工程與生活
科技新生活與微光機電技術

國立彰化師範大學
機電工程學系 王可文 編
Prepared by Kerwin Wang
Department of Mechatronics Engineering

- LIGHT & HUMAN EYES

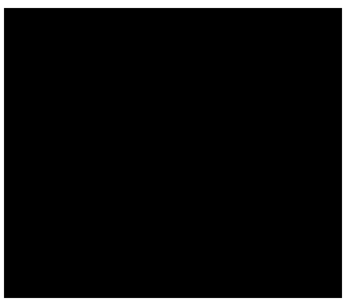
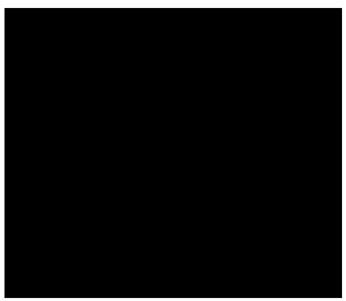
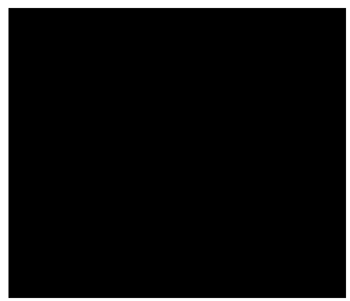
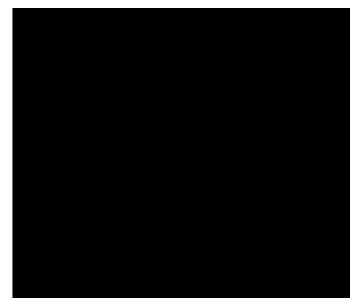
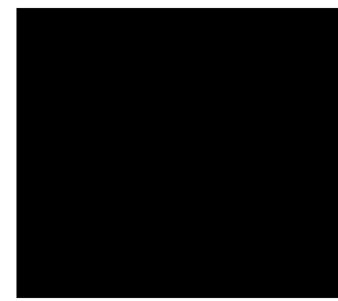
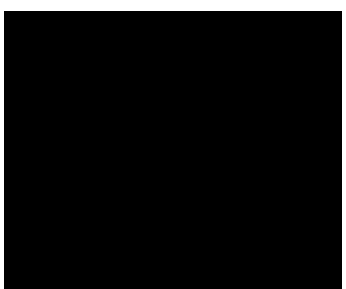
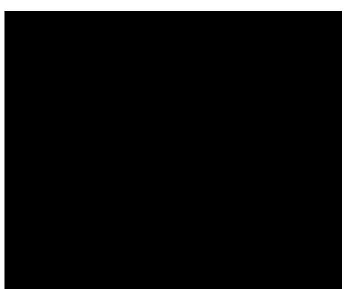
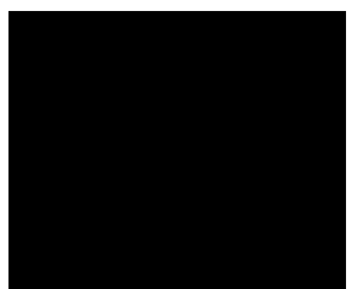
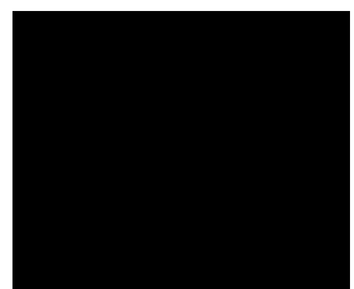
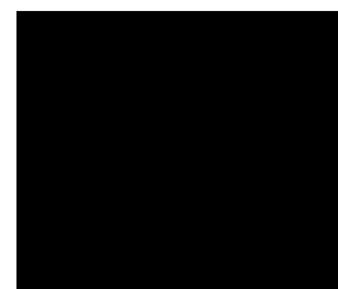


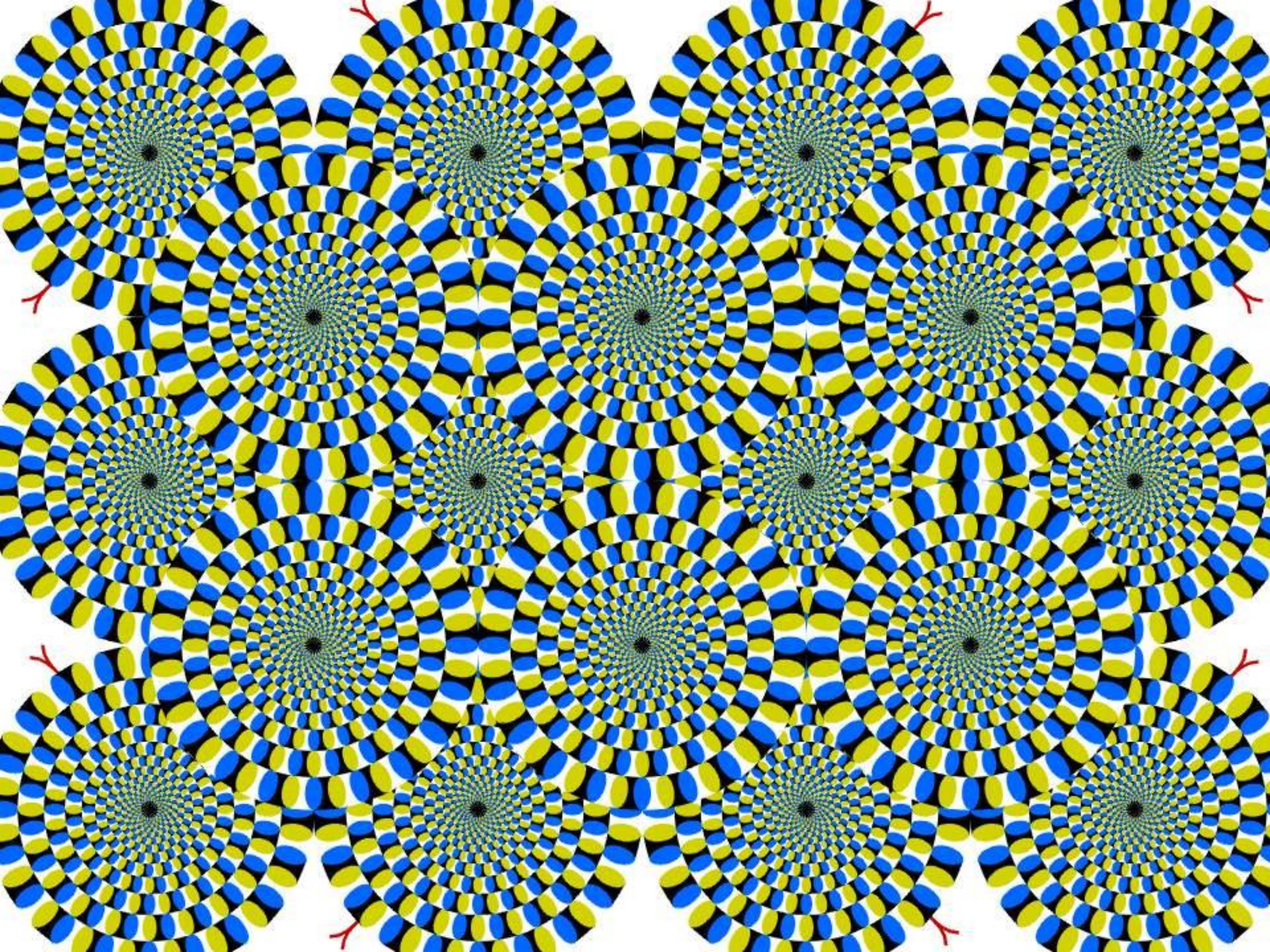






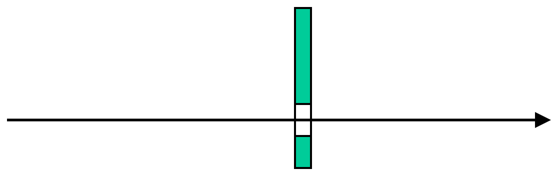


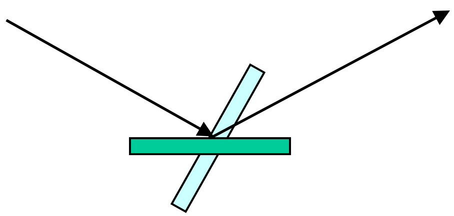


From pixels to eyes

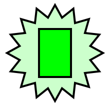
- Transmissive optics

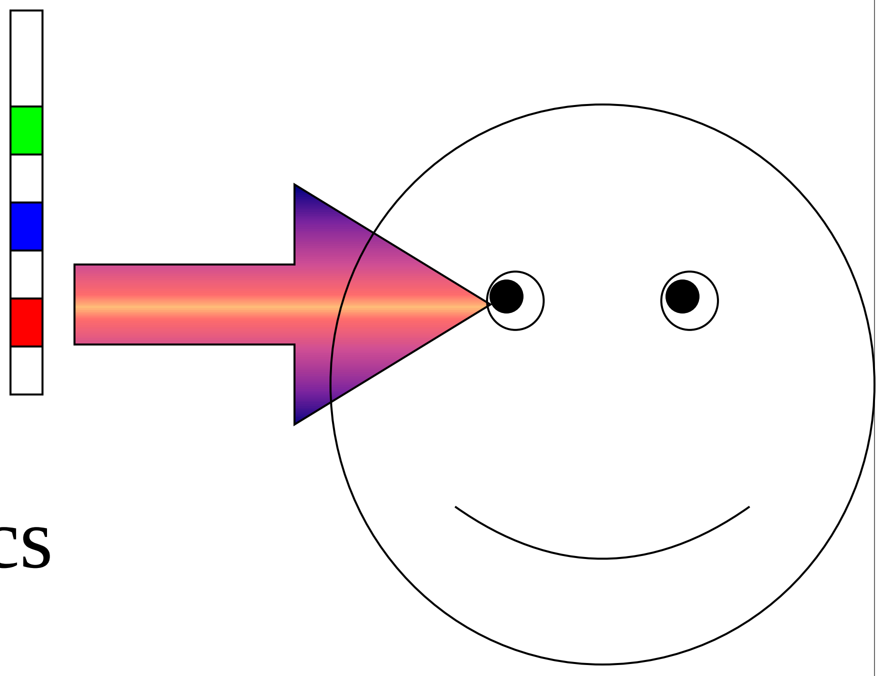


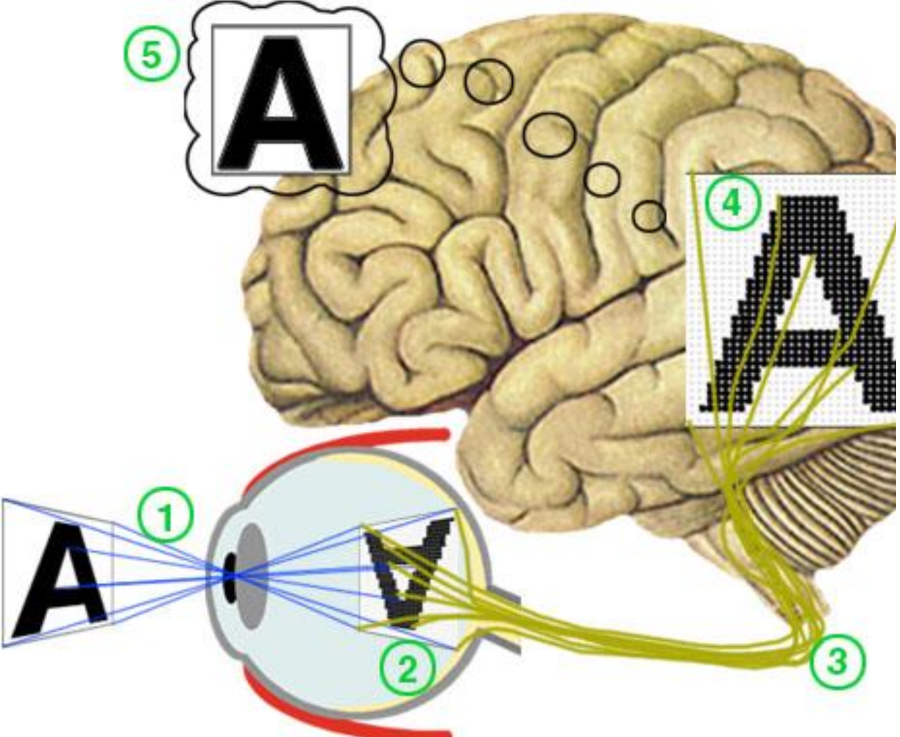
- Reflective optics

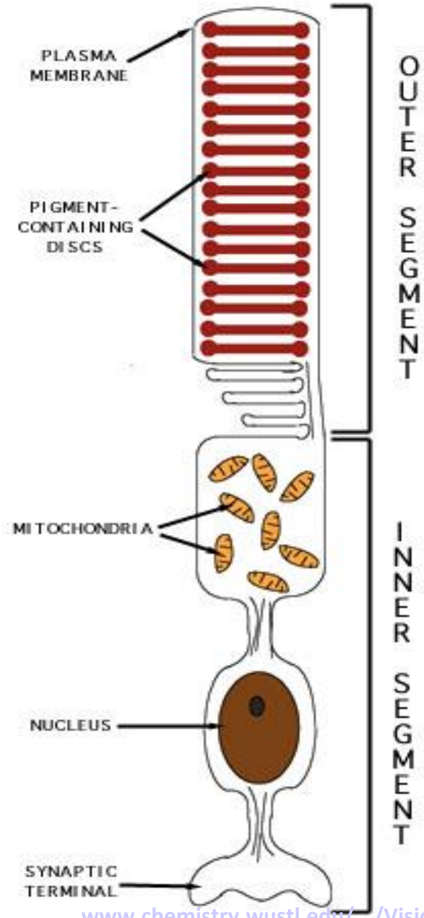


- Self-illuminative optics









Light hits a rod cell and isomerizes retinal.

↓

Rhodopsin converts to metarhodopsin II.

↓

Metarhodopsin II activates transducin.

↓

Transducin activates phosphodiesterase.

↓

Phosphodiesterase hydrolyzes cyclic GMP.

↓

Cyclic GMP is scarce, so Na^+ channels close.

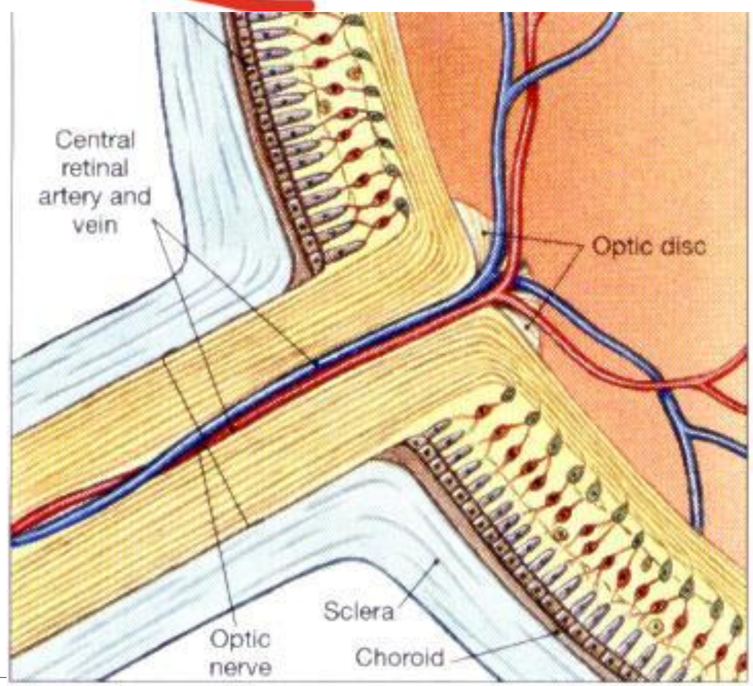
↓

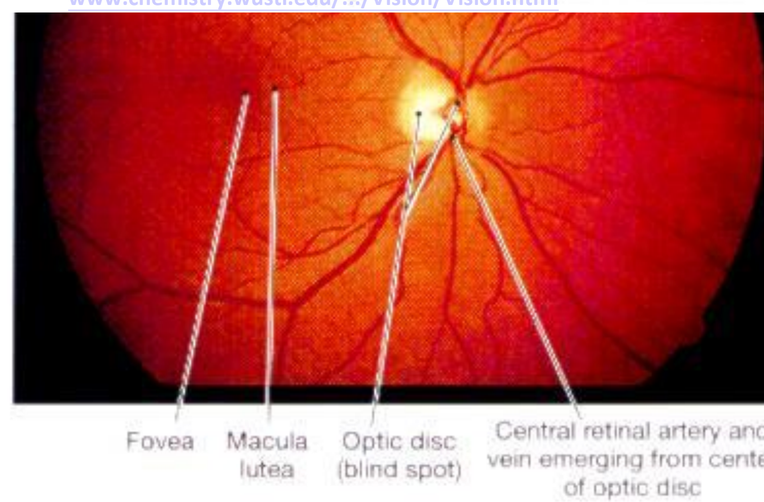
The membrane is hyperpolarized.

↓

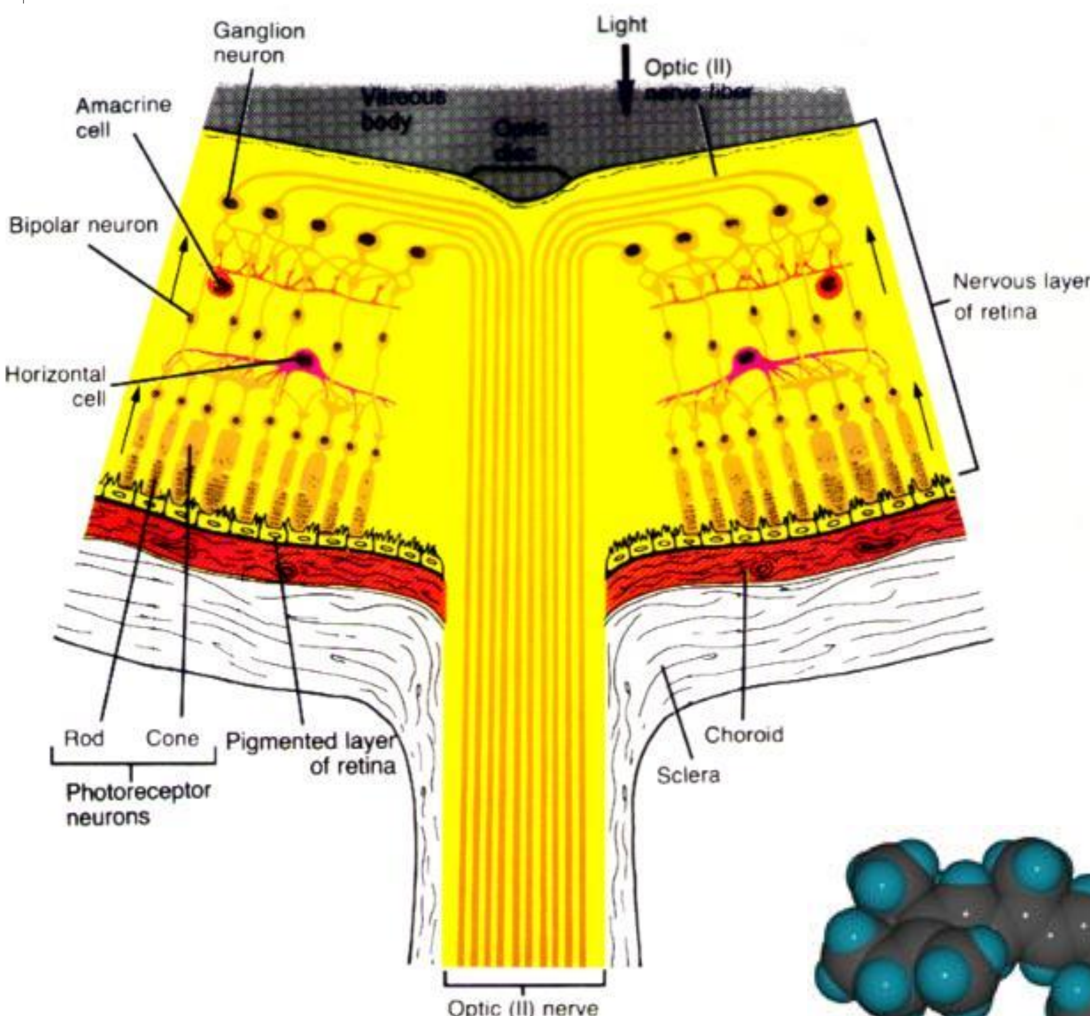
An electrical impulse is sent to the brain.

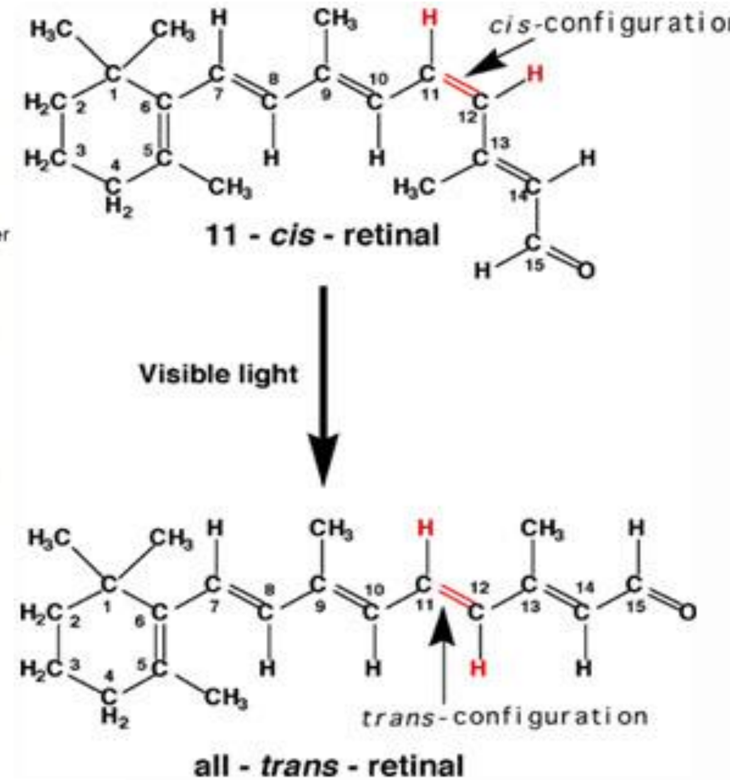
www.chemistry.wustl.edu/.../Vision/Vision.html



