



Holographic Versatile Disc

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What is HVD ?

- Holographic Versatile Disc (HVD) is an optical disc technology which would hold up to 3.9 terabytes (TB) of information .
- An HVD is an advanced optical disk that's presently in the development stage. Polaroid scientist **J van Heerden** was the first to come up with the idea for holographic three-dimensional storage in 1960.
- Holographic memory systems have been around for decades. They offer far more storage capacity than **CDs** and **DVDs** -- even "next-generation" DVDs like **Blu-ray** -- and their transfer rates leave conventional discs in the dust.

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Basics of Holographic Disk

- The first step in understanding holographic disk is to understand what "holographic" means. Holography is a method of recording patterns of light to produce a three-dimensional object.
- The recorded patterns of light are called a hologram.

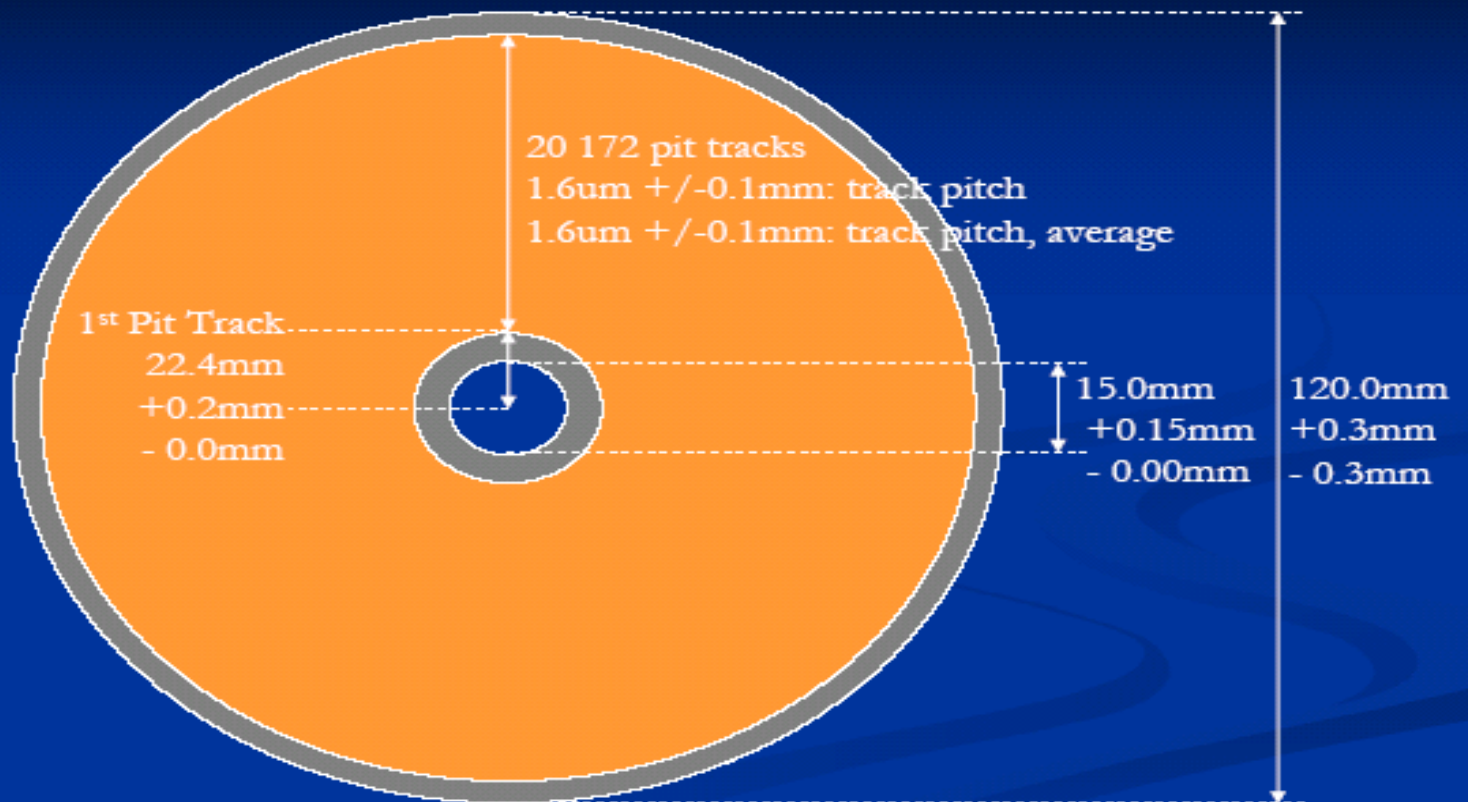
HVD Structure

- Green writing/reading laser (532 nm)
- Red positioning/addressing laser (650 nm)
- Hologram (data)
- Polycarbon layer
- Photopolymeric layer (data-containing layer)
- Distance layers
- Dichotic layer (reflecting green light)
- Aluminium reflective layer (reflecting red light)

