DAG-MCNP & make_watertight

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Brief History

- Undergrad at Kansas State University
- Worked on Pegasus for 2 years at UW - Madison
- Came to CNERG in July of 2013

Research goal:
Improve the robustness & performance of geometry handling in DAG-MCNP
(watertightness, faceting, topology)

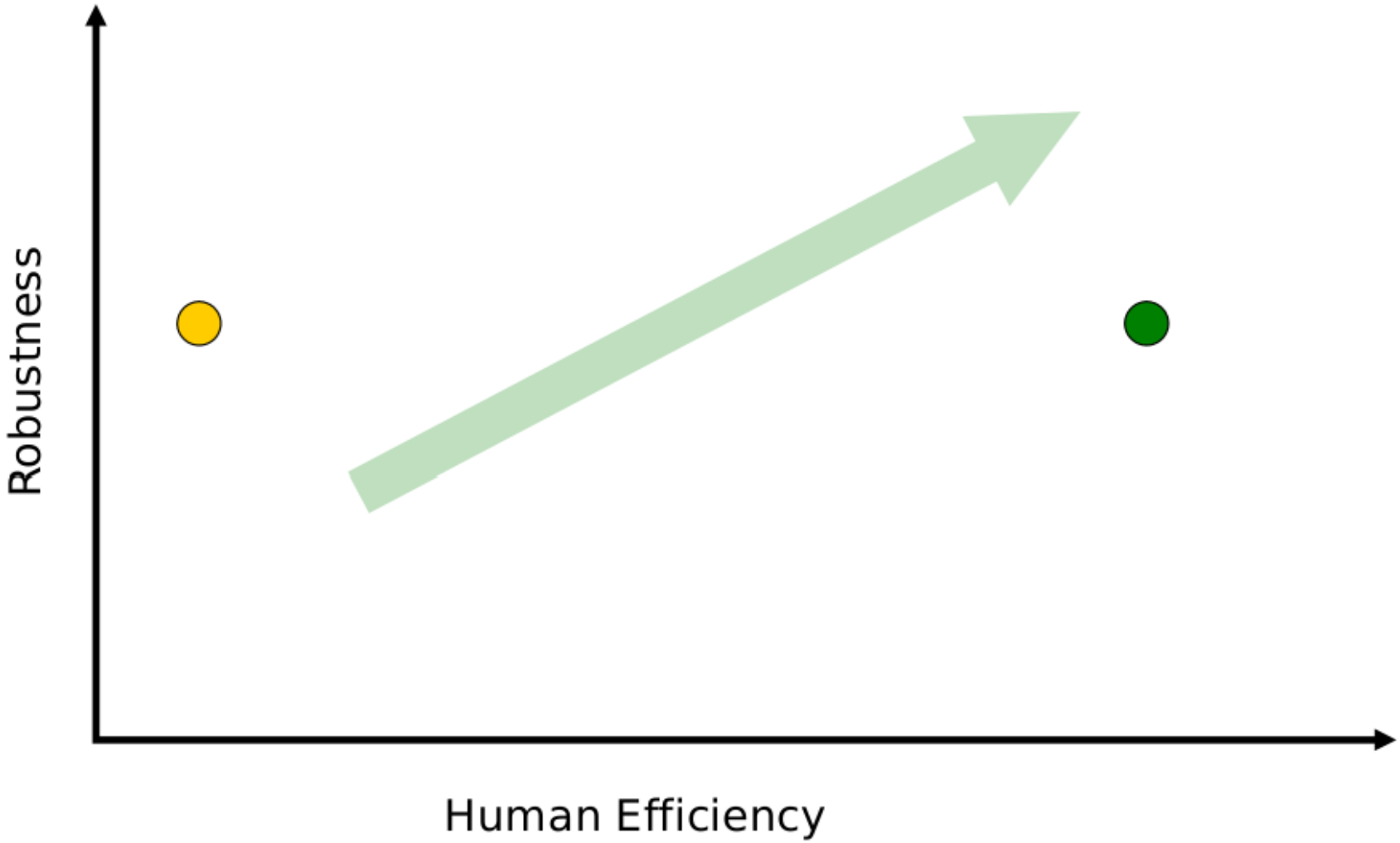
Overview

- Motivation
- Current impact of DAG-MCNP
- DAG-MCNP workflow
- make_watertight algorithm
- Examples
- Limitations
- Current research

