

DMP Implementation Status of IPP

2023-06-02

IMAS installation (previously reported)

On the TOK cluster (i.e. linux systems hosted by MPCDF)

- IMAS/3.24.0-4.2.0
- IMAS/3.25.0-4.4.0
- IMAS/3.30.0-4.8.4
- IMAS/3.32.1-4.9.1
- IMAS/3.34.0-4.10.1
- IMAS/3.35.0-4.10.0
- IMAS/3.36.0-4.10.0
- idstools/1.2.3
- idstools/1.5.1
- UDA/2.5.1

Would like to get a recommendation of which version to install, and which tools

IMAS installation (new installation)

On the IPP-IT Citrix nodes (linux system hosted by IPP-IT running "Ubuntu 20.04.6 LTS")

- IMAS/3.38.1-4.11.4
- fundamental-constants/0.1.1
- IDSTOOLS/1.14.0
- AMNS/1.4.0-gfortran

Notes

- This is in my private area – still waiting for the IMAS volume to be made available
- Used **spack** to install the dependencies
- ~~Only gnu compilers available at the moment~~ **Gnu and intel now supported**

Data mappings

Two distinct branches:

1. Mapping data that already exists (“diagnostics”)
 - a. Can build on what has already been done
 - b. Perhaps few direct users at the moment
 - c. But could be used as new IDS based tools come online (IDA-IMAS)
 - d. Needs UDA with plugins
2. Mapping data that doesn't yet exist (“trview”, augped, IMASgo, or similar)
 - a. This is perhaps the data that users need now
 - i. But I might be wrong
 - b. Currently the tools are based at the experiments
 - i. Which is where the expertise is
 - c. Future tools might use lower level data – and then back to mapping 1
 - d. Good benefit from UDA, but no mappings needed

trview

- Reads AUG shotfiles
- Merges data from multiple diagnostics (various options)
- Writes wall, tf, nbi, ic_antennas, ec_launchers, dataset_description, summary, pulse_schedule, master, equilibrium, core_profiles IDS's

File Setup RABBIT output TORBEAM output Help

Settings	Input	RABBIT output	TORBEAM output	NEMEC output	FEQIS output
Exp settings	TRANSP settings	RABBIT settings	TORBEAM settings	NEMEC settings	FEQIS settings

Exp/fit options

Discard frames close to ELMs

Shot number:

Initial time for input and simulation:

Final time for input and simulation:

Time step for input and simulation:

Equ shotfile exp:

Equ shotfile diag:

Equ shotfile edition:

#radial points for input profiles:

#poloidal points for Fourier sep. fit:

#Fourier moments for DESCUR fit:

PID:C5o ELM-trigger threshold:

Fit tolerance/smoothness:

Throw-away threshold for outliers:

IDS #run:

IDS backend:

Verbosity level:

