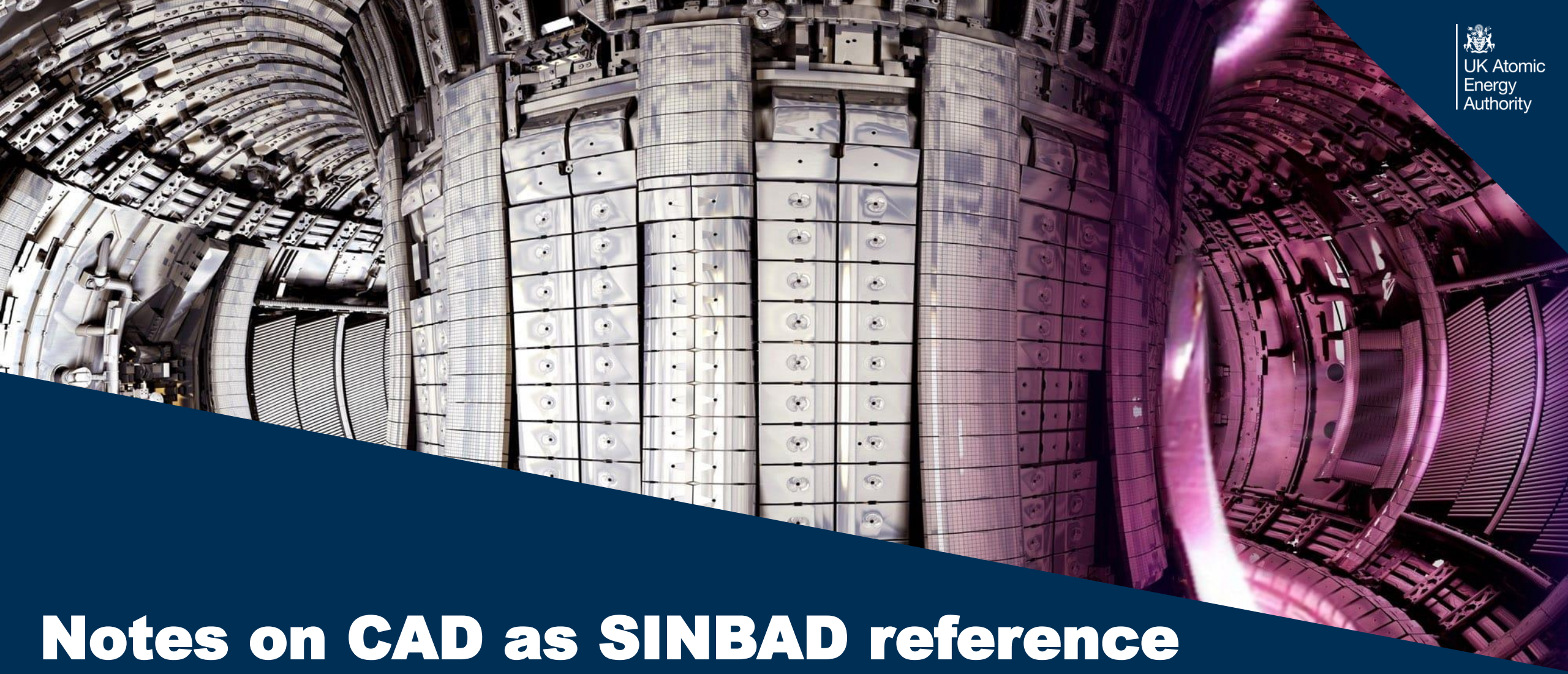

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Notes on CAD as SINBAD reference geometry

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CAD as a reference geometry

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1. Where there is not an existing reference model in MCNP format, CAD software can be used to draw the model. This will require some to exclude systematic errors. Nonetheless, with visualisation, this is much less error prone than creating an MCNP model.
2. Different transport codes have different requirements. What level of simplification should be chosen?
   - Codes using unstructured meshes typically require less stringent simplification of models – no need to remove splines/off axis tori, which is a requirement to convert to MCNP for example.
   - As the reference model should not be changed, a format allowing conversion to MCNP must be adopted. However the increased simplification required for this reduces its accuracy – We typically avoid this problem using density corrections etc but these are applied in MCNP. A benchmark CAD model needs to reflect the experimental set up as accurately as possible. Perhaps we can avoid such issues as benchmarks are generally ‘simple’ geometric set ups?
3. CAD models for which MCNP already exists should be validated by volume comparison. SuperMC is a very powerful tool which can be used to create the CAD model and calculate cell volumes. This can be compared to a stochastic volume calculation in MCNP.
4. The CAD format should be universal. .stp is a good choice and portable between most CAD software but note that protocols can vary and this can effect model conversion. .sat is not recommended because there are many different protocols and errors have been found in the past using different ones. A common protocol standard also? Fds is too specific to the software.

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6. Everything must be traceable. Material information should be referenced and a common database used. This should include the densities. The dimensions should also be stated. This could be presented on a single sheet distributed as a pdf – example is shown on final slide.
7. Those using the CAD model will still need to validate it. Starting with a transport code is trivial as it can simply be run with the correct tallies added. However using the CAD as reference and wanting to use a CSG model introduces another layer for potential errors. For a given reference CAD model, it is irrelevant if it has been demonstrated to convert to a particular transport model previously, the user must still validate their specific conversion. Conversion platforms such as SuperMC will produce different results and are not 100 % stable!
8. In line with above, there must also be validation that the materials are applied correctly. Serpent for examples allows a stochastic calculation of volumes by material.
9. Recommended that void cells are included in the CAD model. Although not relevant to all transport codes, this removes the reliance on other codes to produce it. UKAEA have a python tool for creating the void cells in SpaceClaim.
10. A geometric description of the detectors should be created to allow for cell tallying.
11. A set of standards should be defined for preparing the reference CAD model. SpaceClaim has many built in checks which should be passed as a first validation that the geometry is clean. These checks identify very small gaps, incorrectly defined edges and non-manifold geometry to name a few.

