平面顯示技術概論

以小搏大的投影顯示技術

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2005年11月9日

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光電工業研究所
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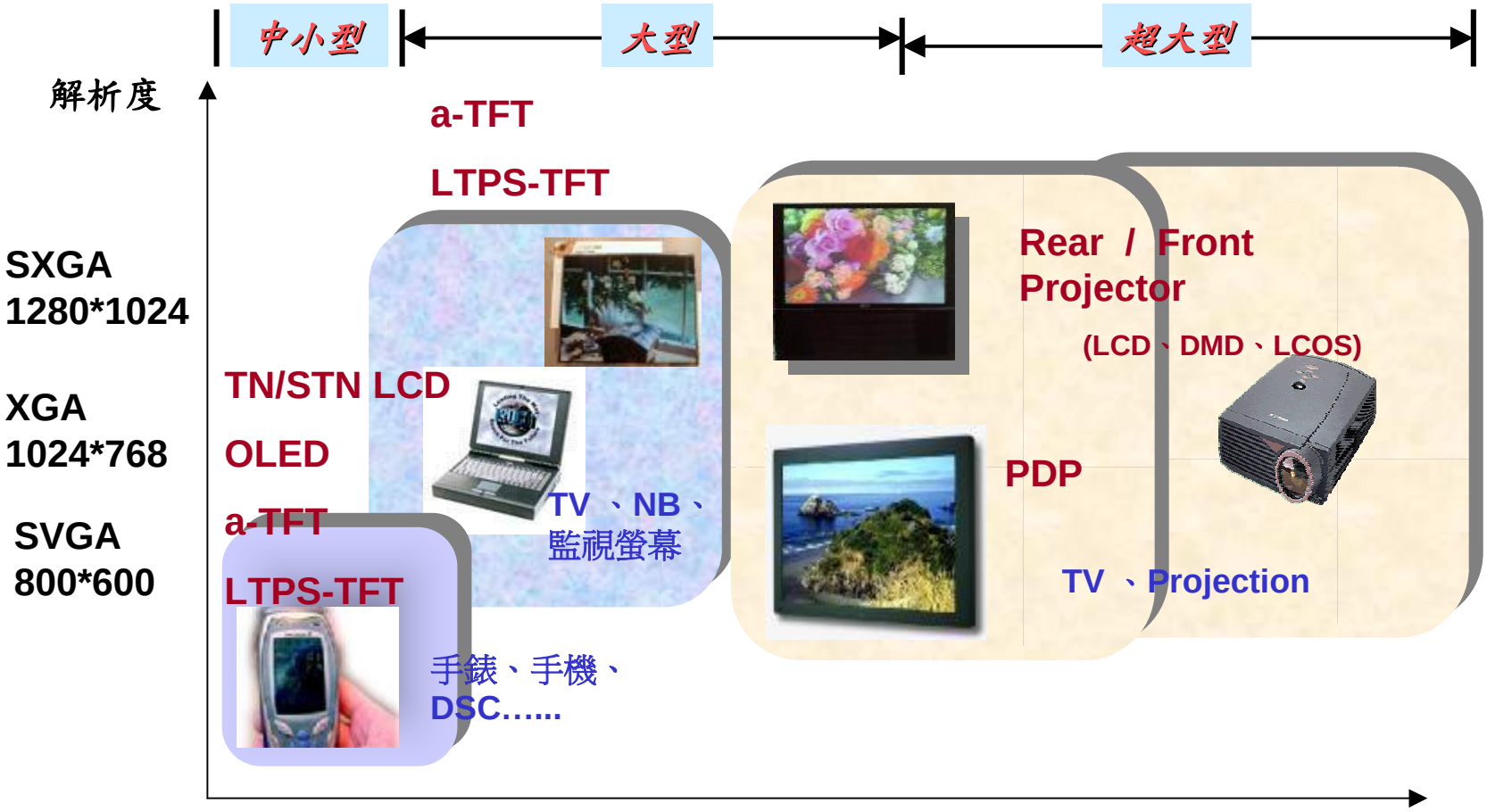
顯示器市場定位



資料來源：工研院經資中心ITIS計畫(2002/11)

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CRT display

體積因素：

38“ CRT TV

100 Kg

100 cm thick

環境保護因素：

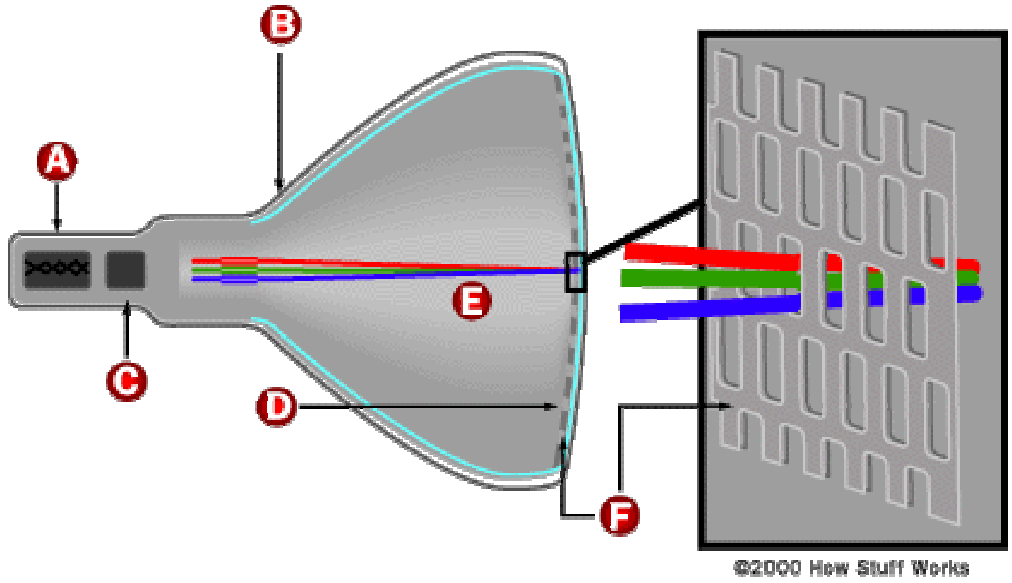
輻射問題

Bulky lead front glass

Montreal & Kyoto公約

歐盟禁用Jul./1/2006

加州立法限制



A Cathode
B Conductive coating
C Anode
D Phosphor-coated screen
E Electron beams
F Shadow mask

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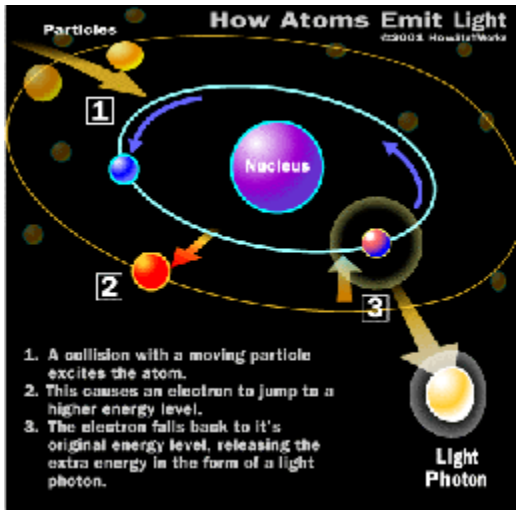
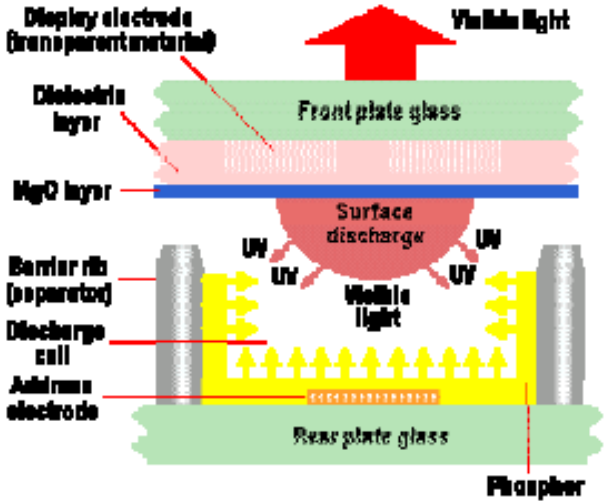
Plasma Display





6 inches
(15 cm)

They work on the principle that passing a high voltage through a low-pressure gas generates light. Essentially, a PDP can be viewed as a matrix of tiny fluorescent tubes which are controlled in a sophisticated fashion. Each pixel, or cell, comprises a small capacitor with three electrodes. An electrical discharge across the electrodes causes the rare gases sealed in the cell to be converted to plasma form as it ionises. Plasma is an electrically neutral, highly ionised substance consisting of electrons, positive ions, and neutral particles. Being electrically neutral, it contains equal quantities of electrons and ions and is, by definition, a good conductor. Once energised, the cells of plasma release ultraviolet (UV) light which then strikes and excites red, green and blue phosphors along the face of each pixel, causing them to glow.

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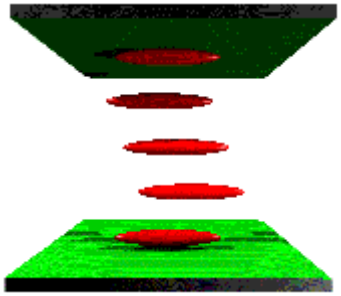
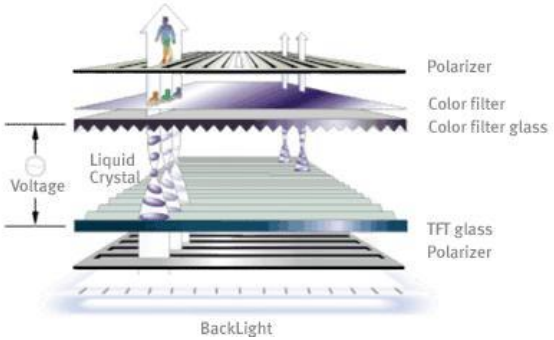
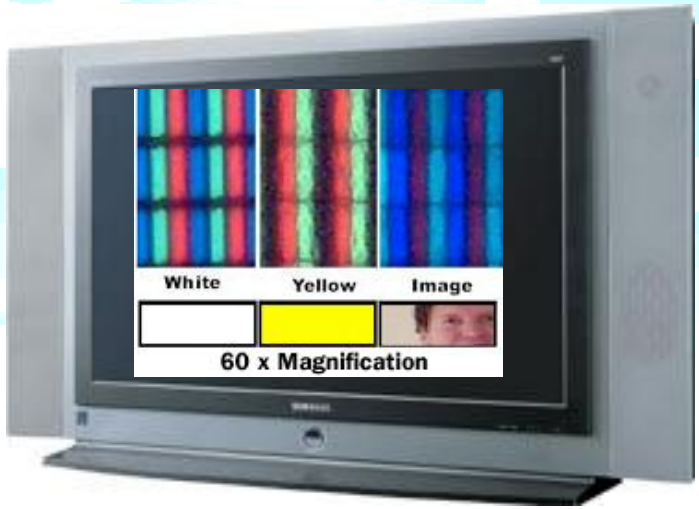
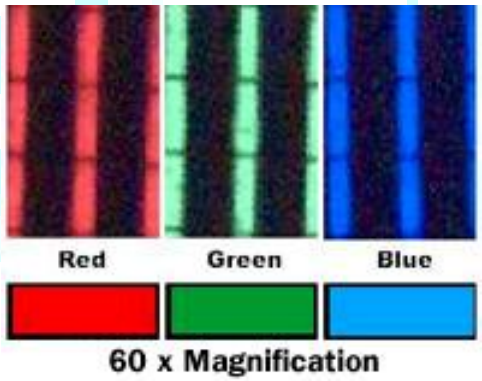
Color Liquid Crystal Display









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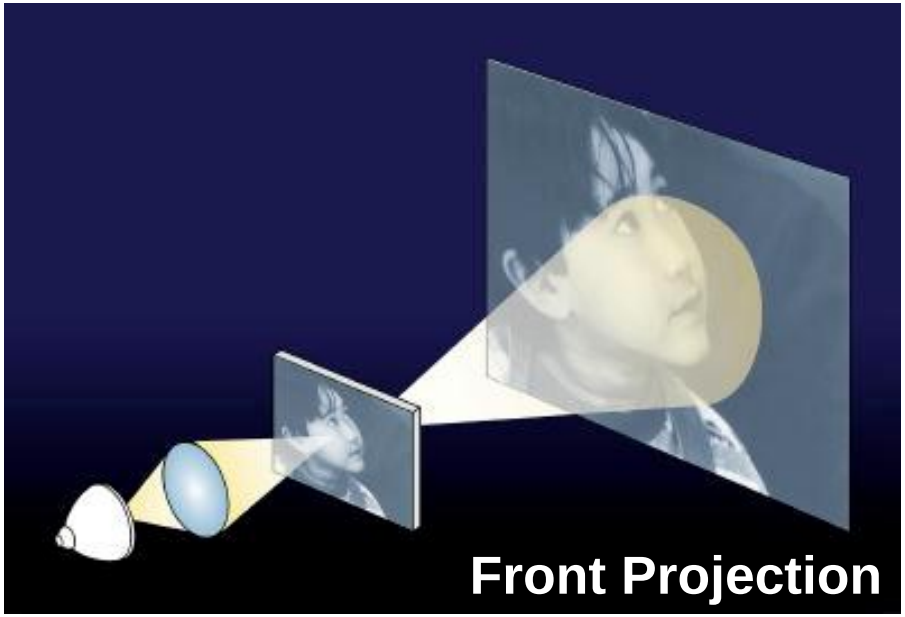
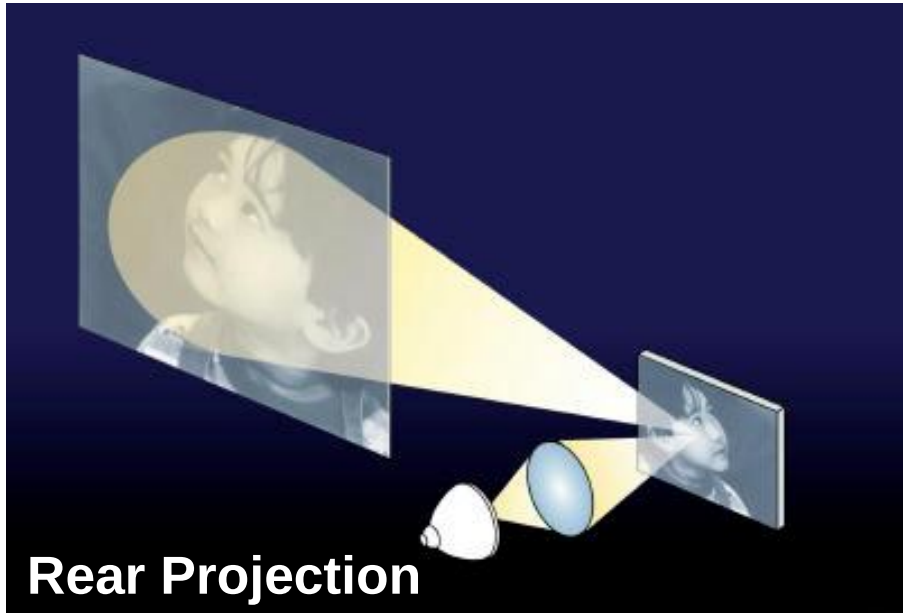
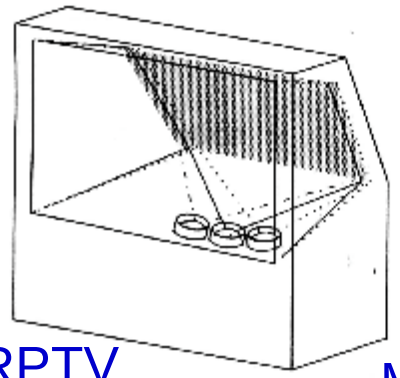
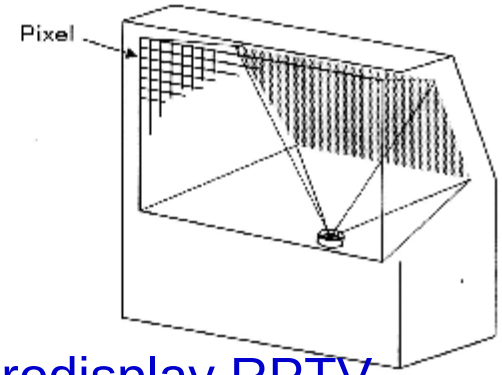
Projection Display







CRT RPTV



Microdisplay RPTV

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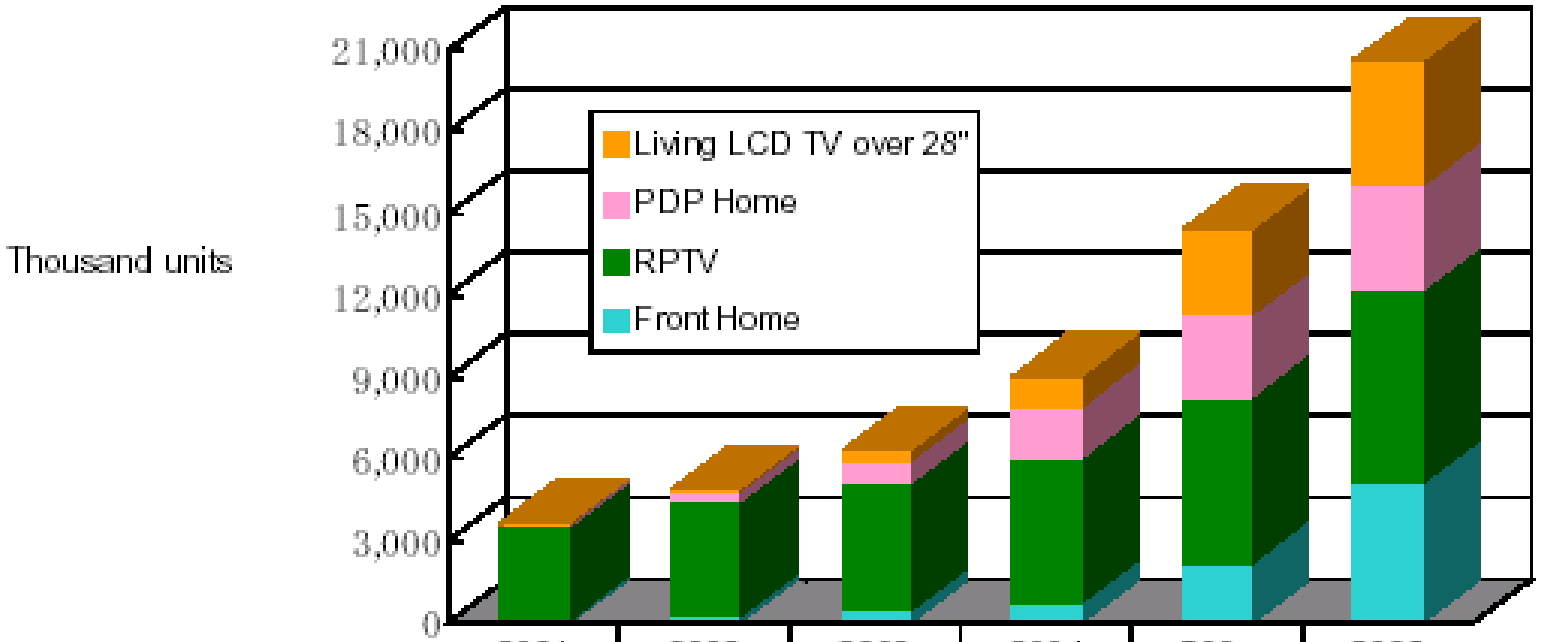
Big-Screen TV Market

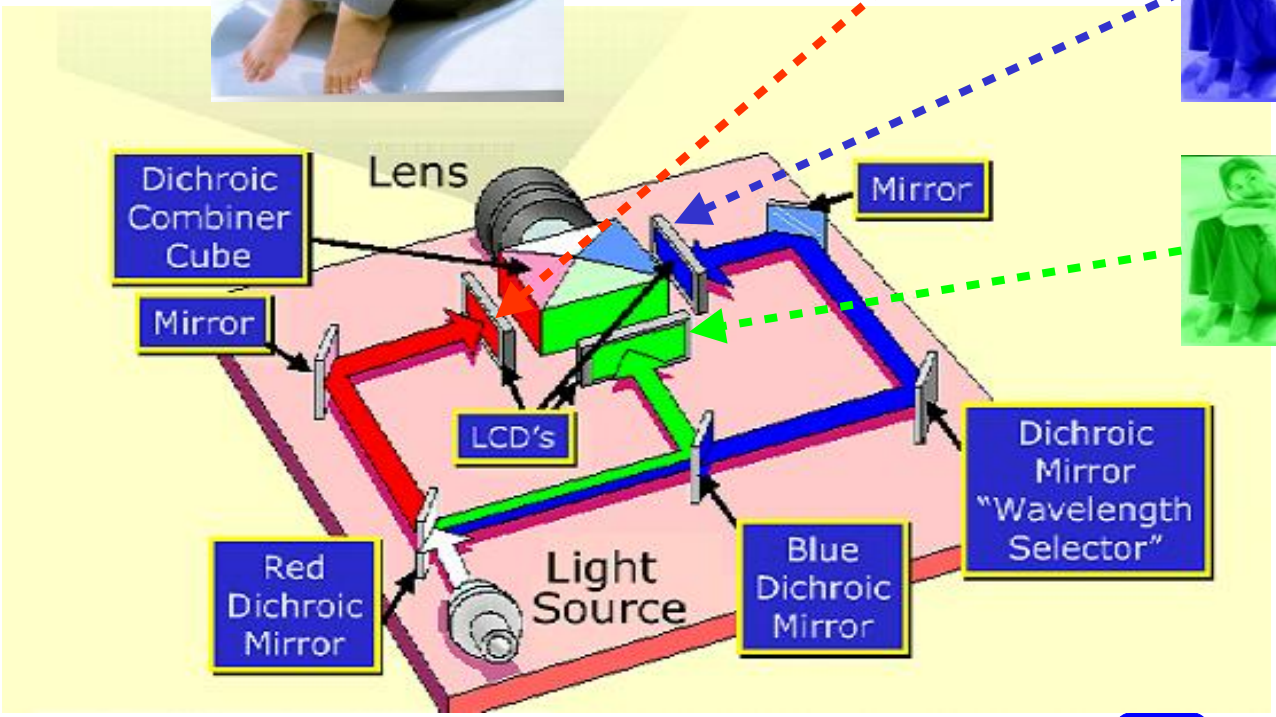
Production of major large displays



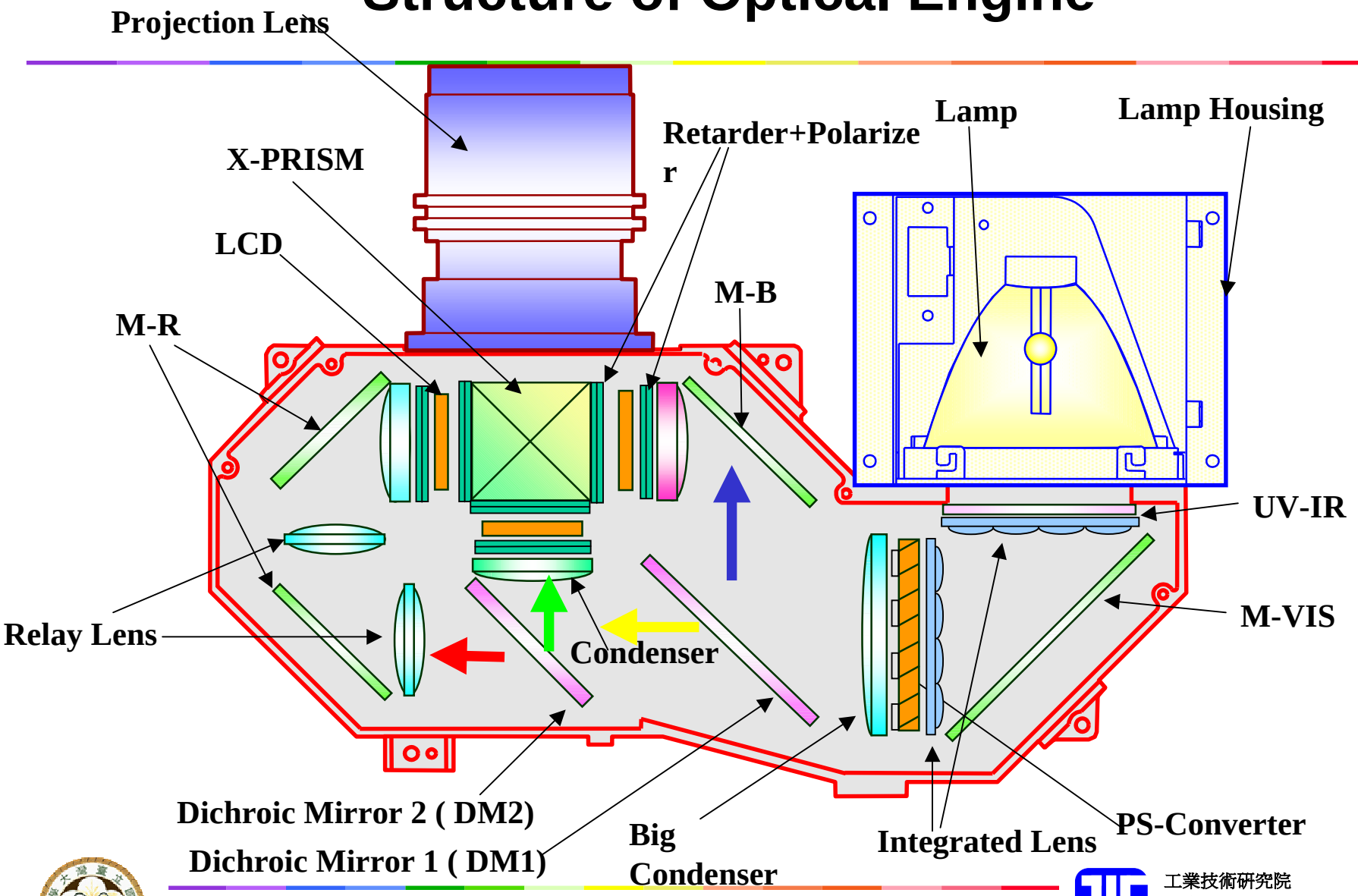
	2001	2002	2003	2004	2005	2006
Living LCD TV over 28"	19	61	382	1,132	3,177	4,575
PDP Home	113	384	834	1,853	2,954	3,851
RPTV	3,433	4,200	4,676	5,328	6,120	7,100
Front Home	98	229	430	739	2,202	5,100

投影技術

投影顯示器－架構與原理



Structure of Optical Engine



Microdisplay (Panel)