Dimension of HVD

Dimension of HVD

TechnoConsulting



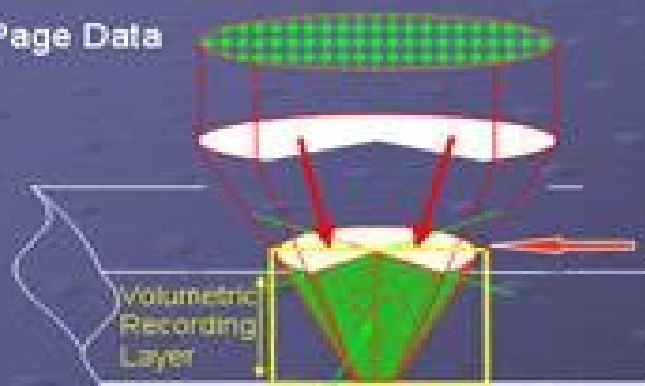
Working Principle

- ❖ HVD uses a technology called 'collinear holography,' in which two laser rays, one is blue-green and another is red, are collimated into a single beam..
- ❖ The blue-green laser reads data encoded as laser interference fringes from a holographic layer near the top of the disc while the red laser is used as the reference beam and to read servo information from a regular CD-style aluminium layer near the bottom.
- ❖ Servo information is used to monitor the position of the read head over the disc, similar to the head, track, and sector information on a conventional hard disk drive.

Collinear Holographic System

Computer simulation shows the cross-section of Holographic recording

Page Data



Page data are recorded into the volumetric recording layer in Holographic recording



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Reference: <http://electronics.howstuffworks.com/hvd.html>

[HVD Write System]

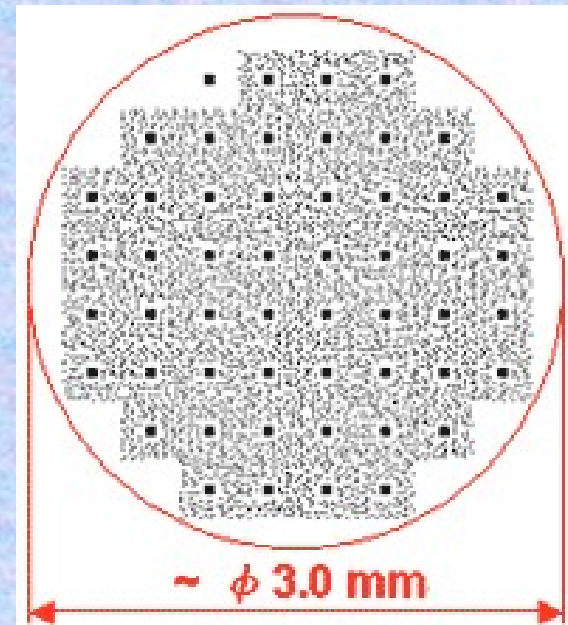
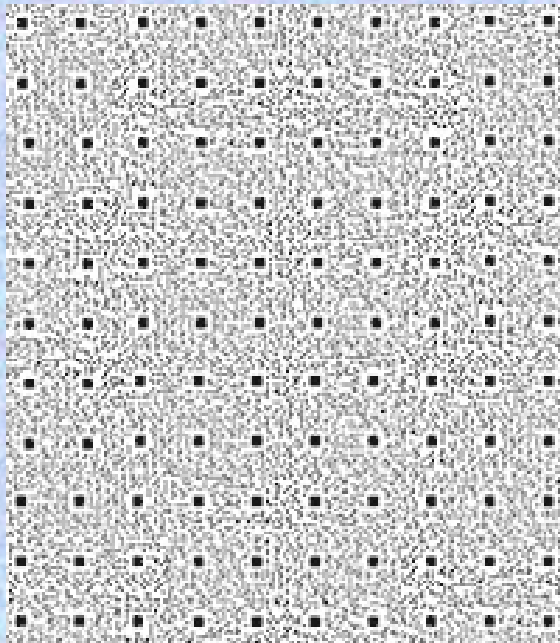
- A simplified HVD system consists of the following main components:
 - ❖ Blue or green laser (532-nm wavelength in the test system)
 - ❖ Beam splitter/merger
 - ❖ Mirrors
 - ❖ Spatial light modulator (SLM)
 - ❖ CMOS sensor
 - ❖ Polymer recording medium

[Cont.....]

