Plans for Future SCALE Development Beyond Version 6.0

Mark Williams, Steve Bowman, Cecil Parks

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WE STILL HAVE TOO MANY SOFTWARE FAULTS. WE'LL MISS OUR SHIP DATE.
www.dilbert.com scottadams@aol.com
MOVE THE LIST OF FAULTS TO THE "FUTURE DEVELOPMENT" COLUMN AND SHIP IT.
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90% OF THIS JOB IS FIGURING OUT WHAT TO CALL STUFF.

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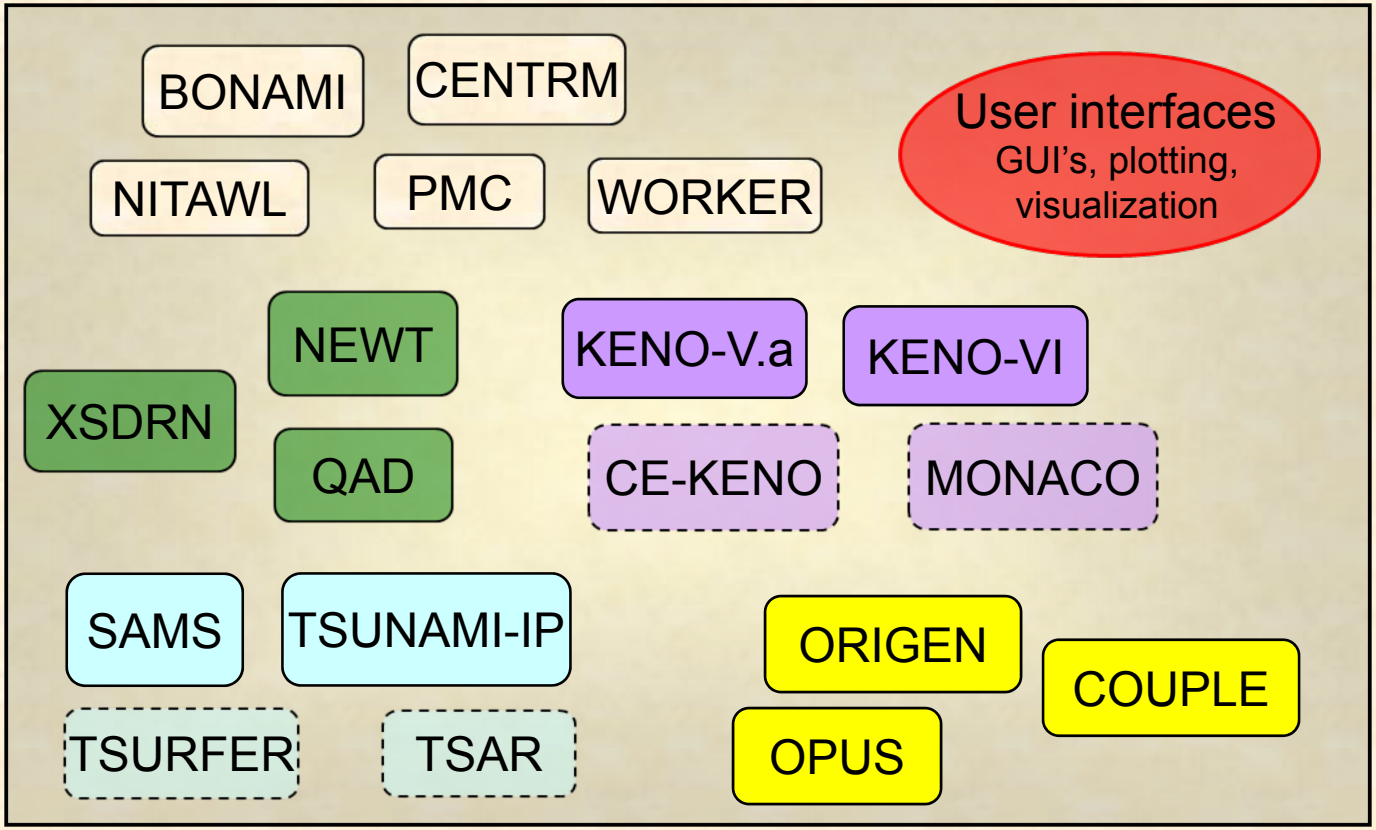
Goal of SCALE Development is to Provide Comprehensive Tool Set for Nuclear Analysis