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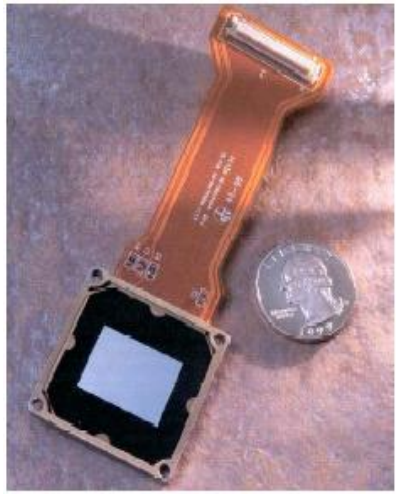
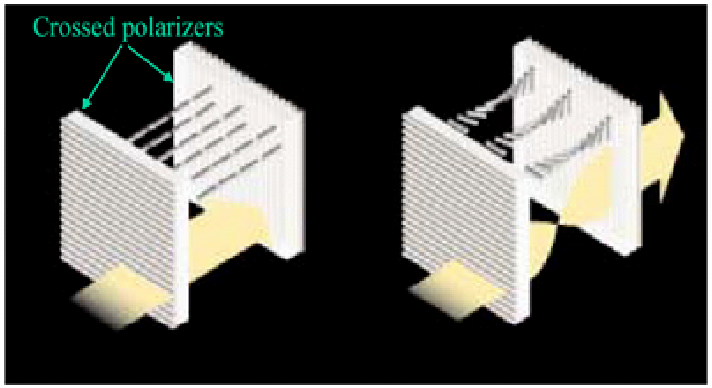
Microdisplay Panel

HTPS-LCD

DMD

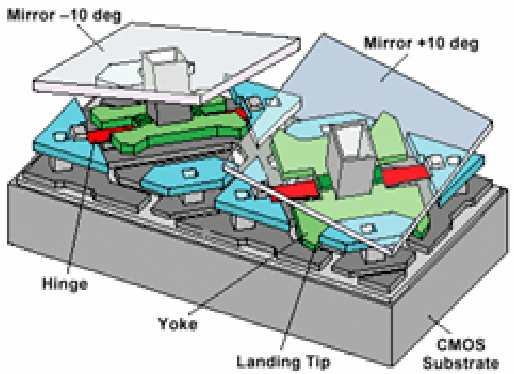


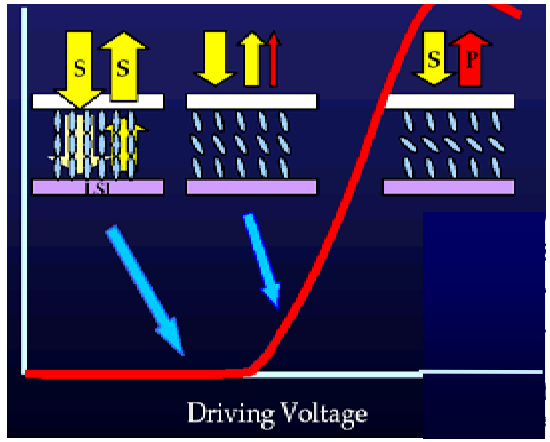
LCOS



Liquid crystal (off state)

Liquid crystal (on state)





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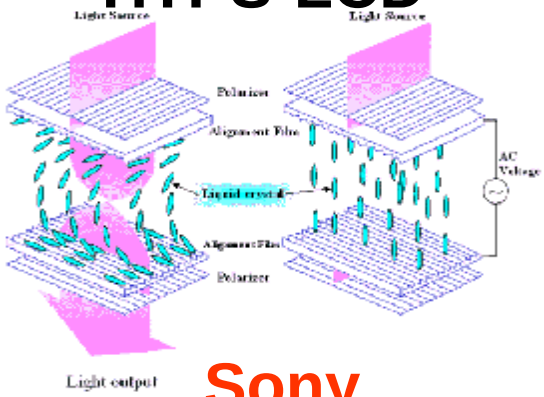
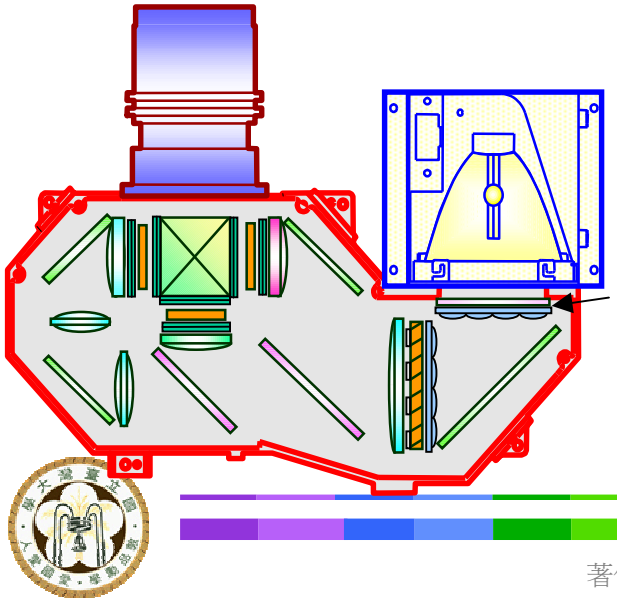
投影顯示器的CPU與光機

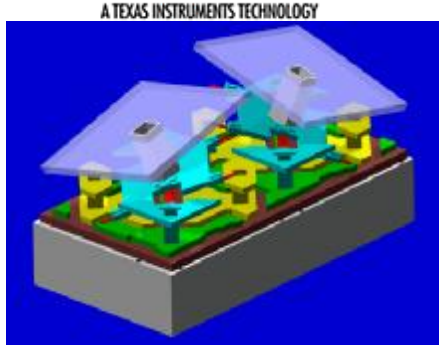
HTPS-LCD



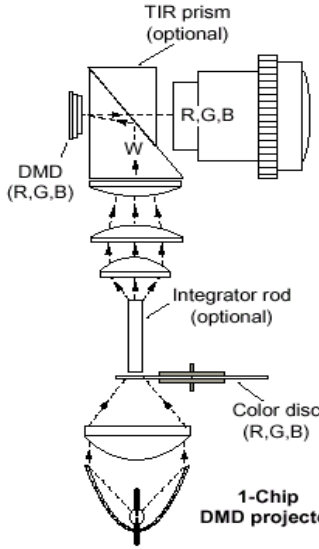
Sony
Epson



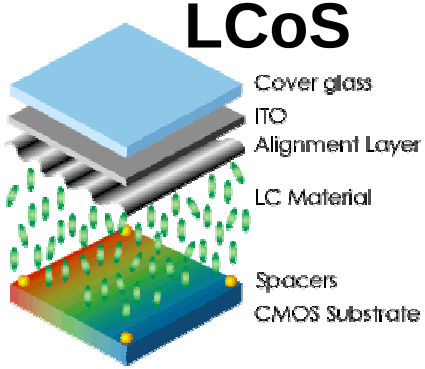
DLP
A TEXAS INSTRUMENTS TECHNOLOGY



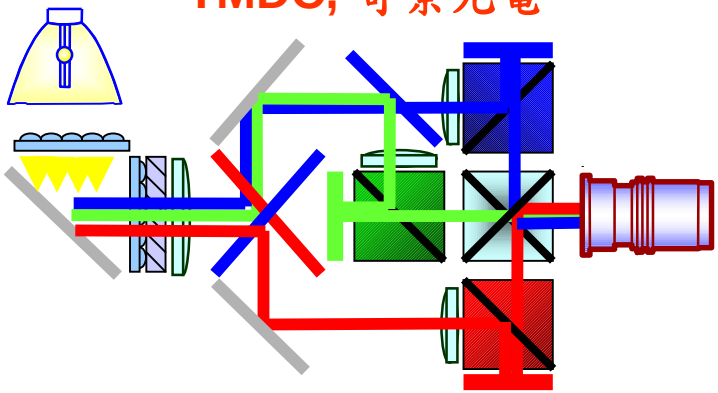
Texas Instruments



LCoS



JVC, Hitachi
Three-Five, Aurora,
MicioVue, Microdisplay,
Micropixel, eLCOS,
TMDC, 奇景光電



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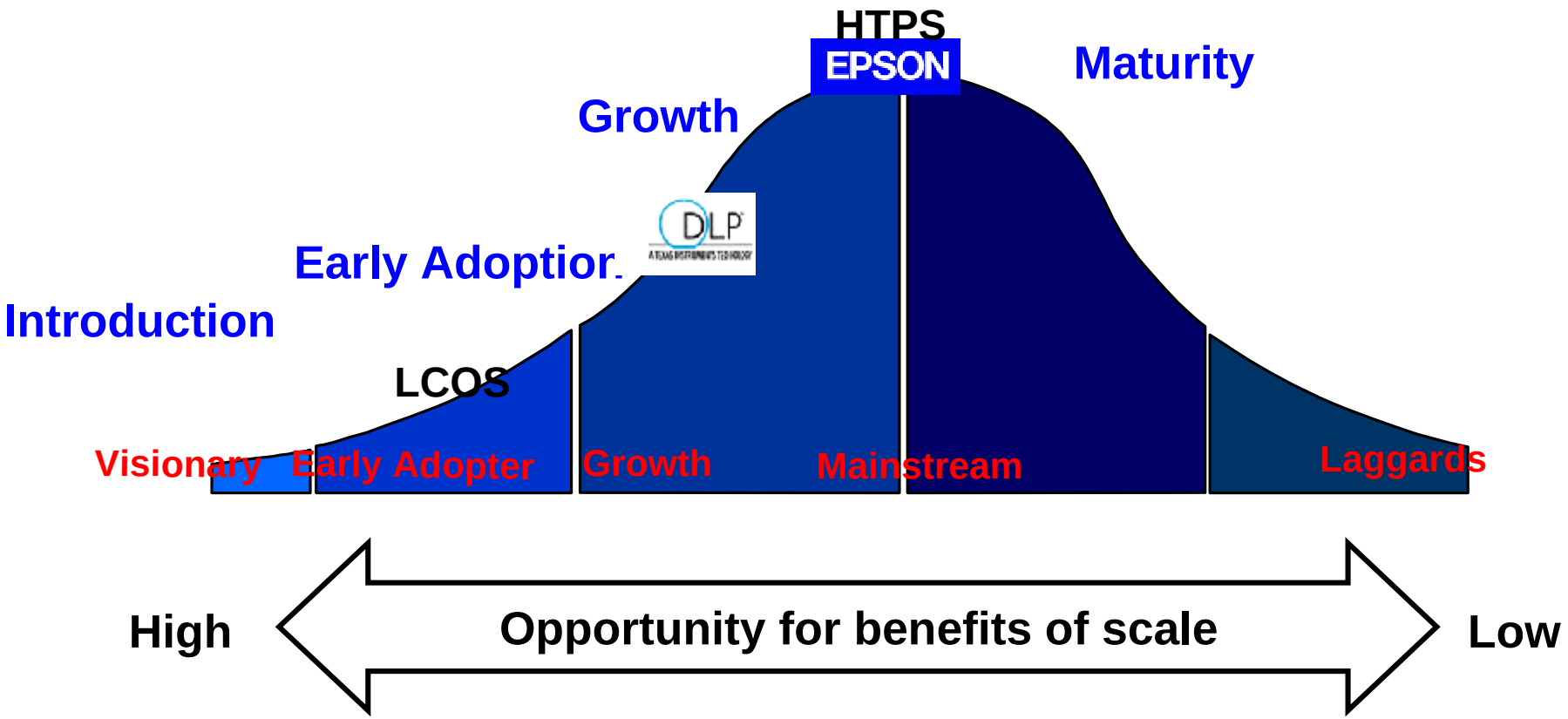
Technology Life Cycle



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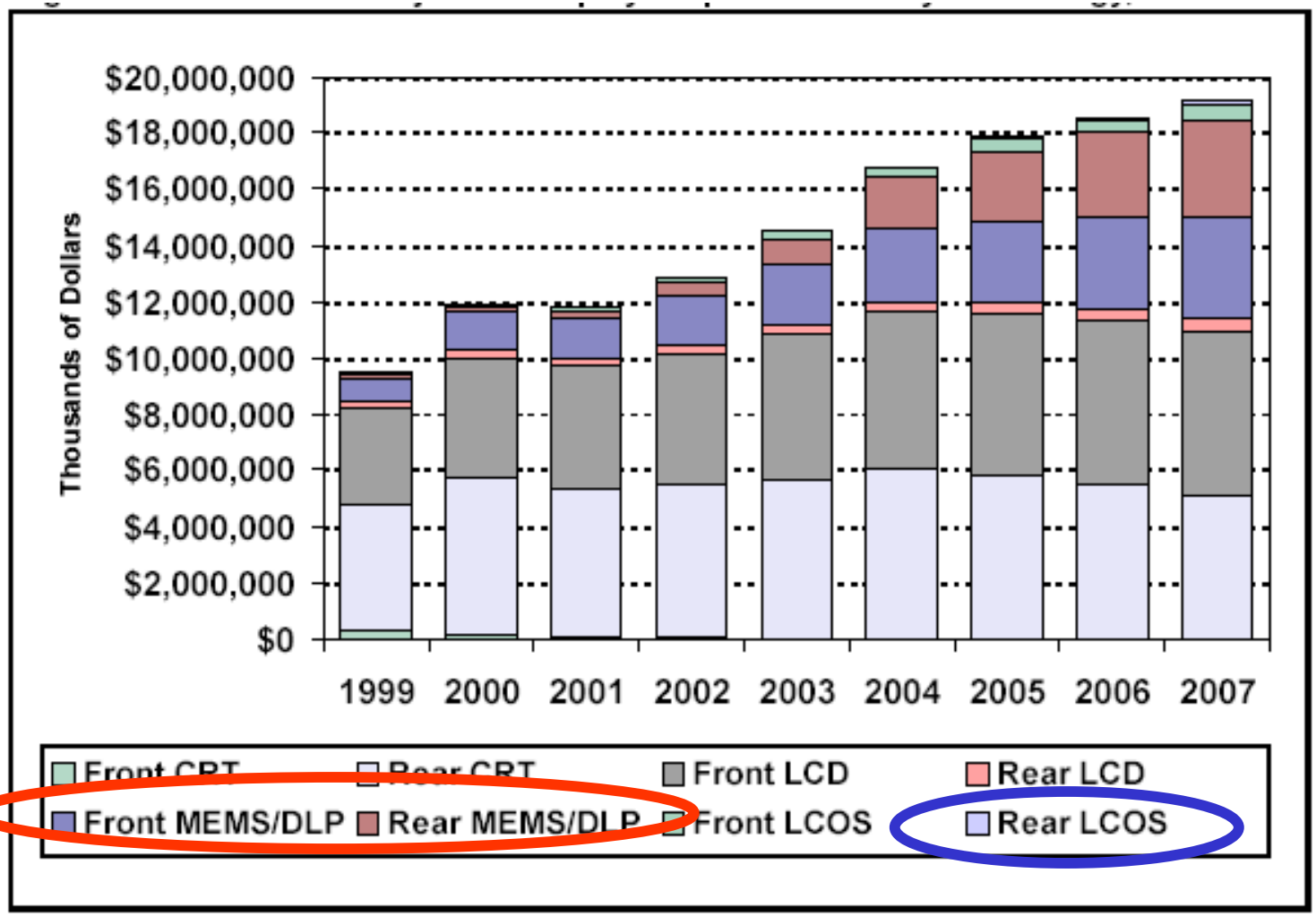
Worldwide Projection Display Shipment Value by Technology, 1999-2007



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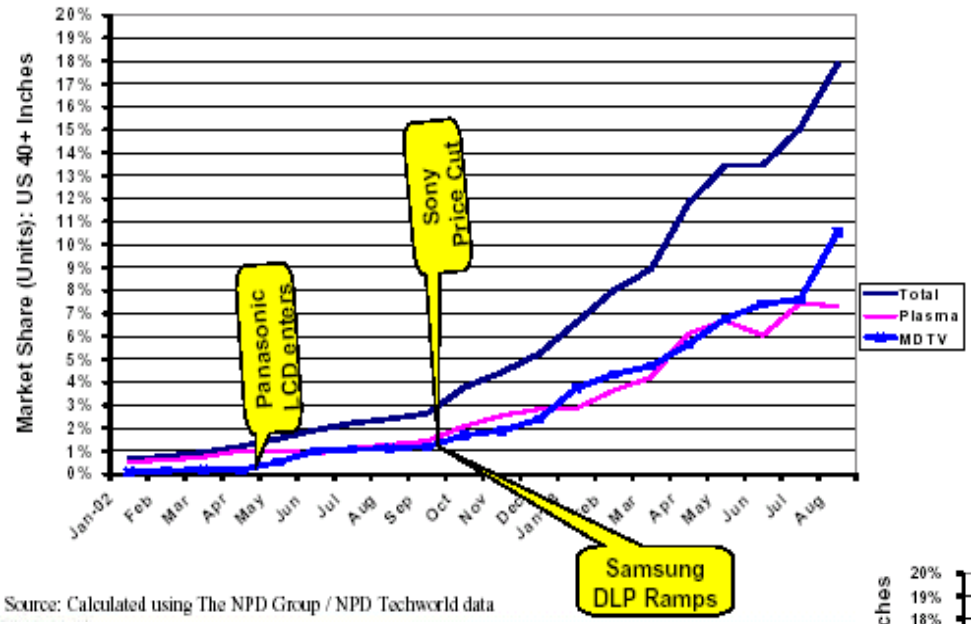
DLP™ TV Exceeds HTPS LCD (in NA)



Source: Calculated using The NPD Group / NPD Techworld data

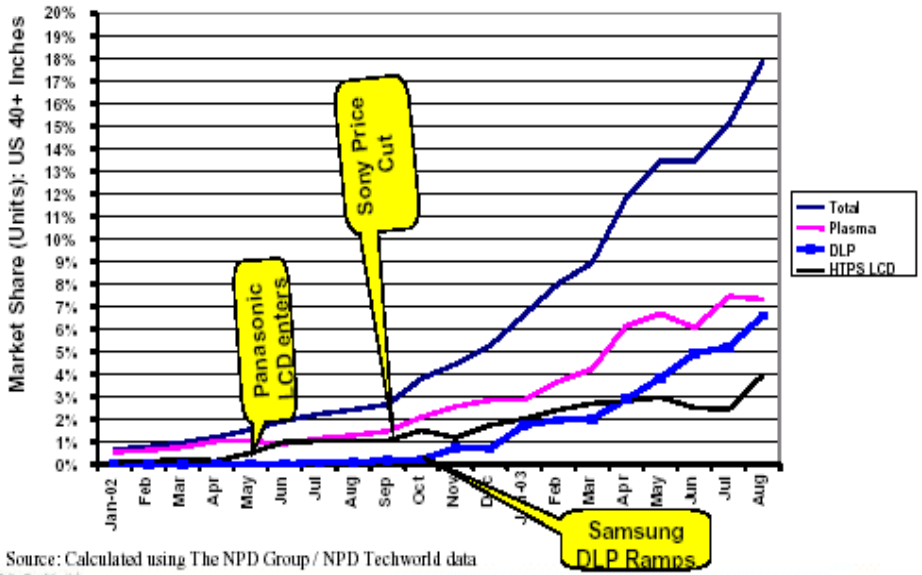
三星在美數位電視市場曜居第一

（國際新聞中心王淑儀／綜合外電）據韓國每日報報導，三星電子表示，2003年1～8月為止三星已拿克美國大尺寸數位電視市場28%的市佔率，超越SONY、三菱、Panasonic等日系廠商成為第一大供應商。

三星電子表示，美國市場需求量大增，水原事業廠產能利用率已突破100%，甚至需要加派人員投入生產，其中尤以DLP背投影電視最受歡迎。

為改良DLP背投影電視最為人垢病的體積偏大問題，三星致力研發新技術，成功將50吋DLP背投影電視的厚度縮減到與20吋映像管（CRT）電視相當，而廣受美國市場消費者青睞。

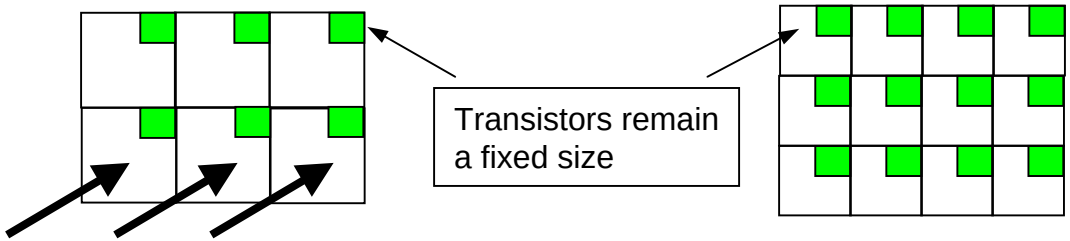
Oct 31, 2003, Digitimes



Source: Calculated using The NPD Group / NPD Techworld data

How LCOS has Resolution advantage

P-Si

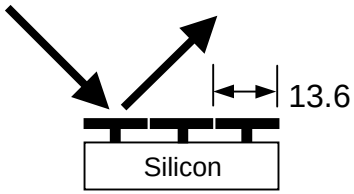


Light goes through the LCD

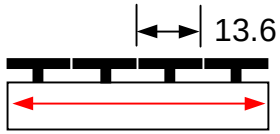
Increasing resolution reduces the size of "cell" letting less light through

- More pixels = Larger Lamp Size (wattage)
  - More Expensive, Shorter Life
  - More heat generated, more fan noise
- More Pixels = Larger die size – More Expensive

DLP

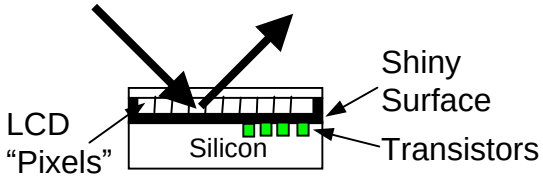


Light reflects off of mirrors

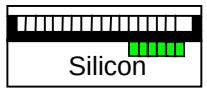


More Pixels = **Larger die size – More Expensive**

LCoS



Light reflects off of shiny surface



More Pixels = smaller pixels

- Transistors are below the LCD cell (no blocking)
- Lithographic Process – pattern the size of the pixel

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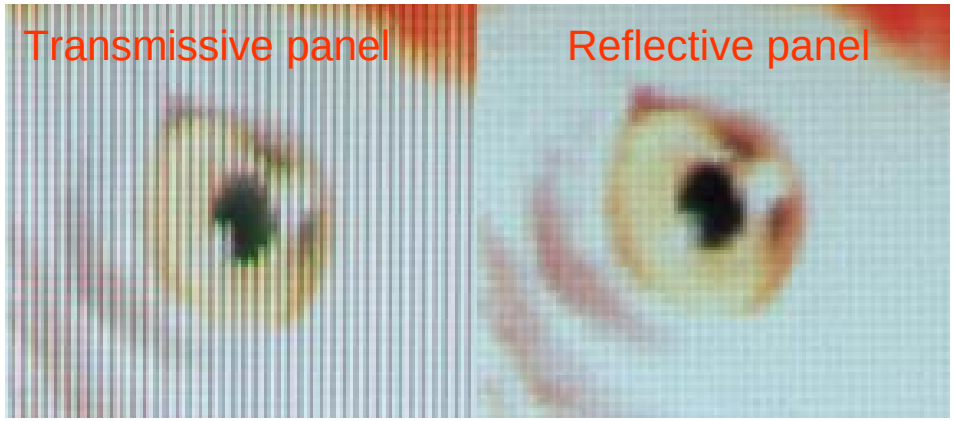
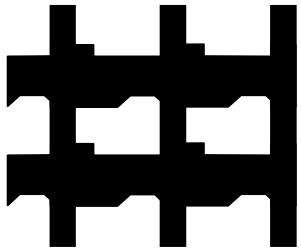
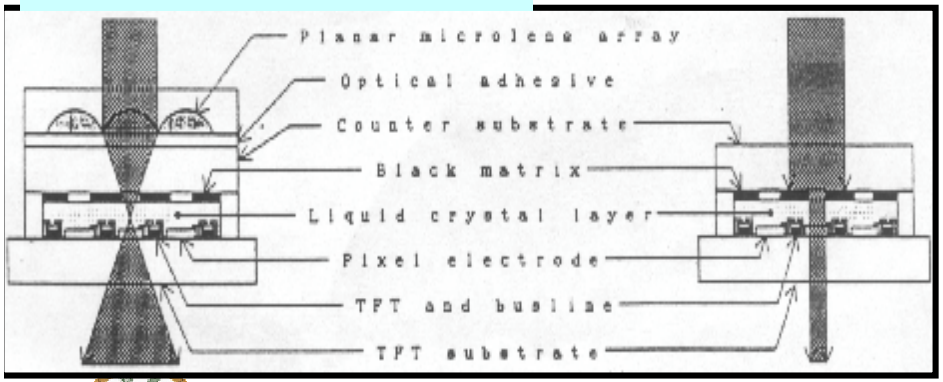
穿透式與反射式面板技術



LCD panel has limited open aperture.
- à Optical throughput
- à Resolution





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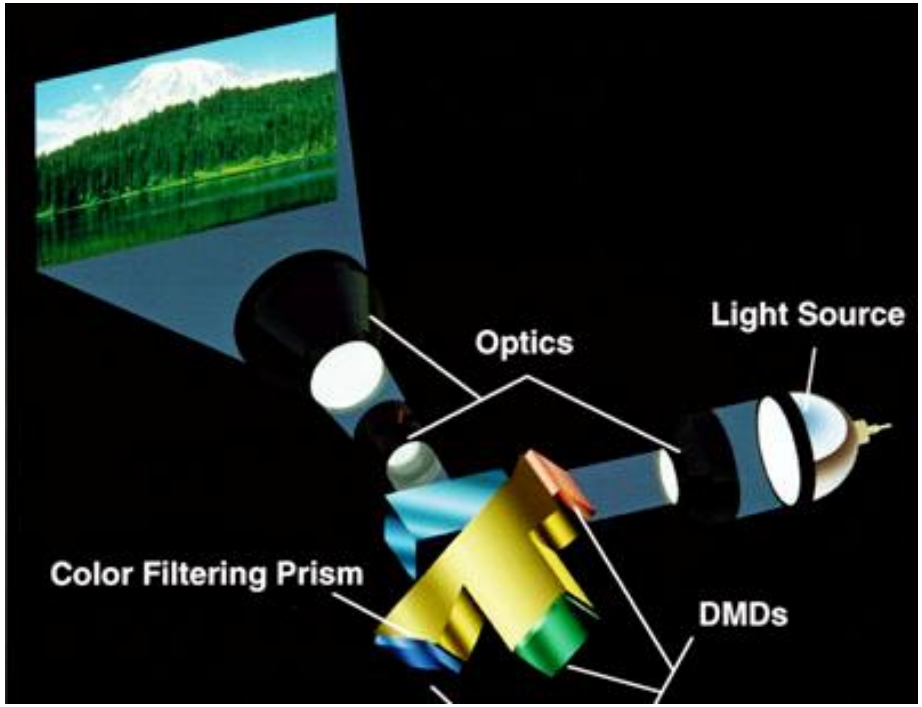
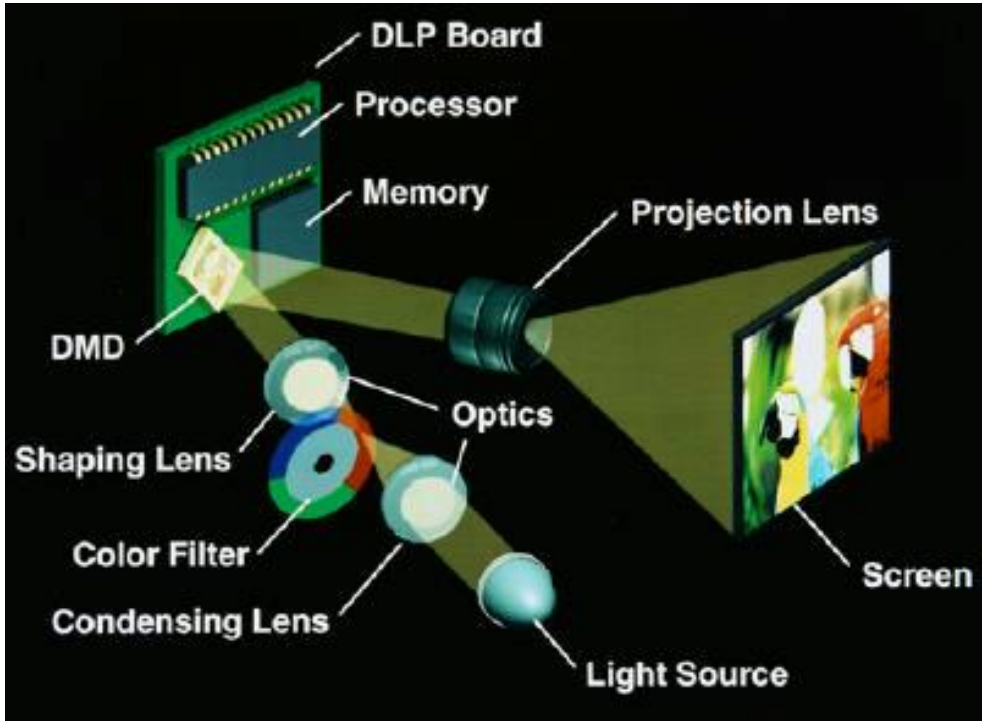
三片式與單片式系統

