UPDATE ON BIASING

PLENARY 5

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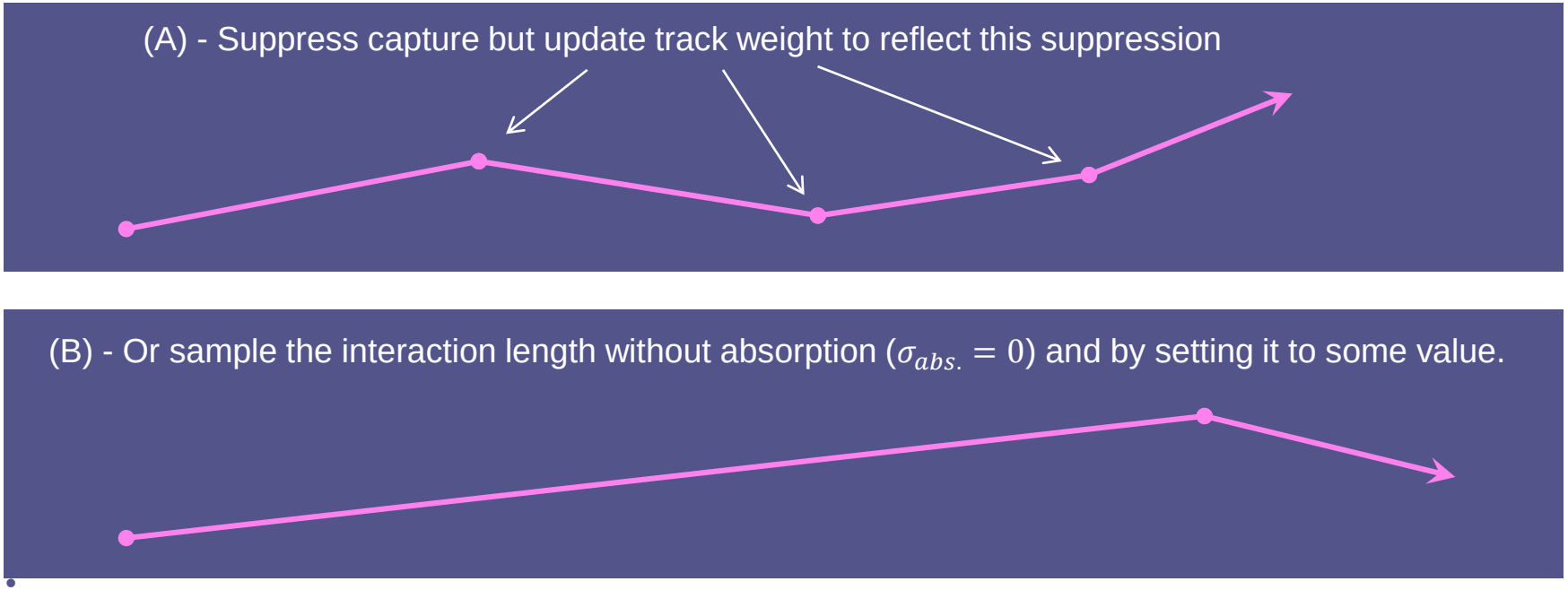
FEATURES UNDER DEVELOPMENT

Implicit Capture

- Aka “survival biasing” or “absorption by weight reduction”
- Biasing technique used for neutrons (and gammas) to prevent “loosing” neutrons by absorption after long travel in matter.
  - Keep neutrons alive wrt absorption to make it exploring more detector domains.