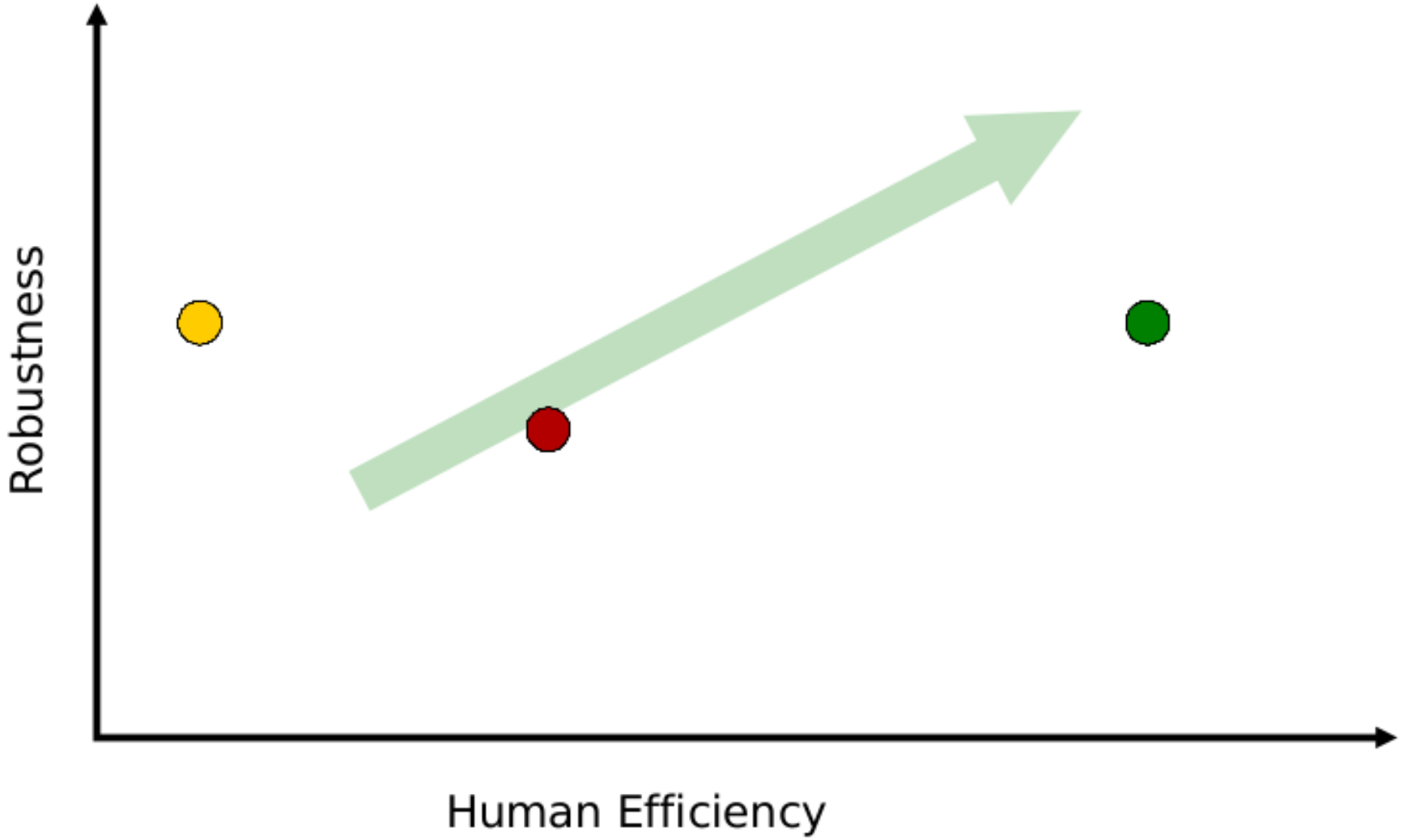
Motivation for CAD-based Monte Carlo

- Faster
  - faster design iteration
  - provides a common domain inter-analysis coupling
- Cheaper
  - reduced human effort
- Better
  - avoidance of human error
  - ability to describe higher-order surfaces

