Australian Synchrotron

Marrying a HPC with Beamlines at the Australian Synchrotron

Richard Farnsworth

Where is it?

WHAT IS IT?

A collaborative venture with local Uni and Govt research organisation (Monash and CSIRO)
Called: Multimodal Australian Synchrotron (Australian Sciences) Images and Visualisation Environment
Two part
MASSIVE I – State funded (for Synch); and
MASSIVE II – Federal funded (For others)

Use cases

Need:

Computation , imaging and visualization for Computed Tomography;

Fluorescent Tomography;

Protein Structures

Supports programs to develop and train the field workers

Science programs

Real time image reconstruction at the imaging and Medical therapy beamlines

Macromolecular Crystallography

Microspectropscopy

Small and Wide angle scattering Beamlines

Post processing from same

Medical imaging beamline

MI Beamline for real

Software development

New 3d parallel algorithms for 3 D phase contracts images

Parallelising the same

Open source shift

URL for CTAS

URL for CSIRO (working on Open issues)

CTAS (For Medical imaging)

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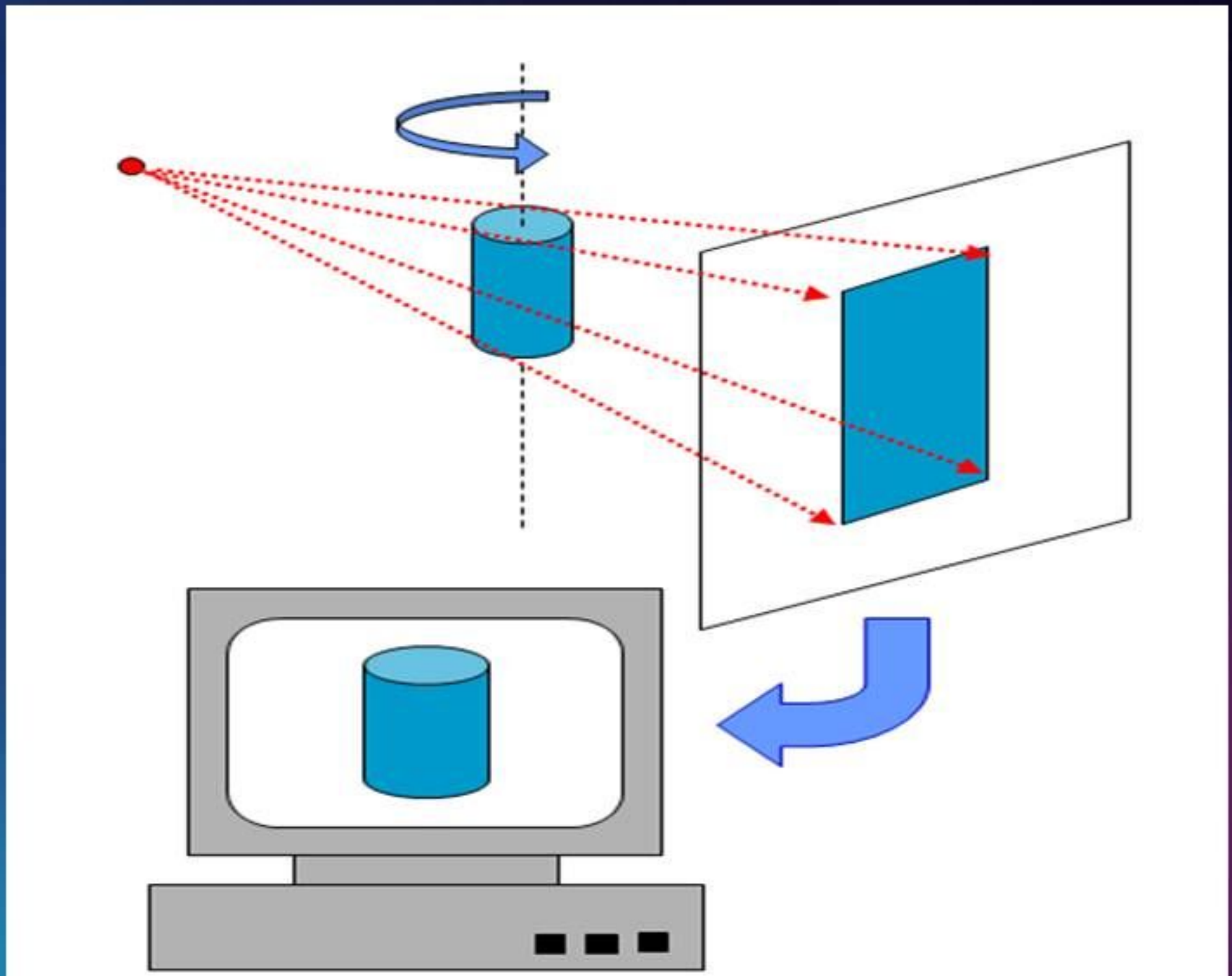
Continuing Development and support with AS: CTAS package is a set of tools for the Computed Tomography (CT) and Tomothynsesis (TS) reconstruction for the parallel beam geometry (usually available at the synchrotron sources). It also contains additional tools for the various X-ray contrast manipulations (Diffraction Enhanced Imaging etc).

