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WP5.3 Kick Off

PSI March/April 2016

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Work Package Leader

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Purpose of this Meeting

- Everyone knows everyone else
- Everyone agrees about what we are trying to do together
- Everyone agrees about how we're trying to move forward
- We establish links to answer future questions and resolve problems

WP5 Partners

PAUL SCHERRER INSTITUT
PSI

ess EUROPEAN SPALLATION SOURCE

Elettra Sincrotrone Trieste

KØBENHAVNS UNIVERSITET

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WP5: Real-time management of ESS data

Objectives

Maximise the scientific output of the ESS by enabling live (real time) processing of the data taken on ESS instruments. This will be achieved by developing the software infrastructure needed to make this data available as a live, publish/subscribe, (data) stream to which data reduction, and analysis, software can subscribe to process the data.

Tasks		
Task 5.1	Creating a standard neutron event data stream for different detector types	ESS, KU
Task 5.2	Creating a standard method for streaming meta-data for fast applied fields	ESS, PSI
Task 5.3	Software to aggregate and make available the neutron event data and sample meta-data	ESS, PSI, Elettra

Deliverables		
5.1	Design report data aggregator software	M12
5.2	Report processing choices for detector types	M21
5.3	Beta-version data aggregator software	M23
5.4	Report filed data acquisition	M24
5.5	Data aggregator software	M35
5.6	Software neutron event data processing	M36
5.7	Software fast field acquisition	M36

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Creating a standard neutron event data stream for different detector types

WP5.1 Neutron Event Processing

- post ^{3}He problems
- background rejection, discrimination and accurate locating and time stamping of neutron events is not easy for all novel detector types
- software processing is more flexible than putting solutions in readout electronics
- processing can be tailored for requirements (high count rate vs high resolution)
- we need a framework for this kind of event formation

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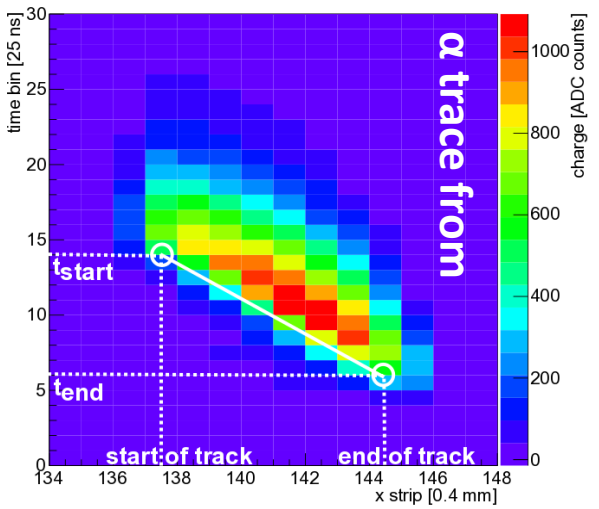
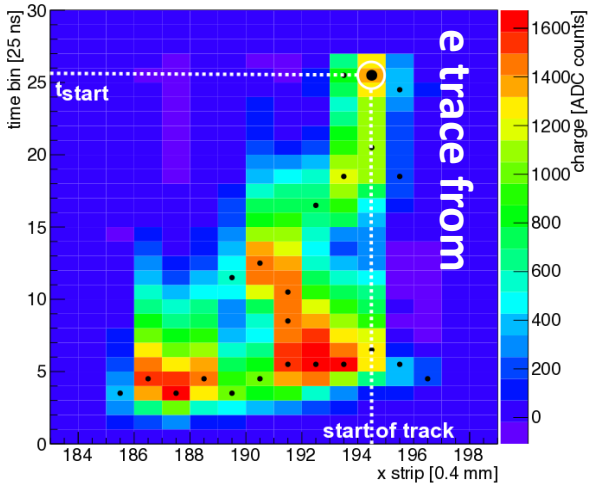
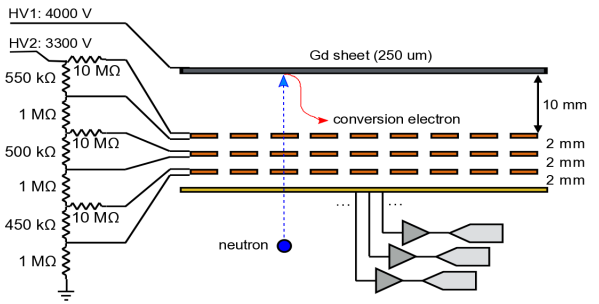
example: TPC Detectors

