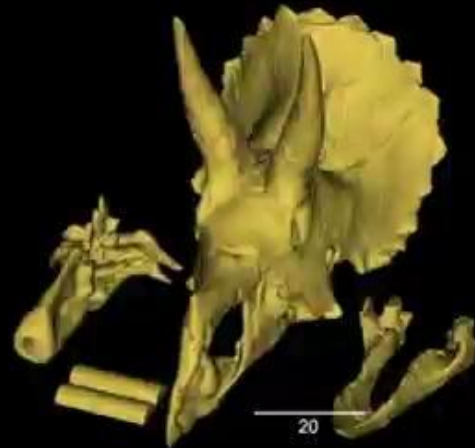
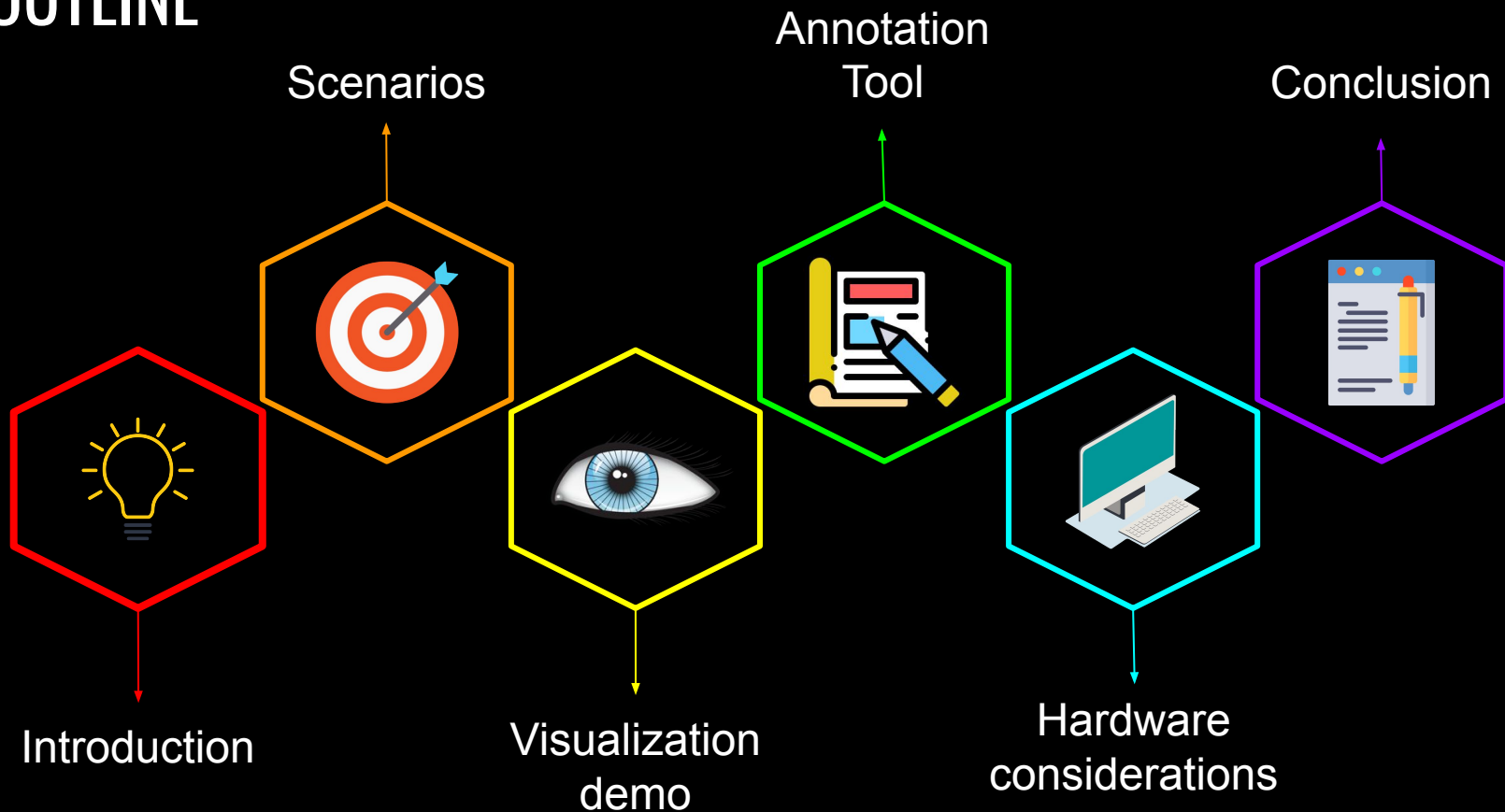


