PAUL SCHERRER INSTITUT

PSI

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Analyzing imaging data
an open-source collaboration

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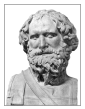
What happens after an imaging experiment?

Gigabytes. . .

Science paradigms and neutron imaging

1. Empirical “Schöni Bildli”
   - Observing and describing phenomena
   - Already the old Greeks did it



2. Theoretical – analytical, many NI experiments

   - Describing observations by model, abstraction/generalization
   - Newton

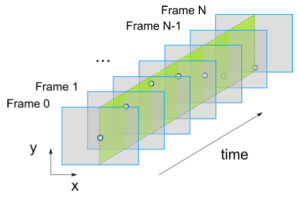
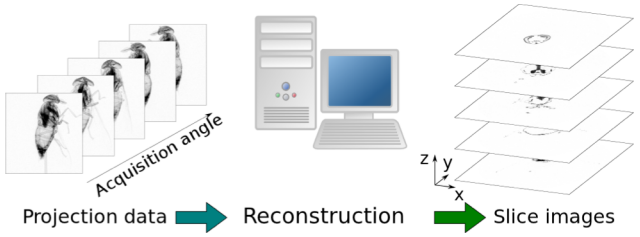
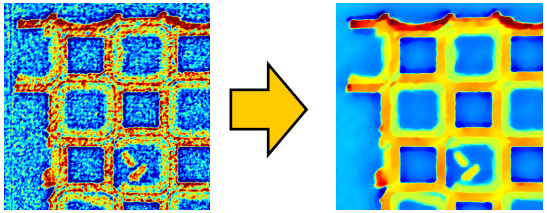
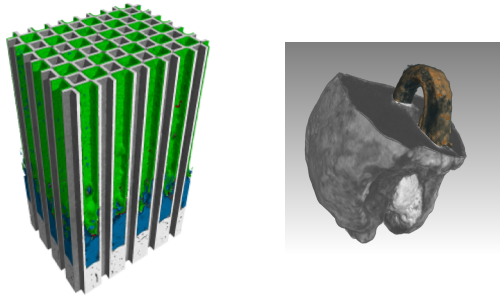
3. Computational – Some NI
   - Complex models, detailed problems → Simulations