- detector electronics emits timestamped information on secondary particles
- neutron scattering only needs time and location of the neutron conversion process
- exact processing needs may be different for other detectors







http://dx.doi.org/10.1088/1748-0221/10/04/P04004

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Creating a standard method for streaming meta-data for fast applied fields

WP5.2 Fast Sample Environments

- sample environments come in different speeds
- most things at neutron sources traditionally happen on long timescales
- cyclic stroboscopic measurements can require high temporal resolution
- existing software interfaces have data rate or reliability limitations
- a model like for detector data would work for the fastest cases

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Software to aggregate and make available the neutron event data and sample meta-data

WP5.3 Data Aggregation

- data from different origins are collected in one point
- neutron events are bundled into per proton pulse frames
- consumers can subscribe to data at one authoritative source
- a common protocol for enables live visualisation and data treatment
- reliability is a primary concern

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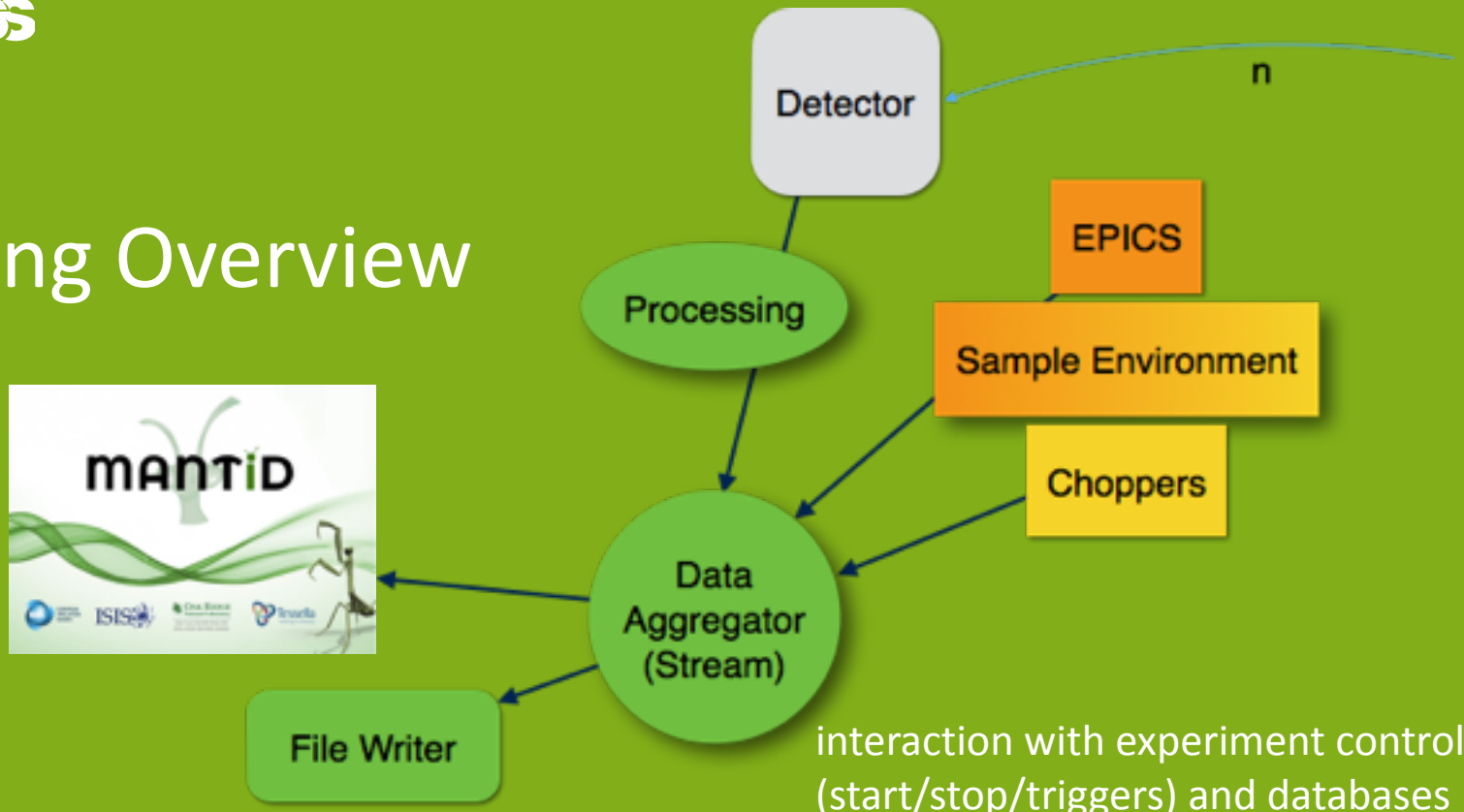
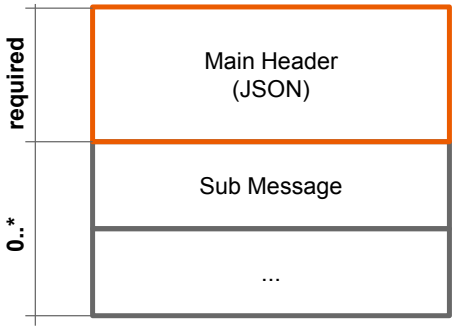
Streaming Overview



