Fusion Competence Centre

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Dissemination level: Public
Disclosing Party: Project consortium
Recipient Party: European Commission

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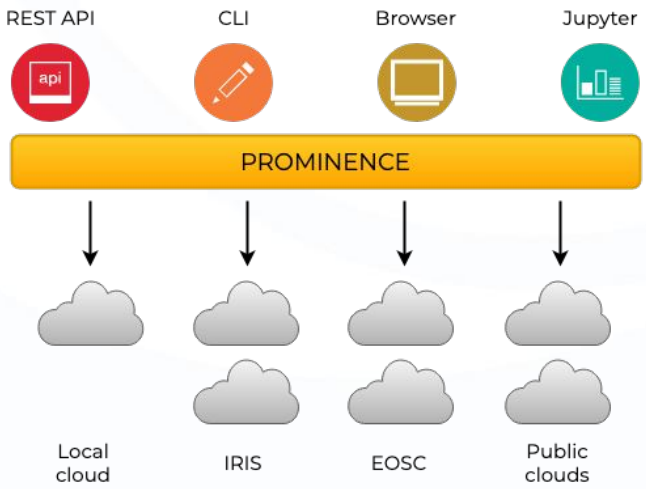
Scientific community

- Nuclear fusion
  - Energy source of the Sun and stars
  - Light nuclei fusing together to form a heavier nucleus release energy
- Recreating nuclear fusion on Earth
  - Typically heat deuterium and tritium to over 100 million degrees Celsius
  - Eventual aim to use the energy created to generate electricity
- Many challenges to overcome, including:
  - Improving our understanding of plasma stability
  - Design & development of materials able to withstand the hostile environment in nuclear fusion reactors
  - High-fidelity modelling of actual nuclear fusion plant infrastructure
- These challenges all require a significant amount of computing

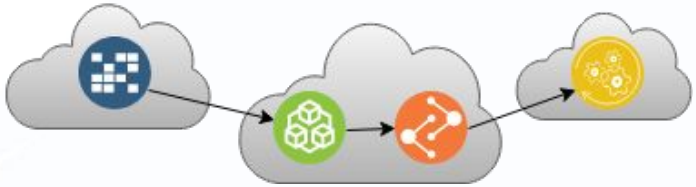
Scientific platform

- PROMINENCE allows users to transparently run jobs across any number of clouds opportunistically
  - Jobs are automatically directed to the most appropriate clouds
  - All jobs run in containers for reliability & reproducibility