1. Data exploration – Few NI
   - Analysis by data management and statistics

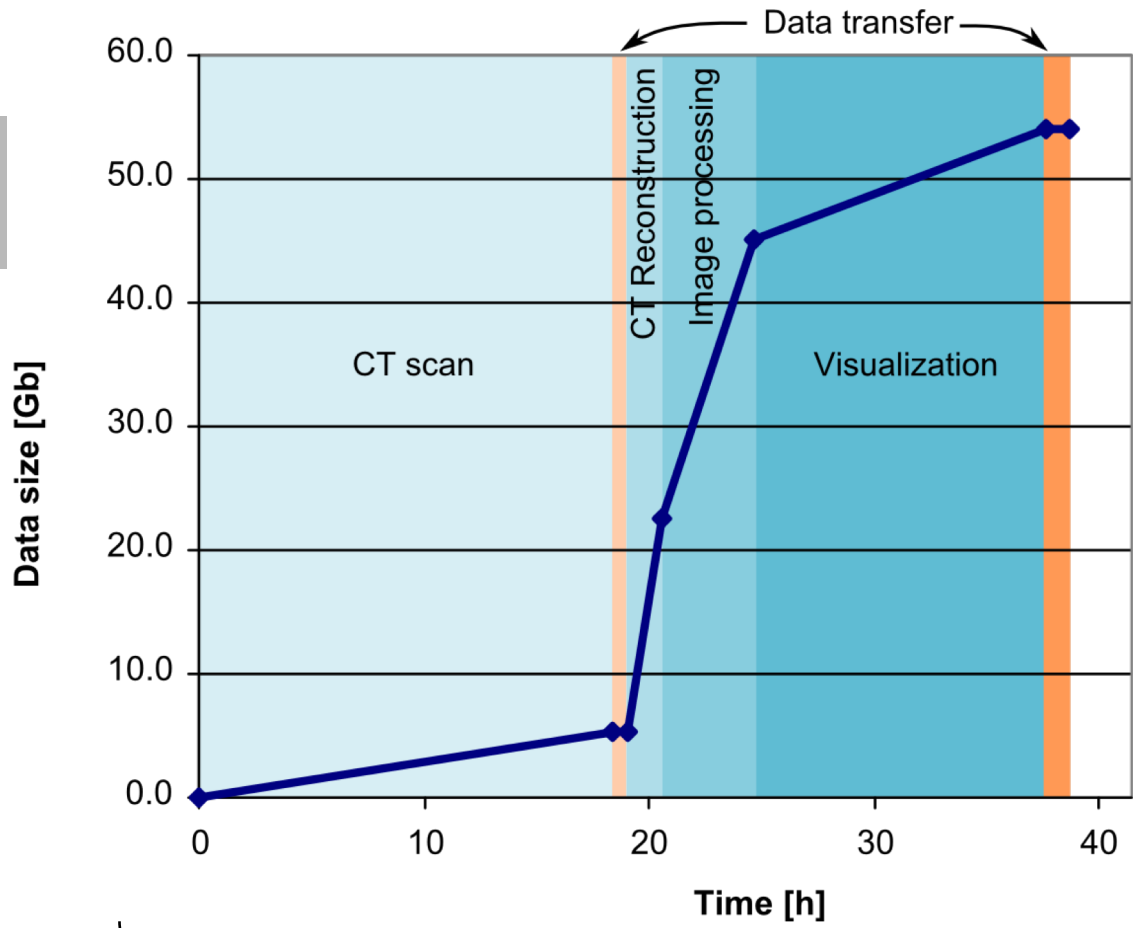
Need computational methods

Data processing

Data processing can be a very labor- and computationally intense task

Basic processing		Minutes, hours
CT reconstruction		Minutes, hours
Image processing		Hours
Visualization Analysis		Hours, days

Data analysis is time-consuming!

