WIMAS-8 Synthetic diagnostics: status, plans, and future prospects

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WIMAS-8 contributors

- Jari Varje (ASCOT & AFSI)
  - Finished his PhD, but will continue to support from new job
  - Seppo Sipilä will maintain actors in the IMAS framework
- Didier Vezinet (tofu)
- Erik Andersson Sundén (DRESS)
- Sean Conroy (DRESS)
- Matthew Carr (CHERAB)
  - Left UKAEA in August.

- Örs Asztalos (RENATE)
- Gergo Pokol (RENATE)

In total: 0.7 py

- **D1: Plugins for synthetic diagnostics for bolometry**
- **D2: Deployment of alpha source actor at JET, maintenance and user support**
- **D3: Release and verification of synthetic neutron diagnostics actor**
- **D4: Synthetic spectrum of VUV and X-Ray**

AFSI-based synthetic diagnostics

Work done 2019:

- Calculation of 4D fusion product source distributions implemented in the AFSI actor
  - Monte Carlo model [1] for anisotropic thermal, beam-thermal and beam-beam neutron, alpha sources with realistic spectra
  - Simple line-integrated neutron diagnostic [2] implemented as an IMAS actor

To be done 2020:

- Benchmarks with DRESS
- Missing suitable IDS for output for line integration output

[1] P. Sirén et al 2018 Nucl. Fusion 58 016023
[2] P. Sirén et al 2019 J. Instrum. 14 C11013

DRESS-based synthetic diagnostic

Work done 2019:

- The DRESS code has been updated to calculate the volume integrated (energy resolved) neutron emission along a Field of view through a plasma.

To be done 2020:

- Update of neutron_diagnostic IDS to allow for the above calculations without reading from file.
- A benchmark between the AFSI and the DRESS actors.
  - Compare the output of the 4D (R,Z,E,pitch) distributions of the fusion products.

[1] J. Eriksson et al., 2016, Comp. Phys. Commun., 199, 40-46

Status of neutron_diagnostic IDS

Work done 2019:

- The current version of the IDS for neutron diagnostics has been reviewed.
  - The IDS is rather specialized to fit the need of one diagnostic.

To be done 2020:

- Generalize the IDS to allow for several diagnostics to be described by the IDS. This includes storage capacities for:
  - The Field of View of the diagnostic
  - The response function of the diagnostic.

Status of CHERAB and RENATE

Work done 2019:

- CHERAB:
  - Draft versions of the CXRS diagnostic in IMAS.
  - Draft version of synthetic diagnostics of bolometry
  - The CHERAB work of WPCD was abandoned in August.
- RENATE-OD 1.2.0 has been released
  - A beam emission spectroscopy code.
  - Integration of RENATE-OD into CHERAB (as detailed in talk by A. Nielsen)
    - RENATE and CHERAB has not been used with IDS input so far

To be done 2020:

- No work planned for CHERAB – might cause problems for RENATE (WIMAS-3)

[1] M. Carr et al, Rev. Sci. Instrum. 89, 083506 (2018)

Status of tofu

Work done 2019:

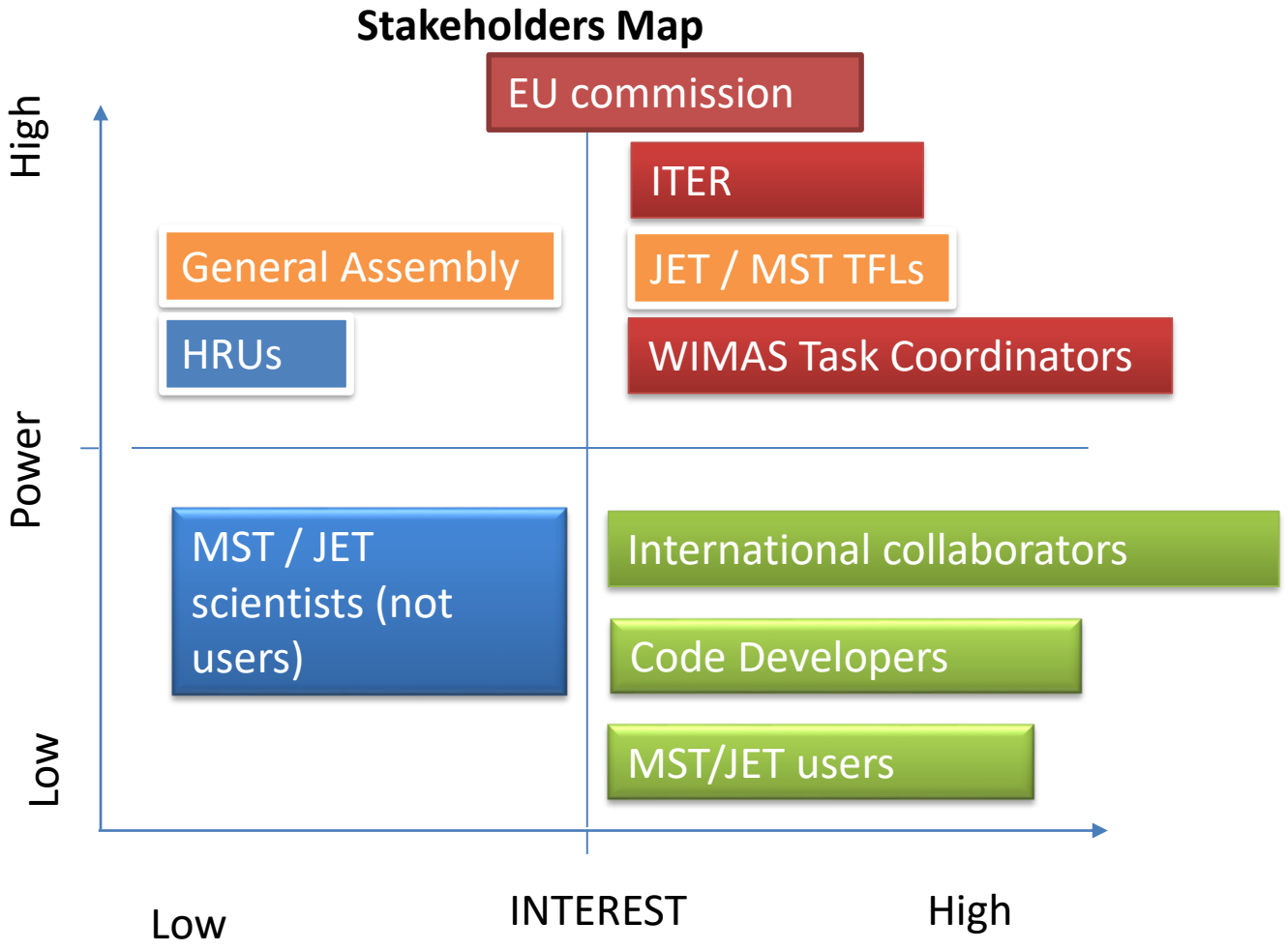
- Release of **To**mography for **Fu**sion (tofu) 1.4.2 with:
  - **Faster** algorithms for **LOS integration**
  - Basic handling of **reflections**
  - New tokamaks added (**ITER**, AUG)
  - More complete documentation
  - Basics for handling **bragg diffraction** (for X-Ray crystal spectrometers)
  - **Faster volume sampling** algorithms
  - More user-friendly interface
  - Better **portability** (Mac OS, Linux)

To be done 2020:

- Finish Volume of Sight developments
- Further 2D X-Ray bragg spectrometer developments

Plans for 2020

Identification of Key Stakeholders for Task WIMAS-8



Plans for 2020

Requirements of Key Stakeholders for your Task

EU
- Report of deliverables

ITER
- Realistic synthetic diagnostic data to make predictions

International collaborators / Code developers / MST and JET users
- Realistic synthetic diagnostic data
  - Allows for more interest from diagnosticians
- Benchmarking to real data

DRESS and AFSI -Timeline for 2020

2020 Timeline for

	Jan	Feb	Mar	Apr	May	Jun
Erik			Preparation of the neutron diagnostic IDS	Not available	Preparation of the neutron diagnostic IDS Bench-marking of DRESS and AFSI	Continue
Jari / Seppo					Bench-marking of DRESS and AFSI	Continue

DRESS and AFSI -Timeline for 2020

2020 Timeline for your task

	Jul	Aug	Sept	Oct	Nov	Dec
Erik	Continue		Construction of DRESS actor using neutron diag IDS	Comparison of DRESS and AFSI results in new neutron diag IDS	Report	Report
Jari / Seppo	Continue		Construction of AFSI actor using neutron diag IDS	Comparison of DRESS and AFSI results in new neutron diag IDS	Report	Report

tofu - Timeline for 2020

2020 Timeline for tofu tasks

	Jan	Feb	Mar	Apr	May	Jun
Maintenance	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous
User support	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous
Documentation	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous
Better portability	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous
X-Ray spectro.	Basics	Basics	Basics	Basics	Full 3D synth.diag	Full 3D synth.diag
Classes for handling ions populations				First version	First version	First version
Classes for handling radiation				First version	First version	First version
Volumes of Sight	Volume sampling	Volume sampling	Volume sampling	Solid angles	Solid angles	Solid angles
Meshes						
Tomographic inversions						

Tofu - timeline for 2020

2020 Timeline for your task

	Jul	Aug	Sept	Oct	Nov	Dec
Maintenance	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous
User support	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous
Documentation	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous
Better portability	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous
X-Ray spectro.	Full 3D synth.diag	Full 3D synth.diag	Full 3D synth.diag	Full 3D synth.diag	Full 3D synth.diag	Full 3D synth.diag
Classes for handling ions populations	Test, debug and improve first version	Test, debug and improve first version	Test, debug and improve first version	Include second version in release	Include second version in release	Get Return on experience from users
Classes for handling radiation	Test, debug and improve first version	Test, debug and improve first version	Test, debug and improve first version	Include 2nd version in release	Include 2nd version in release	Get ROE from users
Volumes of Sight	Solid angles	Solid angles	Solid angles	Solid angles	Include in release	Include in release
Meshes		Rectangular meshes	Rectangular meshes	Rectangular meshes	Rectangular meshes	Include in release
Tomographic inversions					Start linear regularizations	Start linear regularizations