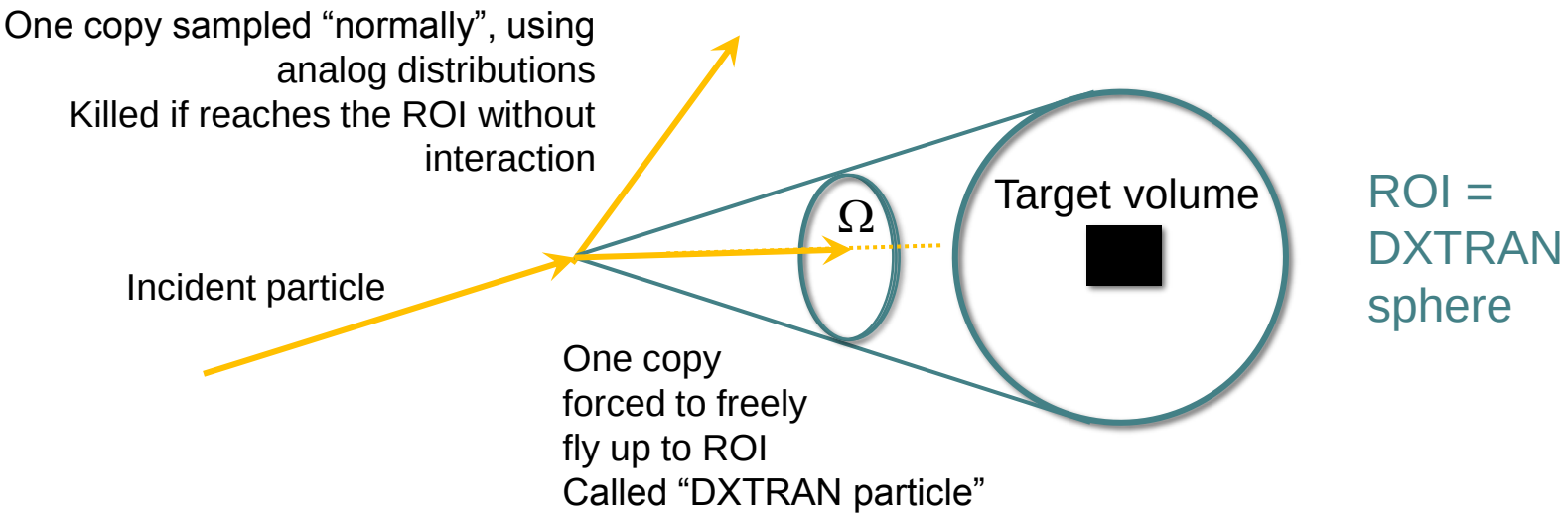


Implicit Capture

- Technique implemented in MCNP and FLUKA under different flavors:
  - MCNP:
    1. After collision nucleus has been selected, ignore $\sigma_{abs.}$ and let neutron continues with $w' = w \cdot \left(1 - \frac{\sigma_{abs.}}{\sigma_{tot.}}\right)$ – biasing case (A)
    2. Cancel $\sigma_{abs.}$ when sampling interaction distance – case (B)
    - Technique to be applied far enough from the region of interest, as we're loosing secondaries from un-simulated absorption
  - FLUKA:
    3. Add the ability to set the cross-section to a desired value – case (B)
- Tentative implementation last year, but got finally confused by the actual biasing procedure and related weight calculation (1.)
  - Reanalyzed, and understood this year.
  - Using the formalism for generic biasing in the general paper.
- Should be in 10.5.

DXTRAN

- An option also re-conducted from previous work plans.
- Option in MCNP to scatter particles toward a preferred solid angle
  - Has some similarities in its use-case with the Reverse MC as it targets small ROI
- DXTRAN = stands for deterministic transportation



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DXTRAN

- Used only for elastic scattering in MCNP
- In Geant4, we'll apply to elastic (or quasi-elastic) only, too.

- Main difficulty:
  - We must compute $w = \frac{p^a(\Omega)}{p^b(\Omega)}$
    - $p^a(\Omega)$: analog angular distribution
    - $p^b(\Omega)$: biased angular distribution
  - That without introducing dependencies to physics packages
  - Agreed last year:
    - Having an abstract class that some process may implement to provide concrete distributions
      - the biasing messaging only through the abstract interface
    - Progress in defining this differential cross-section class
      - Together with Laurent Desorgher, as interesting the Reverse MC as well

- DXTRAN scheme will be difficult to deliver this year.
  - Although it looks of interest to medical from discussions this week !

Other Items

- Geometry importance biasing for several particle types:
  - Daren reported a bug:
    - Problem 1941 - Cannot use importance sampling for more than one particle type
  - Problem related to the geometry importance biasing scheme as primarily provided in Geant4
    - Alex investigates if this is a bug or a design limitation
  - Alternative solution can be provided with generic biasing:
    - Will be demonstrated in extented/biasing/GB03

- Extension of the generic biasing scheme for AtRest particles
  - Duplicate the functionalities developed for PostStep biasing
  - Namely: ability to make splitting/killing, to change the interaction length law (will be interaction time law), to change the final state generation

