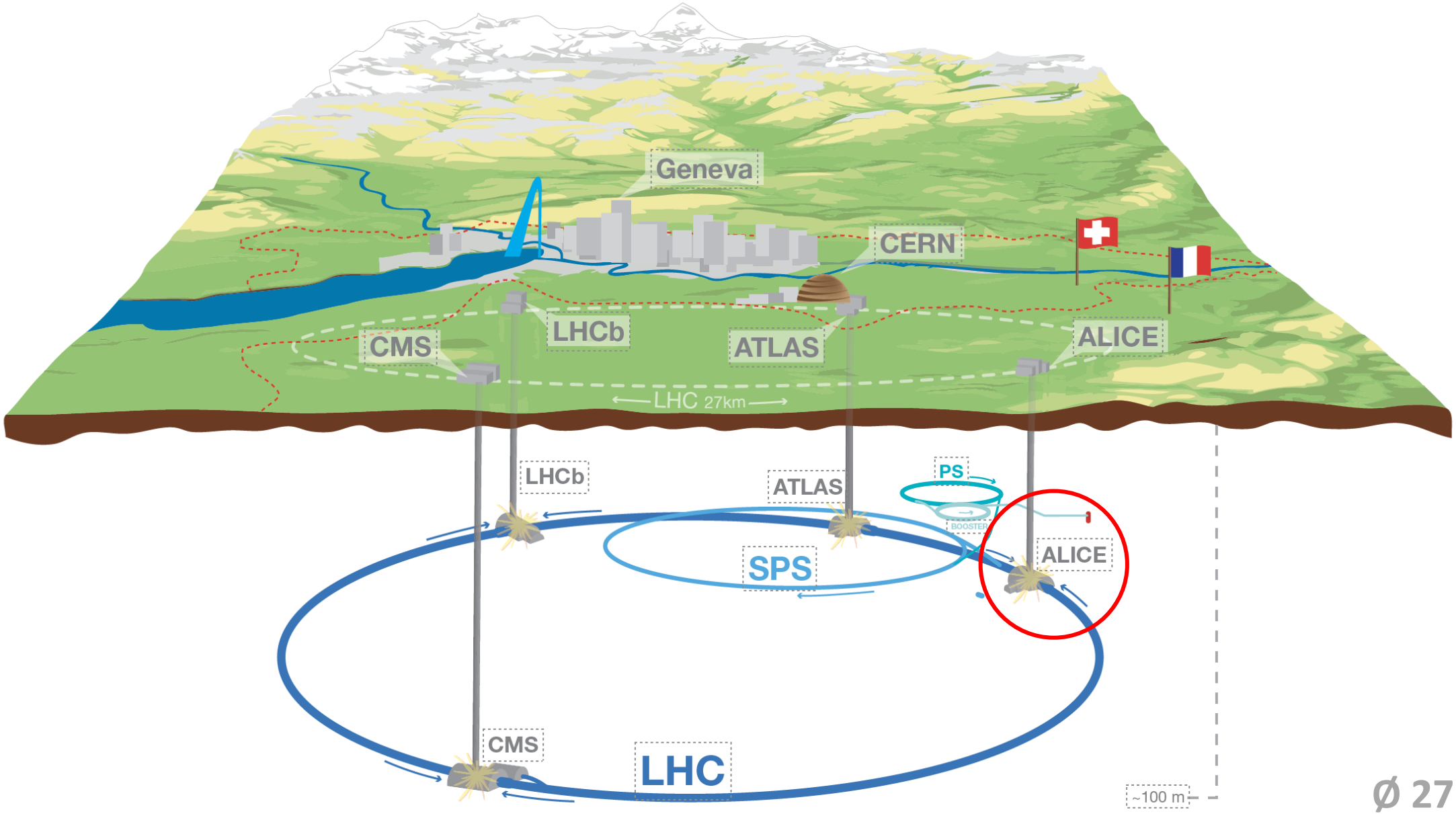
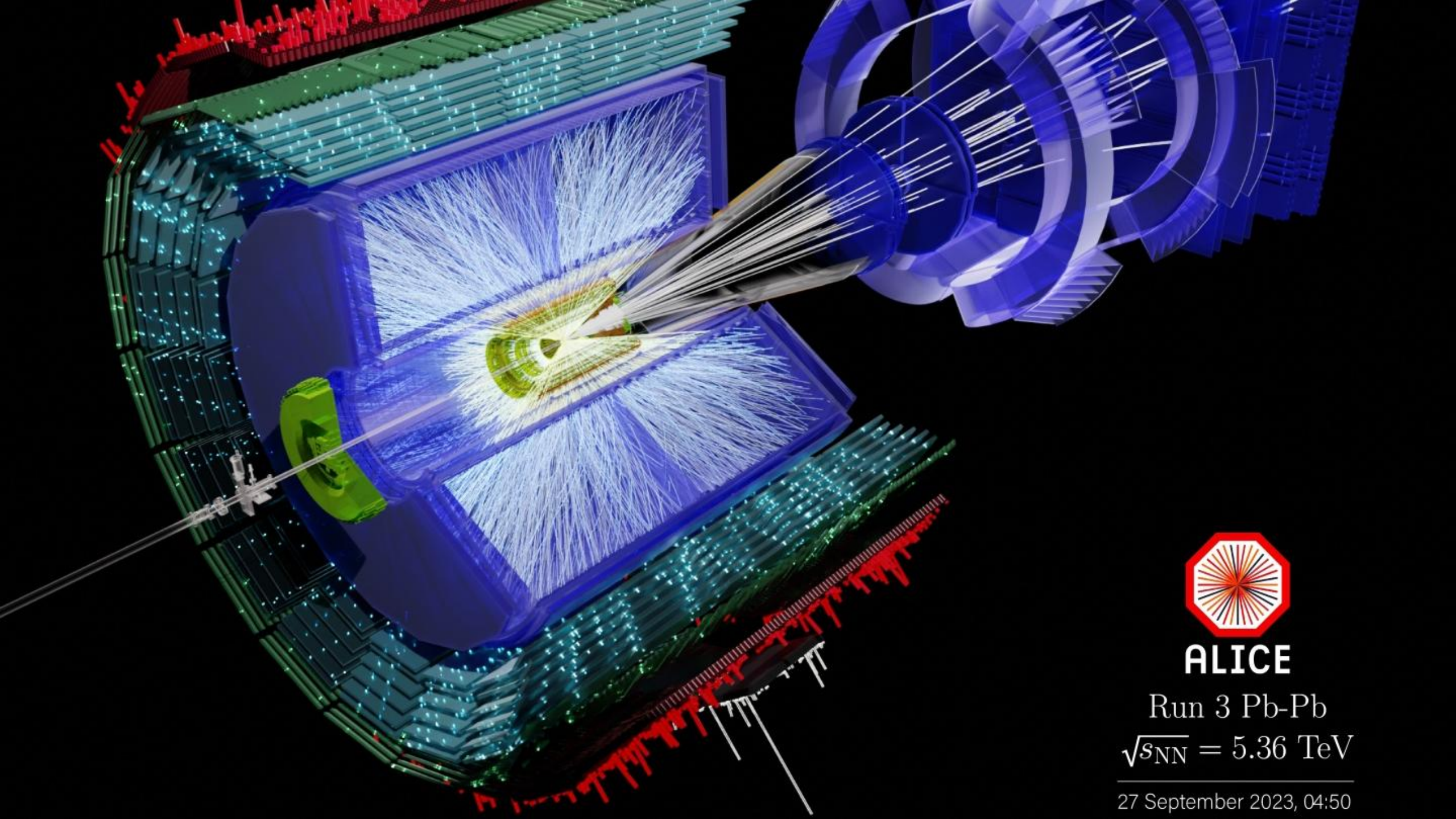
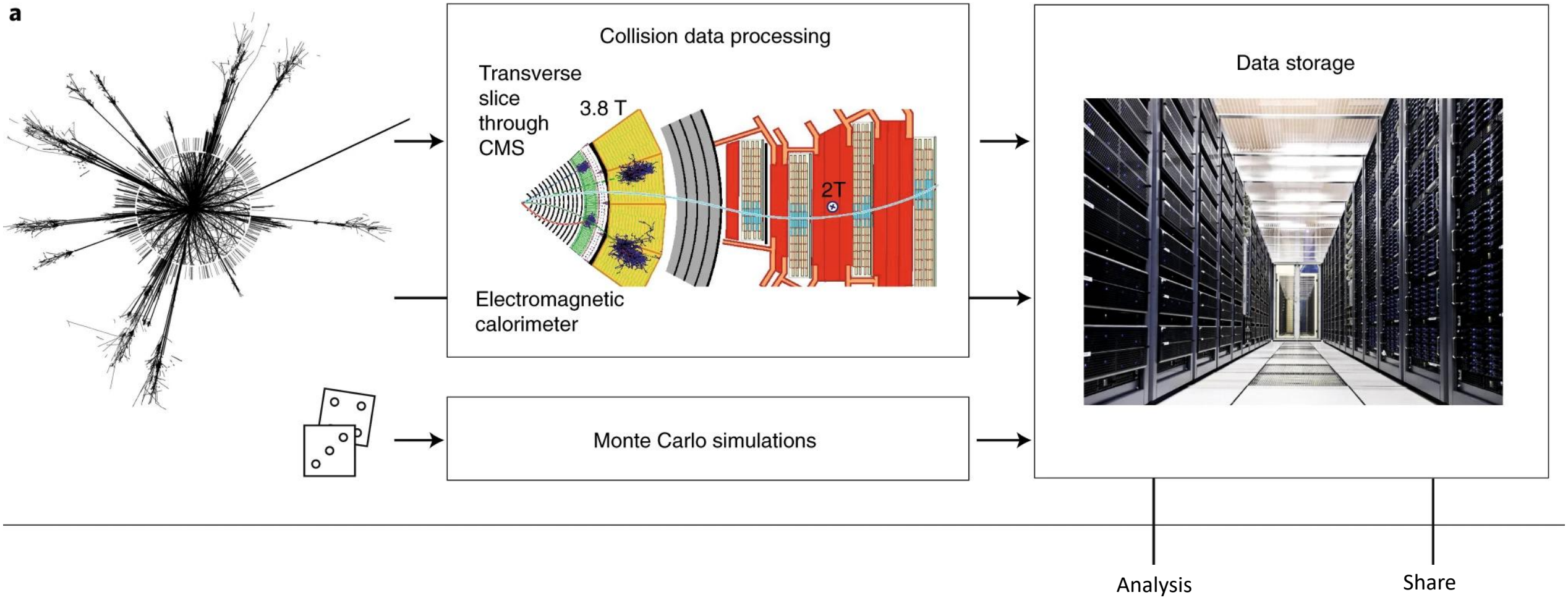
The Globe of Science and Innovation – CERN


Geneva
CERN
CMS
LHCb
ATLAS
ALICE
LHC 27km
LHCb
ATLAS
PS
BOOSTER
SPS
ALICE
CMS
LHC
~100 m

Ø 27 km


ALICE
Run 3 Pb-Pb
$\sqrt{s_{\mathrm{NN}}} = 5.36$ TeV
27 September 2023, 04:50


a
Collision data processing
Transverse slice through CMS
3.8 T
2T
Electromagnetic calorimeter
Monte Carlo simulations
Data storage
Analysis
Share