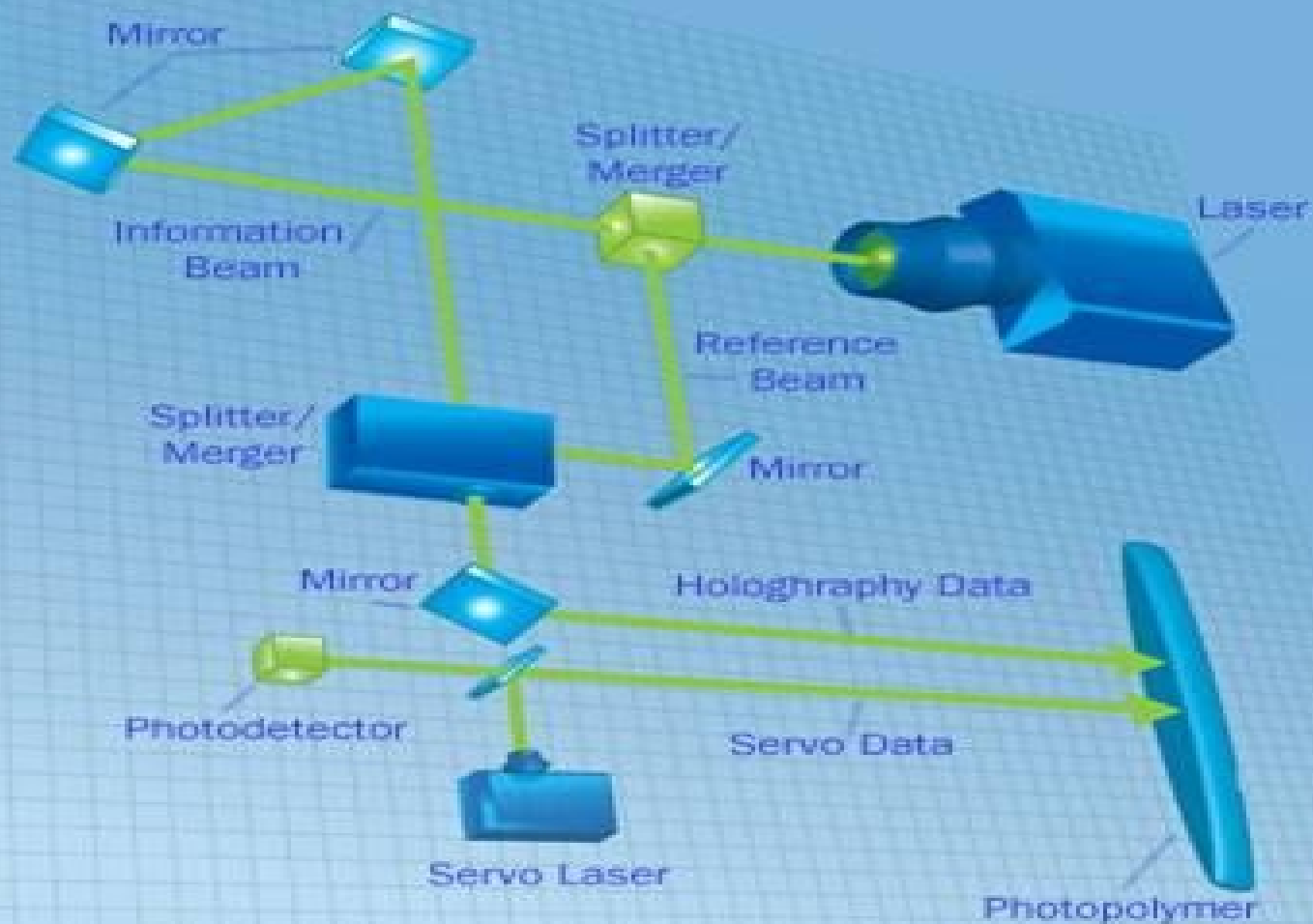
- The process of writing information onto an HVD begins with encoding the information into **binary data** to be stored in the **SLM**. These data are turned into ones and zeroes represented as opaque or translucent areas on a "page" -- this page is the image that the **information beam** is going to pass through.

