

Holographic data storage in IST-FP6

ATHOS

Deutsche Thomson-Brandt GmbH

CEA-LETI

Moulage Plastique de l'Ouest

Optimal Optik

Toptica Photonics AG

RWTH Aachen

Darmstadt University of Technology

Budapest University of Technology and Economics

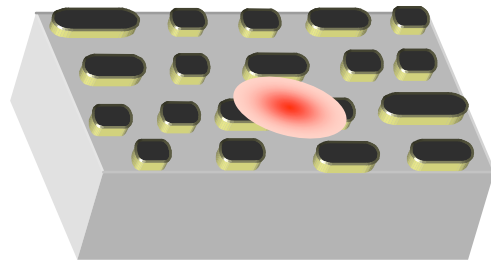
Do we need more capacity ?

- In 2002, around 500 million optical drives and 13 billion disks were sold.
- In 2002, approx. 5 Exa-bytes (1EB = 10^{18} bytes) of unique information per year were produced, equivalent to 800 megabytes for every man, woman, and child on earth.
- Digital storage requirements growing at roughly 100% per annum.
- Development towards an all digital era

YES !

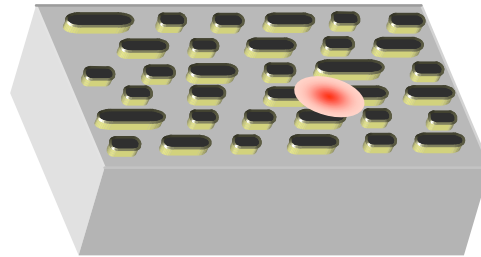
The evolution of the optical disc

0,7 GB



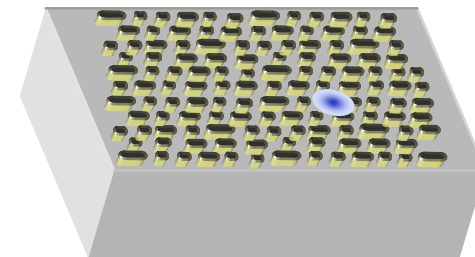
CD

9 GB



DVD

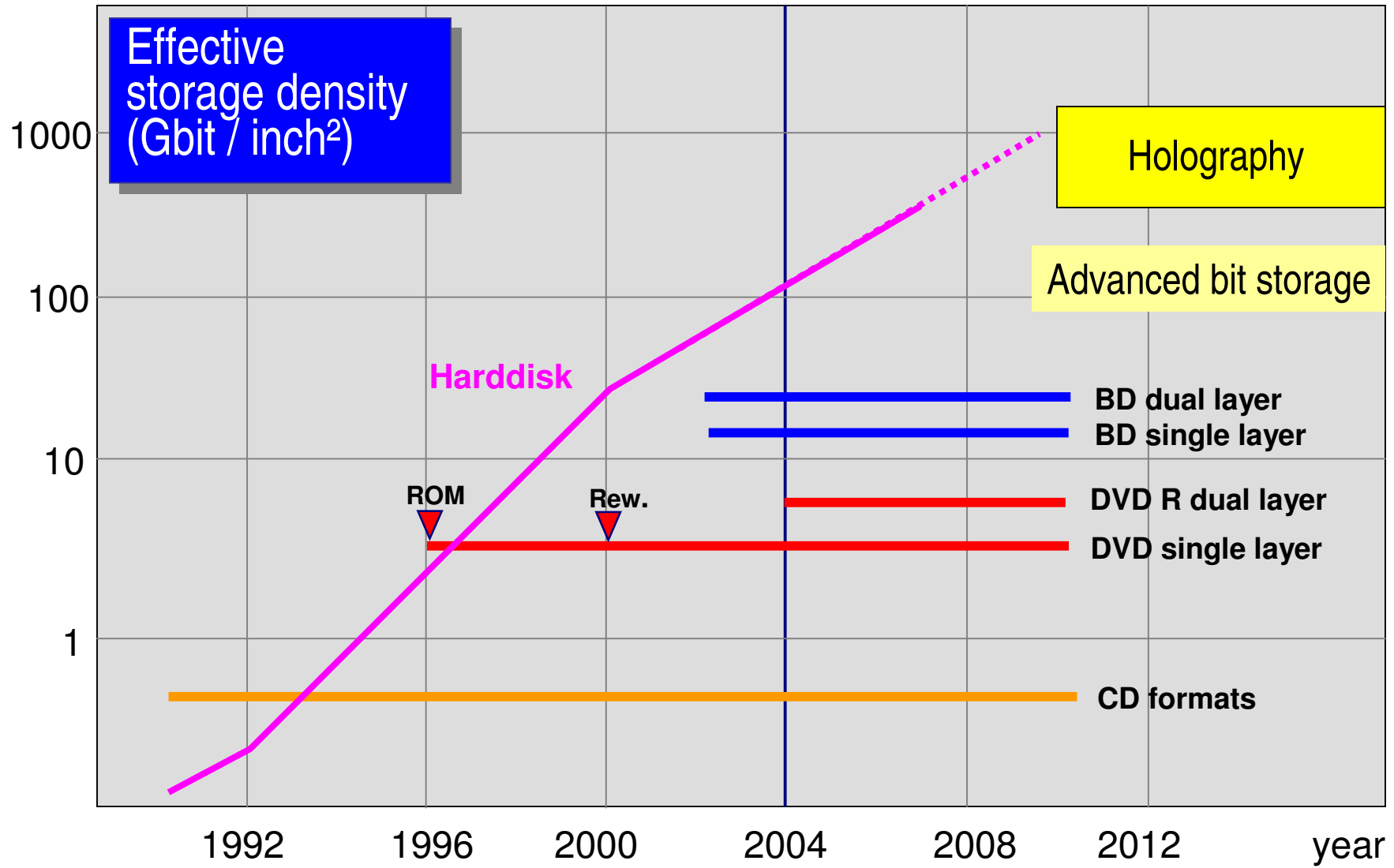
50 GB



Blu-ray Disc

