Mama: Material data-base for secondary emission tools
-
SPINE meeting

Arnaud Trouche[(1)], Benjamin Jeanty-Ruard[(1)], Jérôme Puech[(2)], Julien Forest[(3)]
[(1)] Artenum Toulouse
[(2)] CNES/Toulouse
[(3)] Artenum Paris/Lyon

ruard@artenum.com

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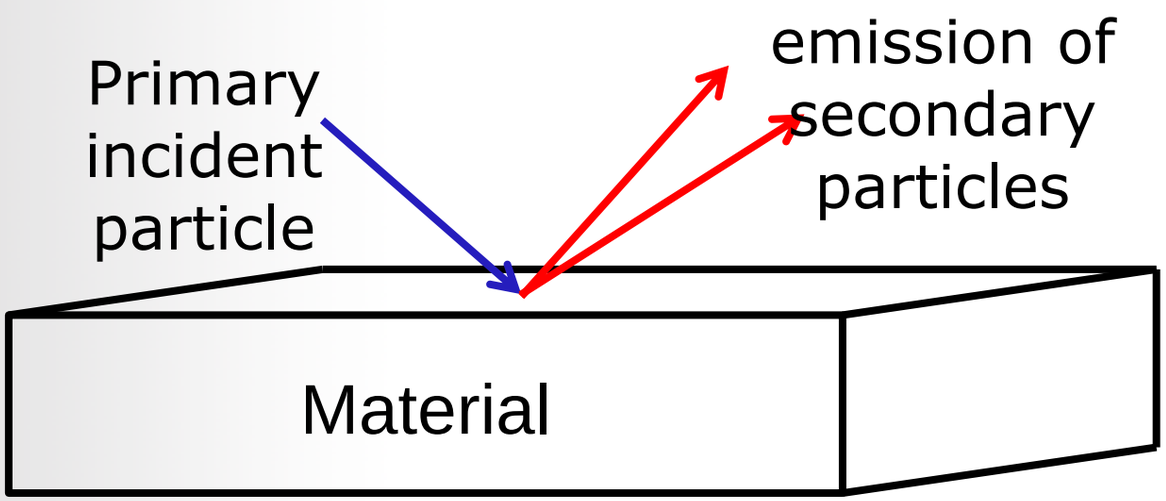
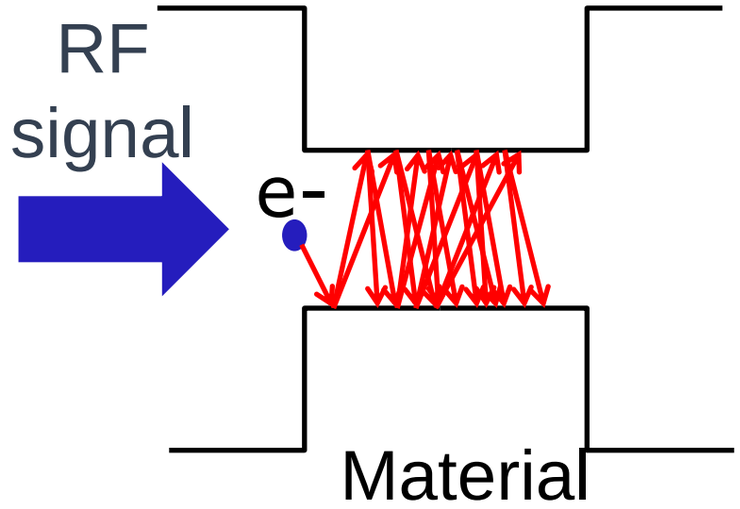
Introduction

Secondary emission appears when primary incident particles hit a surface and induce the emission of secondary ones