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■ Data image



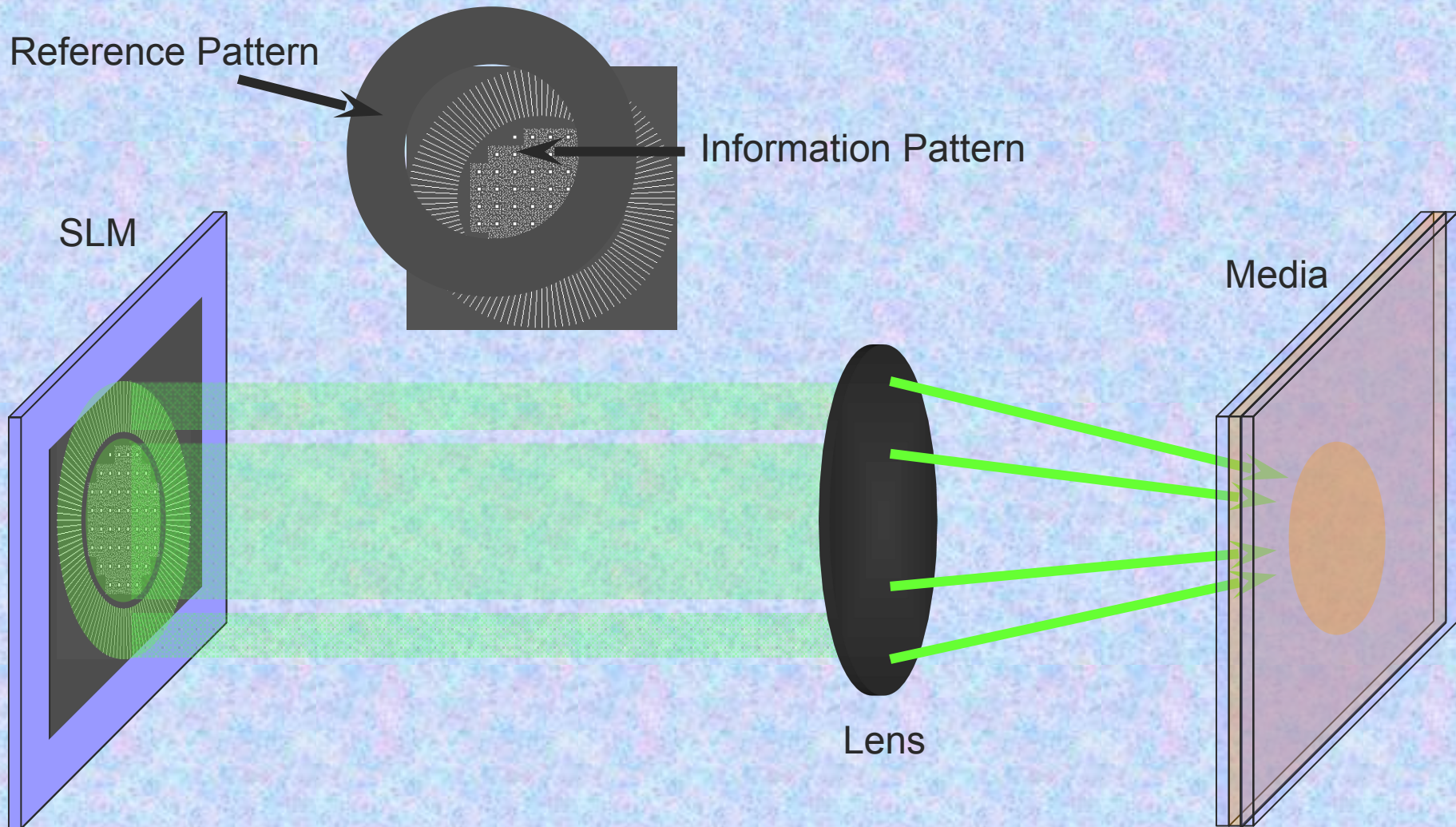
How HVDs Work HVD Write System



Reference: <http://electronics.howstuffworks.com/hvd.html>

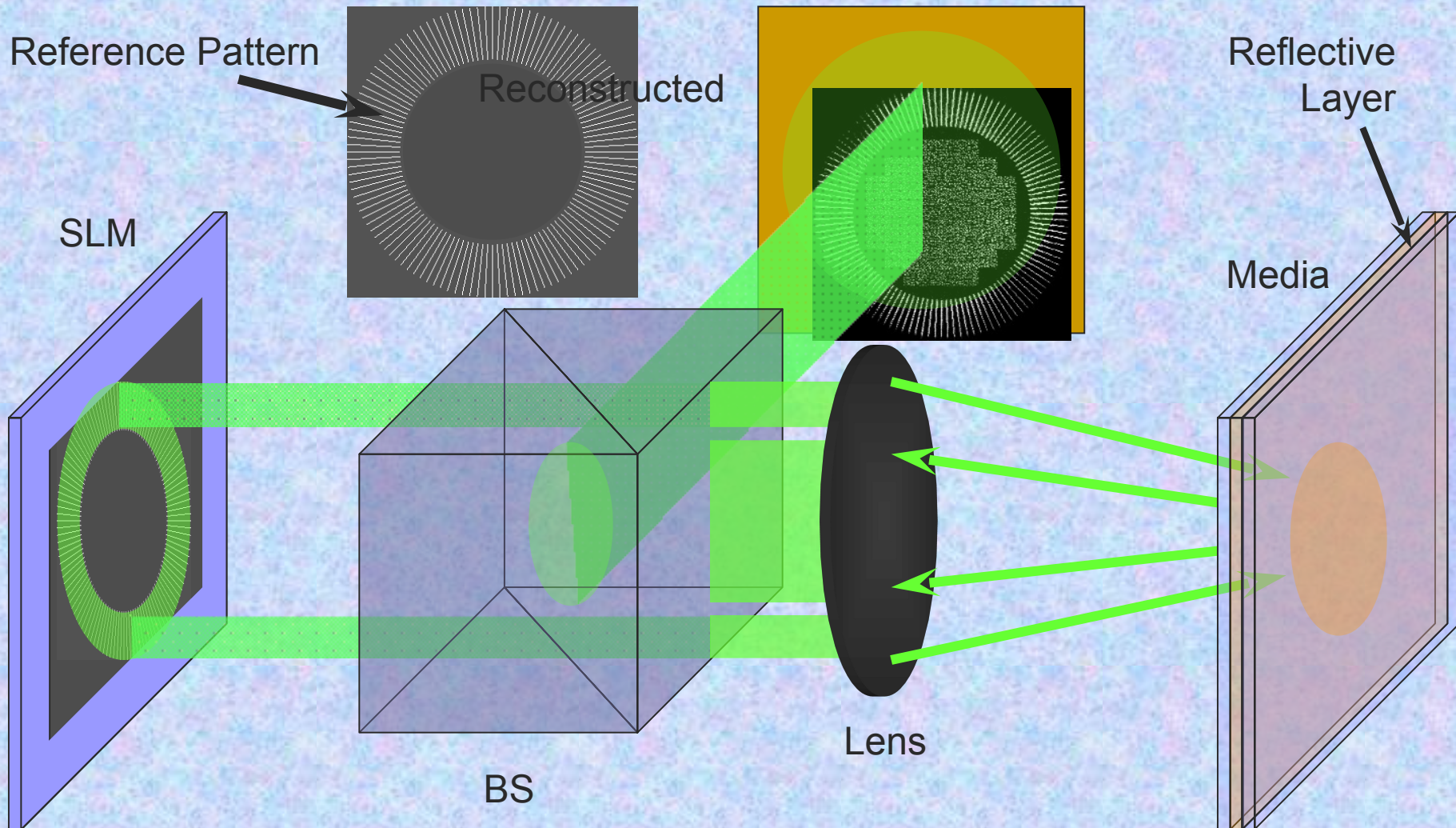