What is next ?

Roadmap for data storage



Advanced bit storage

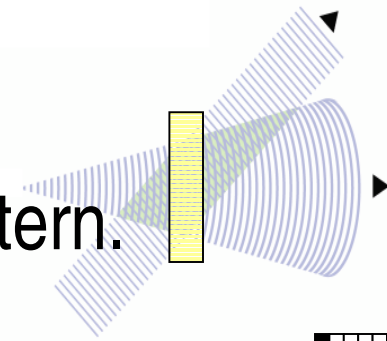
- ❑ Several approaches to increase the capacity:
 - Optical superresolution: marks below the diffraction limit due to subwavelength aperture
 - Magneto-optic
 - Phase-change
 - Near-field recording: subwavelength lightspot
 - Fluorescent materials: Multiple layers per disc
 - UV Recording

- ❑ Difficult to reach the terabyte capacity domain

Holographic data storage

Principle:

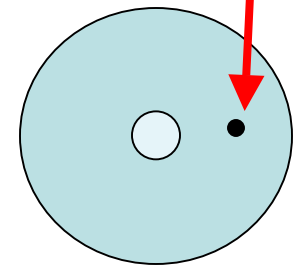
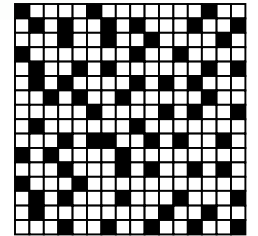
Interfere two beams, record the interference pattern.



ATHOS: Storage of data pages in holograms

Common concept:

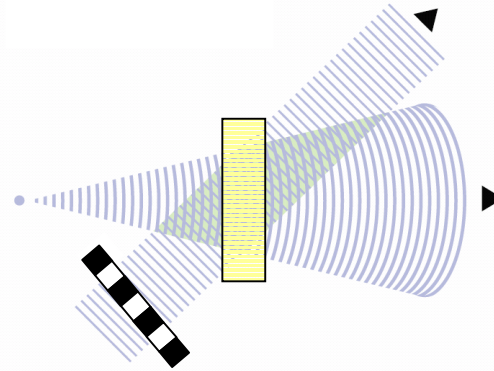
- Use of disc media
- DVD-like servo for tracking and focusing



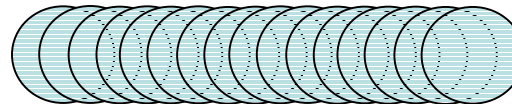
Multiplexing in holographic data storage I

