Experience using CAD with SINBAD

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Like this sub-group this is work that is just starting !!!

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Motivation

- Checking new code versions, new nuclear data libraries, new codes for spallation facilities
- Often codes and data understandably very focused on fission
- Want to automate as much as possible – equivalent to continuous integration testing in software development
- Not just code to code but code to experiment

Input files in SINBAD

	Fission	Fusion	Accelerators
Number of benchmarks*	46	31	23
Number with an input file	24	28	12
Number with more than 1 code input file	4	8	0

* Based on SINBAD2010

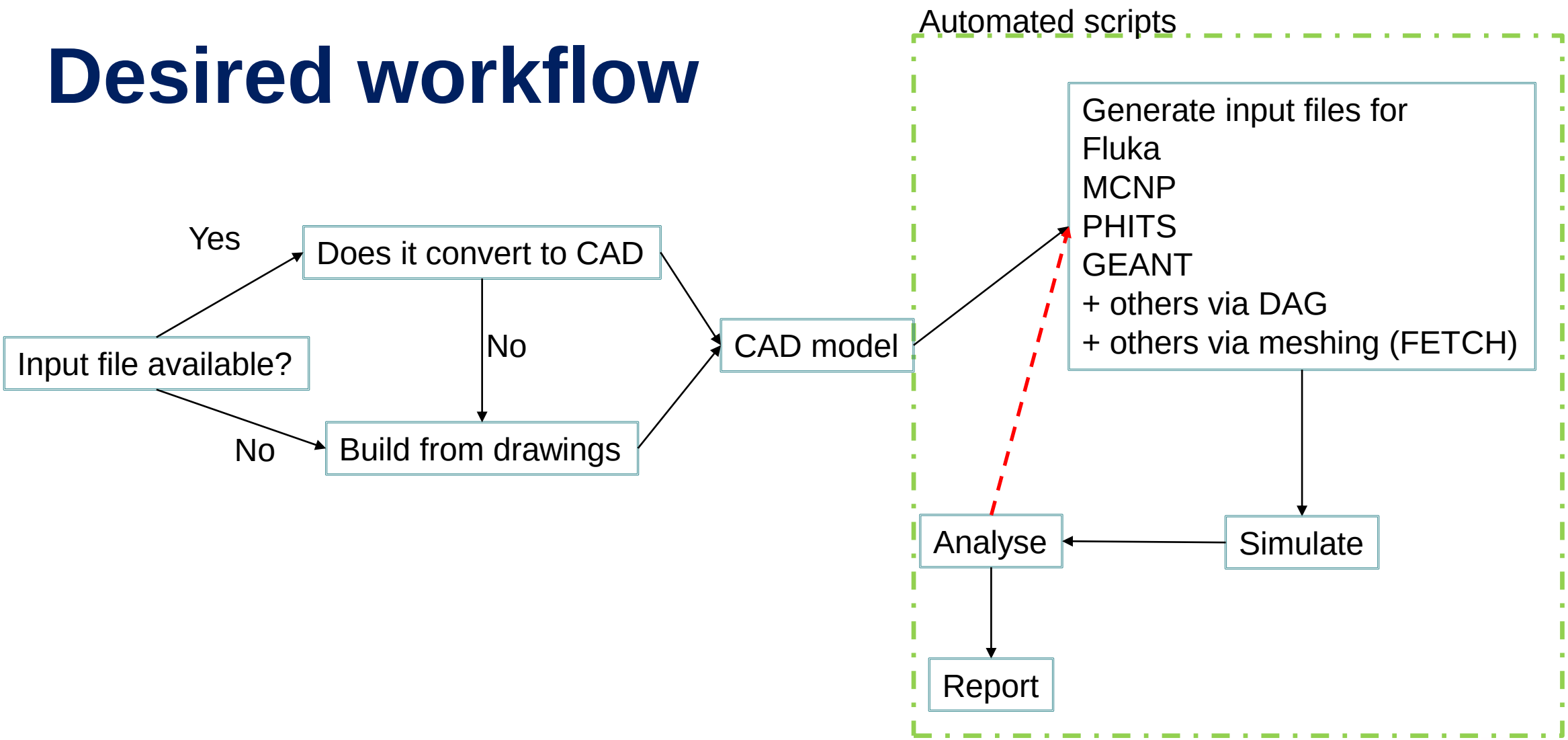
Code	Number of benchmarks
MCNP4/5/6/x	44
Dot3.5	8
Dort/Tort	8
Fluka	4
McBend	3
Tripoli	6
MCNP3	2
Mars	2
TwoDant	2
ANSIN	1