Impact various domains of physics and engineering

- Spacecraft charging
- Multipactor
- …



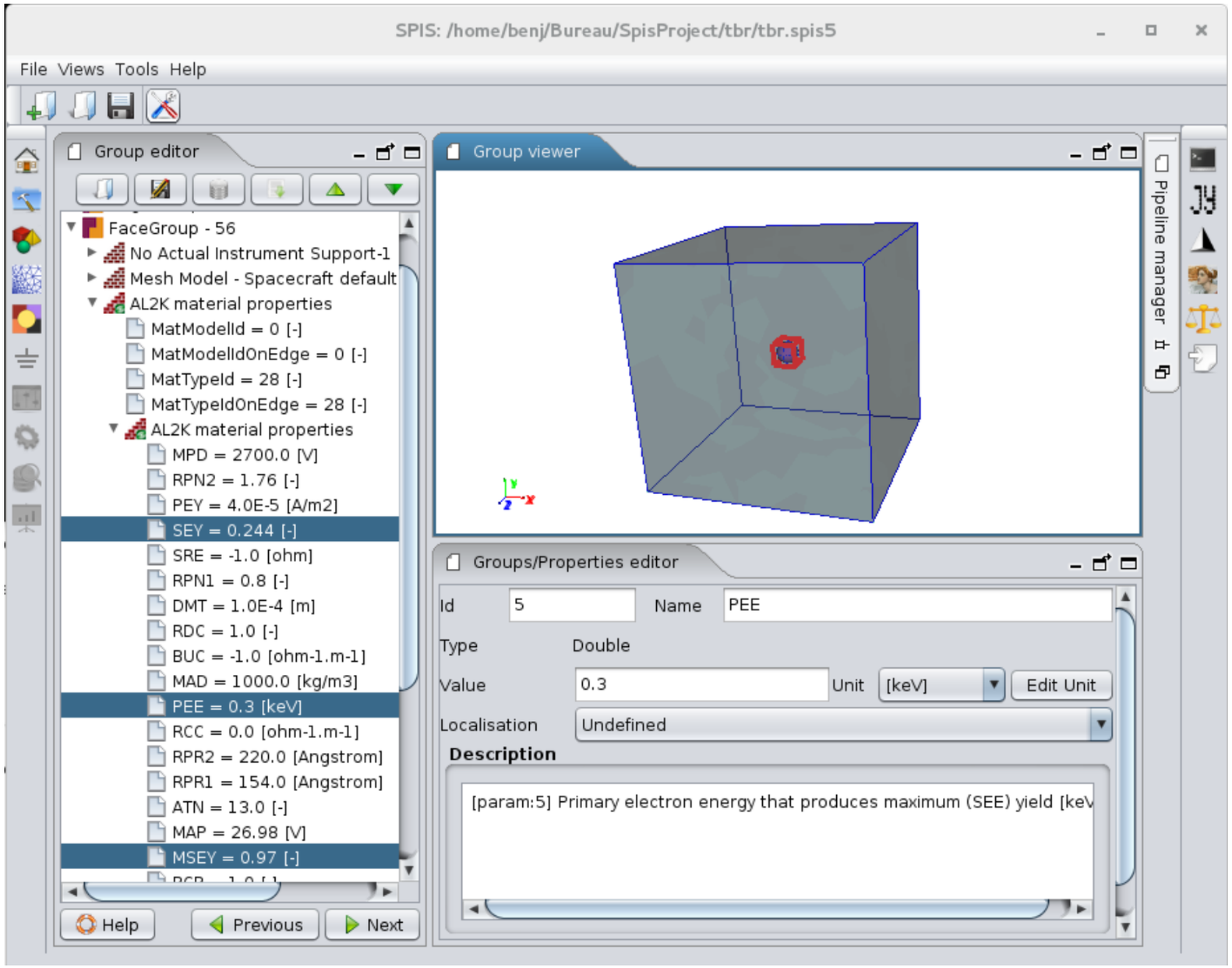


A proper and precise characterisation of material properties is needed

Charging

Important during the modelling process of the effect of the space environment for different communities

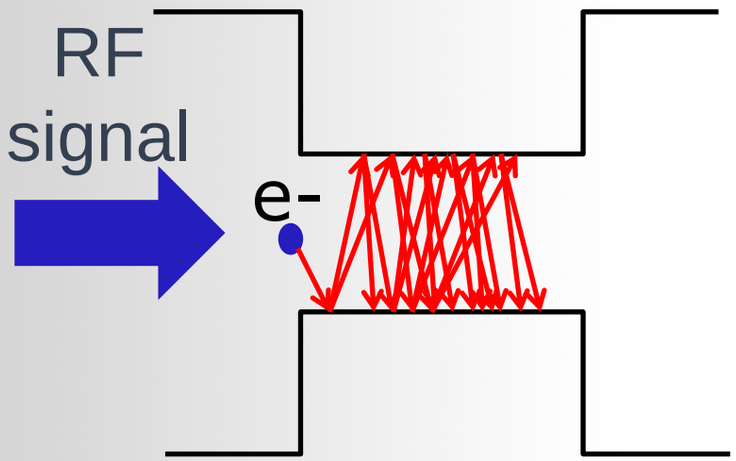
- modelling of the spacecraft charging:
  - for example SPIS
    SEY characteristic
    PEE characteristic
    MSEY characteristic
    IPE characteristic