- Efficient use of volume by multiplexing enables high capacity

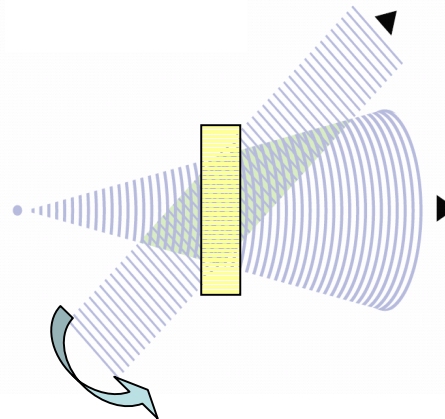
- Phase



- Shift



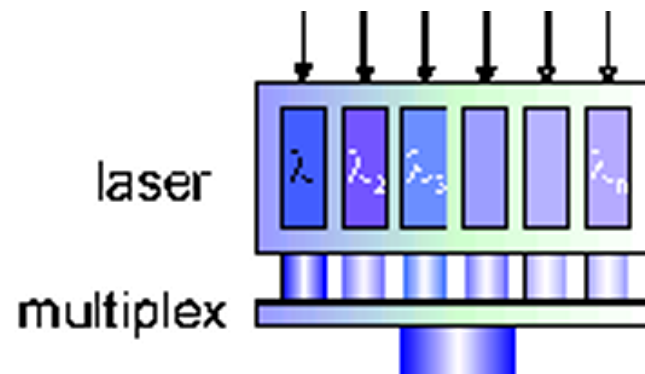
- Angle



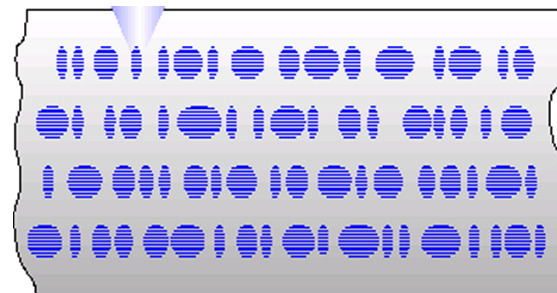
Multiplexing in holographic data storage II