How CT works - I



How CT works - II

- Rotation stage of an X-ray imaging instrument enables stereo and tomographic data acquisition
- For tomography collect images of sample at many different rotation angles spanning 180 or 360 degrees
- Combine images using parallel-beam or cone-beam CT reconstruction algorithm to produce 3D representation
of the object

X-TRACT (For Medical imaging)

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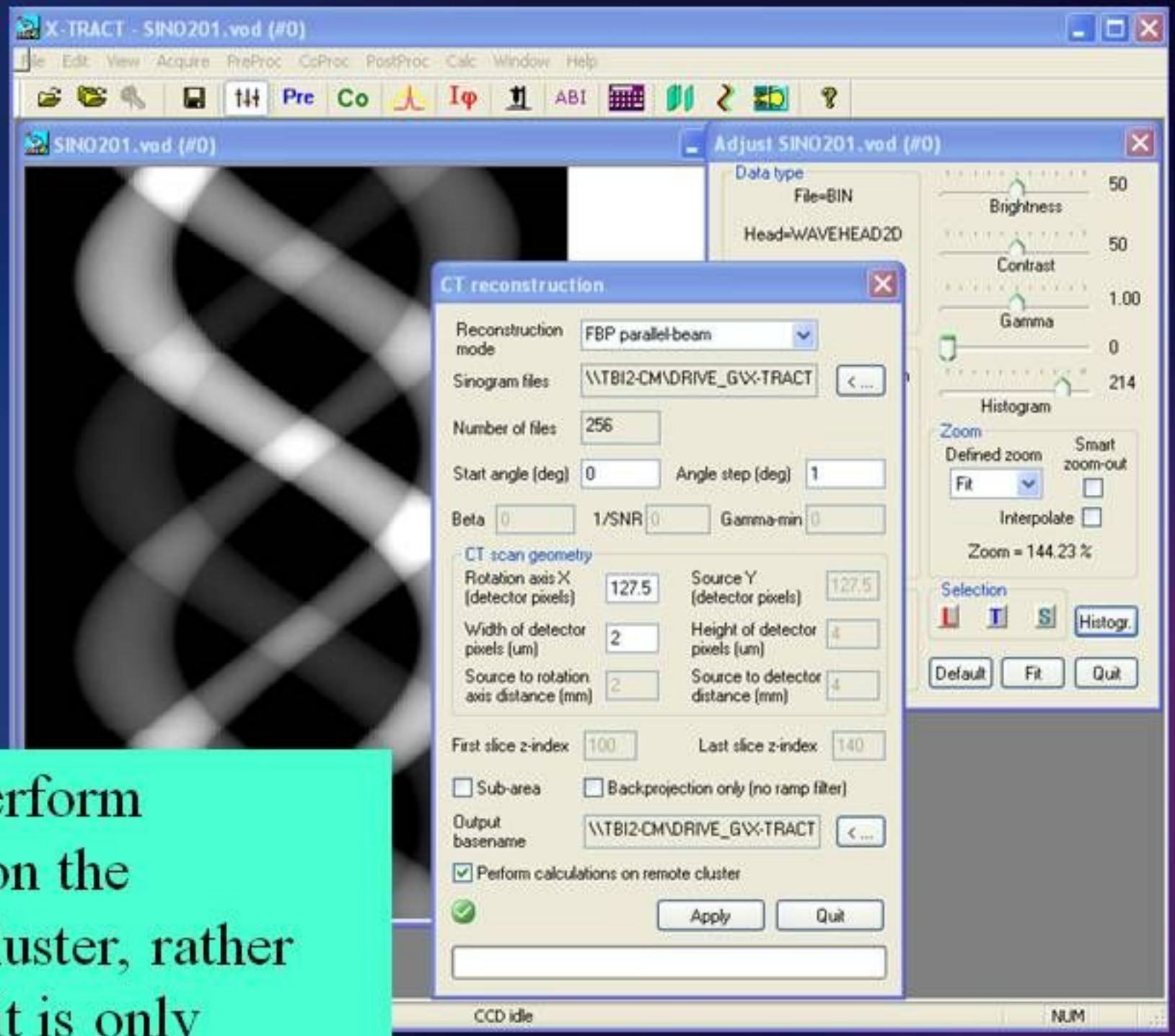
Continuing Development and support CSIRO: An image analysis and processing application with functionality targeting researchers working in imaging science and technology fields, especially in optical, electron and X-ray microscopy and astronomy.



