Integrated Scientific Platform for Heterogeneous Research and Engineering

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iSPHERE has mainly grown out of the FP7 Project IMPEX.

iSPHERE is currently represented by a 14 member European consortium, including 4 SME’s.

8 countries involved: Austria, Spain, Romania, Germany, Finland, France, Belgium and Russia.

There are 12 Work Packages covering all aspects from science and technologies to requirements engineering and professional software engineering and development.

Requirements are based on four complex science scenarios (2x space physics, 2x experimental physics).

Requirements engineering and software development to be carried out in an agile manner.
Main Objectives & Goals

- Creation of a versatile platform for generation, storage, analysis and processing of scientific data
- Observational, experimental and simulation data unified in one single environment.
- Transparent access to commercial cloud resources for the execution of complex modelling codes and chains.
- Integration of multiple data sources, access protocols and data models via a Scientific Service Bus.
- Provision of an API to allow for new applications to be added.
Main target group of the system are scientists and (post-)graduate students working in one of the covered fields (e.g. plasma physics or planetary science).

The system also aims to address engineers as well as users from industry and education.

The range of physical phenomena covered is expected to grow along with its community and hence the inclusion of new data and simulation models as well as data sources.

The system is expected to attract experimental as well as theoretical physicists including modelling experts.
Comparative studies of experimental results, observational data and simulation outputs.

Simulations of complex physical phenomena that are not covered by a single model and/or need extensive computing power.

Interdisciplinary research that requires to set up complex simulation chains and overlay the results with empirical data.

Investigations over a broad range of (empirical or modelled) data (sources) that require advanced data mining, visualization and analysis tools.
JRA 5 - Science Cases & Research Scenarios

- Space Weather (SW-SC)
- Planetary Atmospheres (PA-SC)
- Entry Flows (EF-SC)
- Material characterization (MC-SC, including Uncertainty Quantification)
**Project Structure**

**Requirements Cycle**
- (Requirements Meetings, ~4w)
- Requirements Backlog
- Product Backlog
- Requirements Backlog
- Research Scenarios

**Development Cycle**
- (Sprint Review and Planning Meetings, ~4w)
- Sprint Backlog
- Decomposition

**Meetings**
- weekly meeting
- daily “stand-up”

**iSPHERE Advisory Board**
- community, project reviews, ...

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**iSPHERE H2020**
Remote Data
[Observational Data, Modeling and Experimental Data]

Cloud Providers
[Model Execution]

Data Ingestion

Data Provision

Cloud Computing

Scientific Service Bus

Data Registry/Repository

Data Models, Mapping & Transformations

Model Operation

Data Discovery

Data Visualization

iSPHERE H2020
Public and private cloud infrastructures will be integrated for the **on-demand provision of virtualized resources** (mainly processing).

Cloud integration via **virtual appliances** and support of **protocols** for cloud access (**WP5**) and **billing systems** (**WP8**).

Support of 4 basic types of **cloud** infrastructures:
- Commercial Public Clouds (**IaaS** (Amazon Web Services, ...))
- Science Public Clouds (**SurfSARA, CESGA, SurfSARA, ...**)
- European e-Infrastructures (**EGI Federated Cloud, Helix Nebula**)
- Private Clouds

Web based interfaces for **model upload and seamless integration** into the **iSPHERE** cloud including **model operation**.
Clear definition of **meta data** and **taxonomies** is essential for basic **data discovery** and **search tools**.

**iSPHERE** will support **multiple data models** including clear **procedures for the extension** of the data model suite.

**SSB** will provide “translators” to support **modelling chains** and to foster **interoperability** with other infrastructures.

A common **meta data standard for experimental plasma physics** will be defined and introduced to the experimental physics community via the **iSPHERE** platform.
 iSPHERE SSB will support a (probably REST based) **API** for web clients to communicate with the infrastructure.

 The *HTML5/CSS3* based **standard interface** will use the **API** and provide functionalities for: **data discovery**, **visualization**, **model operation** and **data processing**.

 Depending on **user rights** and available resources, operations can be carried out on the client, the **SSB** or in the **cloud**.

 **Additional user interfaces** can be developed, leveraging the **API**, providing additional functionalities.

 **SSB** will also support **custom extensions** via “plug-in” architecture.
Tool Support – Data Discovery

- Design and implementation of advanced discovery methods, filtering, content-based search, constraint based pattern recognition (including AI).
- Investigation of domain dependent query languages.
- The goal is to provide optimal support to users who attempt to:
  - Overlay observational, simulation and experimental data.
  - Analyse empirical data by identifying relevant simulation runs.
  - Verify numerical data by identifying real-world reflections of the obtained results.
The system aims to provide **purely web based 3D visualization** based on latest *WebGL* Technology.

No need to install local (*Java*, ...) applications etc., only an up-to-date browser needed.

The visualization will hence be **tightly integrated**.

Released as an **open source** library – can be **re-used** for e.g. other web clients developed for the *iSPHERE API*.

Visualization can **grow** along with the simulations suite and data.

*WebGL* is **supported by most major browsers** in their latest version and is leveraging locally installed **graphics acceleration**.
THANK YOU!

QUESTIONS...?