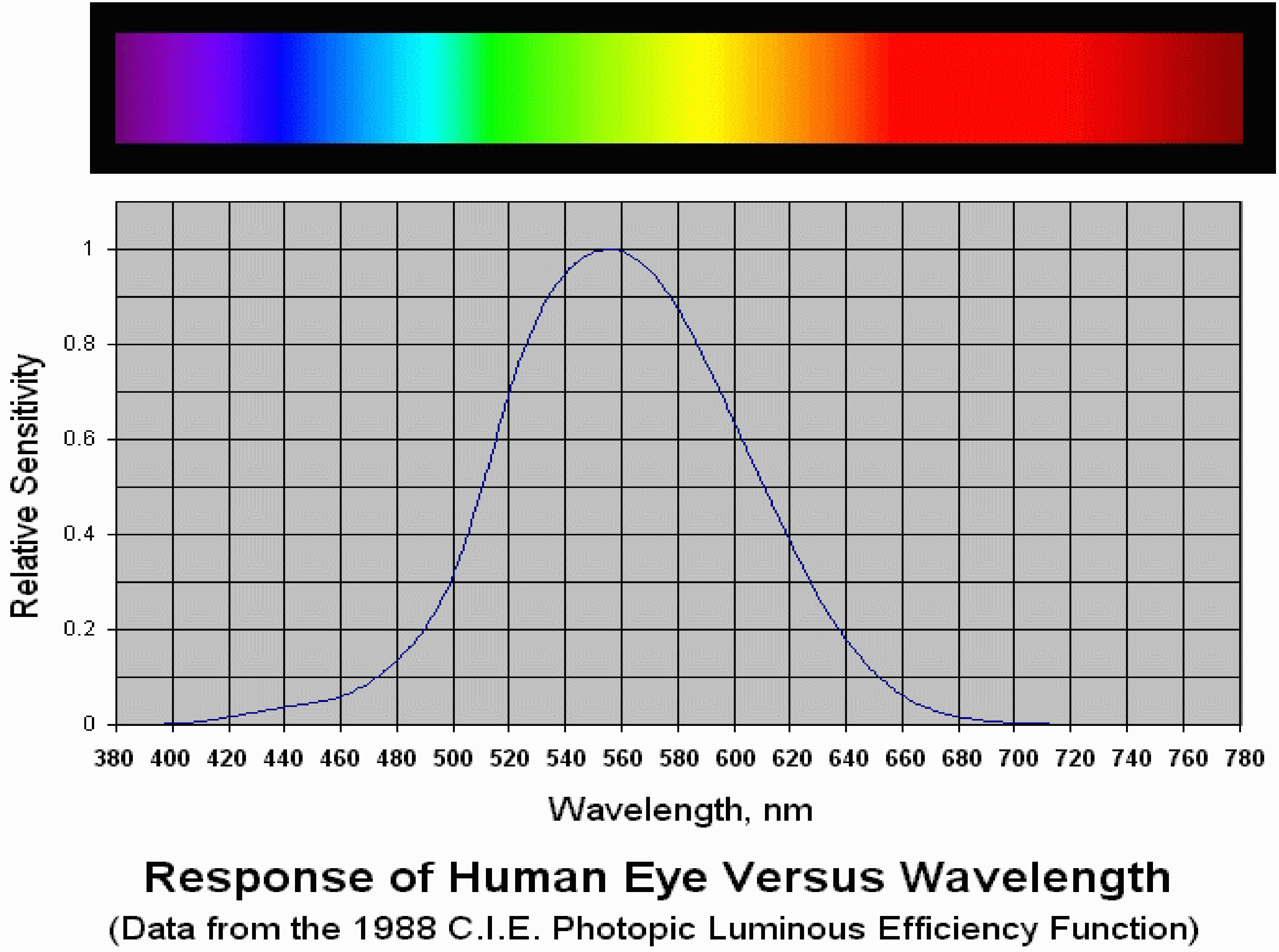


THE SENSORY PHYSIOLOGY



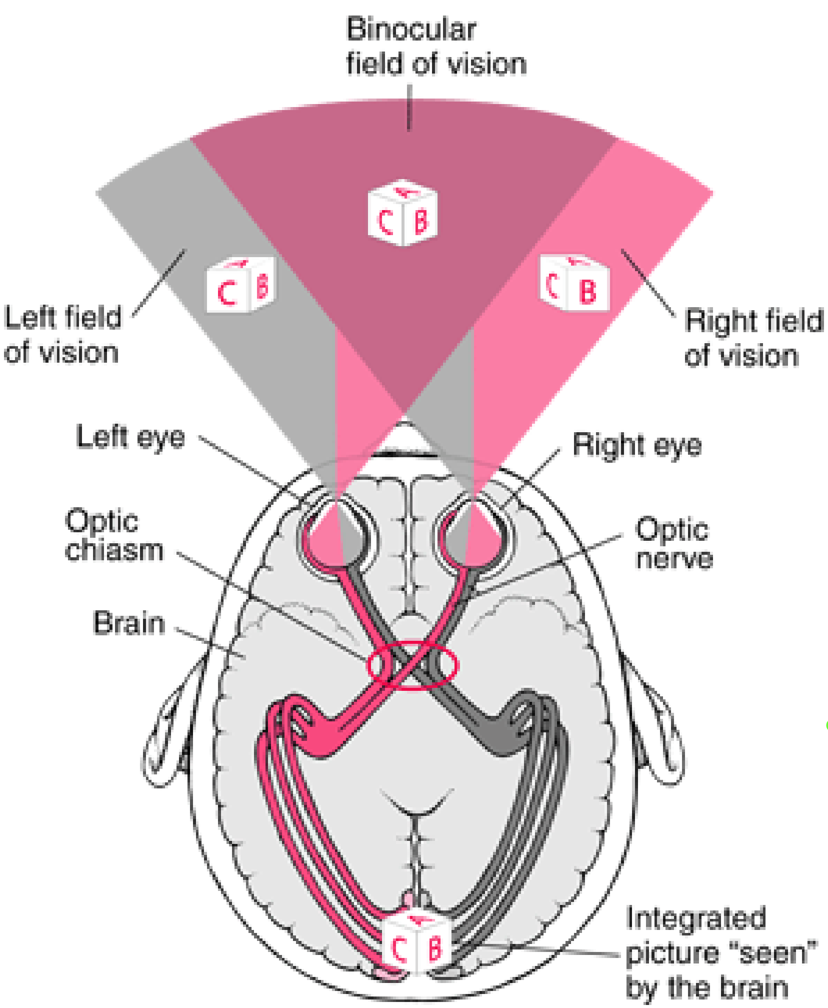


From:http://faculty.etsu.edu/currie/images/vision3.jpg



http://www.kellerstudio.de/repairfaq/sam/cie1988.gif

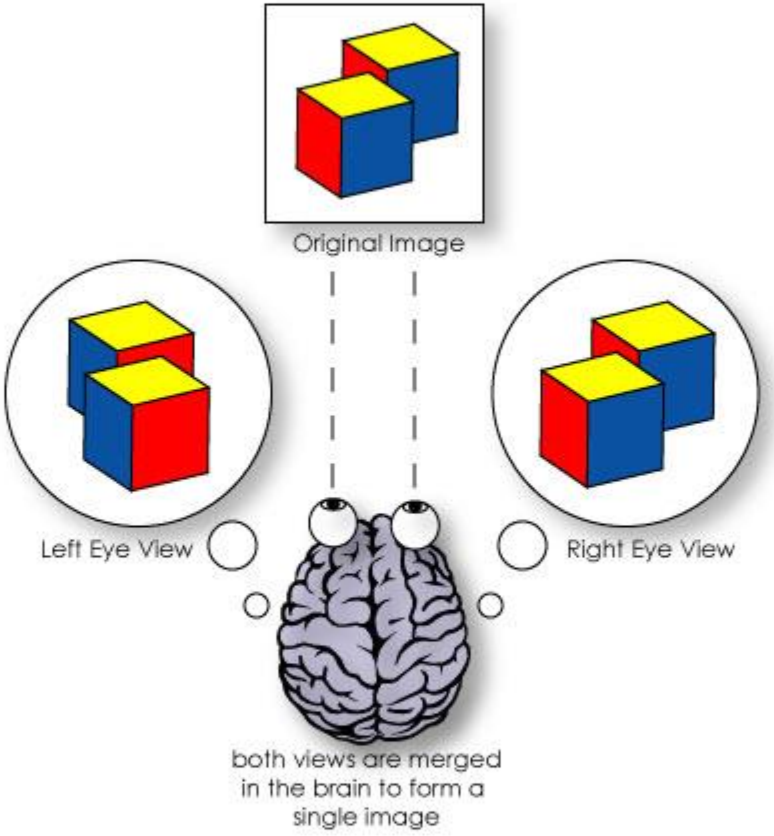
Biology of the Eyes



- Nerve signals travel from each eye along the corresponding optic nerve and other nerve fibers to the back of the brain, where vision is sensed and interpreted. The two optic nerves meet at the optic chiasm. There, the optic nerve from each eye divides, and half of the nerve fibers from each side cross to the other side and continue to the back of the brain. Thus, the both side (right &left) of the brain receives information through both optic nerves. The middle of these fields of vision overlaps. It is seen by both eyes (called binocular vision).
- An object is seen from slightly different angles by each eye so the information the brain receives from each eye is different, although it overlaps. The brain integrates the information to produce a complete picture.

FROM : www.merck.com/mmhe/print/sec20/ch224/ch224b.html

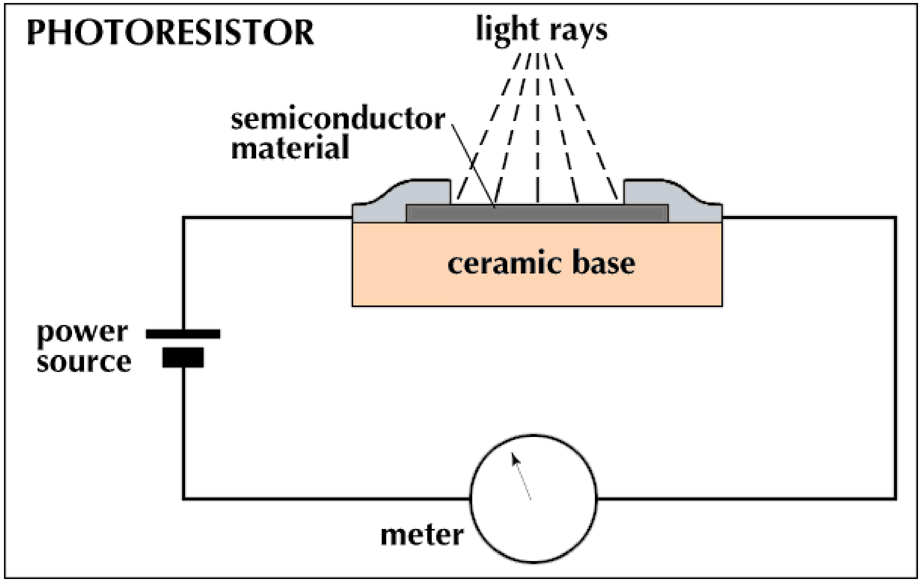
Why We Can See the Stereo TV?



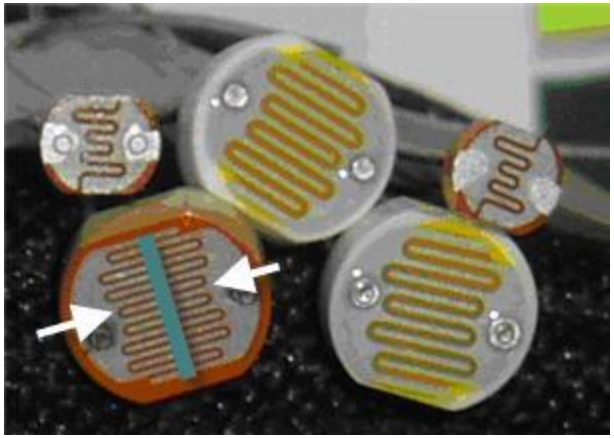
Coding and Signal Processing Technology

Disparity in stereo pair (3D) pictures

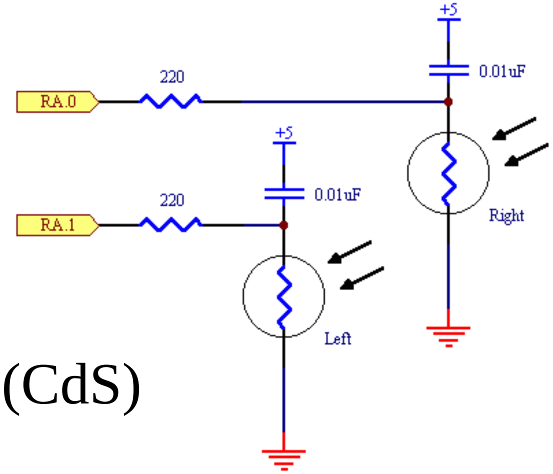
Photoconductive cells

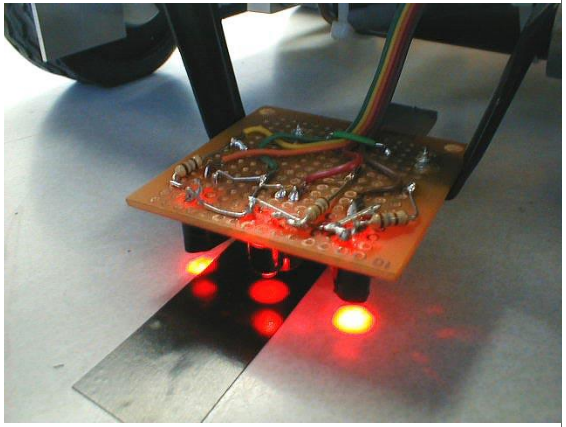


Photoresistors: a photosensitive crystalline materials such as cadmium Sulfide (CdS) or lead sulfide (PbS) is deposited on a ceramic substance.

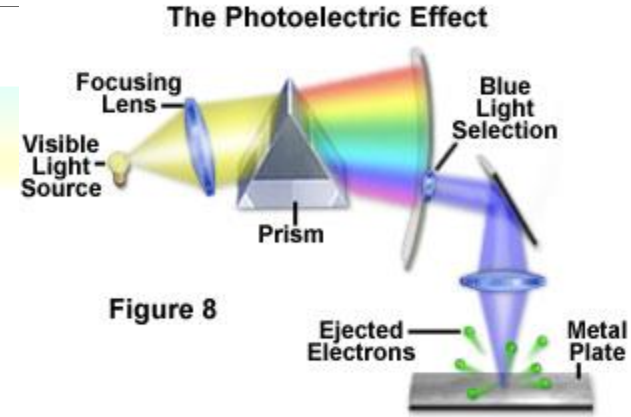


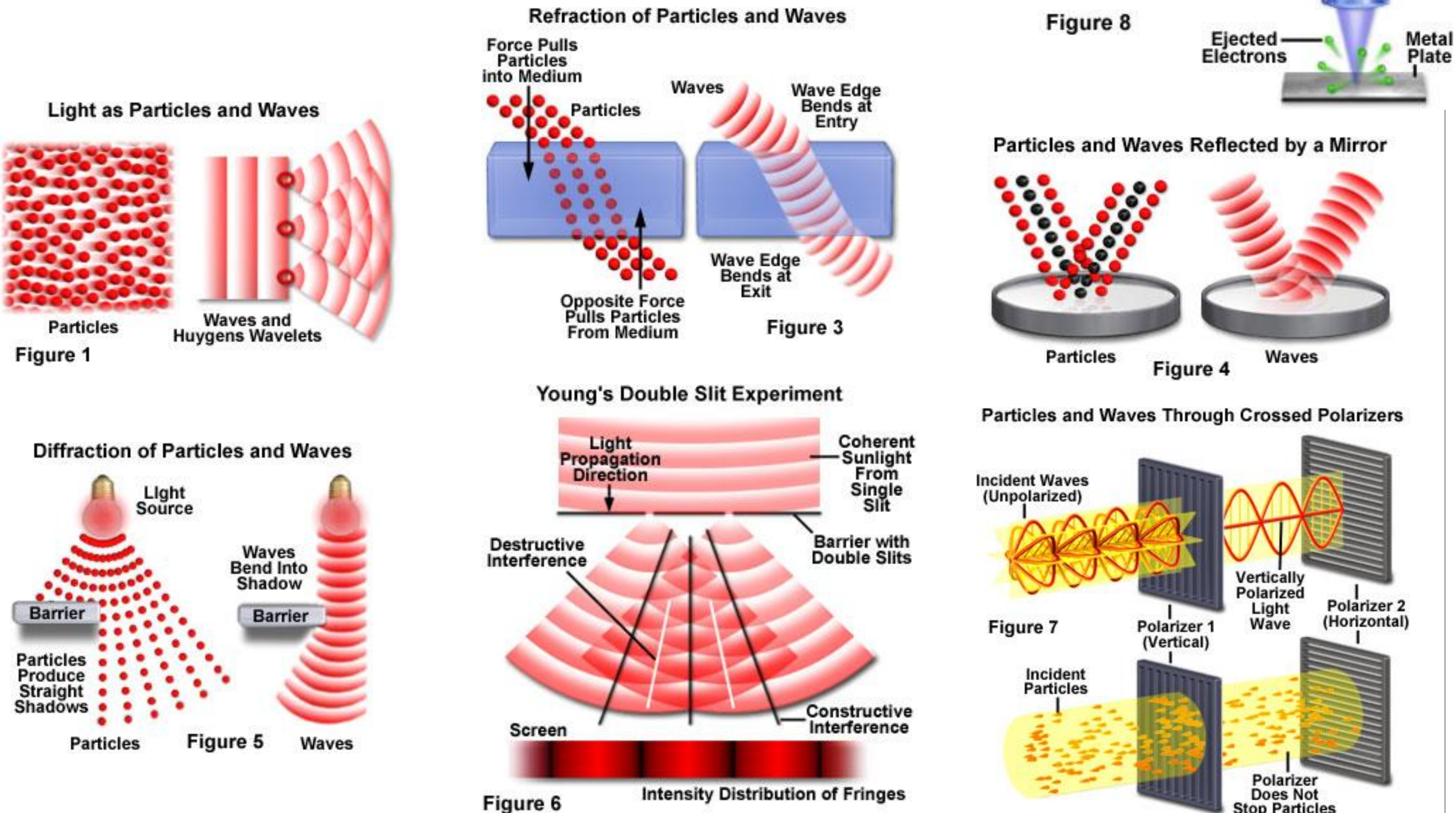
(CdS)





Dual Character of Light



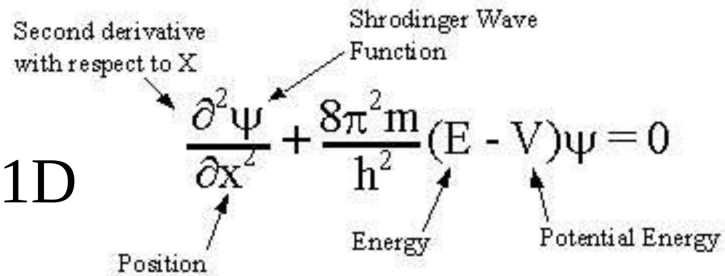


micro.magnet.fsu.edu/…/particleorwa

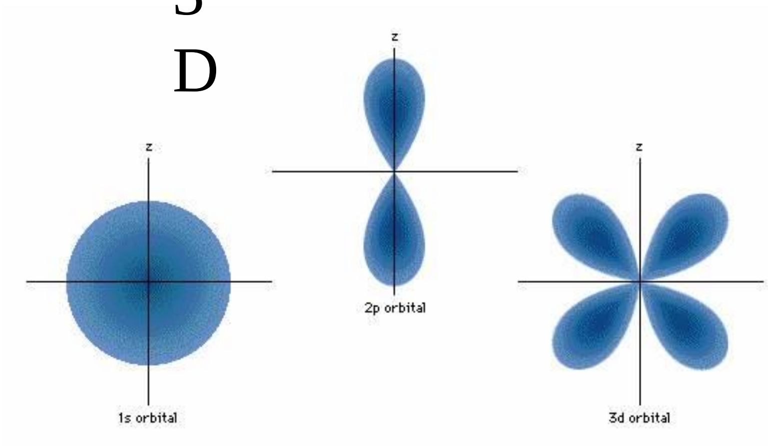
Nature of Matter

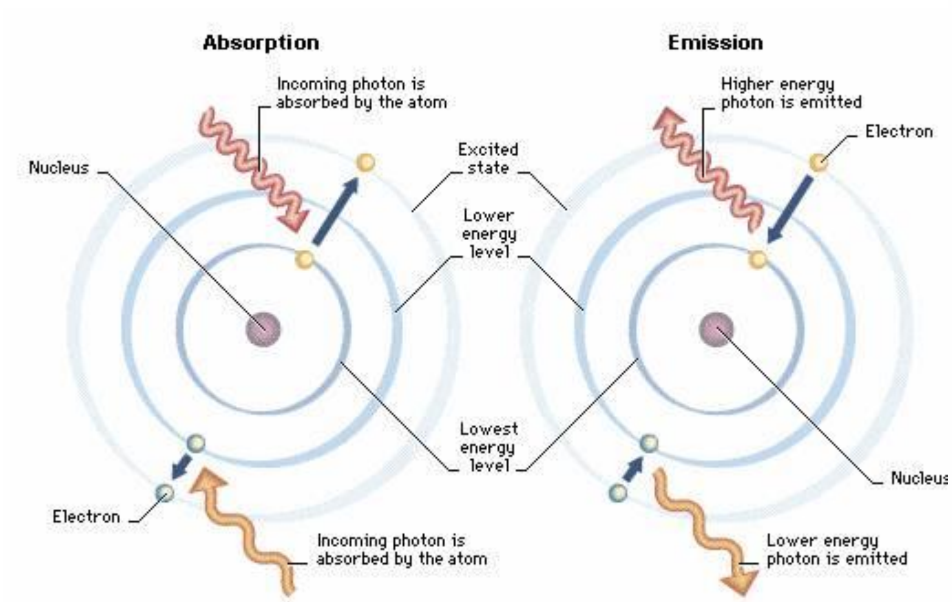
3
D

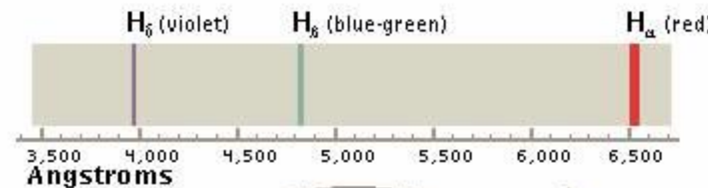
1D

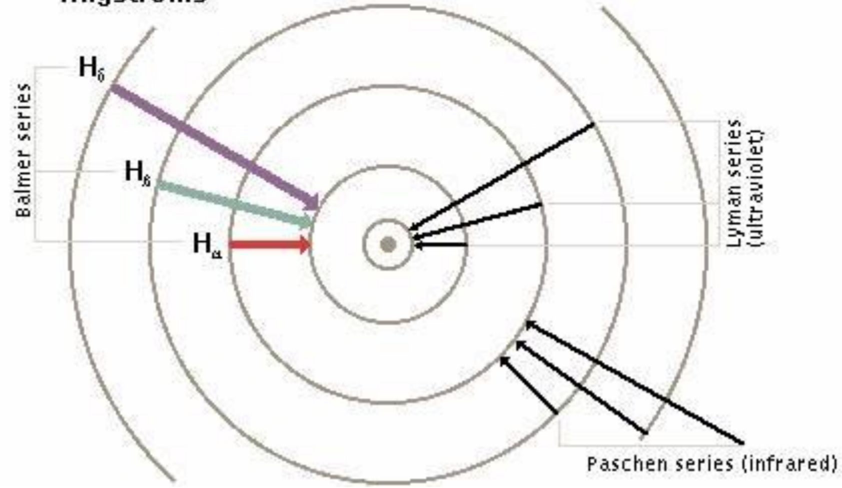


$$\frac{\partial^2\psi}{\partial x^2} + \frac{8\pi^2 m}{h^2}(E - V)\psi = 0$$



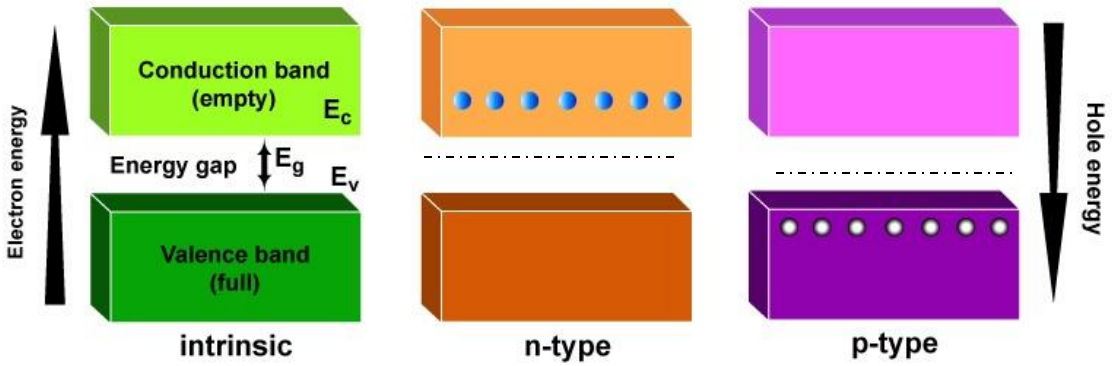






Types of Semiconductors

1. **Intrinsic**
2. **n-type**
3. **p-type**



- Types 2 and 3 are semiconductors that conduct electricity - How?
  - by alloying semiconductor with an impurity, also known as **doping**
  - carriers placed in conduction band or carriers removed from valence band.

Note: Color Protocol

APPLICATIONS OF LED

-

ILLUMINATION

LED Magazine

SIGNS & DISPLAYS

TRAFFIC SIGNALS

Philips Lumileds' Luxeon LED chips, which incorporate a flip-chip design, already illuminate architectural attraction such as the Clifton Suspension Bridge in Bristol, UK, completed in 1864. The addition of the thin-film technology to Lux products will take the performance to a new level and help to initiate penetration into the residential-lighting market.