Collinear Holography

Recording Process

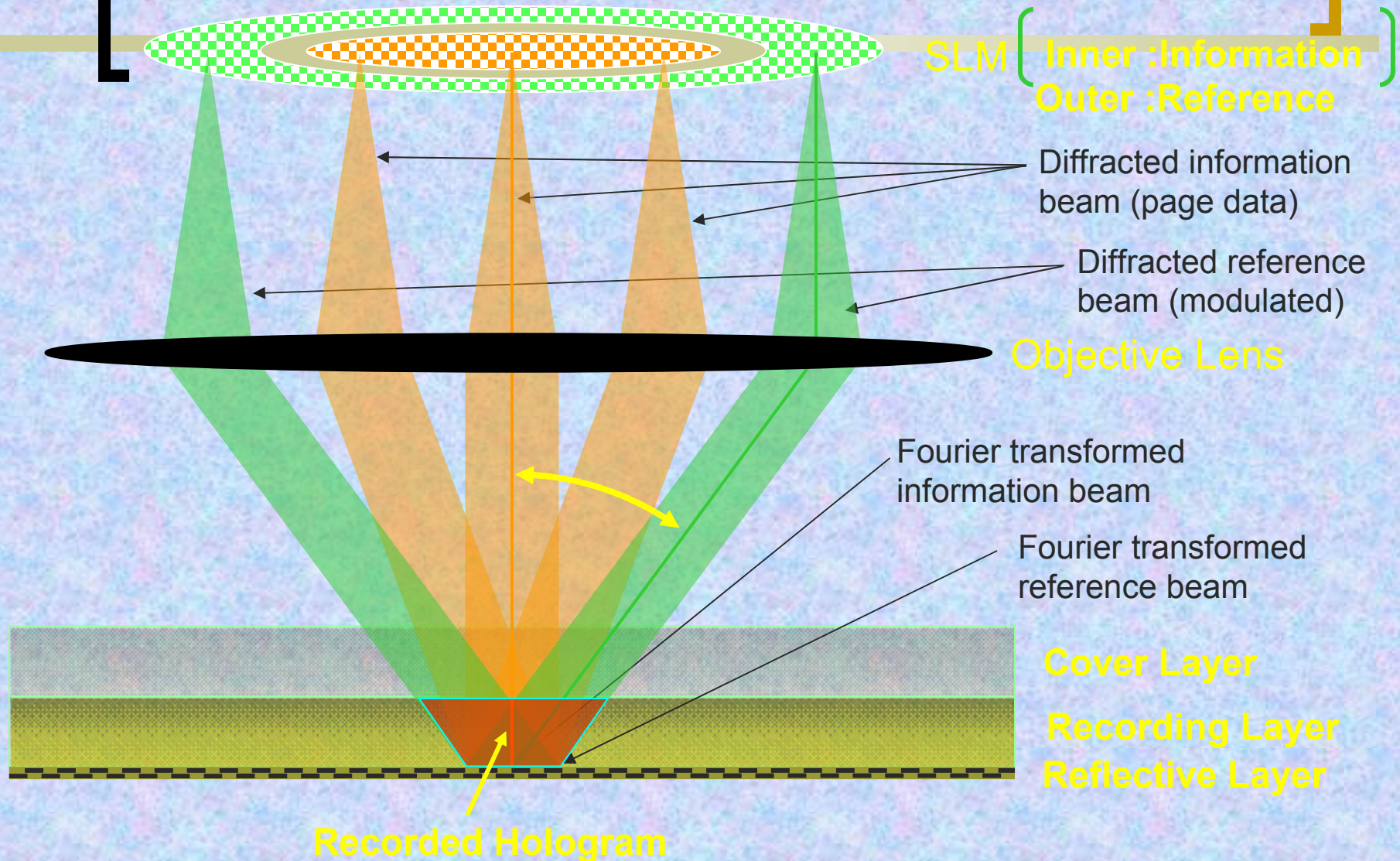


Collinear Holography

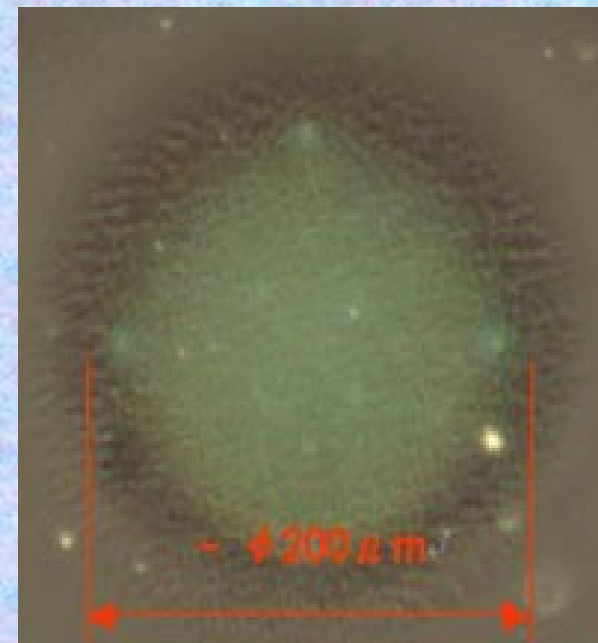
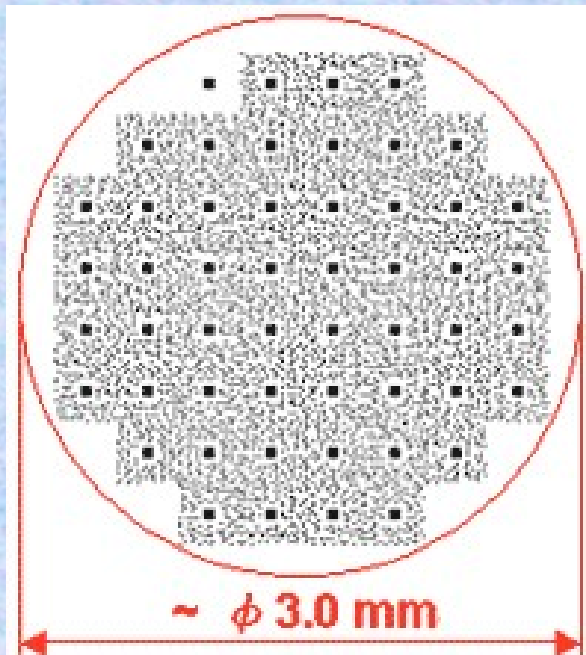
Reconstructing Process