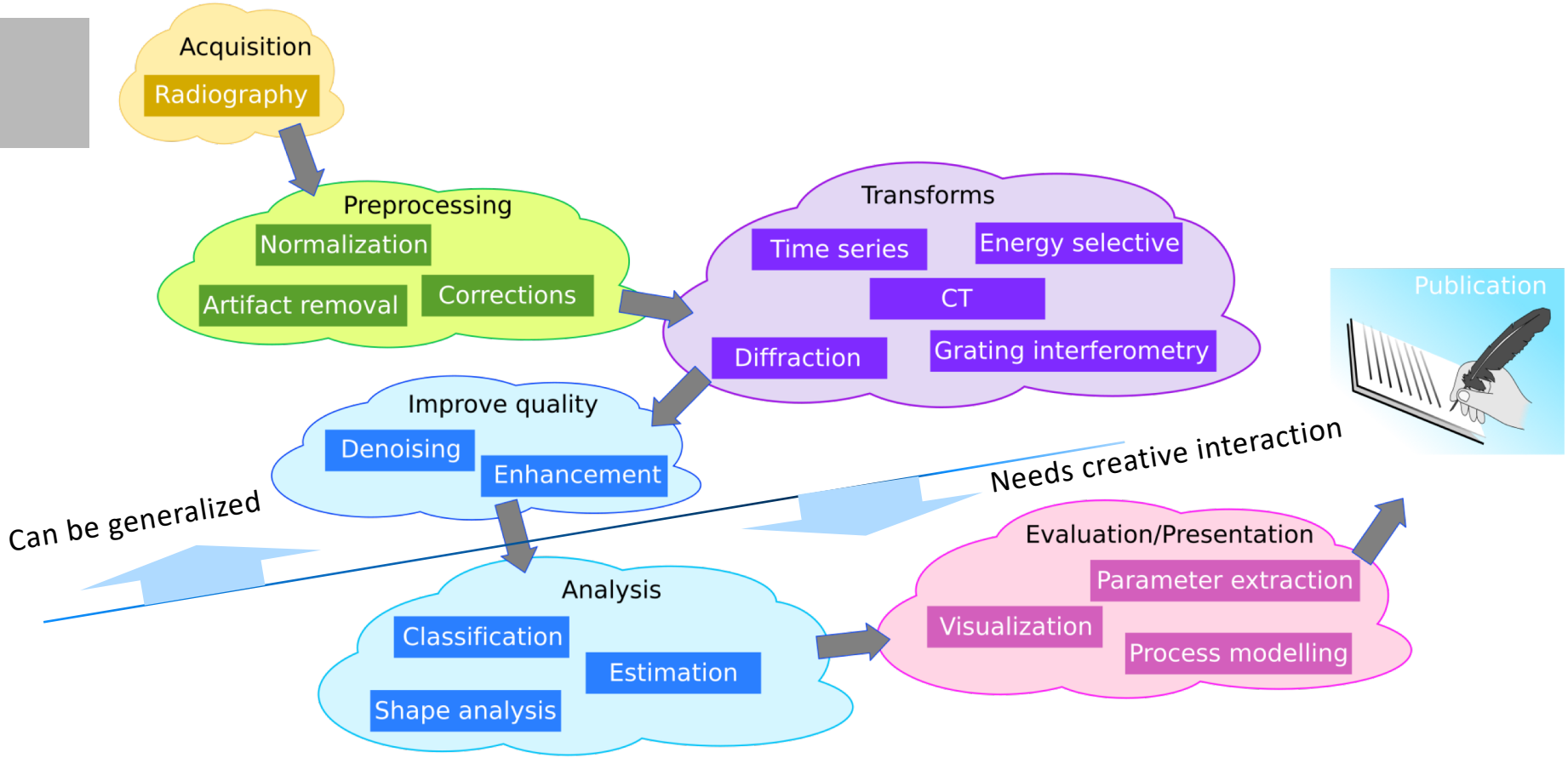


+ evaluation
+ modeling
+ publication

Months of work from experiment to publication…

… if ever!!!

Analysis workflow



Characterizing neutron imaging data

Data quality

- Limited number of observations — *long experiment times*
- Low SNR — *weaker sources*
- Less sharp than X-rays — *detection principle*