In order to perform calculations on the MASSIVE cluster, rather than locally, it is only necessary to check one box

Fast fluorescence detector

The 'Maia' detector – a fast fluorescence detector – has been developed through a collaboration between the CSIRO and BNL

This detector – in combination with a stage upgrade will enable fluorescence tomography at a quality higher than that shown next with around 6 hours of synchrotron beamtime. The capability would be two orders of magnitude in advance of world's best practice

Need to process on MASSIVE

GEOpixe (For Microspectscopy):

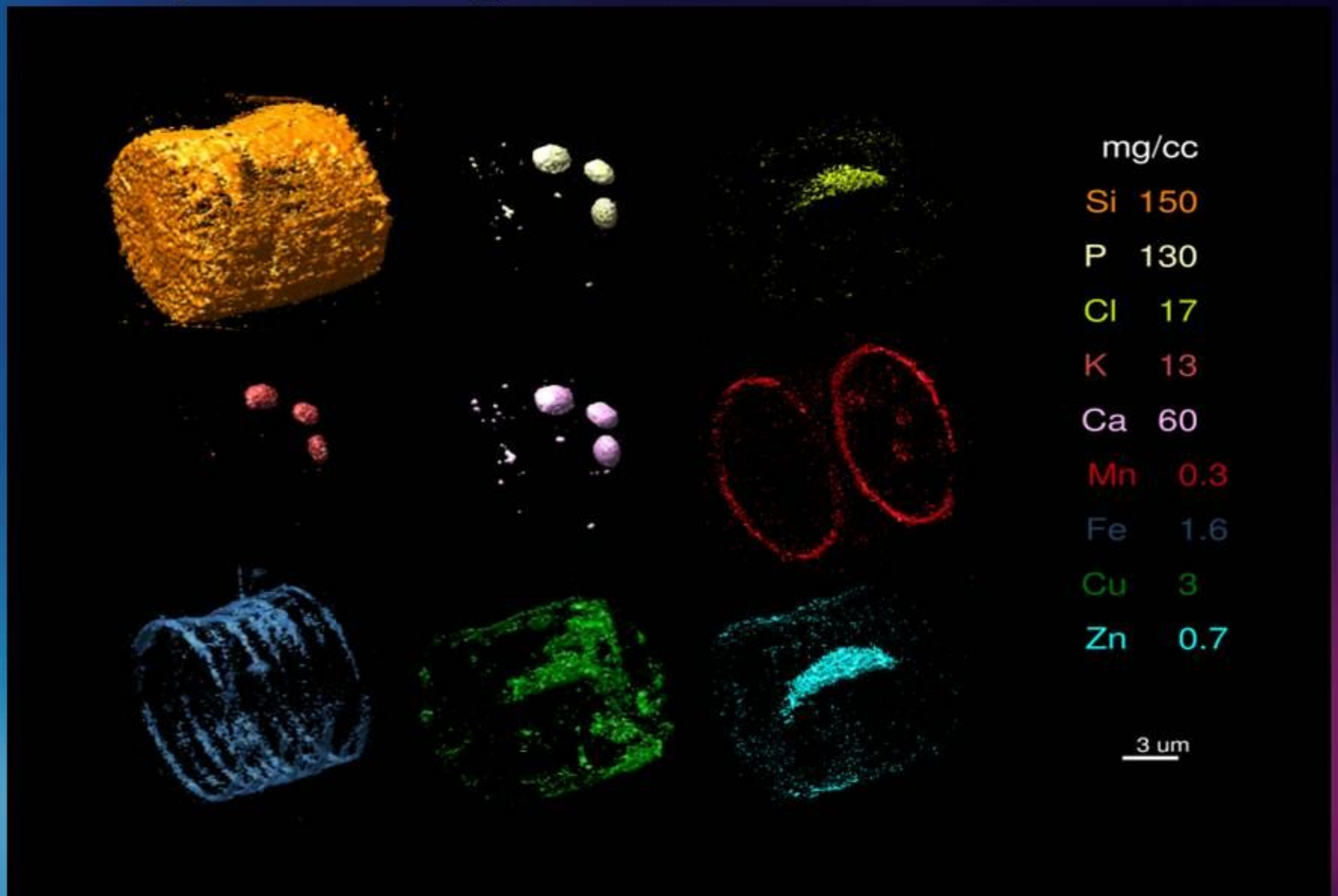
Software for quantitative and non-destructive Particle- Induced X-ray Emission (PIXE) analysis and imaging. Needs to be parallelized.

Short term

Runs in IDL and will be images will broken into small strips for processing, one for each CPU.

Long term: will be ported properly

Example FT mages



Hardware

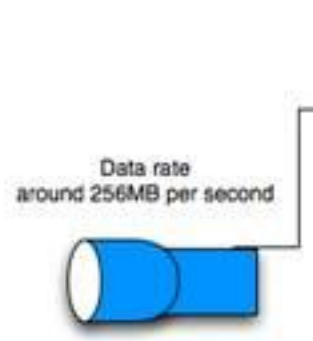
Off the shelf.

512(or more) Cores, mixtures of CPU and around 20% GPU's

Trying to get away without extremely high end disk infrastructures

- Prototyping data flows to determine exact bandwidth needs

MASSIVE CT compute engineering Node 0



Data rate
around 256MB per second

X-RAY Imaging detector

Detector Server
?.synchrotron.org.au

Existing

10G

Distance
120M

Storage Server
store.synchrotron.org.au

Storage Nodes
(1) max memory
(3) 2 x OS Disk 500G + fill bays 1T
(4) 3 x 10G + Capacity for later High speed Infinityband connector
(4) OS CentOS X64