# REAL-TIME Visualization & Analysis

Lorentz Workshop | November 10, 2023



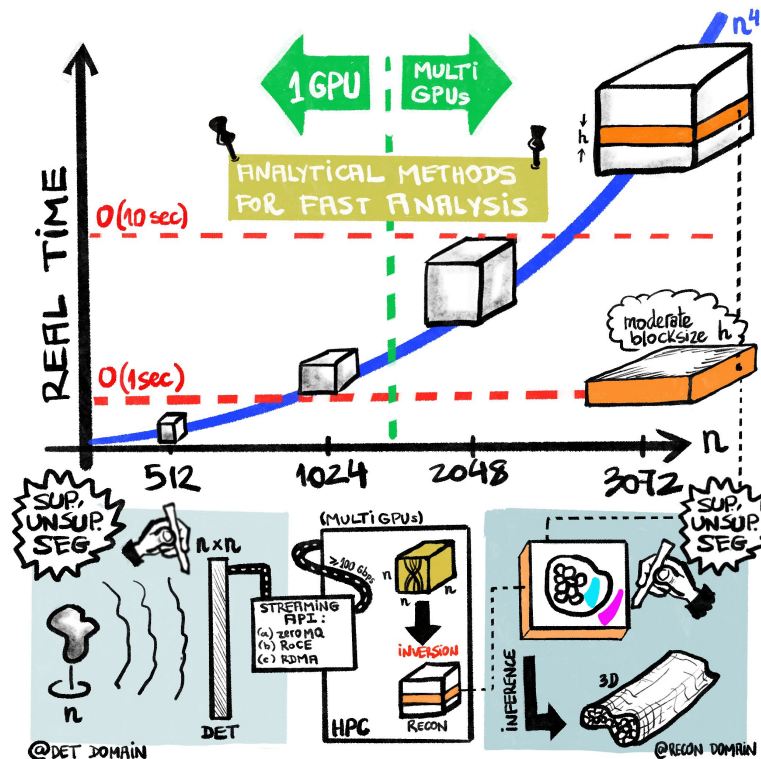
# OUTLINE





# INTRODUCTION

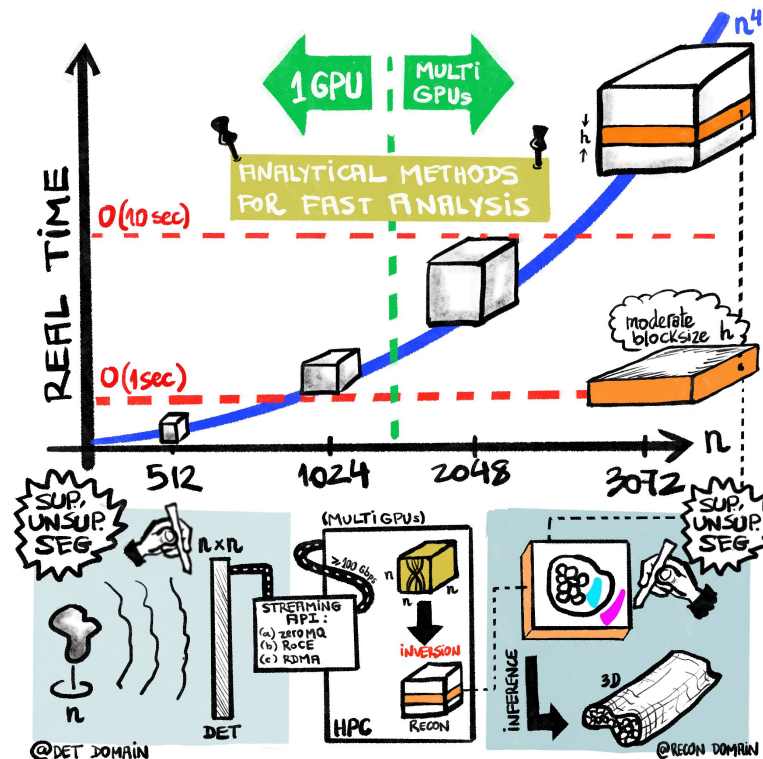
- Compiled a list of available software
- Defined “real-time” as:
  - Live interaction (order of seconds)
  - Fast batch processing (order of minutes)
- Operational model is yet to be defined, e.g.,
  - Analysis on beamline computers (interactive)
  - Analysis on HPC with different nodes, SLURM, etc