- Some input files are for old versions of codes – e.g. (MCNP3A)
- Typically if more than 1 code there is a Monte Carlo code and deterministic code
- Often custom source routines are provided

Benefits of CAD for SINBAD

- Consistent starting point
- Many tools to convert CAD to input files for both Monte Carlo and deterministic codes
- Same geometry – many codes – access more nuclear data and physics models
- Test processing as well as original data
- Speeds up model generation and allows automation

Desired workflow



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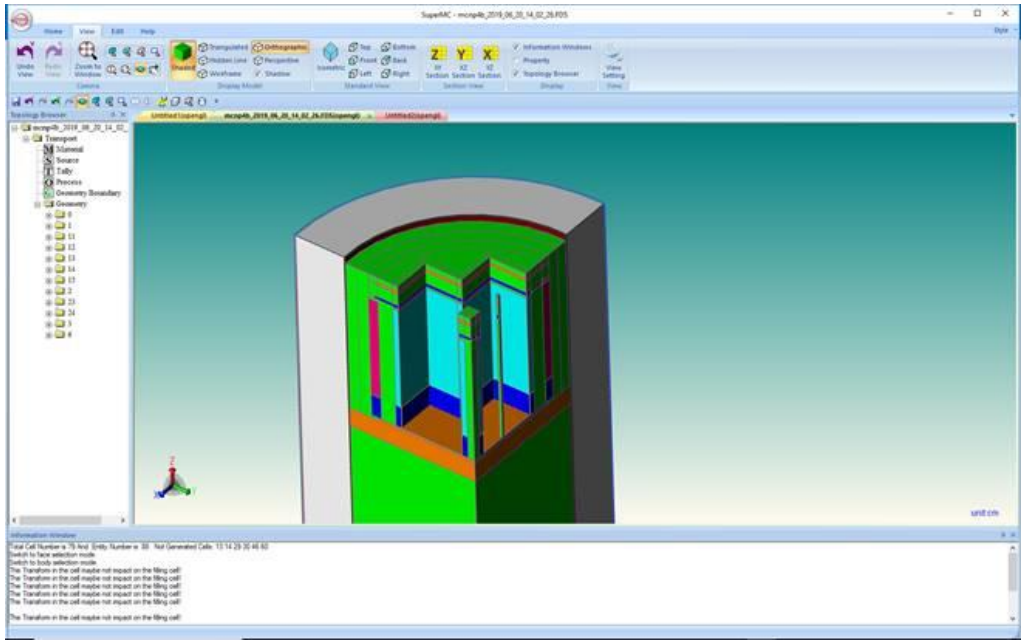
Generating CAD models

