



Sustainable Data Storage

to keep data accessible forever

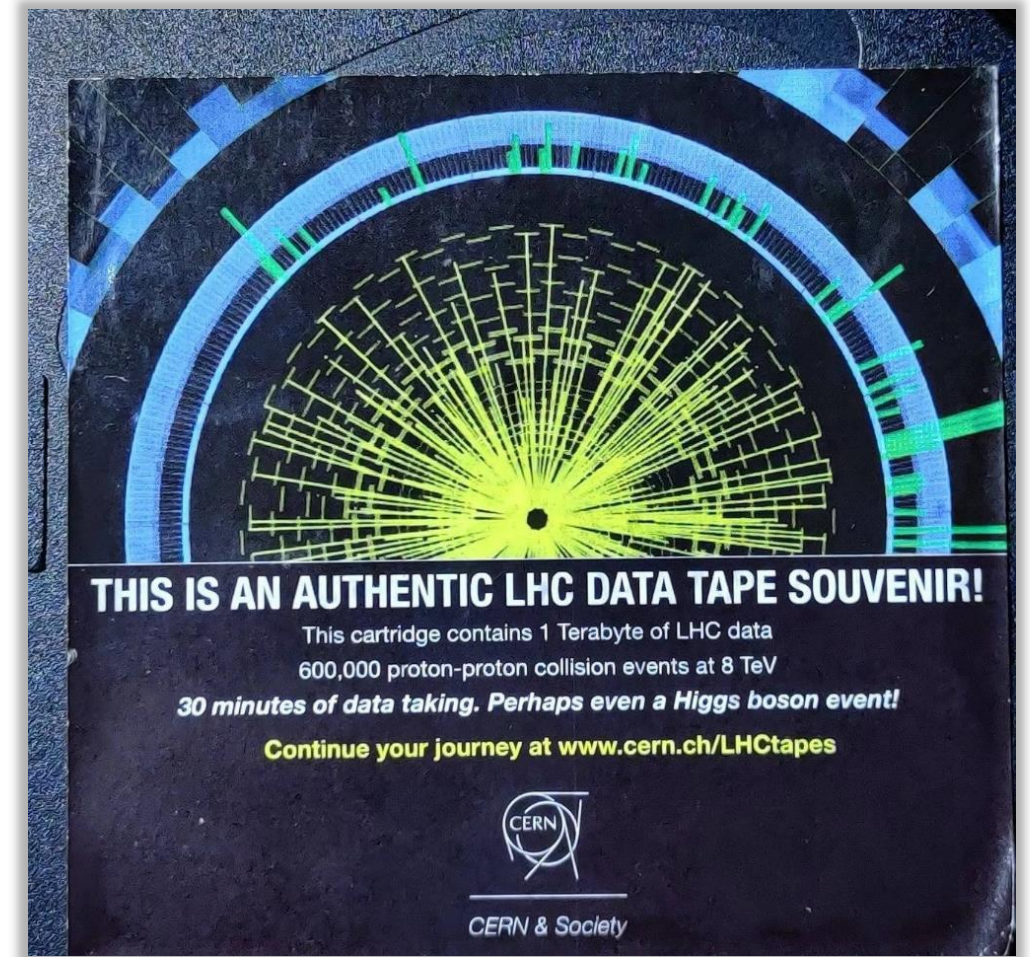


CERN's tape library is the world's largest archive of scientific data



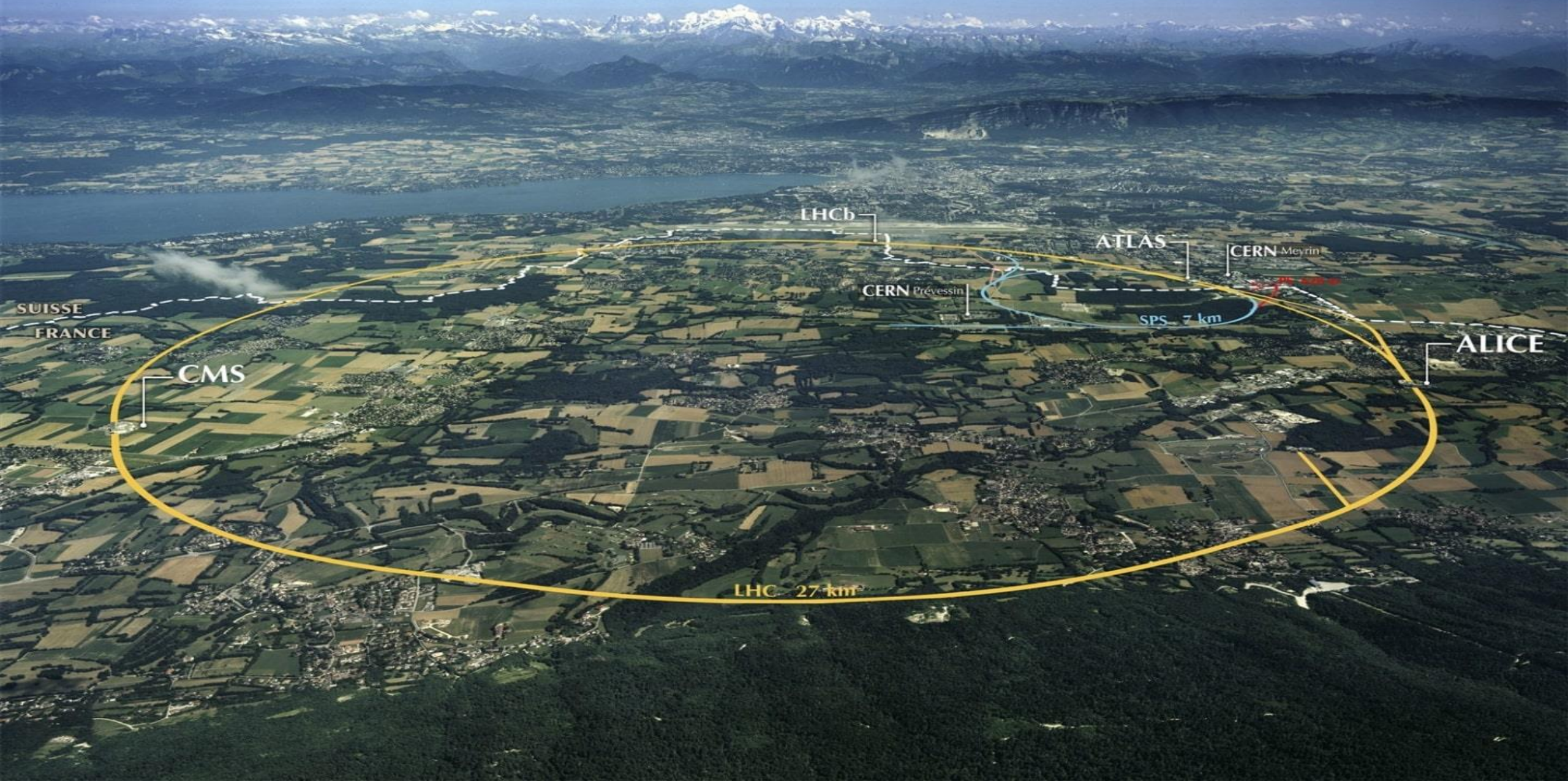


# Obsolete Tape - a souvenir like no other – creative reuse!