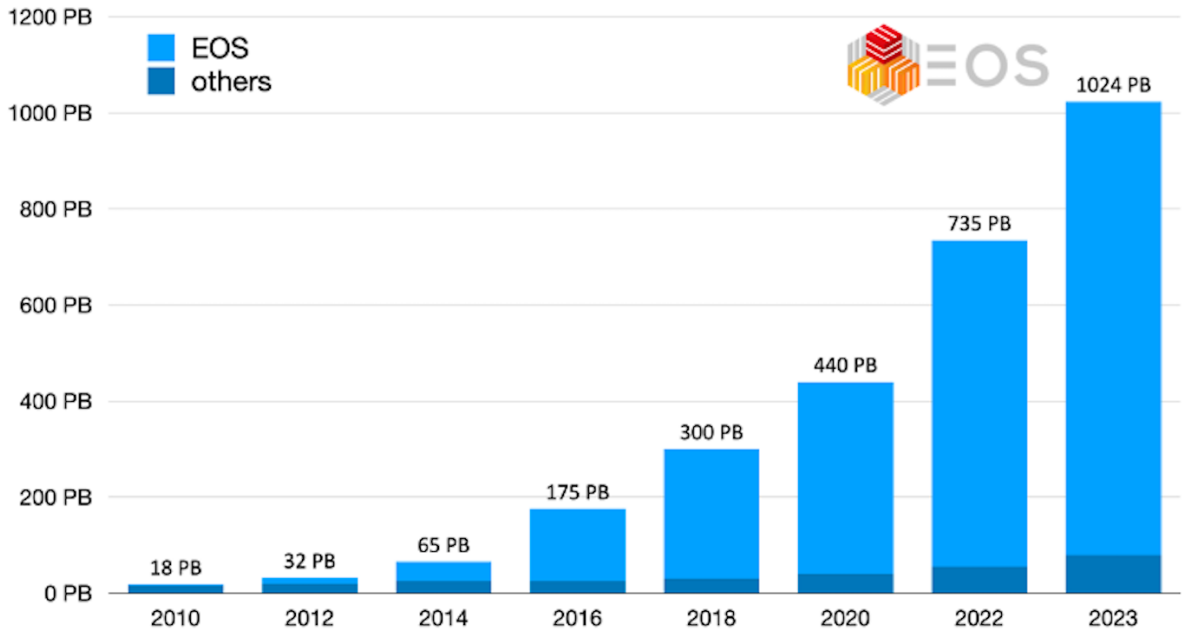
ALICE – Run 3

1.2×10^{10} collisions in 5 weeks
2800 GPUs
50 000 CPUs
770 GB/s

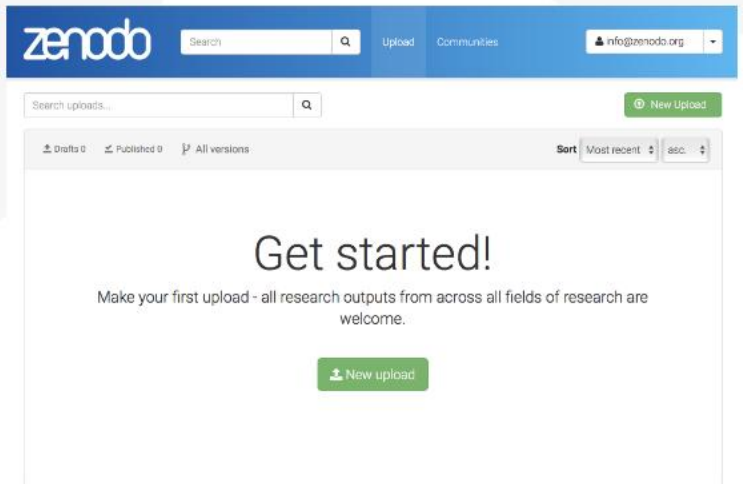
LHC

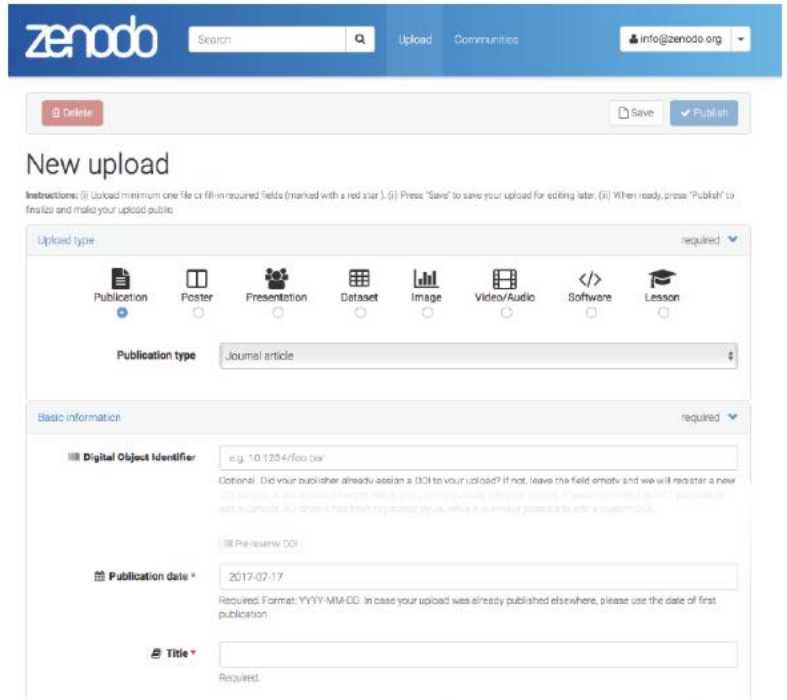
10^{9} collisions every second
6×10^{17} bytes of record

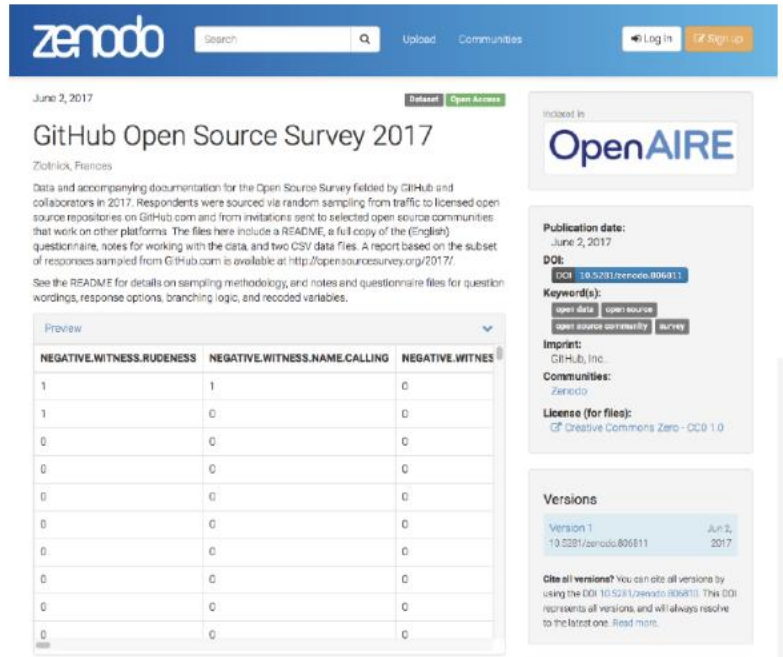
Low latency storage infrastructure for physics data from the LHC and CERN



- Data stored in CERN's EOS service in a 5 PB disk cluster
- Each file copy has two replicas located on different disk servers
- A daily incremental backup in a different geographical location (~3.5 km apart)
- The retention lasts 7 daily backups, last 5 weekly backups and last 6 monthly backups







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Article Level Metrics

Data stewards

- Know what data an organization possesses
- Understand where that data is located
- Ensure that the data is accessible, usable, safe, and trusted
- Safeguard the transparency and accuracy of data lineage
- Enforce rules and regulations on how data can be used
- Help to make data for competitive advantage
- Drive toward a data-driven culture
- Be an advocate for trusted data
- …

Journal of the Mechanical Behavior of Biomedical Materials
Volume 155, July 2024, 106566

Understanding frictional behavior in fascia tissues through tribological modeling and material substitution

A. Streďanská [a], D. Nečas [a], M. Vrbka [a], J. Suchánek [b], J. Matonohová [c], E. Toropitsyn [c], M. Hartl [a], I. Křupka [a], K. Nešporová [c]

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Highlights

- Developed reliable tribological model for fascia friction and lower back pain (LBP) investigation.
- Identified PVA hydrogel and PU gel as potential substitutes for biological samples in the model.
- Established strong correlation between HA properties and fascia friction, suggesting new treatment possibilities for LBP.

102 219 586 328

591/s

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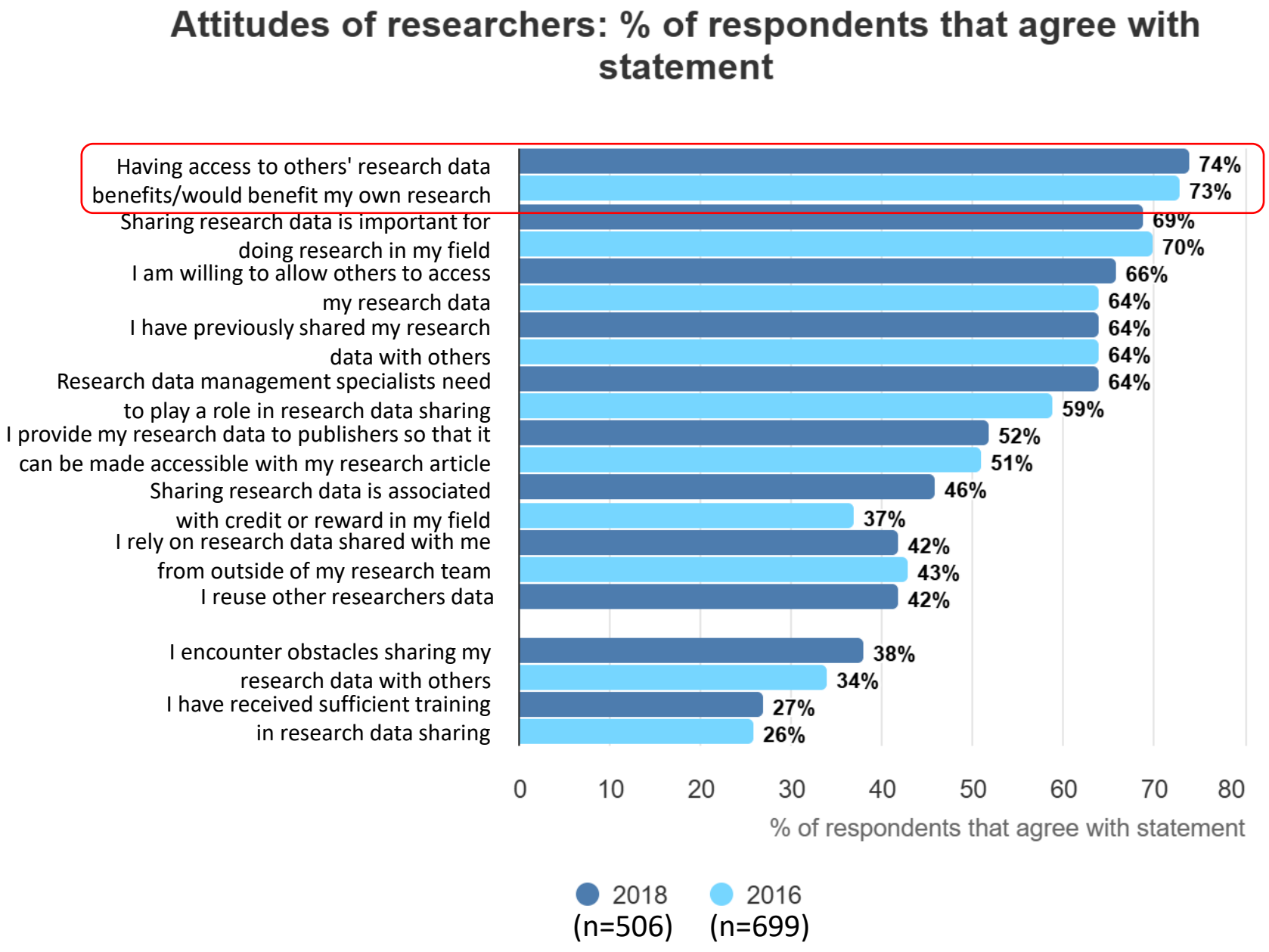
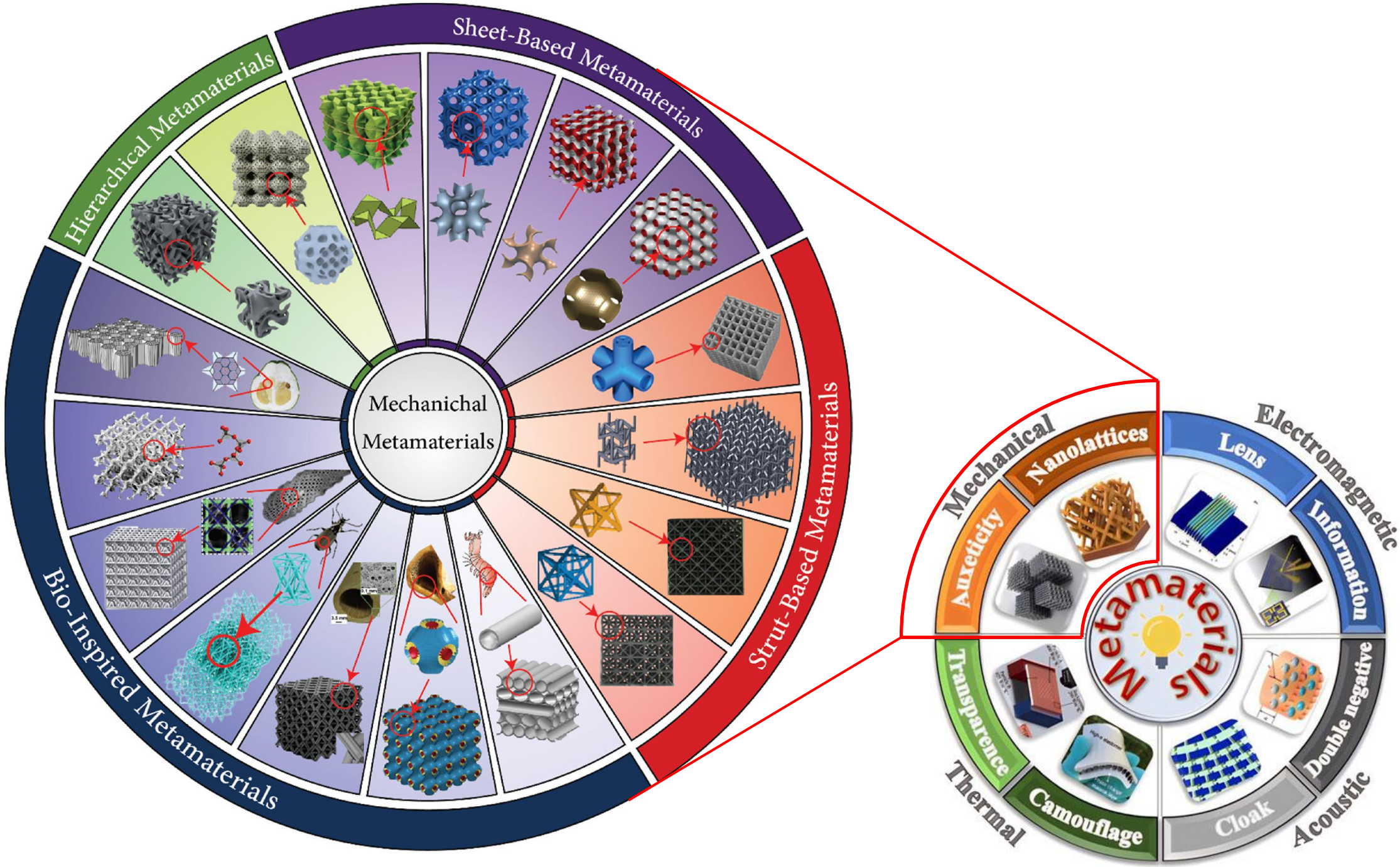
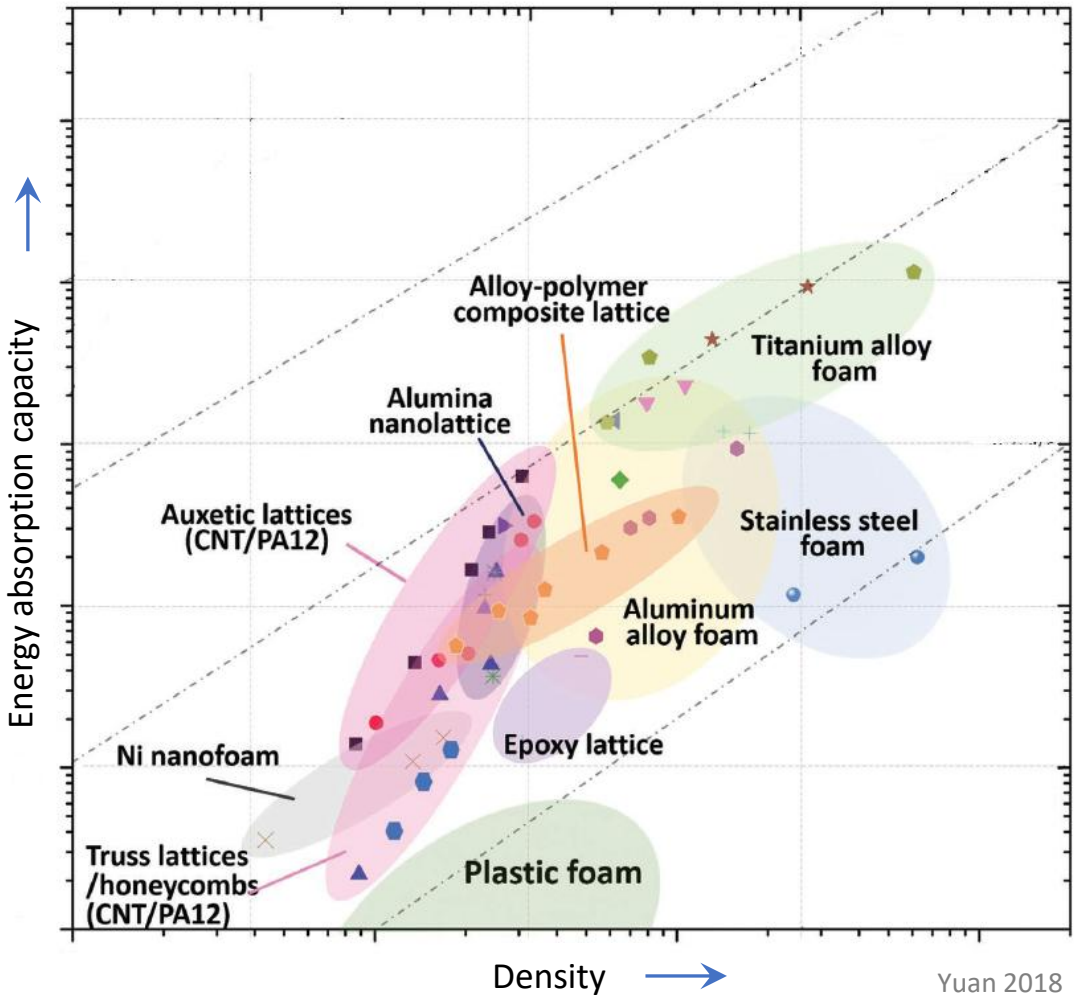