3-panel projector



1-panel projector



§成本問題

§量產對位問題

§亮度問題

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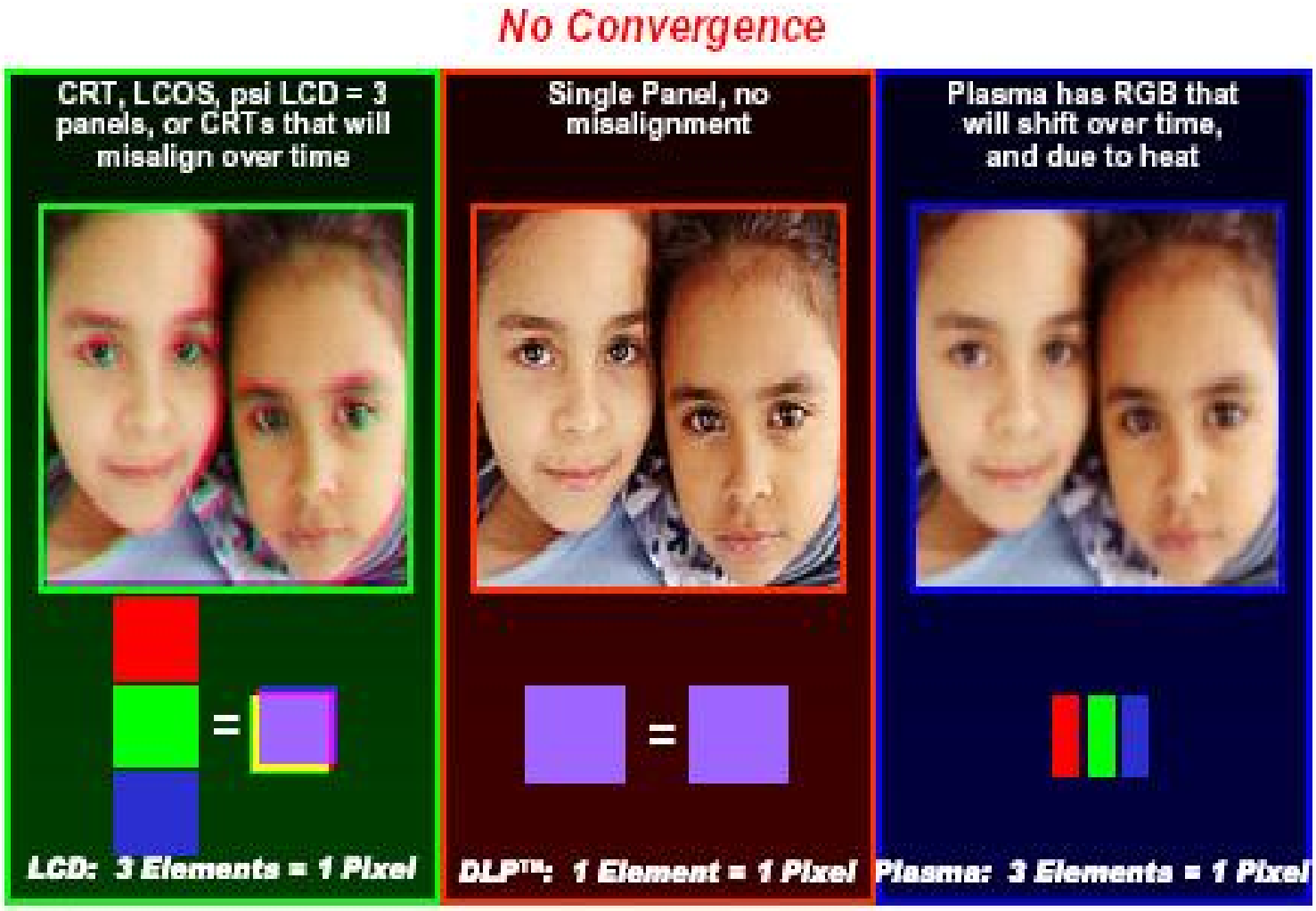
Single-panel Advantage:
Easy on the Eyes - No convergence Problems



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Lamp

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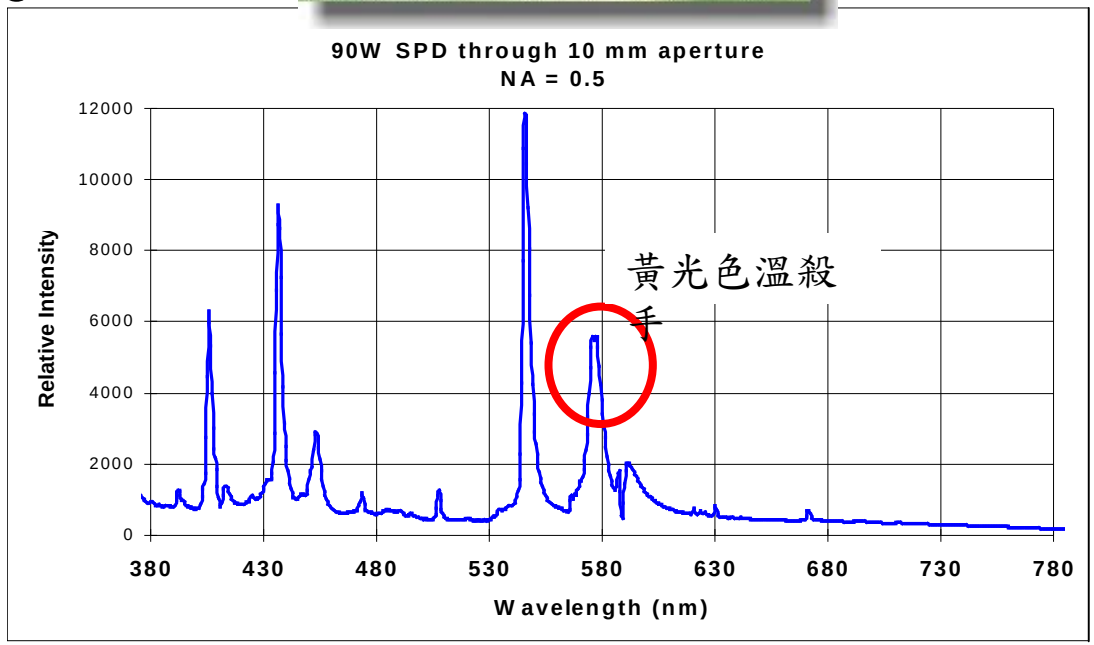
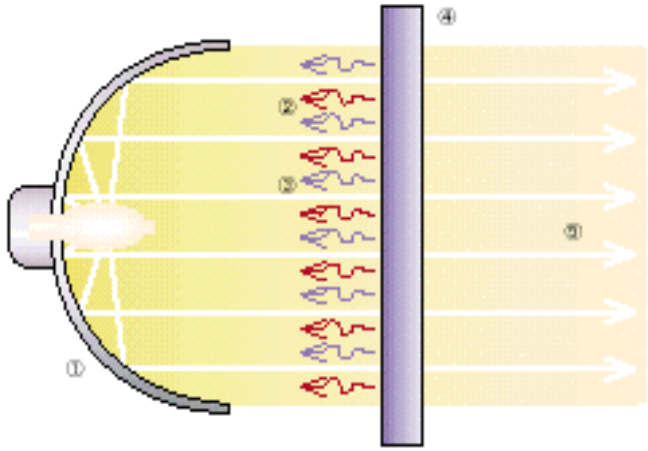
Lamp

- Luminous Flux
- Luminous Efficiency
- Color temperature
- ARC gap
- Etendue
- Lamp Wattage
- Life-Time



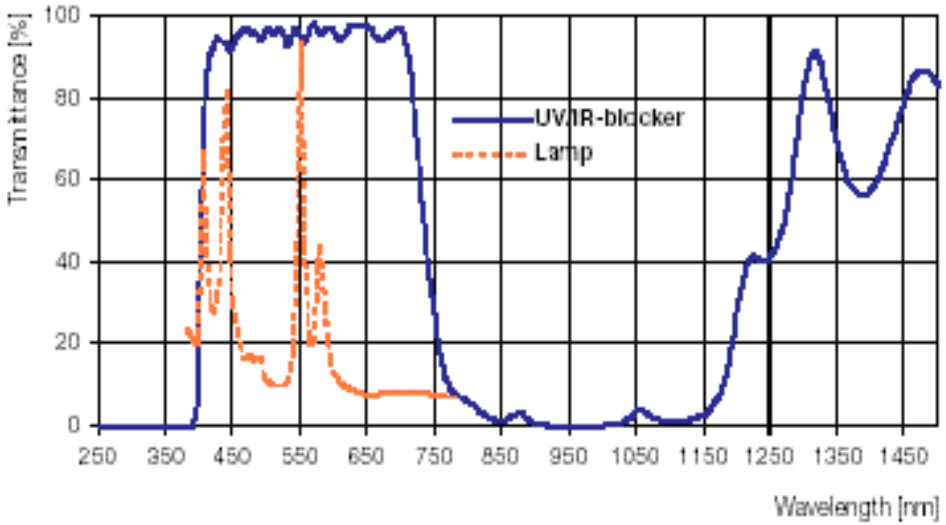
UV-IR CUT

Schematic of UV/IR-blocker



① Lamp with reflector
② IR-radiation
③ UV-radiation
④ UV/IR-blocker
⑤ Visible light

Spectral curve of UV/IR-blocker
and emission spectrum of typical projection lamp



Temperature resistant	up to 400 °C
Spectral characteristics, AOI = 0°	
T abs. < 1%	up to 380 nm
T = 50%	for λ = 405 +/–10 nm
T avg. > 90%	for λ = 425–680 nm
T = 50%	for λ = 730 +/– 20 nm
T avg. < 5%	for λ = 800–1150 nm
Standard size	160 x 110 x 1.1 mm

UV光之害處：破壞液晶分子，脆化塑膠元件

IR光之害處：使光機內部產生高熱

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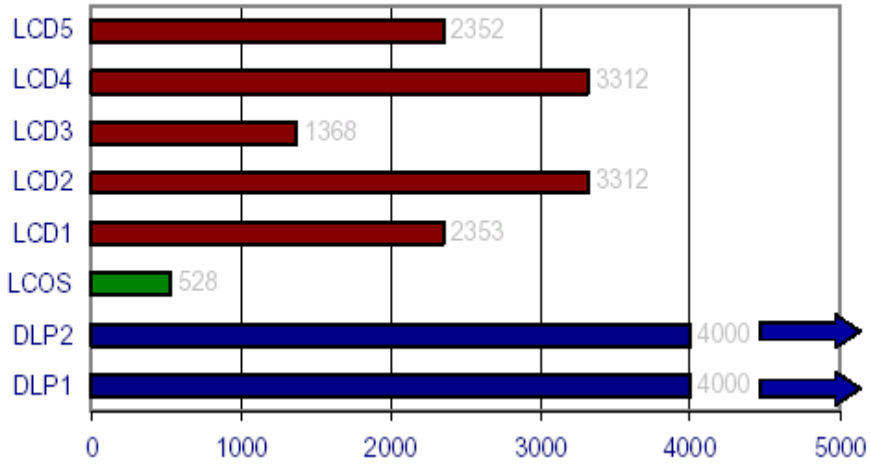
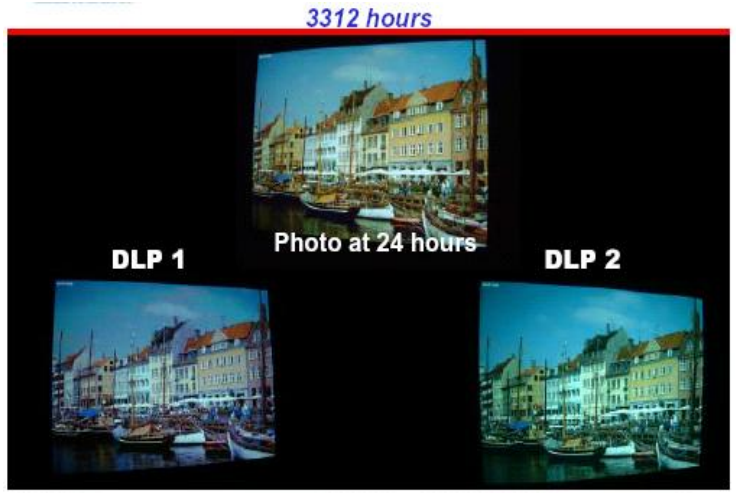
Time to Failure





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Uniformity

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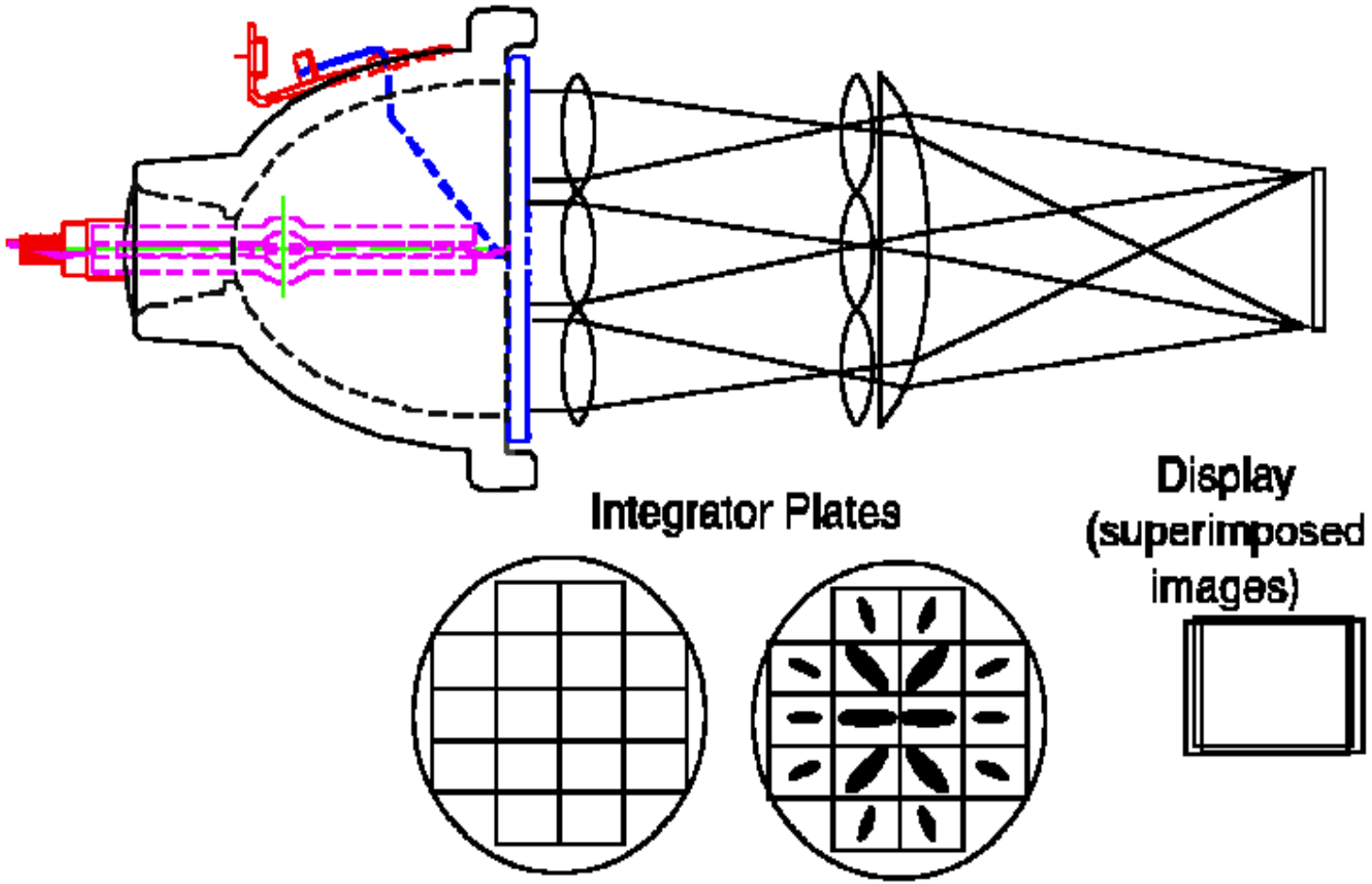
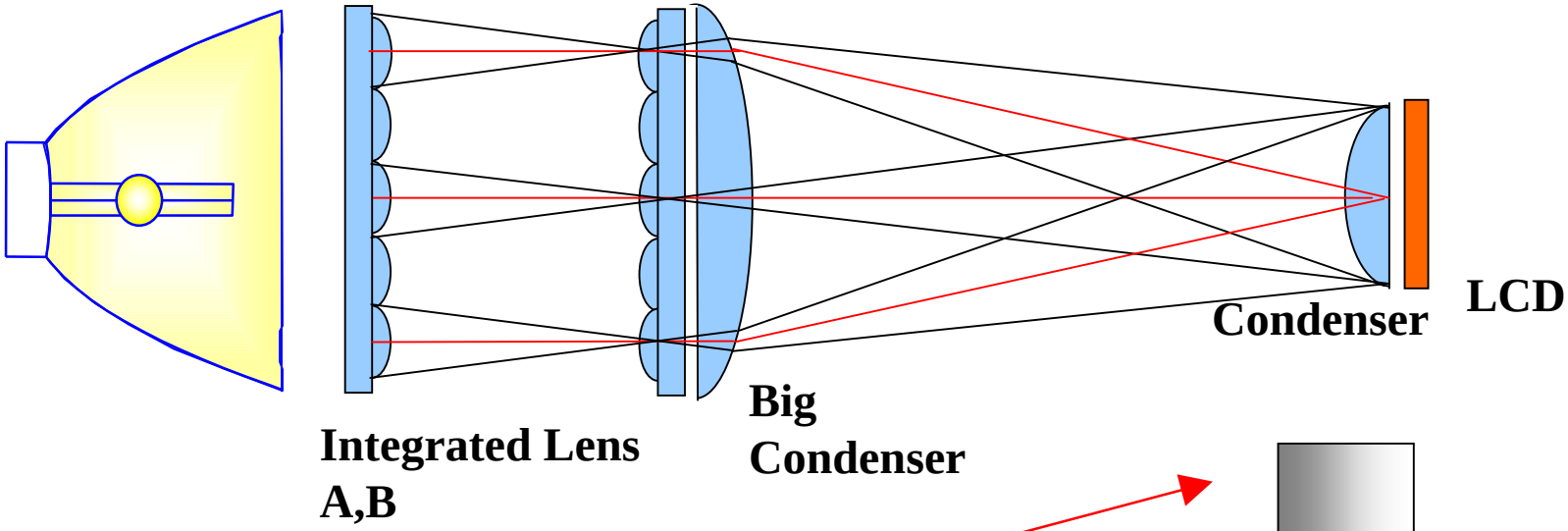
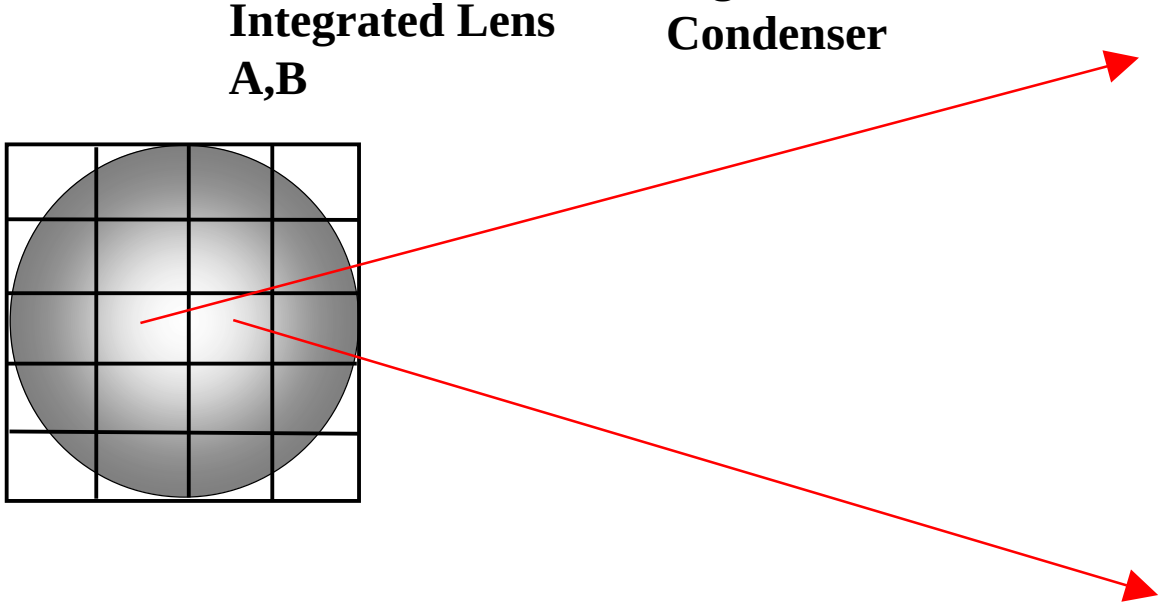
Integrated Lens

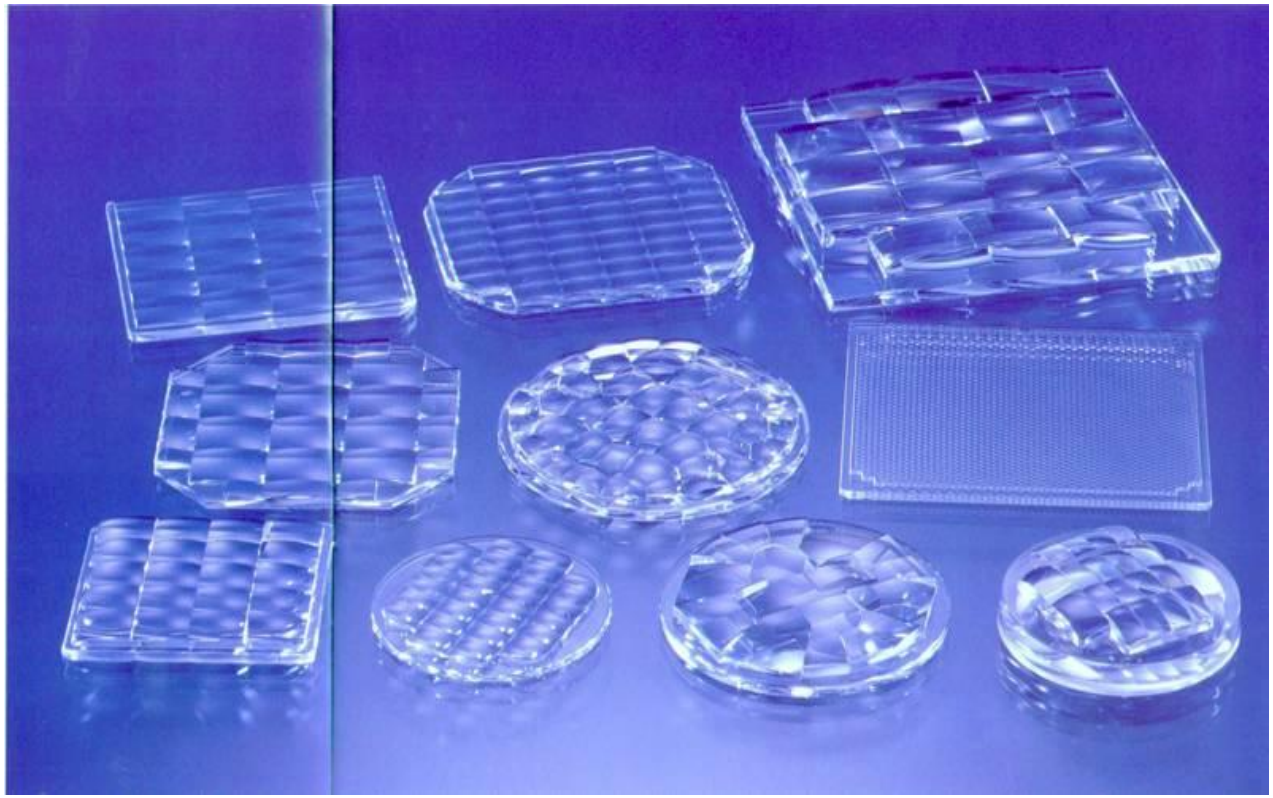


Integrated Lens





Integrated Lens



Function:

1. **Illumination Uniformity**
2. **Light shape changed from circle to rectangle**