# CERN Archival demand by 2033 from the LHC: 6 EB





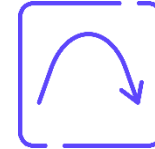
# Data from the LHC: stored for... ever?



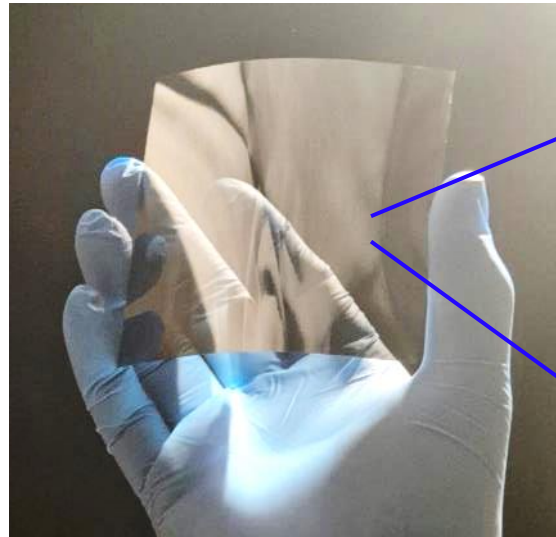
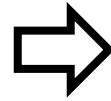
Looking with new insights into old data

