



News from fullsim core development

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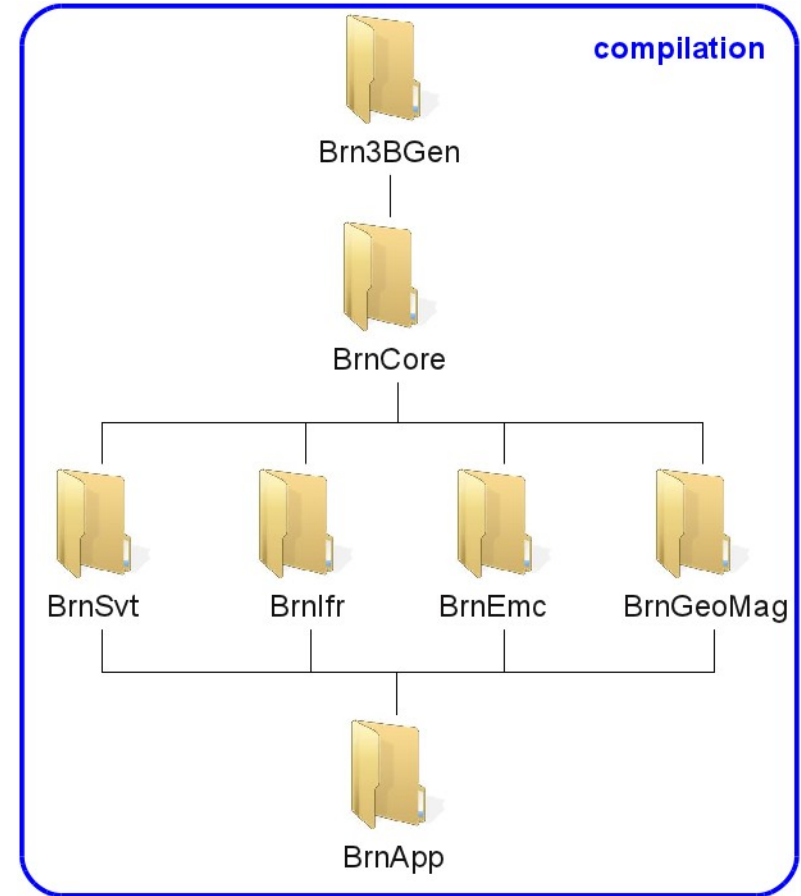


Outline

- Packaged version
- Simulation robustness

Packaged simulation (reminder)

- Packaging means dividing the code base into modular, self consistent units
 - It helps code maintenance
 - It helps code development, in the sense that it enforces clear separation between different functionality, possibly handing over responsibility to different persons
 - It encourages detectors to take more control of their own simulation, by creating detector-specific packages
- A fully working packaged version of the simulation was presented at the Elba meeting
 - Its results were found to be identical to the ones of the “monolithic” Bruno



Packaged simulation: status

- At the Elba meeting it was agreed that the packaged version of Bruno had reached a level where it could be considered as an alternative to the “legacy” Bruno
- In the past months, main effort of full simulation team has been
 - To complete the migration
 - Some bugfixes
 - Porting of the latest developments from the monolithic Bruno to the packaged one
 - Ensure interaction with production system
 - To provide some documentation to users
 - <https://sbrepo.pd.infn.it:8911/projects/BRN>
- In this meeting, you will see the results of this work
 - All developments on the legacy Bruno version have been stopped
 - New features implemented now on the packaged version
 - The latest full sim production has been completely done using the new version
 - All new fullsim plots you will see come from this software