Distance
Same Rack

Compute Node
massive-0-1.synchrotron.org.au

10G

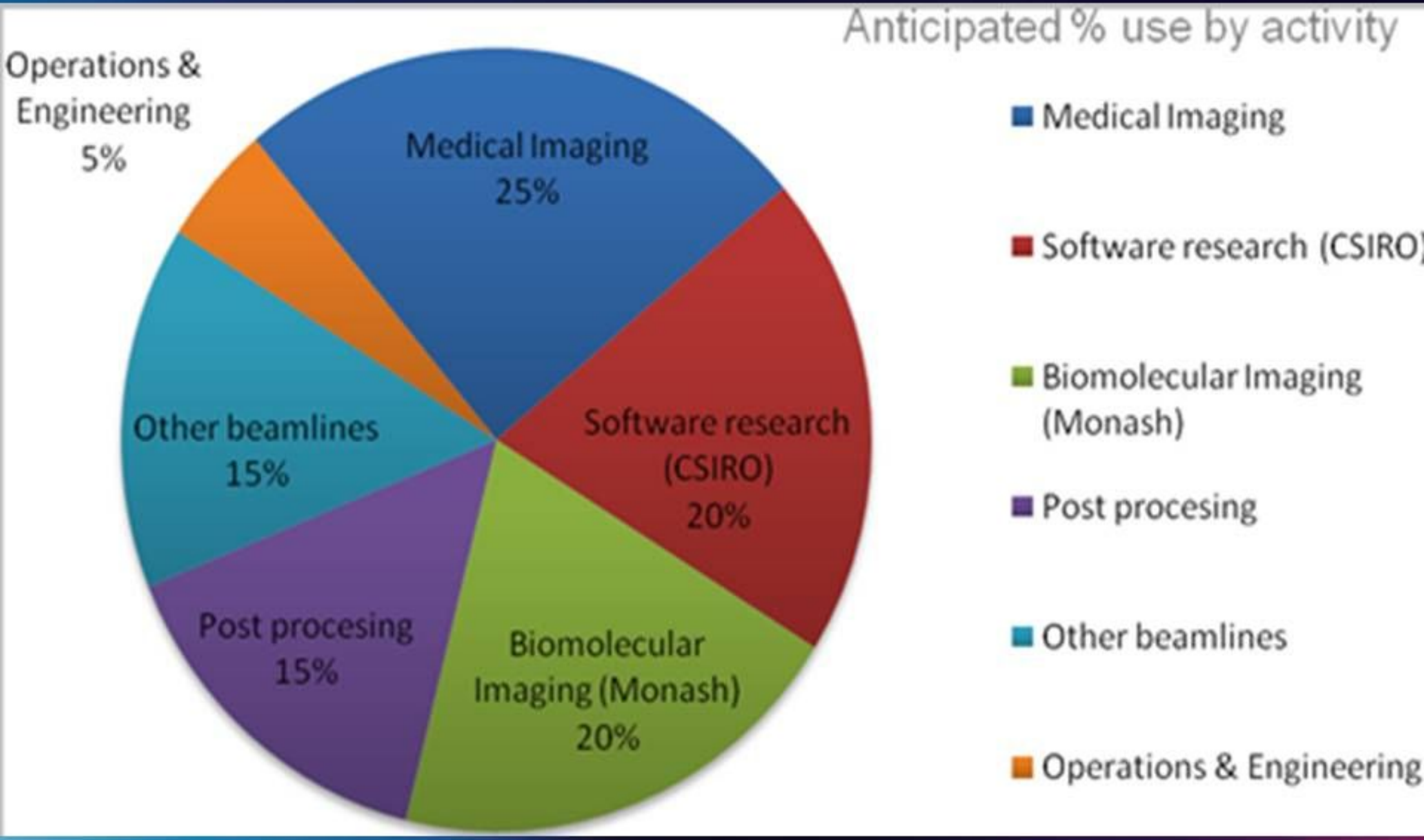
Compute Node
massive-0-2.synchrotron.org.au

10G

Compute Nodes
(1) 2GB of RAM per CPU core (16GB total)
(2) high-end CUDA-compatible NVidia GPUs
(3) OS Disk 500G + storage disks 2 x 1T
(4) 1 x 10G + Capacity for later High speed Infinityband connector
(5) Microsoft HPC Server 2008 (2 licences)

VeRSI

Anticipated use



E-research, data, grid, etc

Optiportal

GRidFTP

IRODS/TARDIS

Curated data storage

Petabyte Data storage

Imaging and Visualisation

Any Questions

Thank you for your attention