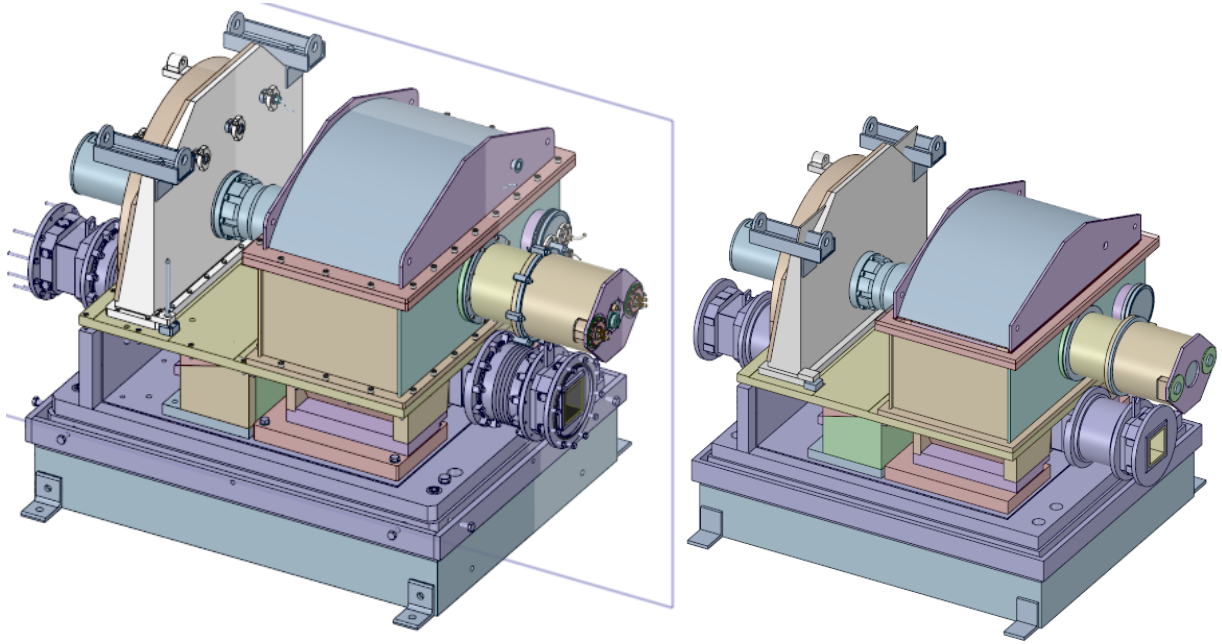
- From input file
  - Tools:
    - SuperMC/MCaM
    - McCad
    - SimpleGeo
    - MCNP2Cad



- Not always successful – some tools only support limited geometry definition options e.g. lattices, universes

Generating suitable CAD models

- From drawings or existing CAD
  - Tools:
    - Space Claim – good for simplification
    - Trellis – good for meshing
    - Freecad



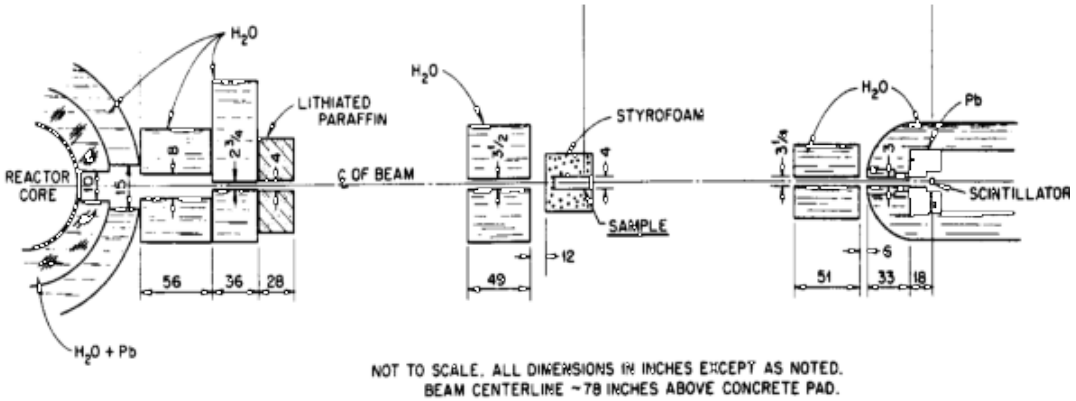


Fig. 1. Schematic of Experimental Arrangement.