interaction with experiment control (start/stop/triggers) and databases

Potential serialisation lifted from Simon Ebner (PSI):




```
{"htype":"array-1.0",
"shape":[10,20],
"type":"uint16", "frame":0}
```

htype defines content of main header as well as the structure of the whole message (sub messages)

Sub Message(s) can be binary or JSON

EPICS V4

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Slow Sources	Medium Fast Sources	Fast Sources
Motion	Choppers	Detectors
Sample Environments	Sample Environment	Sample Environment
less than 14 Hz on average	less than 20 kHz maximum	
labelled monitor messages	buffered readout	event-type message stream

Data Aggregator

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“Metadata” — relevant or interesting auxiliary data

- Monitors
- EPICS
  - choppers
  - sample environment
  - motion
- configuration changes
- geometry changes
- accelerator information

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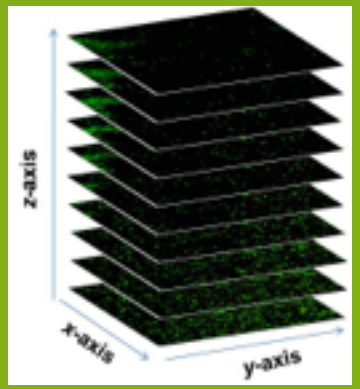
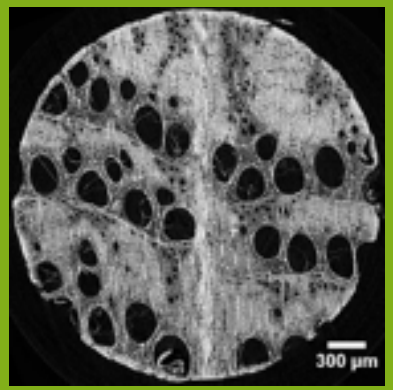
Non-event detector hardware

Neutron Imaging

- also needs to record to proper formats
- using standard interfaces (EPICS area detector)
- supporting all fancy trigger modes
- otherwise all beamlines collect data the same way





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Not BrightnESS scope!