## Challenges of digital long-term preservation:

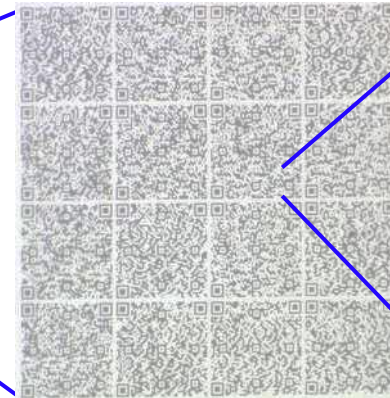
- Regular acquisition costs for media + W/R HW
- Limited media lifetime
- Limited data retention due to bit rot
- Workload of migration & fixity checks
- Energy supply, climate control, vulnerable to EMP
- In fact using the wrong media is unsustainable



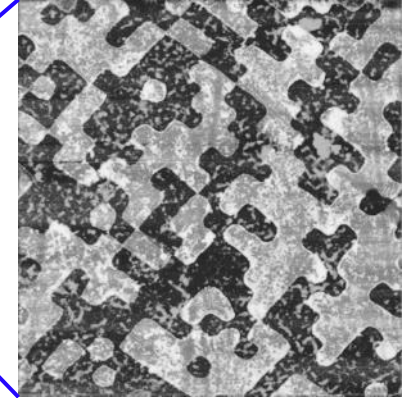
# From Clay Tablets to Ceramic-on-Glass Sheets



Ceramic-on-glass sheets



Data matrix



Physical bits ablated in dark ceramic layer

# Durable & Sustainable Permanent Data Storage



-272 °C  
-459 °F



+500 °C  
+930 °F



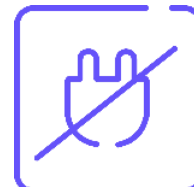
Moisture &  
flood proof



Corrosion  
resistant



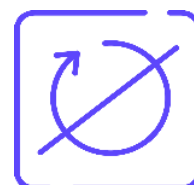
Radiation &  
EMP proof



Energy free retention,  
no AC for storage



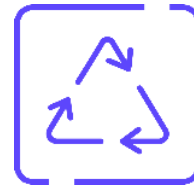
Immutable record,  
cyber secure / WORM media



No media degradation forcing  
periodic replacement



No data migration, **no bit rot** nor  
periodic fixity check



Deletable,  
100% recyclable

# Cerabyte – Ceramic Data Storage



- Martin Kunze, a ceramist, identified the need for permanent storage
- Together with Christian & Alex Pflaum founded Cerabyte in 2022
- The team has raised an initial \$10M seed round & \$4M grant funding
- Raising Series A, support from flash, disk, clean tech & IC companies
- Cerabyte is headquartered in Munich, Germany
- With offices in Vienna, Silicon Valley and Colorado

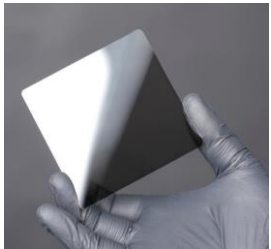


# Cerabyte Company Overview



## Key Innovations & Levers:

- **Ceramic on Glass Media Technology – high volume thin glass ecosystem**



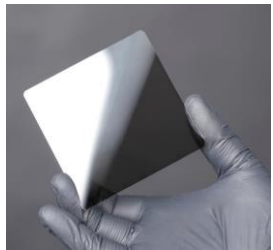
**Ceramic-On-Glass  
Sheets**

# Cerabyte Company Overview



## Key Innovations & Levers:

- **Ceramic on Glass Media Technology** – high volume thin glass ecosystem
- **WORM Technology** punching holes through fs laser/particle beam matrix



**Ceramic-On-Glass  
Sheets**



**Femtosecond  
Laser**

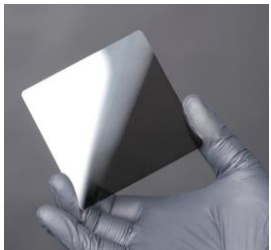


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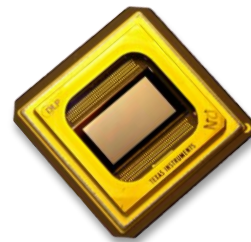
- Ceramic on Glass Media Technology – high volume thin glass ecosystem
- WORM Technology punching holes through fs laser/particle beam matrix
- Leverage semiconductor product and manufacturing fab tool technology