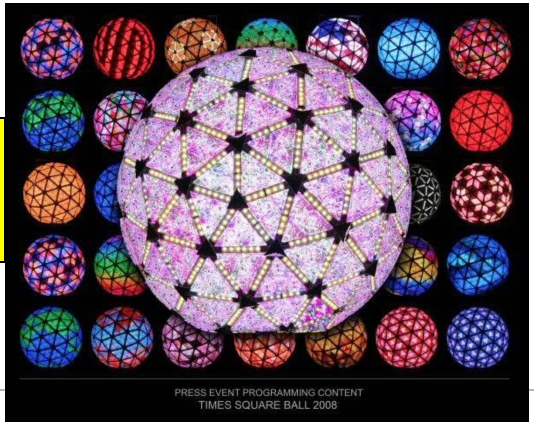
AUTOMOTIVE

Hella web site

MOBILE

LCD BACKLIGHT

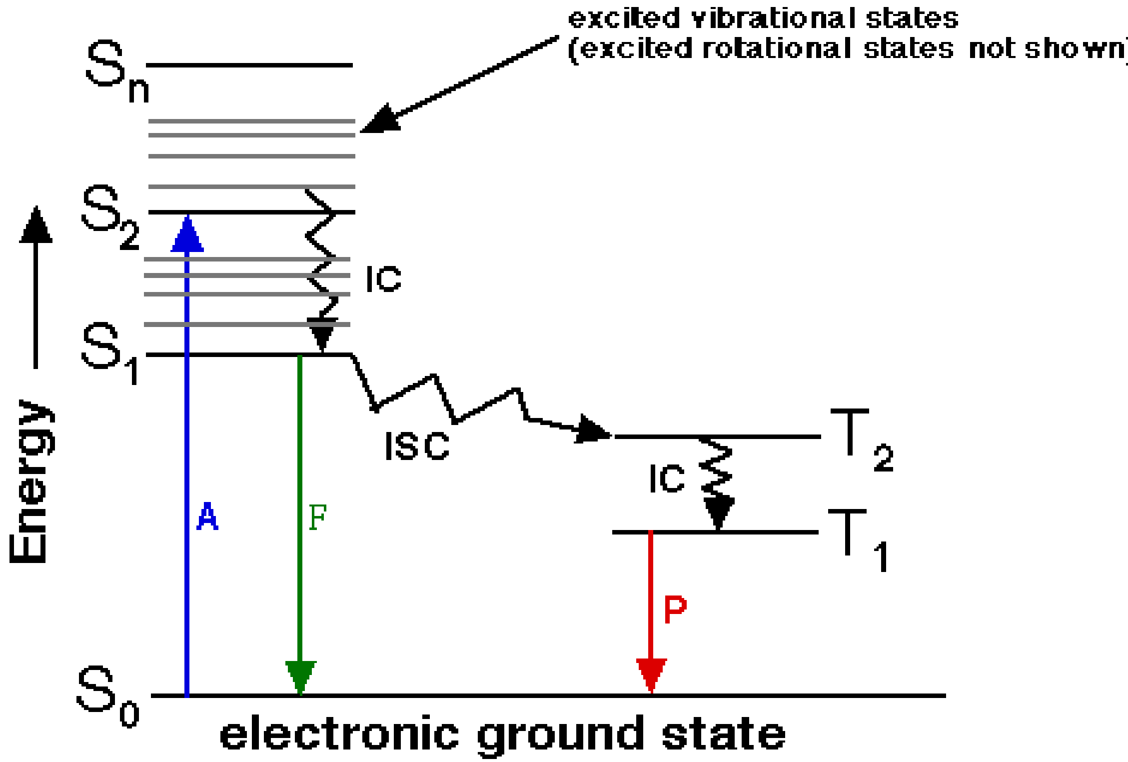
OTHERS



From : OLT 2008 GLG SEMINAR

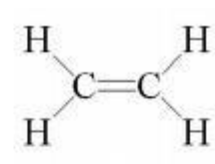
Fluorescence Principle

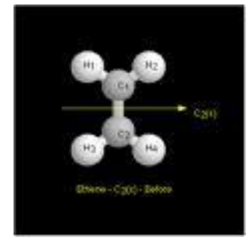
- A-photon absorption
- F-fluorescence (emission)
- P-phosphorescence
- S-singlet state
- T-triplet state
- IC-internal conversion
- ISC-intersystem crossing

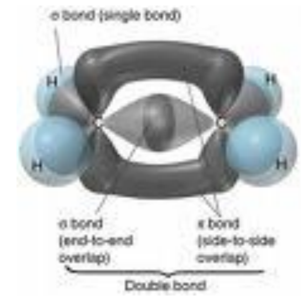


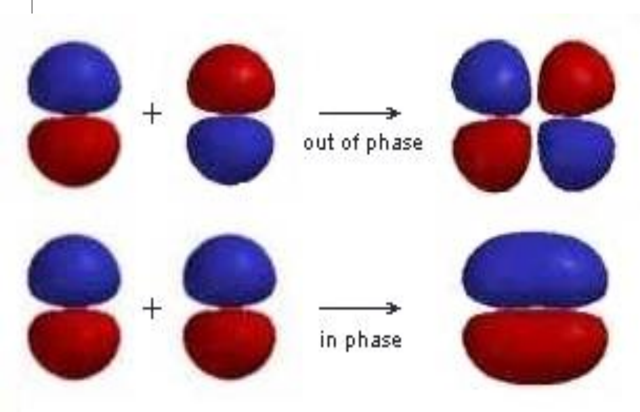
Molecular Orbital (MO)

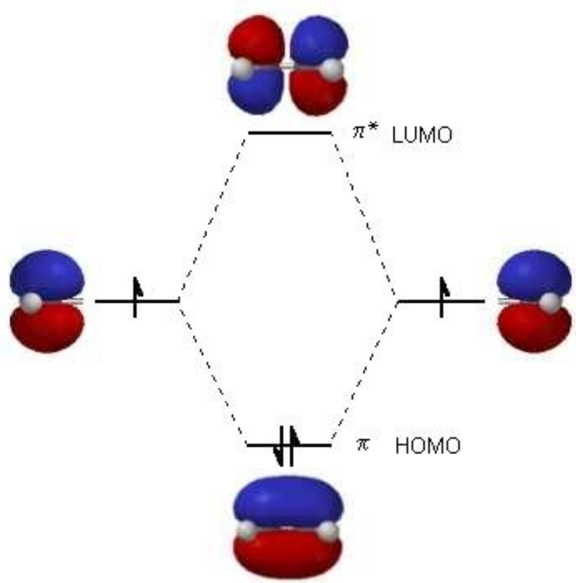
π Molecular Orbitals of Ethene

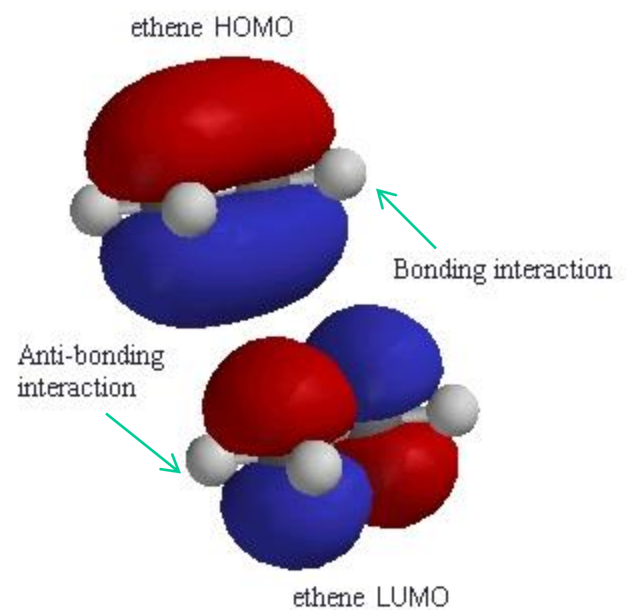












Partition of Molecular Schrodinger equation

Electronic and nuclear motion

Fast electronic motions

Quantized electronic energies

Wave function and quantized energy states

Slow nuclear motions

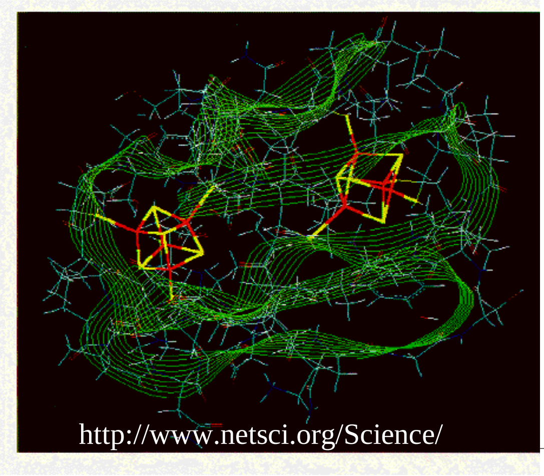
External motions
Center mass movement

Internal motions
Nuclei movement

Transitional Energies
not quantized

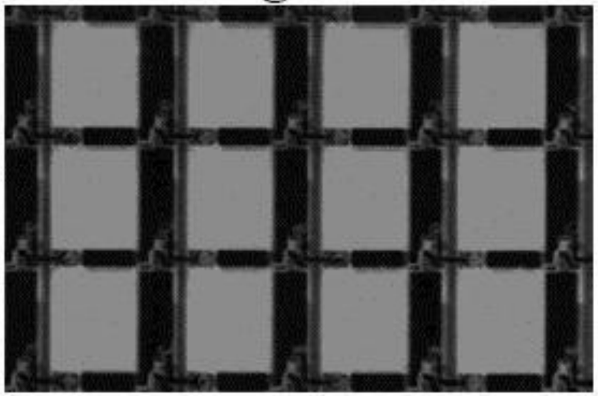
Vibration
Quantized vibration states

Rotation
Quantized vibration states

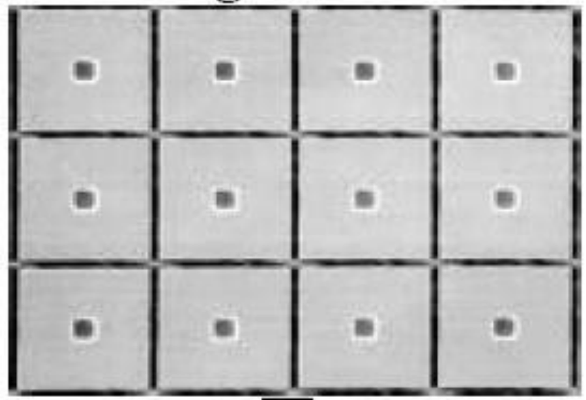


THE COMPLETE DIGITAL SOLUTION

Analog LCD

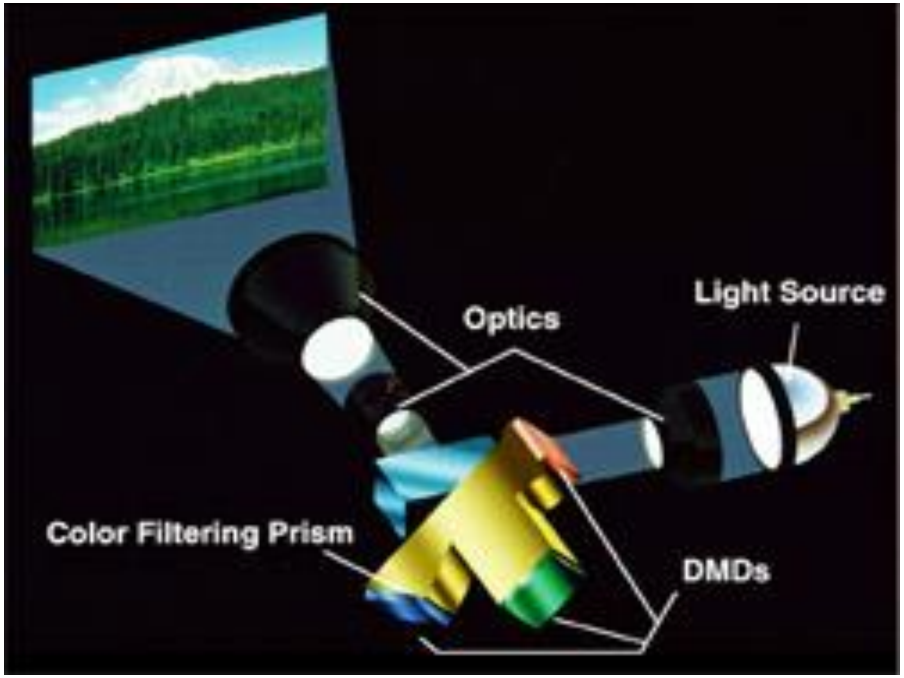


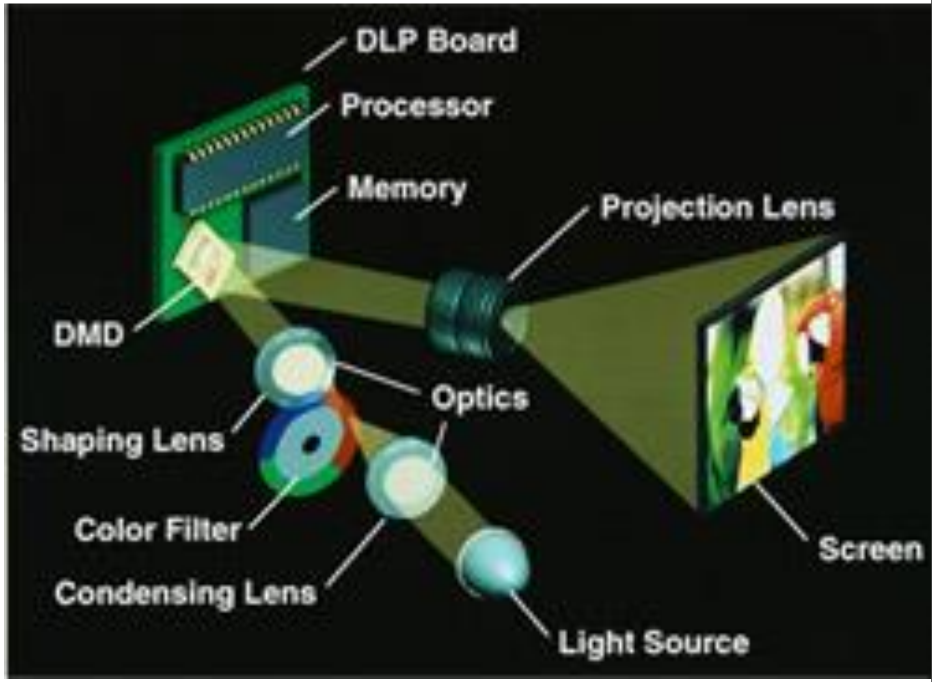
Digital DLP™



See the Digital Difference!

DMD = TWO Major Architectures



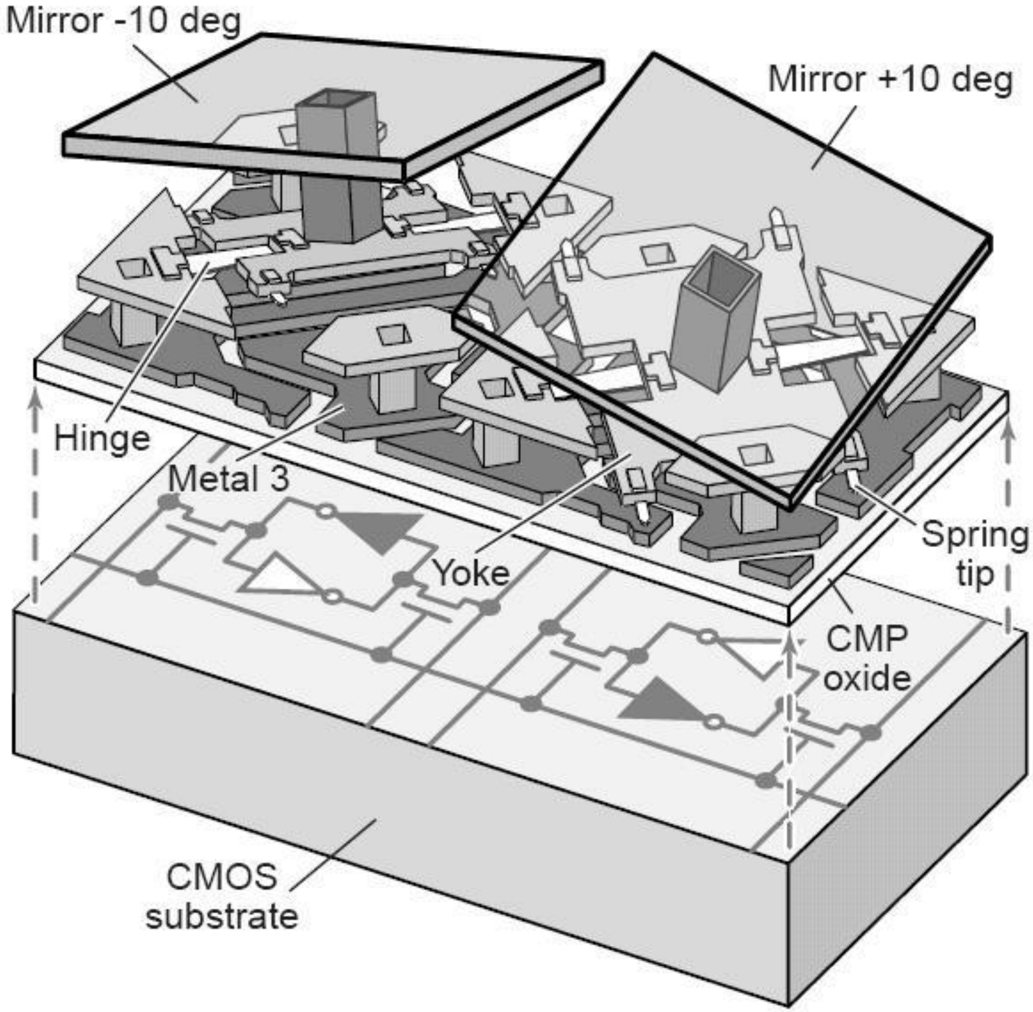


3 DMD

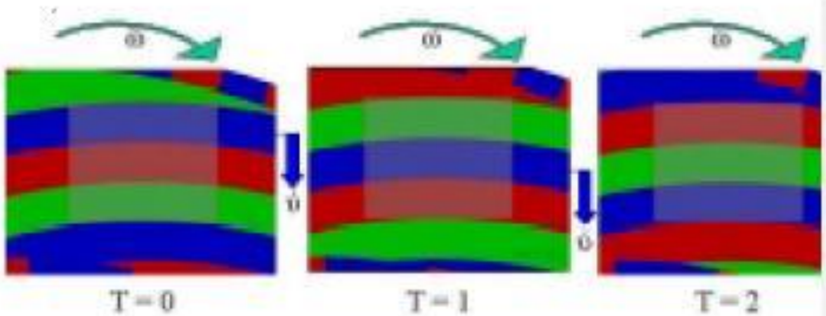
1 DMD

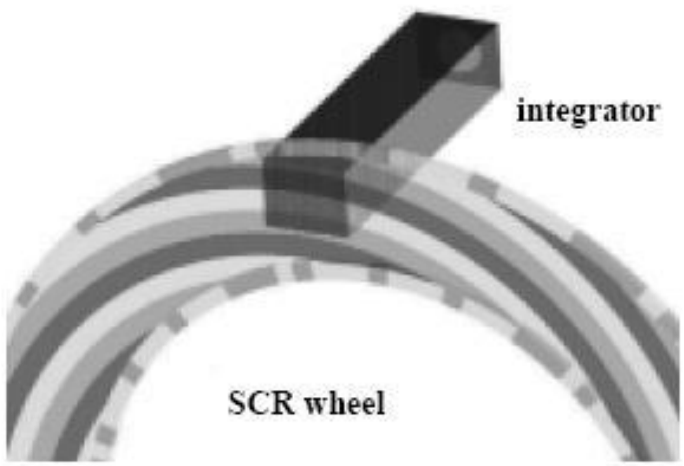
Two DMD pixels

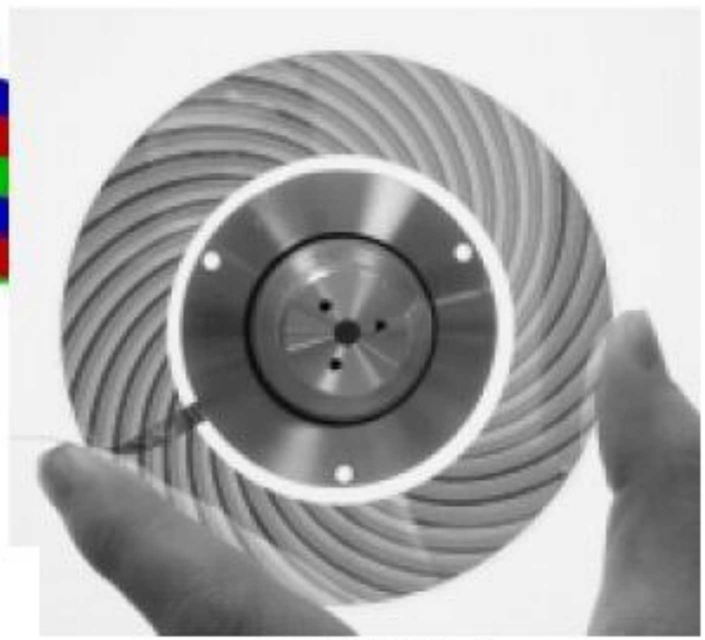
(mirrors shown as transparent).



DMD SCR (Sequential Color Recapture) Wheel







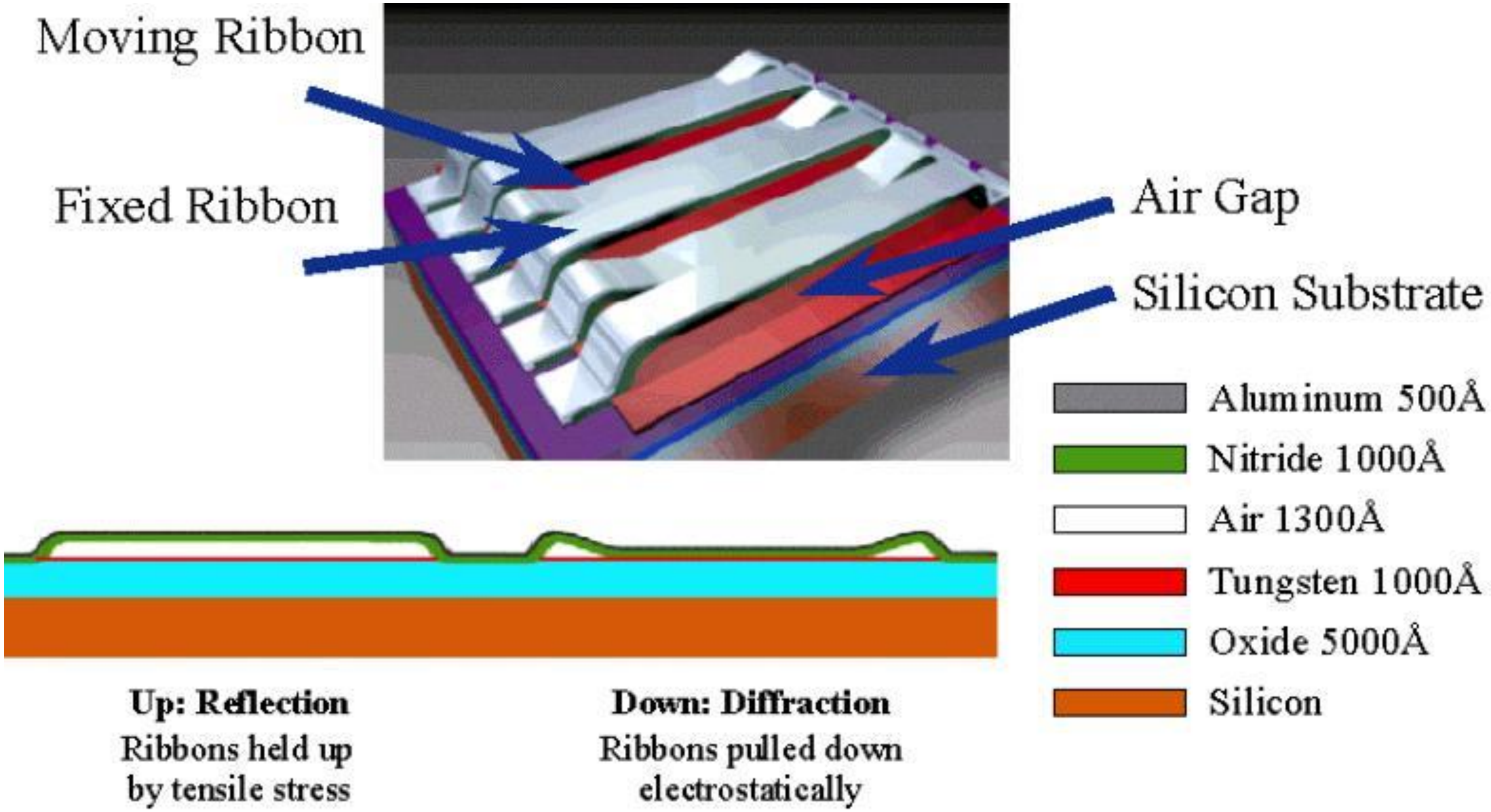
SCR Wheel

Grating Light Valve ™ Display

Multi-chip module consisting of four custom driver dies and a 1,080 element linear GLV array.