[How Collinear Holography works]



- Page data (left) stored as hologram (right)



[HVD Read System]

- ❖ To read the data from an HVD, you need to retrieve the light pattern stored in the hologram.
- ❖ In the HVD read system, the laser projects a light beam onto the hologram -- a light beam -- a light beam that is identical to the reference beam.

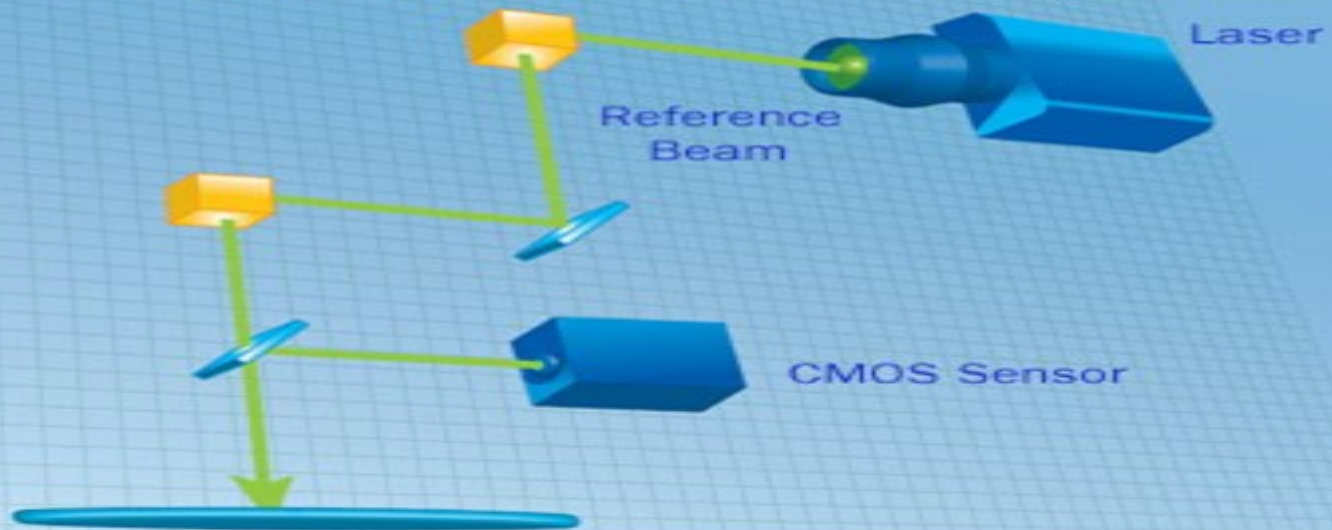
[Cont....]

- An advantage of a holographic memory system is that an entire page of data can be retrieved quickly and at one time. In order to retrieve and reconstruct the holographic page of data stored in the crystal, the reference beam is shined into the crystal at exactly the same angle at which it entered to store that page of data. Each page of data is stored in a different area of the crystal, based on the angle at which the reference beam strikes it.
- The key component of any holographic data storage system is the angle at which the reference beam is fired at the crystal to retrieve a page of data. It must match the original reference beam angle exactly. A difference of just a thousandth of a millimeter will result in failure to retrieve that page of data.

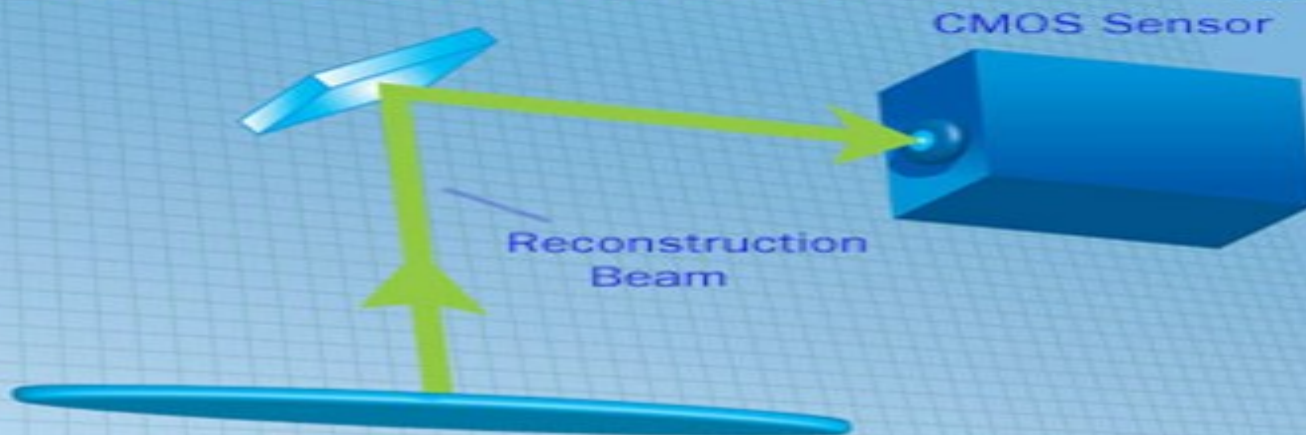
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- During reconstruction, the beam will be diffracted by the crystal to allow the recreation of the original page that was stored. This reconstructed page is then projected onto the CMOS, which interprets and forwards the digital information to a computer.