- Diverse capabilities for criticality safety, reactor physics, shielding, spent fuel analysis, sensitivity/uncertainty
- Modern, quality-assured codes and data available to government labs, industry and universities
- Deterministic/Stochastic and Pointwise/Multigroup methods
- Modular codes that execute within a general framework
  - common geometry description, cross section data/processing
  - simple input and visualization using graphical user interfacing
  - sequence of linked-calculations can be defined by user or by available control sequences

SCALE-6

Ensemble of Executable Code Modules

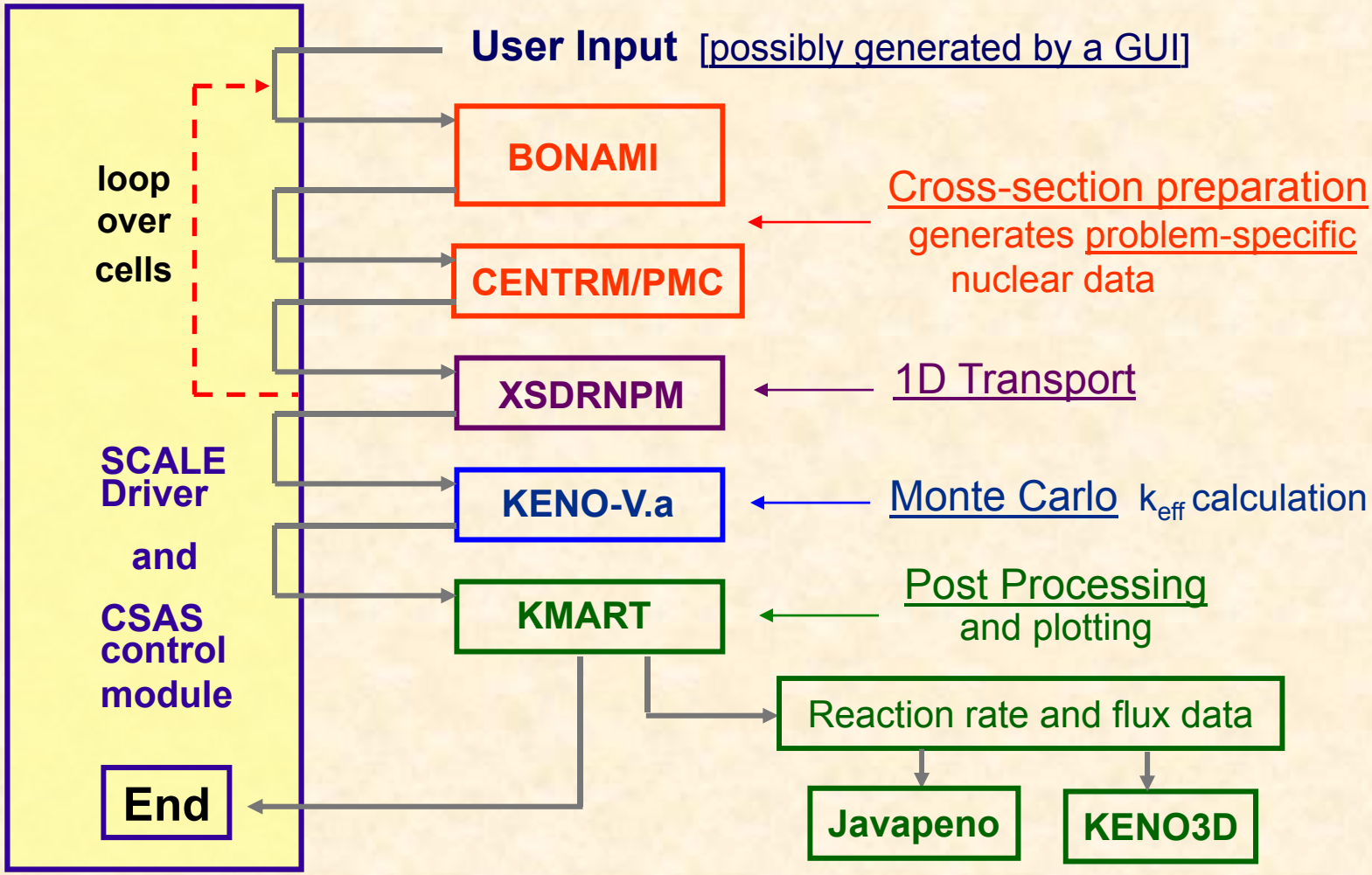


XS processing | Monte Carlo transport | deterministic transport

sensitivity analysis | isotopic depletion

C S A S

Criticality Safety Analysis Sequence



FUTURE SCALE Development Beyond SCALE 6

- **Nuclear Data**
  - PW and multigroup ENDF/B-VII libraries
  - enhanced covariance data libraries for S/U
- **Extension of continuous-energy Monte Carlo methods**
  - additional edits for CE-KENO
  - CE-MONACO for shielding applications
  - CE-TSUNAMI for S/U applications
- **Criticality Safety**
  - CAAS with MONACO
  - testing for fission source convergence in KENO
- **TSUNAMI sensitivity analysis methods**
  - S/U capability for shielding