Attitudes of researchers: % of respondents that agree with statement
Having access to others' research data benefits/would benefit my own research
74%
73%
Sharing research data is important for doing research in my field
69%
70%
I am willing to allow others to access my research data
66%
64%
I have previously shared my research data with others
64%
64%
Research data management specialists need to play a role in research data sharing
64%
59%
I provide my research data to publishers so that it can be made accessible with my research article
52%
51%
Sharing research data is associated with credit or reward in my field
46%
37%
I rely on research data shared with me from outside of my research team
42%
43%
I reuse other researchers data
42%
I encounter obstacles sharing my research data with others
38%
34%
I have received sufficient training in research data sharing
27%
26%
0
10
20
30
40
50
60
70
80
% of respondents that agree with statement
2018 (n=506)
2016 (n=699)

Mechanical metamaterials

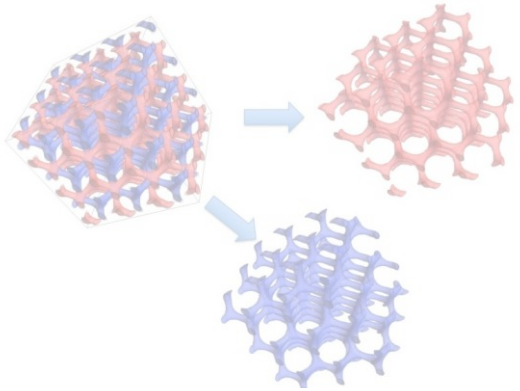

Mechanichal Metamaterials
Sheet-Based Metamaterials
Strut-Based Metamaterials
Bio-Inspired Metamaterials
Hierarchical Metamaterials
Metamaterials
Mechanical
Nanolattices
Auxeticity
Electromagnetic
Lens
Information
Double negative
Acoustic
Cloak
Camouflage
Thermal
Transparence