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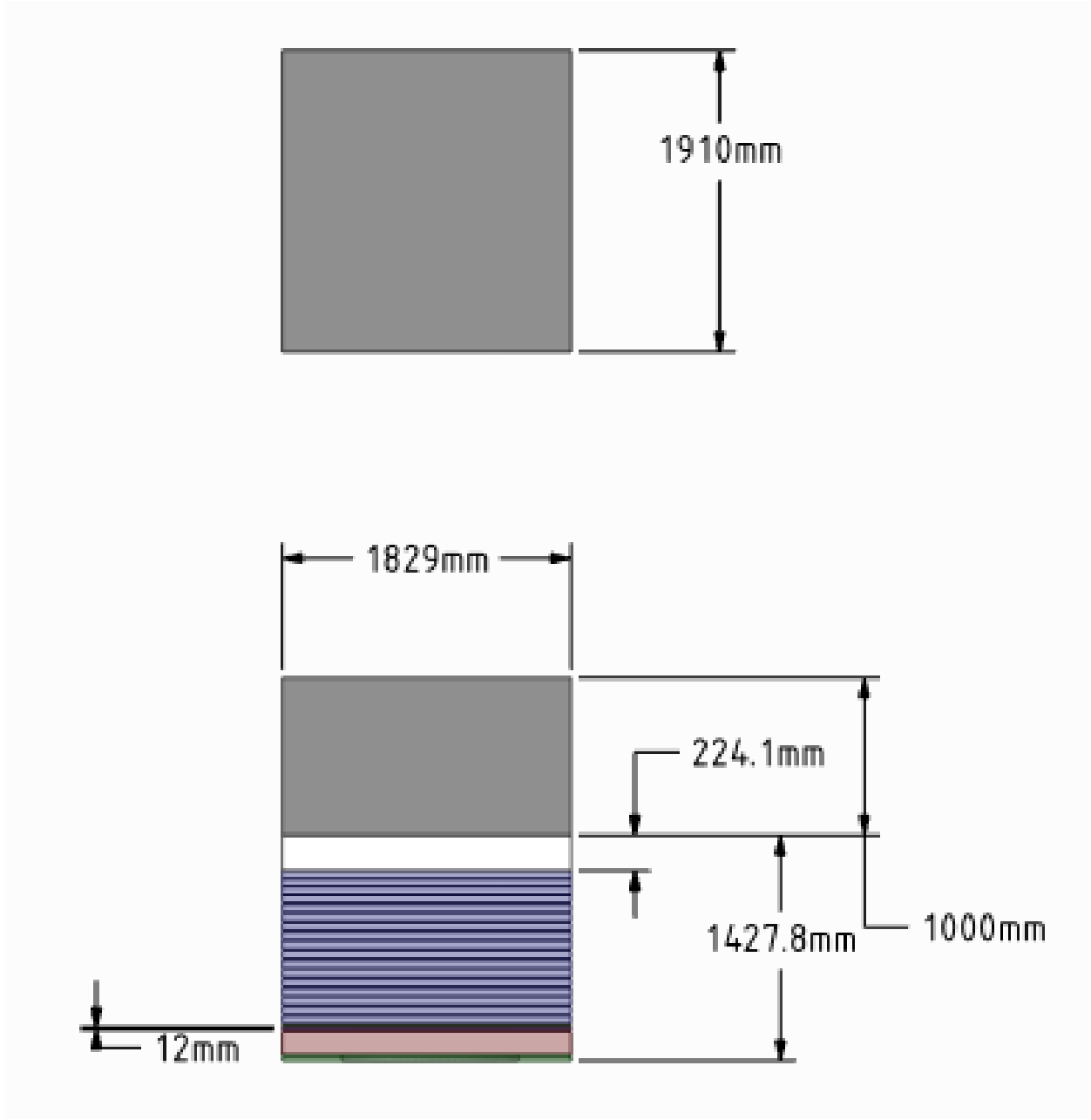
12. Mesh resolution in CAD based codes will effect accuracy. For example, resolving small streaming gaps is important.
13. CAD based codes also may still rely on proprietary software. For a database like SINBAD, a more opensource workflow is desirable. Is this in progress and if so, are there specific requirements that need to be considered for the CAD model? In line with this, McCAD may be a better choice than SuperMC
14. SuperMC only outputs MCNP, Tripoli, Geant4, Fluka and PHITS, although we have less experience with codes other than MCNP.
15. CSG2CSG is a robust tool which can be used to convert between MCNP, SERPENT, PHITS and OpenMC. For this reason, there is a case for having a MCNP as the reference model. Perhaps the ideal scenario is to have both a CAD and MCNP reference model that have been validated to mirror each other. It is likely this was not done in the past because we did not have tools like SuperMC available to us.
16. It must be made explicitly clear where there are deviations from the experimental set up (Ideally none). This is fundamental to understanding differences between experimental data and calculated values. If information of on the experimental set up is missing how do we account for this.
17. Many benchmarks will have more than one geometric description. For example activation foil experiments using different material activation foils. This should be made clear and a material description provided for each. On this point, the material information (.json?) provided needs to include all the materials relevant to tallying as well as the geometry.


1910mm
1829mm
224.1mm
1427.8mm
1000mm
12mm