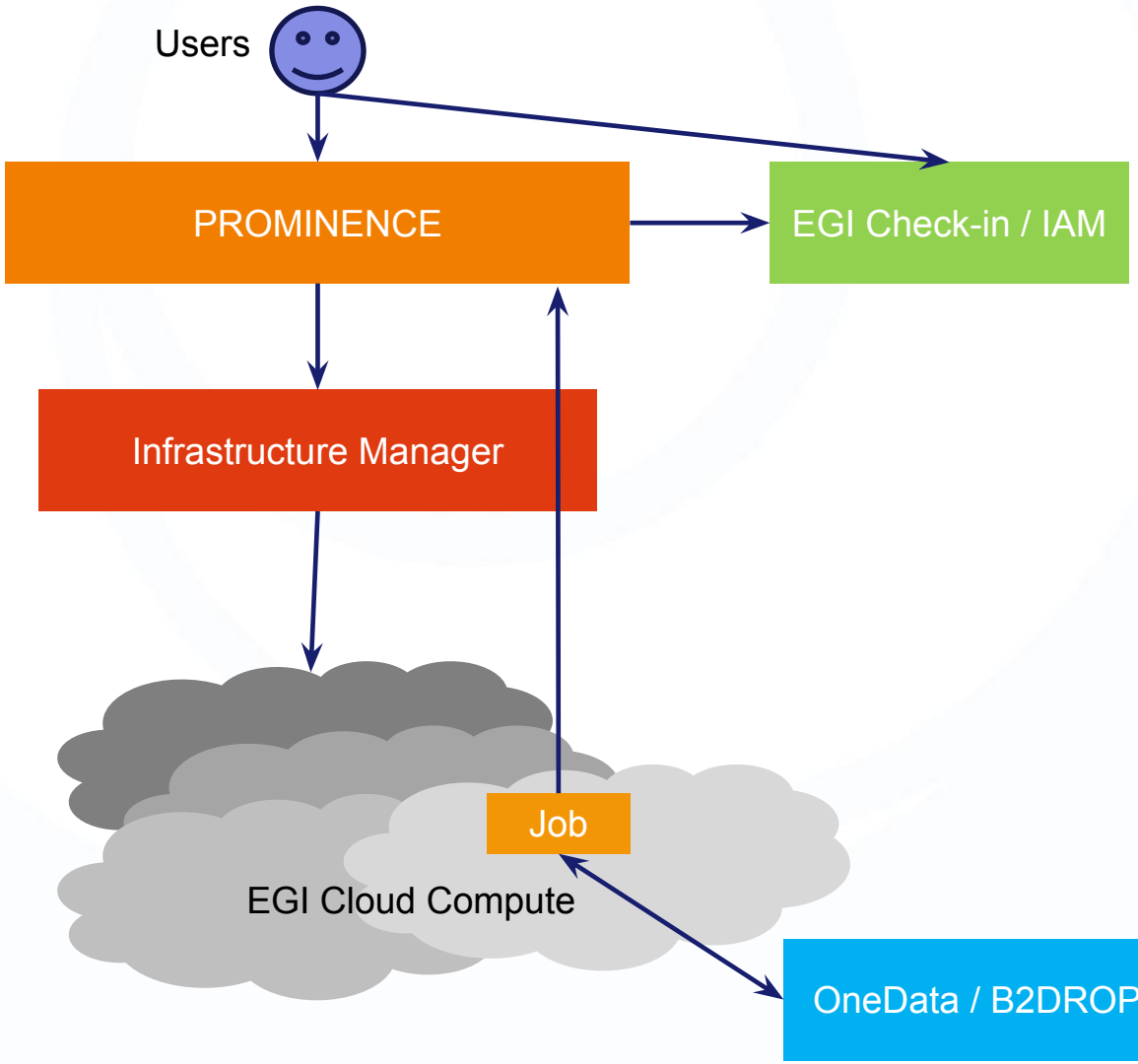
Run jobs across many clouds



Run workflows across multiple clouds



Integration with EOSC-hub



Services from the EOSC Marketplace

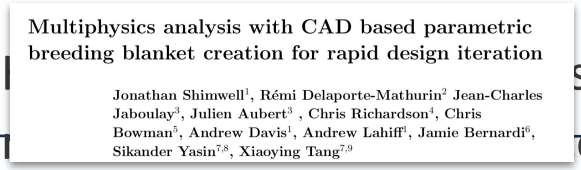
- EGI Check-in / IAM
- EGI Cloud Compute
- Infrastructure Manager

Storage options from the EOSC Marketplace:

- OneData
- B2DROP
- B2SAFE

Impact

- Distributed computing does not exist in the Fusion energy research community
- PROMINENCE allows users to gain access to additional resources
  - Increasing computing resource requirements mean that local resources are more likely to be full
  - A single point of access to global heterogeneous resources
  - Applications can be built once then run anywhere
- Important to be able to leverage cloud resources
  - Clouds are increasingly becoming the standard way of deploying computing infrastructure
  - Computing allocations are increasingly in the form of clouds
- I[illegible]s of papers which would have been delayed by l[illegible]e & access to cloud computing resources

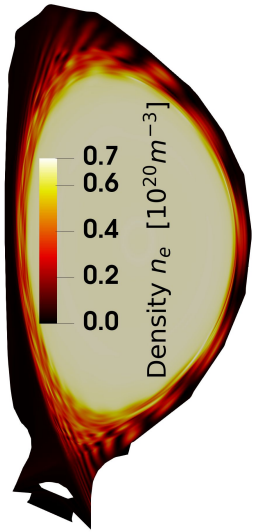

Multiphysics analysis with CAD based parametric breeding blanket creation for rapid design iteration

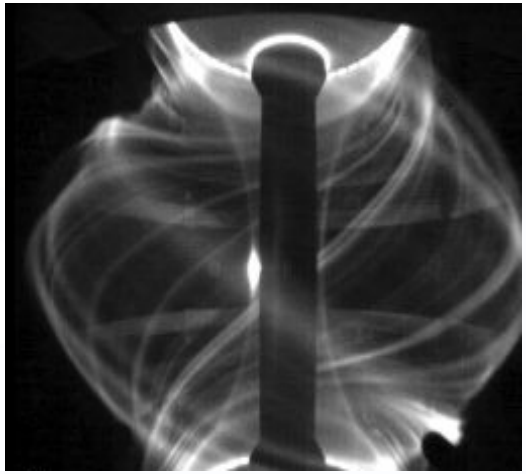
Jonathan Shimwell[1], Rémi Delaporte-Mathurin[2] Jean-Charles Jaboulay[3], Julien Aubert[3] , Chris Richardson[4], Chris Bowman[5], Andrew Davis[1], Andrew Lahiff[4], Jamie Bernardi[6], Sikander Yasin[7,8], Xiaoying Tang[7,9]

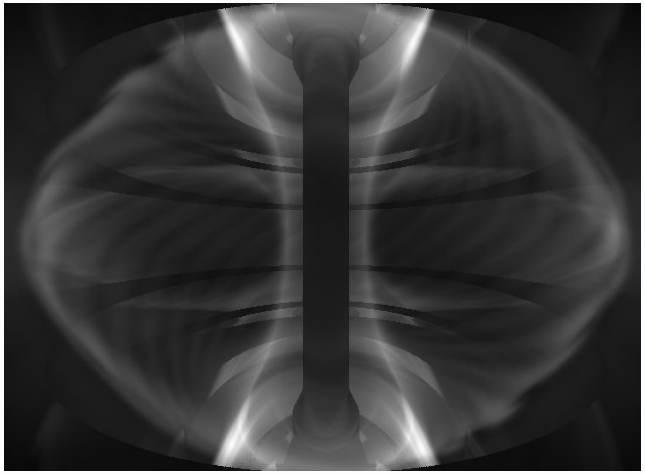
Optimizing tritium production, using 3D CAD based neutronics models