Energy absorption capabilities

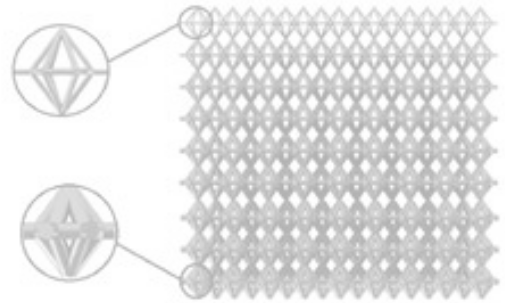
Performance of metamaterials



Yuan 2018

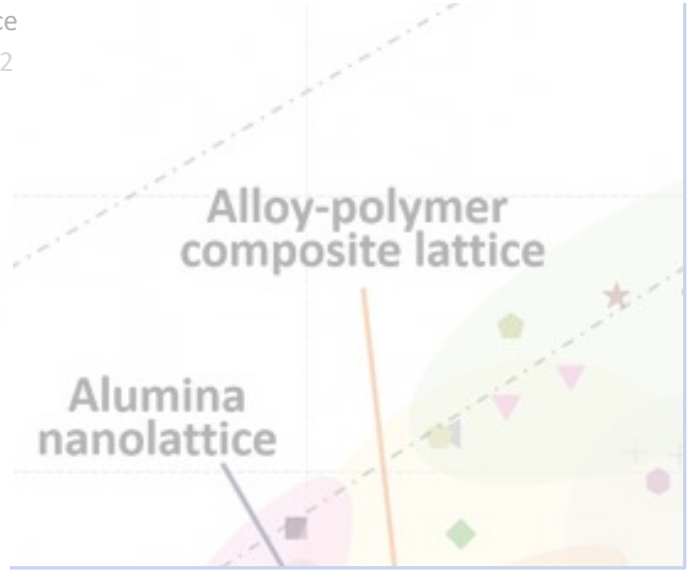


Double gyroid lattice
Science Trends 2022

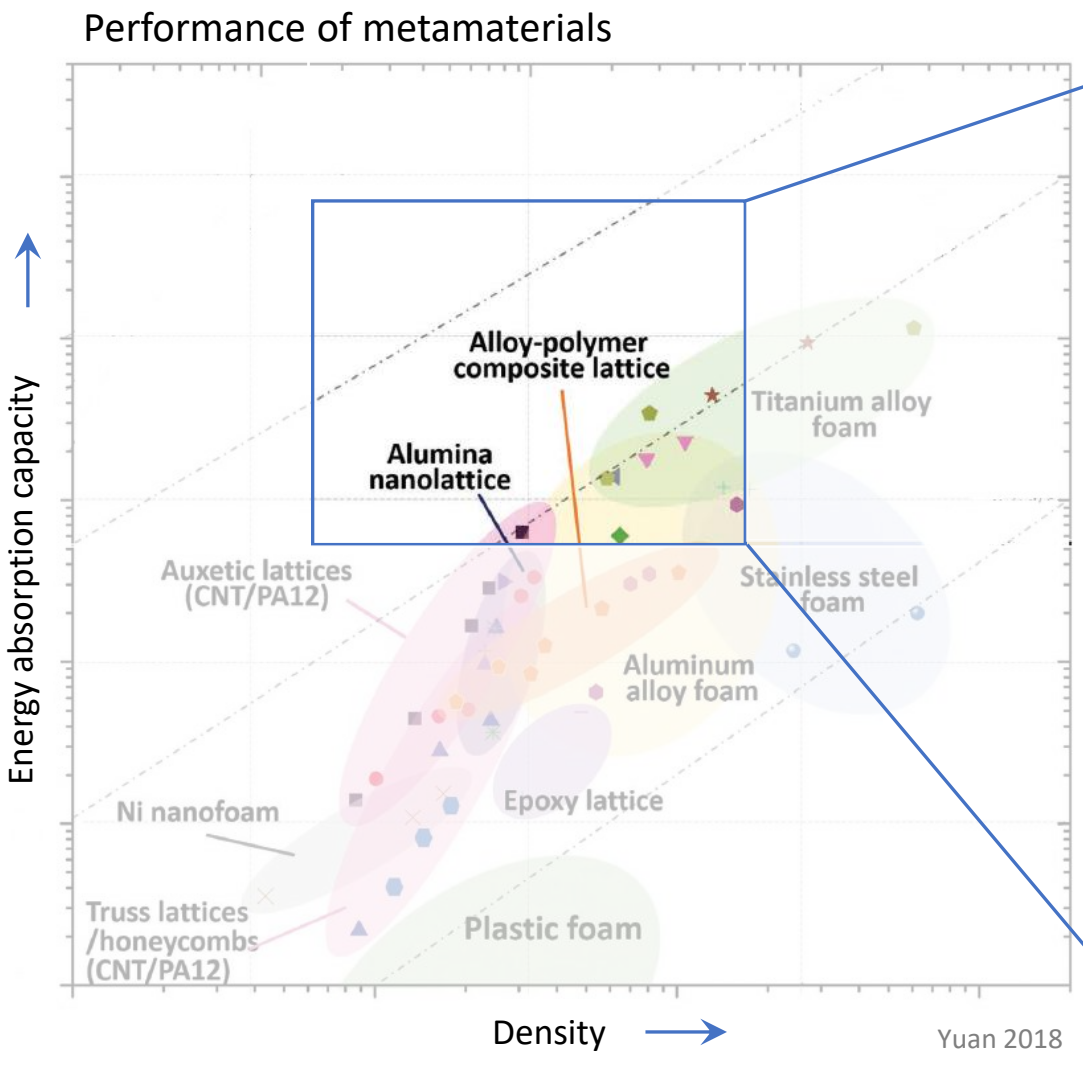


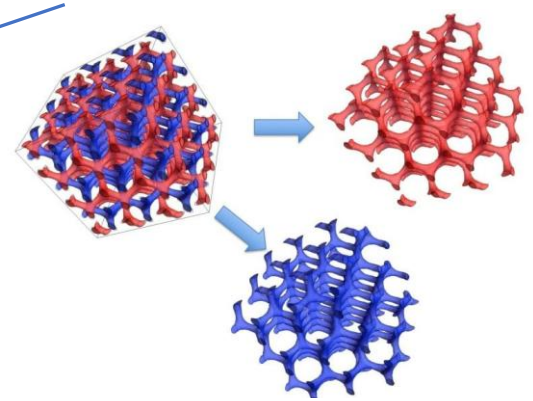
Graded pyramid dodecahedron
Mahbod 2019

Auxetic lattice BCC-6H
Yuan 2018

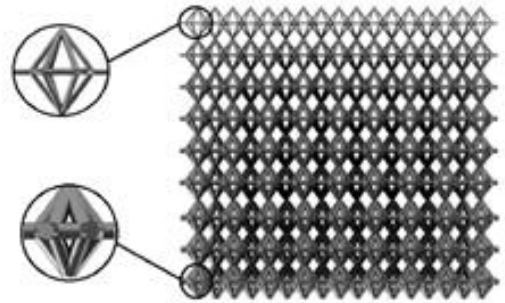


Energy absorption capabilities





Double gyroid lattice
Science Trends 2022



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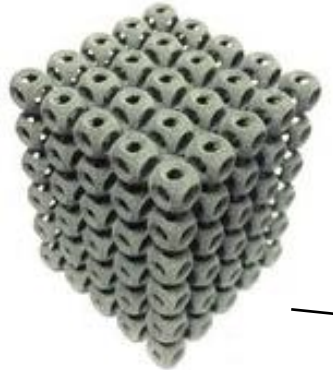
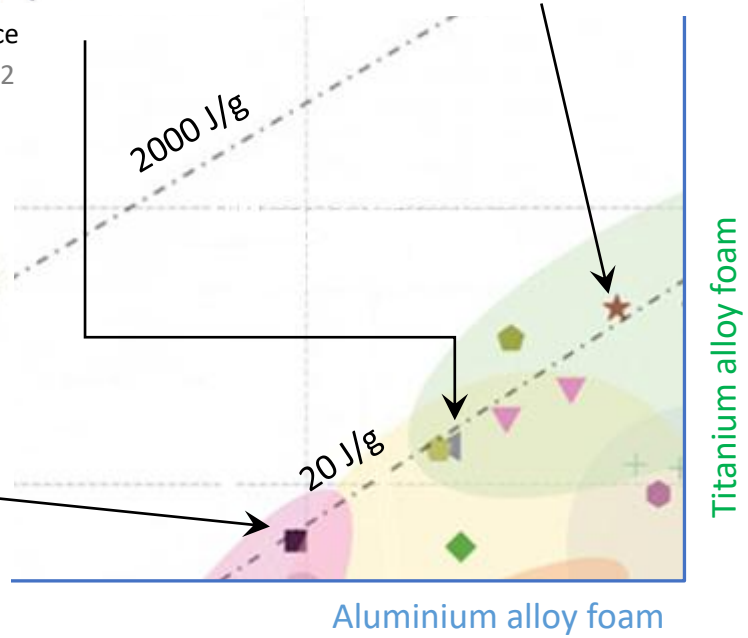
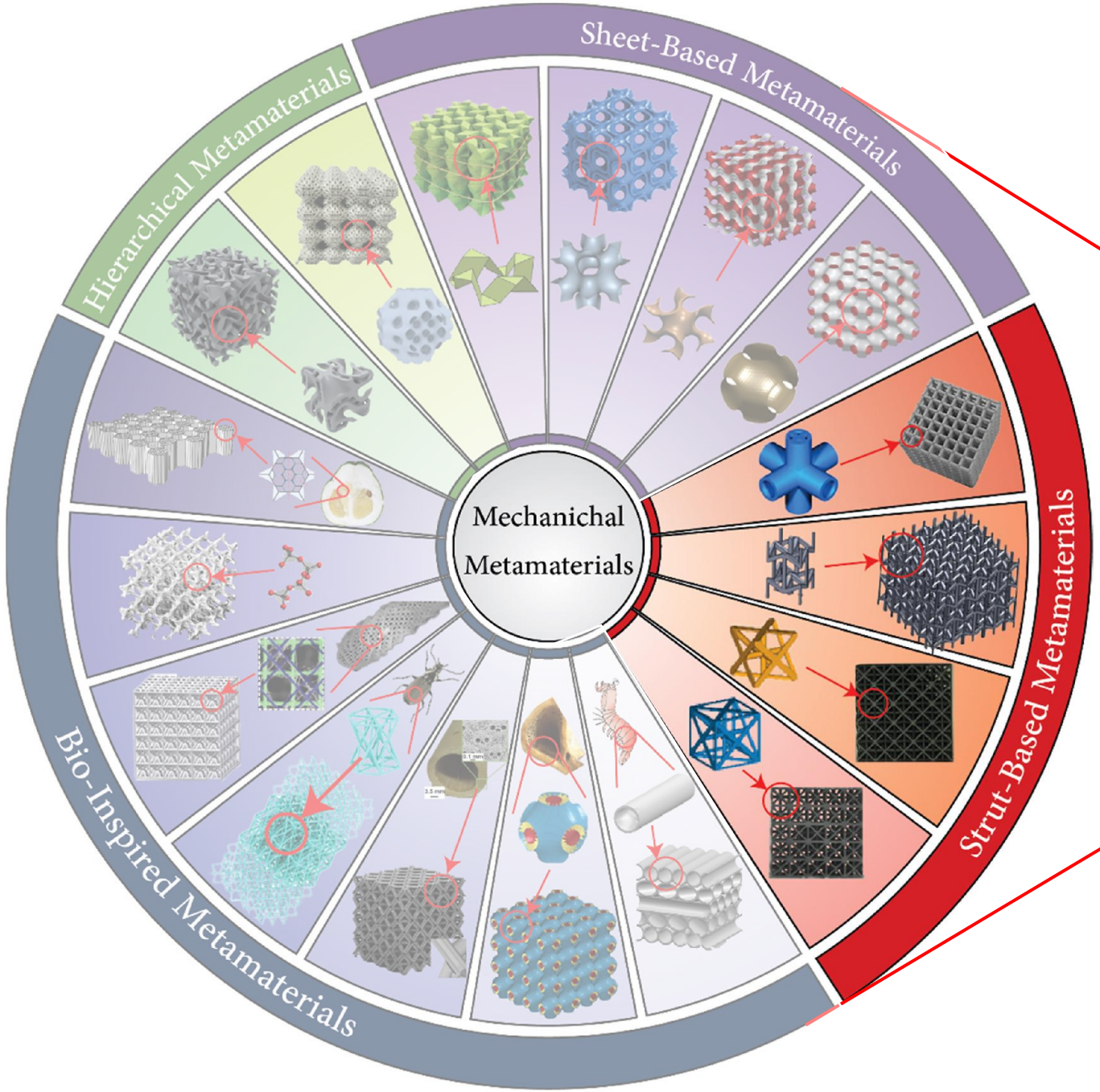
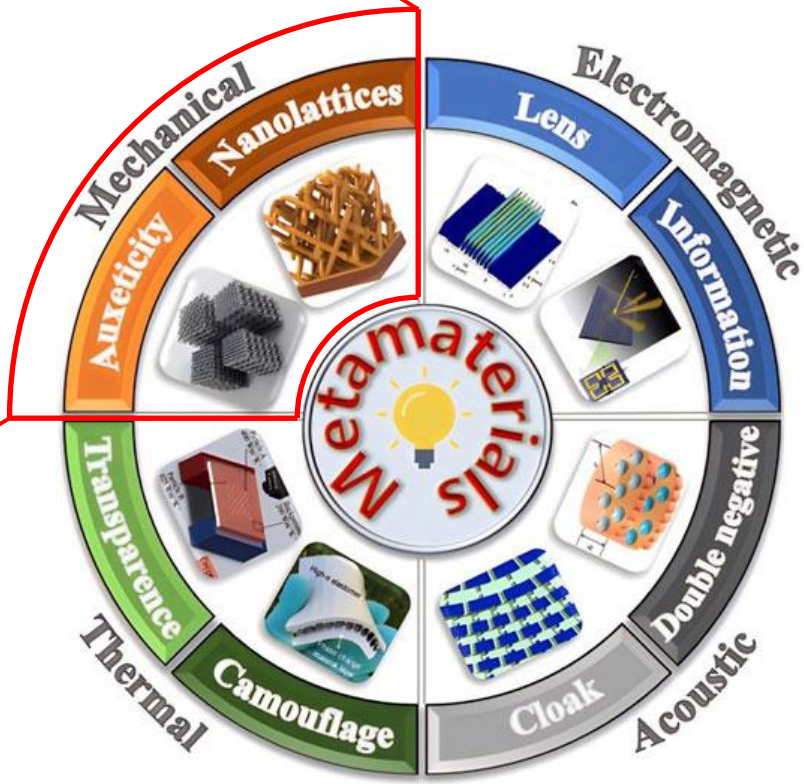


Auxetic lattice BCC-6H
Yuan 2018




Sheet-Based Metamaterials
Strut-Based Metamaterials
Bio-Inspired Metamaterials
Hierarchical Metamaterials
Mechanichal Metamaterials


Metamaterials
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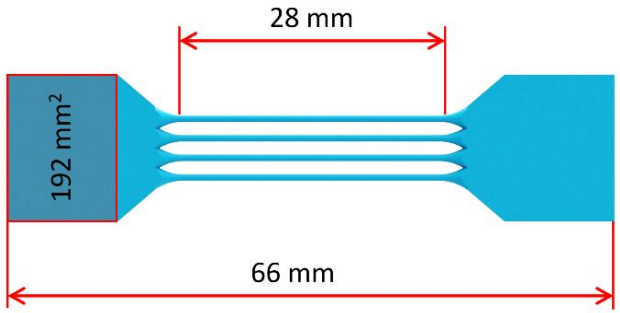
Auxeticity
Electromagnetic
Lens
Information
Thermal
Transparence
Camouflage
Acoustic
Double negative
Cloak

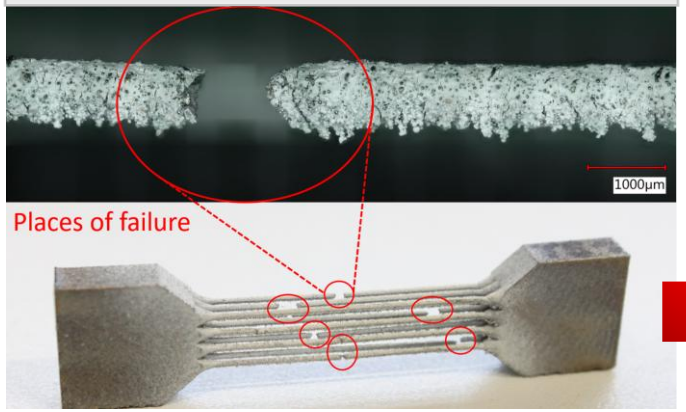
Strut-Based Metamaterials

- Červinek 2020-2024

Series of process parameters
Multi-strut tensile samples



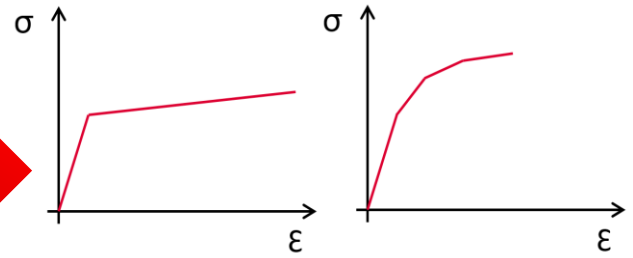
True stress-strain values based on engineering data



Single-strut tensile samples
FEA post-processing

Not published yet

Finite element analysis – model of material
Non-linear elastic plastic model



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Strut-Based Metamaterials

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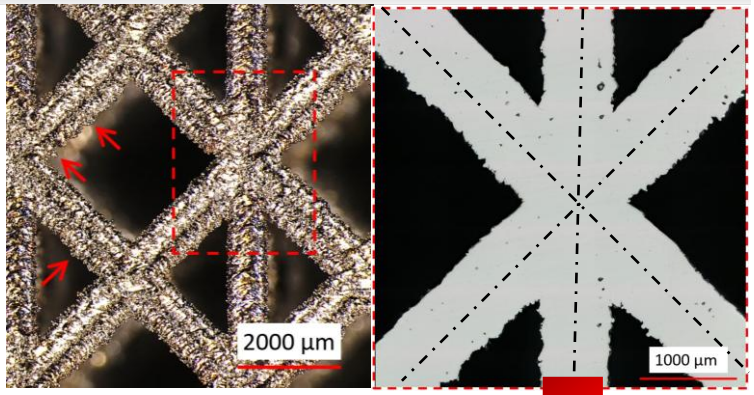
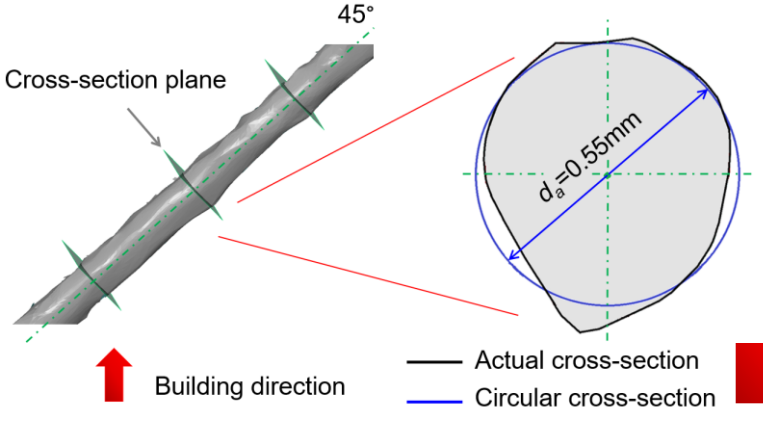
Samples for dimensional analysis

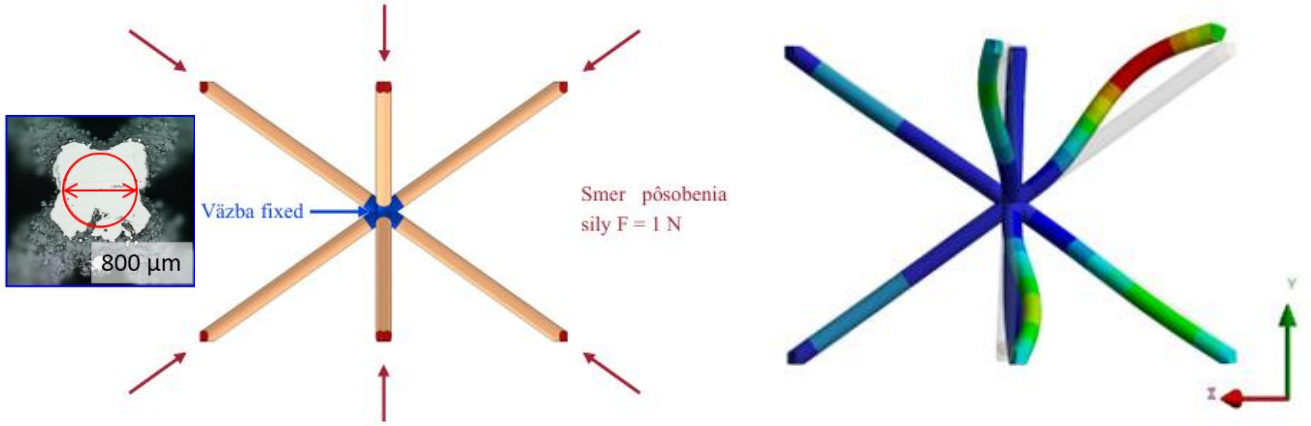


Cross-section based on scans



Finite element analysis – model of geometry

Series of modified geometrical parameters



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a)