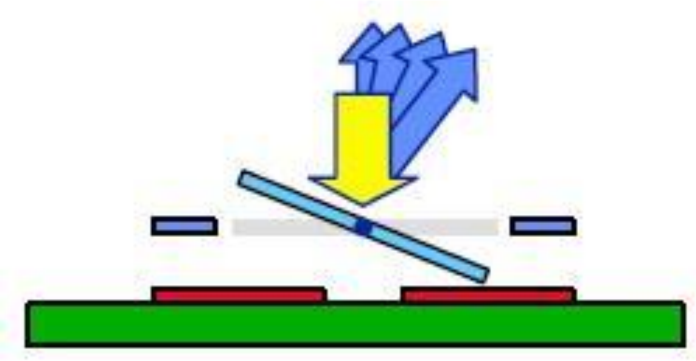
An HDTV–resolution projector utilizing three GLV device optical attenuator modules

Grating Light Valve TM

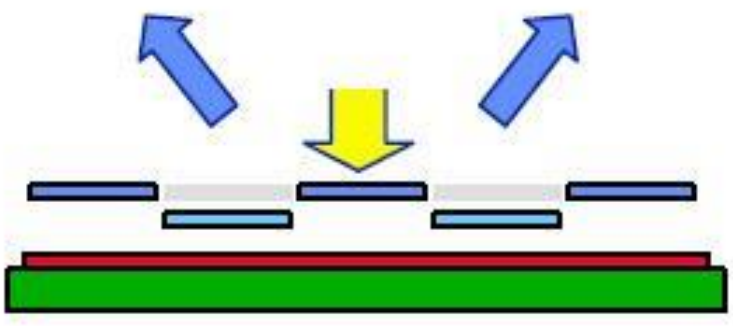


Principle

- GLV devices are unique in that they operate as mirrors in the “OFF” state, and as diffraction gratings in the “ON” state — with the application of control voltages.

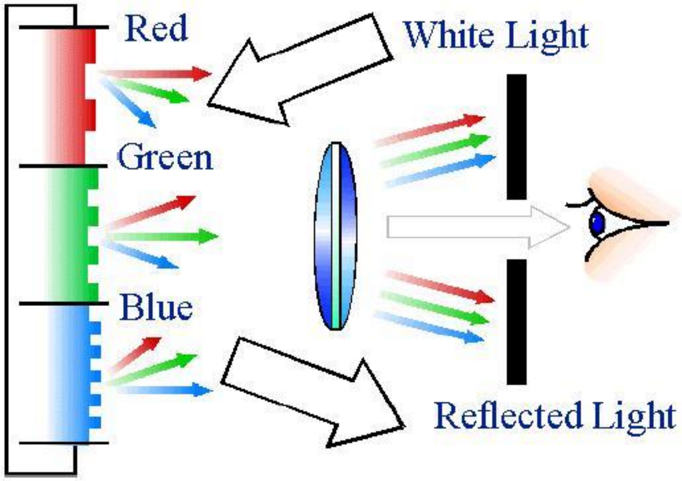


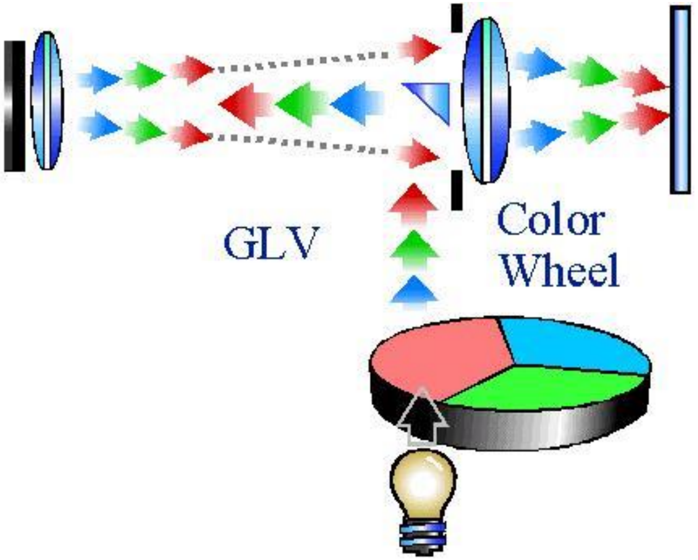
Tilting Mirror Optical MEMS

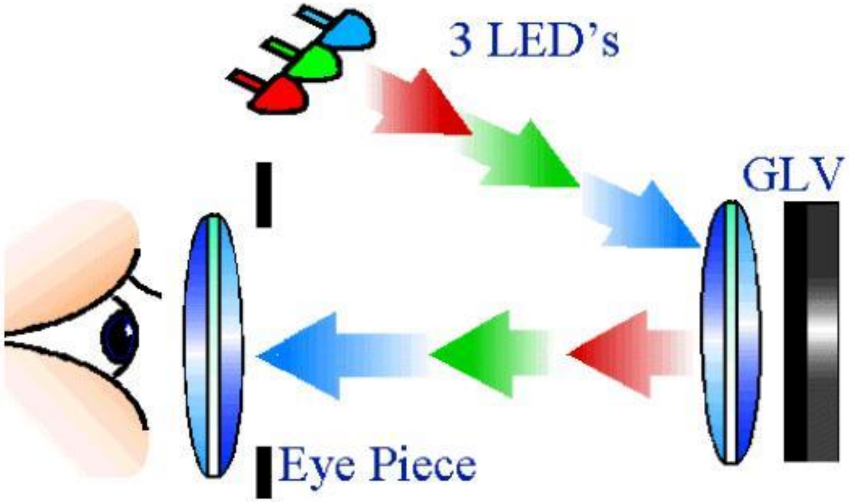


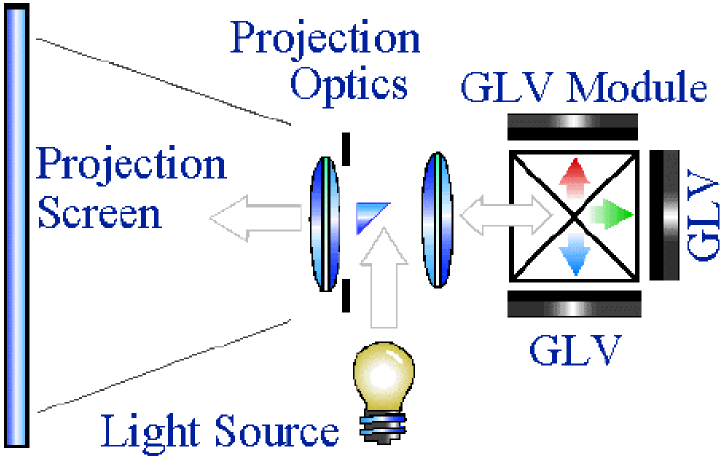
GLV Diffraction Grating MEMS

Colorization

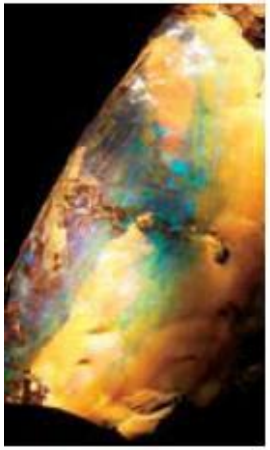






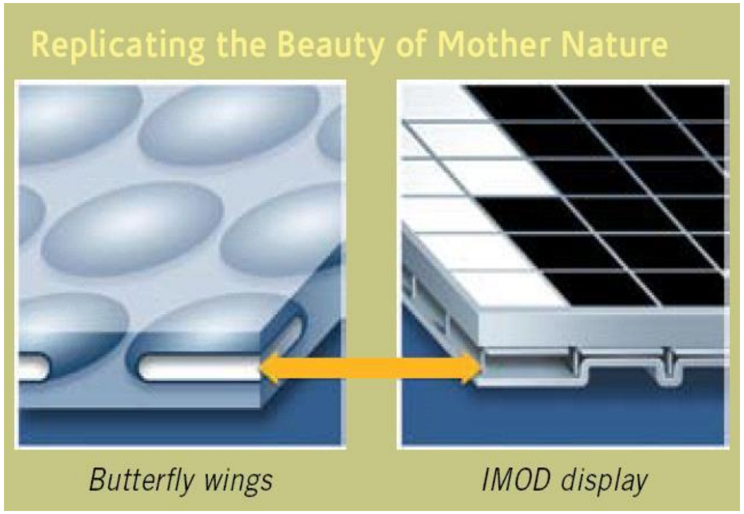


Inspired by Nature

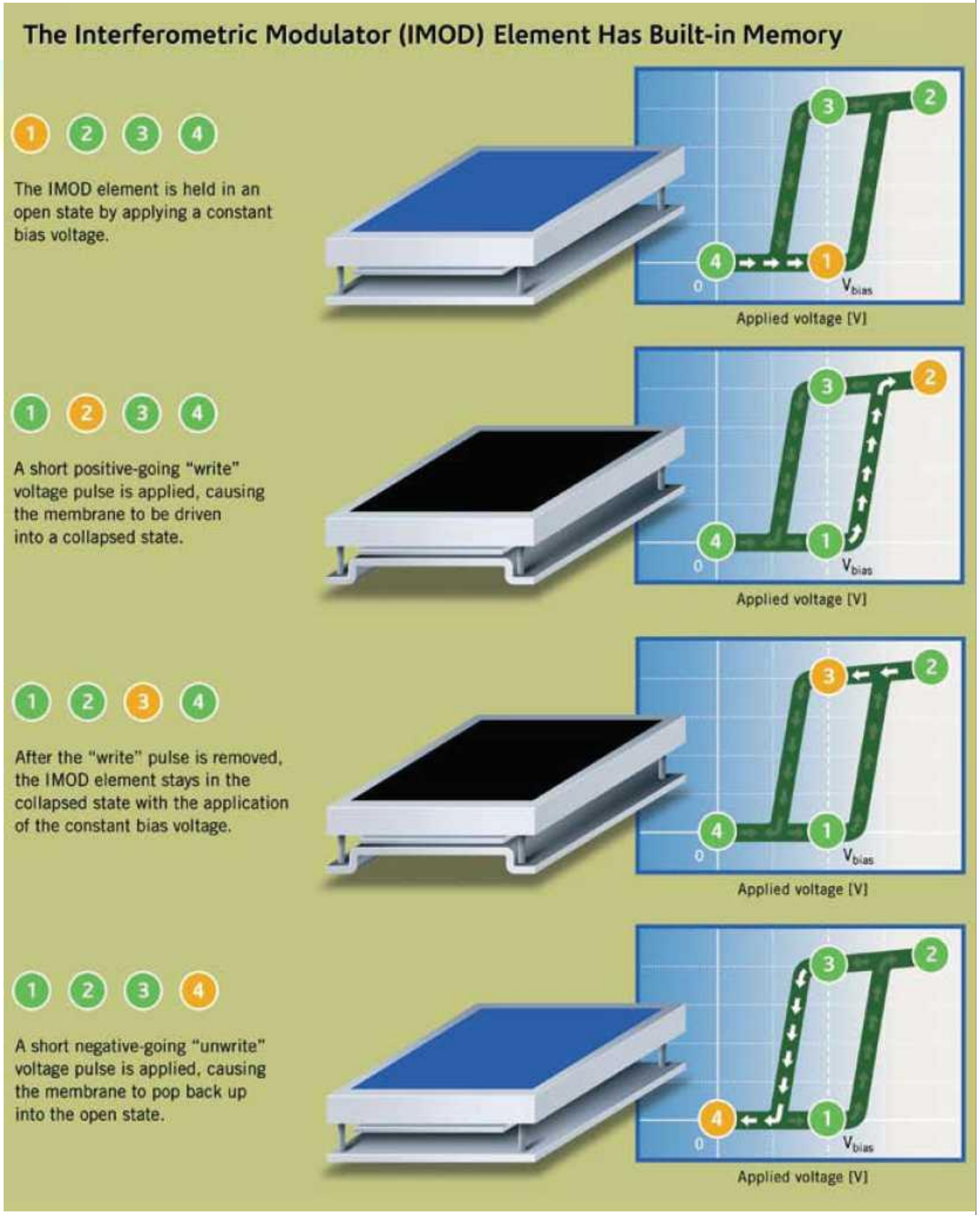


Revolutionary Display Technology—Inspired by Nature

Principle



Replicating the Beauty of Mother Nature
Butterfly wings
IMOD display



The Interferometric Modulator (IMOD) Element Has Built-in Memory
1 2 3 4
The IMOD element is held in an open state by applying a constant bias voltage.
A short positive-going "write" voltage pulse is applied, causing the membrane to be driven into a collapsed state.
After the "write" pulse is removed, the IMOD element stays in the collapsed state with the application of the constant bias voltage.
A short negative-going "unwrite" voltage pulse is applied, causing the membrane to pop back up into the open state.
0
Vbias
Applied voltage [V]

Marketing Strength

No other display technology can match QUALCOMM's clear, crisp display performance. Users get the most out of their mobile devices throughout the day—without annoying "blackouts."

- Even in intense early-morning sunlight, sports monitor displays are easily viewable during a daily workout.
- Running errands is easier when text messages and directions can be easily viewed—inside or outside of the car.
- PDAs and MP3 displays are more useful when information can be accessed and viewed anywhere—indoors or out, enhancing enjoyment and usability.
- Even when relaxing at the park or beach, users can keep connected with easy access to messages and information.

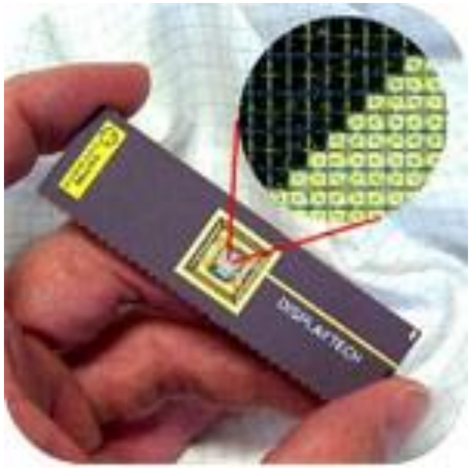
- •Resolution
- •Readability under Sunlight

Liquid Crystal on Silicon (LOCS) displays

History of LCOS

1973–1983: Direct-view Display

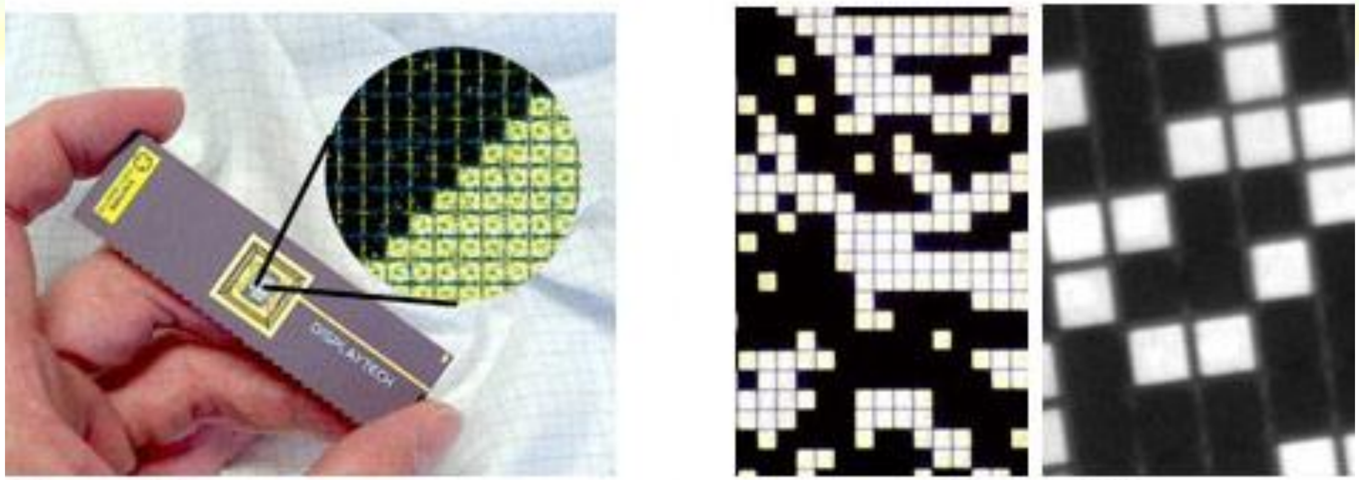
1973 Hughes Aircraft: the first LCOS device
1980 Toshiba: direct-view television screen
1981 Seiko Epson: textured diffuser mirrors
1981 Std. Telecomm: 40 × 40 dichroic
1983 Toshiba: 480 × 480 with planarized mirror

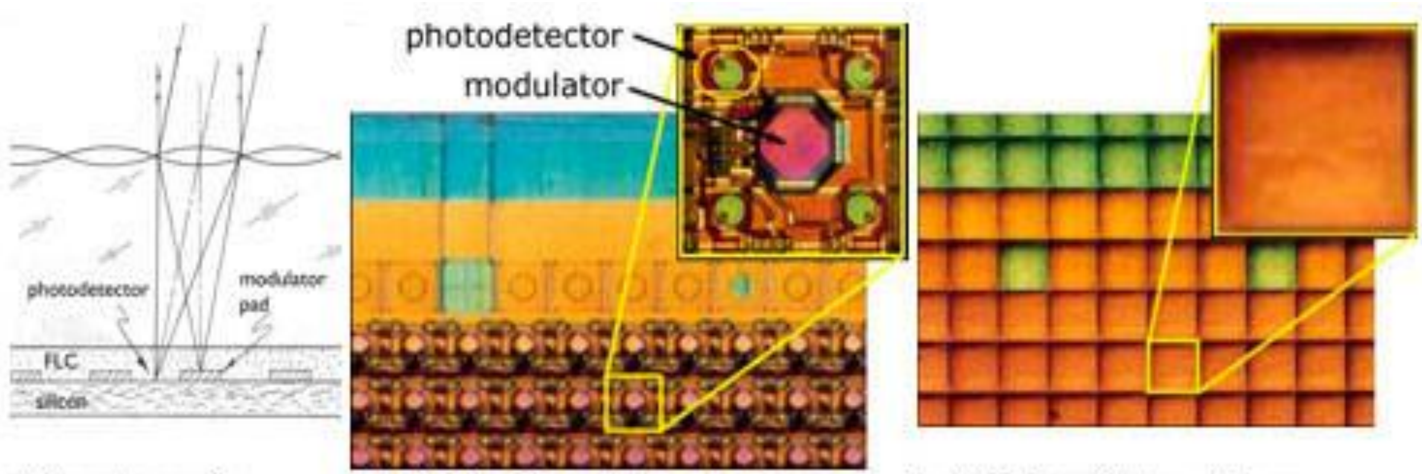


1983–1998: Spatial Light Modulators

1983 Hughes: silicon liquid-crystal light valve
1989 Displaytech: 1st foundry silicon & FLC
1994 Displaytech: CMP
1995 Displaytech: SLM with lenslet

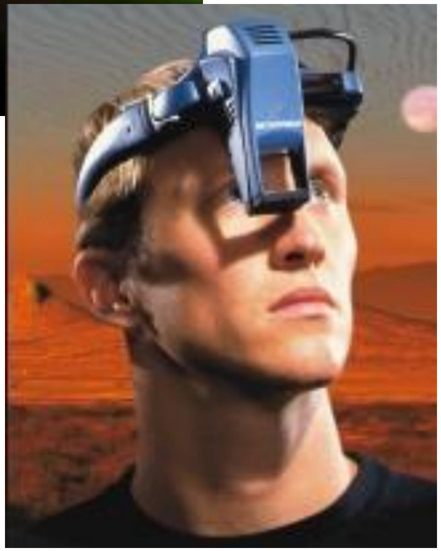
LOCS





(a) schematic (b) SLM without lenslets. (c) SLM with lenslets.

Micro-Vision
Scanning Display



OLED=BENDABLE

SID 2007

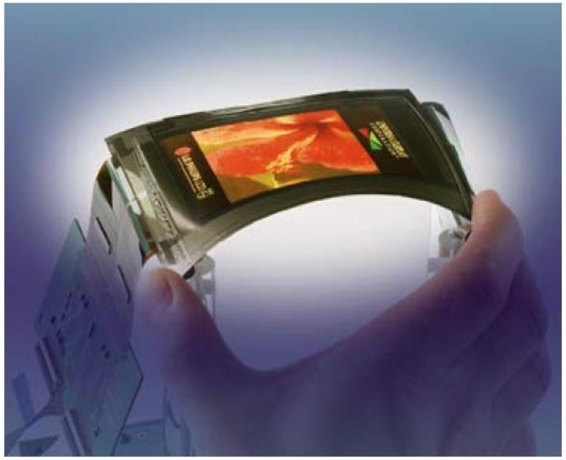
AM, p-Si, RGB, QVGA

Substrate: metal foil

AM Backplane: LGPhilips

OLED: UDC

Barix encapsulation: Vitex



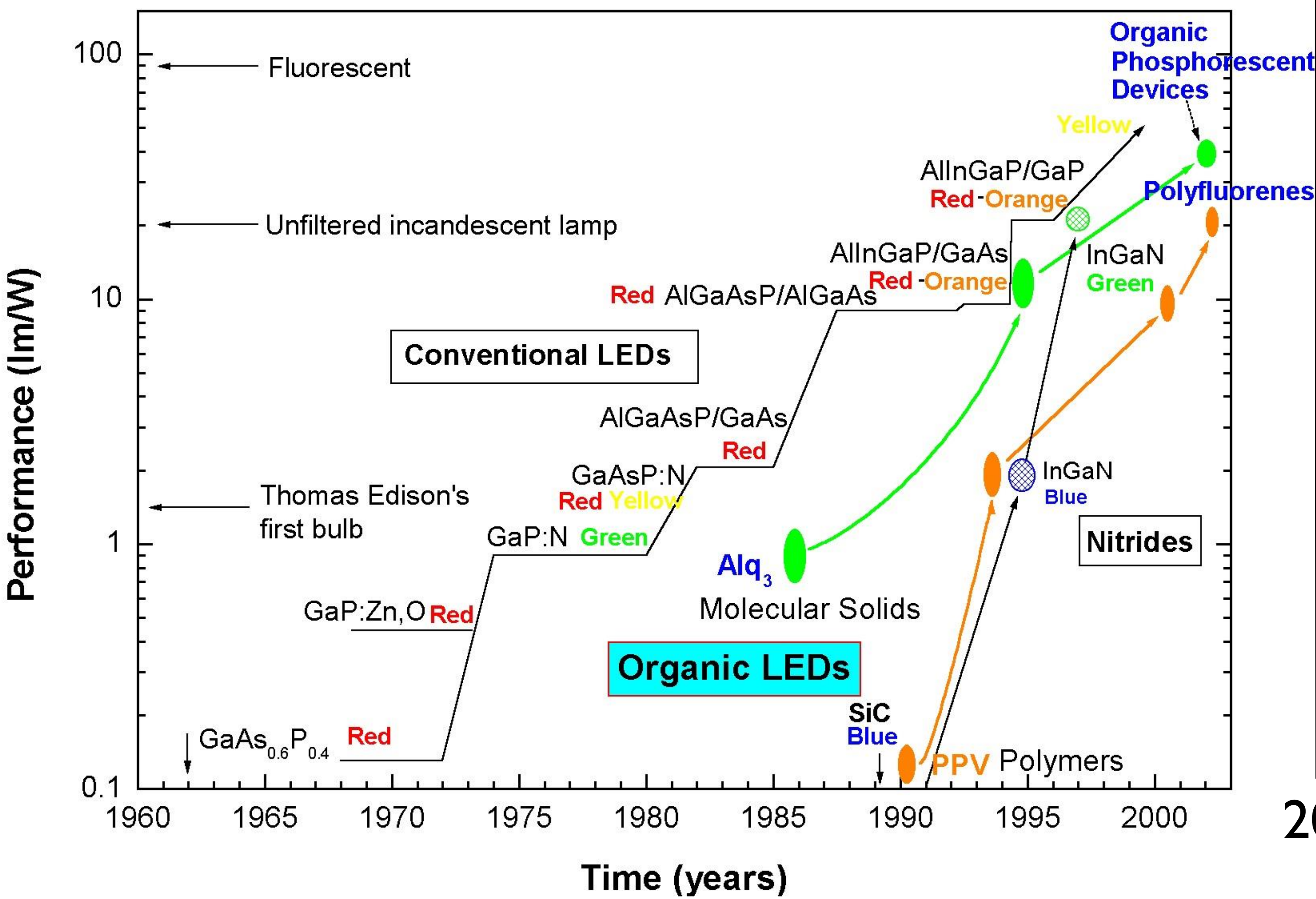
Robert Jan Visser:SID-Display Applications Conference 2007

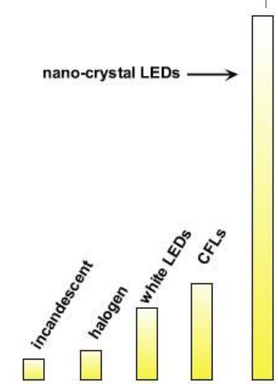
Sony 2007

OLED vs. LED

2008 LED: 242 lm/W

2008 OLED GREEN :133 lm/w.





2012

from Science 273, 884

OLEDs: Displays You Can Print

- Manufactured in small molecule (SM-OLED) and dispersed polymer (P-OLED) designs
- Both are low-voltage semiconductors that emit light when current flows through an organic film layer
- Poised to take over the handheld display market

