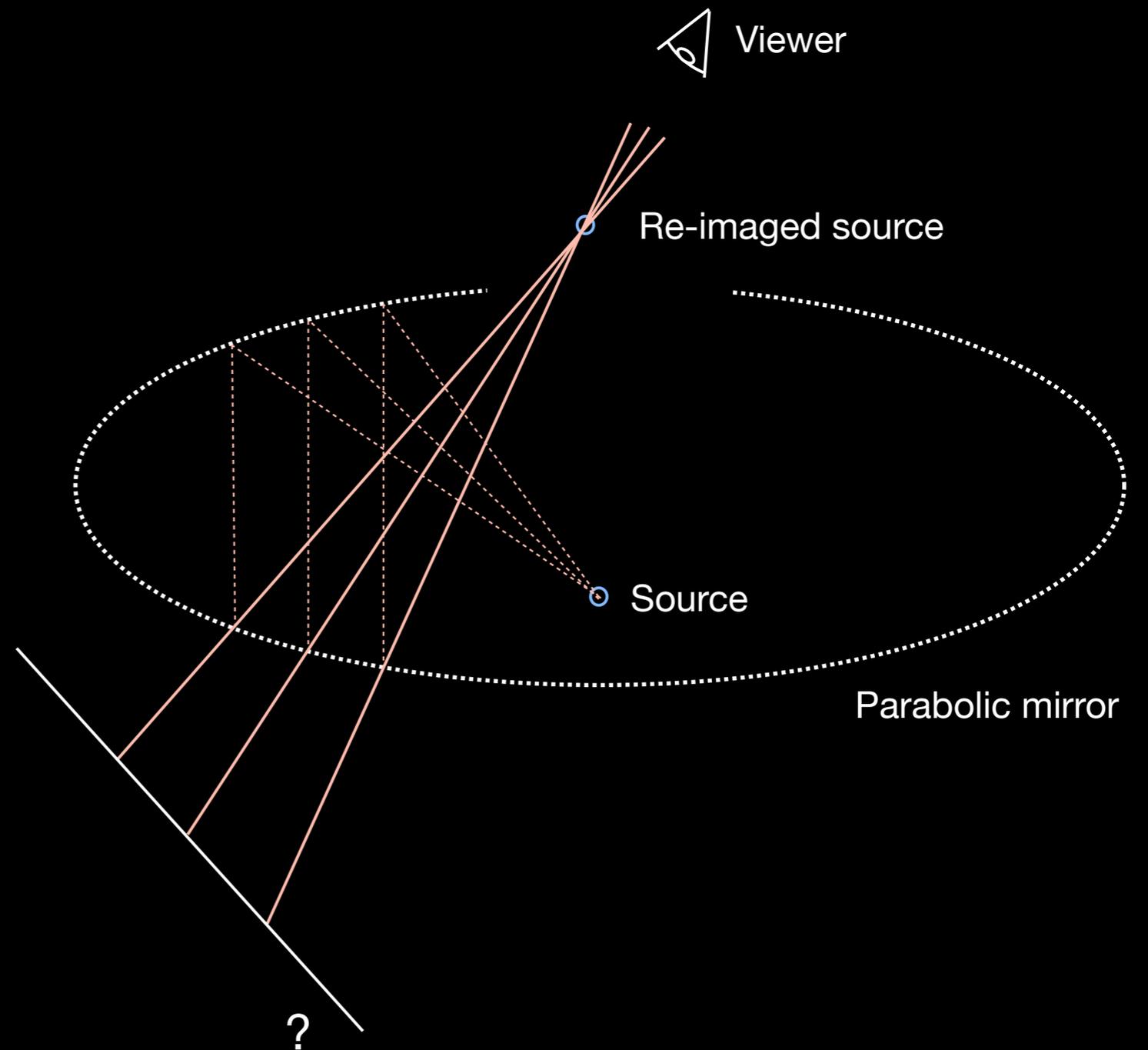
Optical devices

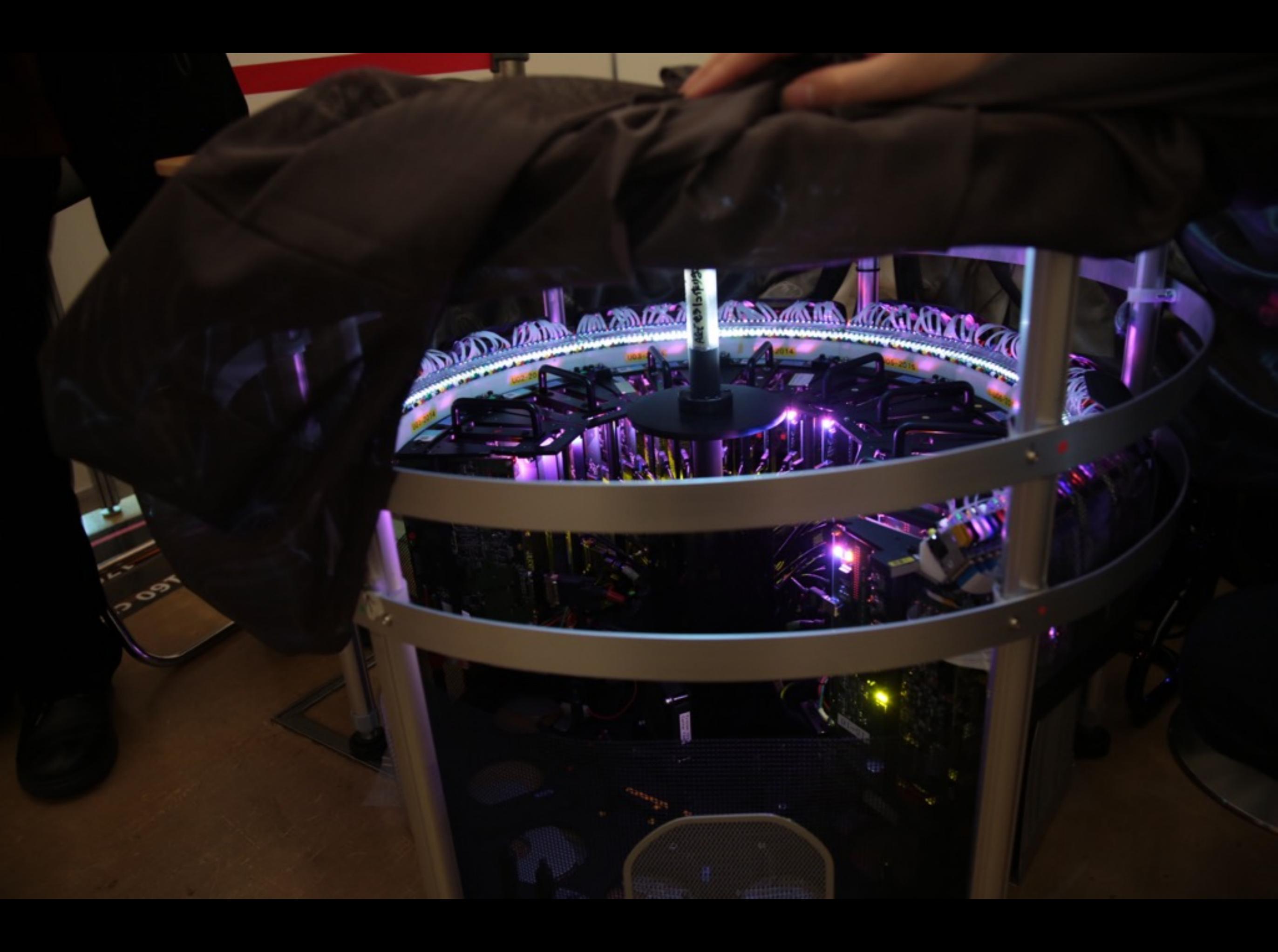


Mirascope



Mirascope

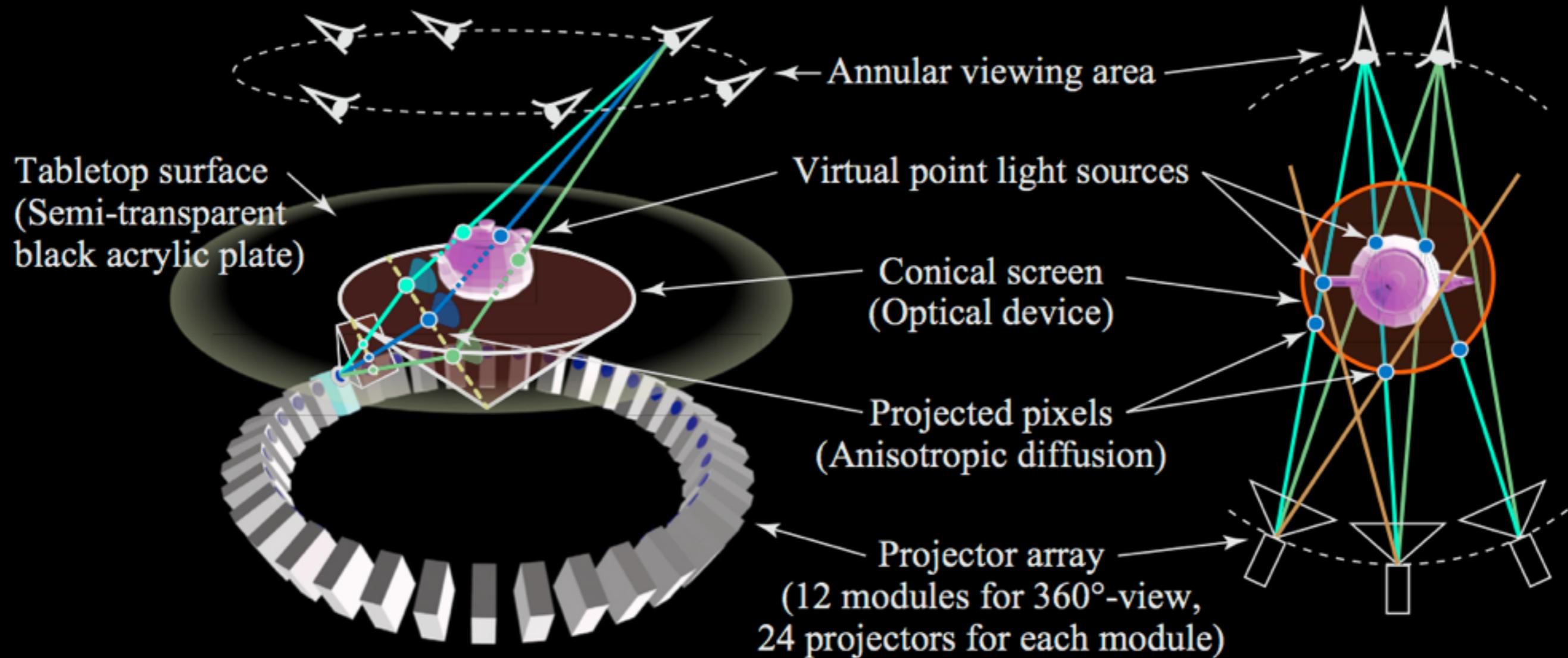






Bird's-eye view

Top view



Summary

- All these displays can be compared by how well they represent (sample) the light field, the plenoptic function.
- Still no clear winning technology.
- Suitable for visualisation applications around outreach (engaging) or static prints.
- As a means of providing depth perception for active visualisation the current techniques seem fundamentally limited, and future technologies are still not ready.