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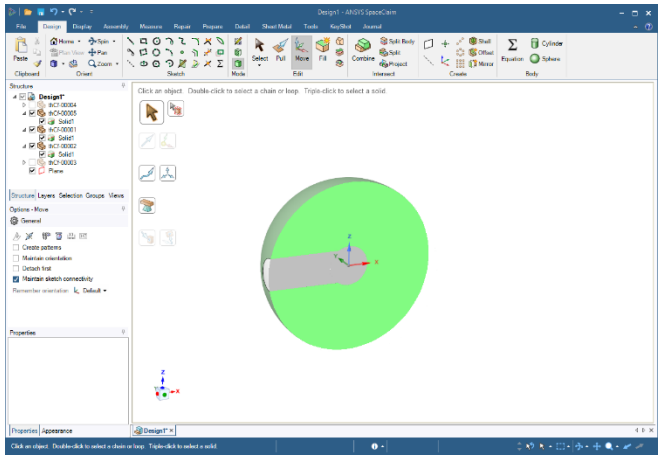
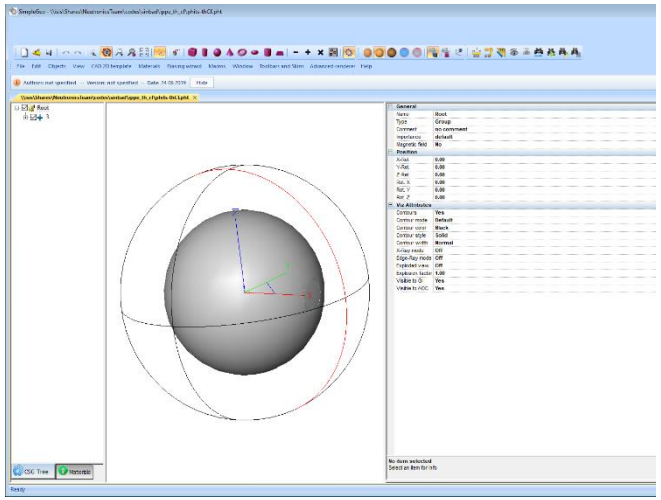
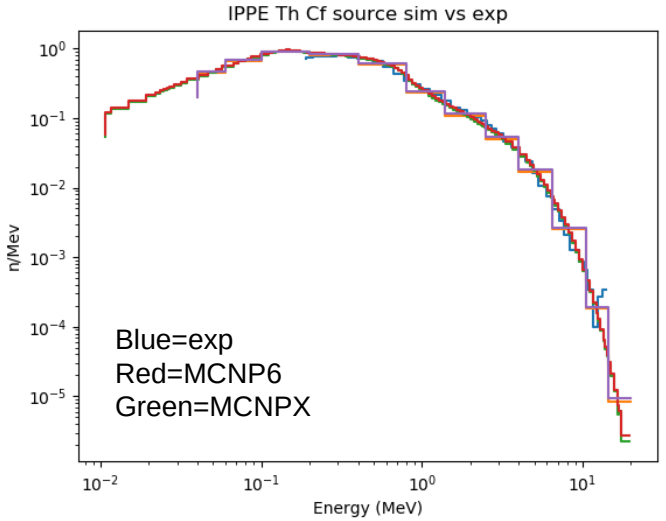
Issues with CAD for SINBAD

- 2D vs 3D
- 1 benchmark many experiments – multiple similar CAD models
- Not all the dimension information is available/is unclear
- Material information could be included as meta data, only some tools can use this.
- Many codes need the air/vacuum to be defined, CAD models typically just the solid parts.
- CAD experts are not simulation experts and vice versa

Examples – IPPE Spheres







- MCNP inputs provided
- Several inputs available, different materials and 2 different sources.
- Converted via SuperMC and SimpleGeo
- Geometry generated and auto-analysed for several MCNP versions