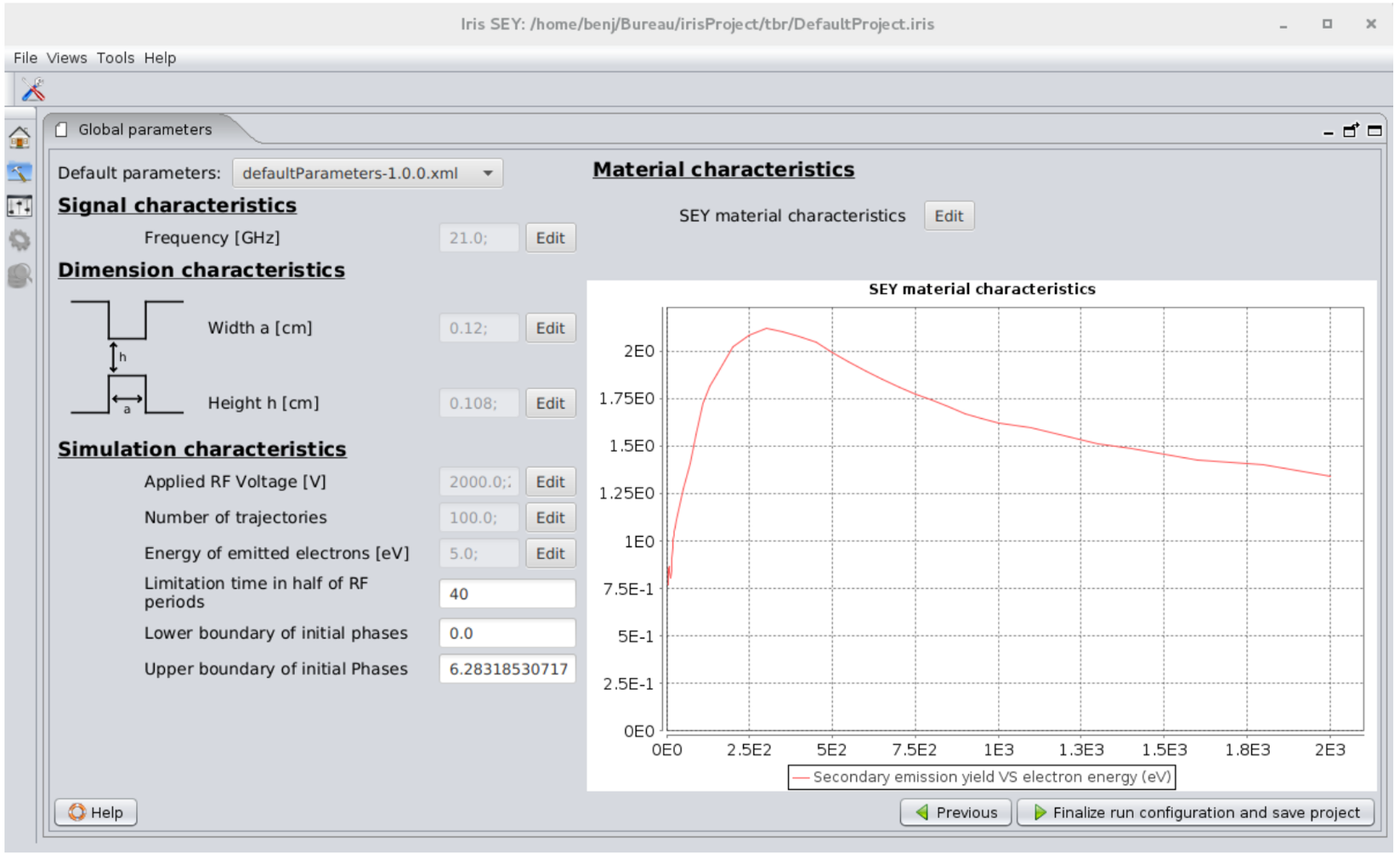


Multipactor

Important during the modelling process of the effect of the space environment for different communities

- modelling of the multipactor effect:
  - for example Iris SEY where the secondary emission yield characteristics is needed to run a simulation