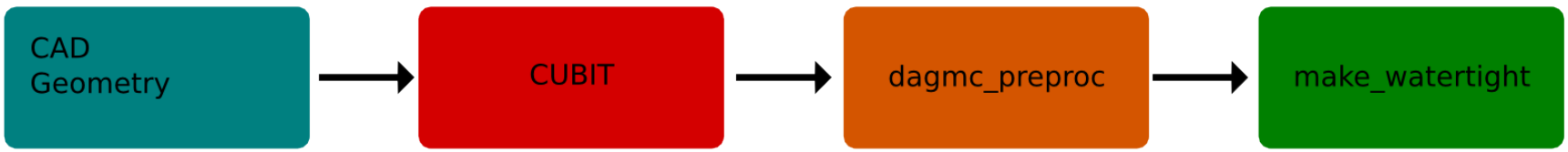
Impact of DAG-MCNP



Impact of DAG-MCNP



DAG-MCNP Workflow



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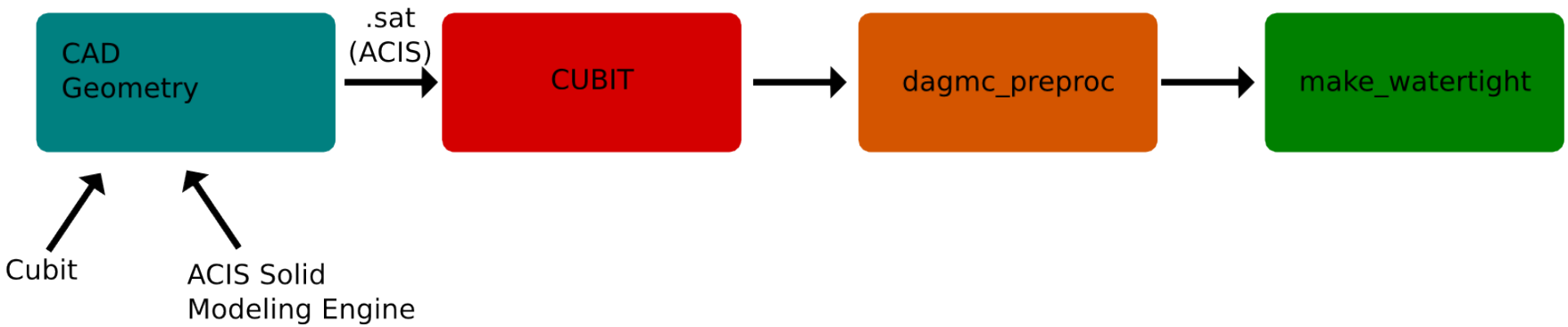
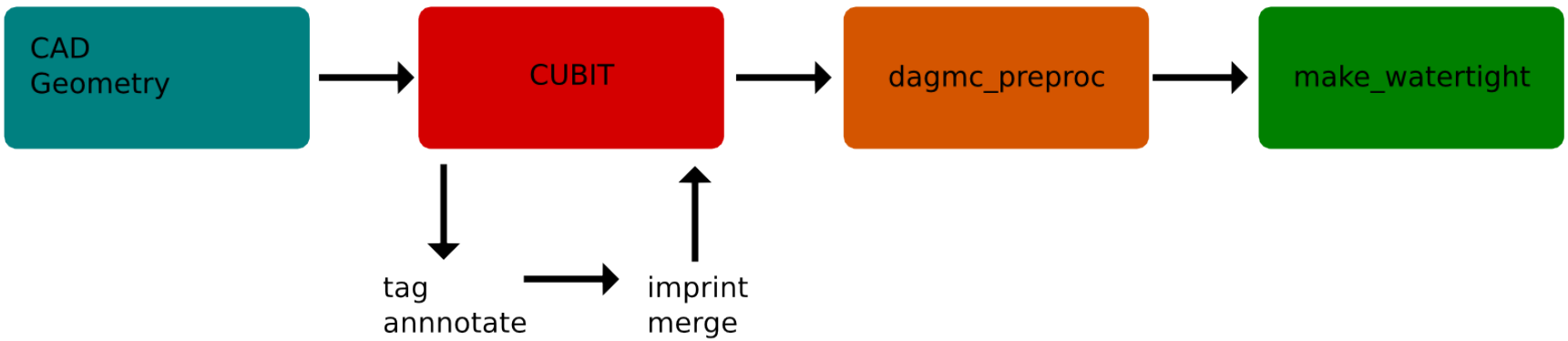
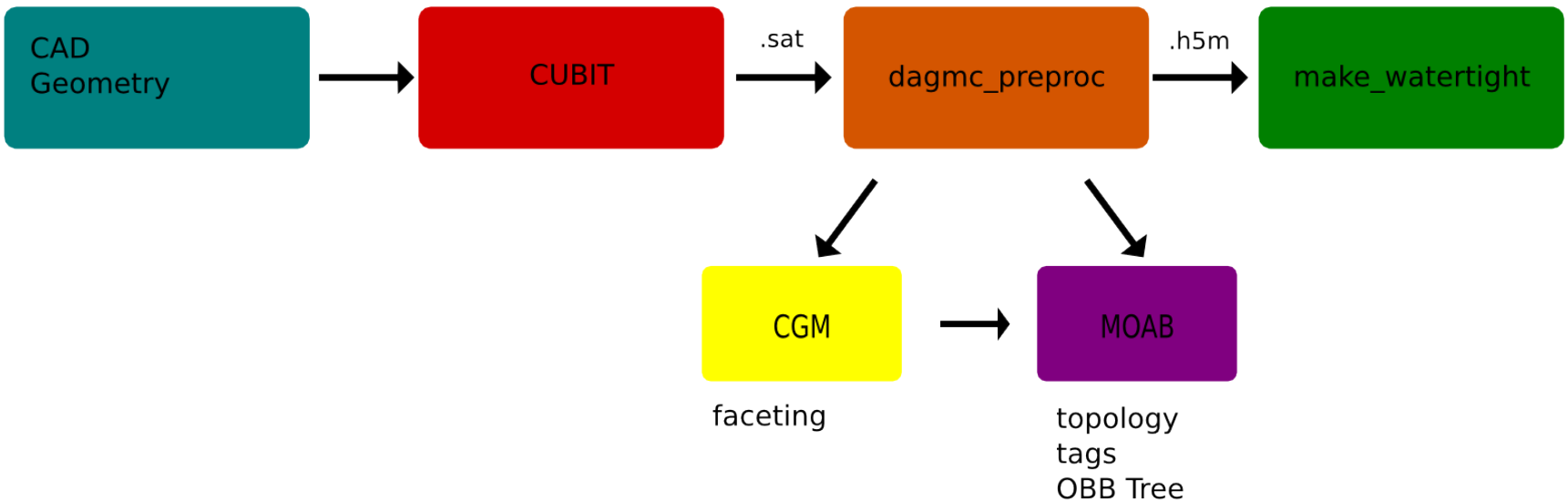