  - NEWT generalized perturbation option in TSUNAMI

FUTURE SCALE Development, *continued*

- **Lattice physics**
  - option for faster/less-rigorous self-shielding
  - automated correction for non-uniform lattice self-shielding
- **Improved code-user interfacing**
  - improved/standardized GUI for sequences
  - CAD geometry input option for MONACO
  - extension of Javapeno plotting capabilities
- **Depletion sensitivity methods for ORIGEN ARP**
  - inverse depletion
  - adjoint transmutation solutions

S C A L E - UP

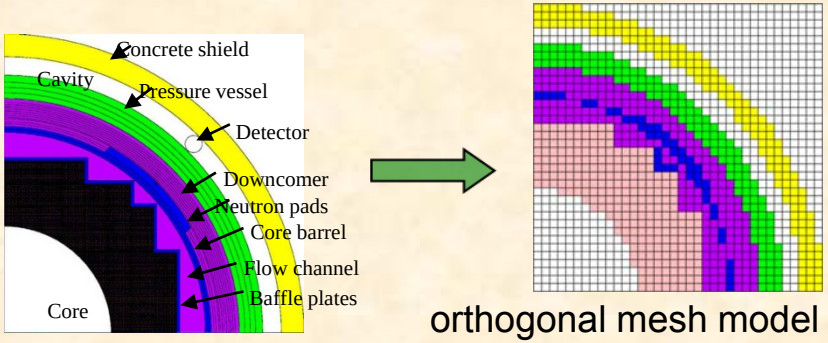
Standardized Computational Analysis Library for Execution of Unified Procedures

Project to define future capabilities and computational architecture for SCALE

- Identify new code modules and specifications
- Redesign computation sequences into more efficient and generic structure for multiprocessor platforms
- Improve data transfer between modules in sequence
- Multiple, coupled computation methods within spatial domain

New Deterministic Transport Modules
Replacement for TORT 3D Sn Code?

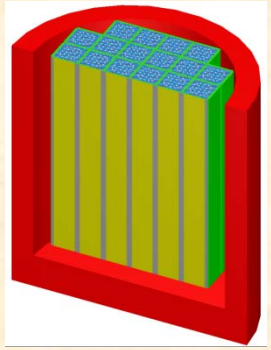
- **Modern 3D SN code for orthogonal mesh**
  - TORT → DeNova



orthogonal mesh model of core

- **Modern SN code for unstructured mesh**
  - *Possibilities*: NEWT-3D DeNova; NEWTRNX