Photo courtesy Cambridge Display Technologies

OLEDs: Displays You Can Print

- Yes, OLEDs are very, VERY thin! (< 5mm for film layer)
- Samsung 40-inch active matrix OLED shown at SID
- Polymer-based colors are developed with Dupont
- Issues remain with white balance and motion image sharpness


BACKDRAF
COMING SOON


Children
made to order
1-888-4-BEST-DNA
GATTACA
(800) 242-2343


JOCKEY
abc NEWS
SAVE ME A SEAT
God

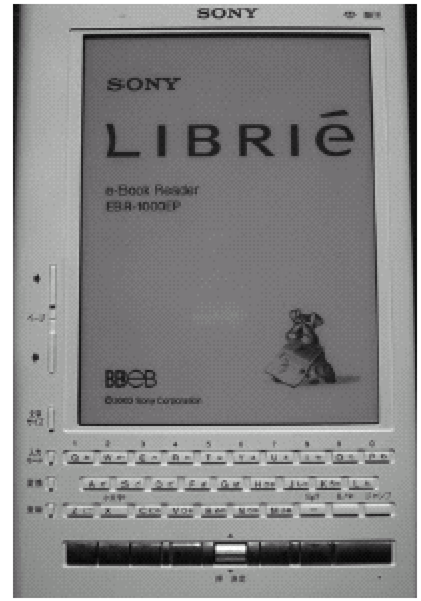

MARLINS

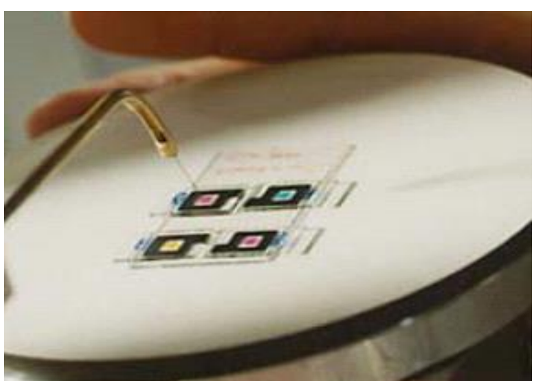

REVLON

Recent Advances in Electronic Ink

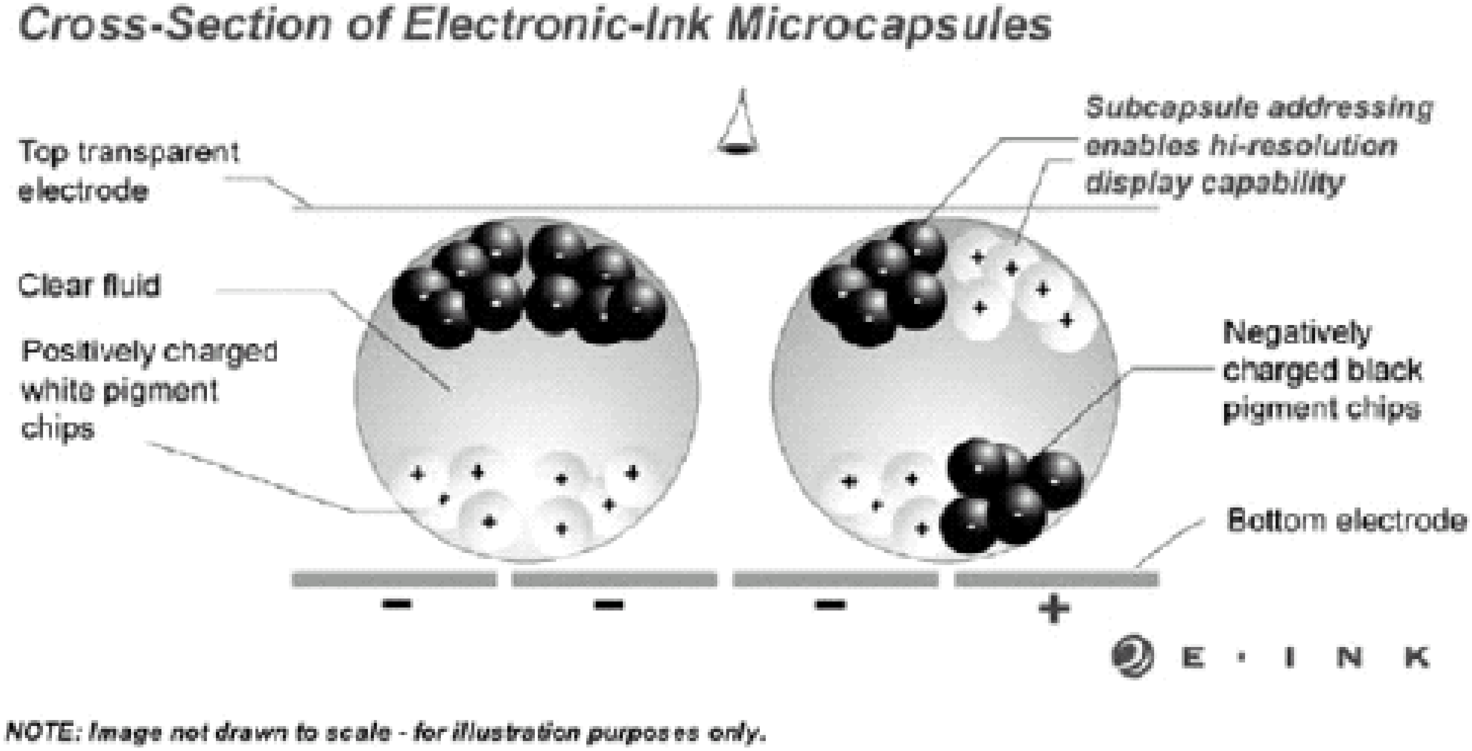
Guniea Pig: This Digital Book by E Ink and Philips is the first major product to use electronic ink. It's slated to begin mass production in 2004.

The ol' RGB: This prototype was the first high resolution color electronic ink display. It combines E Ink's electronic ink technology with a color filter array from Toppan, and Philips' active matrix backplane.

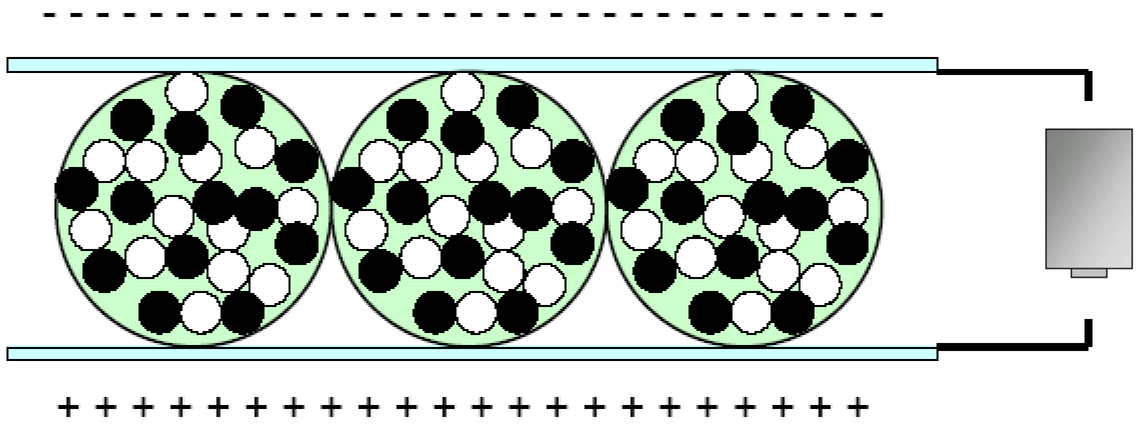




E-ink Principle



Electro-Phoretic Displays Principle

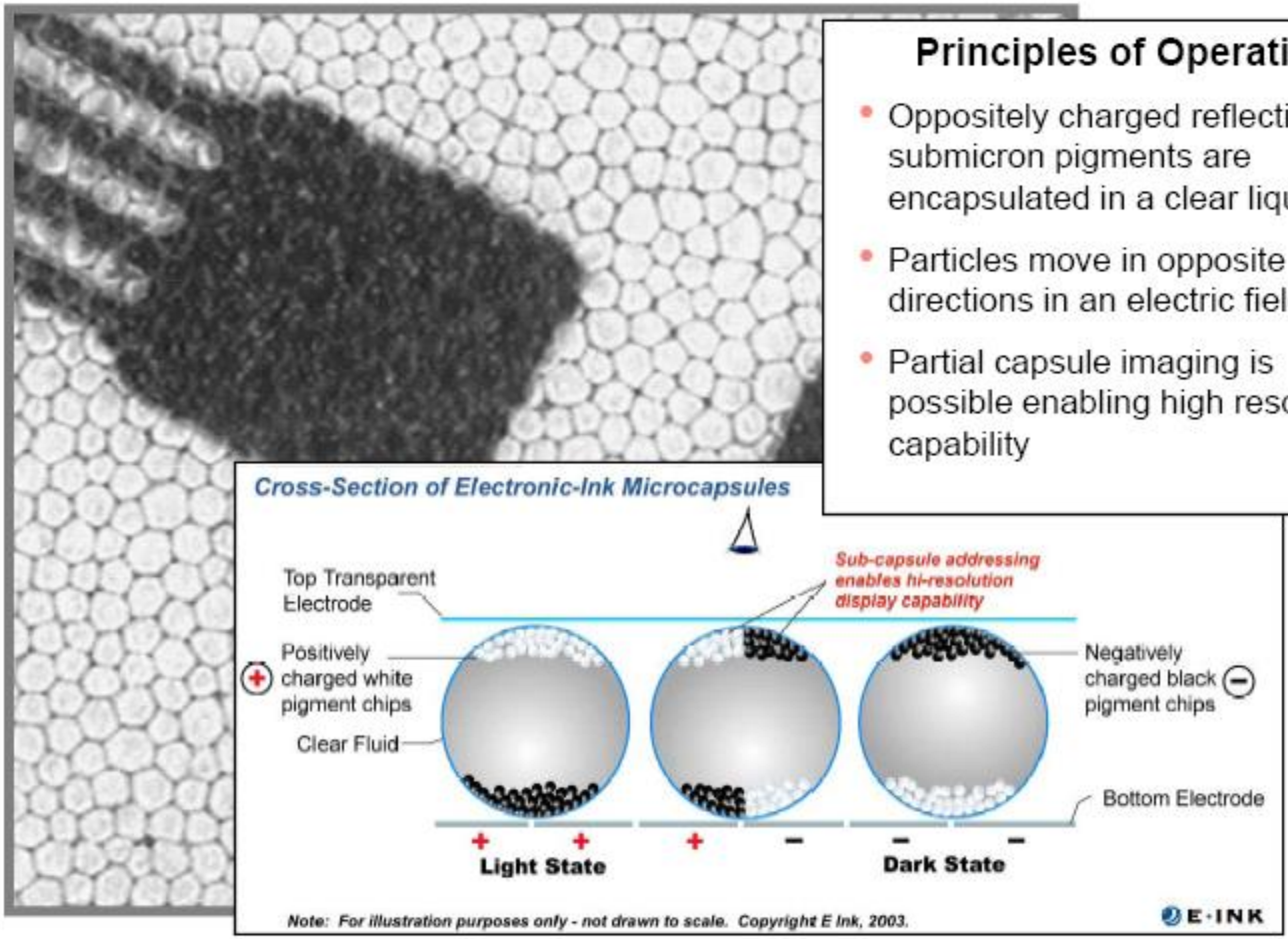


- Black and white particles are contained in micro capsules.
- Black particles are attracted to + electrode; white particles to -.
- Attracted particles remain in place even when electrodes return to neutral.

E-Ink

Electrophoretic Display Media

E·INK

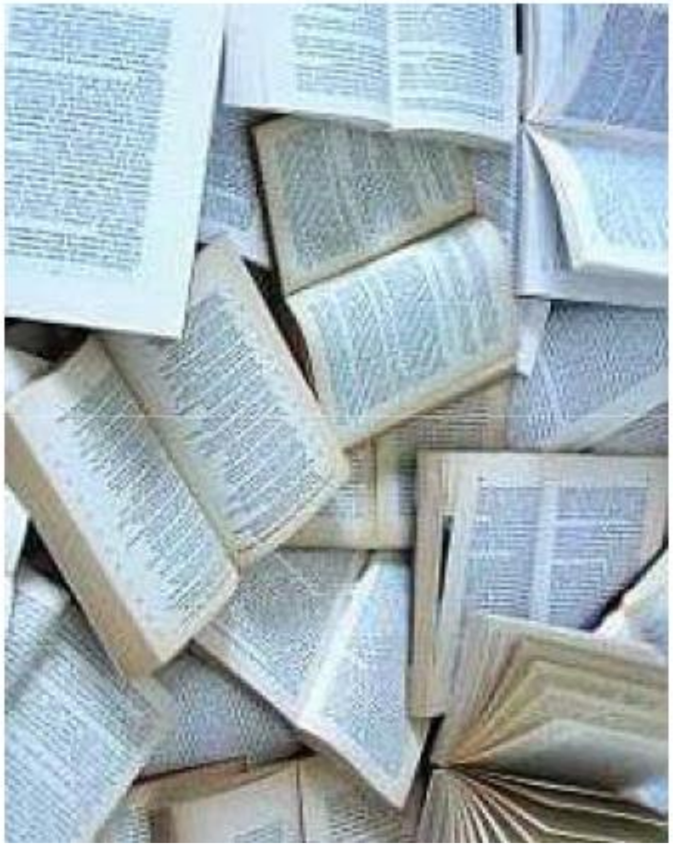


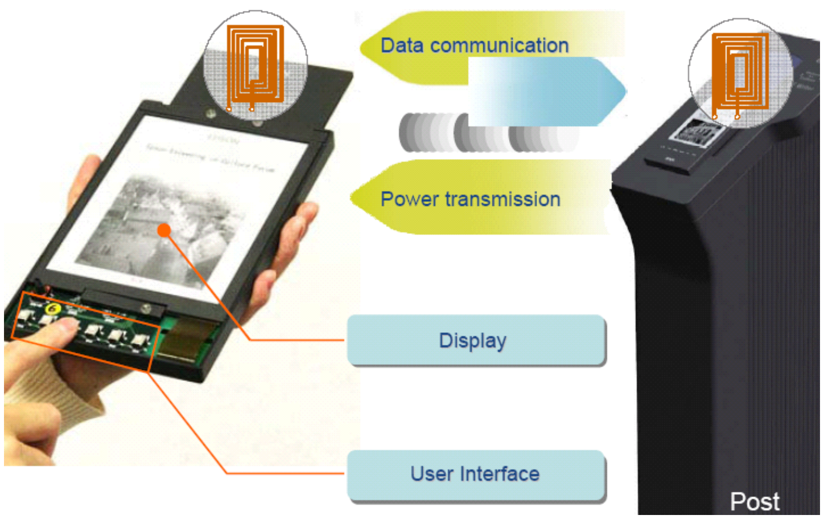
Principles of Operation

- Oppositely charged reflective submicron pigments are encapsulated in a clear liquid
- Particles move in opposite directions in an electric field
- Partial capsule imaging is possible enabling high resolution capability

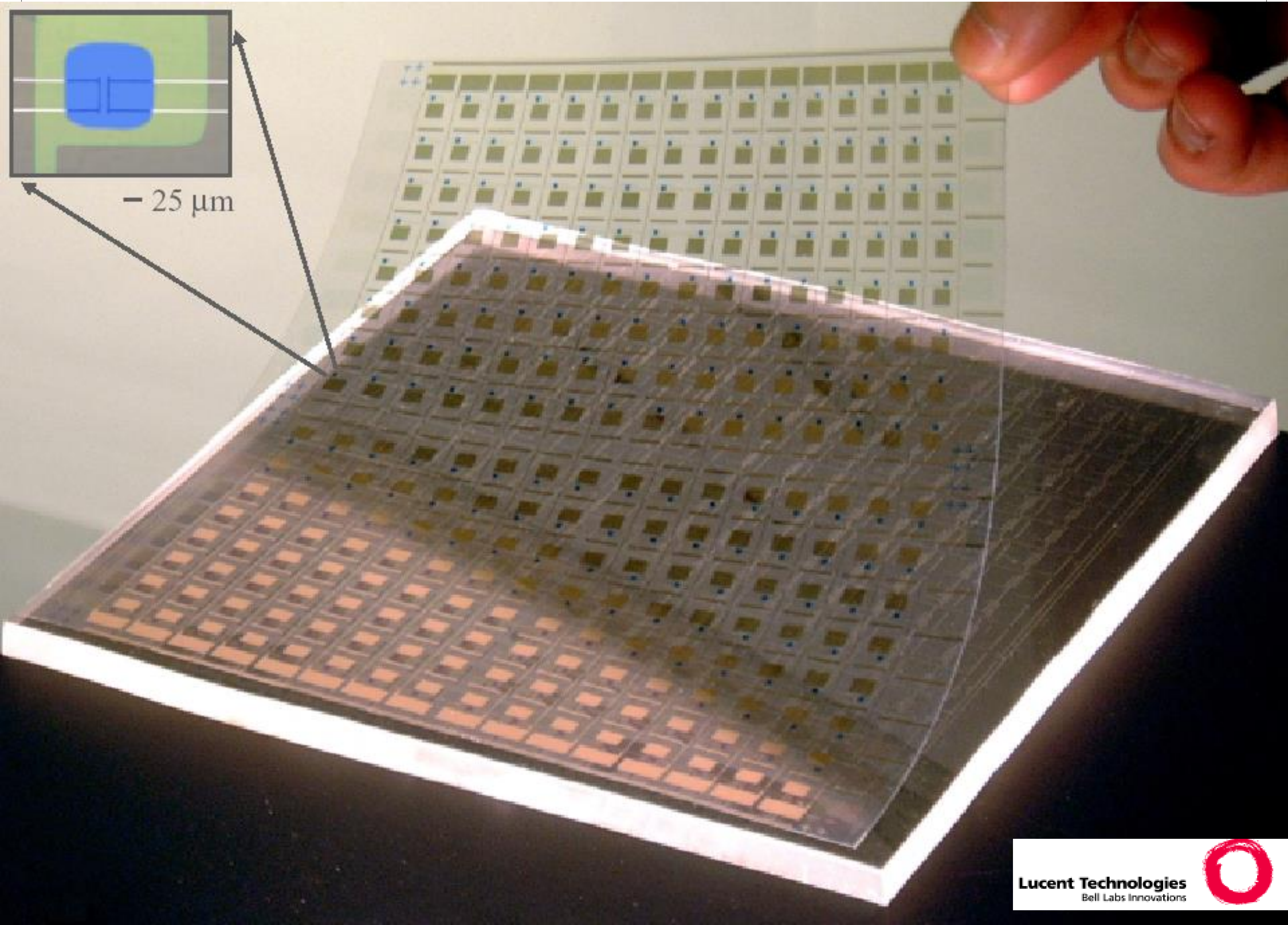
A staff of Citizen Watch presents a digital clock that is as thin as a piece of paper and fully flexible in Tokyo on Dec 15, 2005.

E-PAPER!



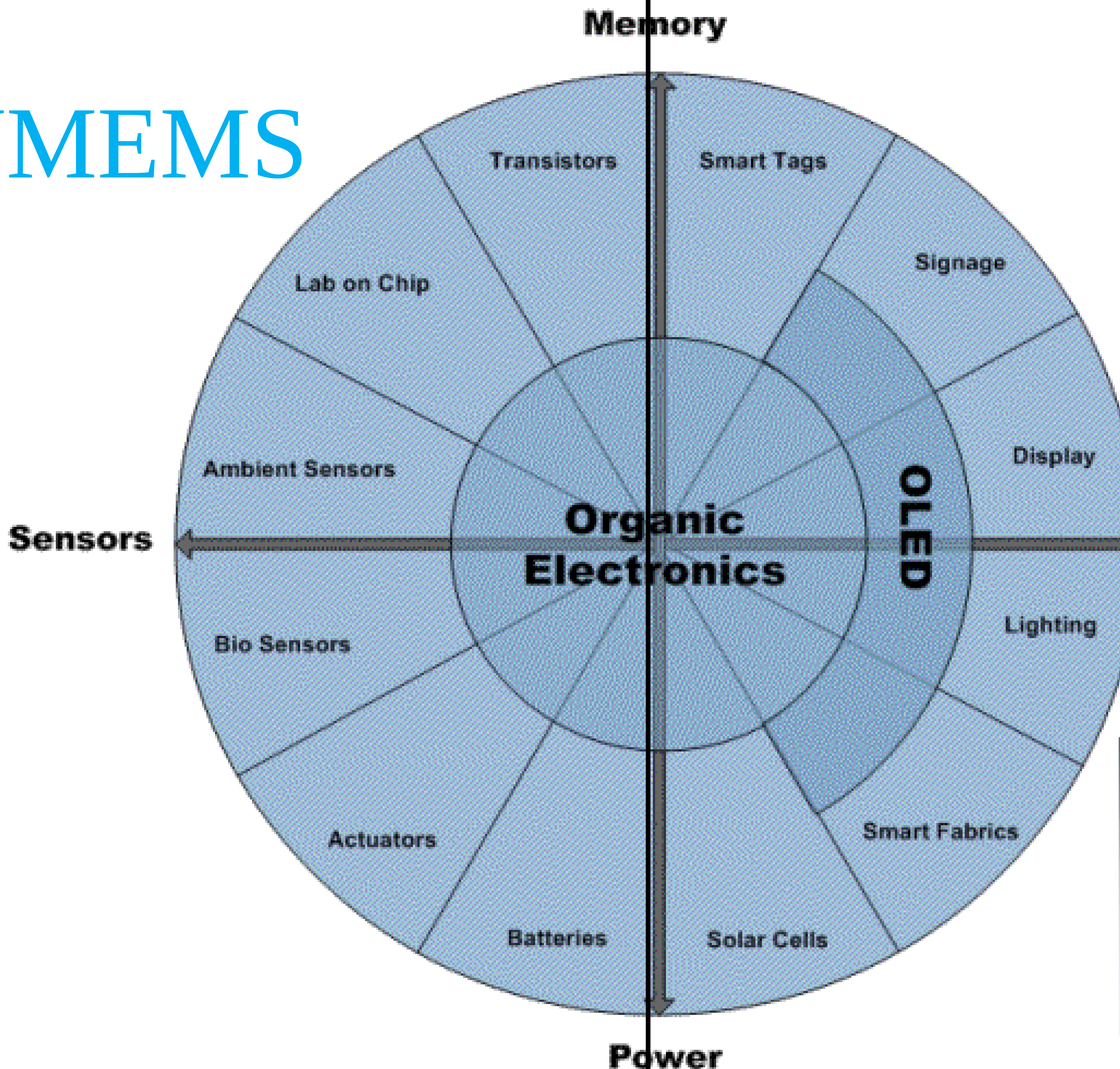


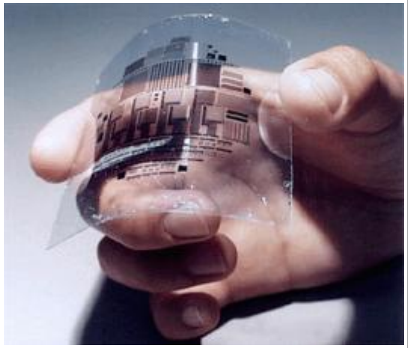
The portable E-guide displays appropriate information when touched to a post placed next to a museum exhibit.