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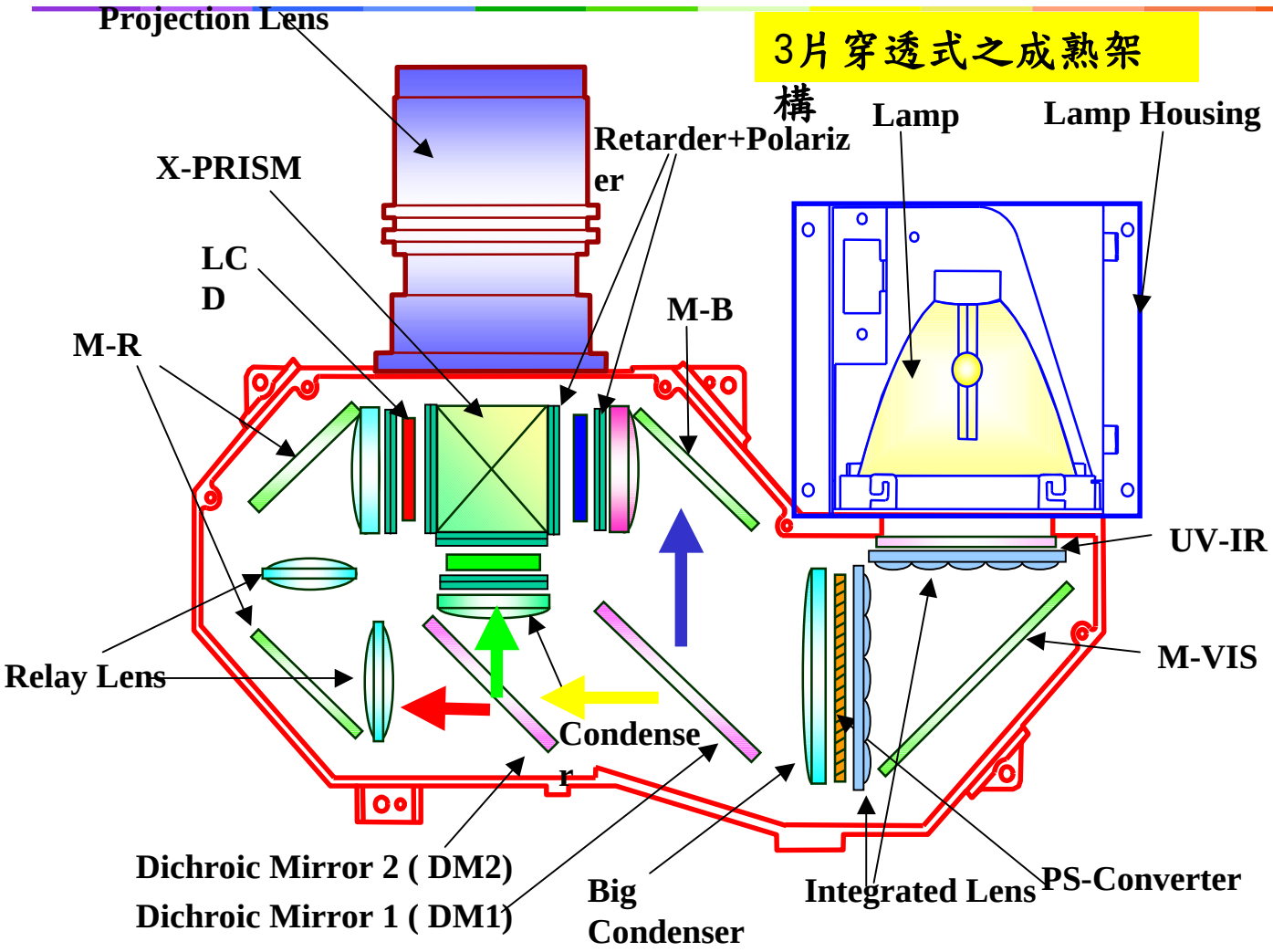
Three Transmissive Panels in X-prism Type

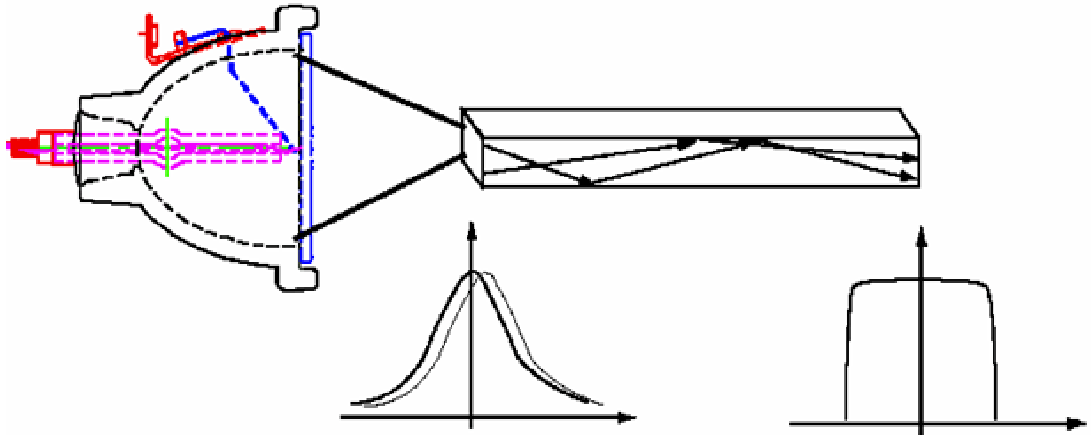


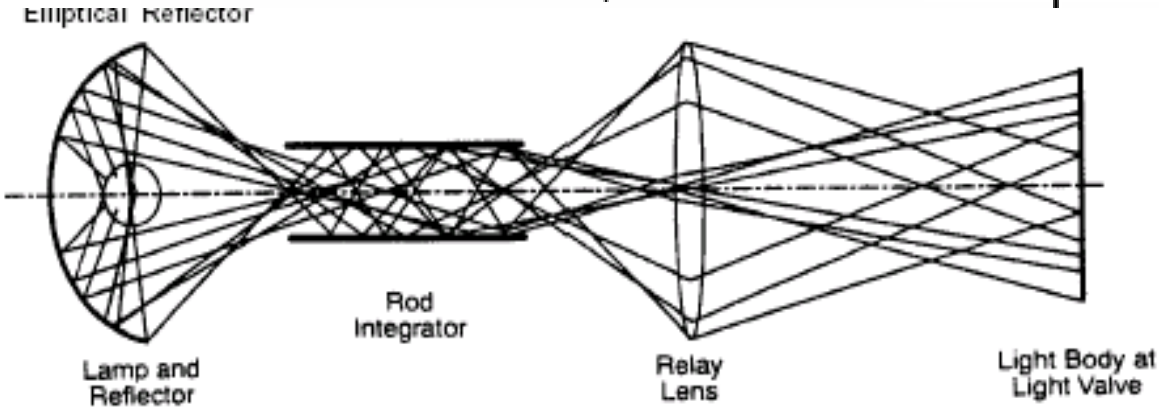
CPT(華映) CLP-2000

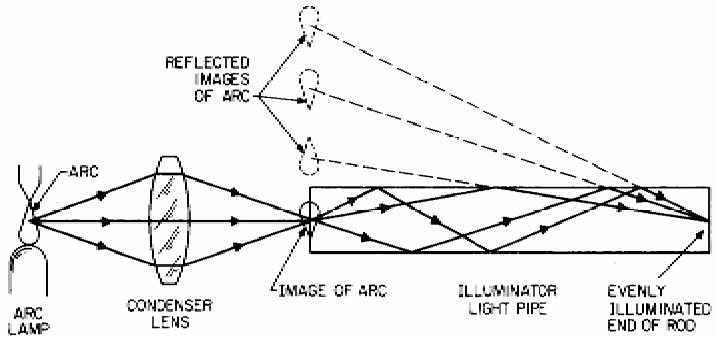
1800 ANSI Lumens

1024x768

Light Tunnel







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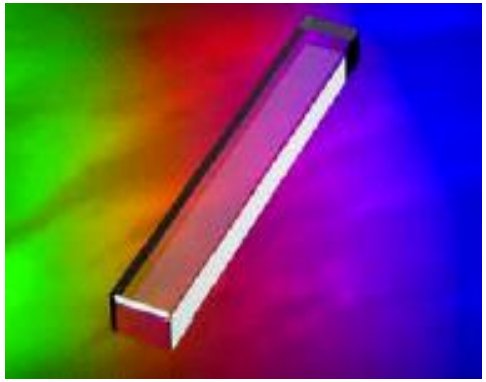
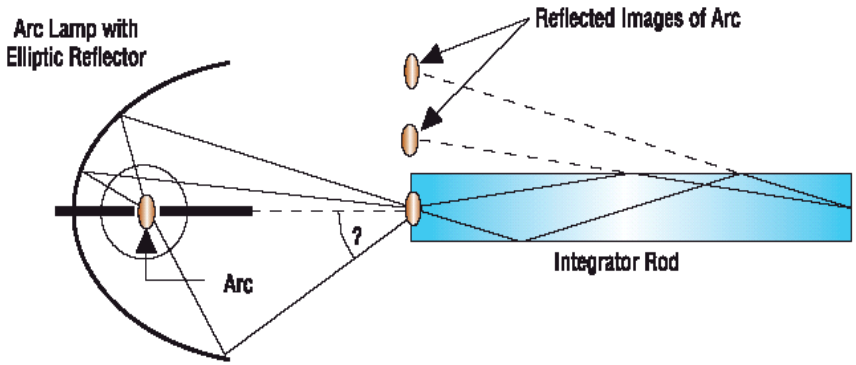
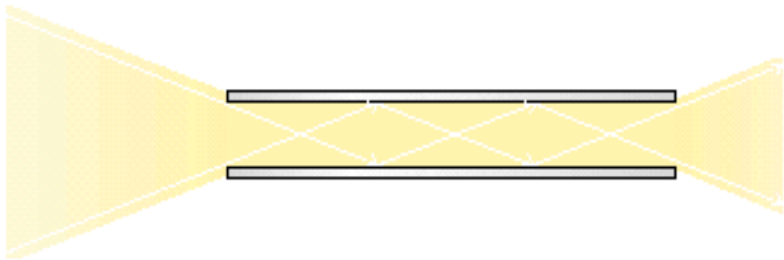
Integrator Rod & Hollow Integrator LightTunnel™







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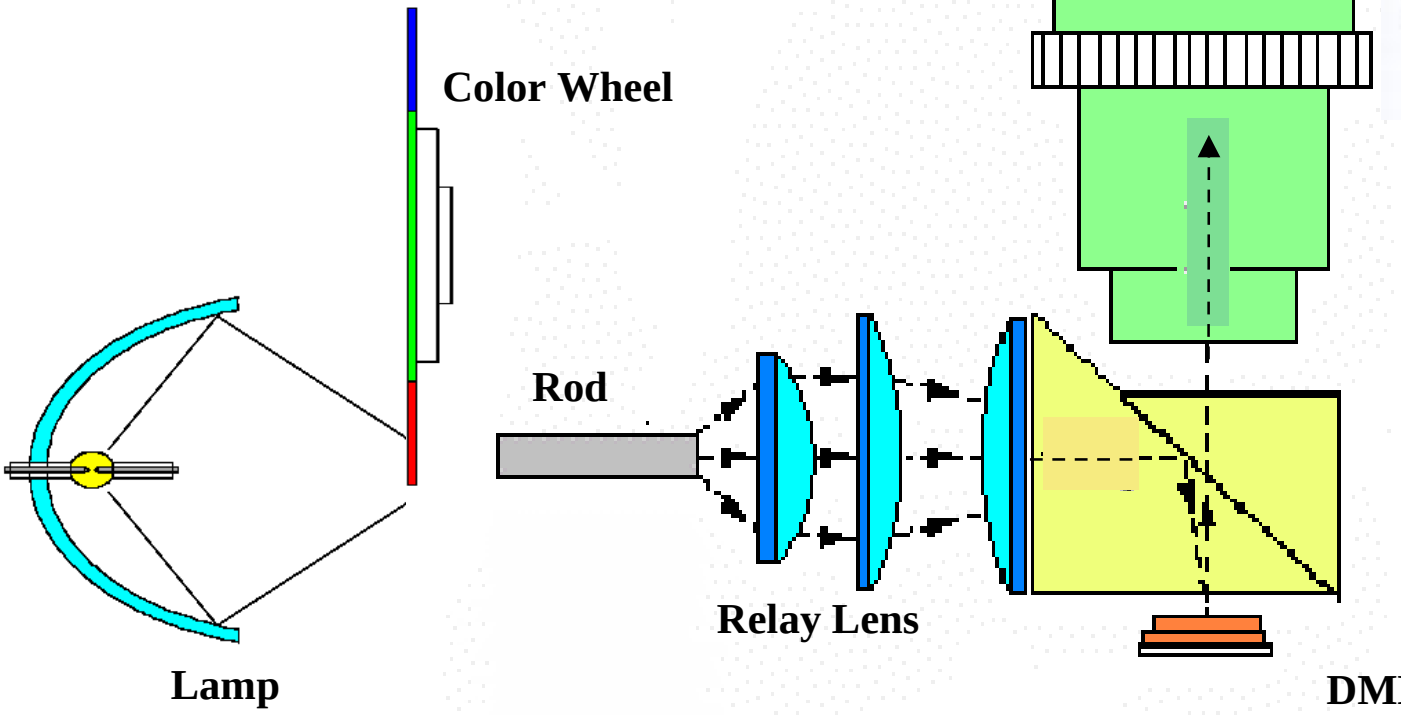
TIR prism型單片式DLP光機



BenQ 7765

Optoma EzPro 715

Beam Direction

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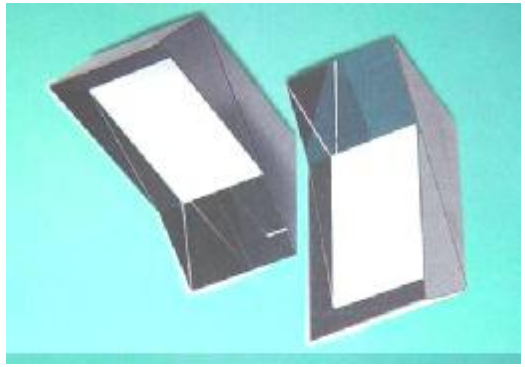
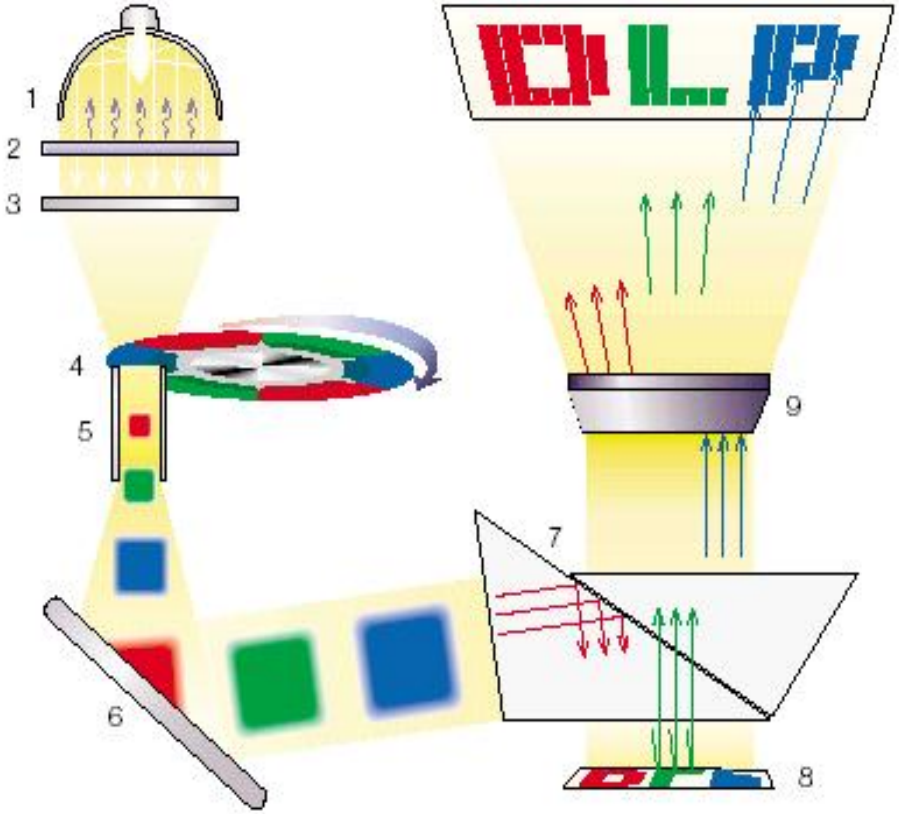
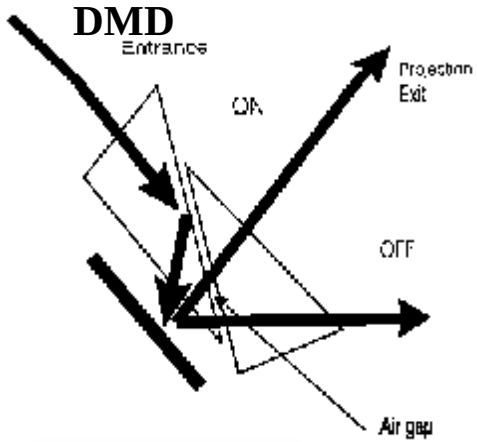
TIR PRISM

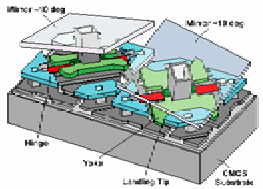




Schematic of DLP™ brand projector showing ColorWheel™, LightTunnel™ and LightGate™

1. Lamp with Cold Light Reflector
2. UV-Blocking Filter
3. Field Lens
4. ColorWheel™
5. LightTunnel™
6. SILFLEX-VIS™
7. LightGate™
8. DMD™ (Digital Micromirror Device™)
9. Projection Lens





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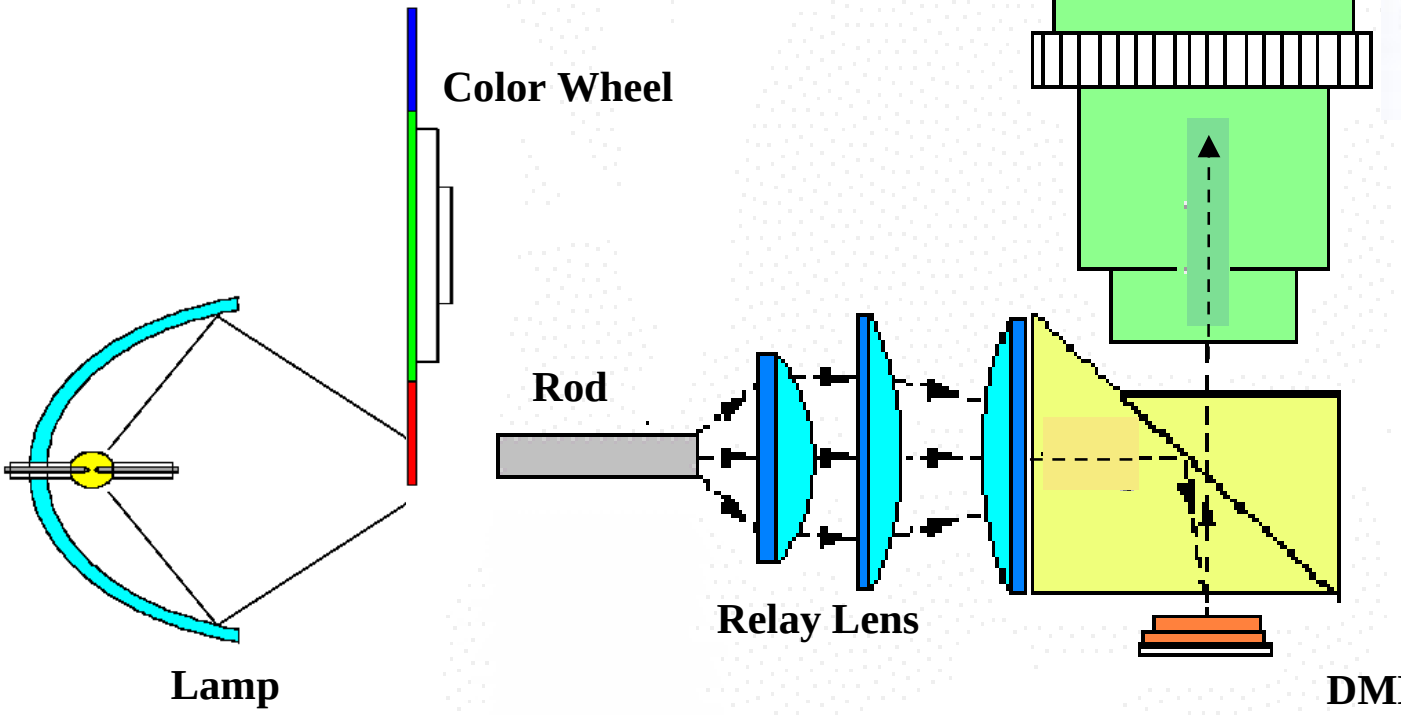
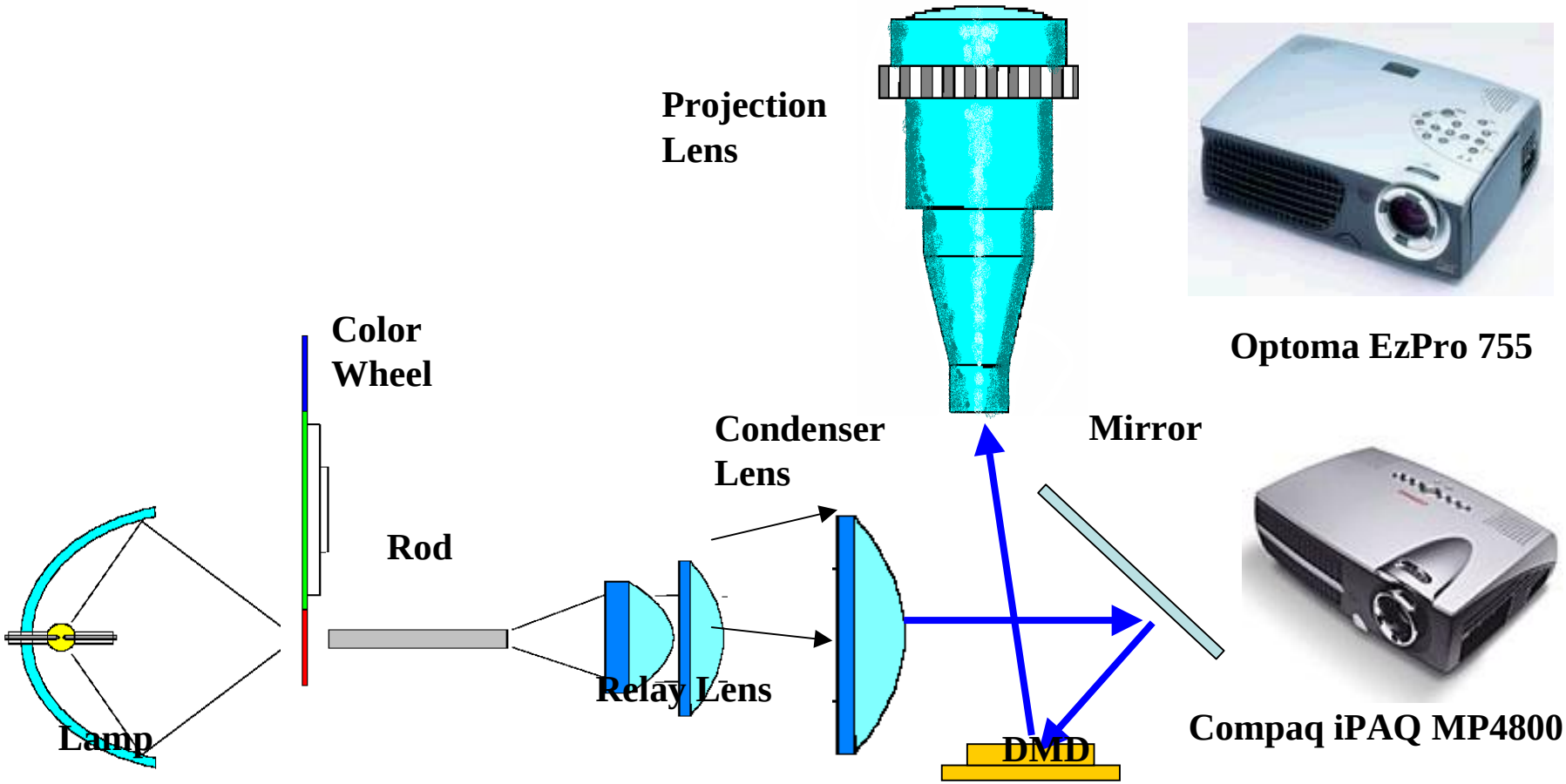
TIR prism型單片式DLP光機