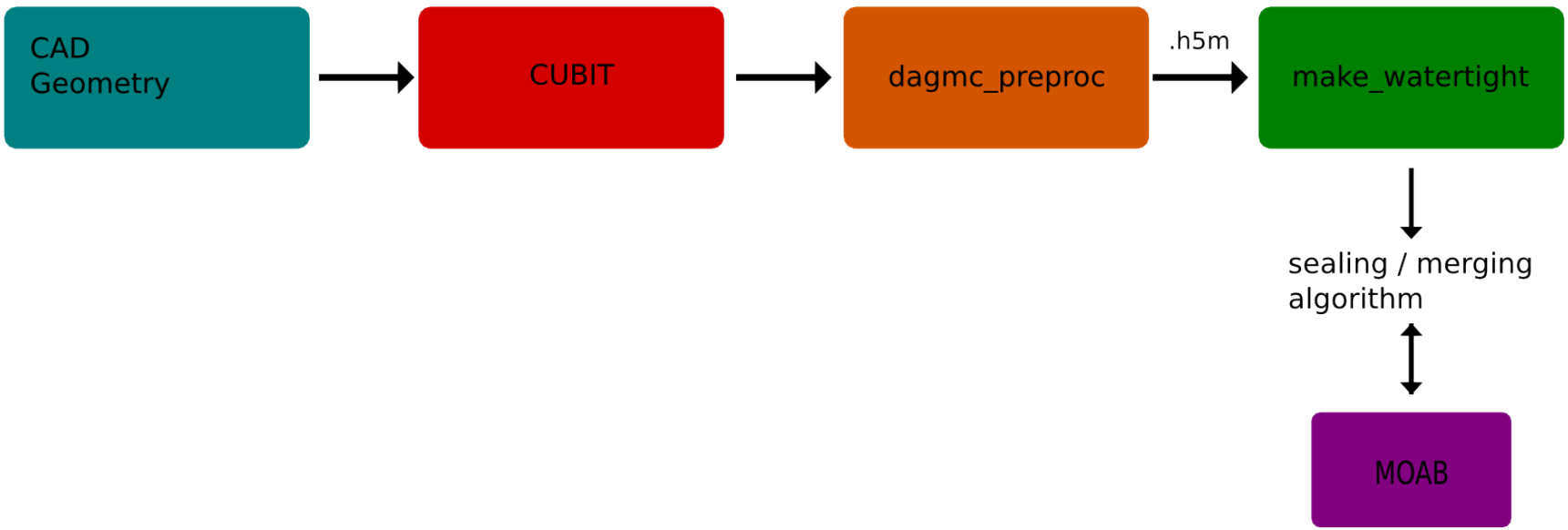
DAG-MCNP Workflow



DAGMC Workflow



DAG-MCNP Workflow



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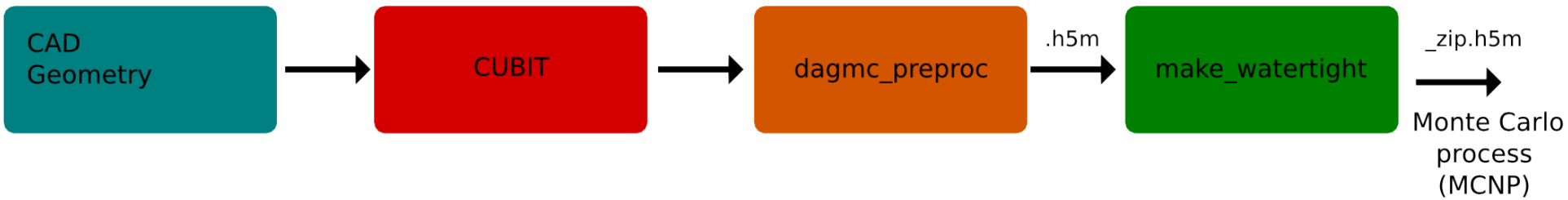

DAG-MCNP Challenges

- Quality of CAD geometry
  - small gaps & overlaps
  - lost particles