Ne

Rec. spline Gaussian fit Fit 2D

VTA:Ne_c VTA:Ne_e VTA:Ne VTN:Ne DLP:ne

DPR:ne DCR:profile LIN:ne YAG:ne YAP:ne

YPR:Ne IDA:ne IDZ:Ne PED:neFit FRS:ne

Te

Rec. spline Gaussian fit Fit 2D

CEC:Trad-A RMD:Trad-A IDA:Te IDZ:Te PED:TeFit

VTA:Te_c VTA:Te_e VTA:Te VTN:Te YPR:Te

Ti

Rec. spline Gaussian fit Fit 2D

CAZ:Ti_c CEZ:Ti_c CFZ:Ti_c CHZ:Ti_c CMZ:Ti_c

COZ:Ti_c CPZ:Ti_c CUZ:Ti_c CAZ:Ti CEZ:Ti

CFZ:Ti CHZ:Ti CMZ:Ti COZ:Ti CPZ:Ti

CUZ:Ti IDI:Ti PED:TiFit

Angf

Rec. spline Gaussian fit Fit 2D

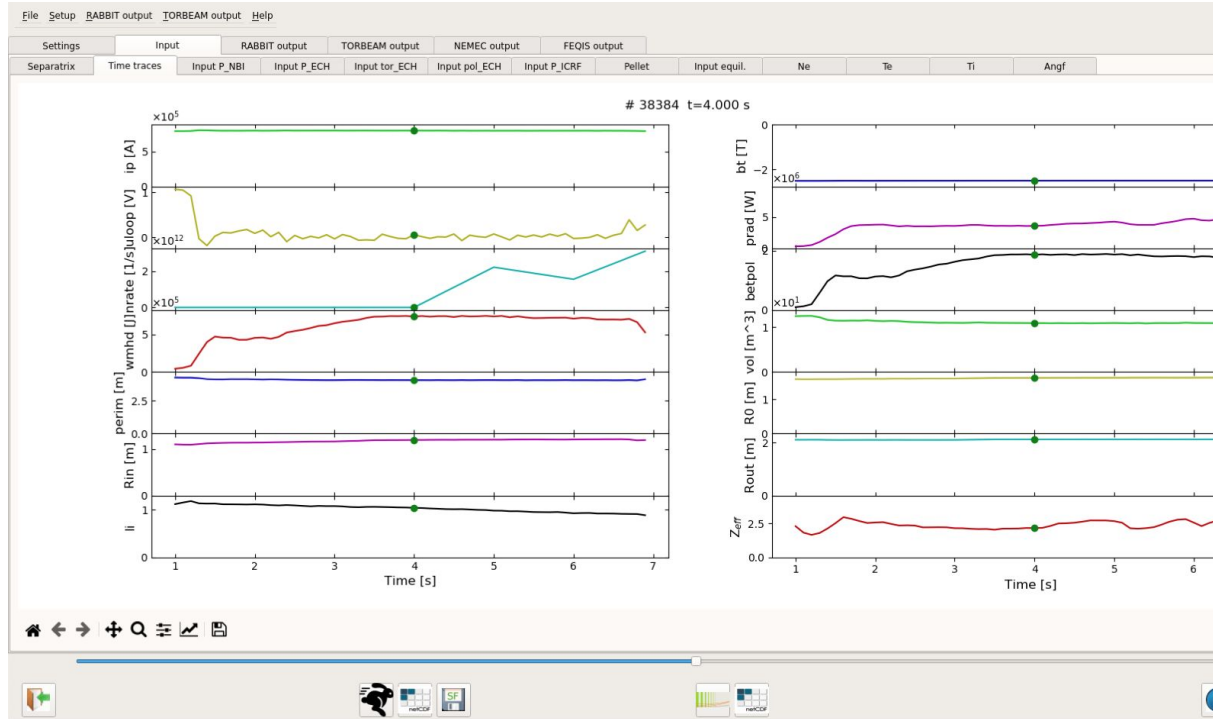
CAZ:vr_c CEZ:vr_c CFZ:vr_c CHZ:vr_c CMZ:vr_c

COZ:vr_c CUZ:vr_c CAZ:vrot CEZ:vrot CFZ:vrot

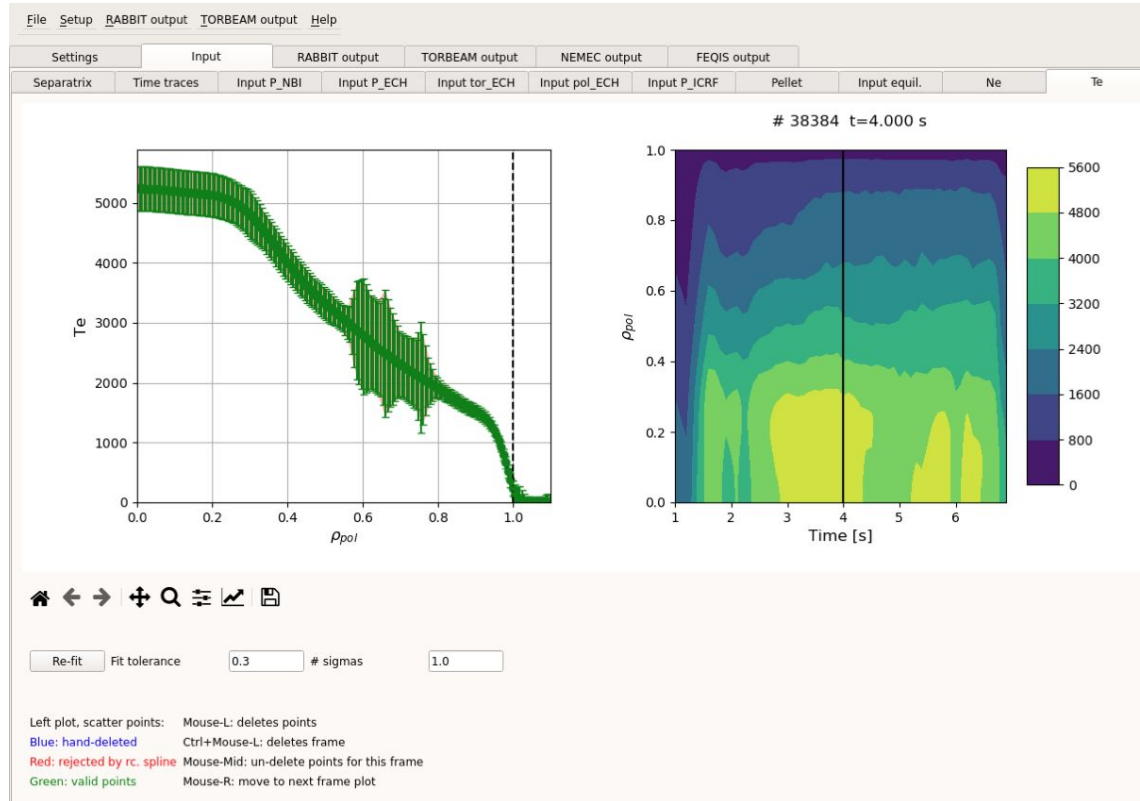
CHZ:vrot CMZ:vrot COZ:vrot CUZ:vrot PED:vTFit