Writing NeXus files

Groups

Attributes

Datasets

base classes

application definition

```
/:NXroot
  @creator="CBFlib - edited"
  /entry:NXentry
    /data:NXdata
      @axes= [ "", "y", "x" ];
      @signal="data"
      @x_indices=2; @y_indices=1
      /data= [11, 11, 13, 13, 11, ... 9, 13, 9, 18]
        @signal=1
      /x= [ 0, 0.172, 0.344, 0.516, ... 83.248, 83.42, 83.592]
        @depends_on="/entry/instrument/detector/transformations/DETECTOR_X"
        @offset = [41.05, 52.32, 0]; @offset_units ="mm"
        @transformation_type ="translation"; @units ="mm"
        @vector= [-1, 0, 0]
      /y= [ 0, 0.172, 0.344, 0.516, ... 105.952, 106.124, 106.296]
        @depends_on="/entry/instrument/detector/x_pixel_offset"
        @offset = [0, 0, 0]; @offset_units ="mm"
        @transformation_type ="translation"; @units ="mm"
        @vector= [0, -1, 0]
    /definition="NXmx"
      @version="1.2"
    /instrument:NXinstrument
      /detector:NXdetector
        /count_time=1; @units ="s"
        /data -> "/entry/data/data"
```

Data files written in an agreed comprehensive format

NeXus

McStas

MANTID

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Construction Roadmap

- **2015**
  - Roadmap planning
  - In-Kind agreements
  - Startup of BrightnESS & Recruitment
- **2016**
  - Recruitment & more In-Kind
  - Transition from planning into implementation
  - Evaluate feasibility of technology choices
  - Begin development of necessary frameworks (Streaming & Messaging)
  - Start working on lab demonstrator of data readout and streaming (Lund office)
- **2017**
  - Implementation phase
  - Hardware performance tests
  - Deployment and reliability tests
  - Worry more about transition into operations
- **2018**
  - Real instrument devices may become available for integration
  - BrightnESS finishes (August)
- **2019**
  - Bug fixing
  - Cold commissioning

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Milestones

Core	Stream IK	BrightnESS	Date	Title
	x		2016-03	Kickoff Meeting
	x		2016-06	Roadmap Choice on Streaming
		x	2016-08	Design Report Aggregator
x			2016-09	Software Design for Raw Data
		x	2017-02	Design Report Event Processing
	x		2017-06	Prototype Performance Test
		x	2017-07	Aggregator Beta Test
		x	2017-08	Fast SE Design Report
		x	2017-08	Event processing Beta Test
x			2017-10	Software Design Cataloguing
		x	2018-02	Integrated test Event Processing
	x		2018-06	Functional Test at ISIS
		x	2018-06	Final Software Delivery for Event Processing
		x	2018-08	Software Delivery Data Aggregator
		x	2018-08	Software Delivery Fast Sample Environment
x			2018-09	Software Design Archiving
	x		2019-08	Roadmap Document for Operations