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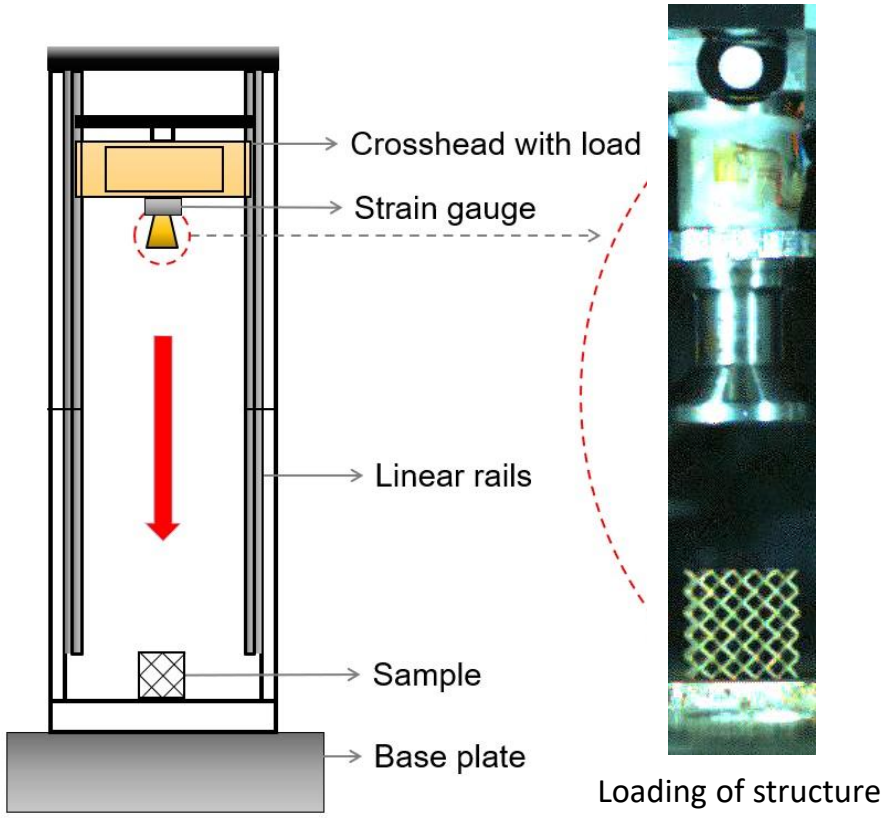
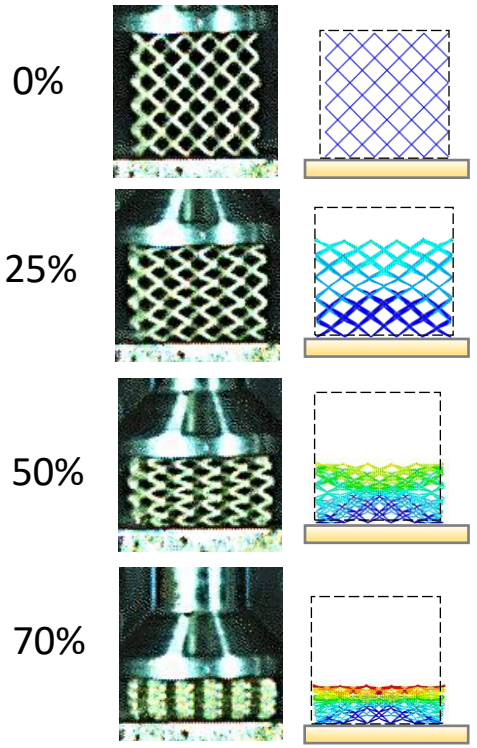
- Červinek 2022

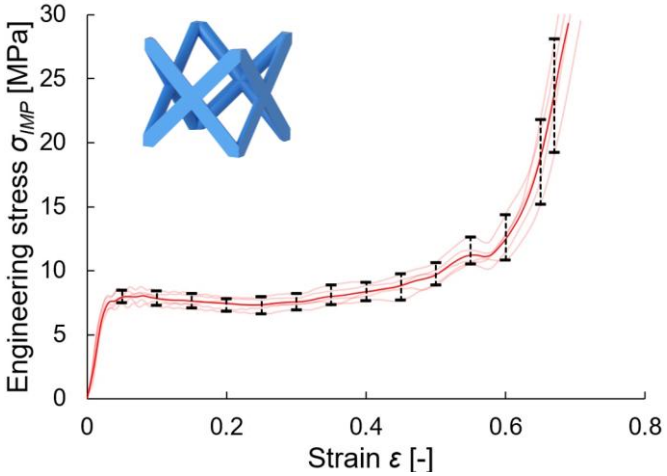
Impact tester
Series of modified geometrical parameters

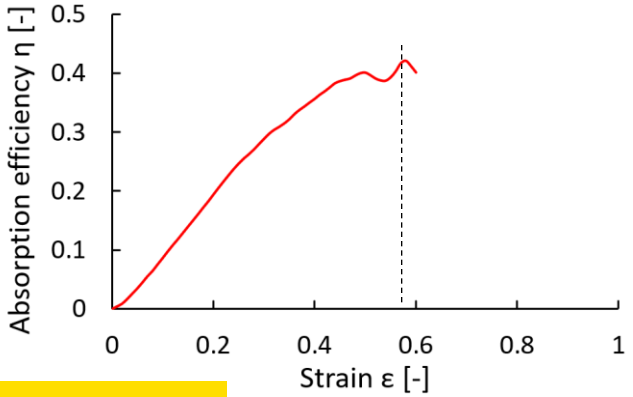


Loading of structure

Data post-processing
Matlab evaluation (high-speed camera, strain-gauge)







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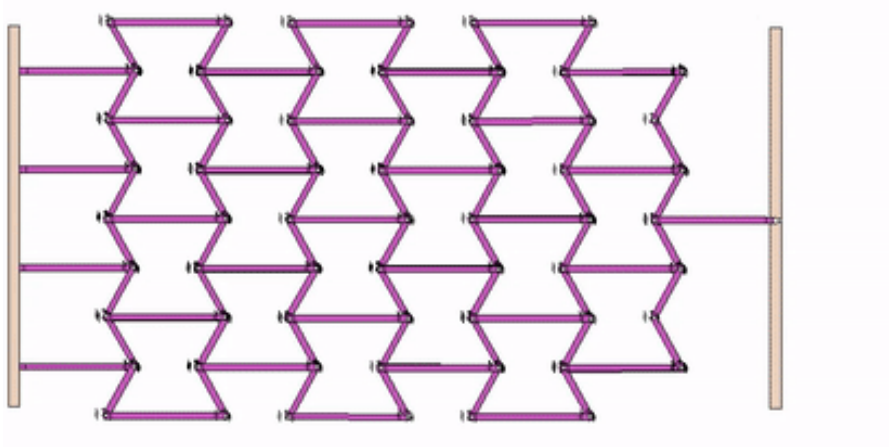
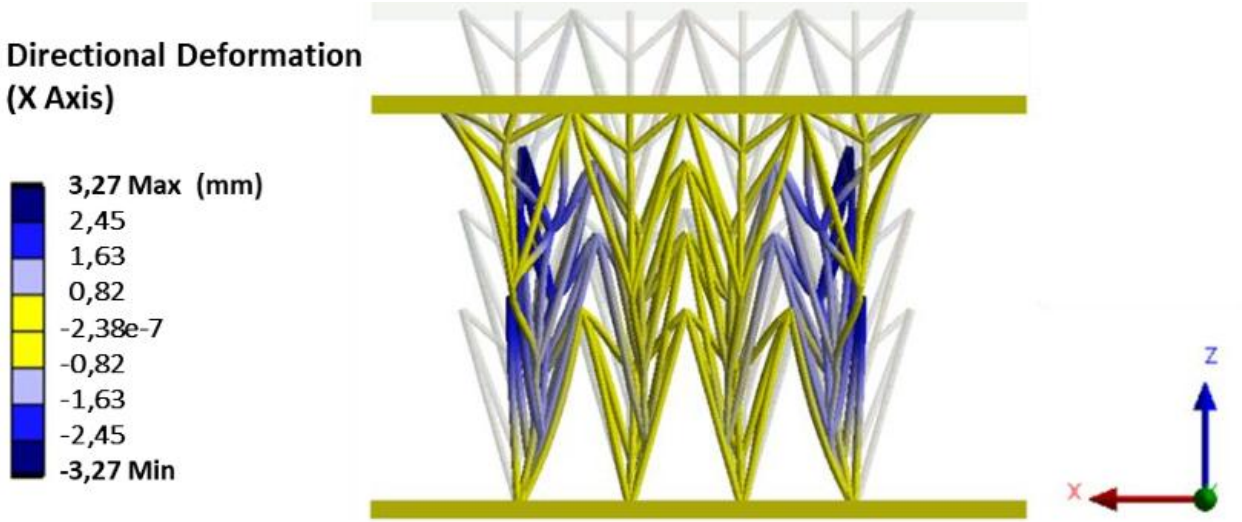
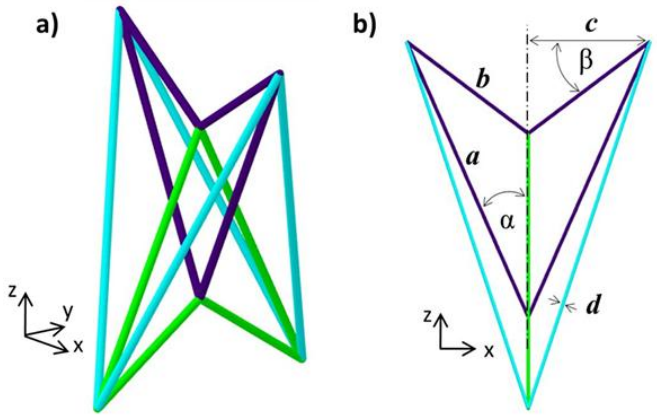
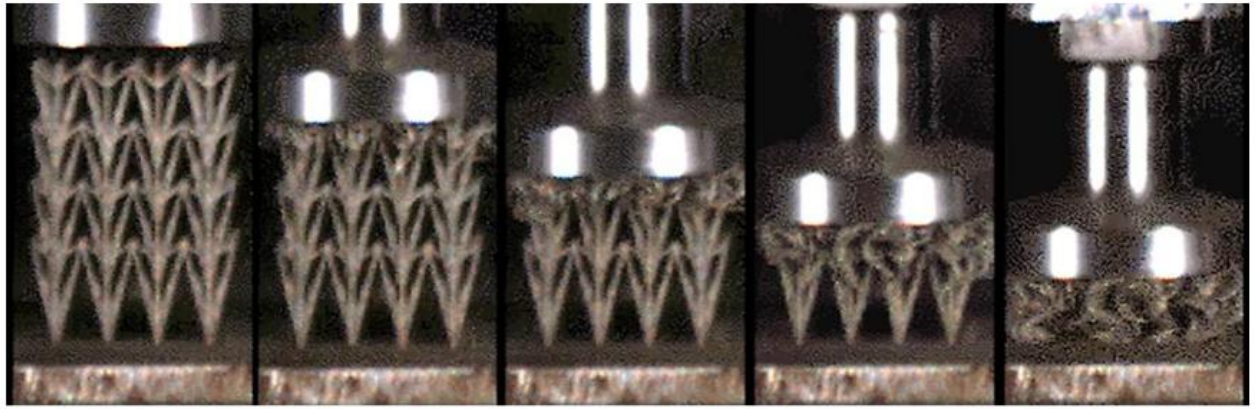
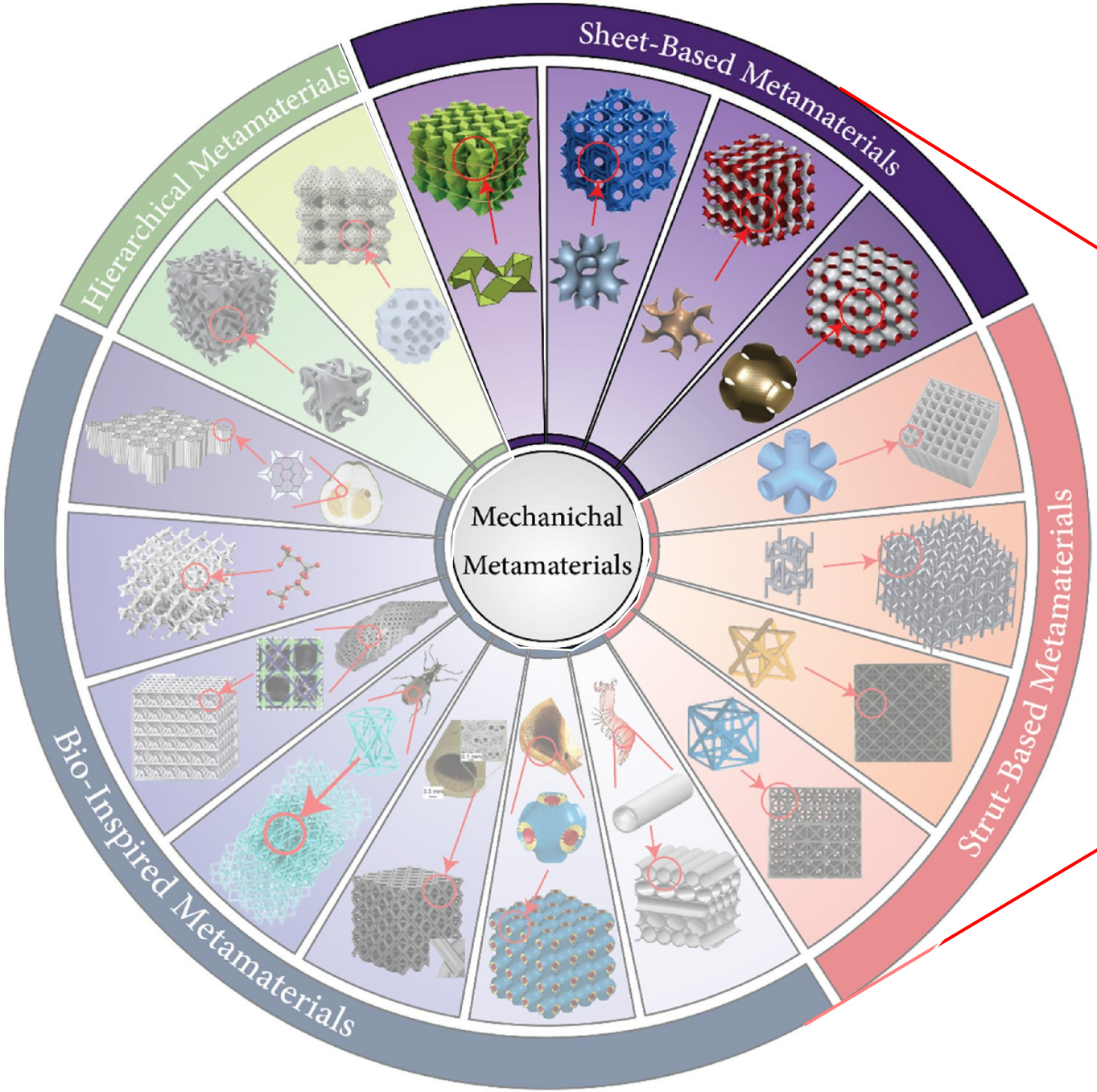