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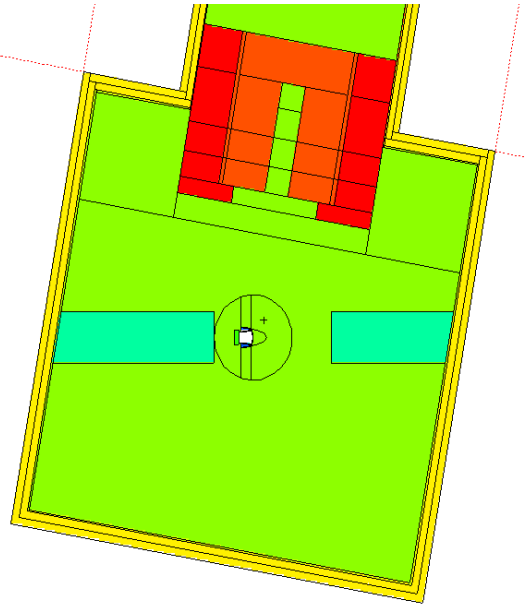
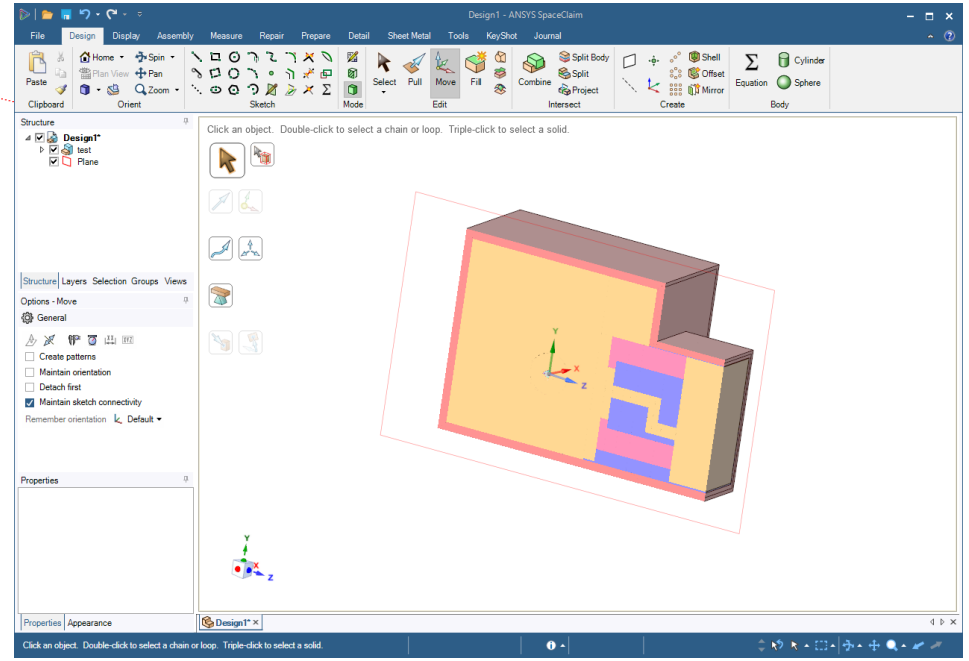
Examples – FNS duct streaming

- MCNP input provided
- Converted to CAD via SuperMC
- Volume check in Spaceclaim
- Generating models in other codes via SuperMC