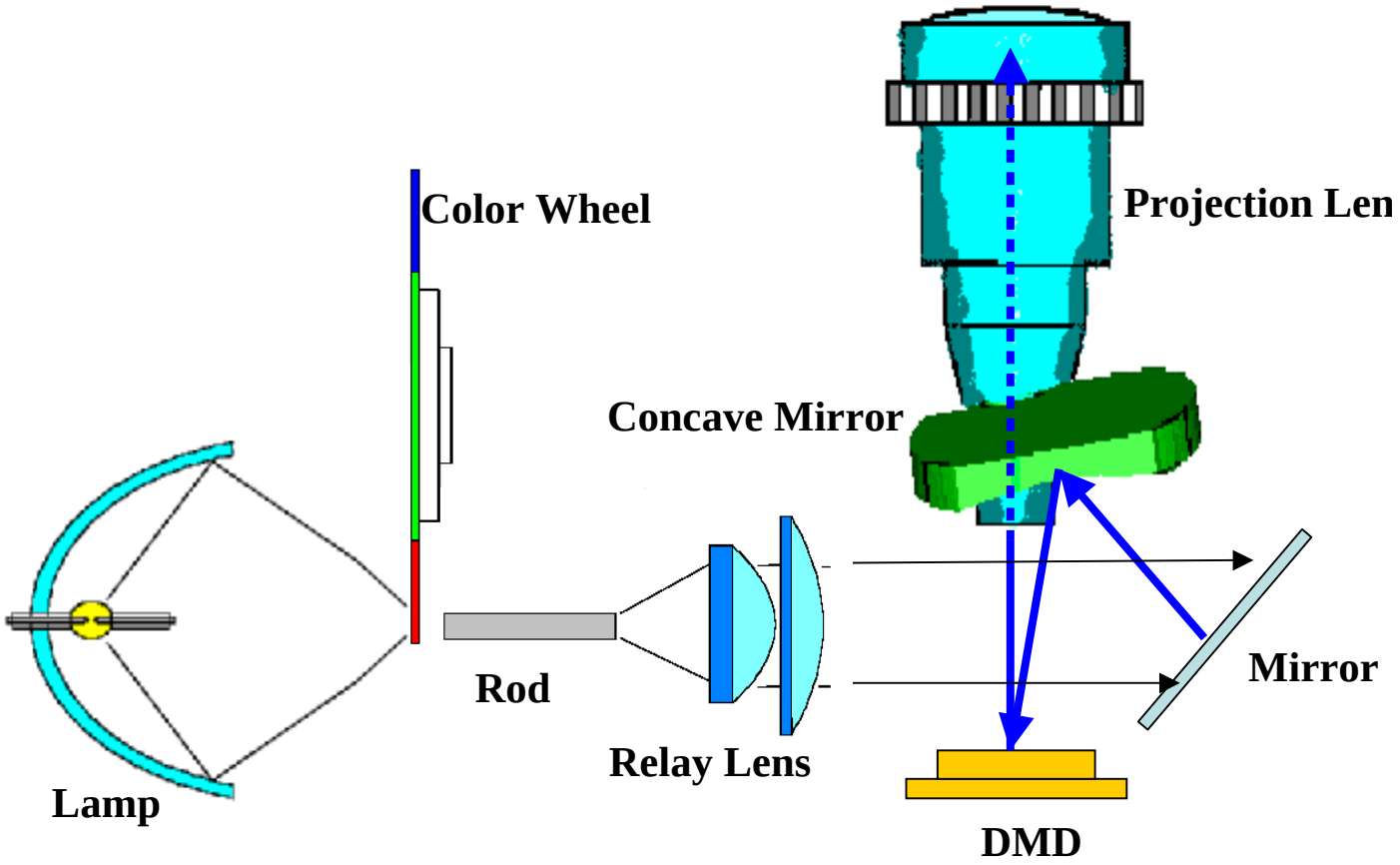
BenQ 7765

Optoma EzPro 715

Condenser Lens型單片式DLP光機



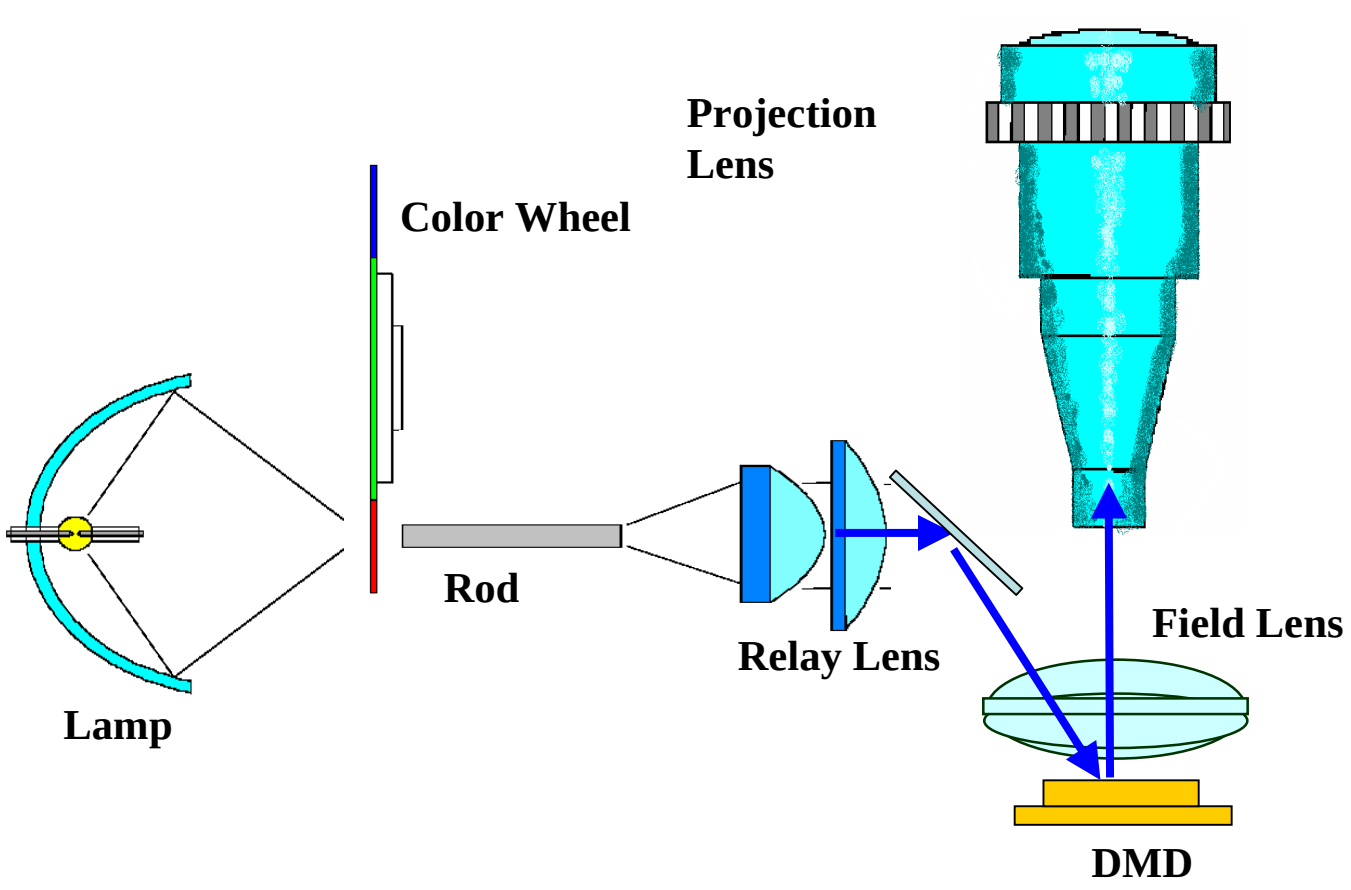
Concave Mirror型單片式DLP光機



PLUS U3-1100WZ

BenQ SL705X

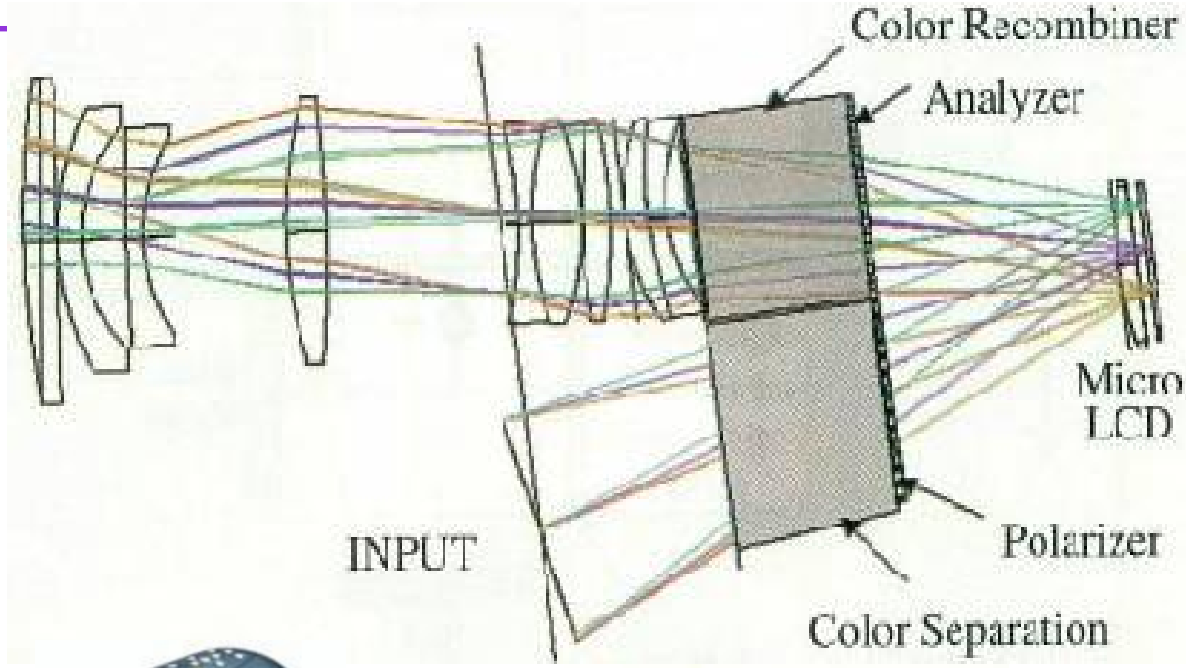
Field Lens型單片式DLP光機



InFocus LP130

Optoma EzPro 730

Off-Axis Projection System



無PBS之束縛

Contrast 佳

Nova engine 專利

適合AURORA LCOS 面板

離軸式(off-axis)鏡頭

光機不易扁平化

The Everest RX1300

The IQI 7800

Luxeon's X3

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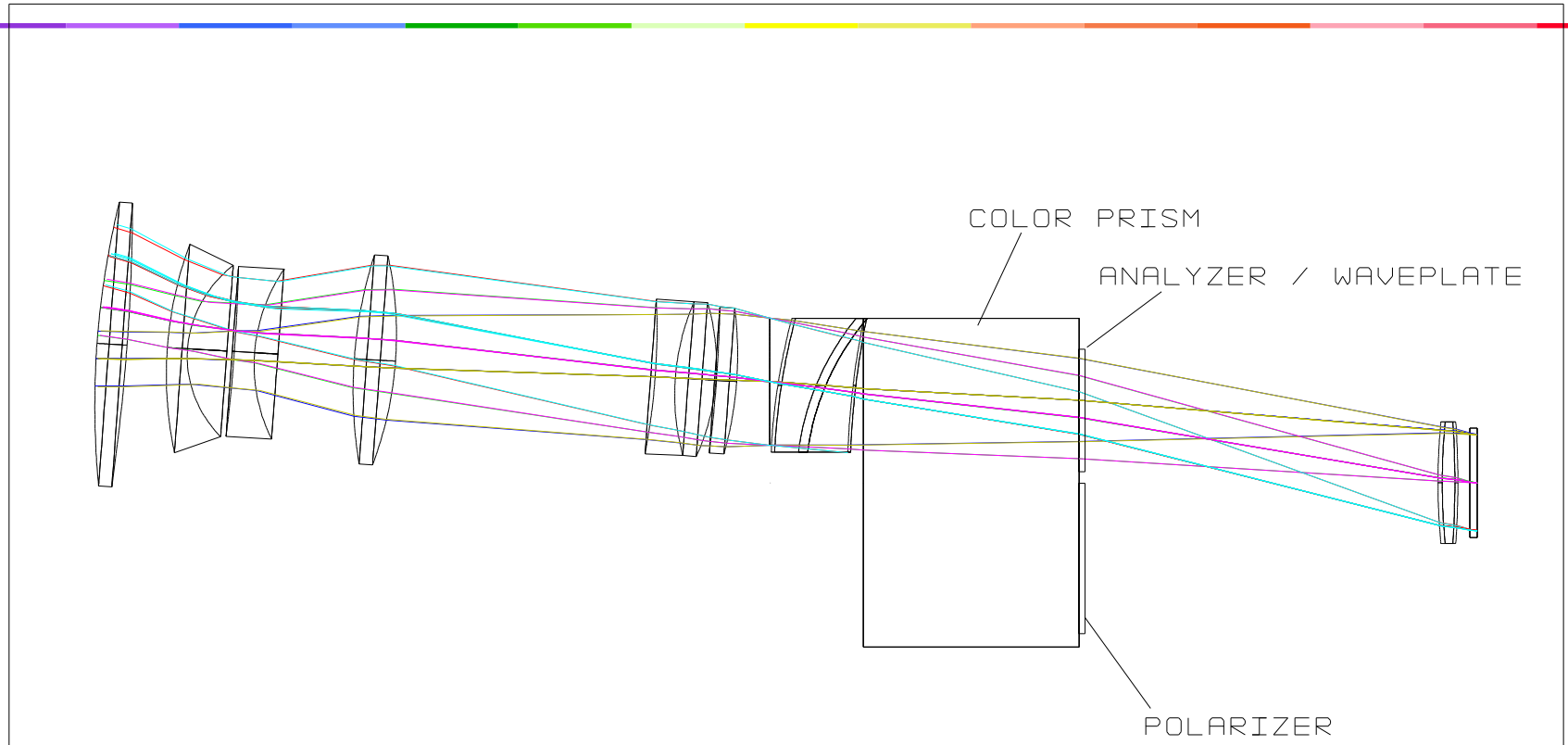
Off-Axis Zoom Lens Design



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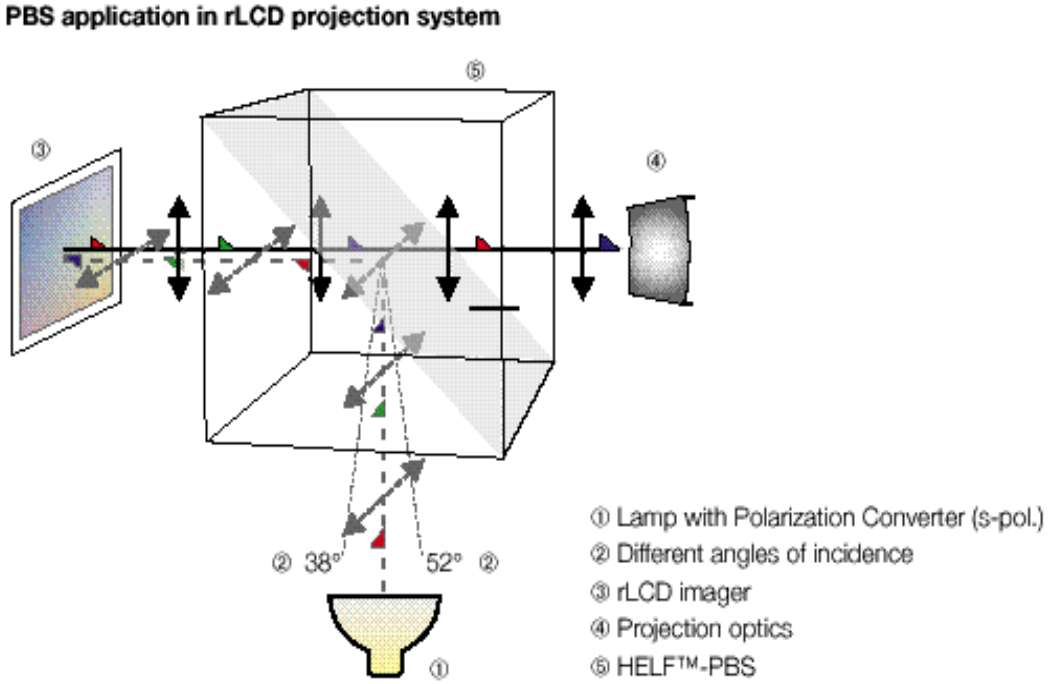
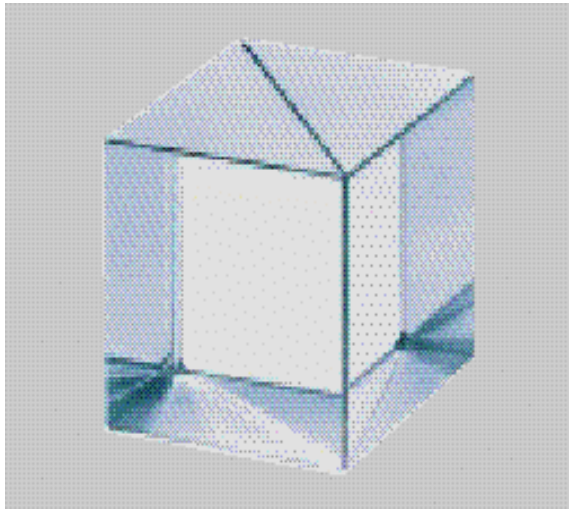
PBS





Antireflection coating, typically 2-4 layers, is deposited on the outer faces of each triangular segment

On the inner surface,tricky 30 to 100+ layer stack of thin films that can separate the polarization state of light over a fairly wide range of f-numbers (perhaps down to f#2).

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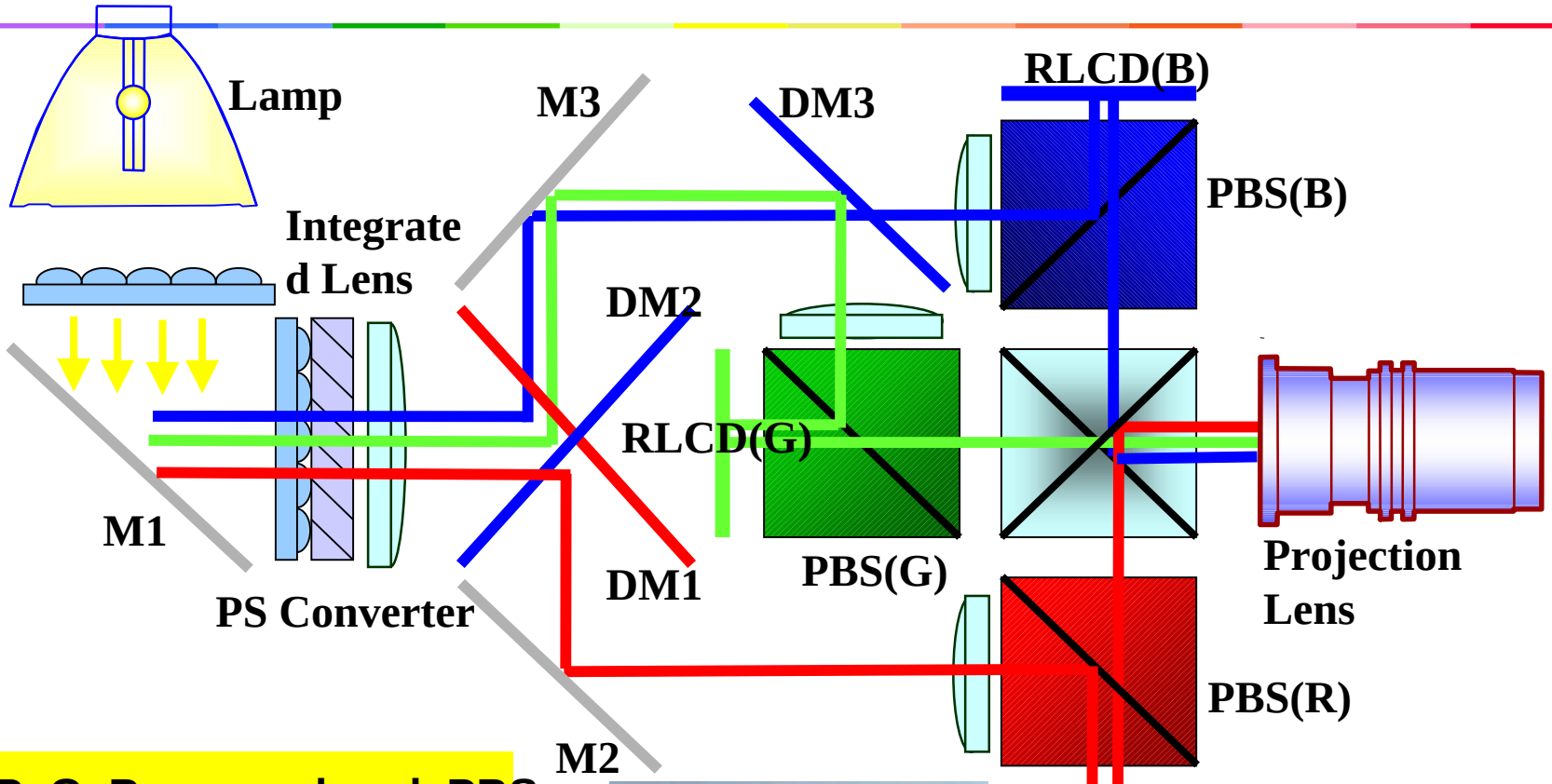
Three LCOS Panels in 4-Cube Type



R, G, B narrow band PBS

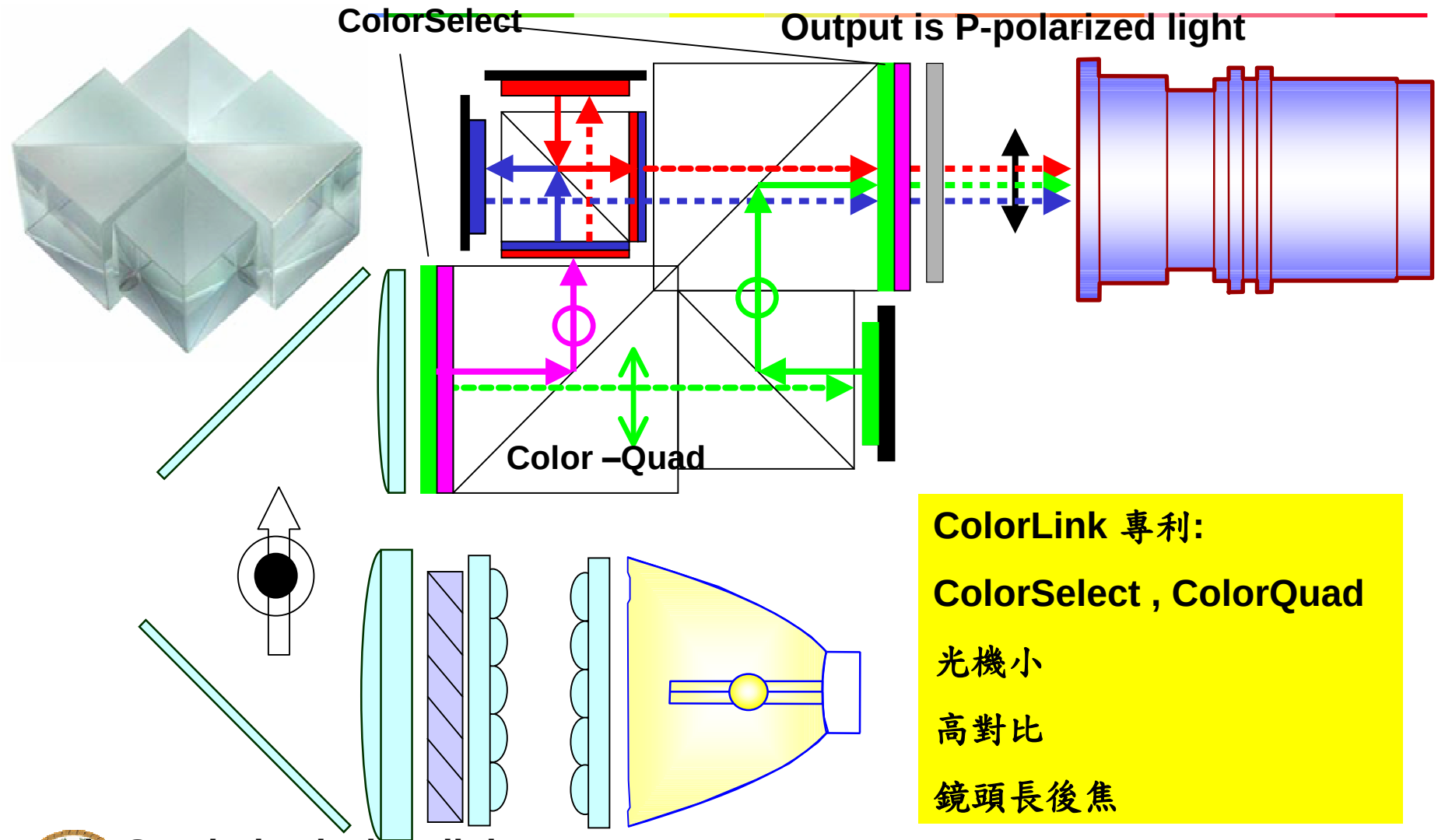
成熟的光學元件

鏡頭長後焦

光機體積大

IBM-APTI AP1500SX

Three LCOS Panels in Color –Quad Type



ColorLink 專利:

ColorSelect , ColorQuad

光機小

高對比

鏡頭長後焦

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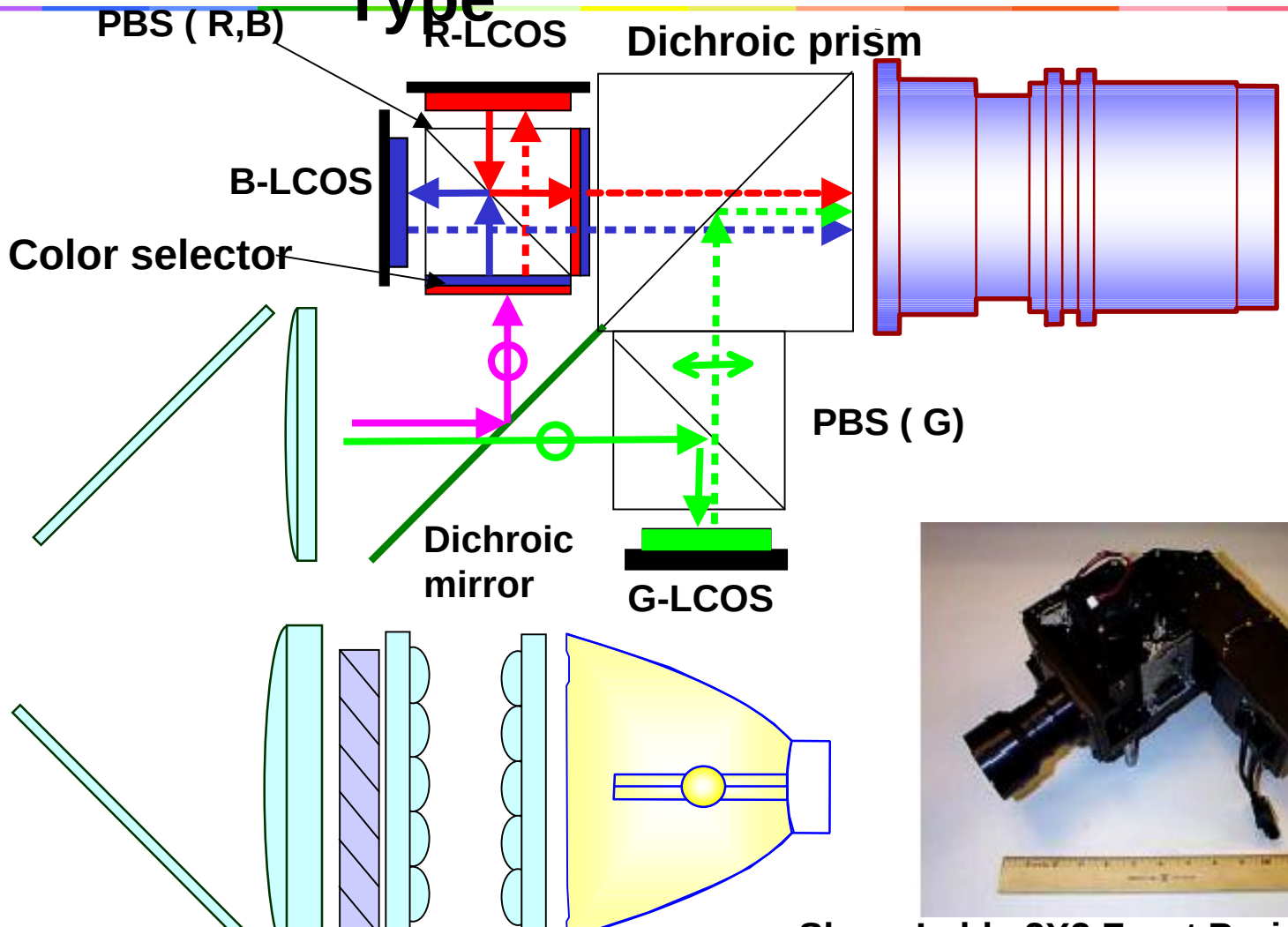
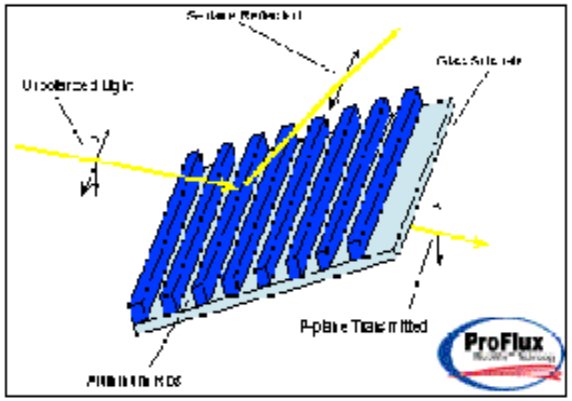
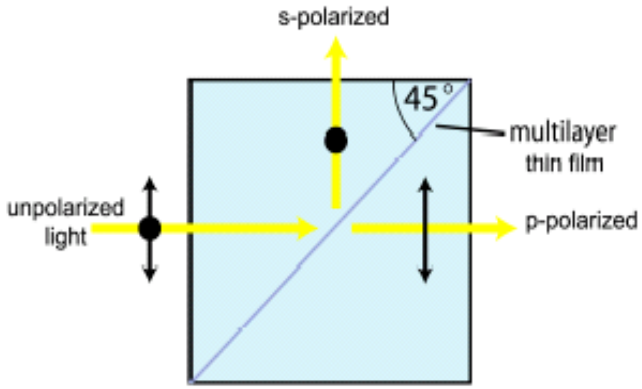
Three LCOS Panels in PBS-Dichroic Prism Type