Example scientific use case: VVUQ

- Application: HPC modelling
- Nonlinear MHD instabilities (JOREK https://jorek.eu)
  - Code validation
  - Generating databases for machine learning
  - Inverse rendering of experimental images

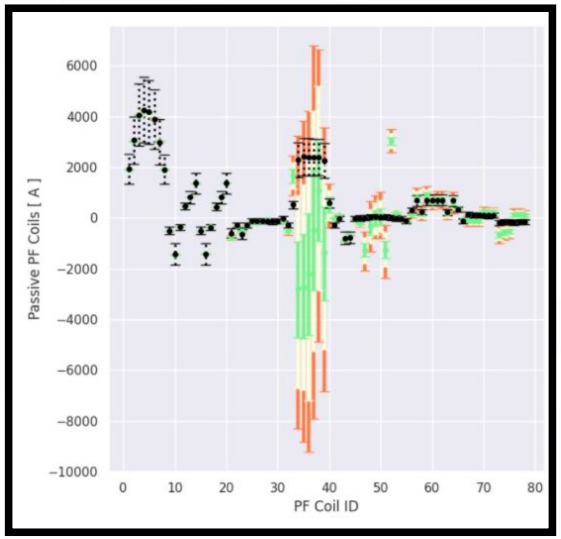


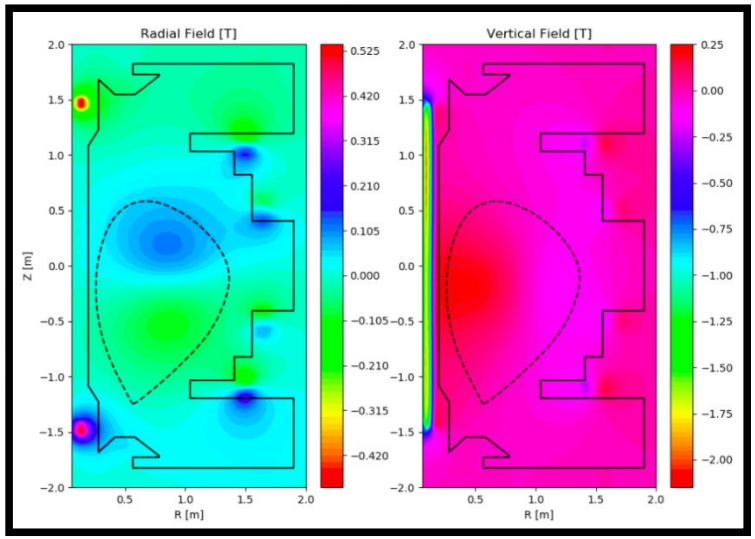




Example scientific use case: VVUQ

- Application: Data Analysis
- Data analysis of Tokamak experiments
  - Magnetic configuration of plasmas
  - Error propagation from measurements

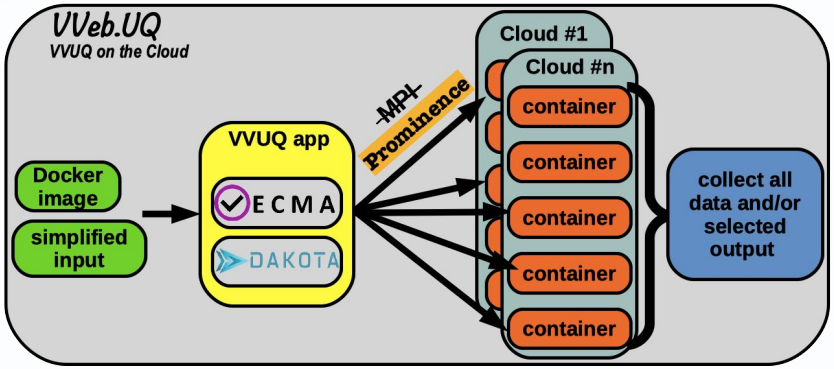




Demonstration of *VVeb.UQ*

- VVUQ on the cloud
- Simple input: Docker image + data & errors
- VVUQ software
  - DAKOTA https://dakota.sandia.gov/quickstart.html
  - ECMA https://easyvvuq.readthedocs.io/en/latest/basic_tutorial.html
- Cloud deployment: PROMINENCE
- Check progress of jobs
- Collect output upon completion

https://github.com/ukaea/ALC_UQ/tree/master/VVeb.UQ



Thank you for your attention!

Questions?

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