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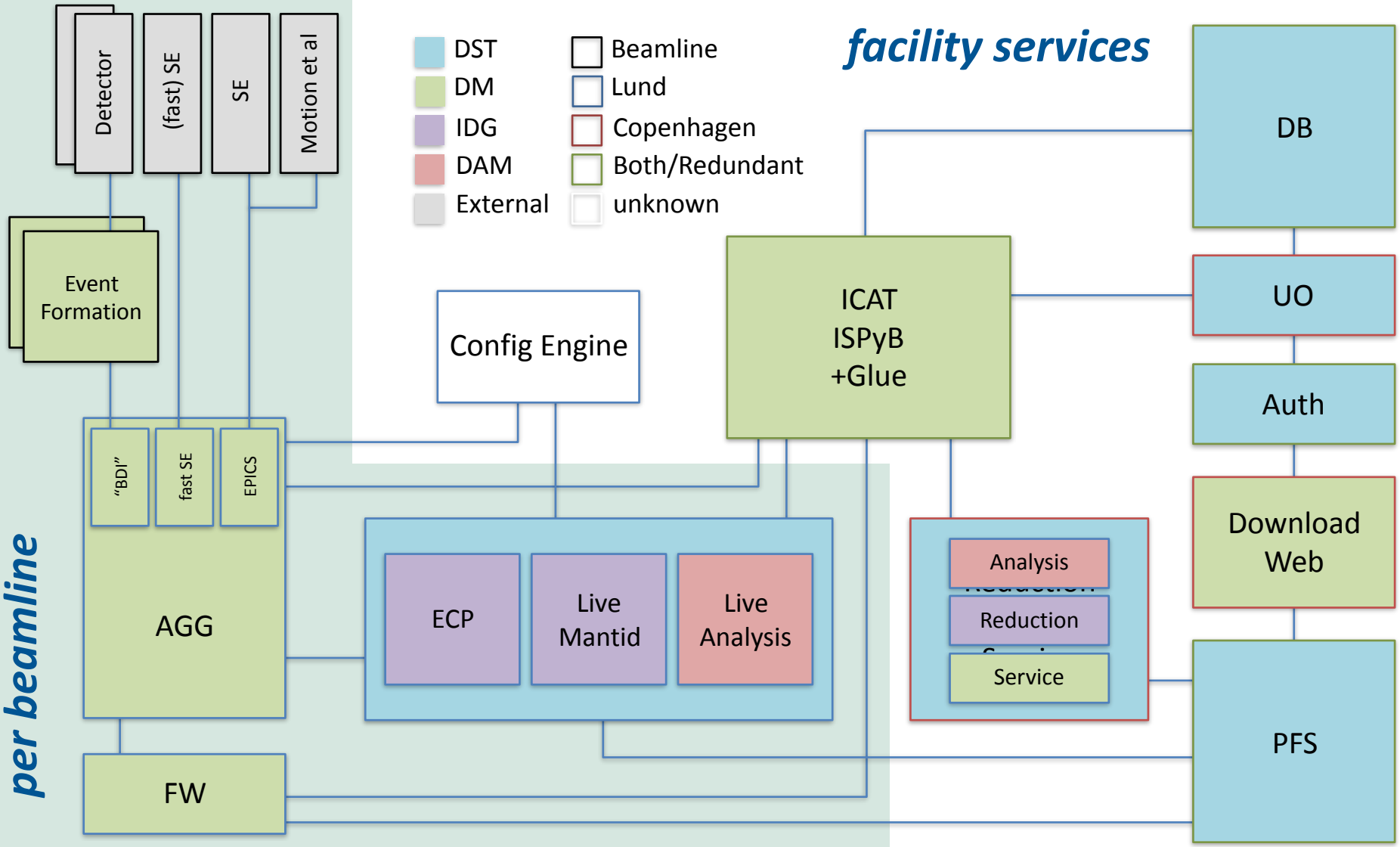
ICS NSS SAD MAG CG DG DMSC

ESSIIP — ESS Instrument Integration Project

Aim is to integrate iteratively, as early as possible, in a physical lab space, where all stakeholders have their equipment for testing.

Interfaces and Responsibilities



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Successful Development and Operations

Aim: Everything runs reliably, but bug fixes can be deployed easily

In case of problems there are automated mechanisms in place to resume service or alert people.

We will have facilities to monitor that detect buildup of bottlenecks and backlogs and warn us appropriately.

Automatic testing before deployment, best software engineering practices and project management will be used.