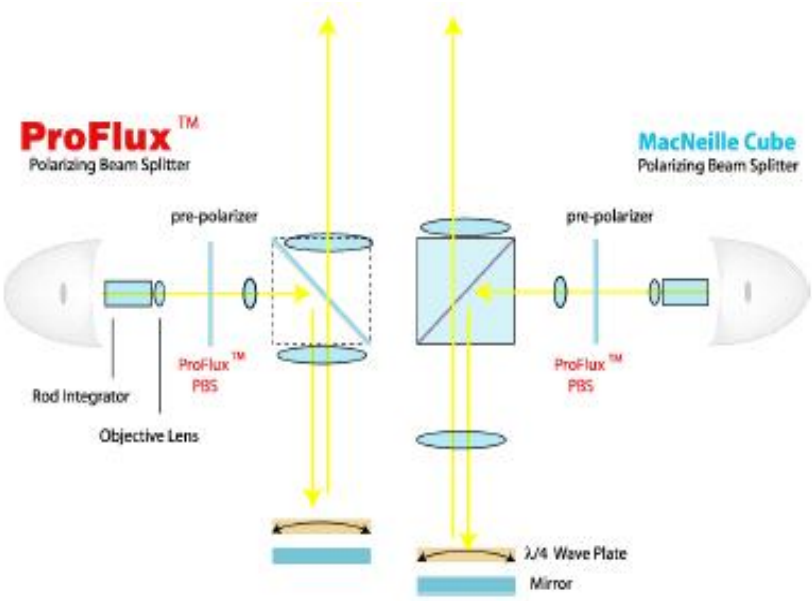


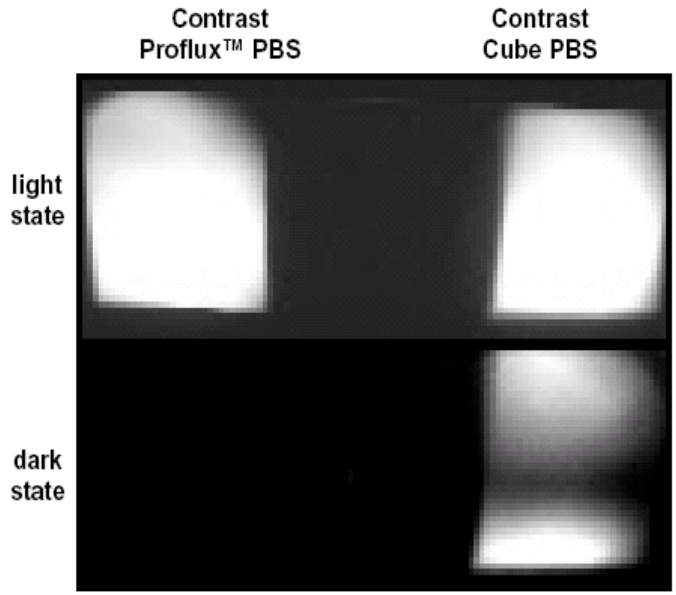
Sharp Lab's 2X2 Front Projector Engir

ProFlux Polarizer [Moxtek]









Polarization Recovery

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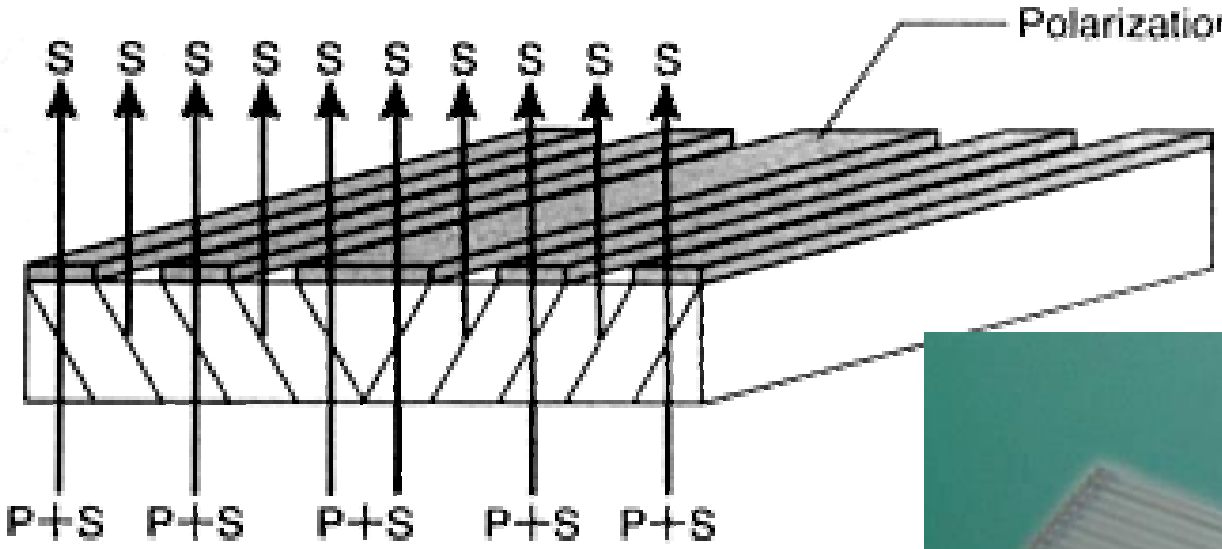
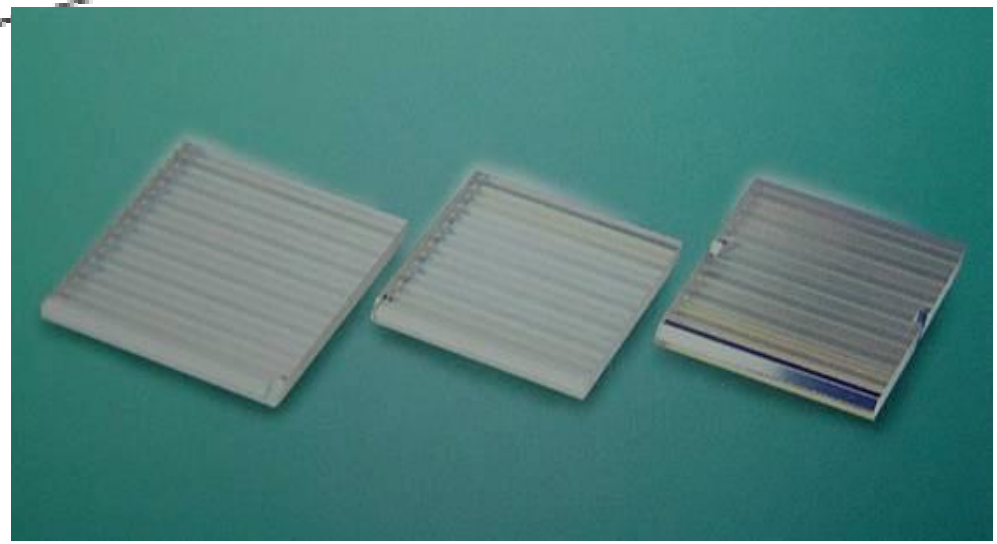
PS-Converter





用途:提昇光機亮度,降低偏光片之負載

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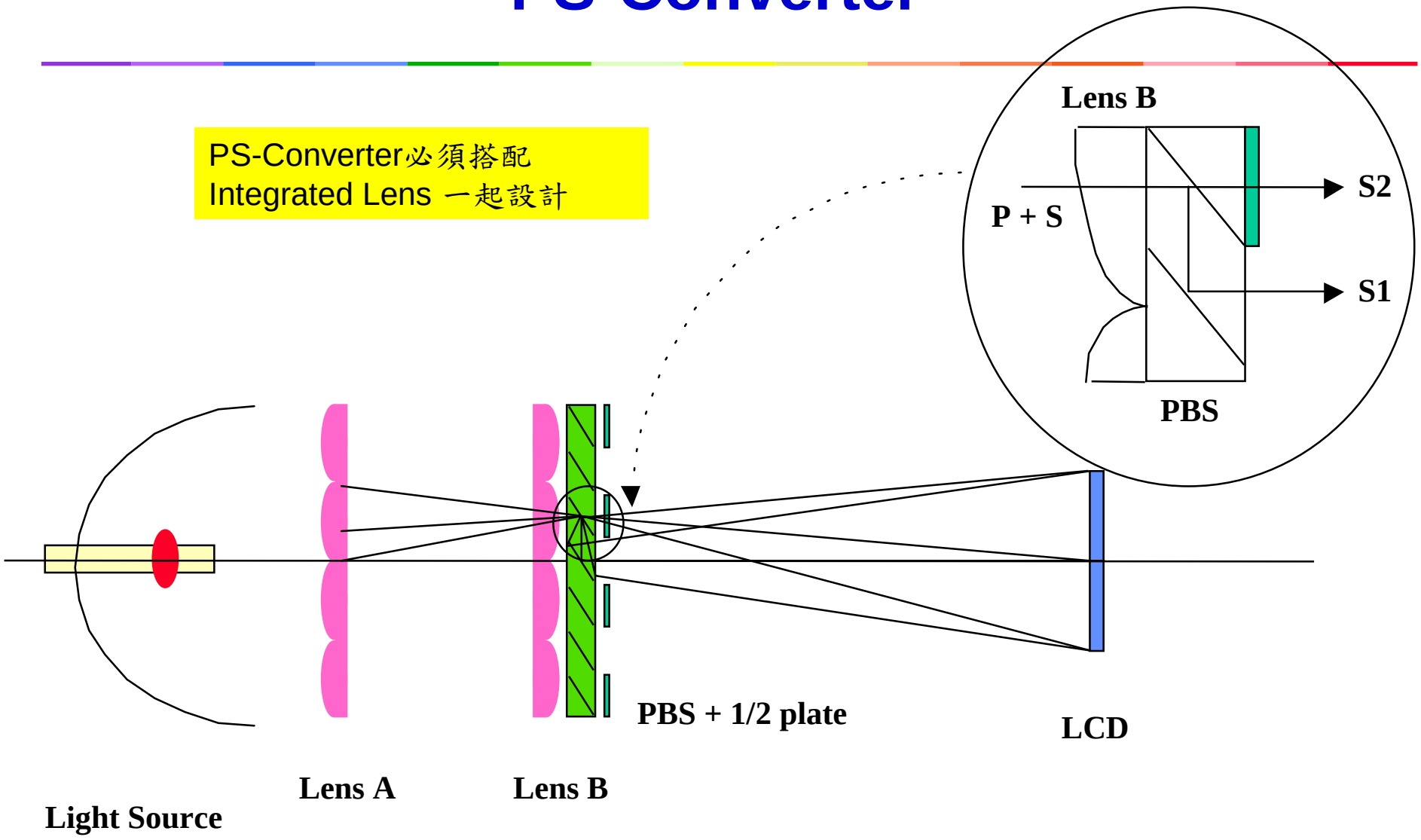
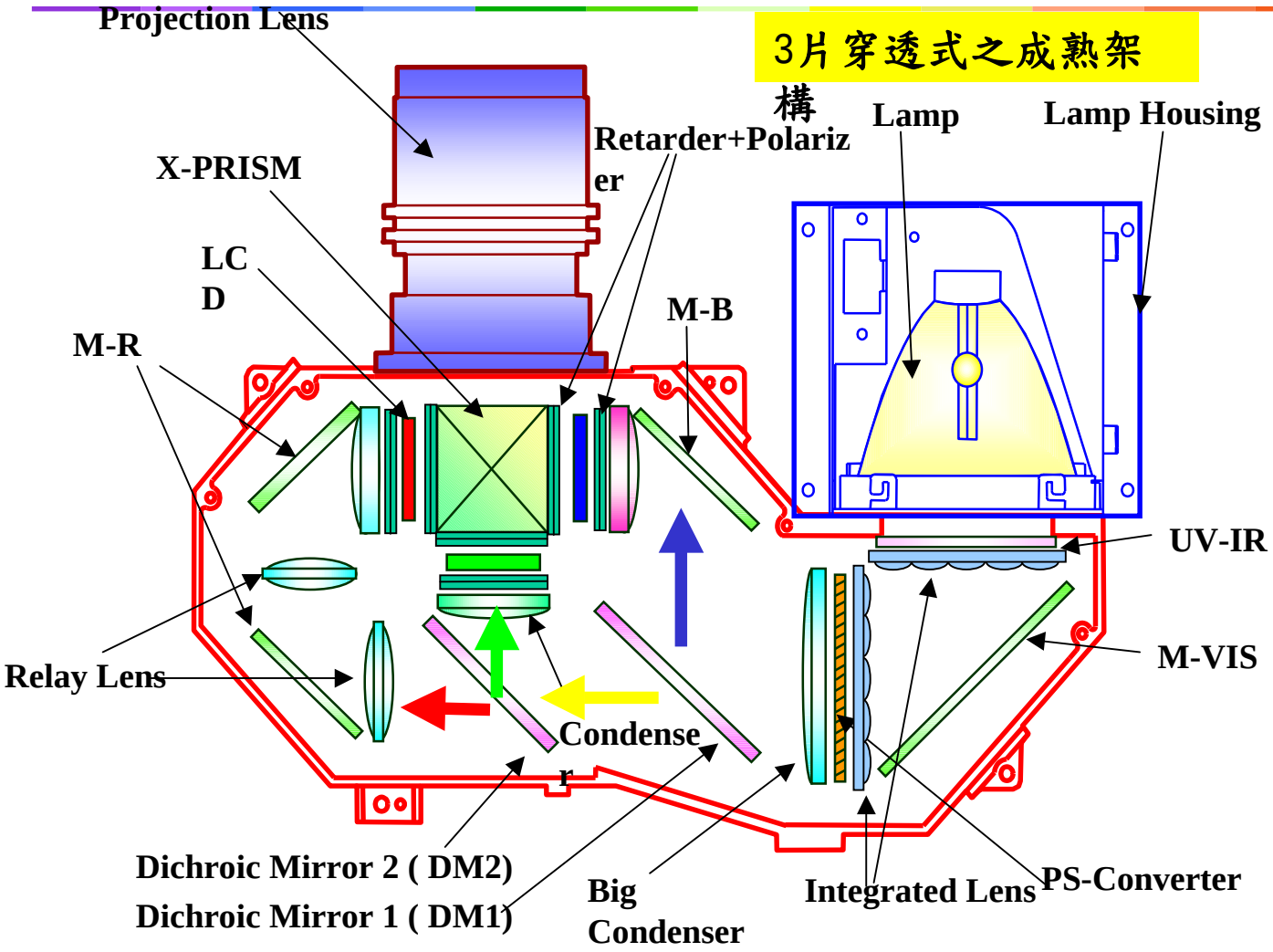
PS-Converter

PS-Converter必須搭配
Integrated Lens 一起設計



Three Transmissive Panels in X-prism Type



CPT(華映) CLP-2000

1800 ANSI Lumens

1024x768

Make Projectors Brighter

- Color Re-cycling
- Polarization Recovery
- Novel Architecture, Novel Devices

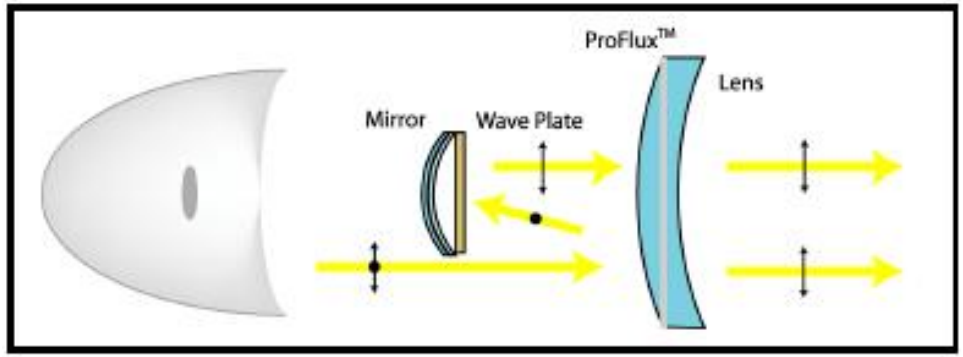


Figure 3. Polarization Recovery Concept

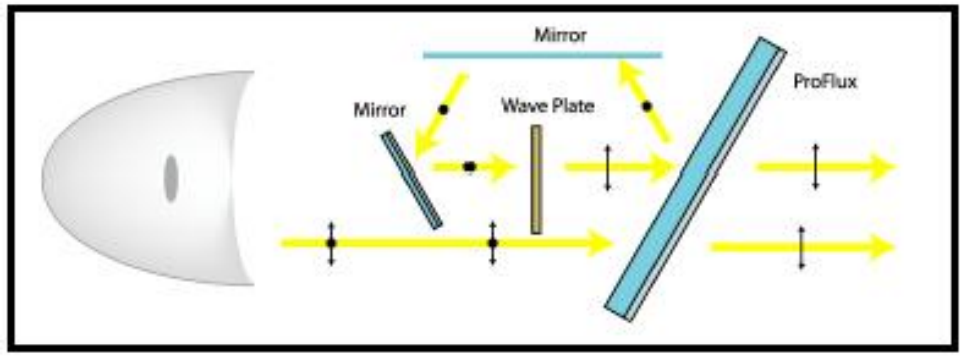


Figure 4. Polarization Recovery Concept

Color Management

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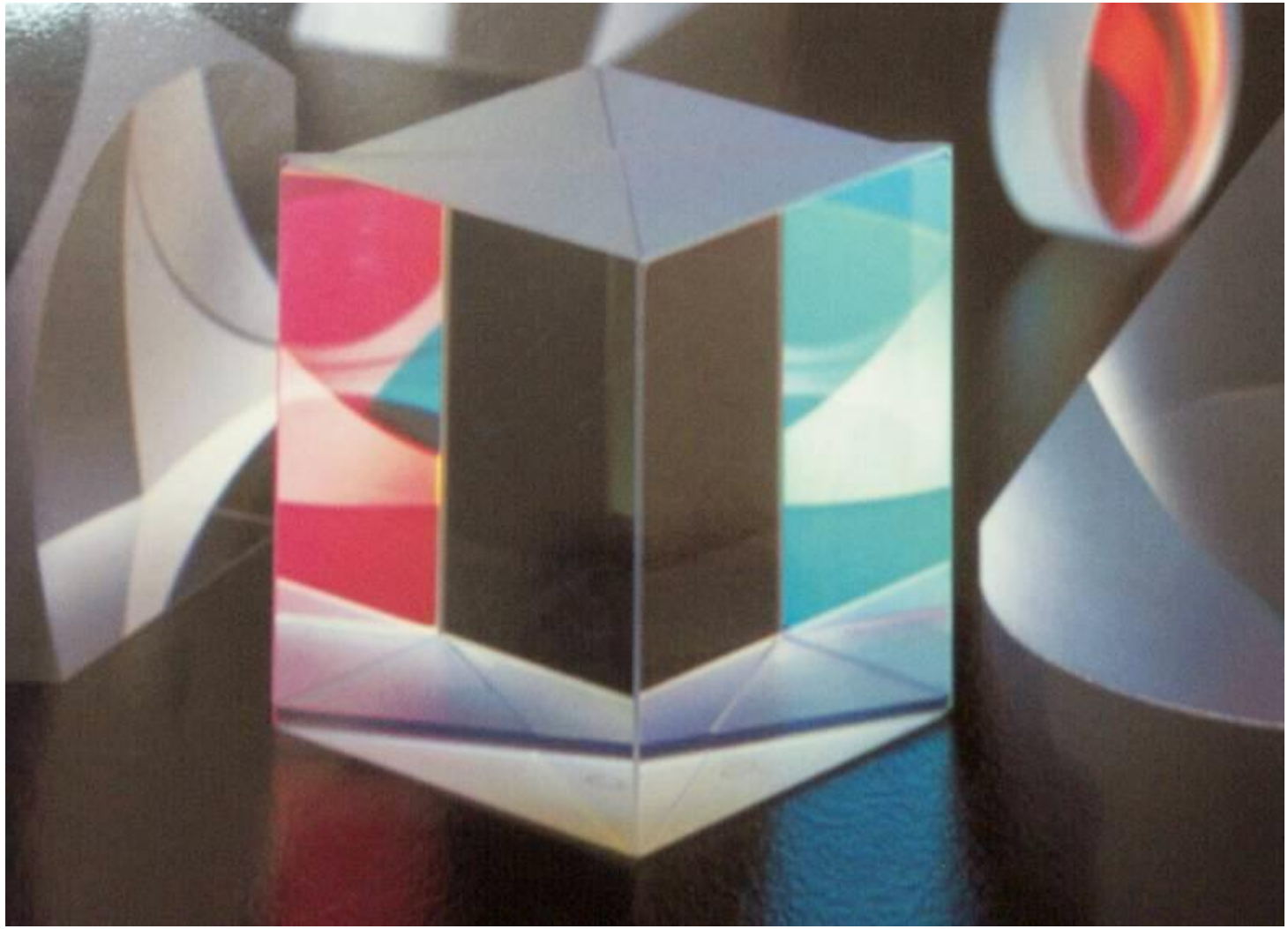
Cross Dichroic Prism



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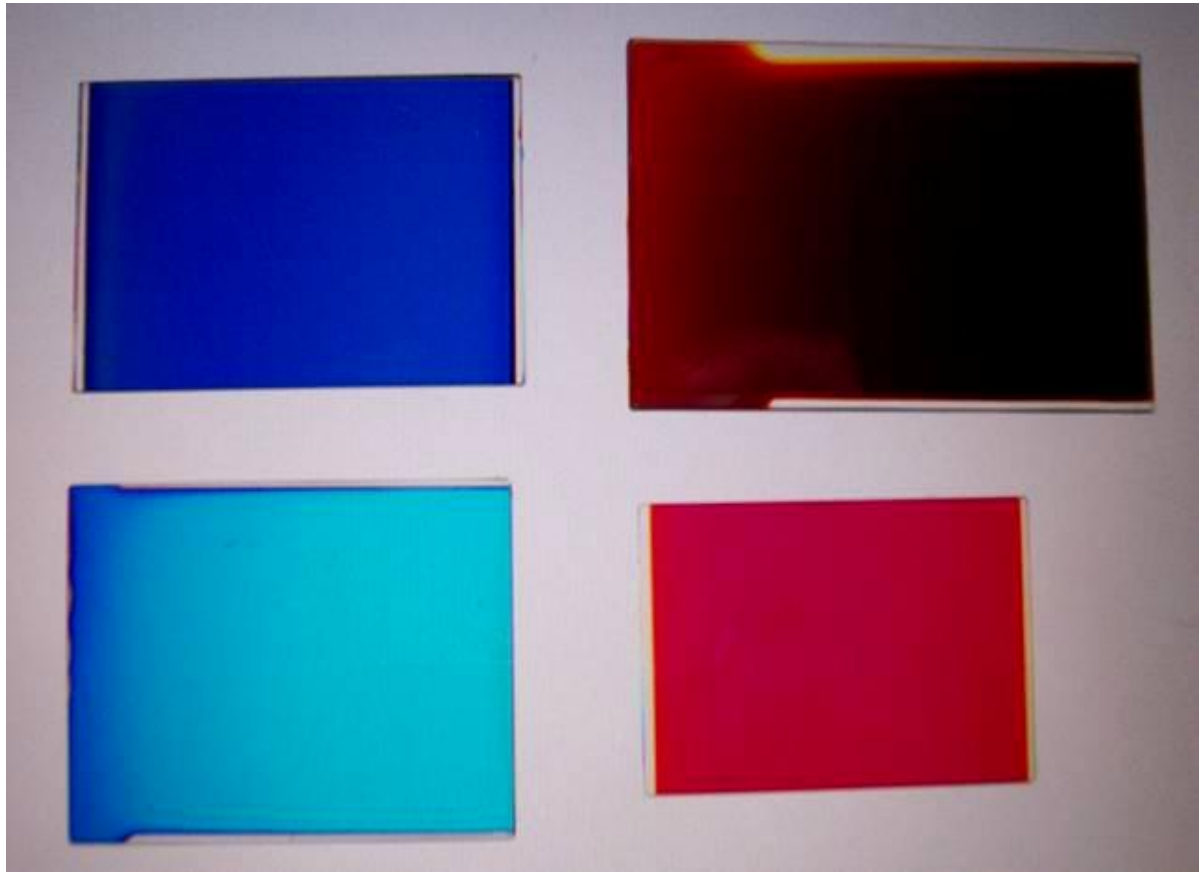
Dichroic Mirror



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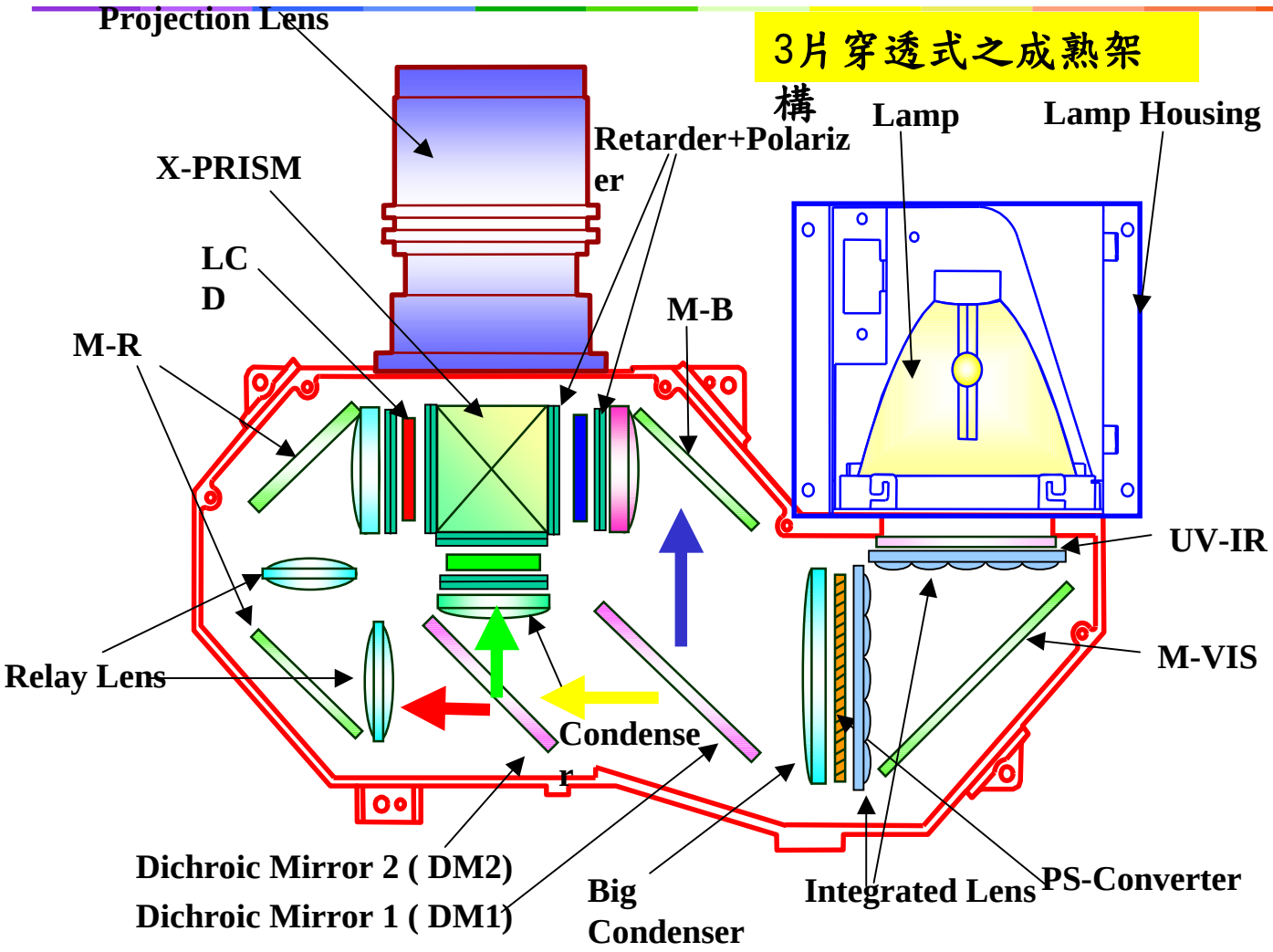
Three Transmissive Panels in X-prism Type