# INTRODUCTION

- Identified two key scenarios:
  - Post-processing and interactive inspect/analyze/decide/visualize
  - High-throughput (dynamic) experiment utilizing real-time pipeline





# SCENARIO #1: Interactive analysis & visualization

- Jupyter notebooks and examples
  - User can be provided w/ tutorials (videos) and Jupyter notebooks for post-processing of scientific data analysis of the experiment
  - What should a user know about their data before full rendering?
    - Go beyond Fiji: data reading, writing, and key python libraries
    - \*example (see QR code or [github.com/dani-lbnl/aitomo](https://github.com/dani-lbnl/aitomo))



## PROS

- whole data available
- multiresolution representations
- optimization of visualization

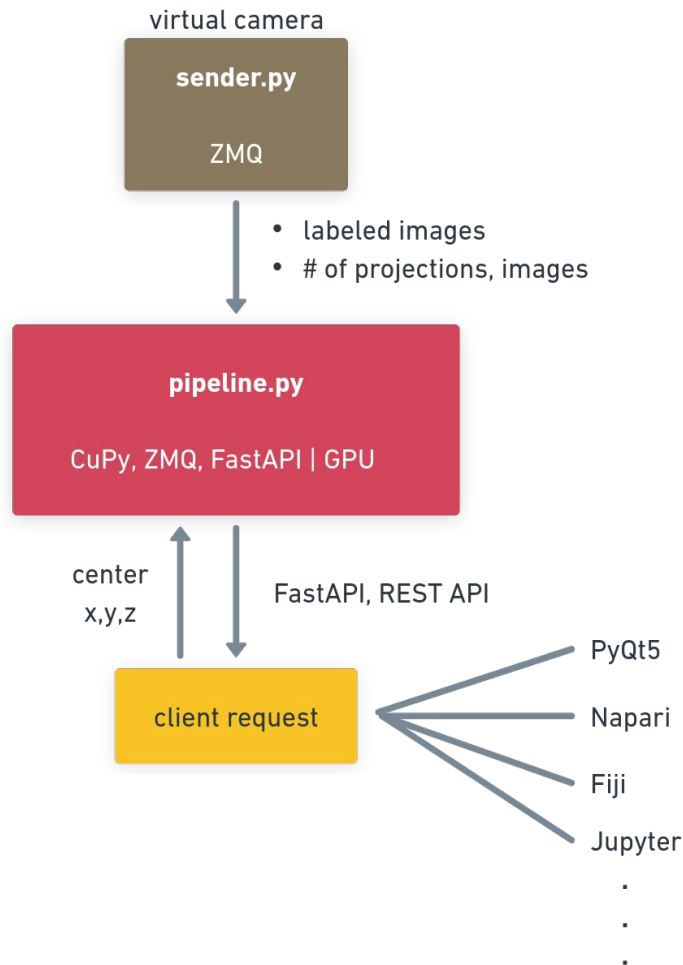
## CONS

- GPU/CPU-intensive tasks in shared computational systems
- ideally have to submit tasks through SLURM scheduler



## SCENARIO #2: Real-time streaming & visualization strategy

- PoC consists of:
  - sender
  - pipeline (code from paper 10.1107/S1600577522003095)
  - client request
- \*We do not have full reconstruction at this point