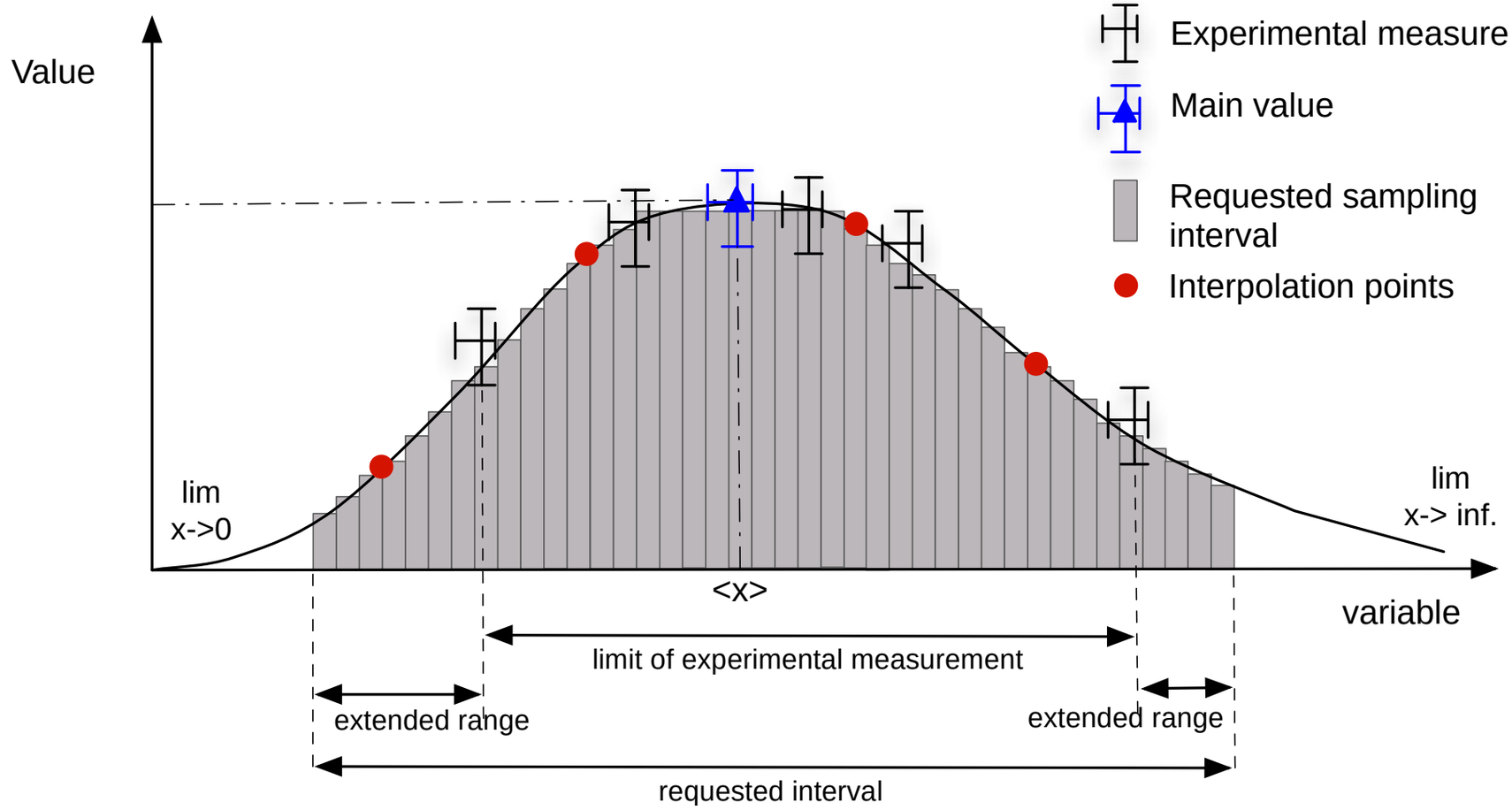


Data polymorphism

Material properties and characterisation present a intrinsic polymorphism

- Can be driven from experimental campaigns
- Can result from analytical models
- May present various levels of details (resolution, dependencies)

But depends on the targeted consumer software as well



Polymorphims

Reinforced constraints if we take into account:

- Various physics and/or integrated modelling approach
  - E.g. Radiations/internal charging analysis
    - EDGE/MoOra/Gras/SPIS-IC chain
    - CIRSOS
- The evolution of knowledge and models (e.g. NASCAP/SPIS)
- Use by non-experts (i.e. identification of relevant data)
- Data are produced by various producers
  - Various levels of details
  - Different formalisms (i.e. different underlying models)
  - Different formats (e.g. Matrex format, VO Table, XML, ASCII raw data, « the scan of my paper notes »
- Different levels of confidentiality
  - Encryption
  - Obfuscation, levels of details
- Need to identify and trust data
  - Id and signature
  - Traceability

Limits of relational data DB

Most of existing material data-bases are relational DB

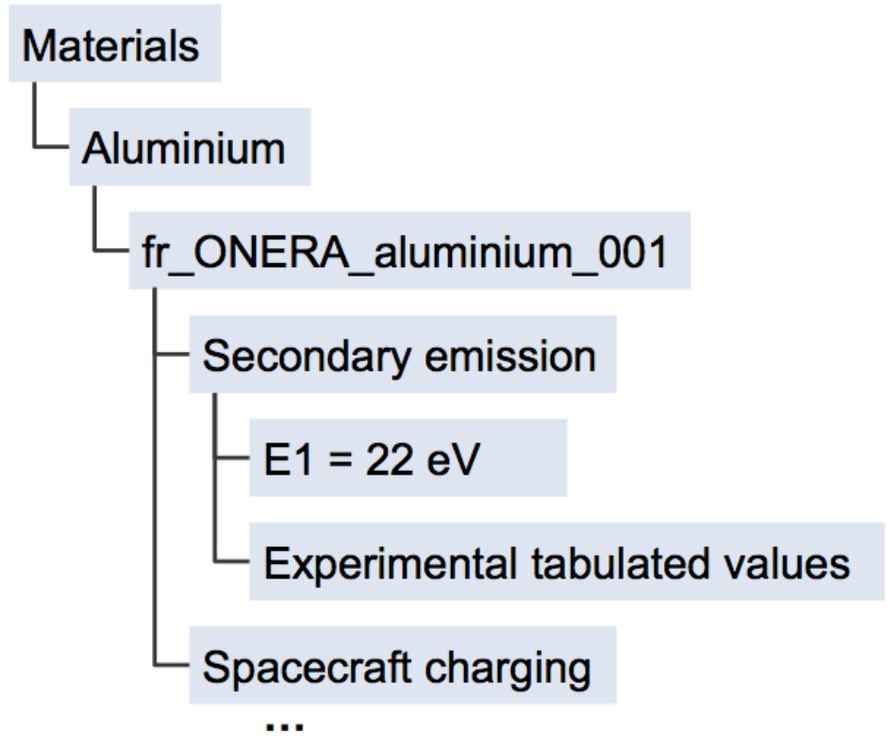
- Induce de facto a formalism (i.e. the tables)
- Polymorphism difficult to handle
- Interfacing with another DB not straightforward
- Evolutions of the structure of stored data might be complex and costly (i.e. refactoring of tables)

Name	Family	Secondary emission	Surface charging	…
fr_ONERA_aluminum_001	Aluminium	22	310,6	….