IDI:vt

Trview: time traces



Trview: profiles (here Te)





SWG Integrated Data Analysis and Validation



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IDA at ASDEX Upgrade



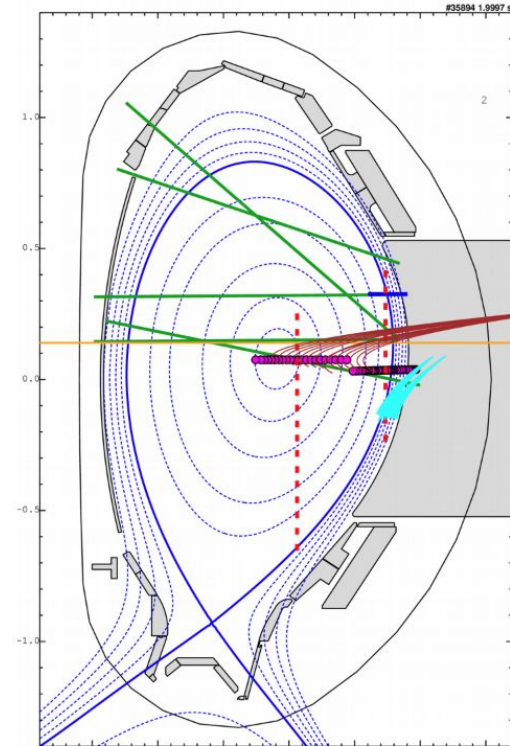
multi-diagnostic profile reconstruction: n_e , T_e

- Lithium beam impact excitation spectroscopy (LIB)
collisional radiative model → $n_e(T_e)$
- Interferometry measurements (DCN) → n_e
- Electron cyclotron emission (ECE)
ECRad: Electron cyclotron radiation transport → $T_e(n_e)$
- Thomson scattering (TS) → n_e, T_e
- Reflectometry → n_e
- Beam emission spectroscopy → $n_e(Z_{eff})$
- Thermal Helium beam spectroscopy → n_e, T_e

-
- Equilibrium reconstructions for diagnostics mapping
(IDE: kinetic Grad-Shafranov solution coupled with current diffusion)

A lot of dependencies and uncertainties:

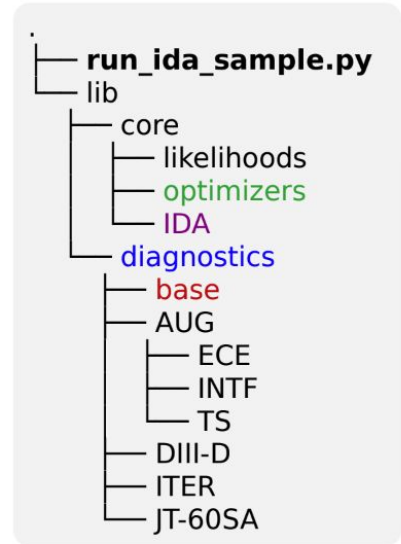
We need a probabilistic approach!