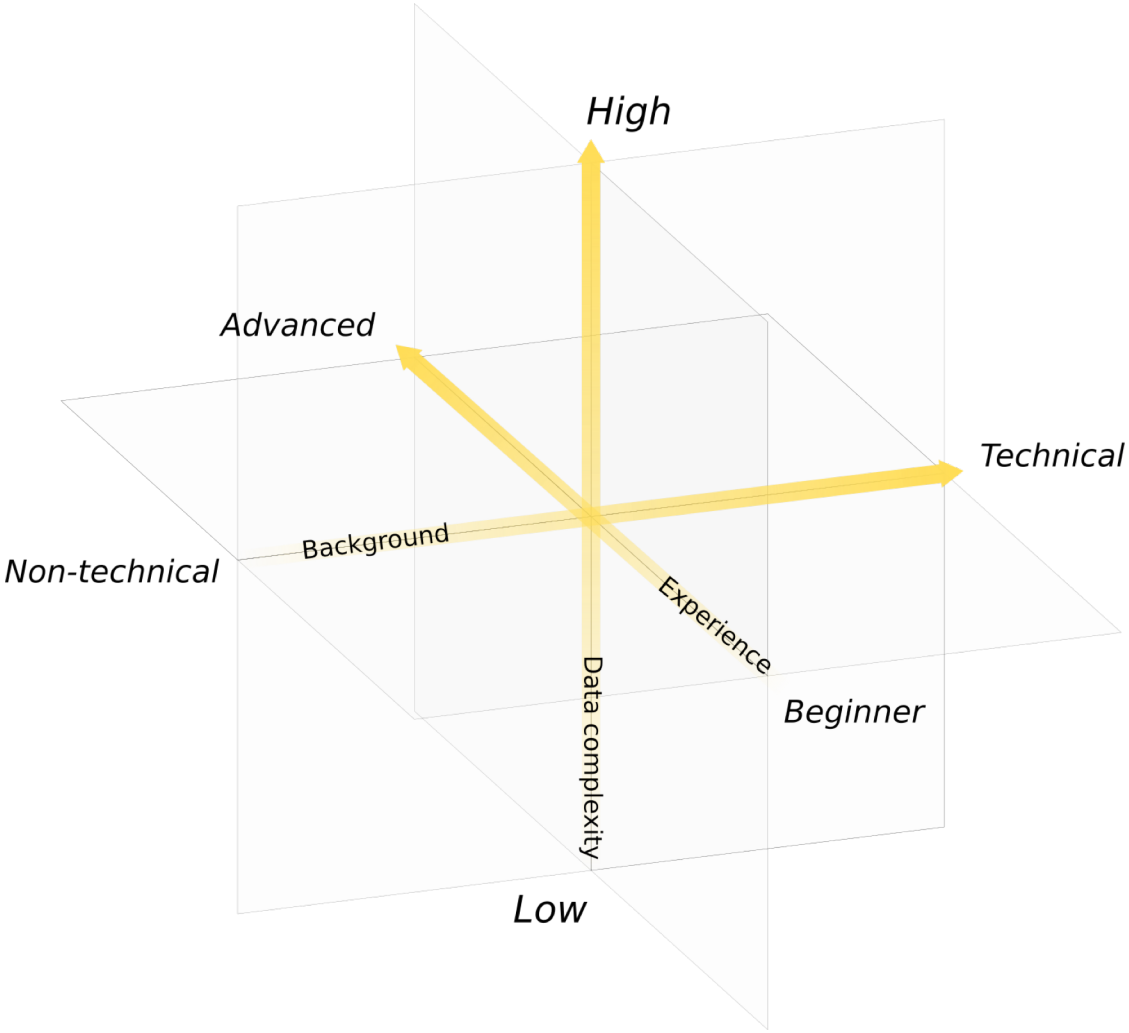
Data structure

- Single modality — *traditional transmission imaging*
- Temporal dependency — *time series*
- Multi modality — *combining images from different sources*
- Multi energy — *material response, mixes*
- Tensor valued — *magnetism, strain, diffraction*

Investigations often only involve few or even single samples → Generalization?