Objectdata base as pivot structure

One alternative: object oriented DB

- Not so new concept (late 90s)
- Polymorphism directly handled by inheritance and composition
- If a tree based structure, the cardinality of data can be changed easily
- Interfacing with other DBs quite easy
- Evolutions of structures of stored data might directly handled by inheritance
- Concept near to pivot formats like STEP



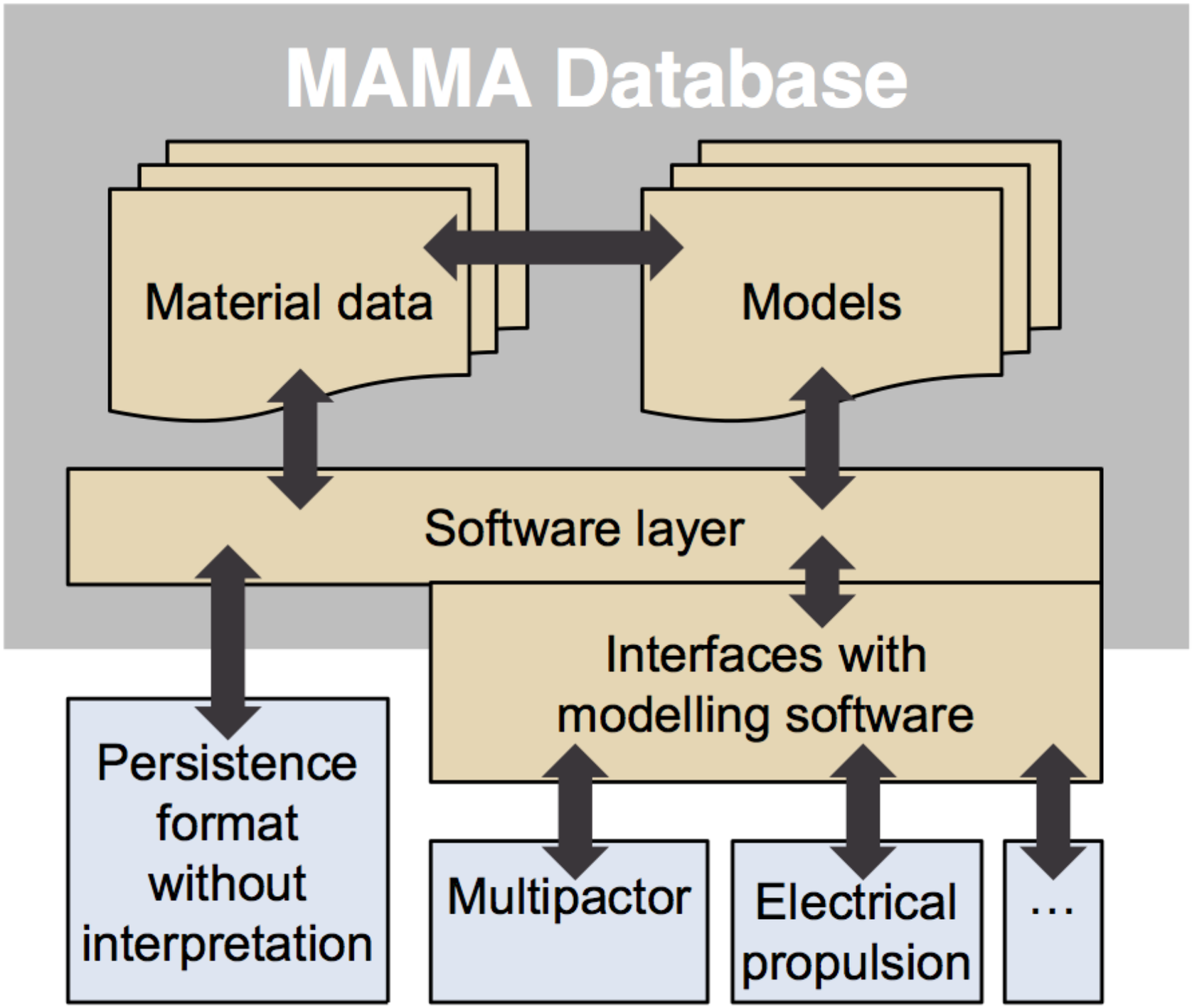
- Processes and pipelines can easy be linked to.
- Easier to build up inter-operability bridges between models, software representations

The MAMA project

Structured effort through of several coordinated actions

- Properties and Groups Editor of SPIS, based on Frida library
- Review of interoparability needs through
  - Two CNES SPIS/Matrex interoperabilities studies (cf. Denis Payan)
  - Requirements and constraints identified in frame of ESA/Interop projet (STEP-SPE)
- First implementation initiated through two CNES / Multipactor related actions (cf. Jérôme Puech)
- First implementation of a multi-physic/multi-model object oriented DB
  - Charging/mulitpactor bridge as demonstrator (SEY)
  - Explore the handling of polymorphism of material data
- **Integration of models inside the DB to**
  - Allow data formalism conversion and "understanding"
  - Import/export capabilities (format conversion)
  - Allow evolution of data structure