- Efficient use of volume by multiplexing enables high capacity

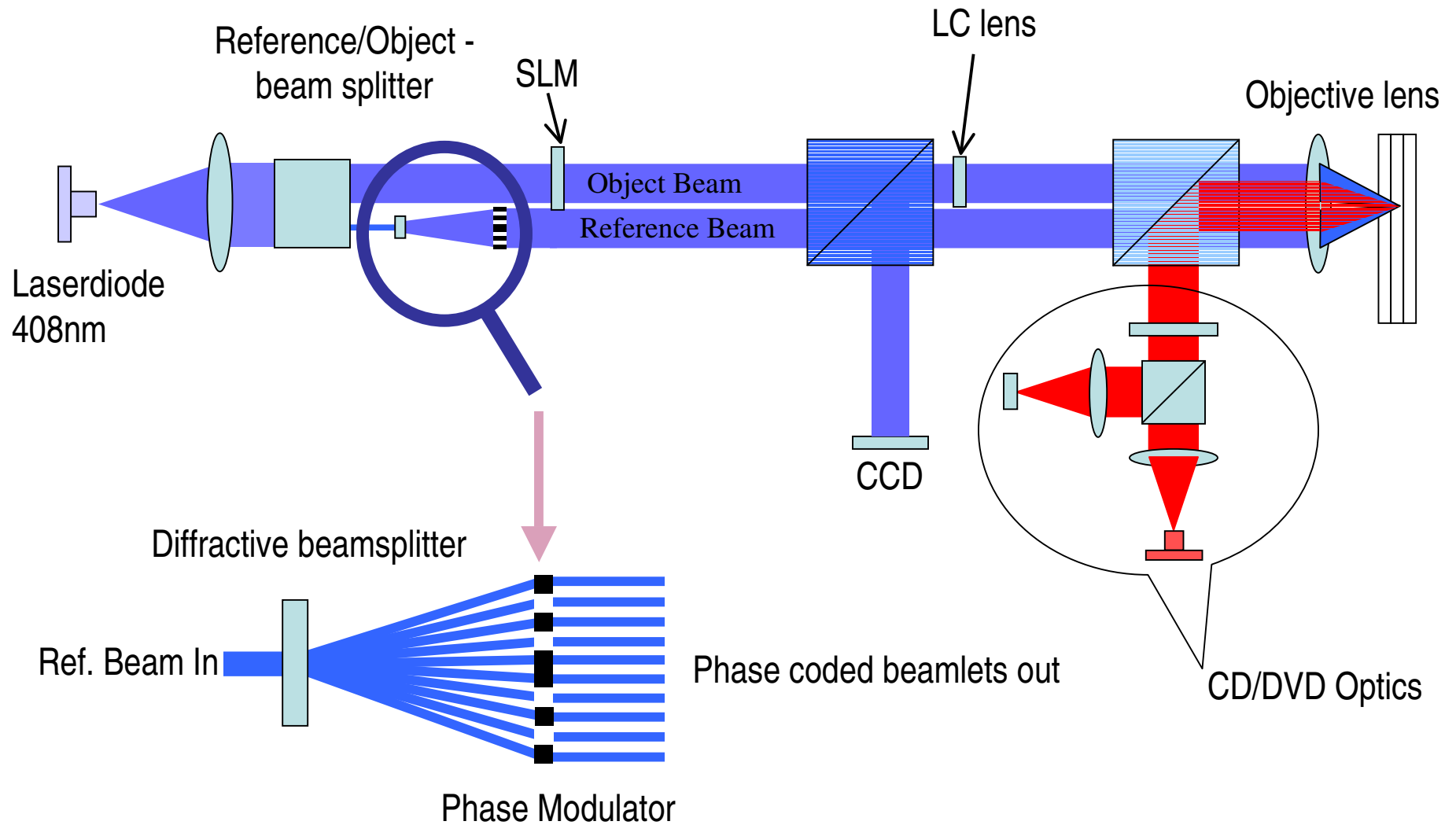
- Wavelength



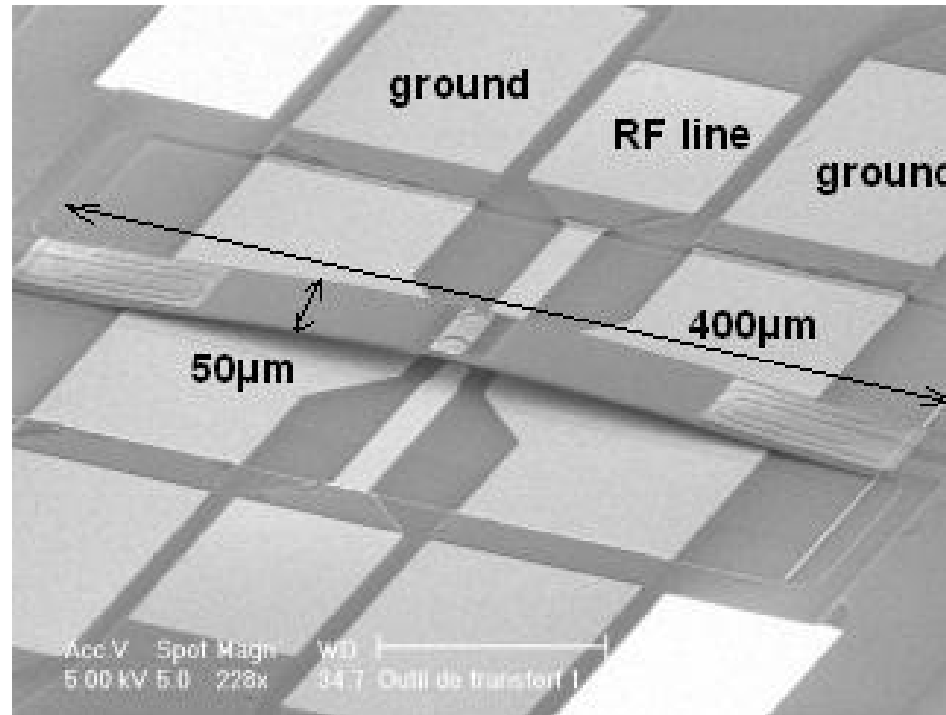
- Multilayer



ATHOS: Optical concept



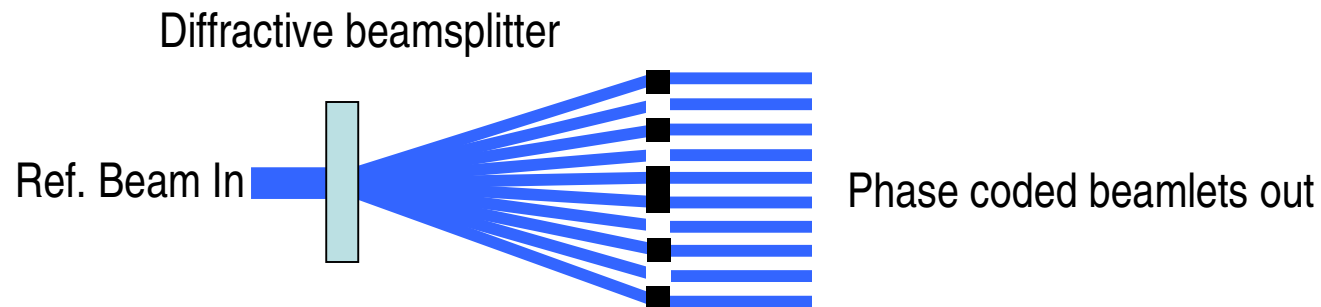
ATHOS: Phase modulation with mirrors



Beam deflection to achieve retardation 0 or π

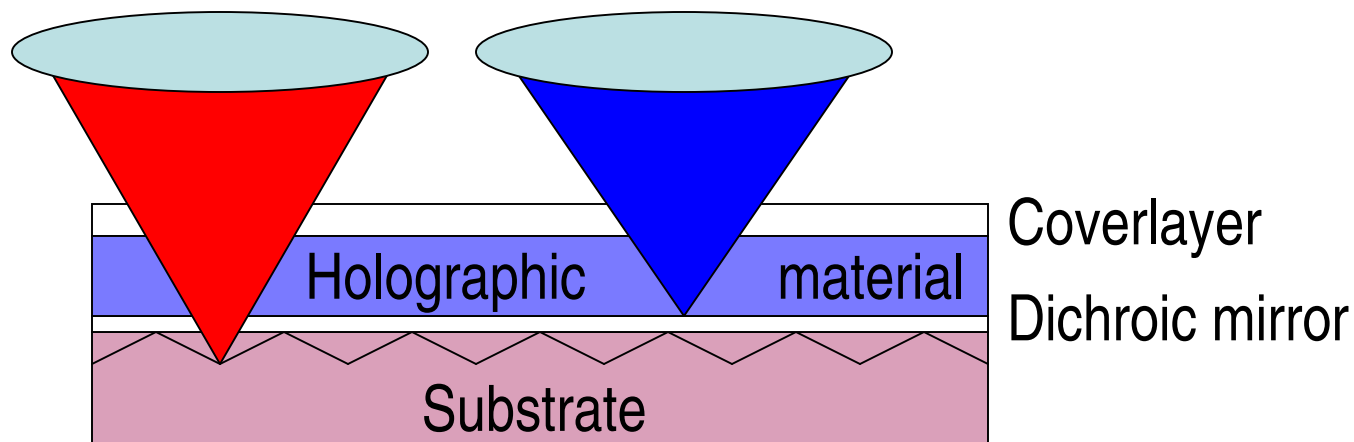
ATHOS: Phase modulation with LC elements

- Beamsplitter to direct beams on discrete LC cells
- 128 phase coded beamlets



ATHOS: Disc structure

- Guiding grooves for focusing and tracking by red laser
- Dichroic mirror to avoid crosstalk between pre-recorded grooves and recorded holograms



ATHOS: Development tasks

- Optical concept for compact pickup (Optimal Optik)
- Development of coherent blue laser diode source (Toptica)
- Phase modulator (TUD, LETI)
- Disc structure (MPO, LETI)
- System
 - Servo control (Thomson, Optimal Optik)
 - Data Detection (Thomson, BU)
 - Media Tester (RWTH)
 - Test / Demonstrator (Thomson)

ATHOS: Target specification

- Capacity: 200 GB per disc
- Data rate: 200 Mbit/s
- Hologram size: 400 kPixel
- Shift multiplexing
- Phase multiplexing
- Blue laser for hologram read/write
- Red laser for tracking and focusing
- Polymer storage material