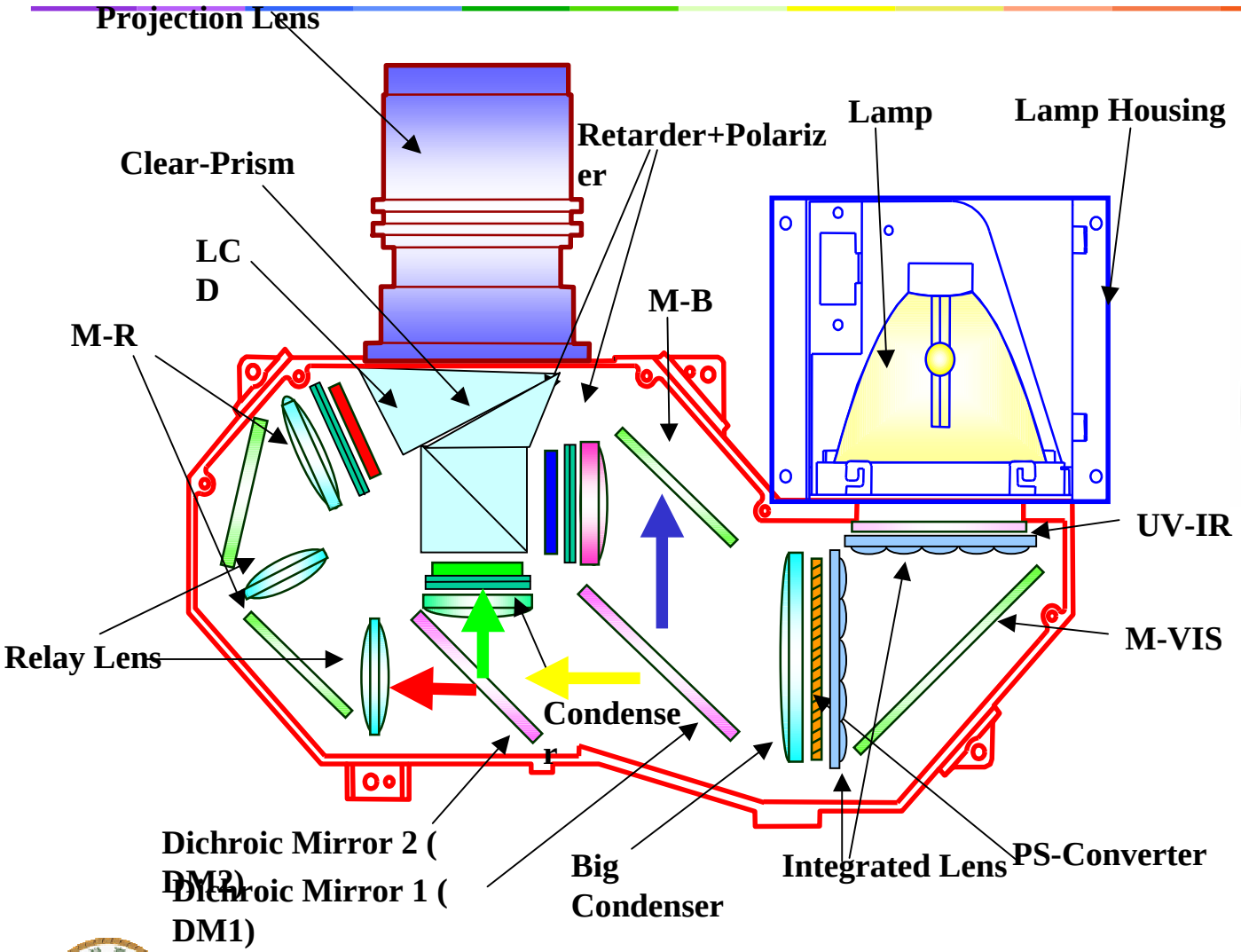


CPT(華映) CLP-2000

1800 ANSI Lumens

1024x768

Three Transmissive Panels in Clear-prism Type

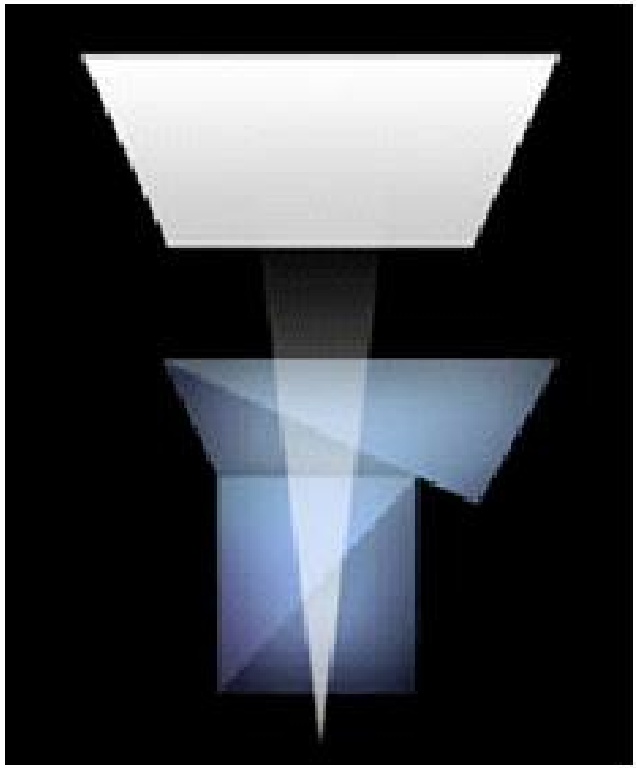


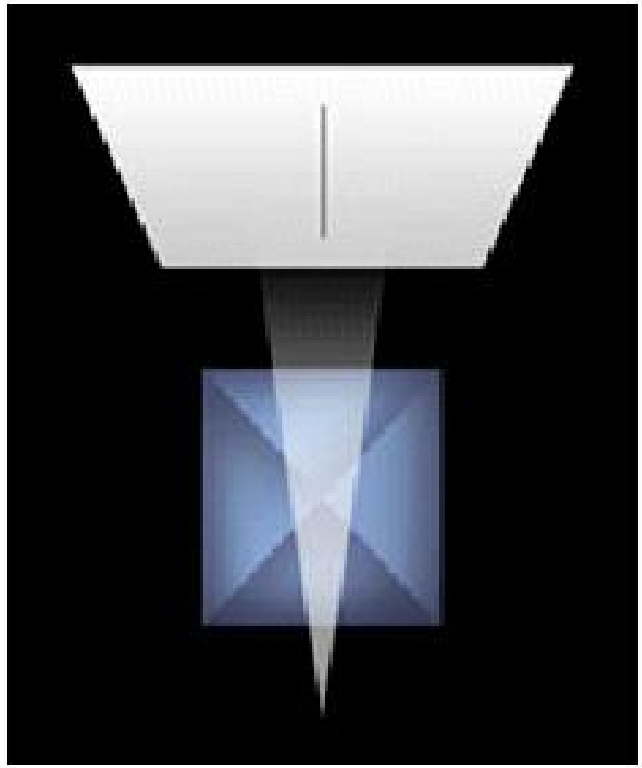
Canon LV-X2-XGA

1100 Lumens

300:1

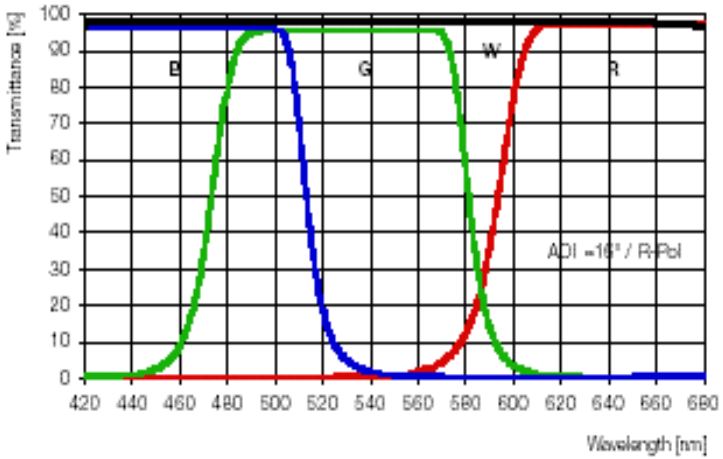
Shadow on Right Caused by X- Prism



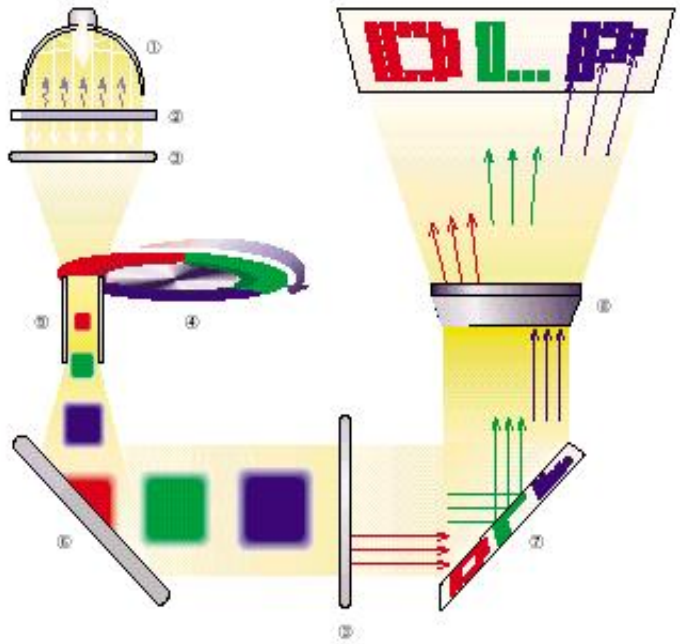


Color Wheel

Example for spectral performance of blue / green / red / white filters



Schematic of DLP™ brand projector showing ColorWheel™ combined with LightTunnel™



① Lamp with cold light reflector
② UV-blocking filter
③ Field lens
④ ColorWheel™
⑤ LightTunnel™
⑥ SILFLEX-VIS™
⑦ DMD™ (Digital Micromirror Device™)
⑧ Projection lens

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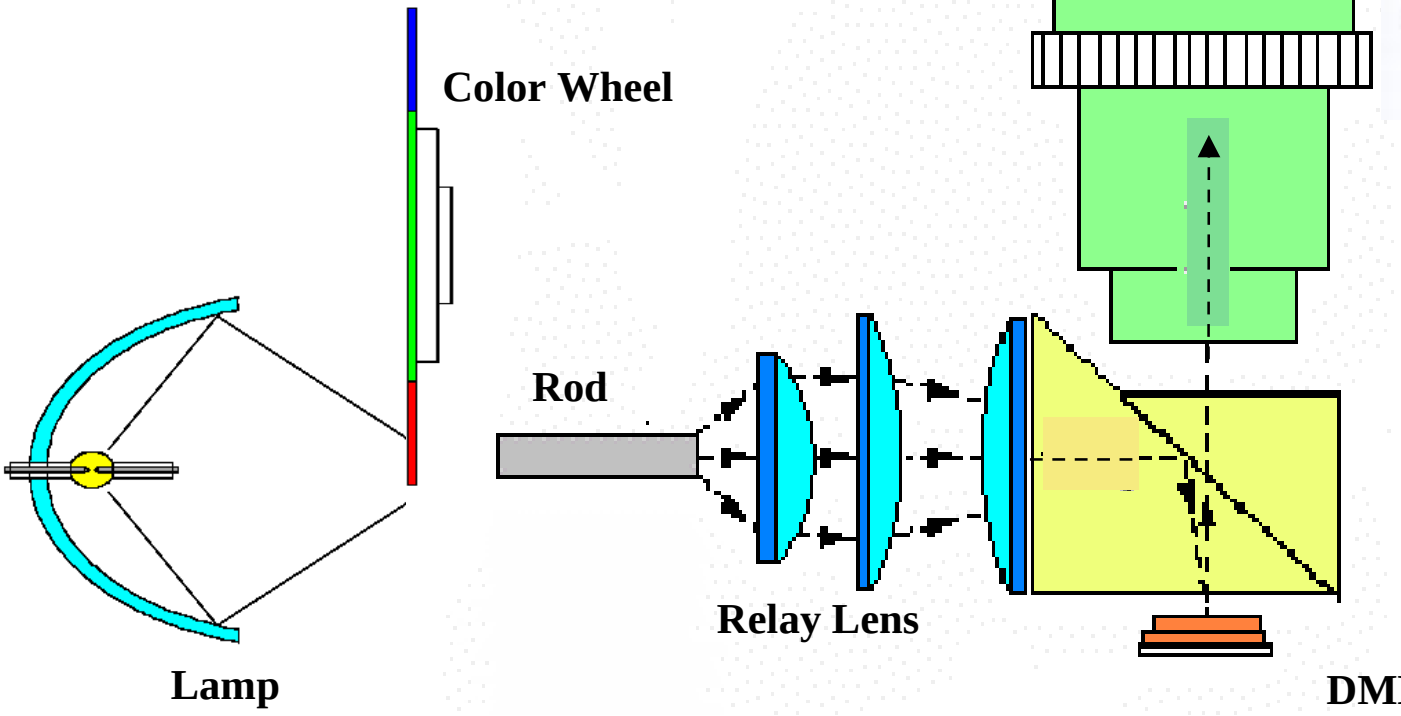
TIR prism型單片式DLP光機



BenQ 7765

Optoma EzPro 715

Color Scrolling

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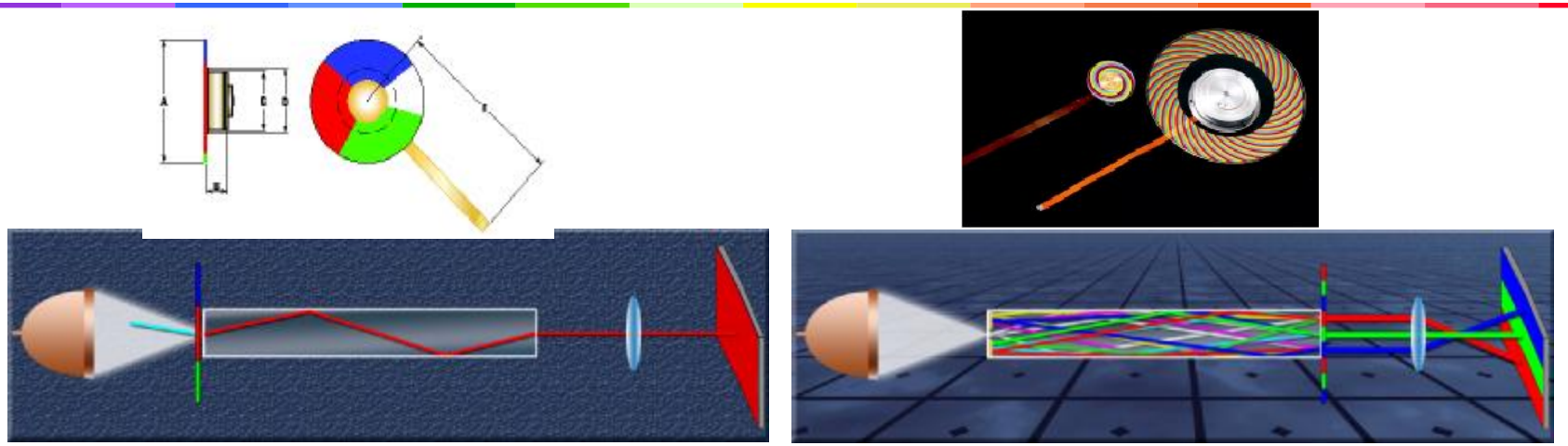
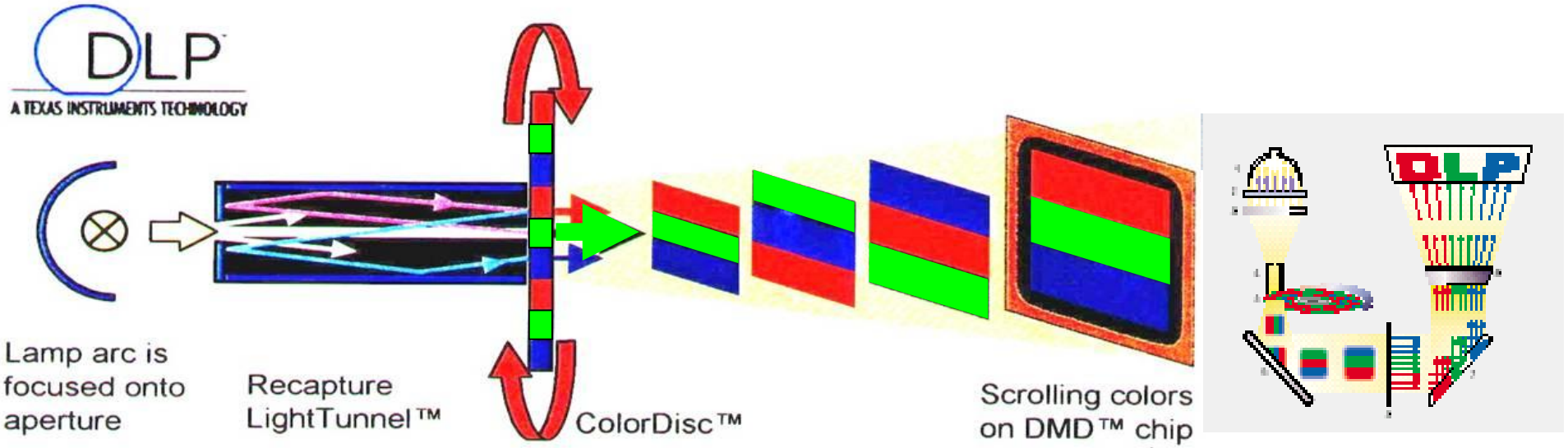
The SCR recycling process





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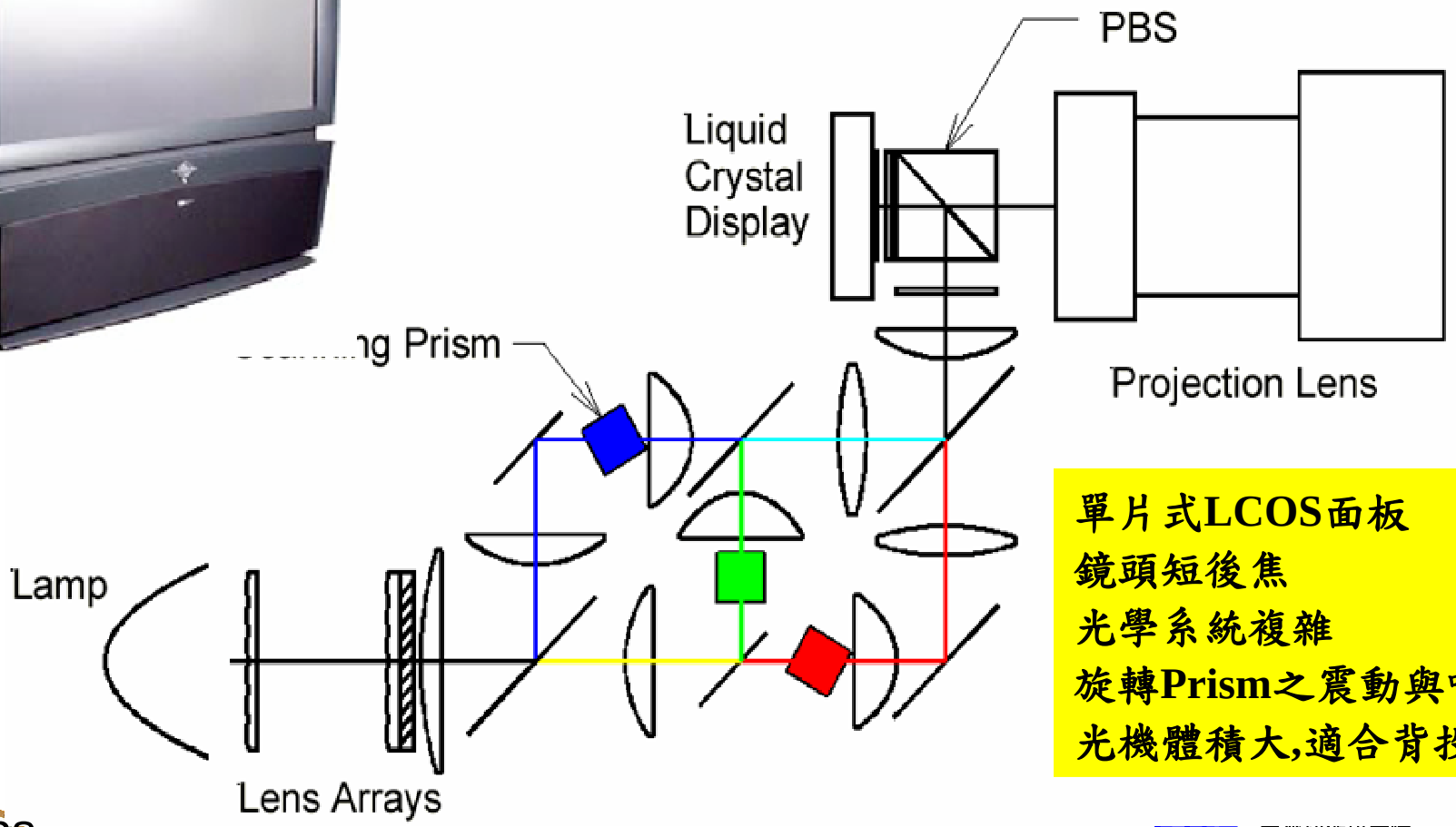
Three Prism Single-Panel LCoS System

Philip's 64-inch HDTV Monitor
Resolution: 1280*768



單片式LCOS面板
鏡頭短後焦
光學系統複雜
旋轉Prism之震動與噪音
光機體積大,適合背投TV

Philips

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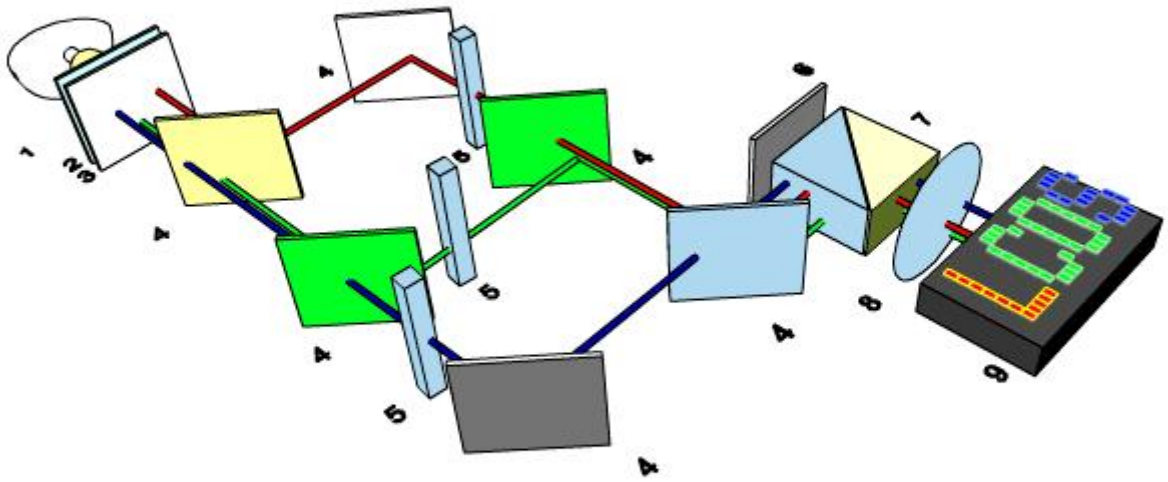
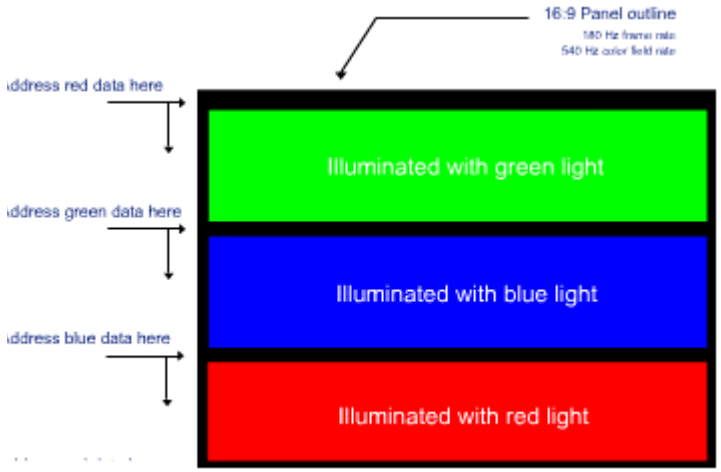
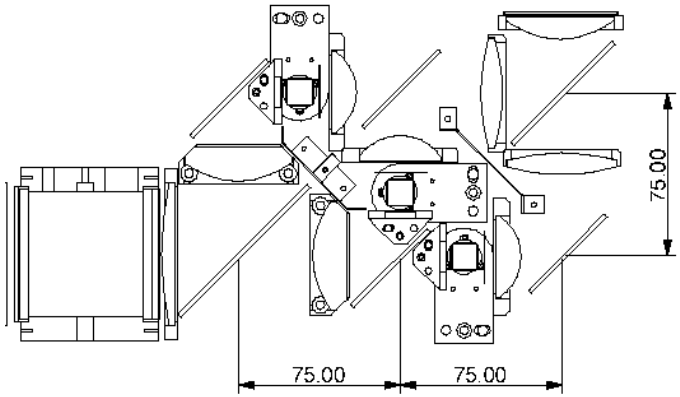
Color-Sequential LCoS Projector with Three Rotating Prisms