  - previous applications of CAD analysis are less sensitive
- Human efficiency gains reduced
  - unique DAG-MCNP skill set required
- DAG-MCNP-specific challenges
  - Inconsistent faceting
  - Robustness of tracking algorithm

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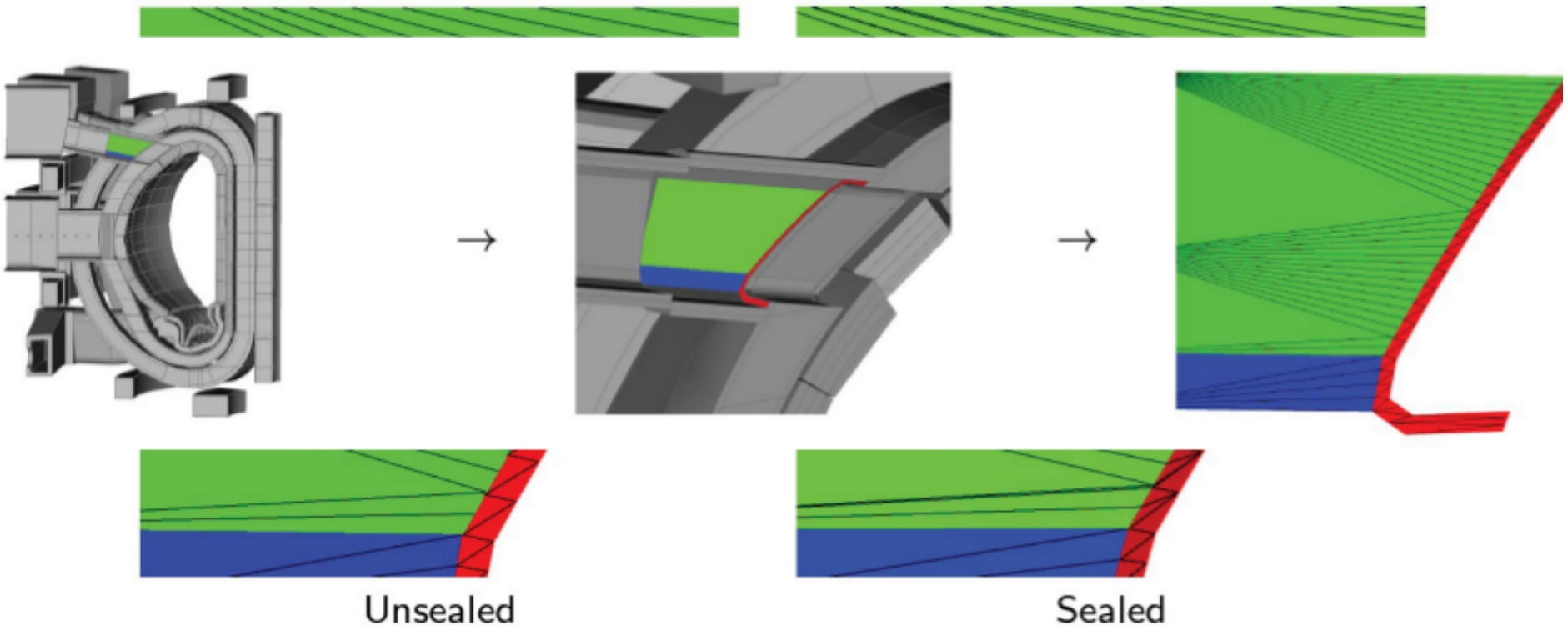
make_watertight