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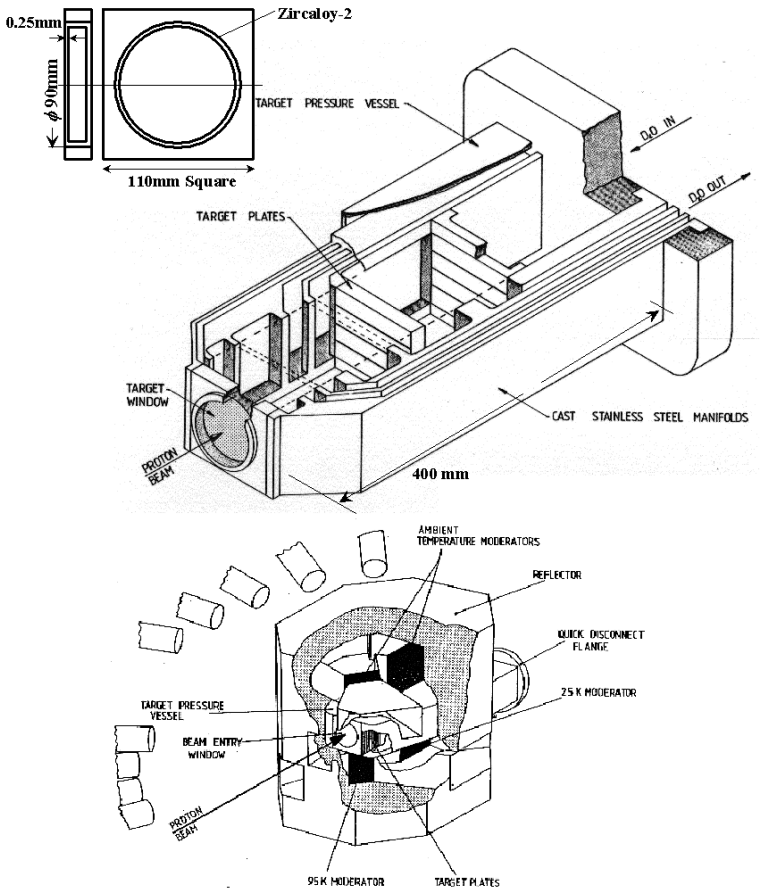
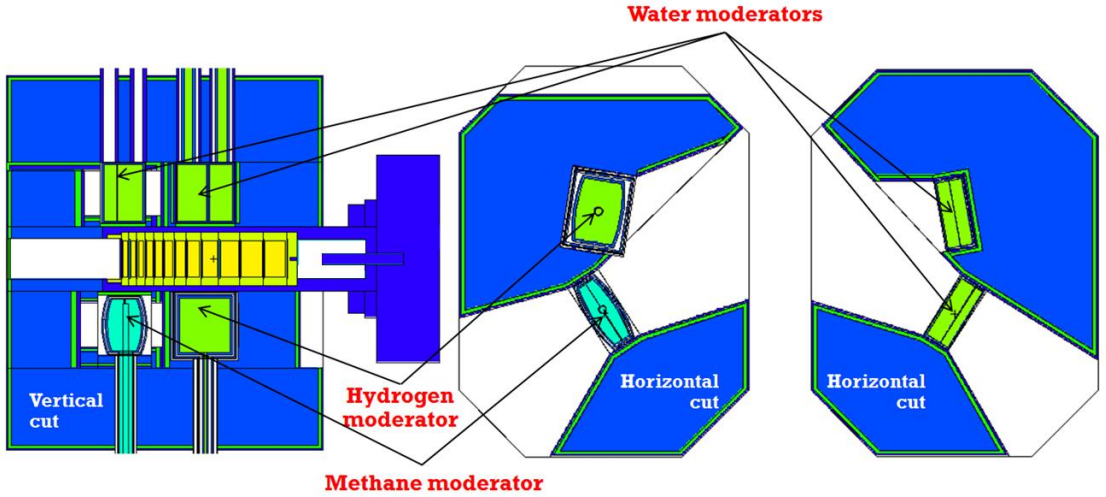
Examples - ISIS

Drawings -> CAD, MCNP + FLUKA – others soon
30 year old facility, full set of drawings not available
Particularly for the monolith shielding
Originally MCNP model built by hand and using Comblayer tool.





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Conclusion

- Creating CAD models of SINBAD experiments can give a common starting point for comparing codes, nuclear data, and nuclear models.
- Helps allow automation of running the benchmarks in multiple codes / code version/ data library versions.
- Not trivial to build the CAD models for many experiments, but a large number can be done very quickly.

Questions?

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