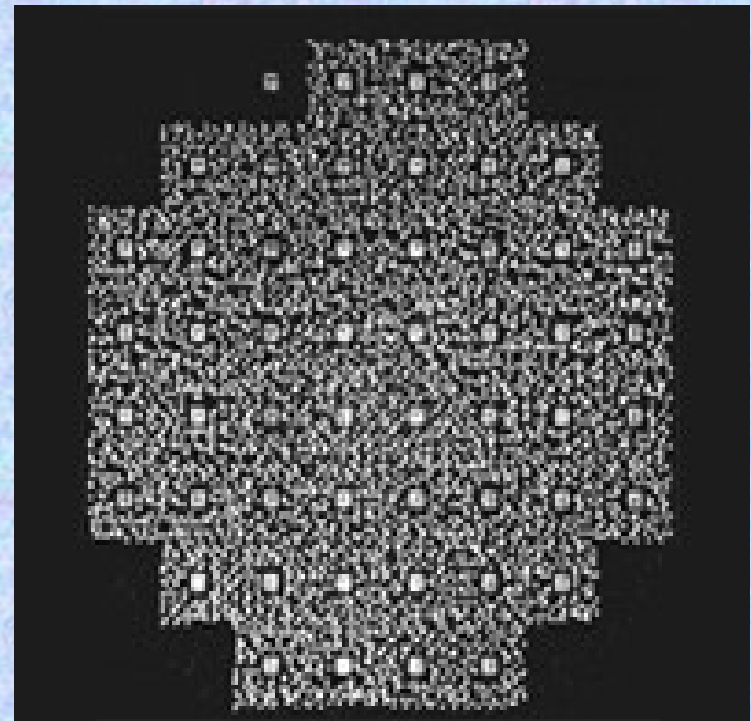
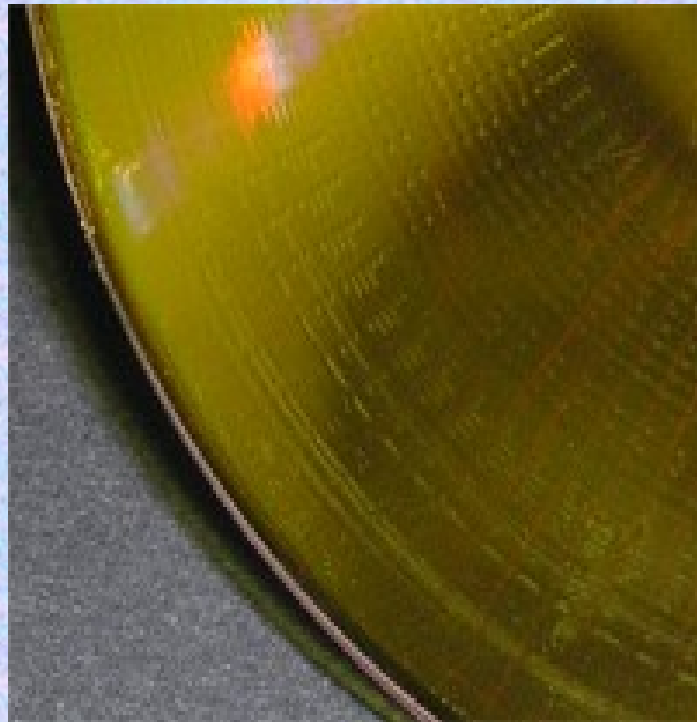
How HVDs Work HVD Read System 1



How HVDs Work HVD Read System 2



Reference: <http://electronics.howstuffworks.com/hvd.html>



Page data stored in an HVD (left) and recreated by CMOS sensor (right)