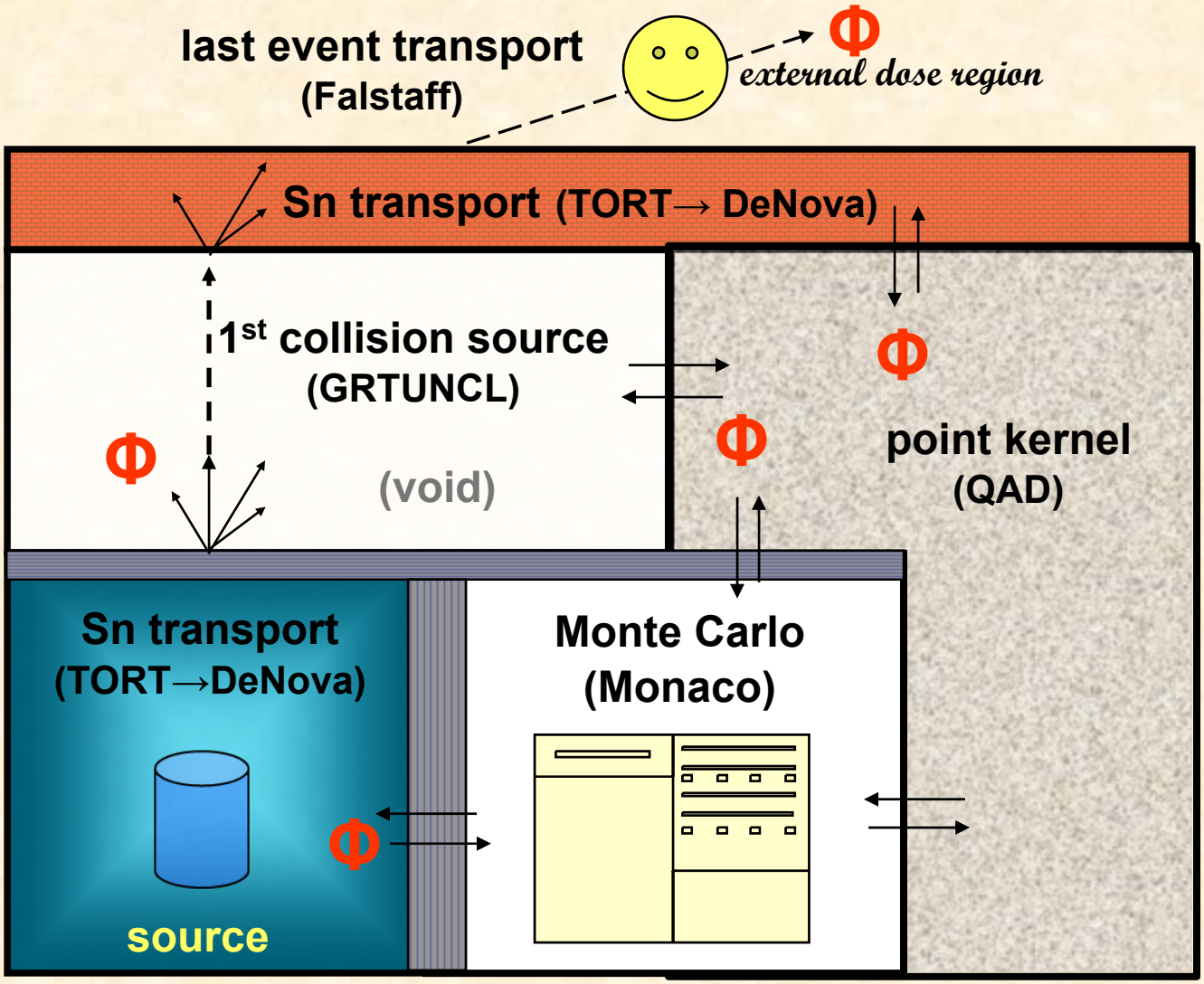
combinatorial geometry model of shipping cask



Generalized Coupling of Transport Methods

- **Extension of "Boot-Strapping" Methods**
- **Geometry modeled by blocks with internal structure**
- **Computation method is designated for each block**
  - Monte Carlo
  - Discrete Ordinates
  - Point Kernel
- **Angular flux at boundaries couple the computations**
  - must transform from/to different phase-space meshes
- **Analytical 1st-collision (GRTUNCL) or last-event estimators (FALSTAF) are available**
- **Optional outer iteration to converge the boundary fluxes**