25 µm
Lucent Technologies
Bell Labs Innovations

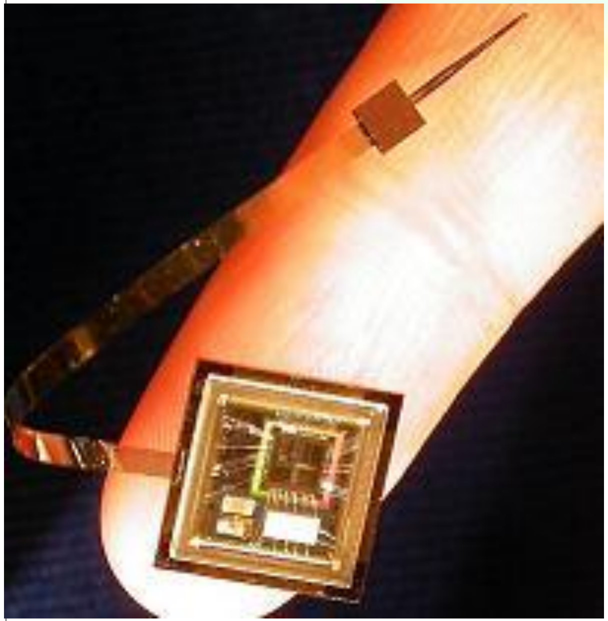
The Future of Organic Electronics

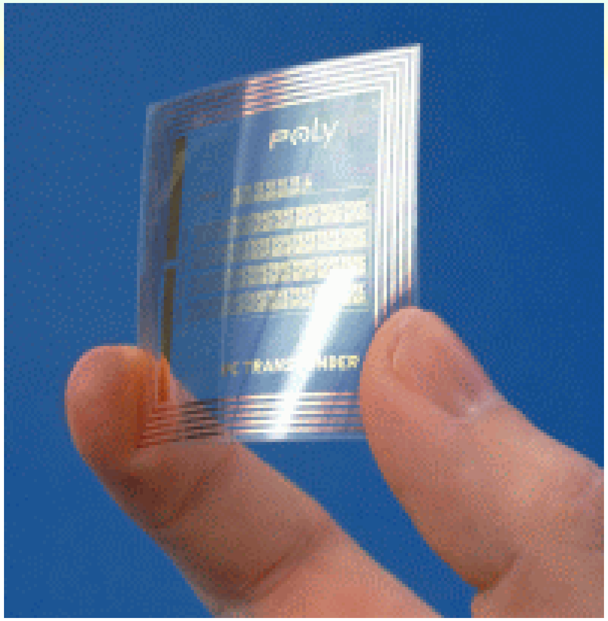
NMEMS

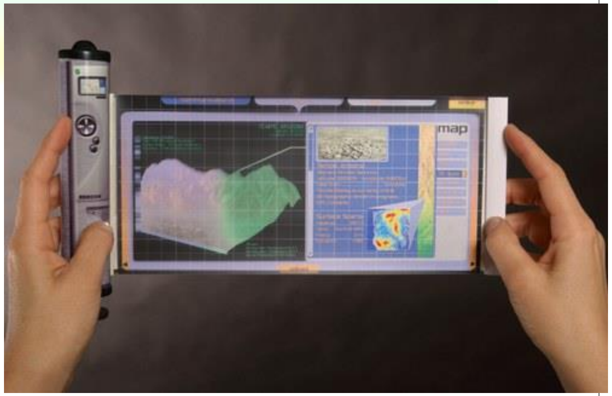


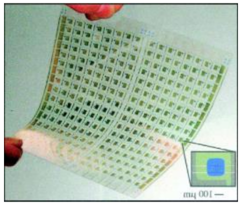


http://www.orgatronics.com/organic_electronics.html









Organic Electronics

http://www.polymervision.com/Technology/downloads/Index.html

http://jscms.jrn.columbia.edu/cns/2005-04-05/gencer-plasticelectronics

Choice of Plastic Substrate

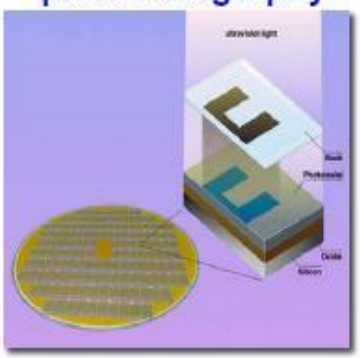
Continuous-use Temp.	Material	Characteristics (good, OK, bad)
900°C	Steel	Opaque, moderate CTE, moderate chemical resistance, poor surface finish
275°C	Polyimide (Kapton)	Orange color, high CTE, good chemical resistance, expensive, high moisture absorption
250°C	Polyetheretherketone (PEEK)	Amber color, good chemical resistance, expensive, low moisture absorption
230°C	Polyethersulphone (PES)	Clear, good dimensional stability, poor solvent resistance, expensive, moderate moisture absorption
200°C	Polyetherimide (PEI)	Strong, brittle, hazy/colored, expensive
150°C	Polyethylenenapthalate (PEN)	Clear, moderate CTE, good chemical resistance, inexpensive, moderate moisture absorption
120°C	Polyester (PET)	Clear, moderate CTE, good chemical resistance, inexpensive, moderate moisture absorption

⇒ **Best candidates: PEN, PET**

General Trends for Process

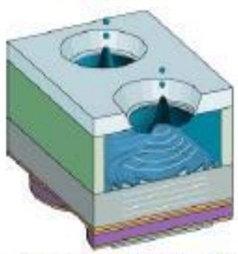
Thin Film Batch | **Printed Batch** | **Printed R2R**

photolithography



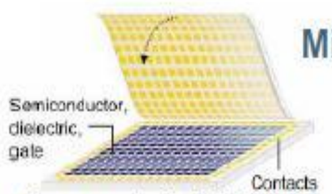
IBM

Screen Printing
web or sheet fed
simple
(Princeton, UCSC, UCLA)



AIP printhead - PARC

Jet-Printing
digital imaging
flexible substrates
direct-write of materials
(PARC, Plastic Logic)



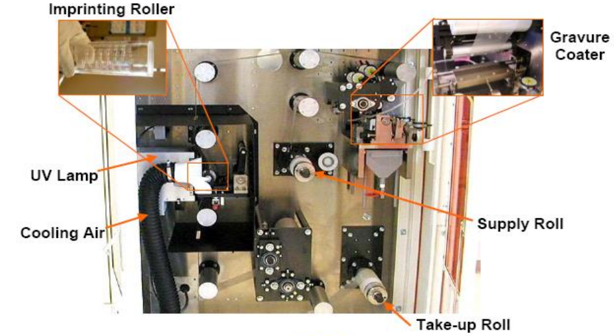
Rogers, et. al. PNAS 2002

Microcontact Printing
small features
rapid patterning
(Harvard, Bell Labs, IBM)

parc
Palo Alto Research Center

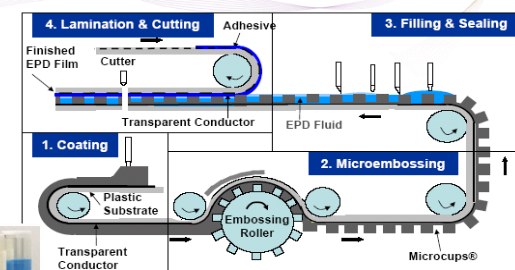
Challenges: materials compatibility, feature sizes, registration, process development

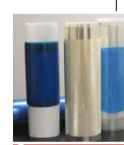
R2R Imprinting Machine



IOWA THIN FILM TECHNOLOGIES
HEWLETT PACKARD

Roll-To-Roll Manufacturing





SiPix

parc

Flexible display technologies

	Small Size	Big Size	Long Life	Full color	Video motion
OLED	yes	no	no	yes	yes
LCD	yes	no	yes	yes	no
Electrophoretic E-Ink	yes	yes	yes	yes	no
Plasma	no	yes	yes	yes	yes

125-inch flexible plasma display just 1mm thick

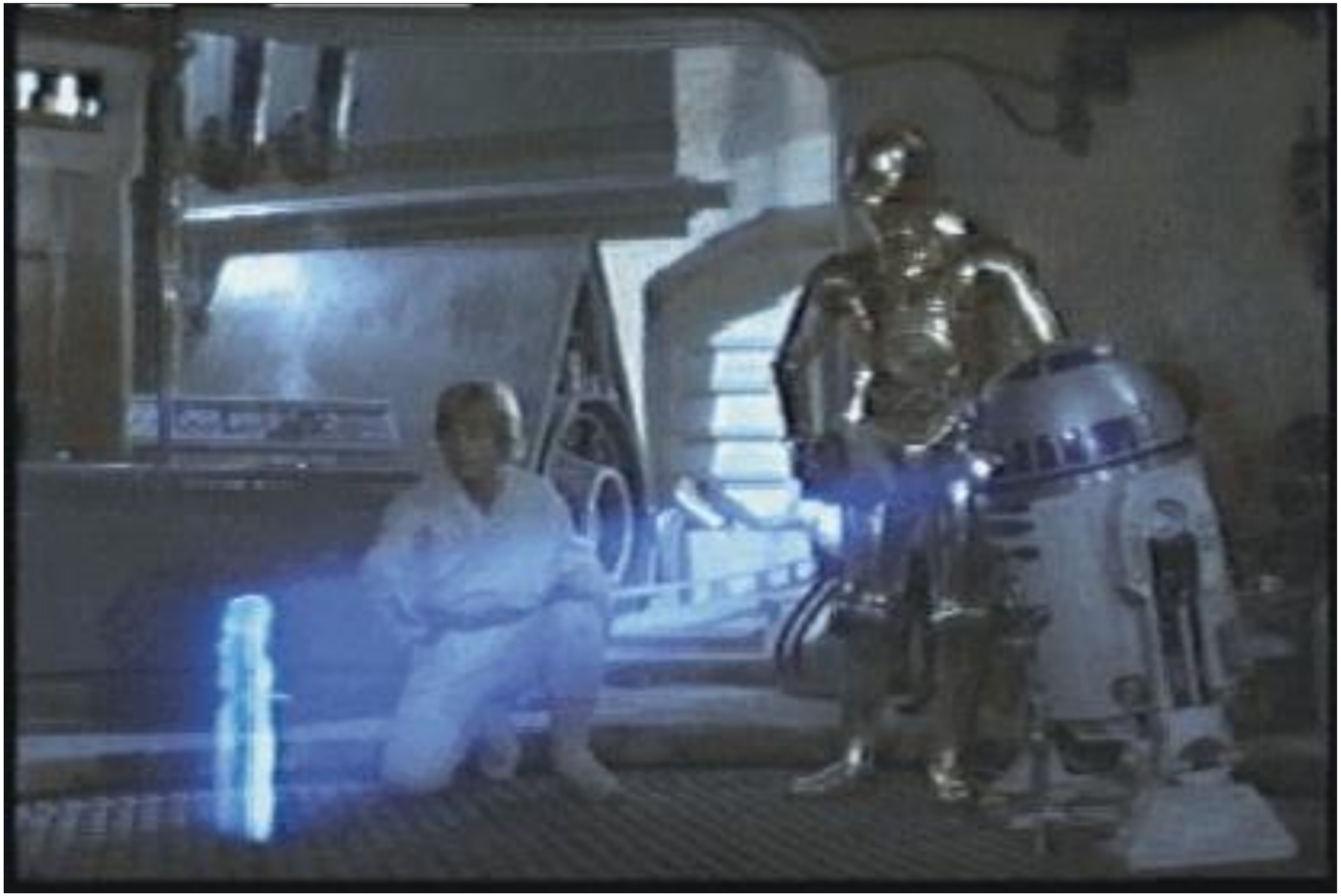
Friday, May 16th 2008 by Chris Davies

Shinoda Plasma

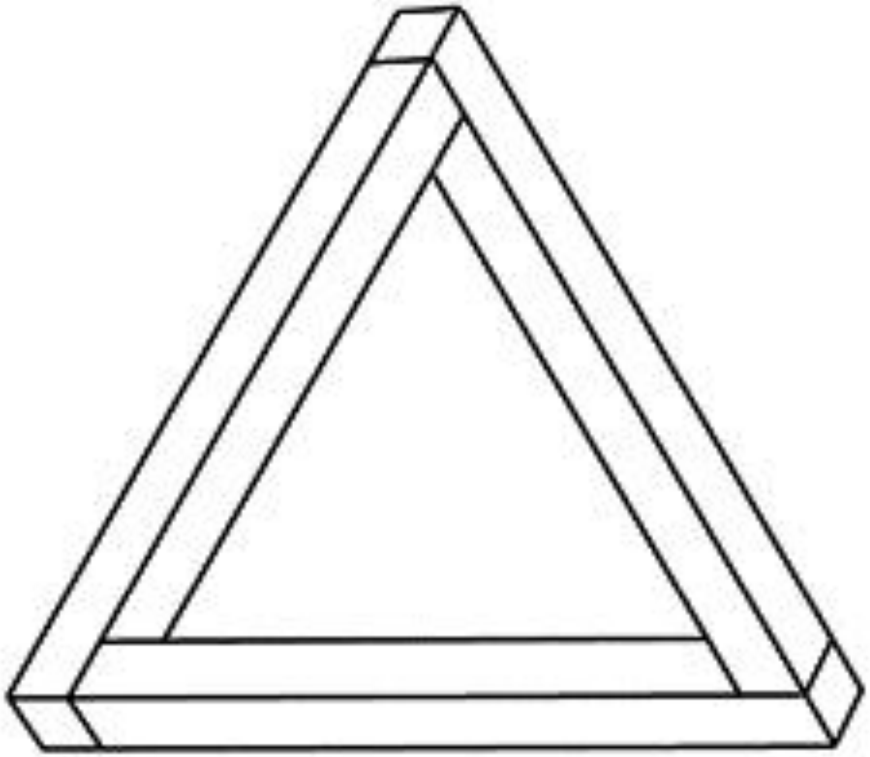
Display

3.8” Electrophoretic Display

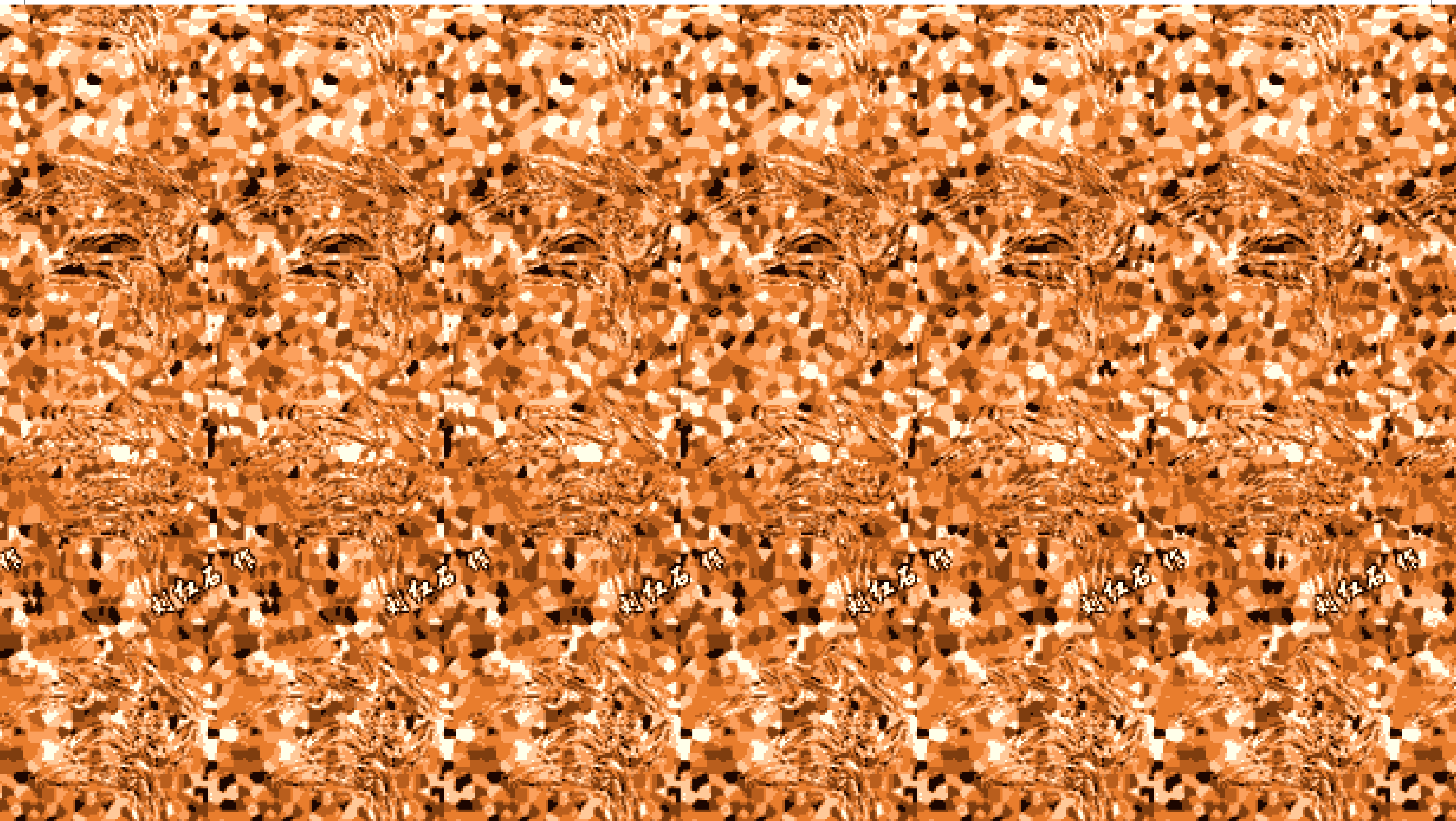
3D Display Technologies



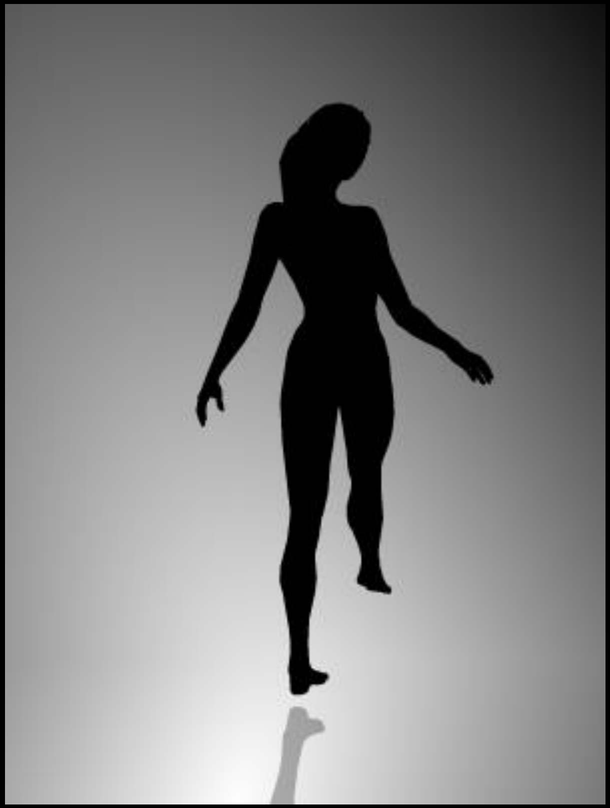
View in 3D



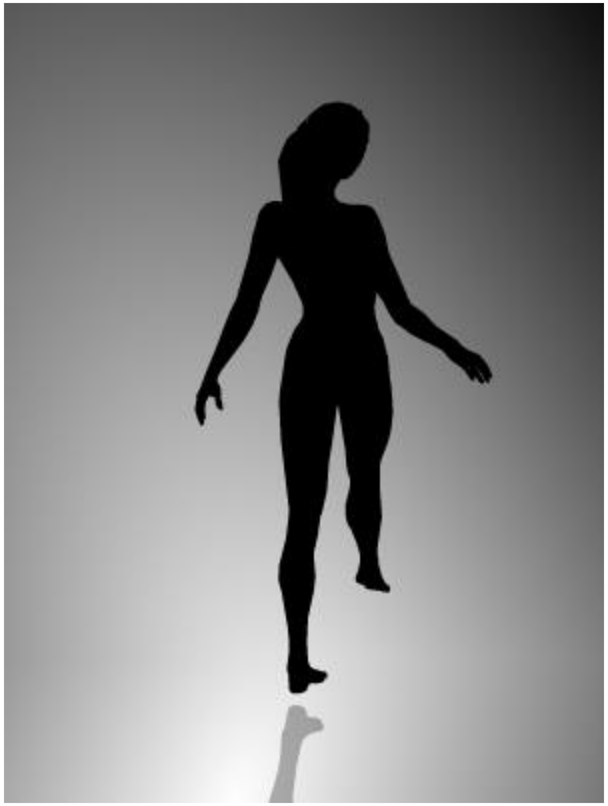
What can you find?



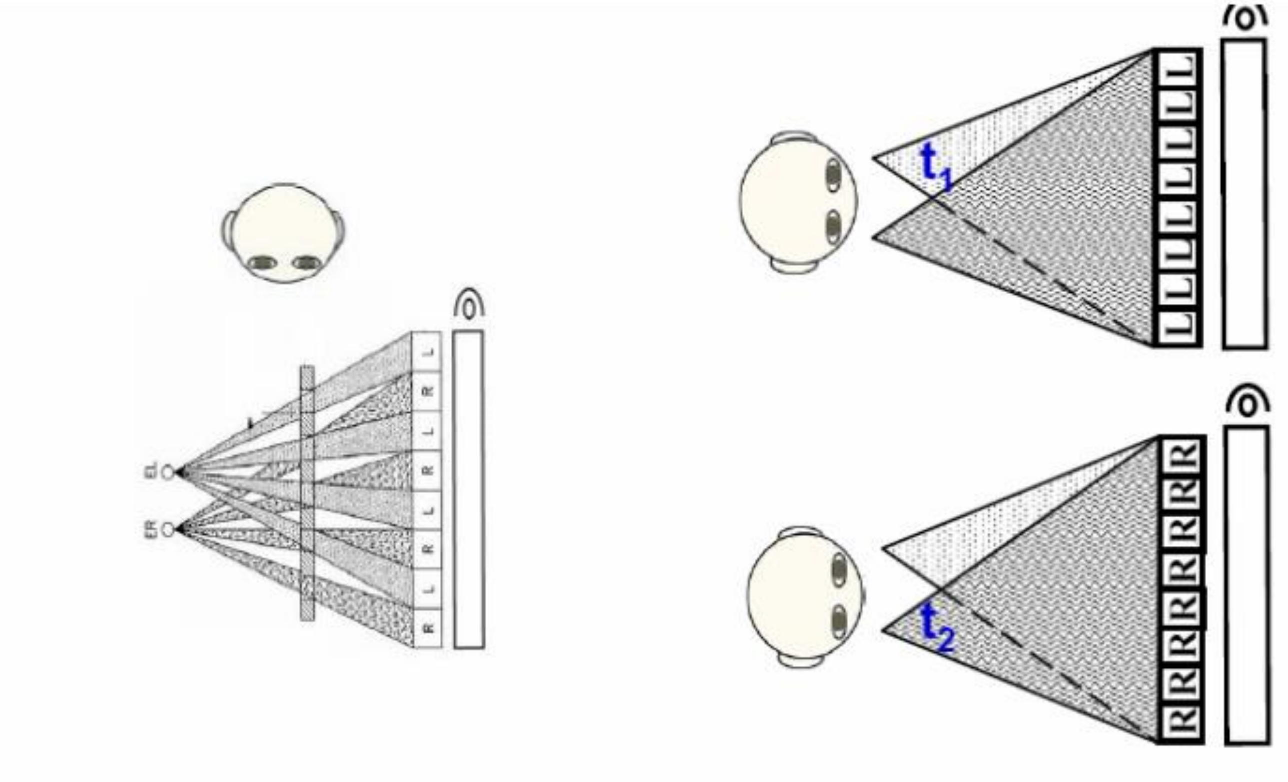
What can you find?



What can you find?