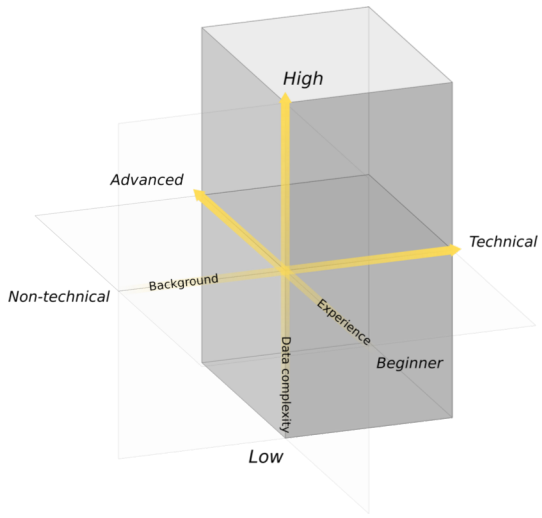
Data evaluation fitness of users

Users neutron imaging have very different background and experience

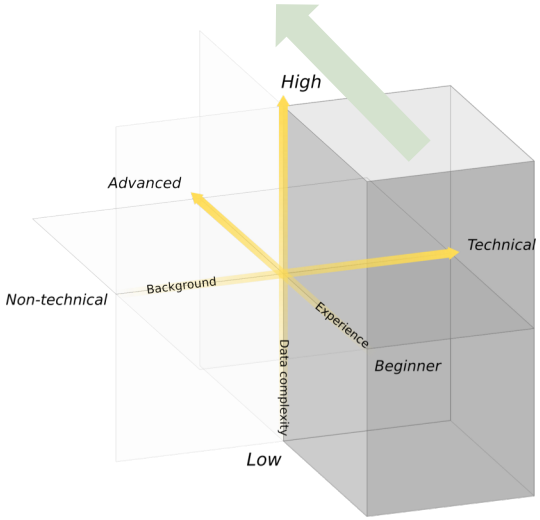


Data evaluation fitness of users - Characterization

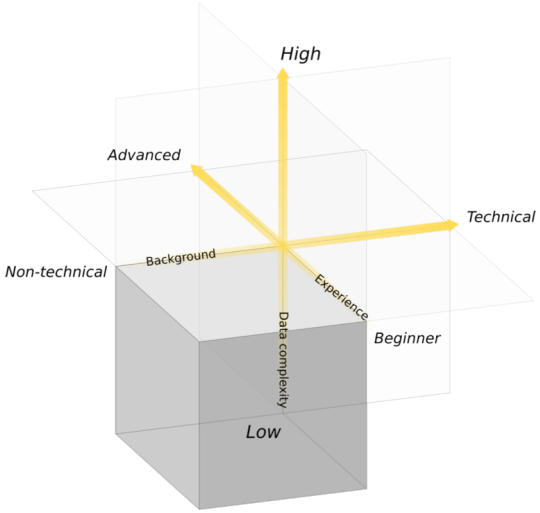
Beamline scientist



Early stage PhD student



Cultural heritage users

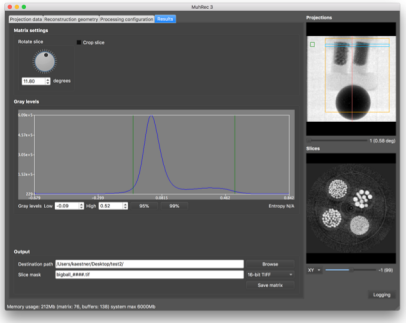


Serving people with different background and needs is a great challenge

Applications developed at PSI

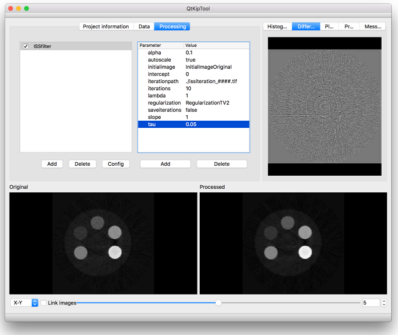
MuhRec

- CT reconstruction tool
- Configurable processing chain



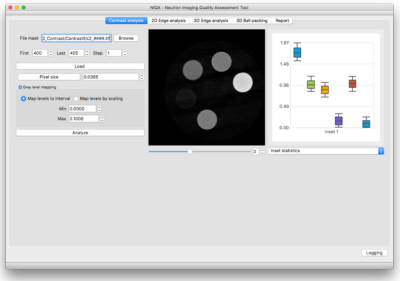
KipTool

- General processing tool 3D images
- Converter tools



NIQA tool

- Analysis of IAEA QA samples



nGI tool

- Reduction of phase stepping scans

Energy resolved imaging

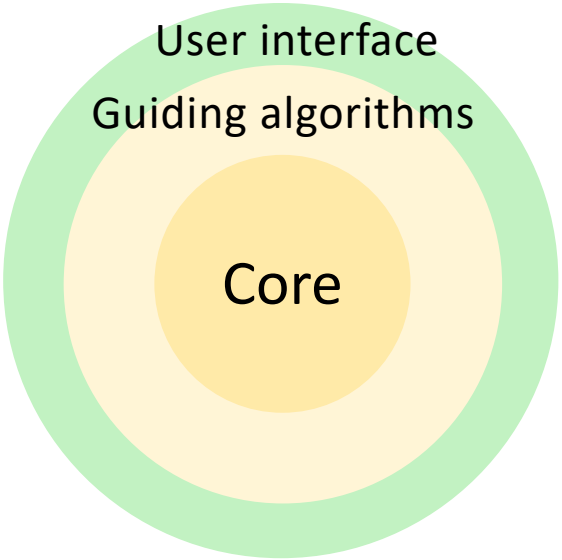
New neutron sources with pulsed beam …

… Reveal new information about the sample → New science (Many WCNR11 Contributions)

- Bragg edge analysis
- Diffraction imaging
- Modulation techniques

Challenges on the development

- Produce large data
- Adds new dimensions to the data
- Workflow flexibility



Modern software development

- Agile development
  - Iterative development
  - Collaboration
- Using repositories
  - New issues in repository branches
  - Maintain stable master through merge reviews
- Issue tracking (New features, Improvements, Fixing bugs)
- Frequent releases (2 x year)
- Automated testing and builds
- Online documentation

Some technical details about the development

The PSI way

Main coding language

In particular: C++11

- XCode (Mac)
- MSVC15 (Windows)
- g++ (Linux)

GUI Library

Version: 5.9 LTS

- Cross platform
- Qmake
- QTest

Planned binding

Python 3

- *Embedded scripting*
- *Call libs from python*
- *Tutorials*
- *Typical work flows*

Repository: GitHub

https://github.com/neutronimaging

- Development history
- Issue tracking
- Documentation (Wiki)

Build server: Jenkins

- Automated builds

Planned:

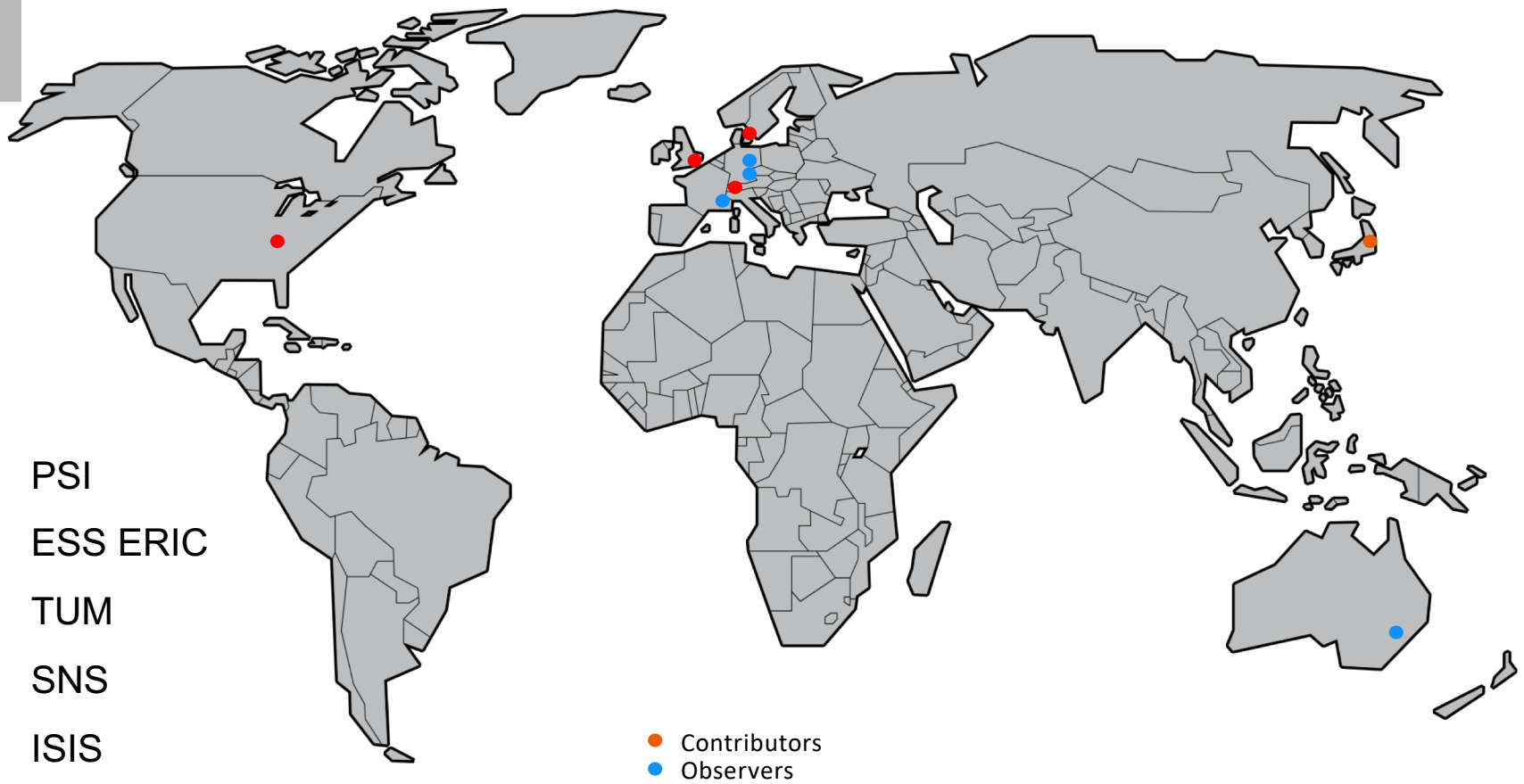
- *Nightly build installers*
- *Automatic unit testing*

Going open source

Why open source?

- Its free → Thus serves a wide community
- Insight in used methods → Reproducibility and traceability
- Promotes interoperability and collaboration
- A requirement from funding agencies

Collaboration Network



Do you want to contribute?

There are different ways to contribute

As user

Using and promoting open source analysis tools

Give feedback (report issues, request new features)

Promote interoperability between different sites

As developer

Contribute to existing code base in ongoing projects

Contribute with your own projects

As stakeholder

Identify use cases

Define requirements

Monitoring

Testing and verification

Wir schaffen Wissen – heute für morgen

The analysis of imaging data should be …

… done in a reproducible way.

… open source to promote collaboration.

… developed with modern techniques.

We welcome new partners to join.