Behavior of auxetic lattice structure
(Purdue.edu)





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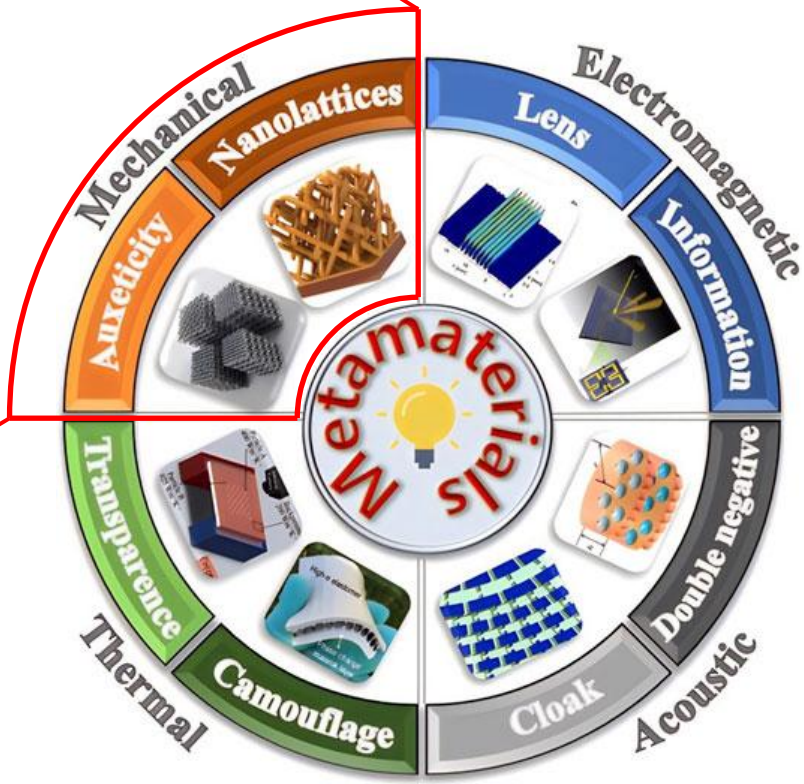
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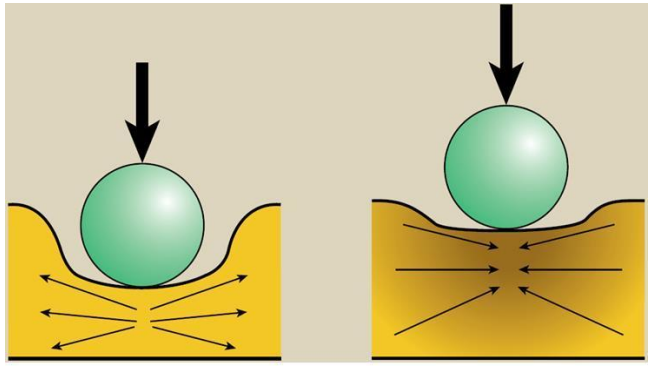
Sheet-Based Metamaterials