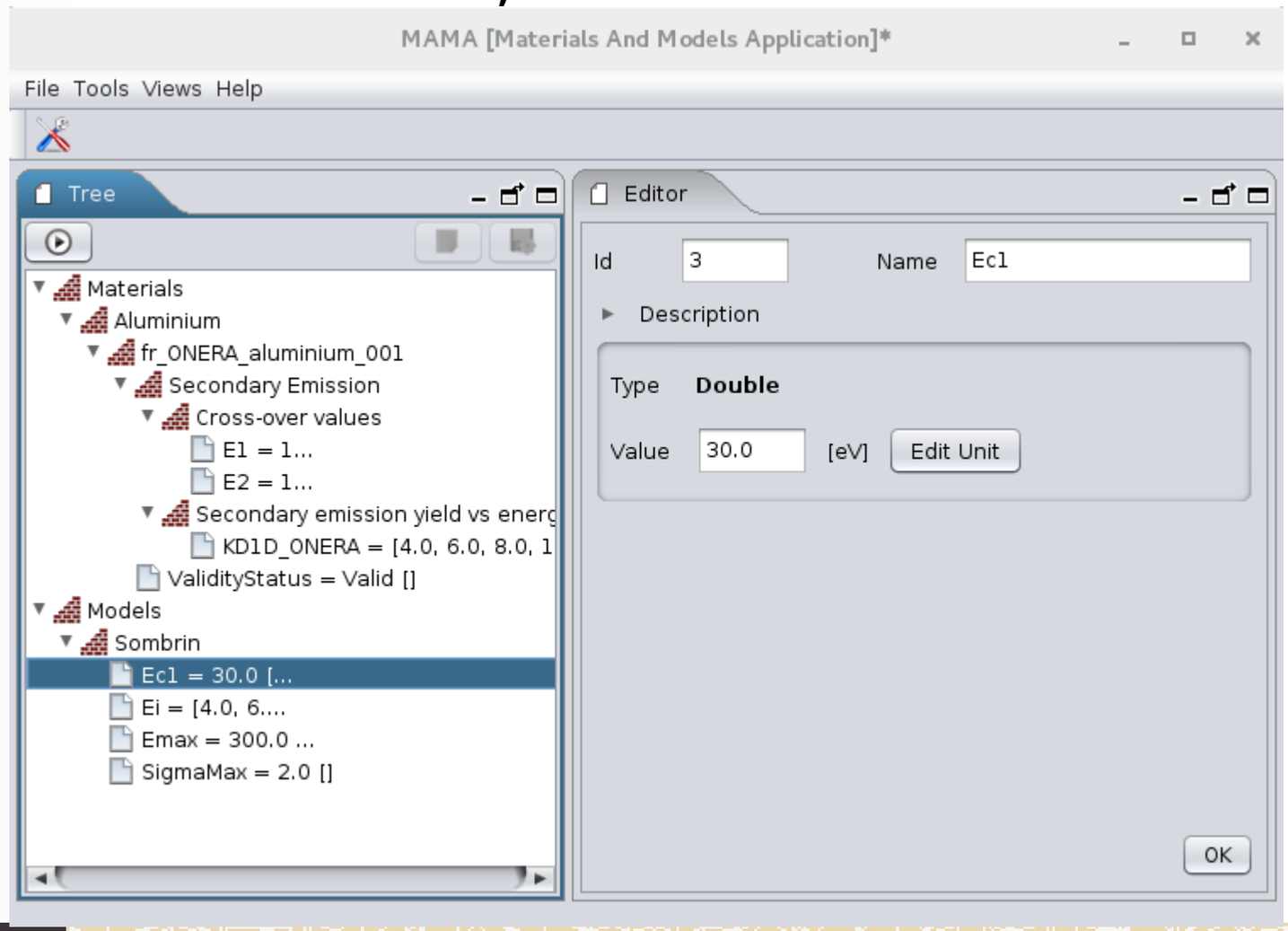
The MAMA project



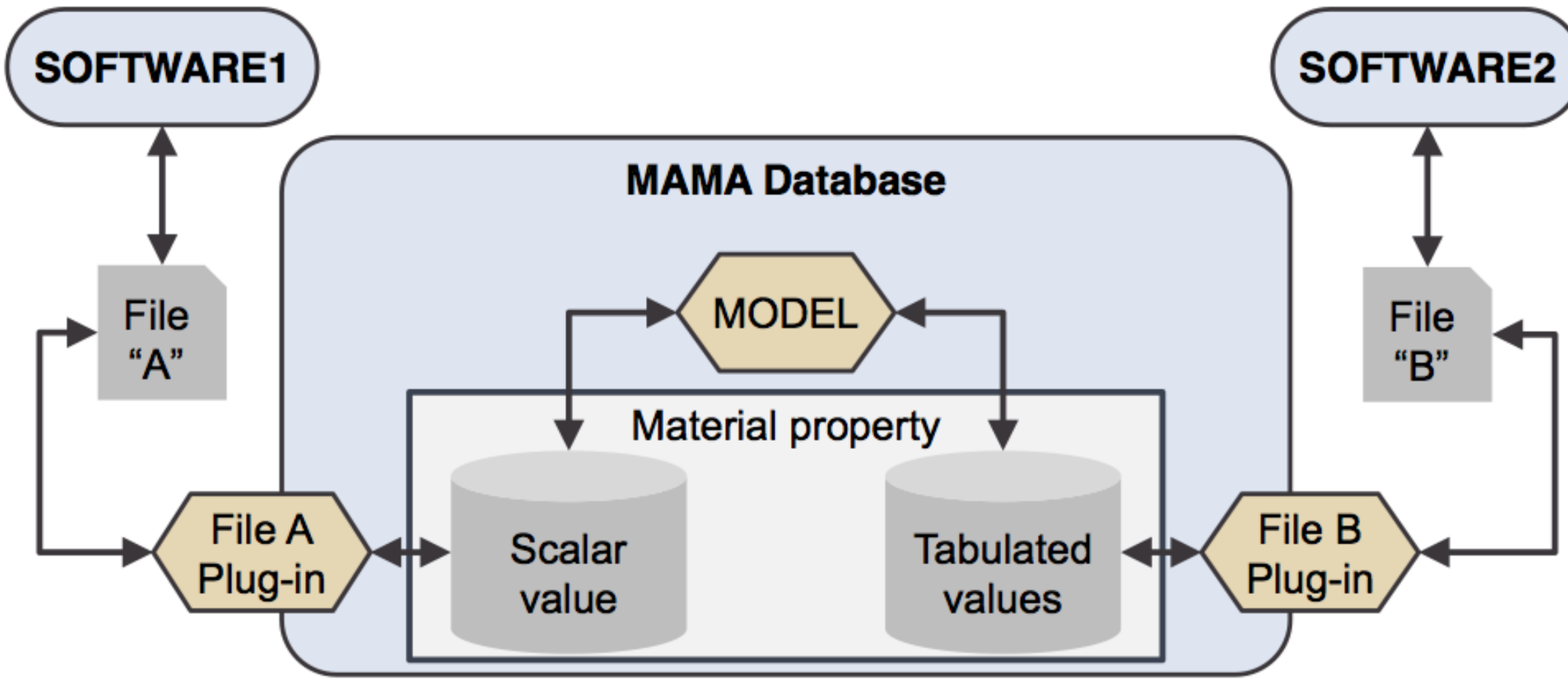
Data base prototype

Models:

- Defined by input characteristics set manually
- Launch the model to compute the characteristics
- Export the result in a dedicated file loadable by MAMA
- Plugins: if the java file is present in the application, the associated model is available, if not it is not available