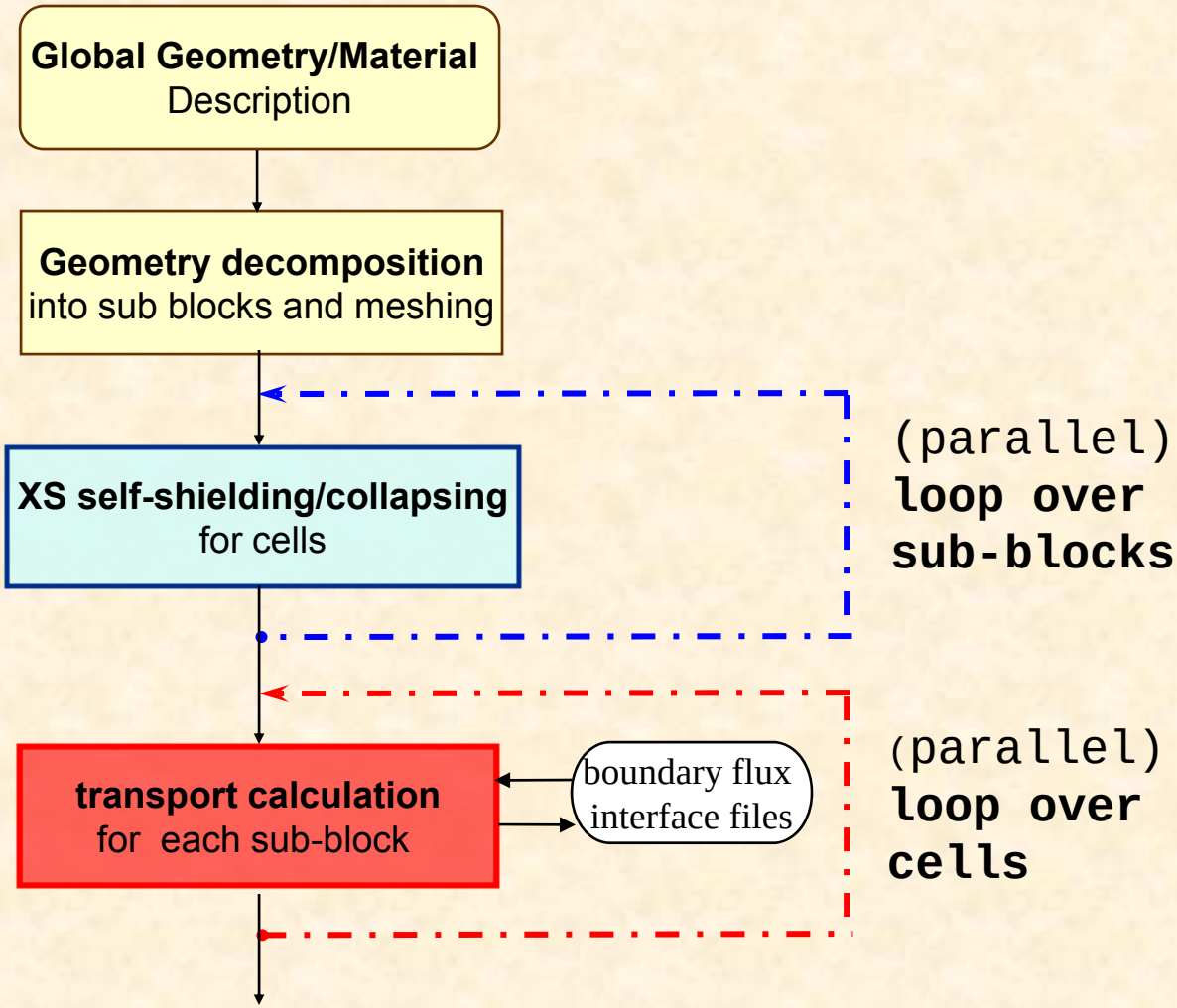
Example Transport-Coupling for Shielding



Parallel Computational Sequences

- Current Sequences
  - SCALE sequences execute each module in series
  - Communication between modules is mainly through external interface files
- Future Sequences
  - Improvements for execution on multicore PC's
  - Modular structure provides method to develop new sequences for coarse grain parallelization
  - Advanced sequences can also be made more generic and standardized

Illustrative Sequence for Post SCALE-6



SUMMARY

- Numerous improvements are currently being tested or on drawing board
- New deterministic transport modules are needed
- New parallel architectures for SCALE sequences are being examined
- Generalized coupling of transport methods can be incorporated within advanced sequences