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Scanning by Prism Rotation

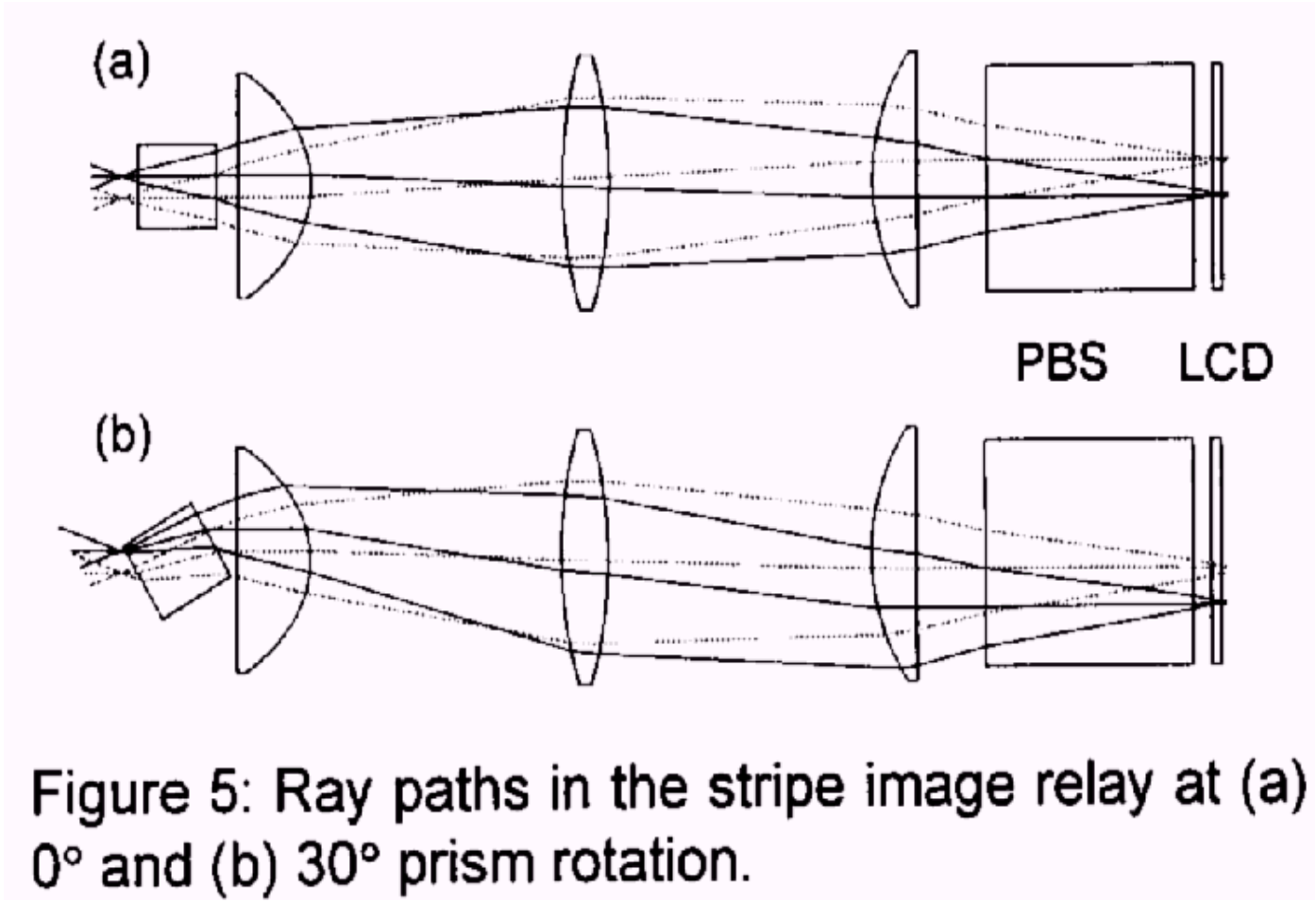

Figure 5: Ray paths in the stripe image relay at (a) 0° and (b) 30° prism rotation.

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Rear Projection

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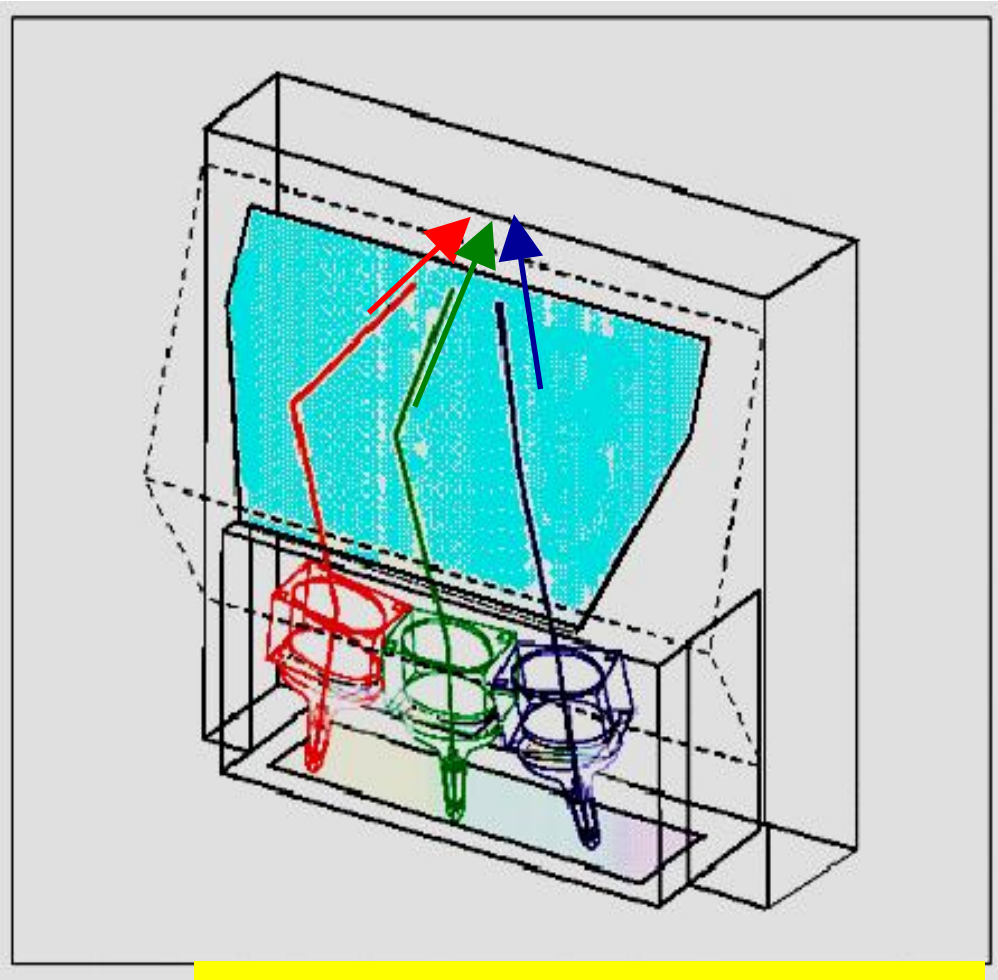
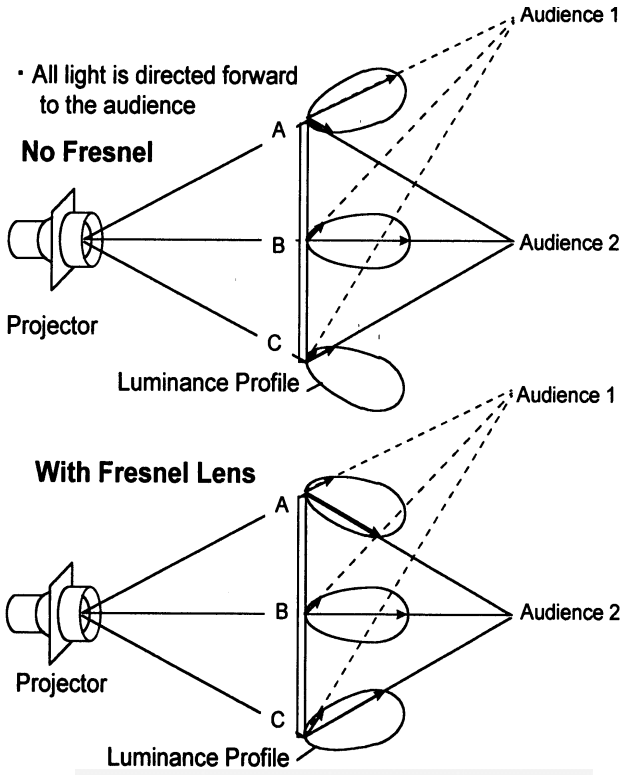
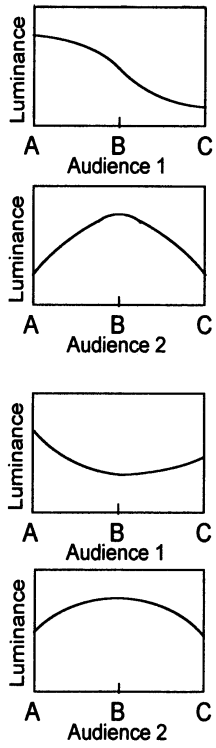
Folding Mirror

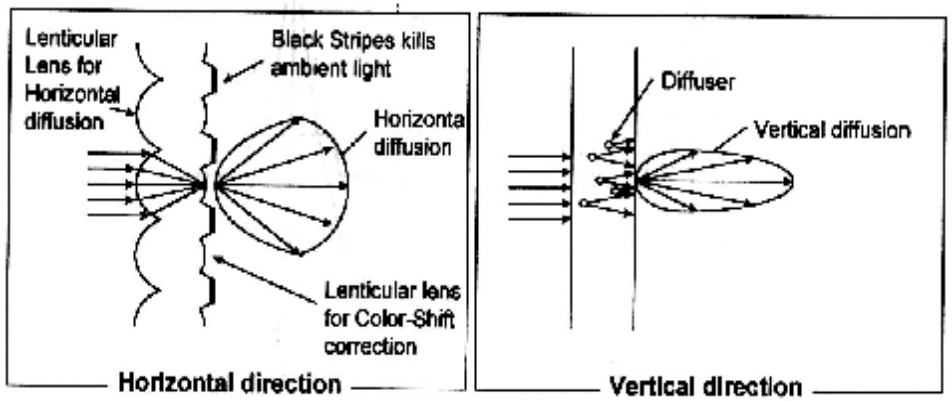


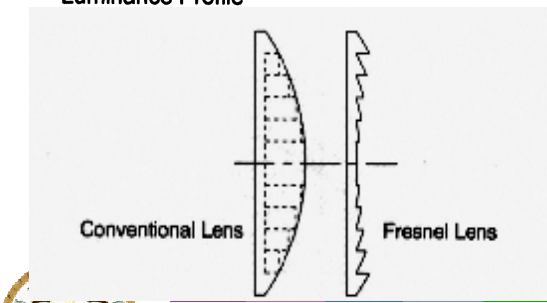
Maker: OCLI , 利科

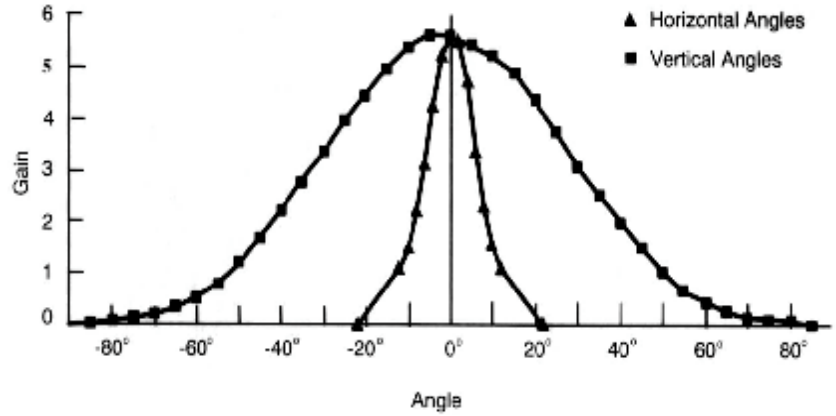
Projection Screens

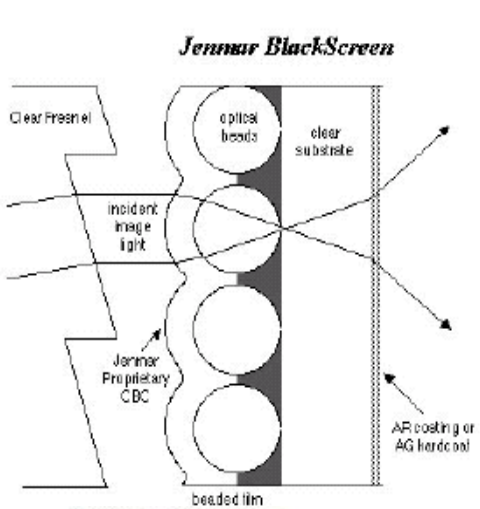


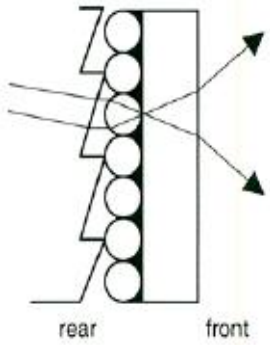






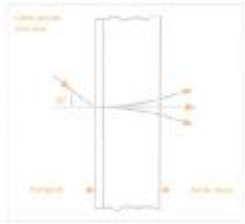






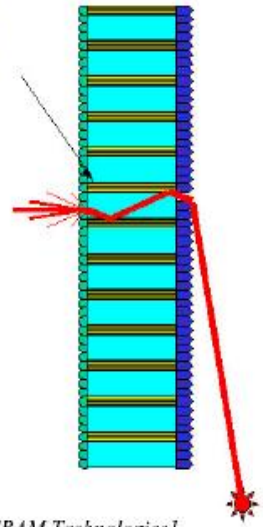
Cross Section of the Black Bead Screen [DNP]

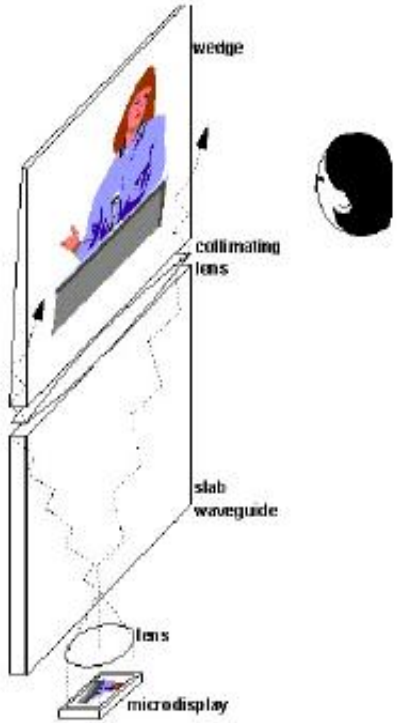
Cross Section of the UCS [DNP]



The SCRAMscreen [SCRAM Technologies]

Ambient room light is off axis to the wave-guides and is ABSORBED rather than REFLECTED





A Wedge-shaped Waveguide Screen [Cambridge 3D Display]

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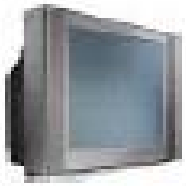
The Big Picture - Center of the Infotainment

TV Market Evolution

42 - 70" CRT RPTV

RPTV
42-70"

Home Projector



30- 40" CRT

30- 50" LCD TV

32- 52"(65")
PDP TV

<30" CRT

<30" CRT TV

<30" LCD TV

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Novel Products

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Evolution to Mini-projectors

Increasing Brightness, Resolution, Image Quality

* VGA Resolution
* 350 lumens
* 10kgs

* SVGA Resolution
* 700 lumens
* 3kgs

* XGA Resolution
* 1,000 lumens
* 2kgs

* XGA Resolution
* 1,100 lumens
* 1.3kgs

Smaller Weight & Size

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Light Weight for Mobilization

	2002		2003		2006(e)	
	Quantity(set)	%	Quantity(set)	%	Quantity(set)	%
<3 lb	199179	12.19%	425590	18.76%	1618985	40.53%
3~5 lb	249910	15.29%	256193	11.29%	275636	6.90%
5~10 lb	593600	36.32%	997795	43.98%	1604673	40.17%
>10 lb	591745	36.20%	589344	25.97%	495469	12.40%
Subtotal	1634434		2268922		3994763	

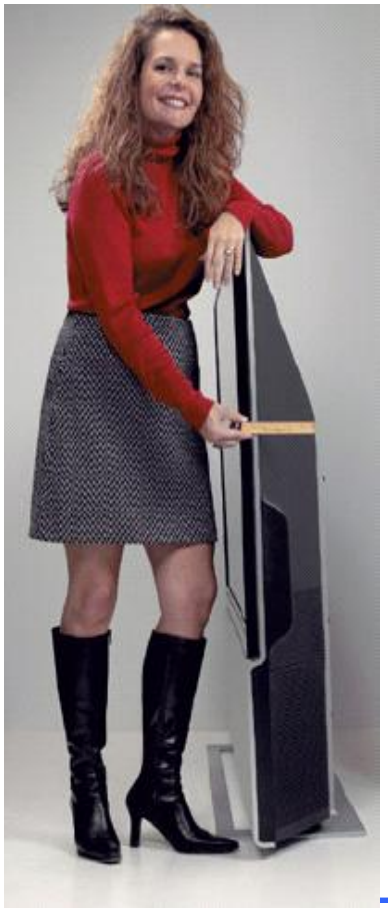
Source:SRI,arranged by TRI .Nov.2003

- ✓Cooling Efficiency — Magnesium Alloy Is The Key Part!
- ✓Compact
- ✓Light Weight
- ✓High Brightness — Solid State Lamp Source:LED

CEATEC 2003

33lm/w by Nichia

Thomson/RCA Wows with Thin DLP-RPTV



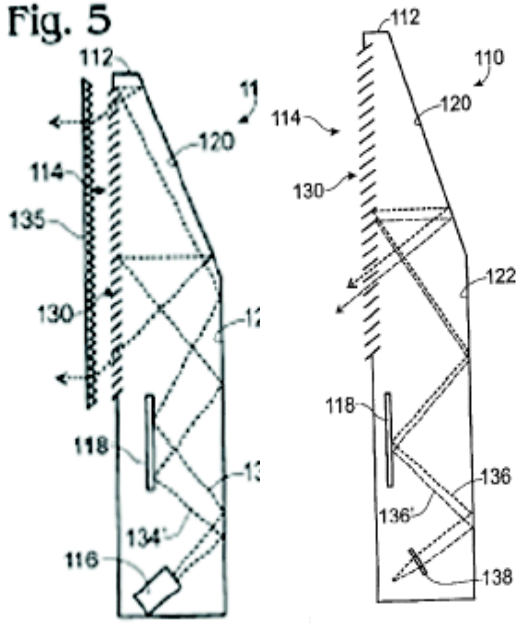
Profile 50 – 50-inch, 1280 x 720, 6.85 inches deep, 1000:1, DLP, $8,999 MSRP

Profile 61 – 61-inch, 1280 x 720, 6.85 inches deep, 1000:1, DLP, $9,999 MSRP

Profile 70 – 70-inch, 1280 x 720, >6.85 inches deep, 1000:1, DLP, $TBA

Patent No.: US 6,728,032 B2
Date of Patent: Apr. 27, 2004

Fig. 5



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Super-short Focus Front Projector with Aspheric Mirror Projection Optical System

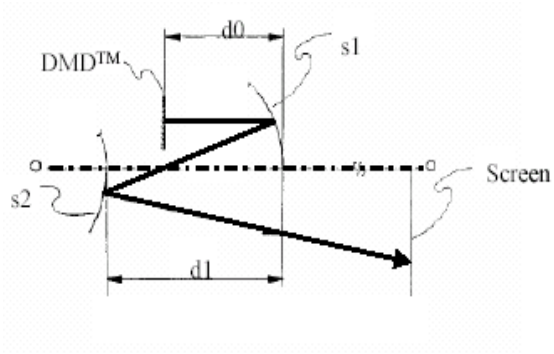


Figure 1: Dual-mirror optical system

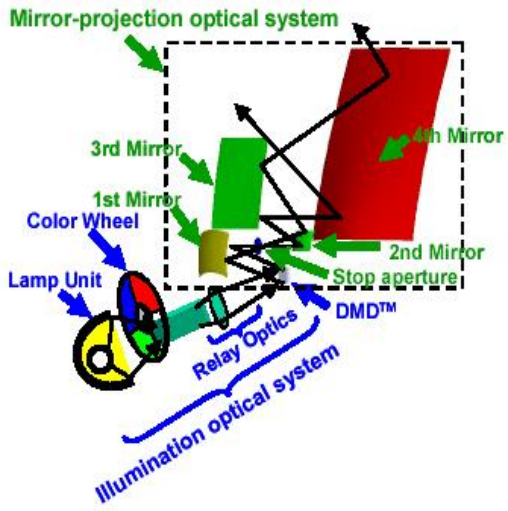


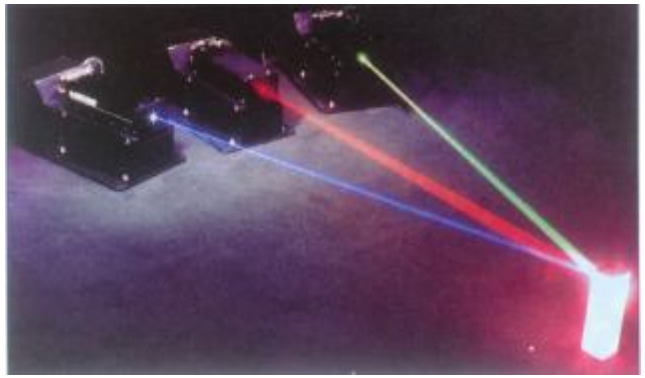
Figure 2 ;Layout of optical system

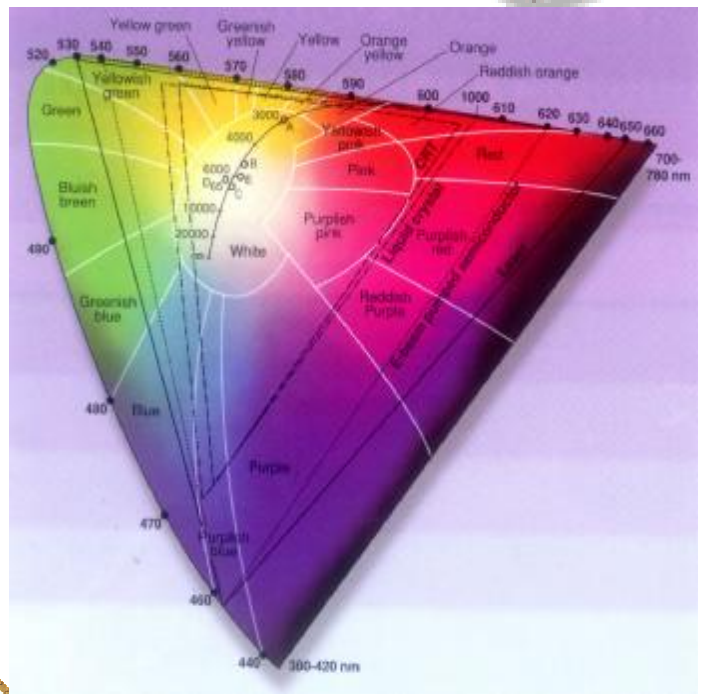
Desktop

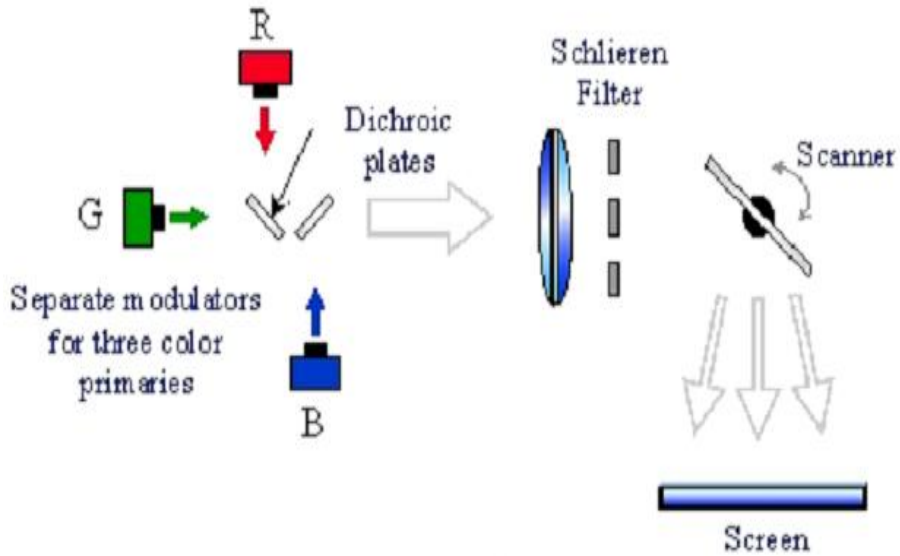
Ceiling mount

Figure 5: WT600™ projector

Laser Display





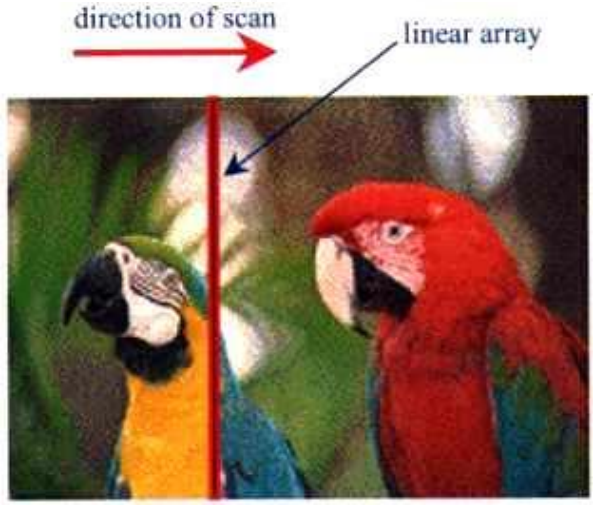


System Performance

Laser Power (total RG&B)	10 W
Vertical Resolution (device pixels)	1080
Horizontal Resolution (scan)	1920
Frame Rate	60 Hz
Display Bit Depth (per color)	11 bit
System Contrast (ANSI)	>250:1
System Contrast (frame-sequential)	>1000:1
Data Stream Content	1080i

Parameter	Value
Resolution	1920 x 1080 (progressive scan)
Contrast	> 200:1
Convergence	± ¼ pixel
Refresh rate	up to 96 Hz
Image size	110" diagonal
Color	24/30 bits

R: 5.8W
G: 3.3W
B: 2.5W



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