# SCENARIO #2:

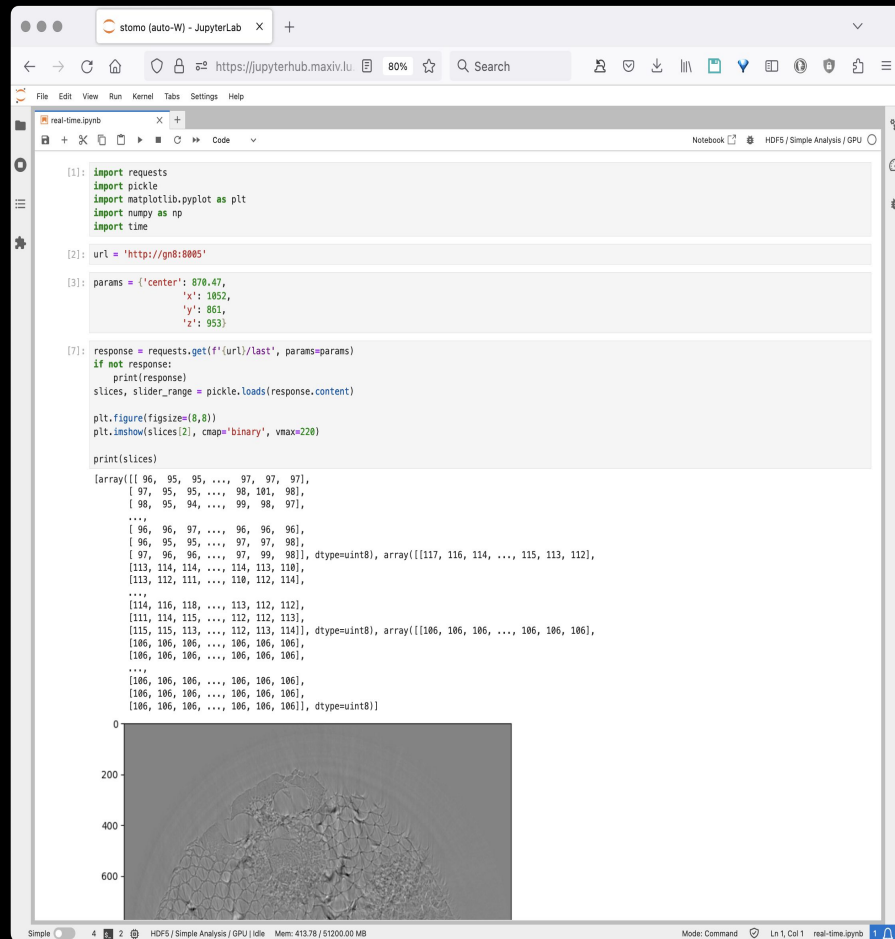
## Real-time streaming & visualization strategy

