Improvements of database system and analysis suite in VEST

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1. Introduction

1.1. Introduction and Motivation

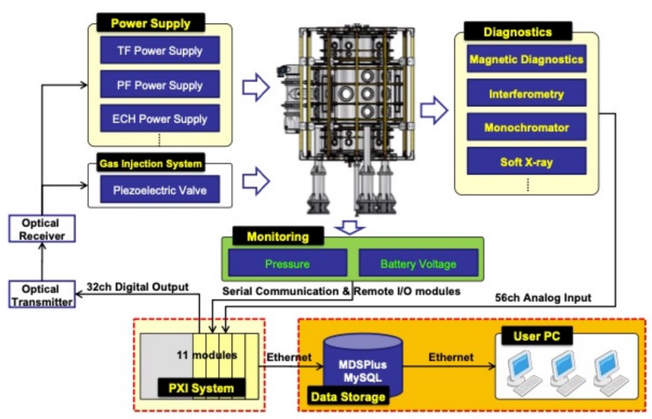


Fig. 1 Current database system of VEST.

- **VEST (Versatile Experiment spherical tokamak)**
- Currently, experiment data from VEST mainly stored in MySQL, but some diagnostic data and simulation data is managed independently.
- Impossible to access all the data in one framework due to absence of a one integrated cooperation system

➢ **Need centralized controllable database system and compatible analysis tool to construct integrated workflow**

1.2. Objective and Methods

- Develop one centralized and compatible database system
  - ➢ Introducing a new data structure (**ODS/IDS**) and backend server (**MDSplus**)
- Implement integrated workflow from the experiment to simulation
  - ➢ Introducing the analysis suite (**OMFIT**)
- **Create a feasible workflow from experimental data to simulation code (Stability, Transport)**

Fig. 2. Introduced software for VEST database system.

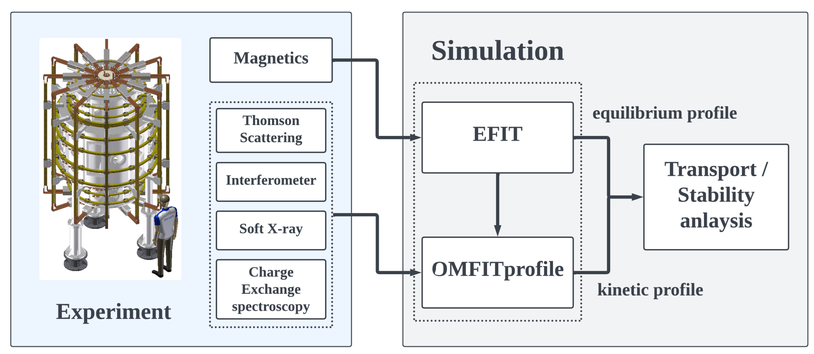


Fig. 3. Connection between experimental data and simulation.

2. Overall scheme

2.1. Overall workflow with VEST database system

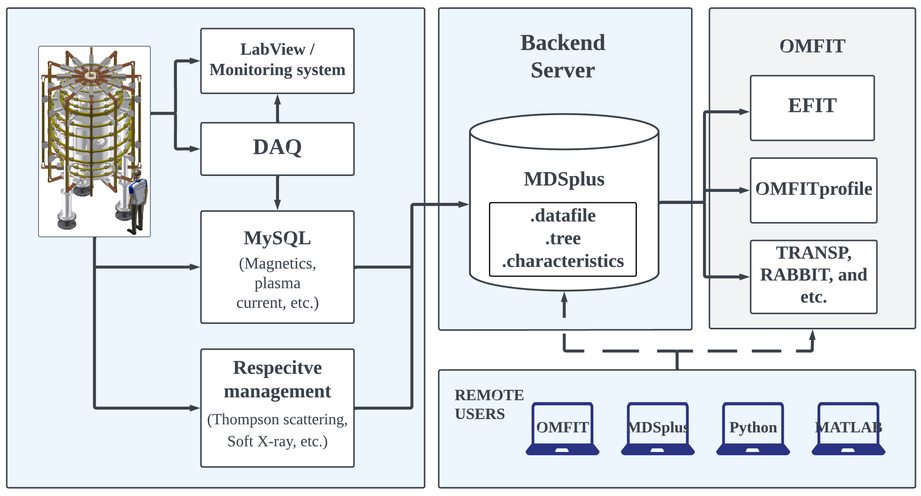


Fig. 4. Overall workflow of improved VEST database system.