Improving Bruno robustness

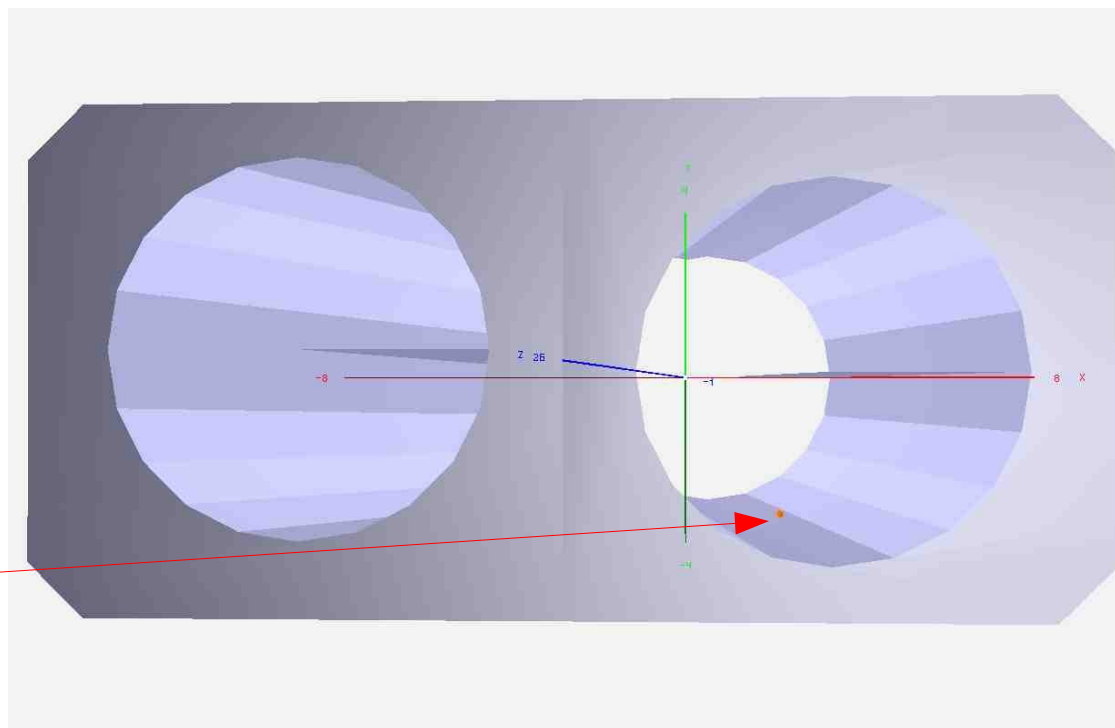
- As part of the QA of our software we started to improve the robustness of the simulation
 - More robust → less crashed/failed/frozen jobs in production
- Starting point based on experience from Elba production
- A significant amount of frozen (or abnormally long) jobs was observed, belonging to one of the following categories
 - 1) Log inspection pointed to “stuck tracks”, i.e. tracks that G4 was unable to push forward during navigation. Problematic events were aborted automatically by G4, and the job continued
 - This was found by Eugenio to introduce a bias in the bg measurements, i.e. since the tracks tended to get stuck in the same region of the detector, events where that region was more crowded tended not to be simulated
 - 2) While nothing in particular was found in the log files, the job was hanging forever, and had to be killed by the batch queue
 - No handles at all from the log, nor from the hits output.

Better handling of stuck tracks

- Under some conditions, G4 can successfully identify a stuck track. An exception is thrown which triggers event abortion
 - This means that all hits produced from that event are flushed. Nothing is kept from the event. Next event is processed.
- After some discussion, it was decided to override this policy
 - Now Bruno has a custom exception handler
 - Stuck track exception is caught and it triggers the following actions
 - The information about the problematic track (position/momentum, particle type etc...) is saved in the output file for offline debugging and better assessment of the bias
 - Only the problematic track is killed, not the full event
- In addition, some attempt to better identify stuck/looping tracks has been made
 - A maximum number of steps is allowed per track (presently 100k). When a track does more steps, it is assumed to be a pathologic track deserving better attention
 - It is killed and saved to the output file

Understanding frozen jobs

- Definitely challenging
 - No hints at all from G4
 - Very complicated to reproduce (for example, recompilation of the G4 libraries in some cases made it disappear)
- Debugging required running a patched G4 version to better understand where control was stuck
- Problem was found to be in a particular solid



**Job got stuck when
a particle was here**

Understanding frozen jobs

- It turned out the culprit was in very low-level geometry code, related to boolean solids and one specific type of solid (tube sections)
 - This was a genuine G4 bug (a **major** bug, in our humble opinion)
 - Resulted in a ticket on the G4 bug tracking system
 - http://bugzilla-geant4.kek.jp/show_bug.cgi?id=1229
 - Unfortunately, developers were not able to identify a solution
 - Suggested to restructure our geometry so to minimize usage of booleans and tube sections...
 - Alejandro successfully removed tubes from the problematic region, replacing them with a different solid (polycone) which implements the same shape in a different way.
 - Results are extremely encouraging
 - Basically no more frozen jobs were observed
- Note that
 - This is a workaround, not a solution
 - In this case, there is really nothing one can do on the Bruno side
 - Problem must be solved in the G4 libraries