IDA Basic Implementation for ITER, JT-60SA, ...

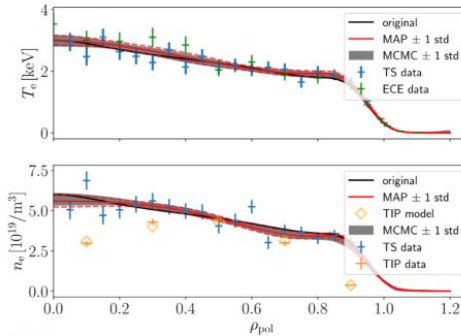
Basic implementation in python being completely modular

- to be compatible with any fusion device (ITER, DIII-D, JT-60SA, ...)
- **diagnostics**: Thomson scattering, ECE and interferometry, ...
- **likelihoods** (data uncertainty): Gaussian, Cauchy (outlier robust), ...
- **multi-fidelity forward models** / synthetic diagnostics
 - ECE: $T_{\text{rad}} = T_e$ vs radiation transport modeling $T_{\text{rad}}(T_e, n_e)$
 - real-time vs offline analysis
- flexible **parameterisation** of, e.g., profiles: splines, GPR, ...
- **priors**: smoothness, positivity, physical modeling, ...
- **results and their uncertainties**:
 - MAP solution (probability maximum and width)
 - MCMC sampling methods (explore full probability space)



IDA: ITER workflow

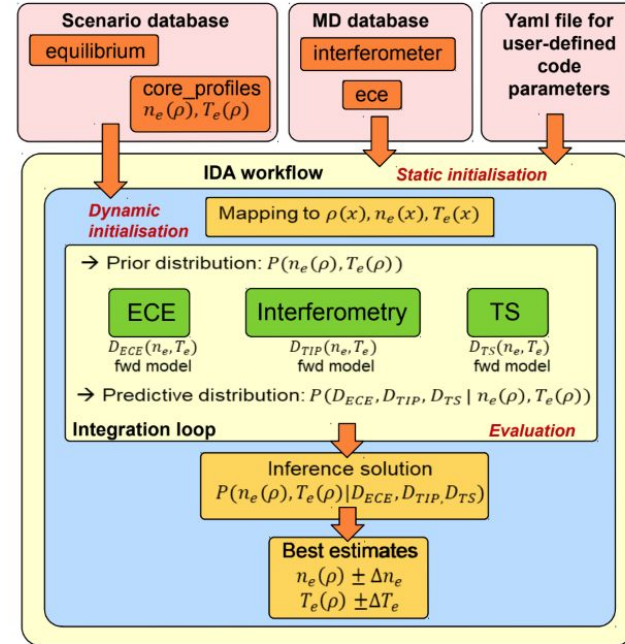
- artificial diagnostics: Thomson scattering, ECE
 - synthetic data set with 10% noise
- 1st ITER diagnostic: Toroidal Interferometer Polarimeter (TIP)
 - synthetic data set with 5% noise
 - IMAS synthetic diag.



- MAP ± 1std
- MCMC (50±34)% percentile

IMAS Interface Data Structures (IDS):

- read: TIP geometry (interferometer_md), equilibrium
- write: results ...



M. Schneider

EX2GK from gitlab.com

For first time users, it is STRONGLY RECOMMENDED to use the GUI developed for the corresponding machine to be analyzed. Note that these GUIs are developed to be executed on the local computing clusters of the machine in question.

Machine-specific GUIs are found in EX2GK/guis/<machine>/

Due to implementation of computing clusters and machine-specific options, each machine requires its own unique GUI

Aaron > EX2GK > Repository

 **Cosmetic! Modified labels for coordinate systems in JET GUI**
Aaron Ho authored 2 months ago babce2cf 

master ▾ EX2GK / EX2GK / guis History Find file ↓ ▾ Clone ▾

Name	Last commit	Last update
..		
📁 aug	Hotfix! Continued fixes for pages script in CI	8 months ago
📁 general	Hotfix! Continued fixes for pages script in CI	8 months ago
📁 jet	Cosmetic! Modified labels for coordinate systems in JET GUI	2 months ago