- All collected data stored in one integrated server, MDSplus with its own optimized tree structure for VEST experiment data
- Directly deal with Python, Java, Matlab and many other tools
- OMFIT, analysis suite, receive data directly from MDSplus in the form of ODS
- In addition to EFIT module, which was previously developed simulation module, constructed OMFIT profile workflow to obtain kinetic profile

3. Improved database system - MDSplus

3.1. MDSplus

- MDSplus : conventional database backend in fusion
- Enable to store all the data from a shot with optimized structure to VEST in one tree
- **Standardized data structure was used to design tree structure and currently accessible in VEST server system.**
- **Using the previously mapped ODS data, ODS data could be stored in this tree structure. (Compatible with IMAS directly)**

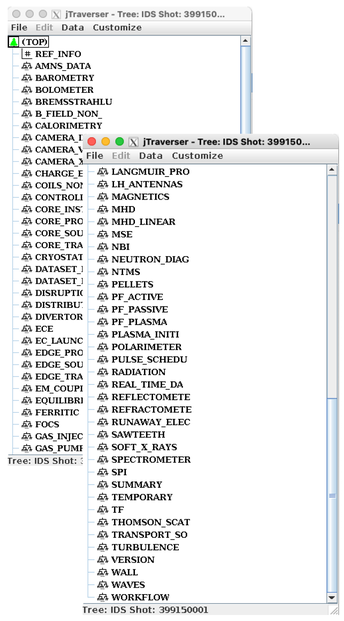


Fig. 5. Shot access by jTraverser.

3.2. Application services in MDSplus

- Example shot #39915 in VEST MDSplus backend server

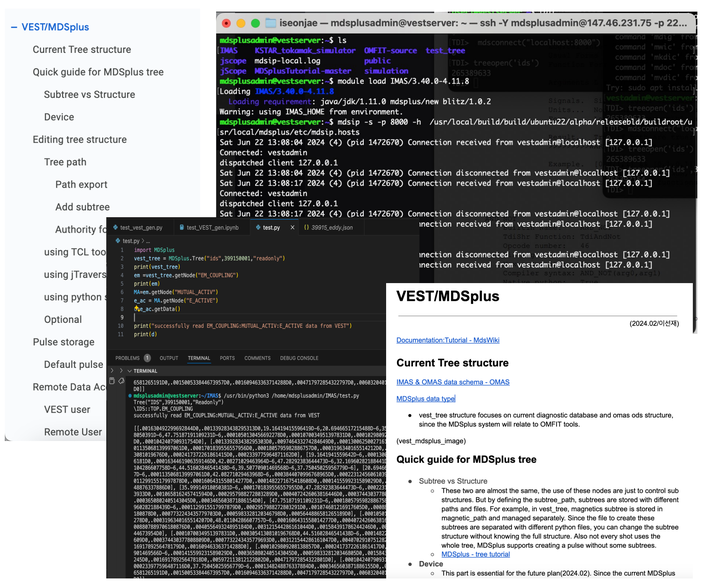


Fig. 6. Shot access by python and other languages.

- VEST MDSplus is accessible with Python, TCL, TDI, Matlab, jTraverser and etc.
- Currently, it's only open to localhost server users and will be open to remote users not in SNU

4. Analysis suite - OMFIT

4.1. OMFIT(One Modeling Framework for Integrated Tasks)

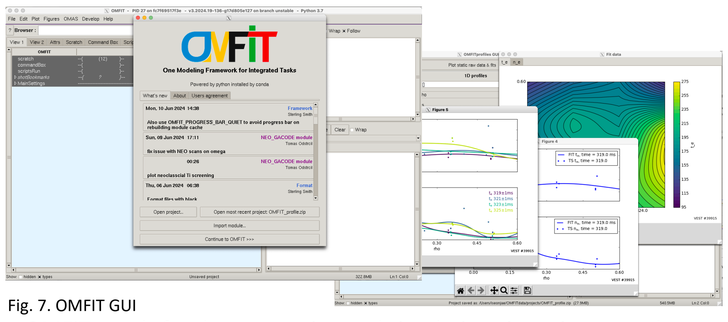


Fig. 7. OMFIT GUI

- OMFIT : tools for data managing and simulations in an integrated workspace using a GUI
- Provide integrated framework for simulation and modeling compatible with ODS/IDS structure

➢ **Currently, equilibrium reconstruction through EFIT and Thomson scattering kinetic profile through OMFIT profile is available**

5. OMFIT profile

5.1. OMFIT profile

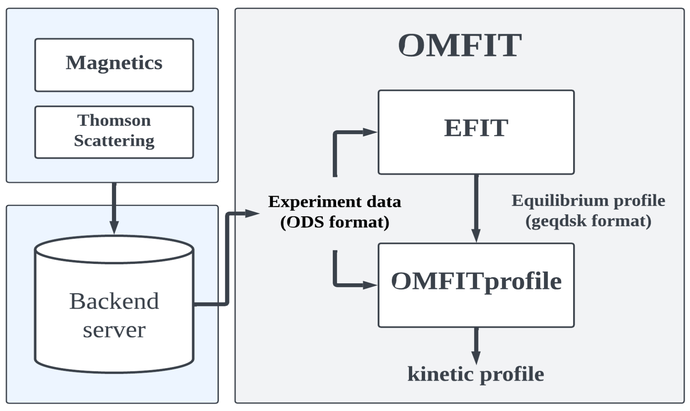


Fig. 8. Data flow inside OMFIT.