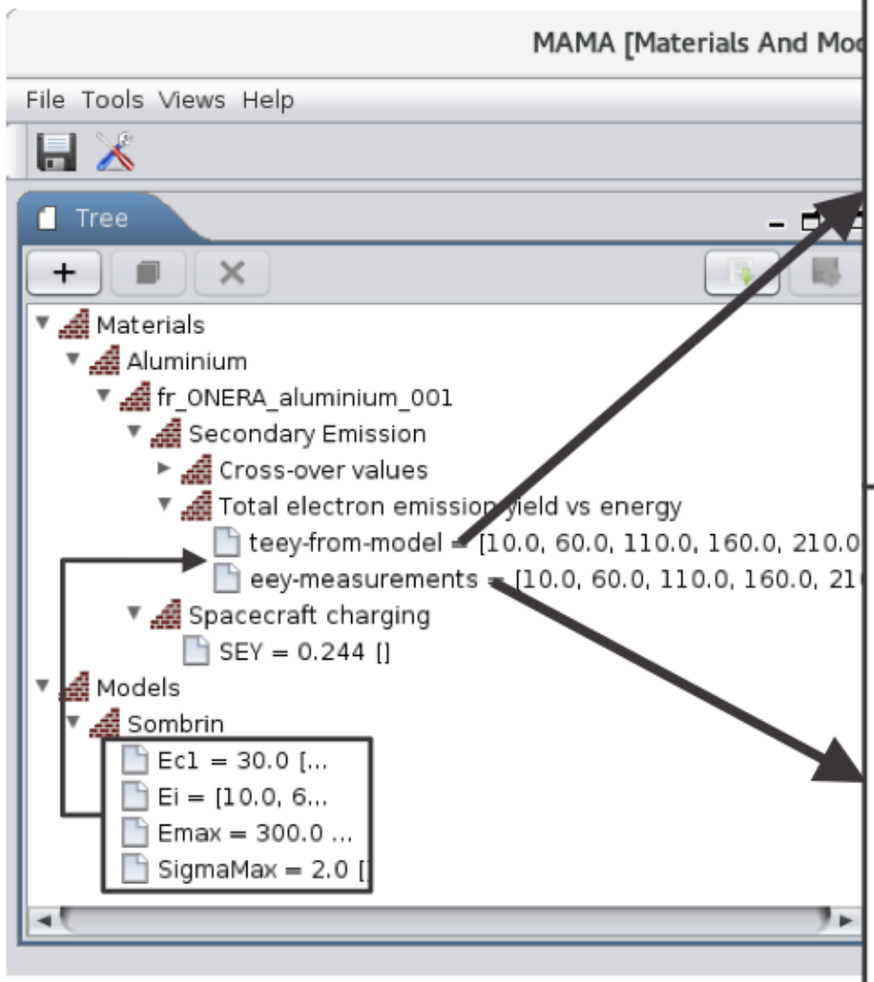
Models integration

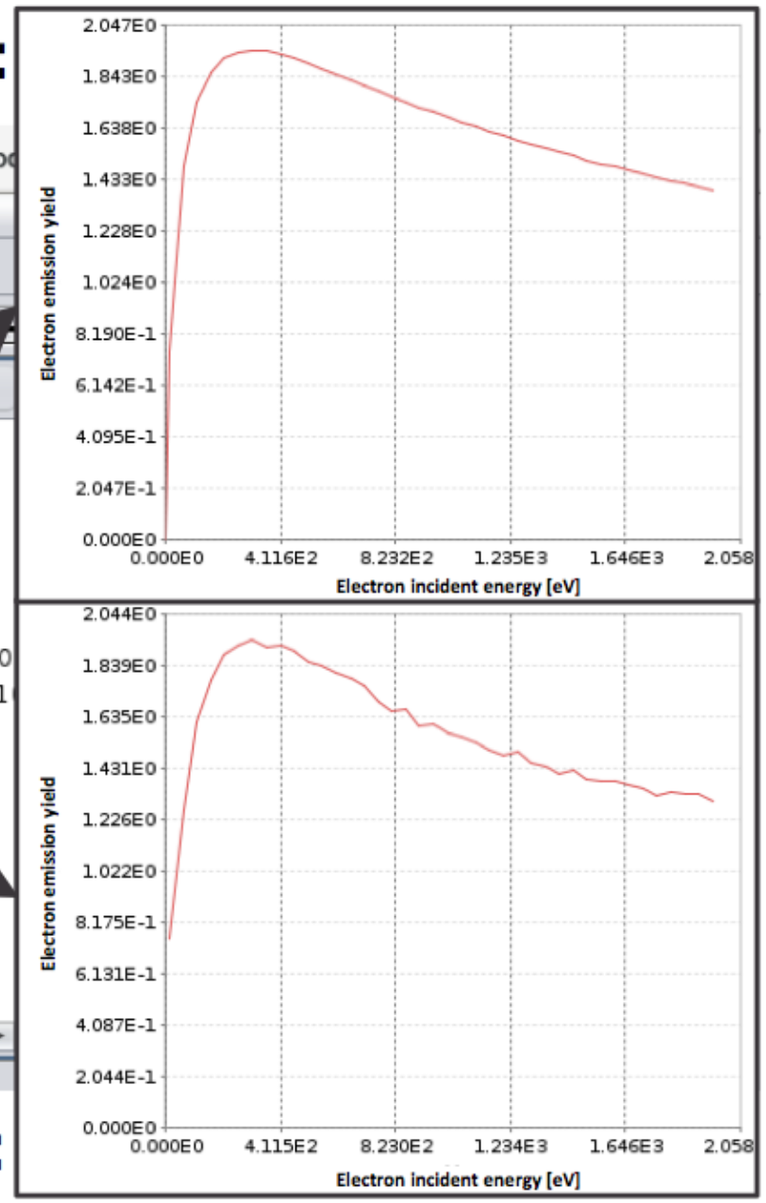


SEY example

- RAW data and measurement
- Sombrin model
- Possibility to produce:
  - Re-built distribution function
  - Export “key parameters” of the models
  - Reduced values (e.g. mean value)

Model values from MAMA:

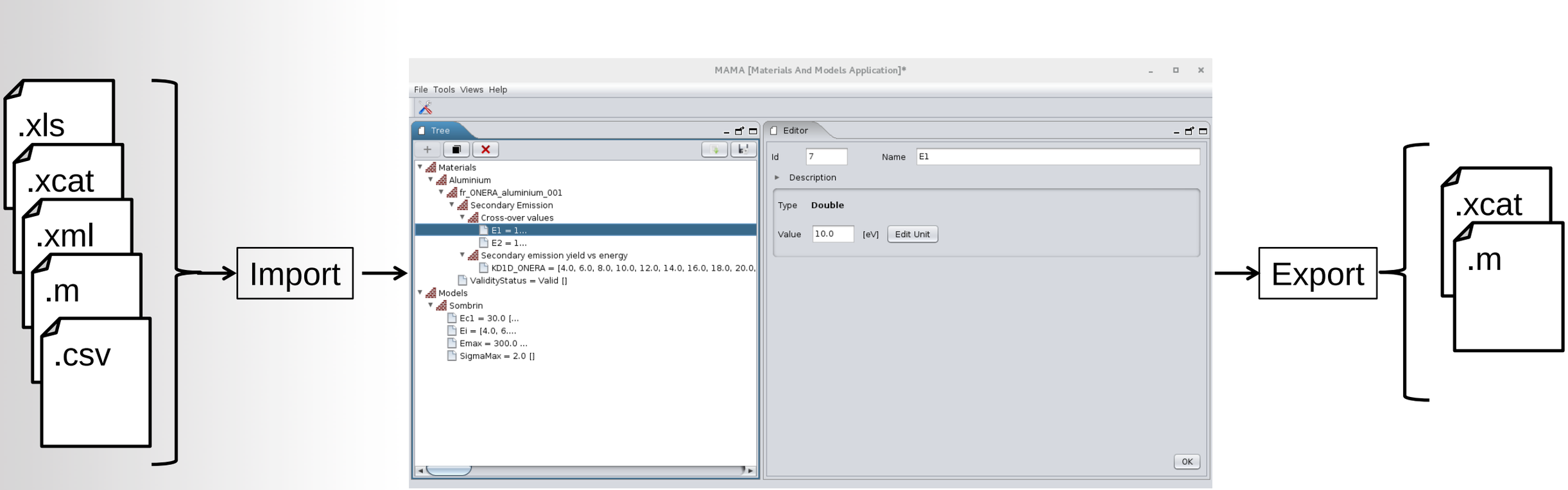




Measurements values:

Data base prototype

Import and Export material characteristics and properties



MAMA

Conclusion

A first prototype of multi-physics / multi-model material data base, MAMA, has been presented

- Attempt to address the issues related to the polymorphism of materials characteristics
- Integration of models to process, “understand” and convert data
- First example of interopability bridge for SEY between multipactor (CNES/IRIS-SEY) and charging (SPIS)
- Informal synergy with other DB projects in social sciences presenting similar constraints (polymorphism, multi-cardinalities, traceability, obfuscation…)

Questions?

trouche@artenum.com