CFEngine puppet labs PalletOps ANSIBLE CHEF SALTSTACK

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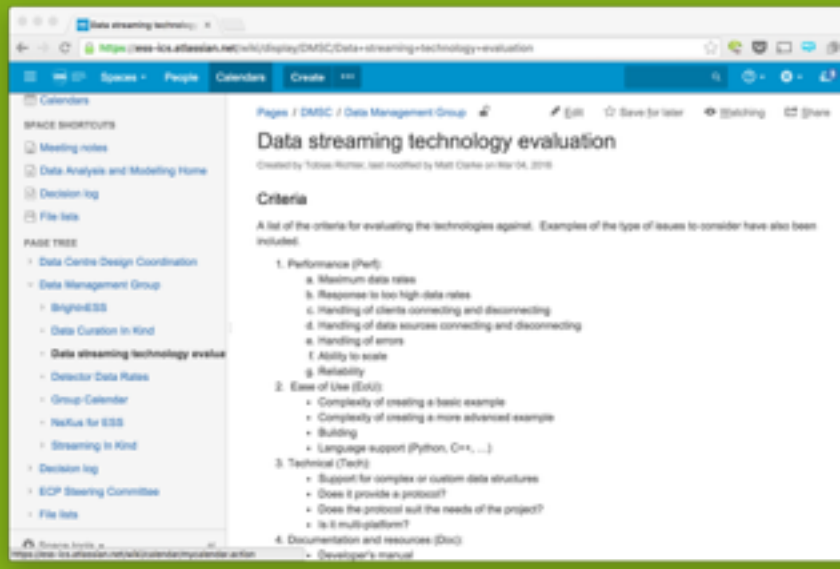
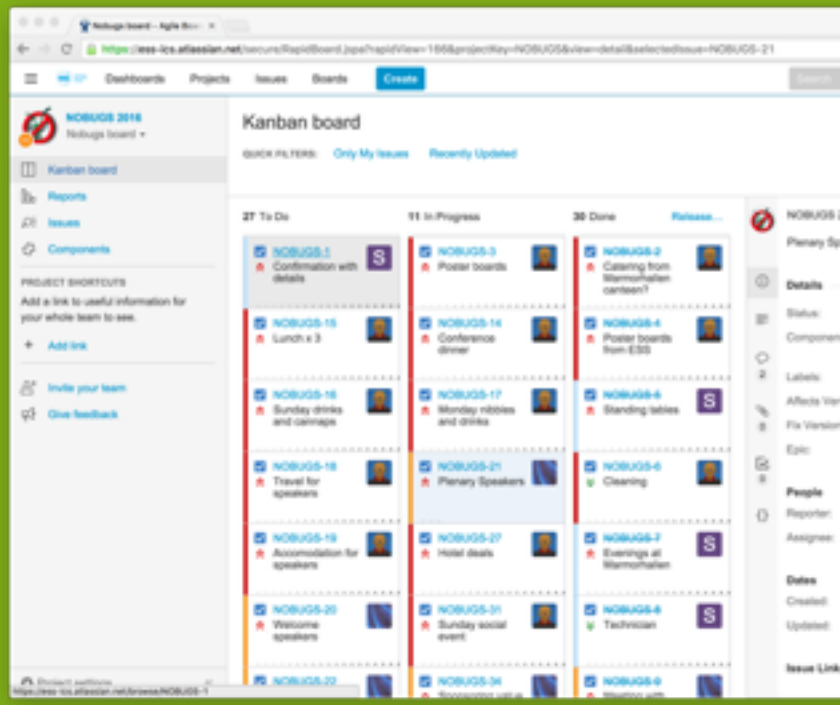
Tools and Infrastructure

- JIRA and Confluence (Issue Tracking and Wiki)
  provided by ESS hosted by Atlasssian
  accounts via Tobias or Afonso

- Git, Github, Bitbucket
  ESS has private repositories at Bitbucket
  Github could be perceived as more open

- Vagrant and Virtualbox
  tools for easy provisioning of (networked) VMs
  for development and testing
  ICS EPICS development standardised this way





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Key Performance Indicators (KPI)

EU project accounting will judge us on:

- number of open source packages generated
- unique conferences visited (with presentation)
- publications
- number of releases deployed for testing on hardware

You get what you measure…

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Rest of this meeting

Mark gives an overview of neutron scattering and SINQ DAQ and we have a tour. Do ask questions!

After that the agenda is still flexible. Please make sure your concerns are addressed appropriately!

We must not forget to talk to Elettra tomorrow!

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After this meeting

EPICS meeting in Lund — there will be a WP/In Kind streaming satellite meeting on the 23rd May
https://indico.esss.lu.se/event/507/overview

NOBUGS — 17th to 19th October in Copenhagen
https://indico.esss.lu.se/event/357/

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