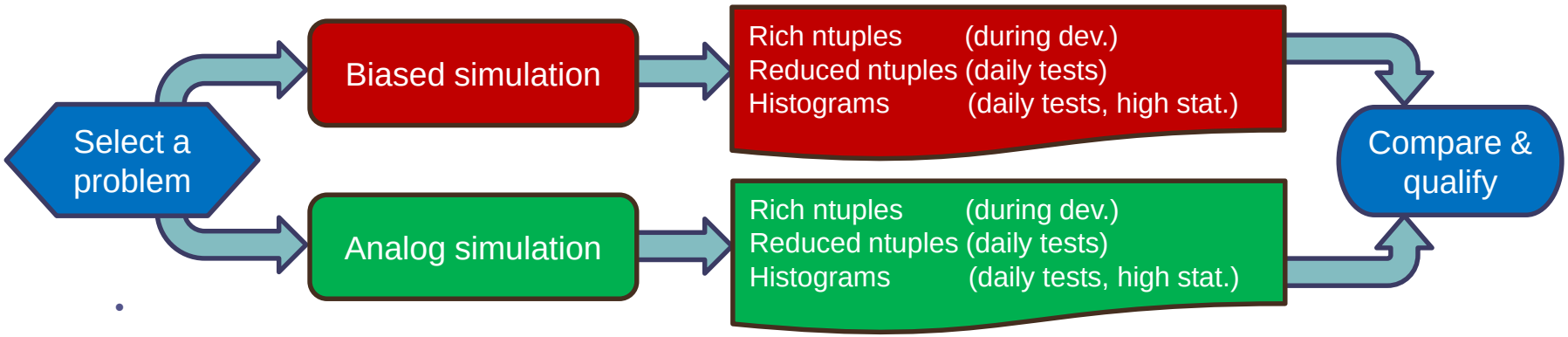
- Possibly, extend the ability to do –say- interaction forcing in a volume with daughter volumes
  - As done in interaction forcing in ReverseMC.

VALIDATION NEEDS IN BIASING

Validation in biasing : requirements

- Biasing validation rapidly needs large MC samples to verify the correctness of the weight calculations
  - Large samples of analog simulation
  - Compared to small / medium samples of biased simulation
  - ☞ In contrast with physics validations, this is a pure MC – MC comparison.
- Issue common to all biasing techniques

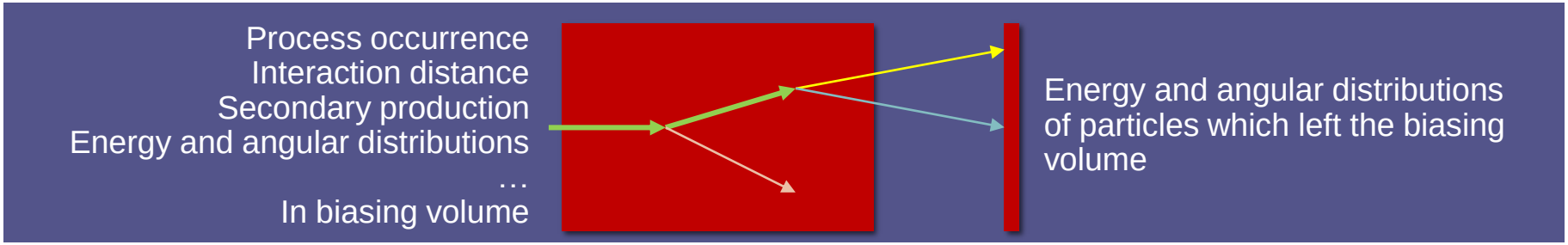
- Tests should be able to run under configurations for:
  1. Development : with tests ran privately
  2. "Daily" testing: running with moderate biasing and moderate statistics
  3. Reference tags, or dedicated runs : running with strong biasing and high statistics
- Each configuration has an adapted output and a specific comparison stage



Example with Generic Biasing

- Development of a testing suite ongoing under test49
  - Some code committed at the trunk
  - Not ready yet !

- Observables:
  - Many variables are common to the various biasing options



  - So, many options can use the same “testing framework”
    - Much desired : better robustness of test, and better use of limited manpower

  - ***I do need technical help to setup this test49 in the testing environment !***
    - Once made, could be duplicated for, say, ReverseMC, but also fast simulation

Conclusion

- Biasing continues providing more options:
  - Implicit capture
  - DXTRAN later on
  - Generic scheme to evolve to AtRest case
- Need for automated validation
  - To run pure MC – MC validations
  - With several types of validation
  - **Technical help needed !**
- Still progressing, even if manpower in biasing has always been and continue to be an issue.