EUROfusion
TECHNOLOGY TRANSFER PROGRAMME

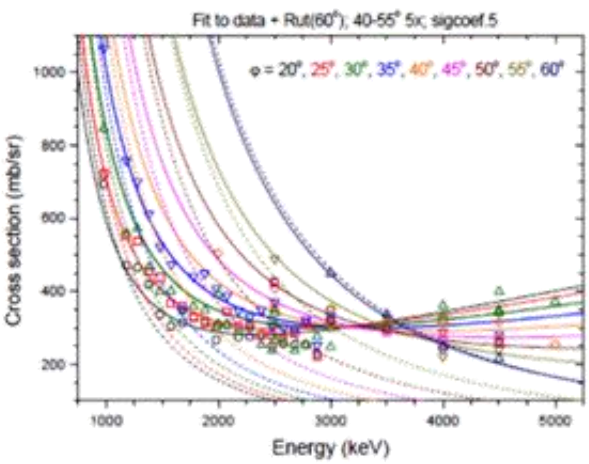
Ion Beam Analysis (IBA) DataFurnace Code

IBA DataFurnace is a general--purpose analytical code for data analysis of ion beam analysis (IBA) data. It is in active development, with the first version released in 1997. It is general within its specifications, and was developed as a general analysis tool for IBA of any type of sample. Its main features are: implementation of the largest array of techniques of any IBA code; implementation of the most advanced physics and algorithms available; simultaneous data analysis of any combination of spectra collected from a given sample.

Description of the technology

IBA DataFurnace is a general–purpose analytical code for data analysis of ion beam analysis (IBA) data. It is in active development, with the first version released in 1997. It is general within its specifications, and was developed as a general analysis tool for IBA of any type of sample. Its main features are:

1. Implementation of the largest array of techniques of any IBA code: Rutherford backscattering (RBS), elastic backscattering (EBS), elastic recoil detection analysis (ERDA), particle induced x--ray emission (PIXE), nuclear reaction analysis (NRA, where a particle energy spectrum is detected), resonant nuclear reaction analysis including particle induced gamma–ray emission (PIGE) and narrow resonance profiling (NRP), neutron depth profiling (NDP), and secondary ion mass spectrometry (SIMS).
2. Implementation of the most advanced physics and algorithms available, including the most general and most accurate algorithms to handle roughness, leading to the highest accuracy of simulation available in analytical codes.
3. Simultaneous data analysis of any combination of spectra collected from a given sample, combining the complementary information obtained with the different techniques into a single global self-consistent solution.
4. Analysis can be made interactively by trial and error, or automatically using either local search (which requires a user-provided initial guess), or with the global optimisation algorithm Simulated Annealing, which does not require an initial guess.
5. The common method for large volumes of data is automated fitting in batch mode with a posteriori human supervision. In previous applications to data collected from JET–related samples (one application within a very large number or other materials analysis applications, unrelated to fusion), typically a one week measurement run produced up to around 1000 spectra collected from up to around 200 spots, and the data analysis was done overnight on the last day of the run, in a fully automated way.
6. The combination of self–consistent automated analysis of any number of spectra collected from the same sample with the most important IBA techniques is unprecedented and extremely powerful. When enough data are collected, quantitative depth profiles can be derived for each element and in some cases each isotope present, accounting for 100% of mass. This is the concept of Total IBA, which requires the technical capability to perform the different experiments, and, so far, also requires the use of DataFurnace to analyse the data.



Fits to 4He on H non--Rutherford cross-sections (fits – solid lines, data--points, Rutherford cross--sections – dashed lines)

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Innovation and advantages of the offer

- Largest array of techniques of any IBA code;
- Implements the most advanced physics and algorithms;
- Simultaneous data analysis;
- Significant modules of the computation engine, 'NDF', are open source;
- Has a Windows GUI, WiNDF, that allows you to keep track of the many output files generated;
- The code is very well reported in the technical literature, with more general reviews in 2003, 2008, and 2012.

Non-fusion Applications

- Ion Beam Analysis has applications in many areas including:
- Microelectronics
- Cultural heritage
- Forensics
- Structural materials
- Biological applications
- Thin film analysis

EUROfusion Heritage

The code has been advanced greatly due to the requirements and constraints that have been put in place by the fusion community. These include measuring the surface composition and morphology changes of JET tiles under plasma interactions.

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www.tech-transfer.eurofusion.eu

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