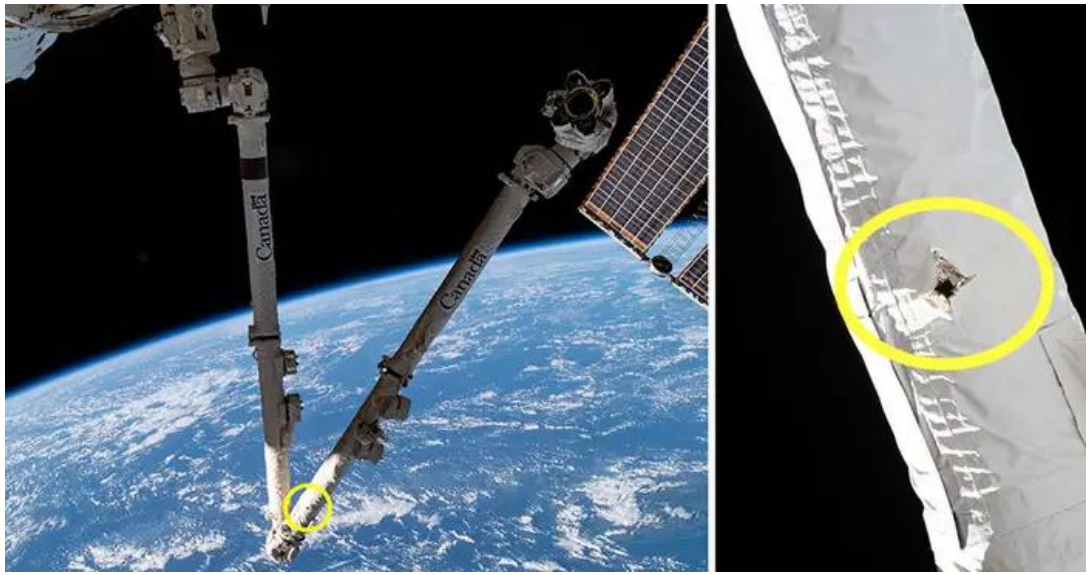
- Pchálek 2023

Positive Poisson's ratio

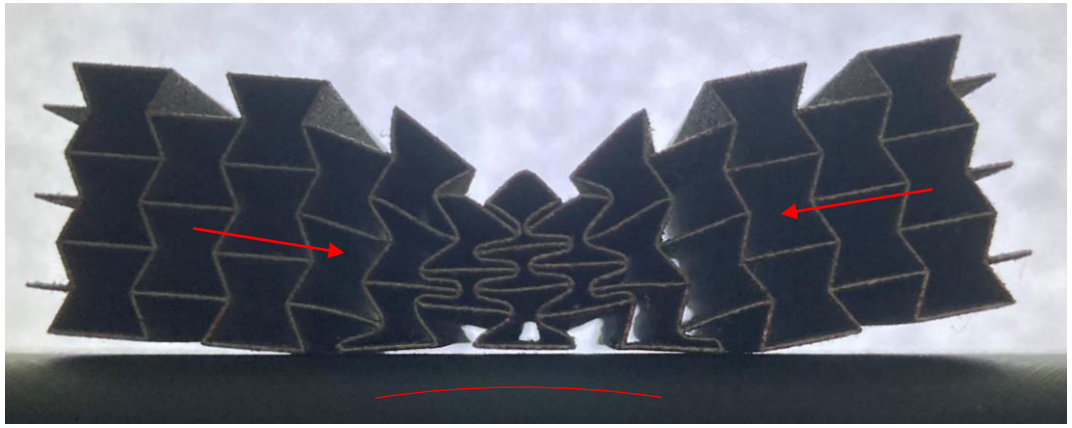


Negative Poisson's ratio

Deformation of auxetic material *(Alderson 1999)*



Damage to the ISS robotic arm by space debris *(businessinsider.com)*

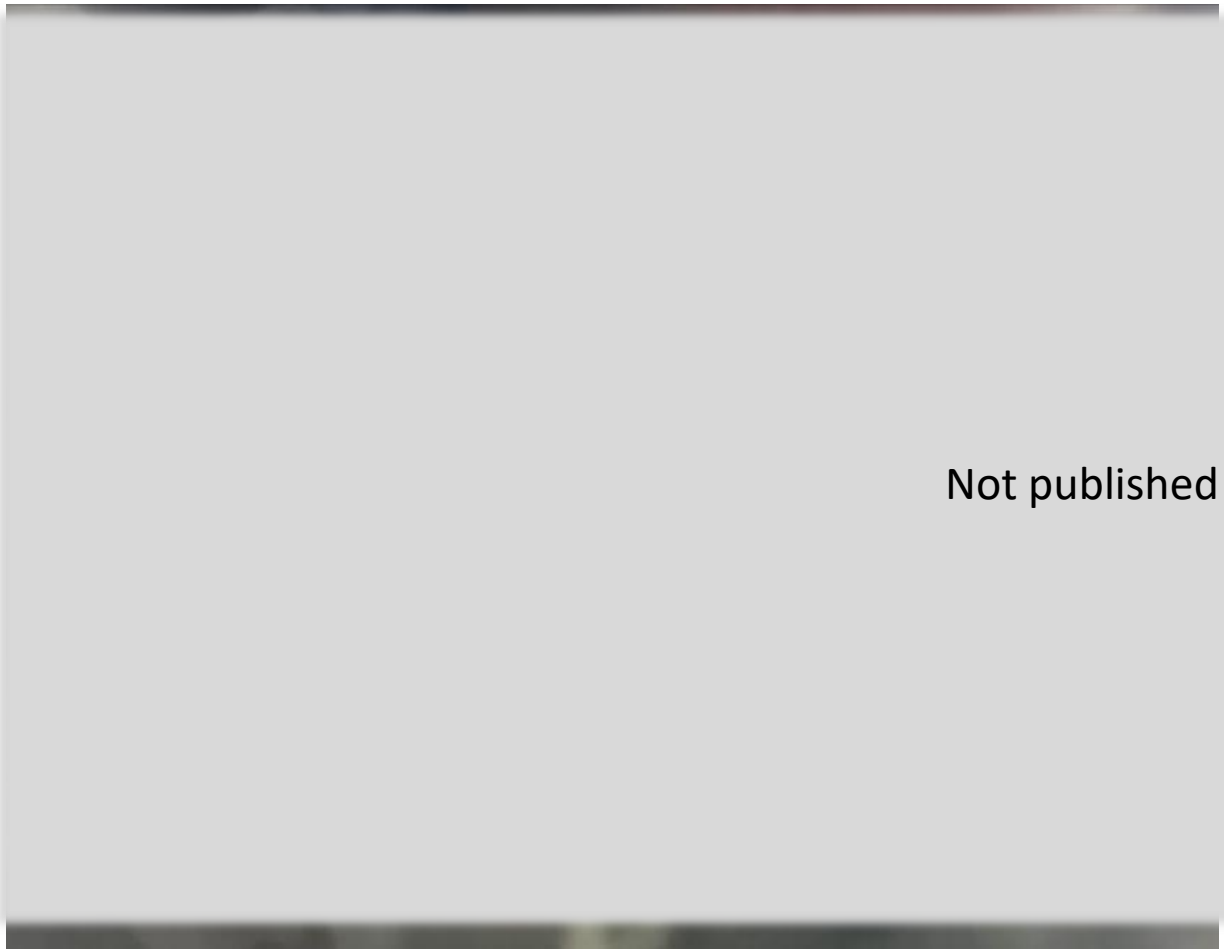


Impact velocity 3 m/s

Impact velocity 139 m/s

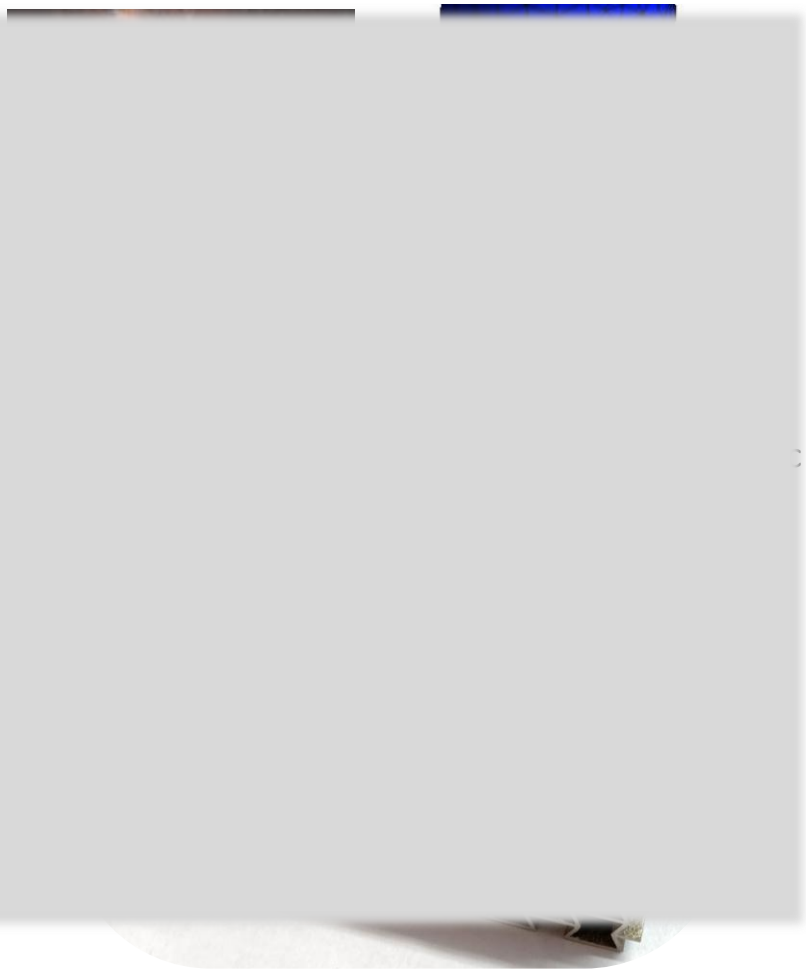
Sheet-Based Metamaterials

- Pchálek 2023

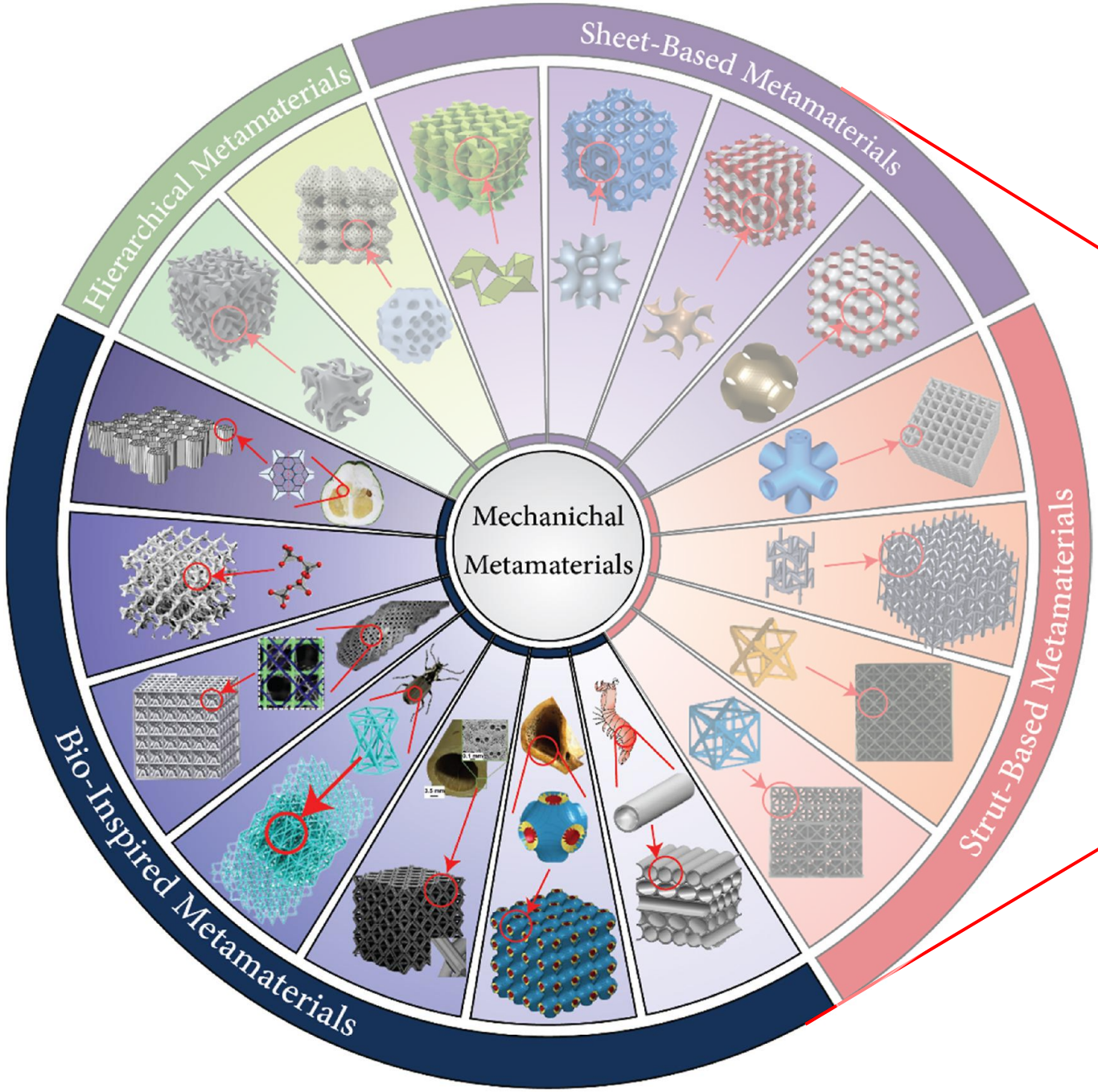


Deformation of the structure in slow motion

Not published yet



Impact velocity 113 m/s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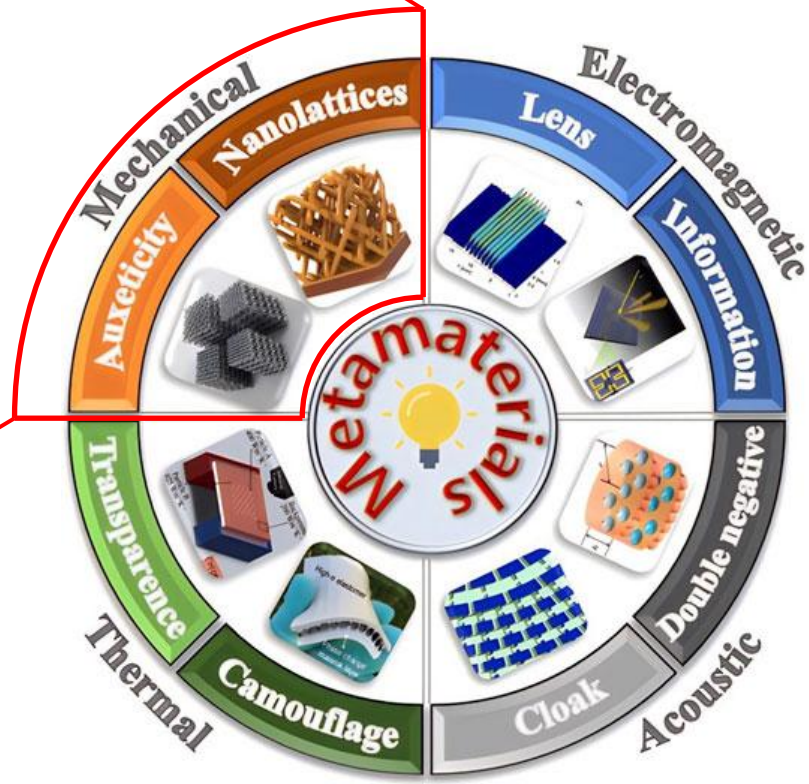
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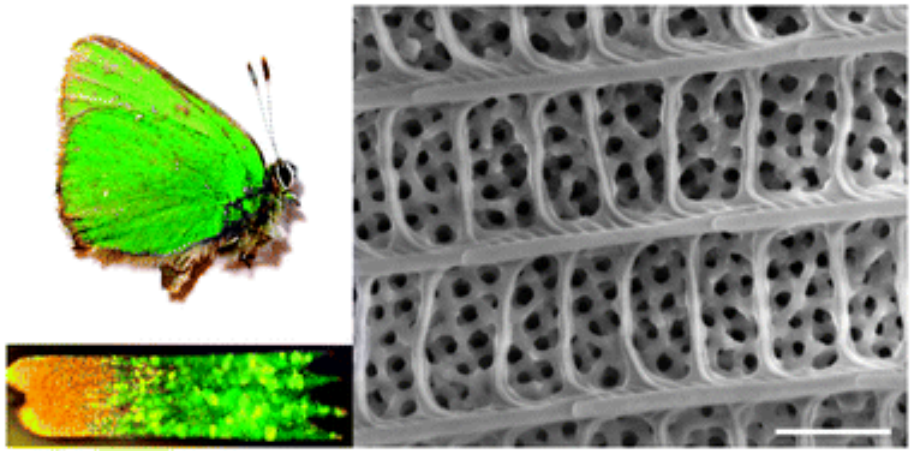
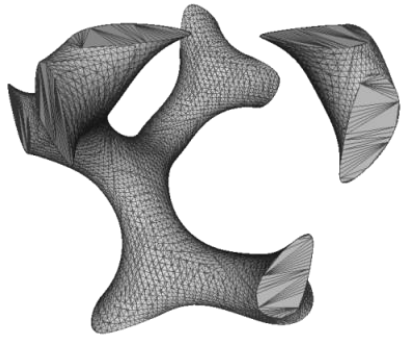
Bio-Inspired Metamaterials