- Developed by Brandon Smith (2011)
- purpose is to seal faceted CAD models using geometric information provided by CGM

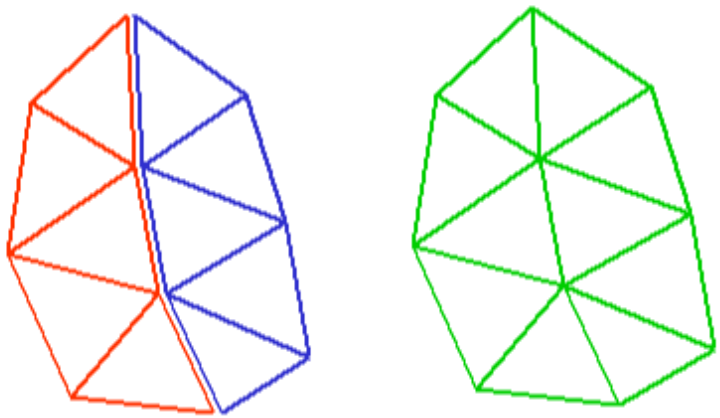


make_watertight

- Algorithm became incompatible with external software infatstructure and has recently been revived
- Improves the topological soundness and accuracy of geometric models
- Recent success in applying make_watertight to complex geometries

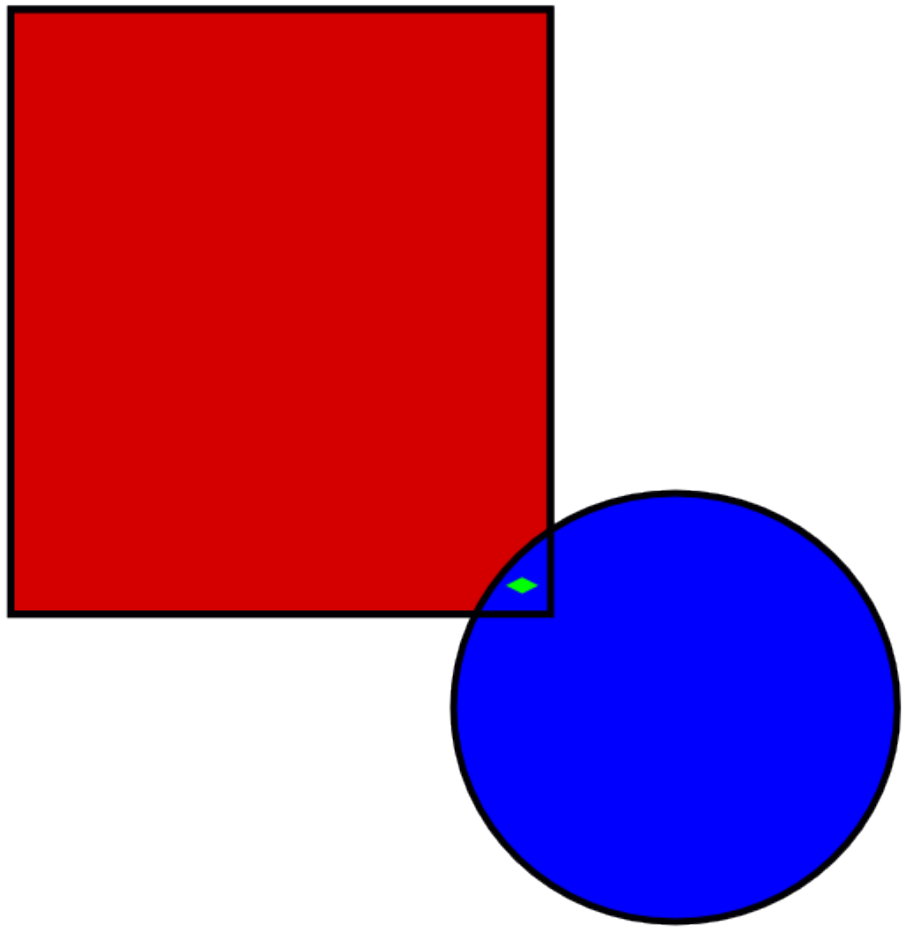
make_watertight

- By definition faceted models are not watertight
  - CGM faceting engine in dagmc_preproc (same as Cubit's)
  - surface edge vertices are not the same
- sealing algorithm makes topological changes to the model for watertightness



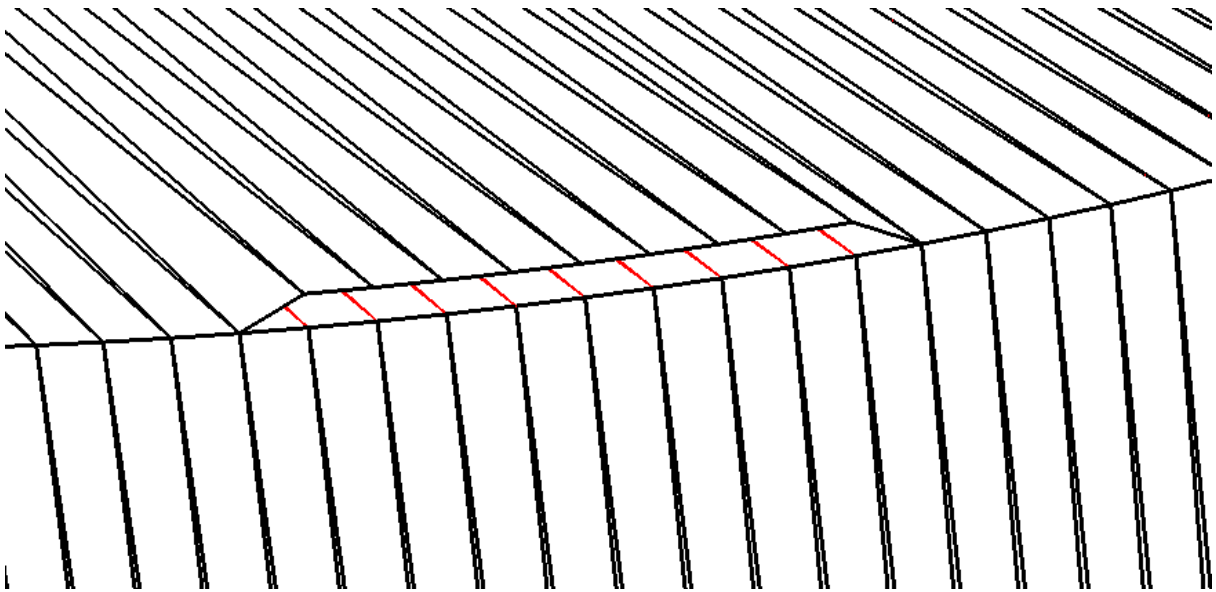
make_watertight

- applies faceted geometric information from CGM to remove topological ambiguity from the model



make_watertight

- Seals small gaps in volumes using faceted geometry curves



Recen Success

- make_watertight has (again) been able to seal complex models for analysis