Classification



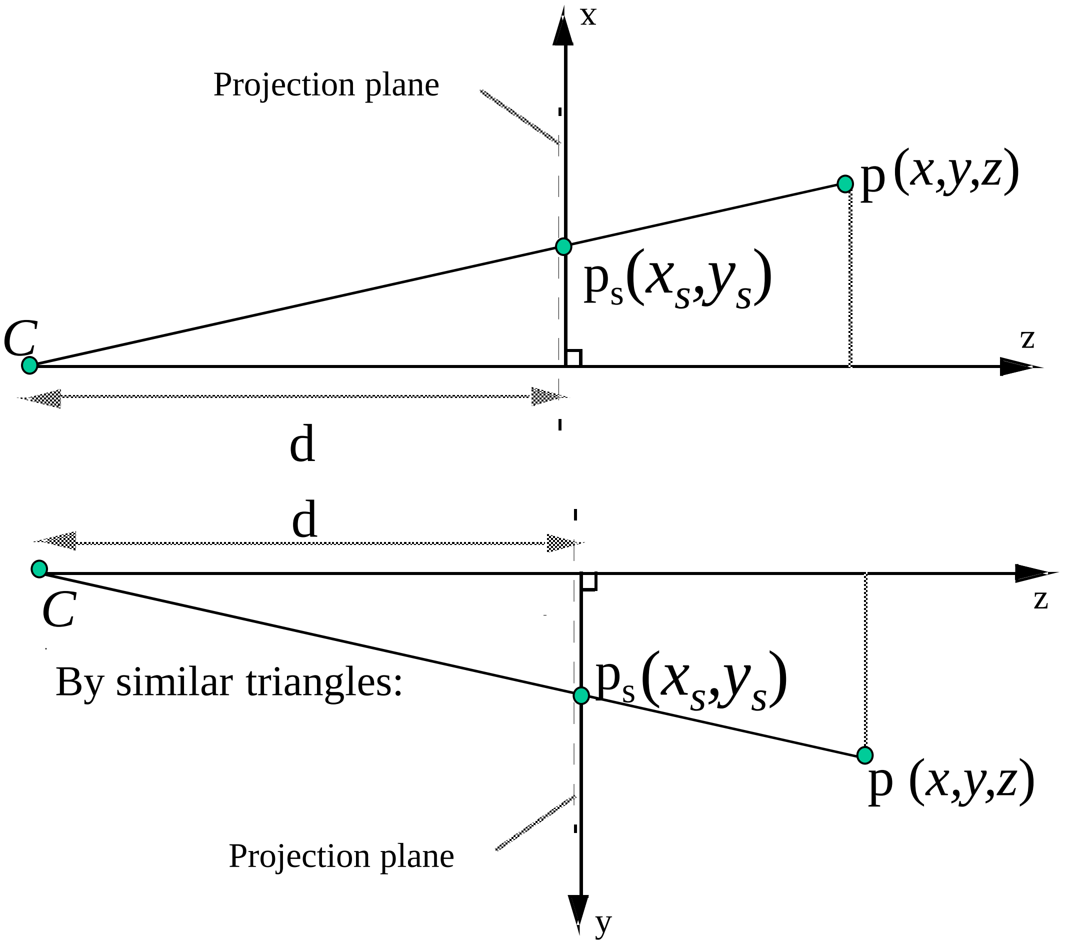
(a) Spatial-multiplexed (b) Time-multiplexed

Perspective Projections

$$\frac{x}{z+d} = \frac{x_s}{d}$$

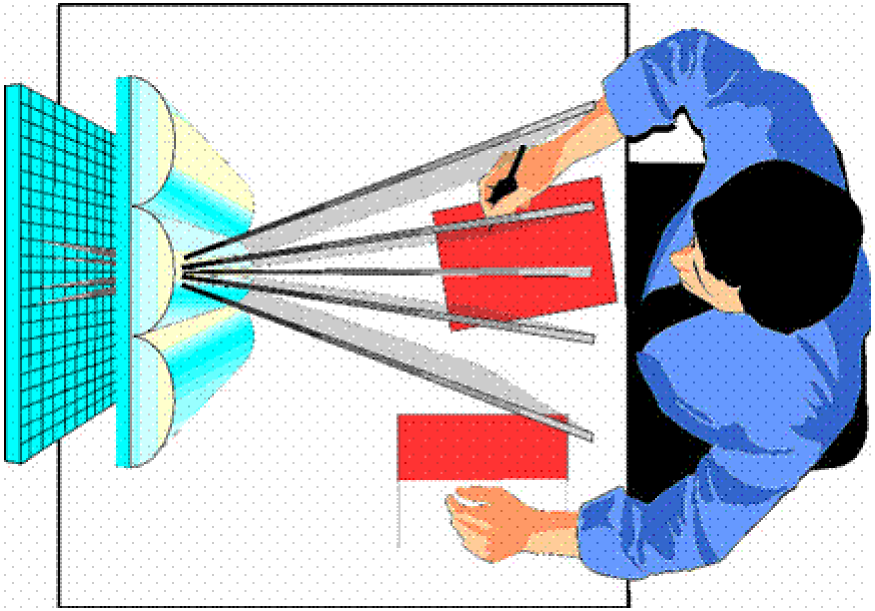
$$x_s = \frac{x}{1+\frac{z}{d}}$$

$$y_s = \frac{y}{1+\frac{z}{d}}$$



By similar triangles:

Distortion Solutions



Increasing number of views (providing motion parallax)

Forming Viewing Zone

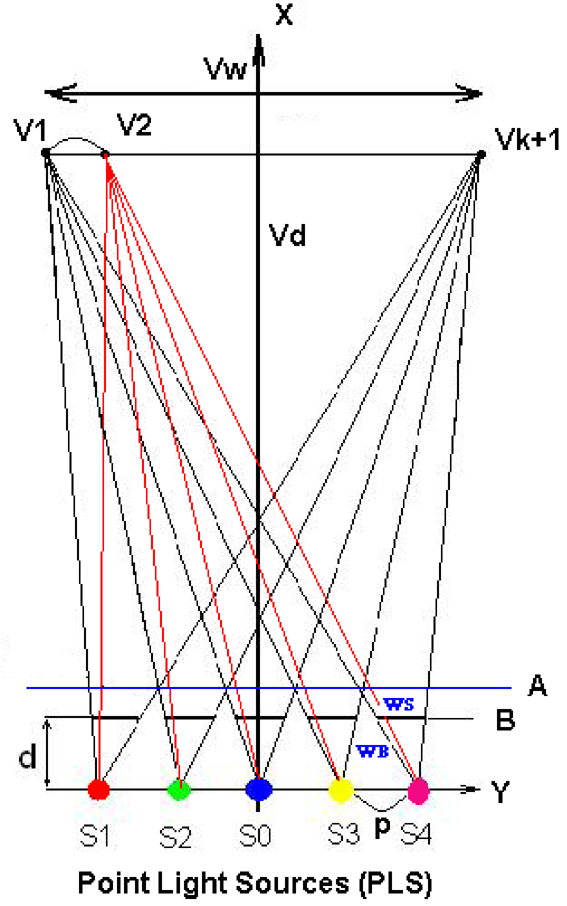
$$W_S = \frac{dV_W}{V_d}, \quad W_B = p - \frac{d}{V_d}(p + V_w)$$

$$W_S + W_B = p\left(1 - \frac{d}{V_d}\right)$$

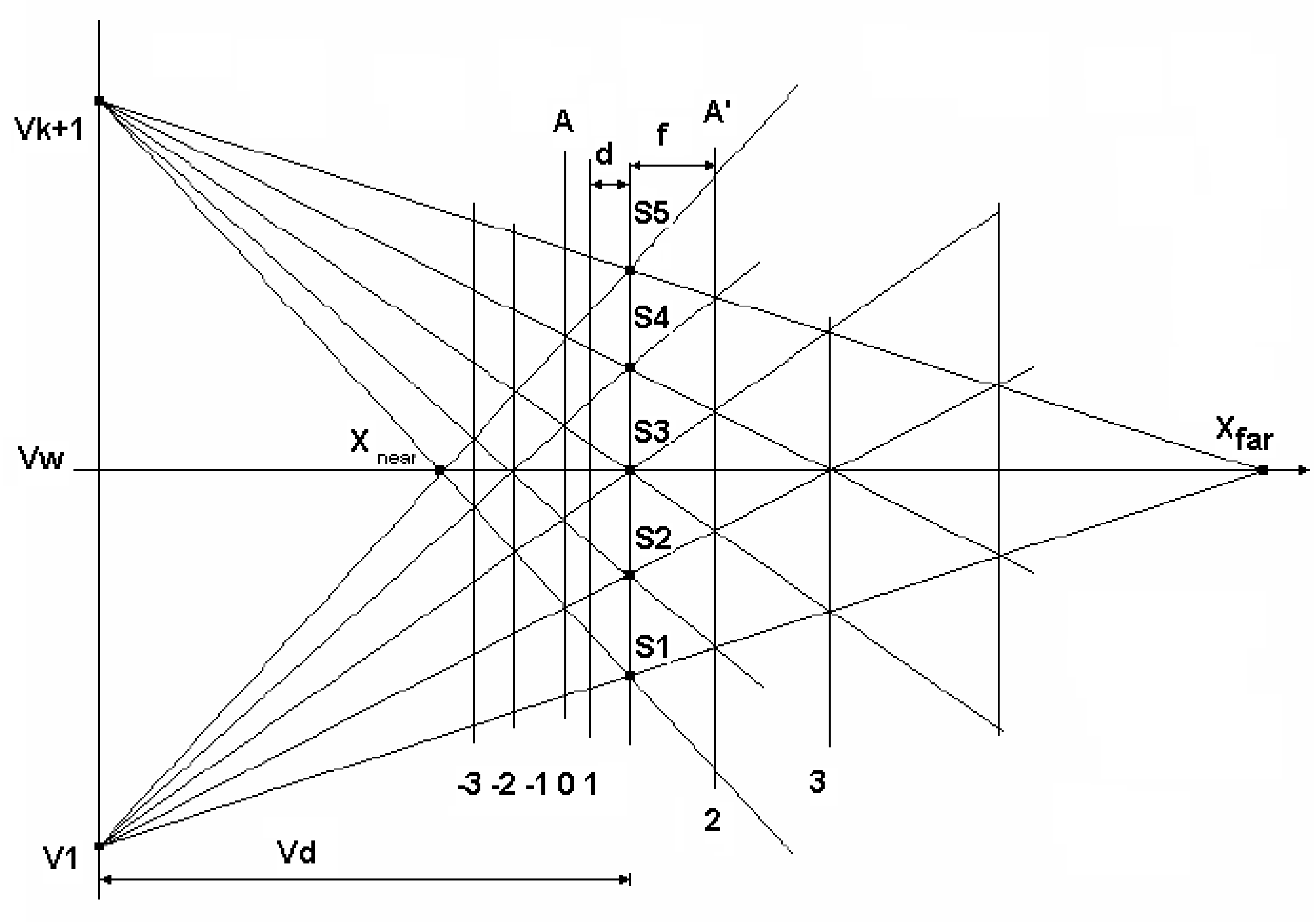
$$d = \frac{pV_d}{(V_w + p)}, \quad W_S = \frac{pV_w}{V_w + p}$$

$$W_{SubS} = \frac{W_S}{K}$$

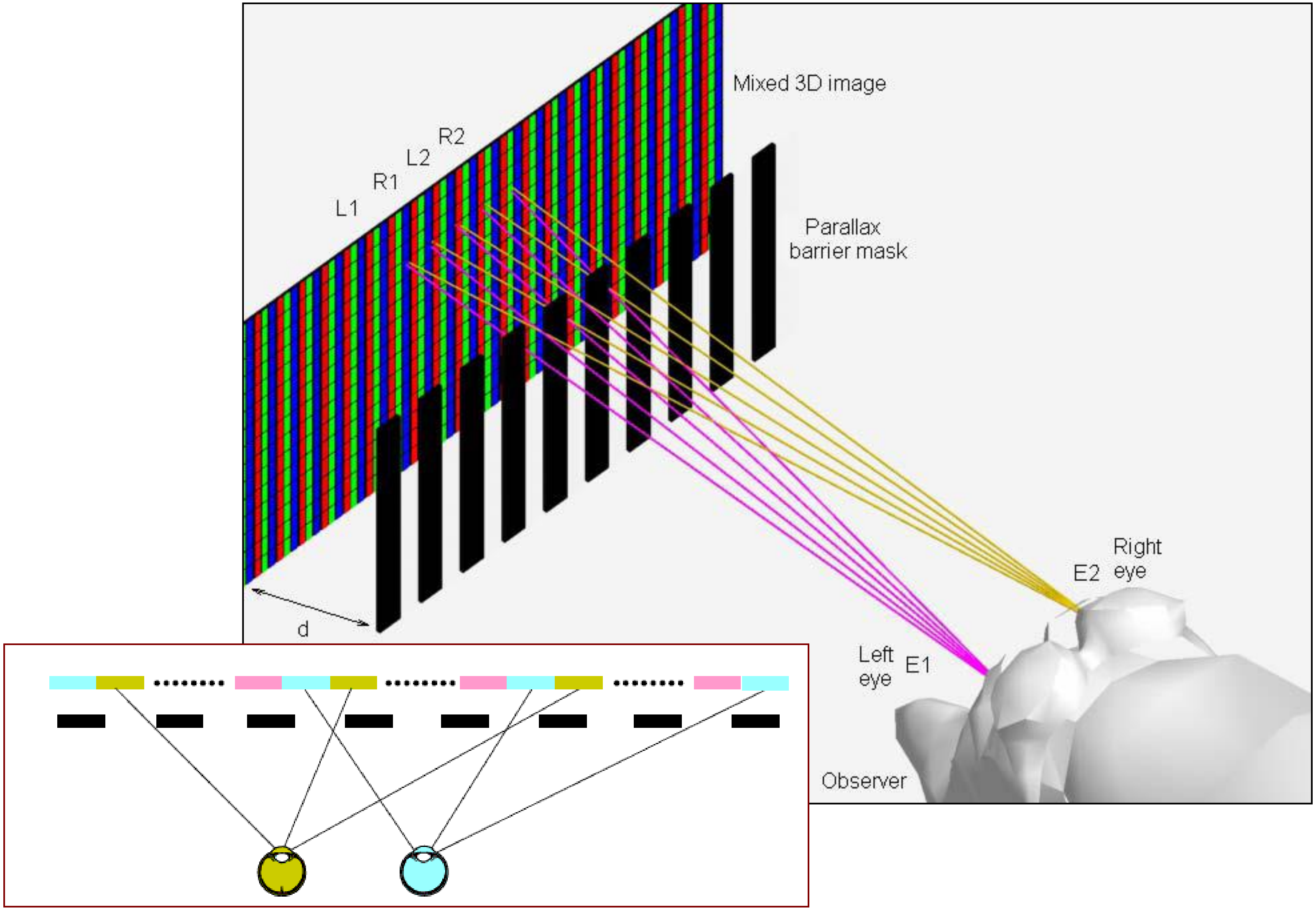
$$f = \frac{pV_d}{(V_w - p)}$$



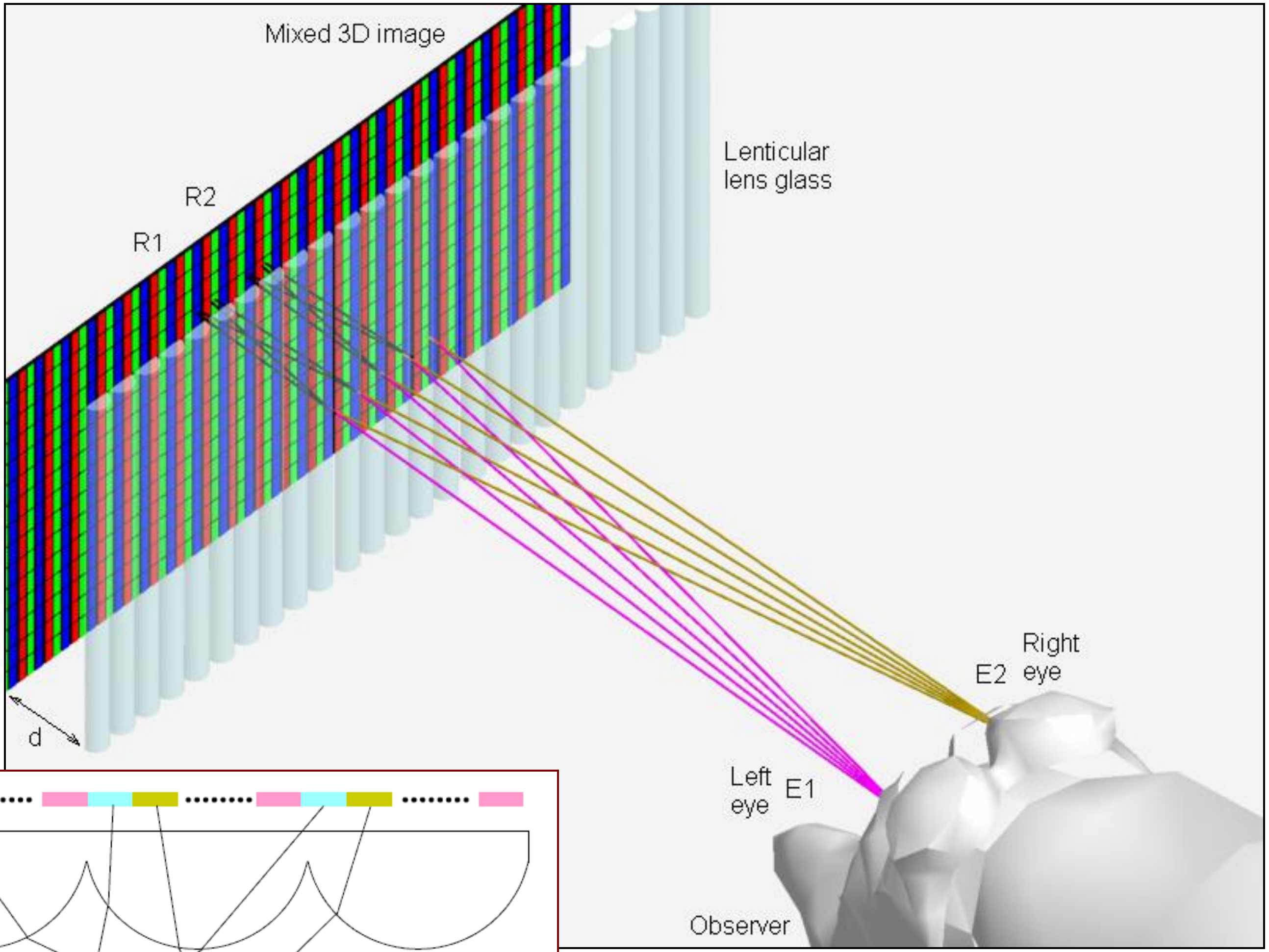
Obtainable Image Depth with PLS

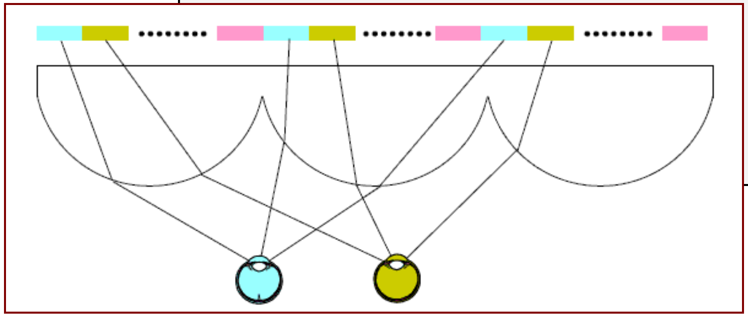


Parallax Barrier



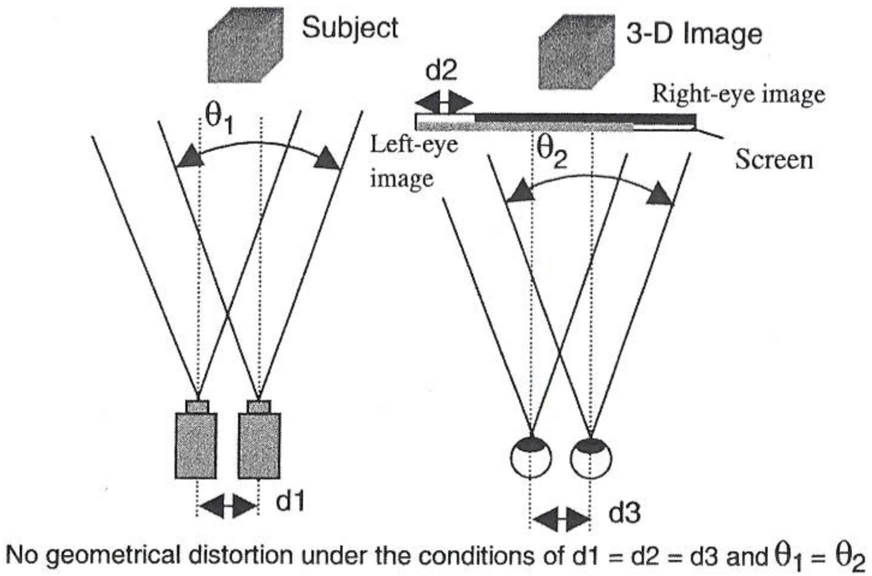
Lenticular


Mixed 3D image
Lenticular
lens glass
R2
R1
Right
eye
E2
d
Left
eye
E1
Observer



Distortion Solutions

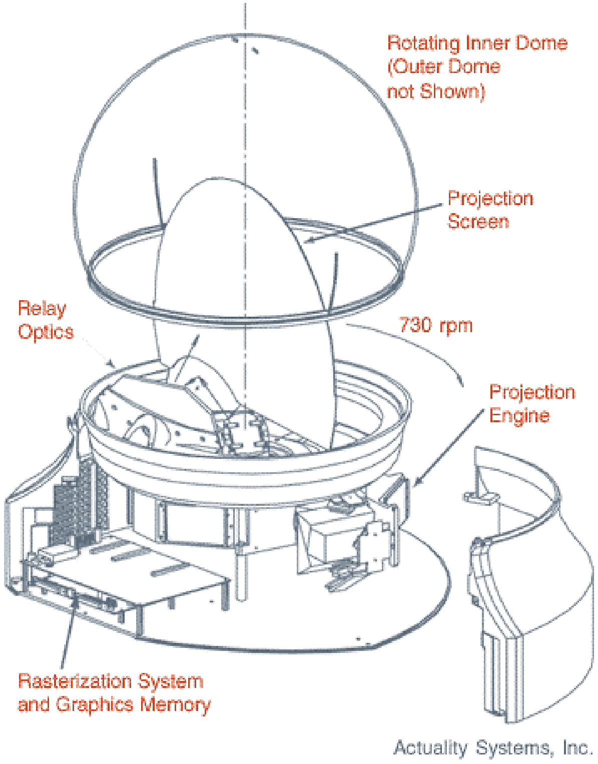
- Using stereo camera having parallel configuration and stereo base equal to human eyes distance and preserving photographing and displaying condition the same



Ortho-stereoscopic Conditions

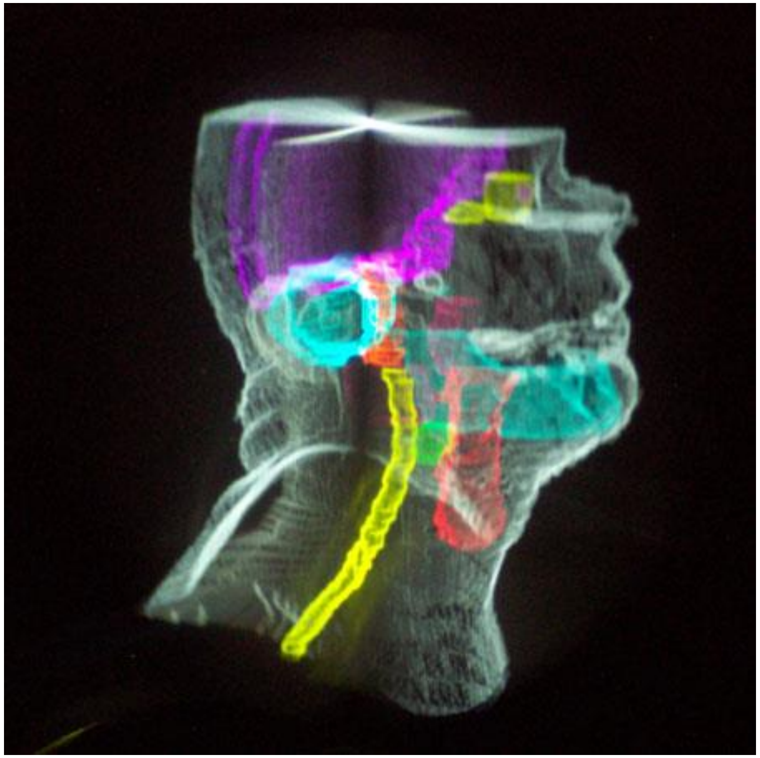
Volumetric Display - Swept Volume

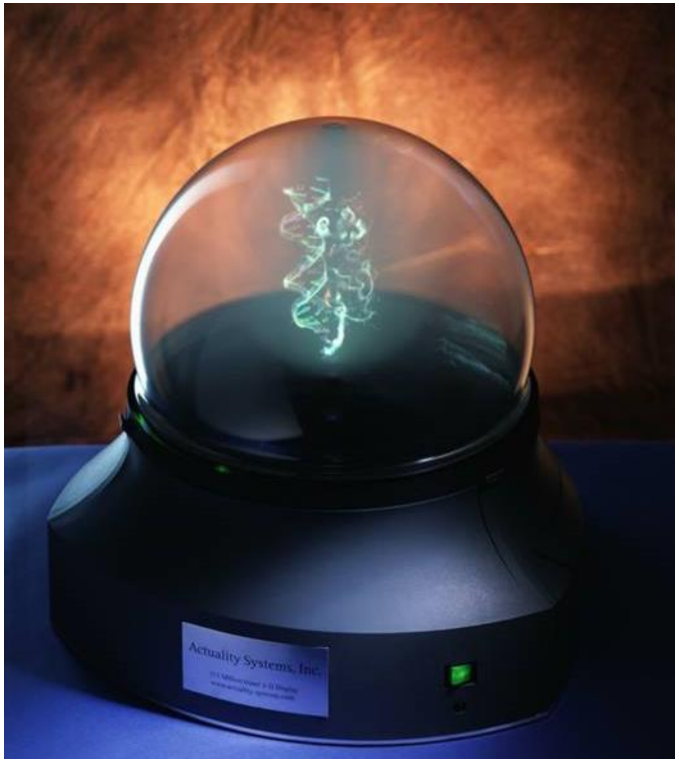
- 3D data set converted to 2D slices
- Flat screen rapidly rotates to sweep out a 3D volume
- Projection screen invisible to the viewer