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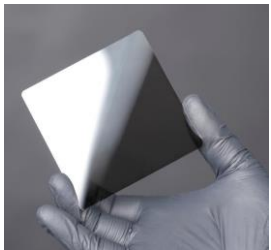
**Matrix Writer  
with DMD**

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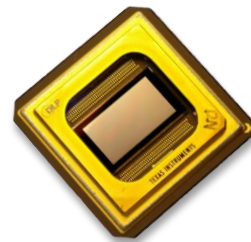
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- Leverage semiconductor product and manufacturing fab tool technology
- Reading via HiRes MegaPixel CMOS sensor, leveraging sensor ecosystem



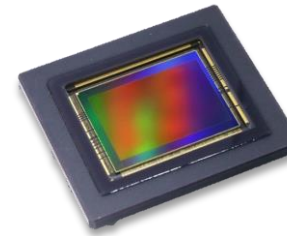
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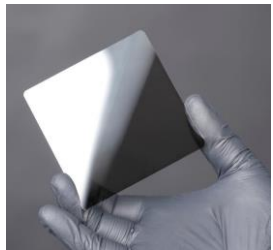


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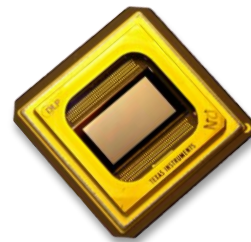
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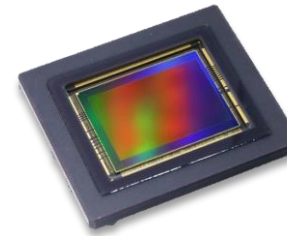
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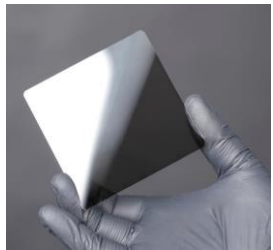
**Existing Form Factors &  
Automation**

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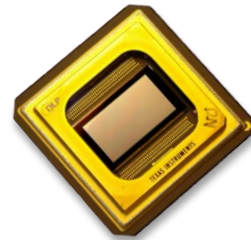
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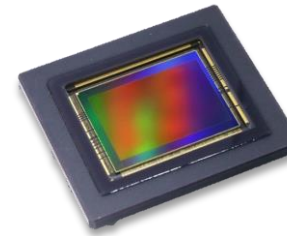
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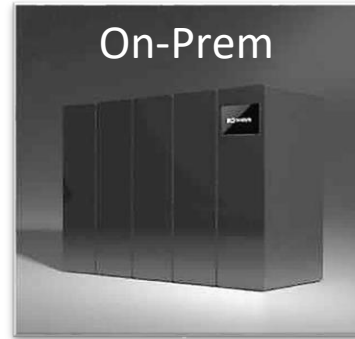
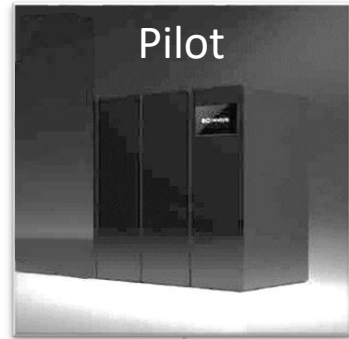
**Existing Form Factors &  
Automation**

**Evolving technology from working prototype to the first commercial system**





# From Pilot to Cloud System



90 sec to first byte  
\$1000/TB

160+ TB/cartridge  
2+ GB/s

1 TB/cartridge  
100 MB/s

< 10 sec to first byte  
\$1/TB

2025-26

2026-27

2027-28

2028-30

# Early Access From Prototype to Product



- 2023** # end-to-end prototype built from components off-the-shelf, QR codes, FPGA
- # quick feasibility demo for system and media
- # limited compatibility between components prevents acceleration