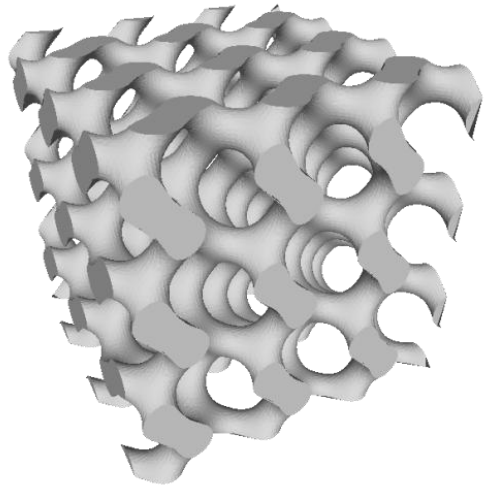
- Červinek

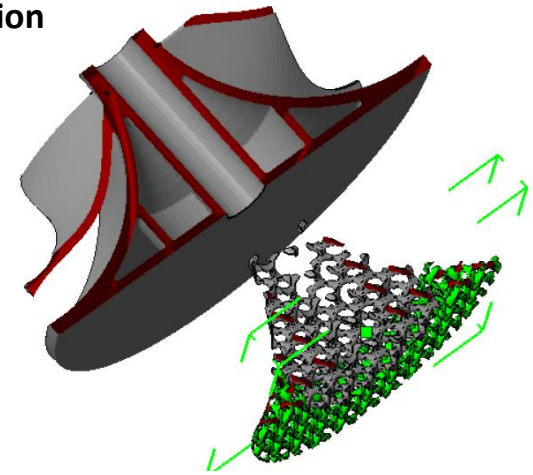


Butterfly wings structure (4µm) *Teoretische Physik*

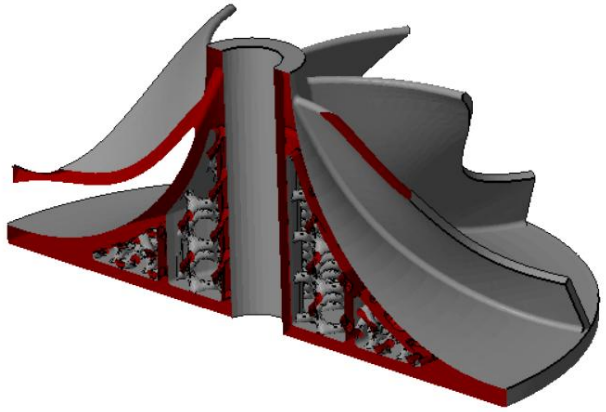


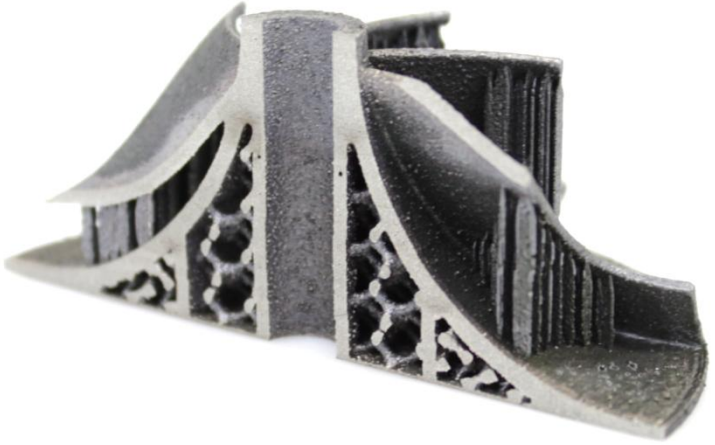
Basic cell of the gyroid structure





Lattice structure integration

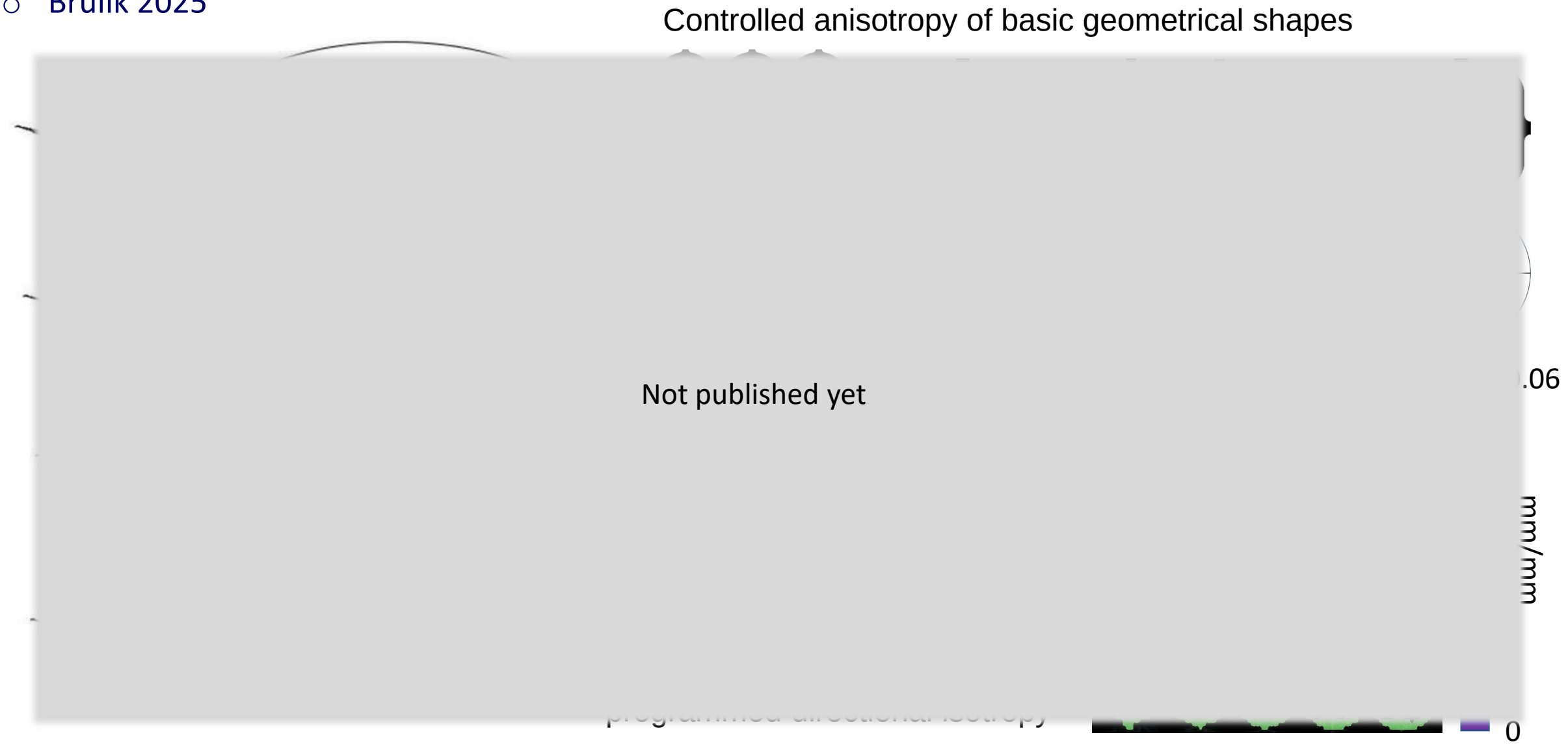




Partially structured turbocharger impeller manufactured using SLM technology

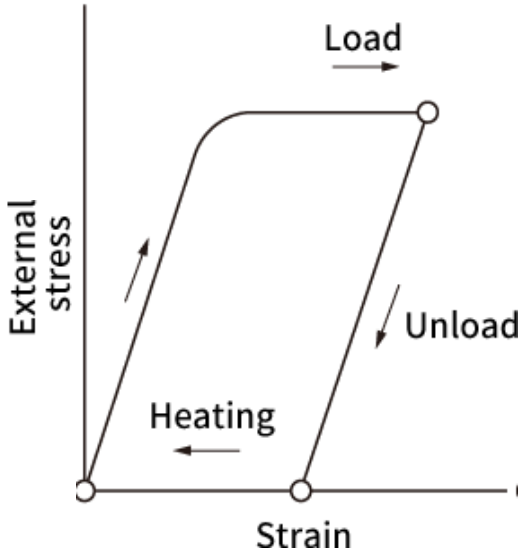
Bio-Inspired Metamaterials

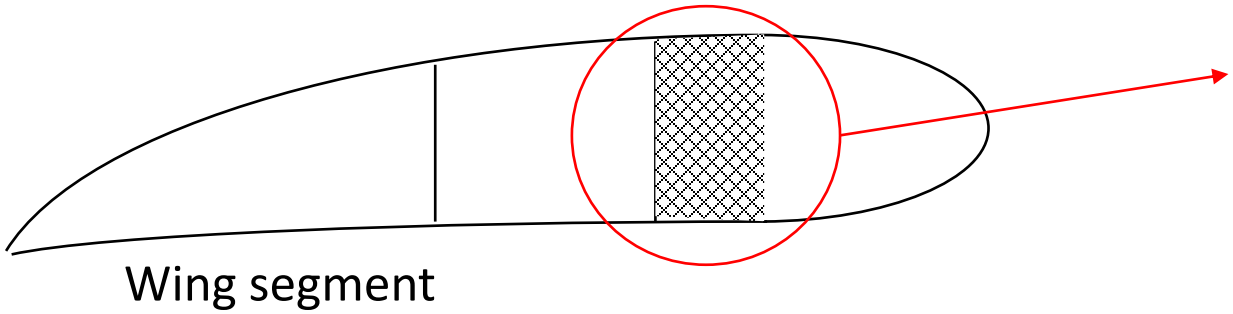
- Brulík 2025



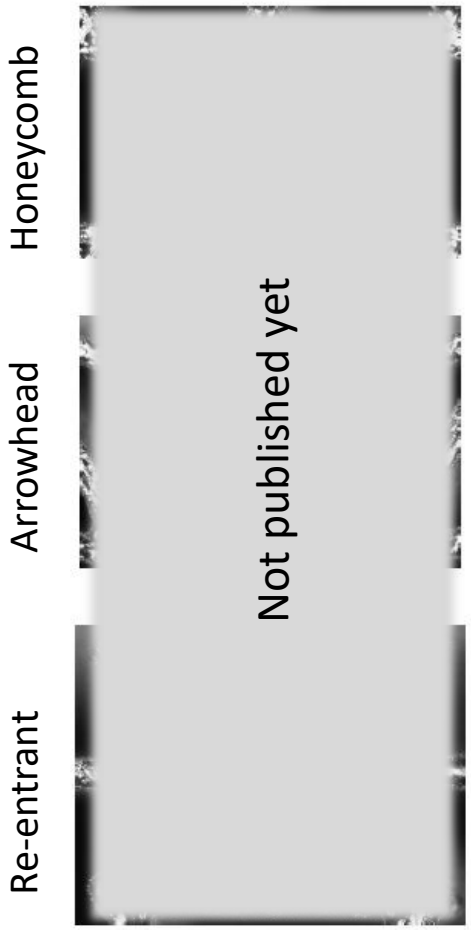
Sheet-Based Metamaterials

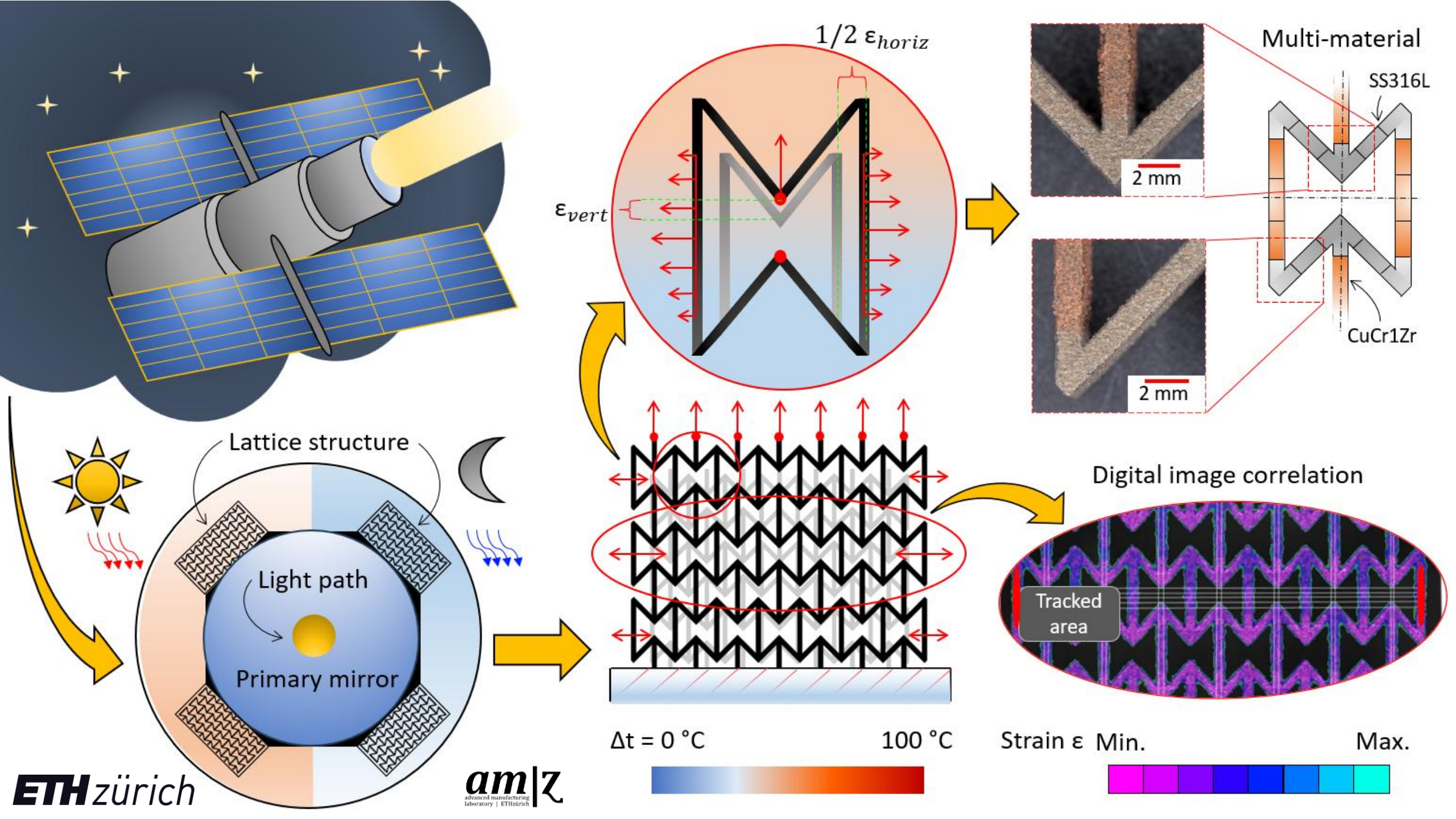
- Červinek 2024





SLM produced





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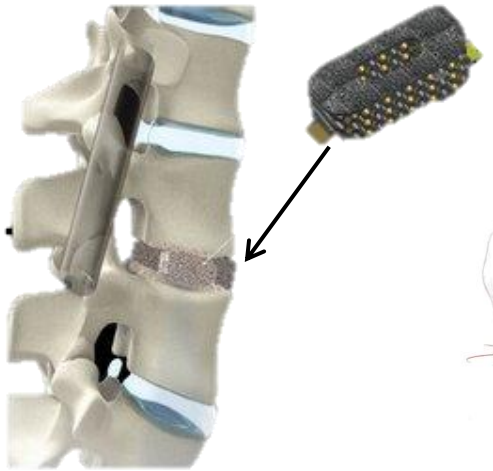
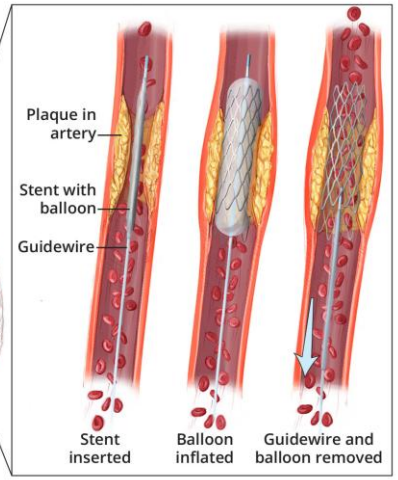
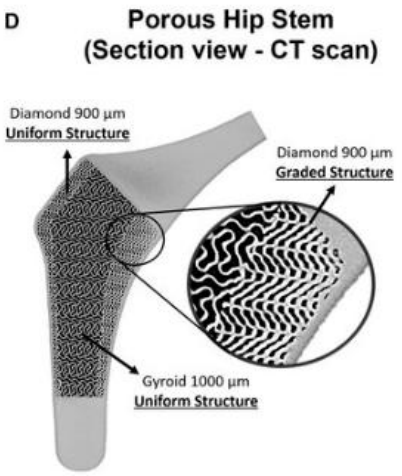
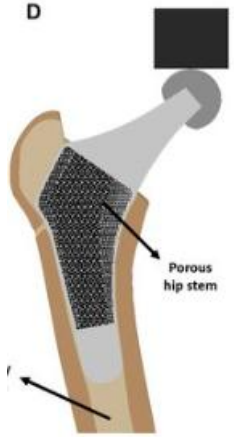
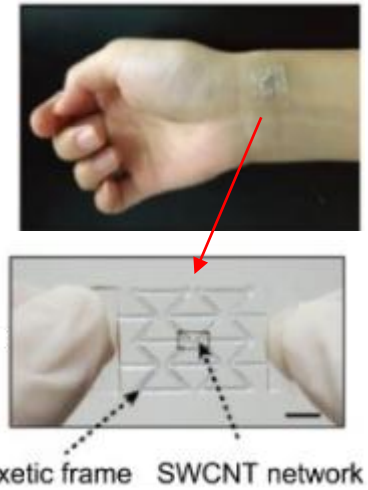




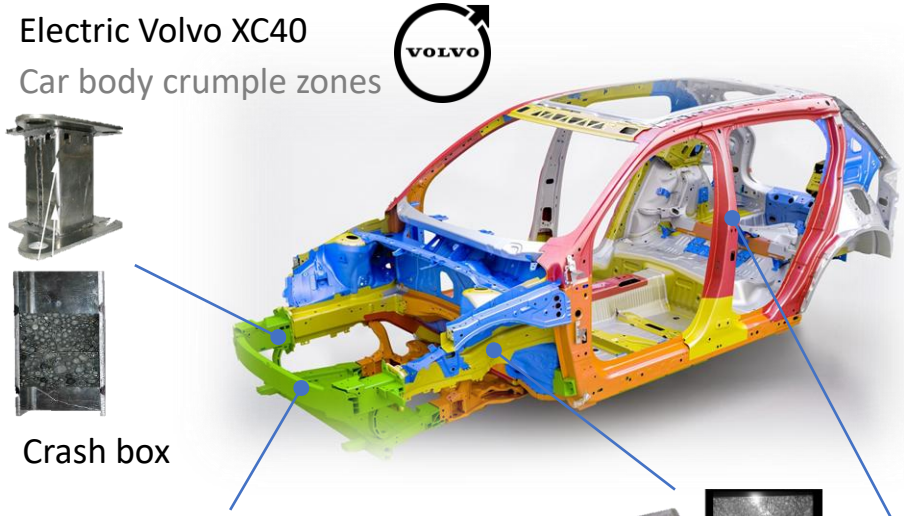




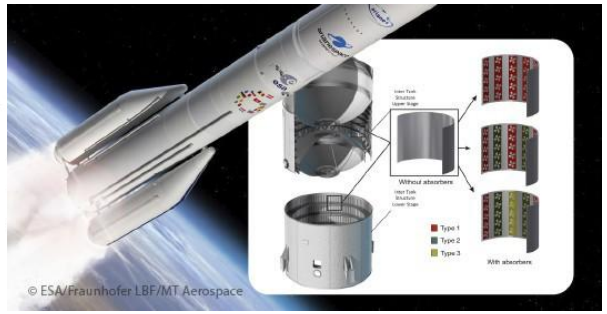


Electric Volvo XC40

Car body crumple zones



Future applications



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