VOLUMETRIC DISPLAY

- Images created occupy a **true volume**

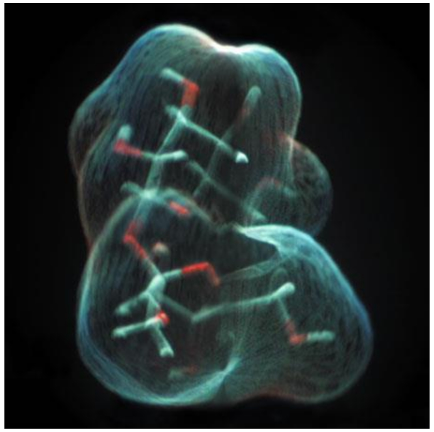




“Perspecta” - Actuality Systems

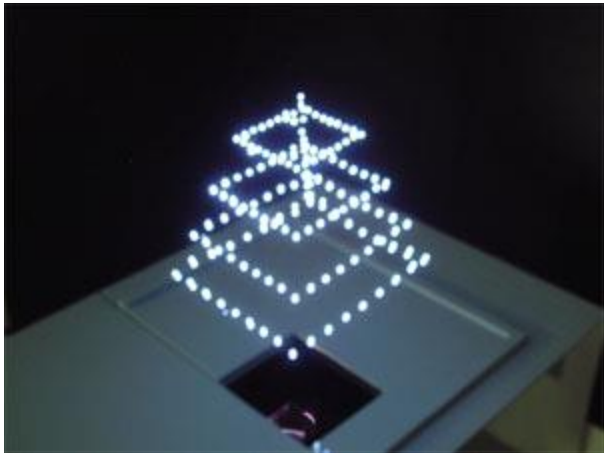
Volumetric Displays

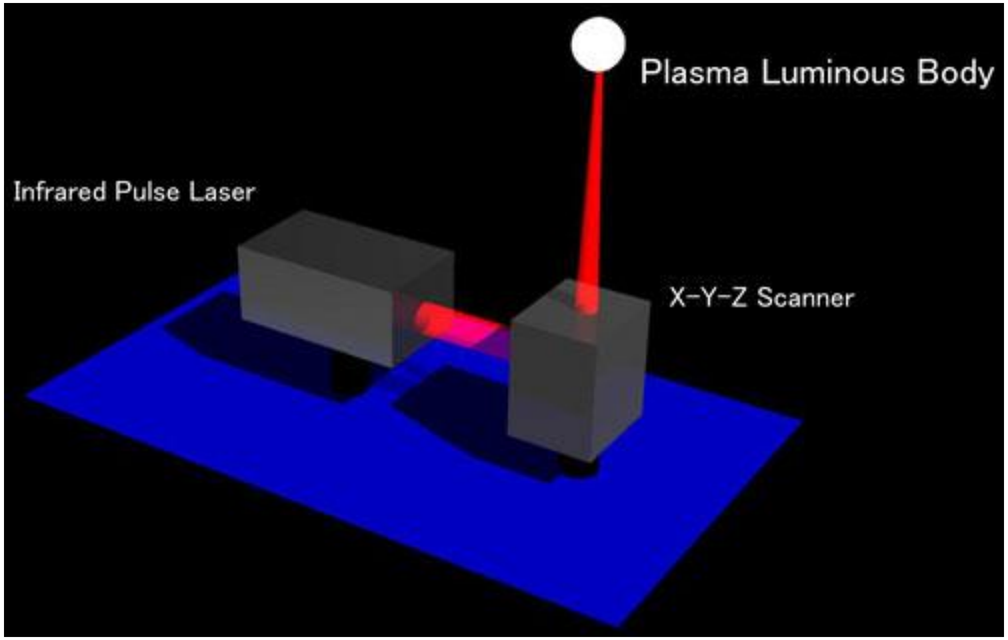
- Perspecta
  - Bandwidth bottleneck
  - 1600x1200x32 bit colors at 85Hz requires 652MB/s
  - 3rd Dimension: 851GB/s



Volumetric Displays

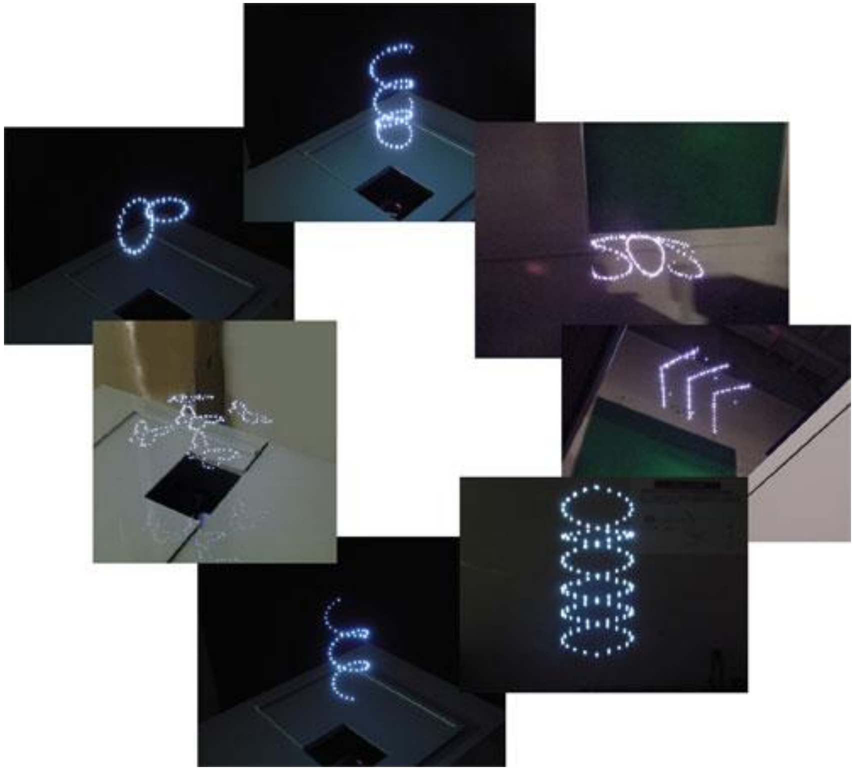
- Plasma Flashpoints
  - National Institute of Advanced Industrial Science and Technology
  - Keio University
  - Burton Inc.





Volumetric Displays

- Plasma Flashpoints
  - Emission time on the order of 1 nano-second (1 pulse for each dot)
  - Human recognition due to after-image effect enables 100 dots/sec



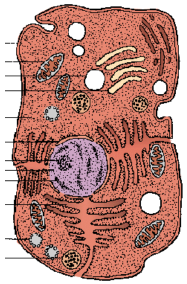
Comparison Between 3D-Methods

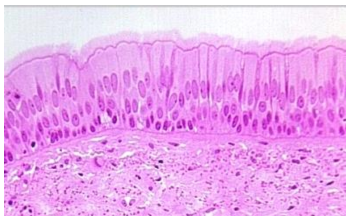
	Eye-Glasses	Multi-view	Holo-graphy	Volumetric	Laser-Beam	Psycho-logical
Natural Depth	☹ 😐	😐 ☺	😐 ☺	😐	☹ 😐	☹
Viewing Comfort	☹	😐 ☺	😐 ☺	😐	😐	☹
Group Viewing	☺	😐 ☺	☺	☺	☺	☺
Compatibility: 2D/3D	☺	☺	☹ 😐	😐	☹	☺
No Degrade Picture	☺	☺	😐	☺	☹	☺
Min Modification of Video Standard	☺	☺	☹	☺	☹ 😐	☺
Moderate Price	☺	☺	☹	😐	☹ 😐	☹

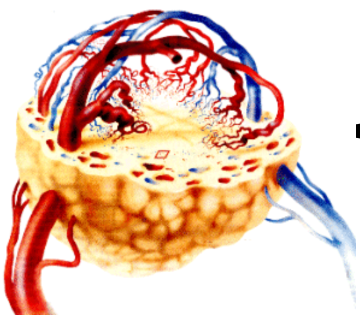
☺ Possible 😐 Some Cases Possible ☹ Impossible

LIGHT AND BIOENGINEERING

Light Tissue Interactions







0.1 μm
1.0 μm
10 μm
500 μm
1mm
ℓ^*
5mm
1 cm
5 cm

Molecules
Assemblies
Sub-cellular Structures
Cell Size/Shape/Density
Extra-Cellular Matrix

Scattering
(ℓ_{sc} ~20 μm)

Coherent

Diffuse

Bulk Properties:
Angiogenesis
Perfusion
Edema
Hypoxia
Necrosis

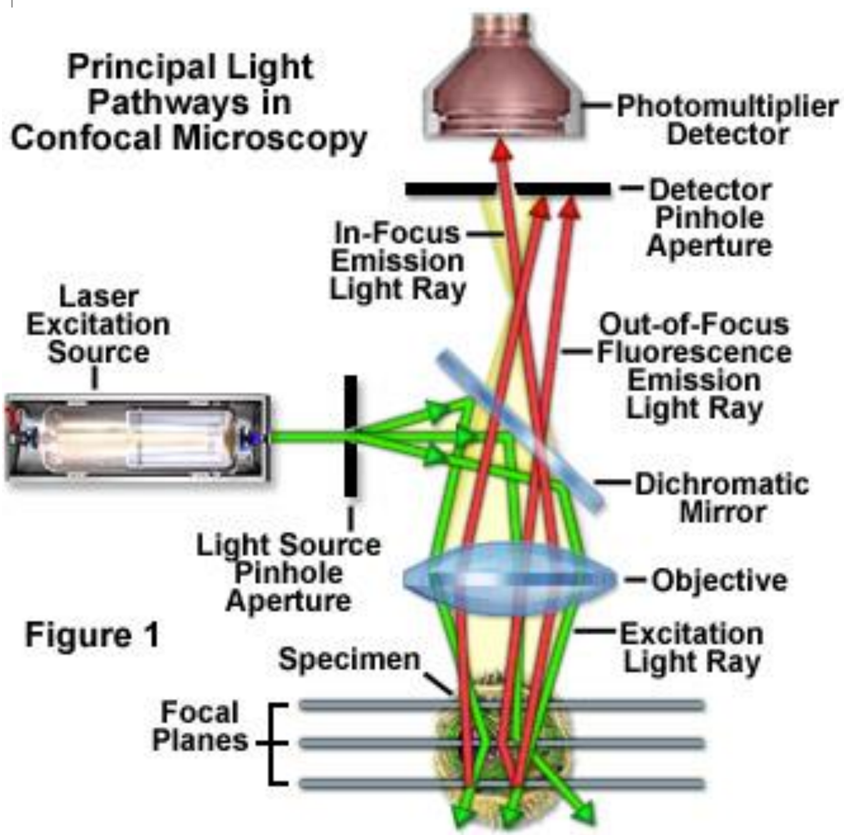
Scattering
&
Absorption
(ℓ_{abs} ~10 cm)

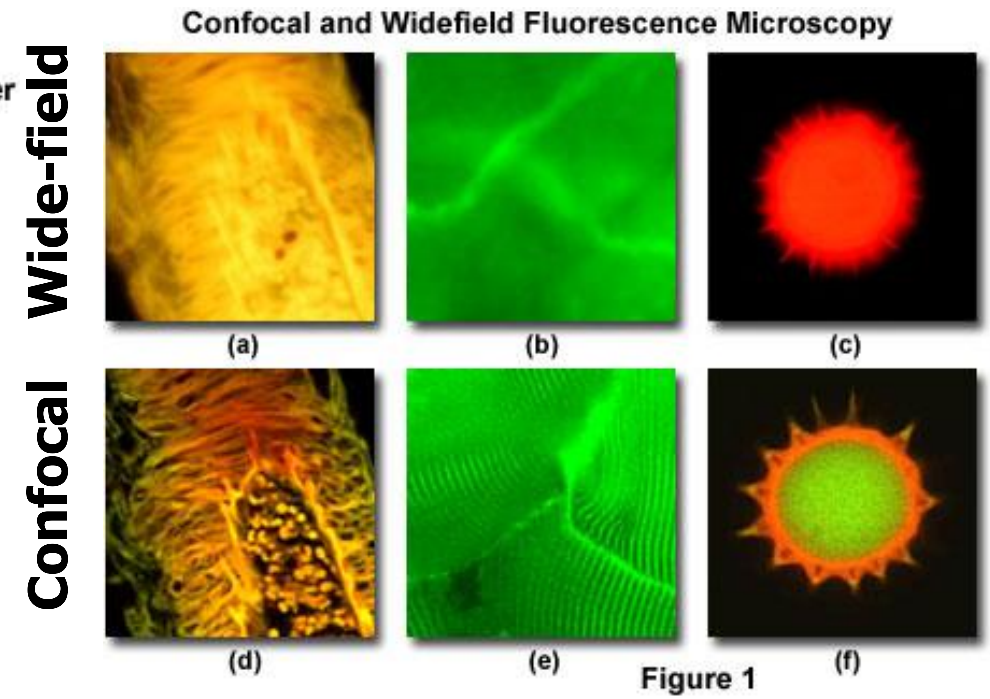
Contrast enhancement techniques

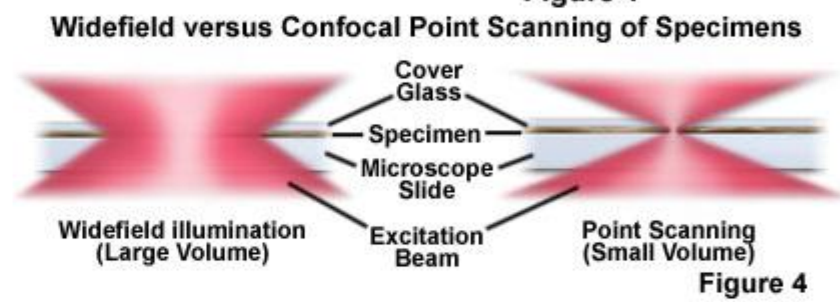
- Bright field (amplitude)
- Phase
- Dark field
- DIC (Nomarski)
- Polarization
- Fluorescence
- Reflectance

Phase Methods

Confocal principle

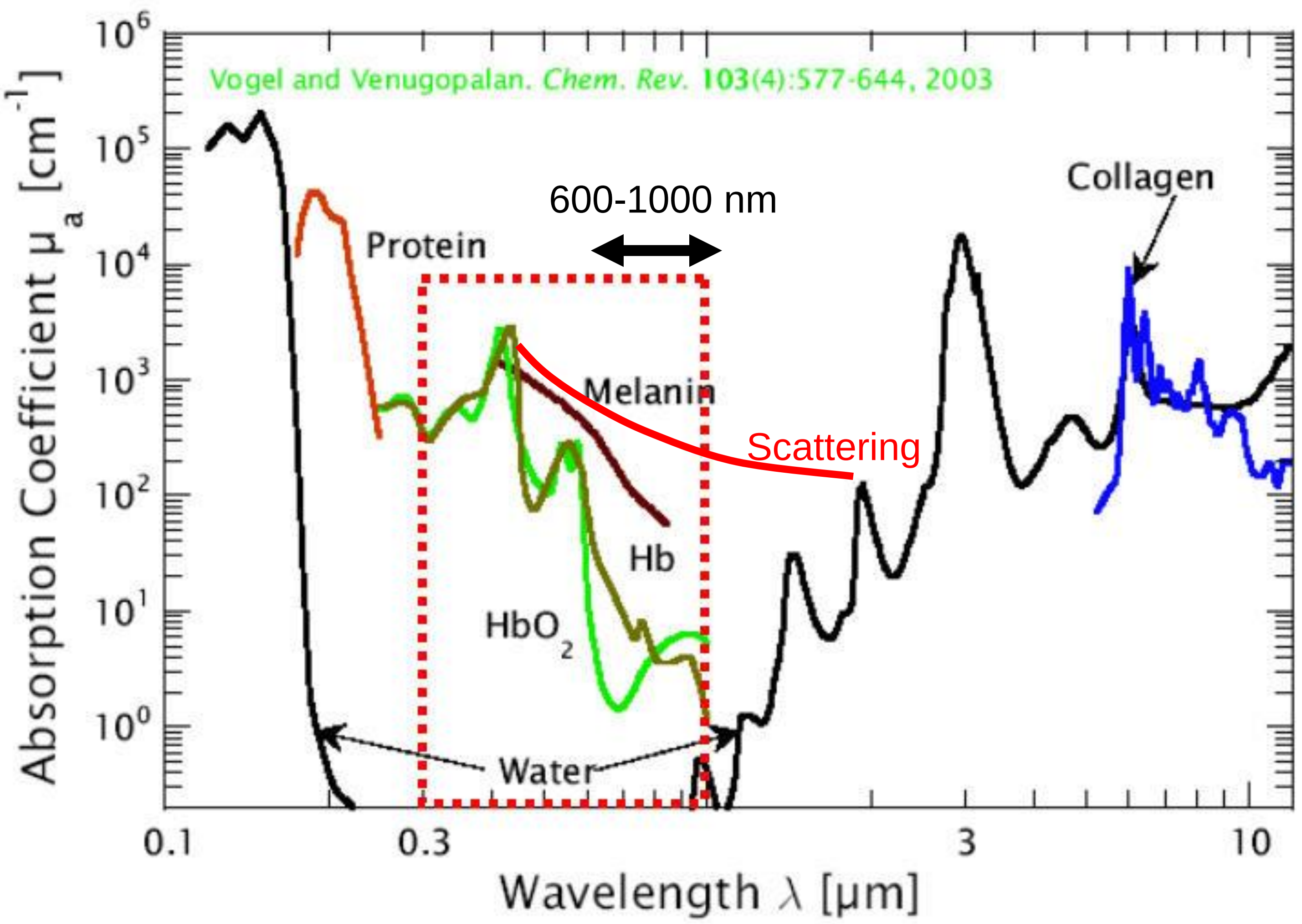




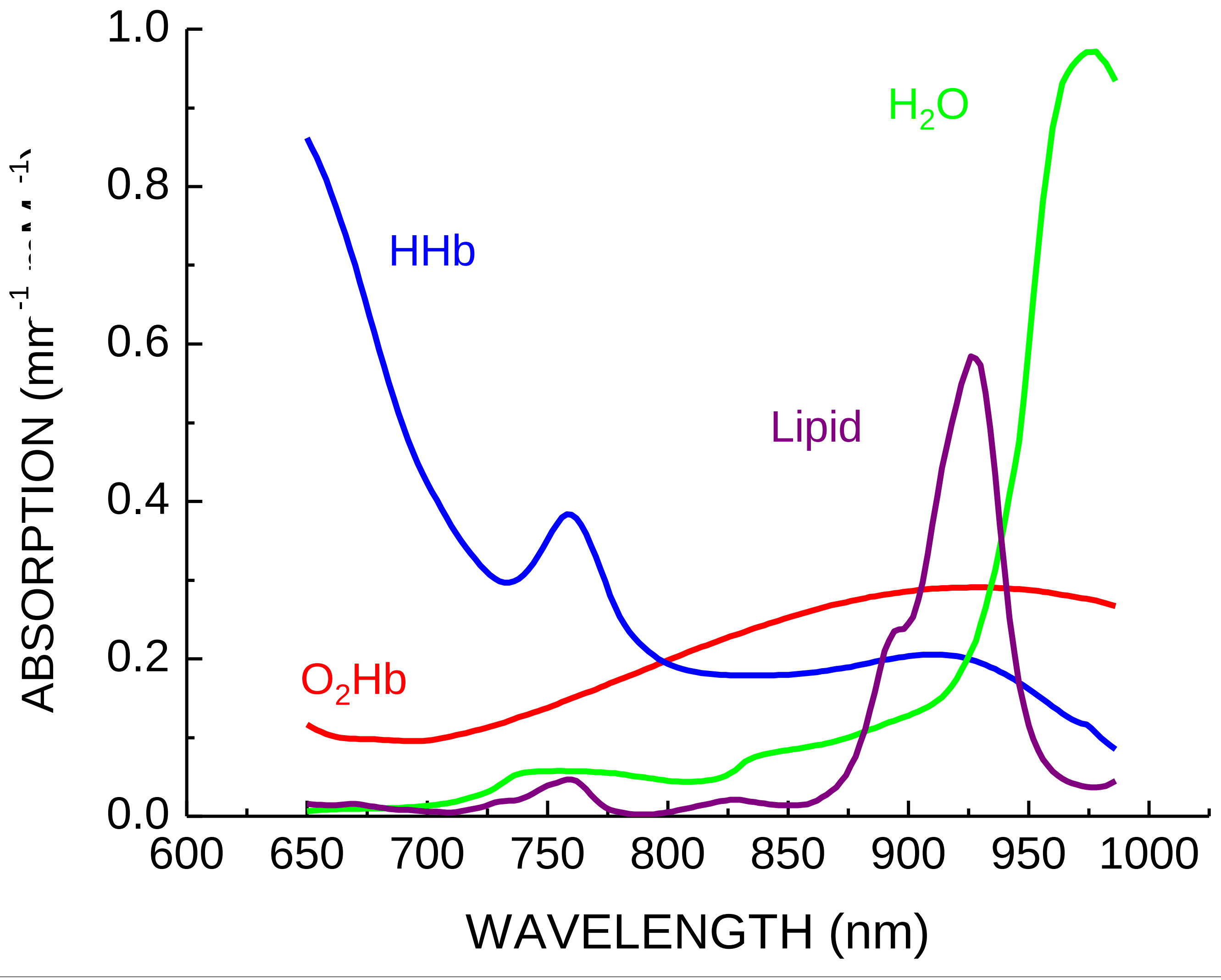


Same NA

Tissue Spectroscopy

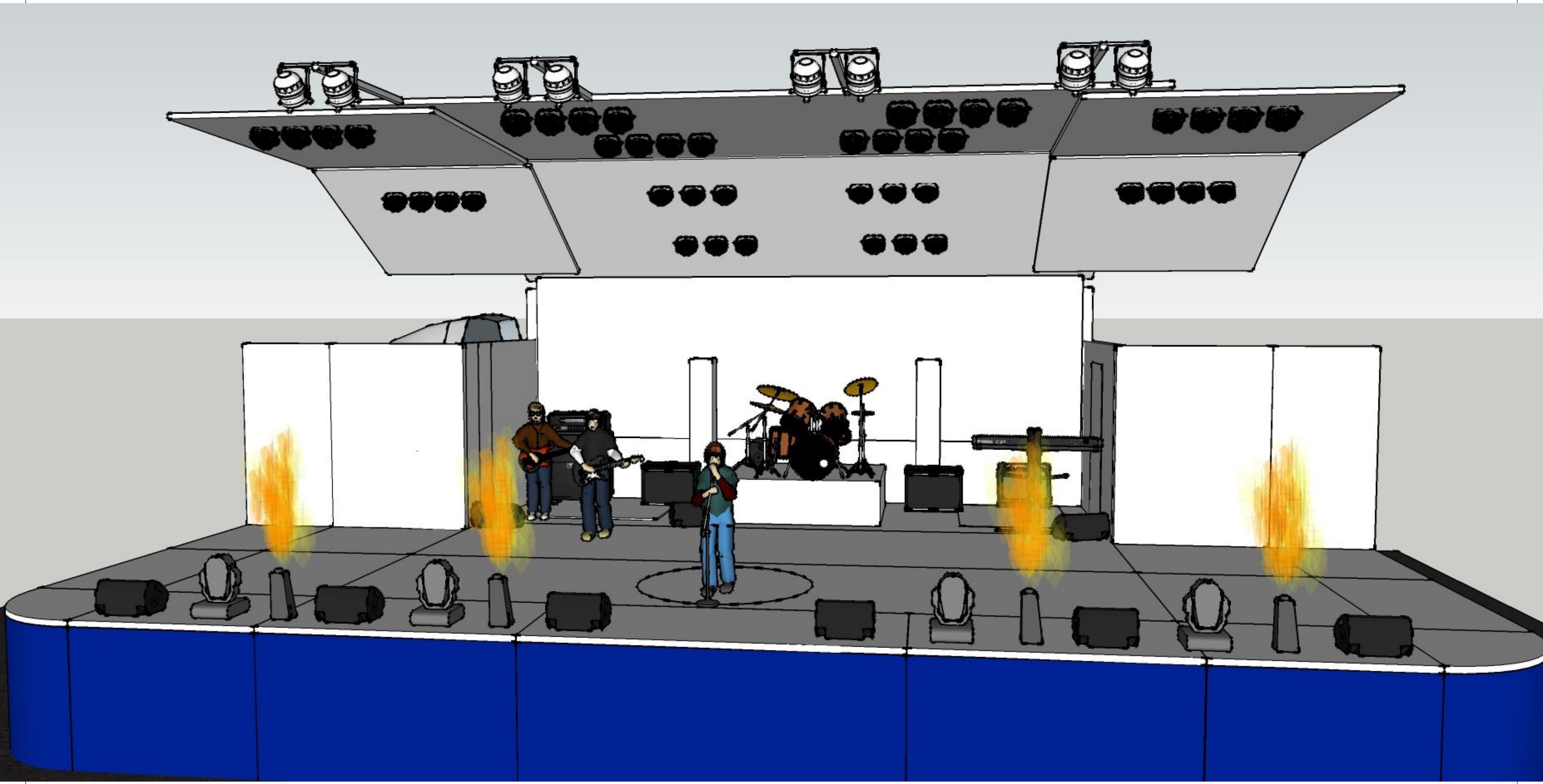


NIR Optical Spectroscopy



Other Applications

近代 光機電機 機動舞台技術




演員不怕舞台小　只怕無法感動觀眾