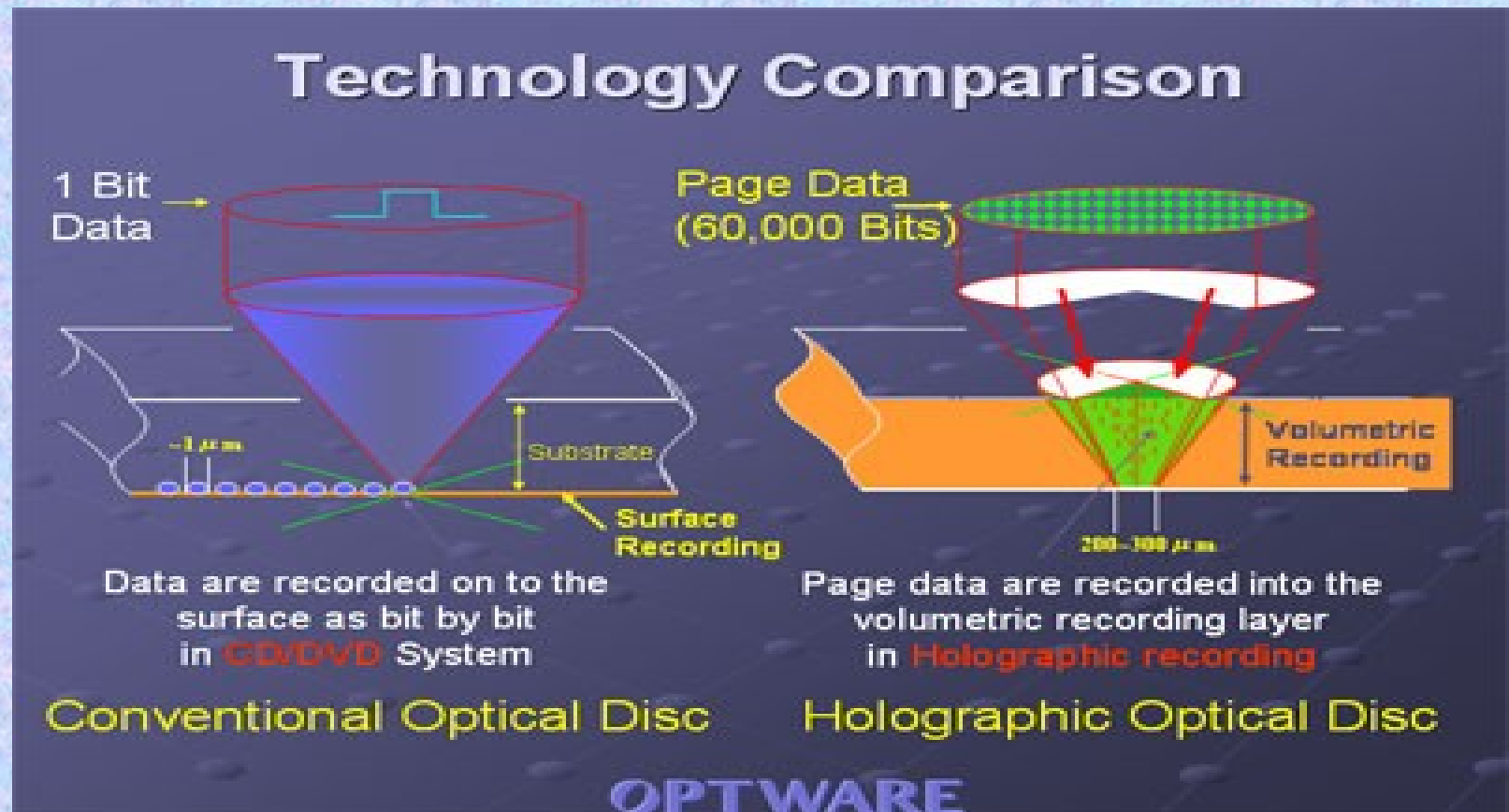
Advantages

- High Storage capacity of 3.9 terabyte(TB) enables user to store large amount of data.
- Records one program while watching another on the disc.
- Edit or reorder programs recorded on the disc.
- Automatically search for an empty space on the disc to avoid recording over a program.

Continued.....

- ❖ Users will be able to connect to the Internet and instantly download subtitles and other interactive movie features
- ❖ Backward compatible: Supports CDs and DVDs also.
- ❖ The transfer rate of HVD is up to 1 gigabyte (GB) per second which is 40 times faster than DVD .
- ❖ An HVD stores and retrieves an entire page of data, approximately 60,000 bits of information, in one pulse of light, while a DVD stores and retrieves one bit of data in one pulse of light.

Comparison

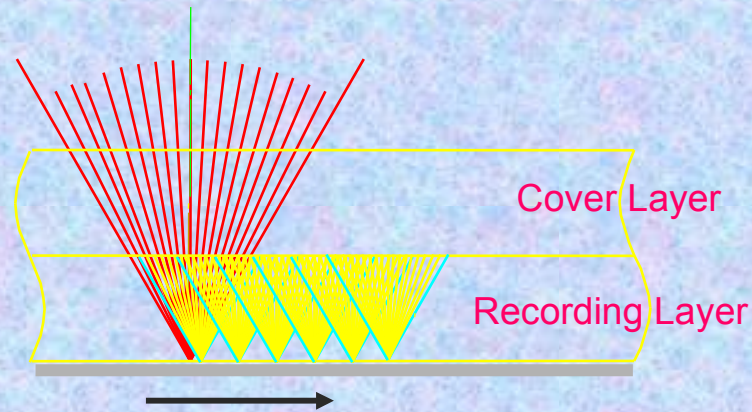


How HVD compares Others ?

While HVD is attempting to revolutionize data storage, other discs are trying to improve upon current systems. Two such discs are Blu-ray and HD-DVD, deemed the next-generation of digital storage.

	Blu-ray	HD-DVD	HVD
Initial cost for recordable disc	Approx. \$18	Approx. \$10	Approx. \$120
Initial storage capacity	54 GB	30 GB	300 GB
Read/write speed	36.5 Mbps	36.5 Mbps	1 Gbps

Multiplexing Method



Write Position Shift

HVD is "On the Fly"

Shift Pitch	Capacity per Disc (12cm ϕ)*
18 μ m	100 GB
13 μ m	200 GB
8 μ m	500 GB
3 μ m	3.9 TB

(*at32kbit/page)

[Conclusion]

- HVD will soon replace previous DVDs.
- It is currently supported by more than 170 of the world's leading consumer electronics, personal computer, recording media, video game and music companies.
- The format also has broad support from the major movie studios as a successor to today's DVD format.