### PROS

- dynamic interaction with users
- partial data

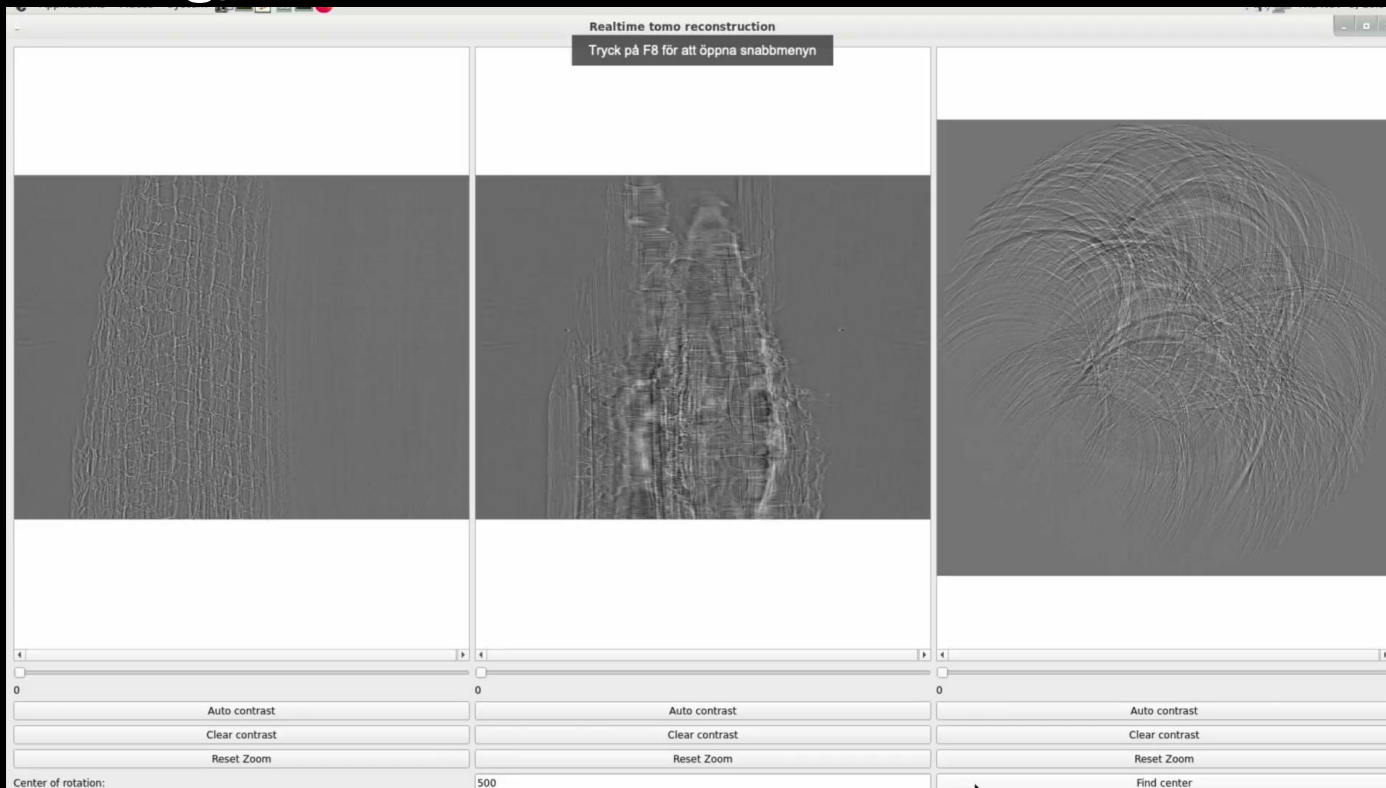
### CONS

- partial data
- complex to design
- costly infrastructure required for large volume data





# SCENARIO #2: Real-time streaming & visualization strategy





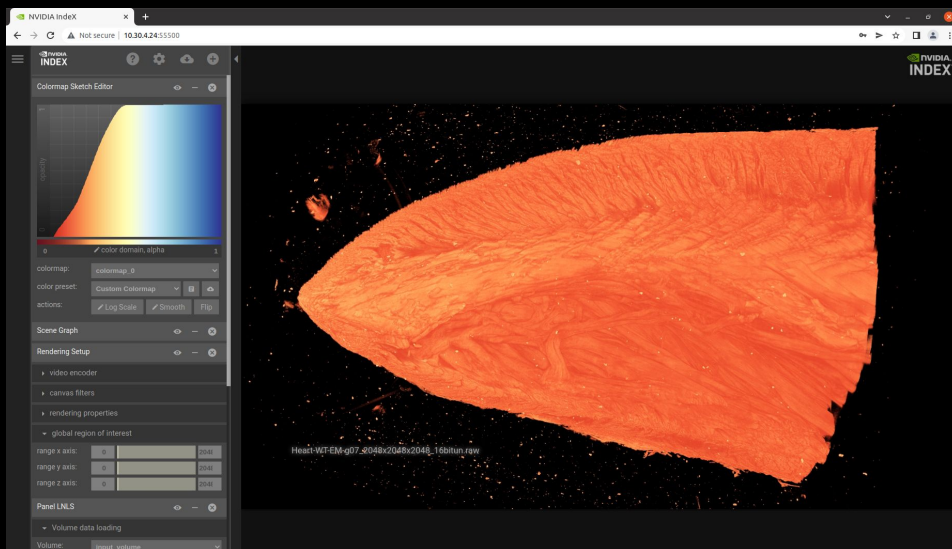


# Visualization demo (NVIDIA-Index)

- Reconstructed dataset can be directly “plugged” into Index
- Example from Sirius: real-time rendering of a 5k x 5k x 5k cube
- Requires specialized HW solutions