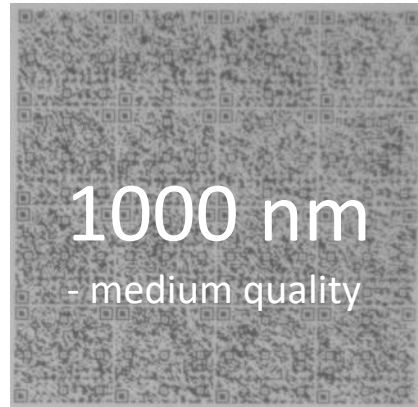


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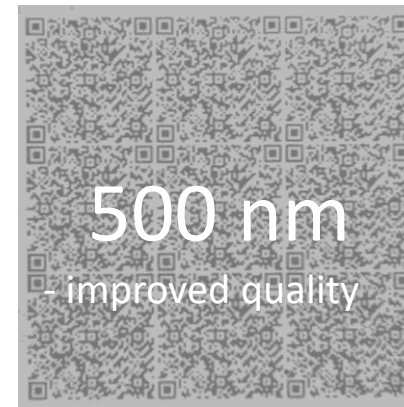
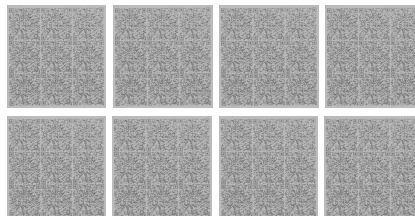


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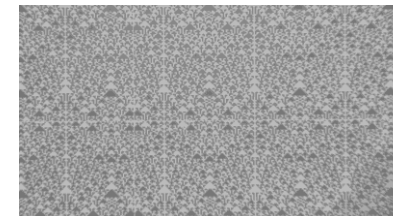
**2024** # design custom-tailored components : align DMD framerate with laser pulserate  
# DMD for UV light for smaller structures/higher density  
# Create efficient data matrix  
# handling of media



8 x shots: 200 x 200 pixel



One shot: 800 x 400 pixel



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- 2025** # reliability test runs to find optimal overhead for EC, processing on CPU to stay flexible (MB/s)  
# minimizing the stucture size – increasing capacity  
# write/read GB data sheets with customer data, write entire TB cartridges

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# write/read GB data sheets with customer data, write entire TB cartridges
  
- 2026** # speed up reading with FPGA/ASIC 100+MB/s  
# shipping 1000 slot library systems with reading unit



# Data from LHC: stored forever.



Looking with new insights into old data

## Digital long-term preservation with Cerabyte

One time media & HW acquisition costs

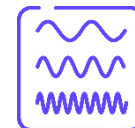
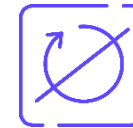
Unlimited media lifetime, WORM, cyber secure

Unlimited data lifetime, no migration & fixity checks

No energy & A/C, sustainable, recyclable

Resistant to water, corrosion, heat, radiation, EMP

Significantly lower TCO



# Cerabyte CERN openlab Engagement



## 2025

Q1 Discuss on open/self describing format/index standard for the Cerabyte data carrier

Q2 GB of real data written on Cerabyte media and evaluated by CERN team

Q3 CERN's validation of the carriers in stress/environmental conditions will be very valuable

Q4 Writing of TB+ cartridges of CERN data with new coding scheme by Cerabyte

## 2026

H1 Installing a 1000 slot library incl reader on CERN premises, testing reading reliability

H2 Installing a write unit into the library for writing on CERN premises



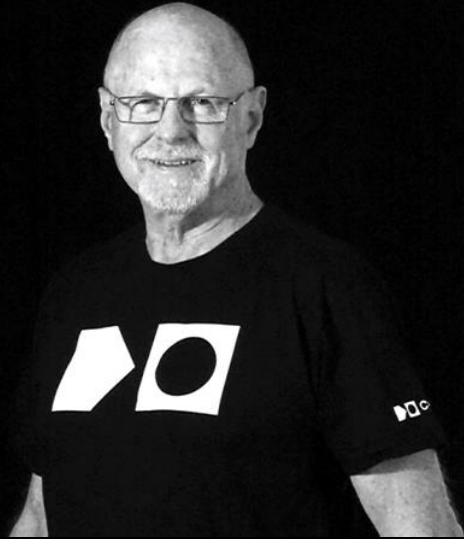
## CERN LOI

“Cerabyte’s innovative storage technology suggests that it may be able to create [new options to store this digital data in the long term in a secure, cost-effective, and environmentally friendly manner.](#)”

“Additionally, Cerabyte’s long-term [particle beam technology roadmap is potentially enabling storage areal densities required for the Yottabyte Era,](#) which could also provide a European technology leadership opportunity.”

## Helped to secure EIC & EIB Funding





Steven Campbell, CTO  
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Steffen Hellmold, President  
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