- OMFIT profile : tools for obtaining kinetic profile, works as the input for transport analysis
- EFIT result g-file and ODS mapped from raw data fetched only with the shot number in OMIFT tool
- Support one-dimensional and two-dimensional fitting, providing time-evolution profiles

➢ **Providing Thomson Scattering profile data that could directly interact other simulations is successfully adapted.**

5. OMFIT profile

5.2. OMFIT profile result

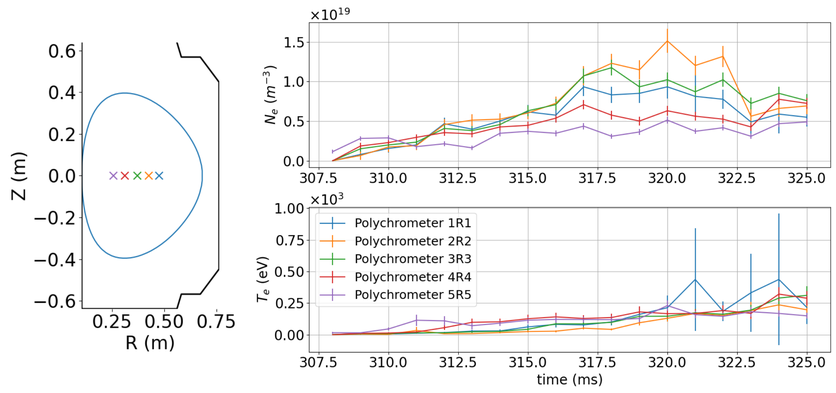
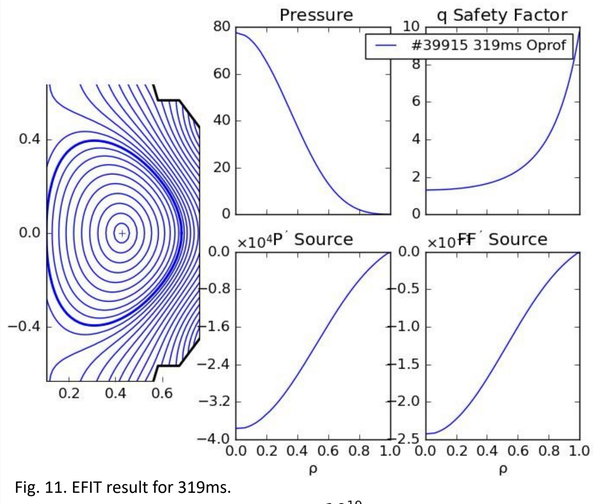


Fig. 10. Thomson scattering location and measured data in time series.



- EFIT result of equilibrium profile and Thomson scattering data used for profile mapping
- Obtain electron density and temperature profile
- Created workflow for OMFIT profile so that could get profile for other shot

Fig. 11. EFIT result for 319ms.

- Establish the basic kinetic profile for transport analysis
- Gaining other diagnostics profile and running the module in remote server environment is planned.

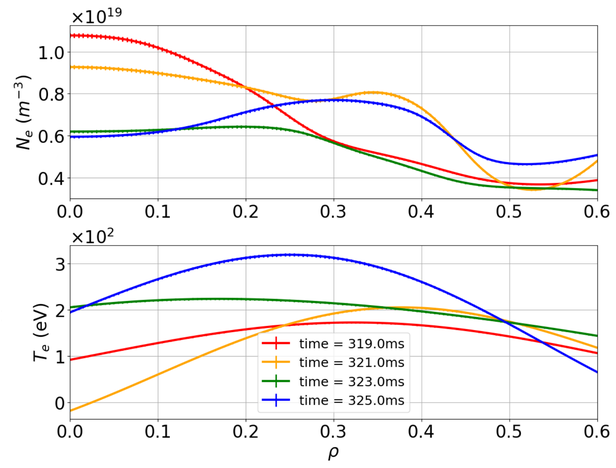


Fig. 12. 1D fit of sliced data

6. Conclusion & Future work

- To establish the main goal, MDSplus and OMFIT connection was successfully done.

- Using the mapping function from MySQL to ODS and from ODS to MDSplus is accomplished for some data.
  - Following the previously implemented module EFIT, construction of OMFIT profile was established
  - Provide an optimized framework and workflow resolving the existing bottleneck due to gap in simulation and experimental data

- For the future works
  - To make remote user connection without any security issue, by making python module connection for easily accessible open database
  - Mapping the data no implemented in current ODS format
  - Make saving routine for the simulation results from the remote users
  - Connection to other simulation tools such as TRASSIC, TRANSP, and etc.
  - Connection from MDSplus to remote OMFIT
  - Overall code refactoring by using OOP concept