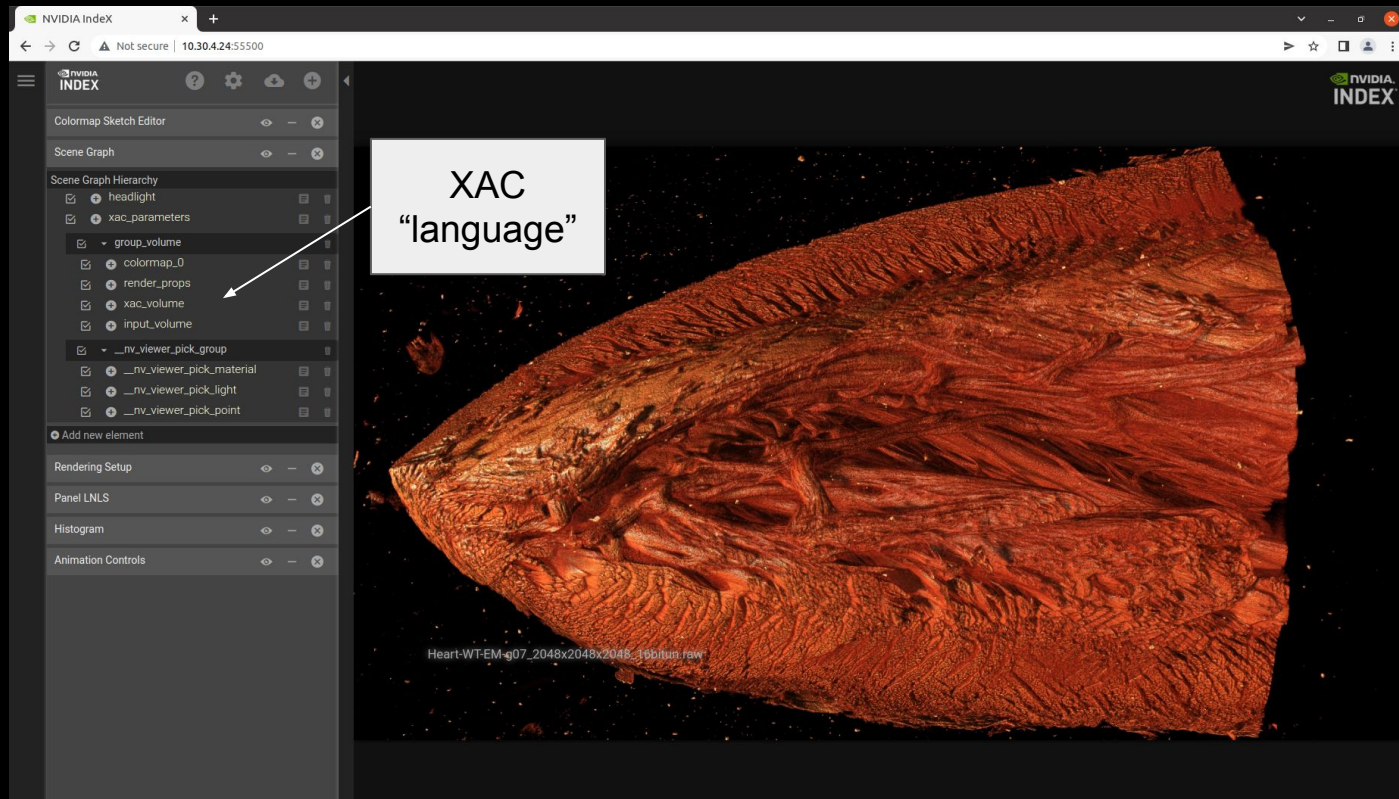


collaboration





# Visualization demo (NVIDIA-Index)

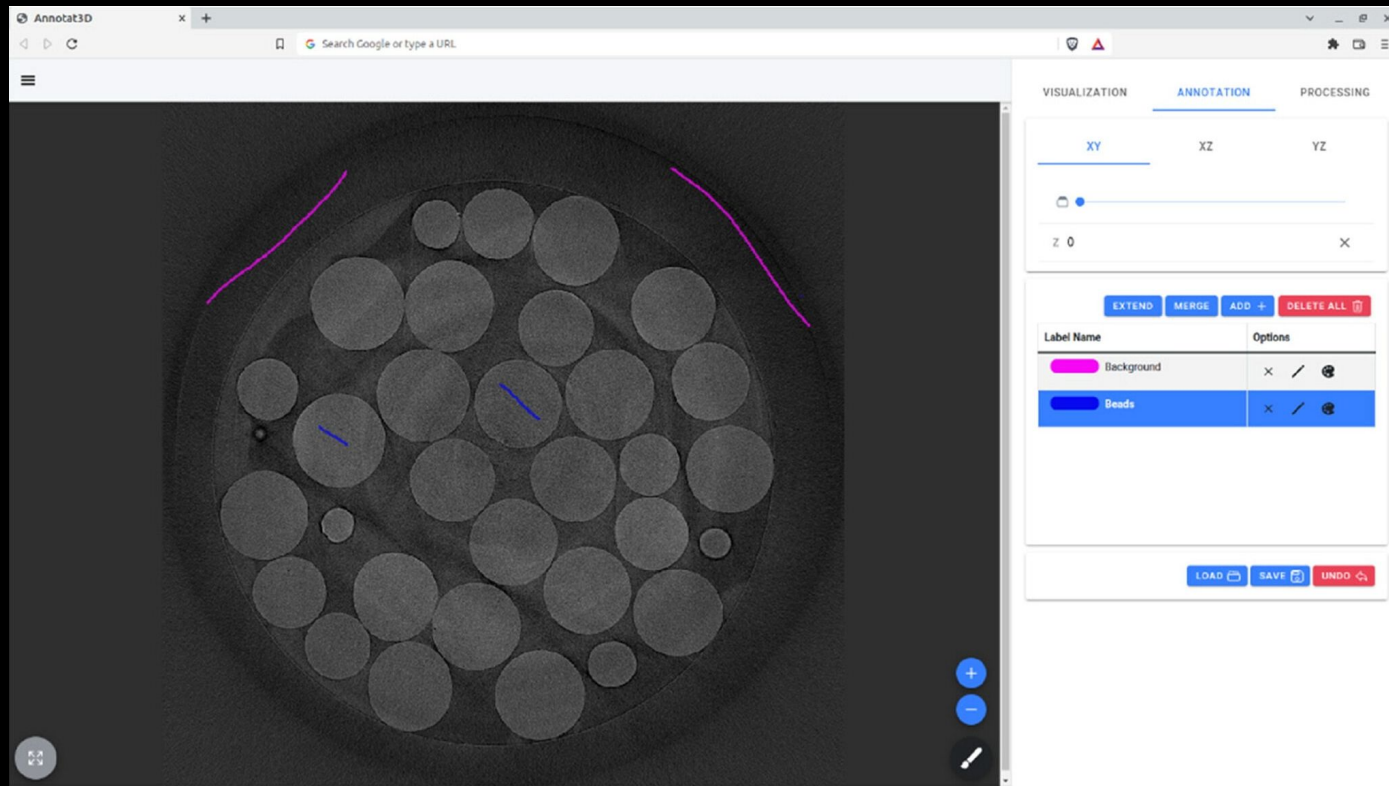


collaboration





# Annotation Tool



Open  
source





# Hardware considerations

- Fast connection between GPU & RAM (NVIDIA DGX)
- Network
- RAM / CPU
- File-server speed
- RDMA/Infiniband/Omnipass/RoCE capabilities



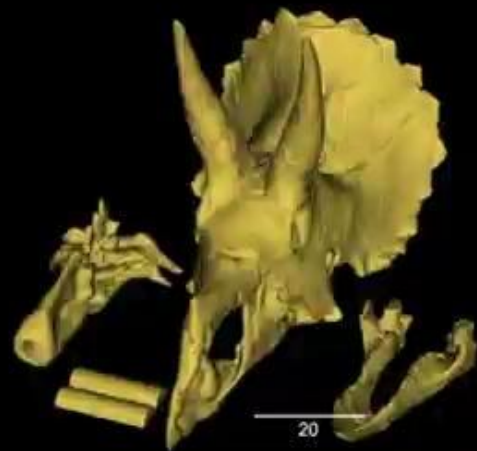
# Conclusion

- When considering **user diversity**, multiple solutions should be available
  - On-the fly
  - Post-processing
- Future work: incorporating AI for enhancement, pattern recognition for reconstruction, etc



# Thank you!

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Credit: Triceratops STL