

Parallel session 8B summary

Event Biasing

Marc Verderi
LLR, Ecole polytechnique
Friday 14th September
Chartres

Session agenda

16:00	Progress in EM	SAWKEY, Daren Lewis
16:20	Progress on occurrence biasing: formalism, ToyMC validation, case of varying cross-sections	DESORGHER, Laurent
16:40	Geometry biasing facilities	HOWARD, Alexander
17:00	Final state biasing: forced flight (along direction), other ?	VERDERI, Marc
17:20	General Discussion : -feedback on design; -plans for 9.6; -plans for X	

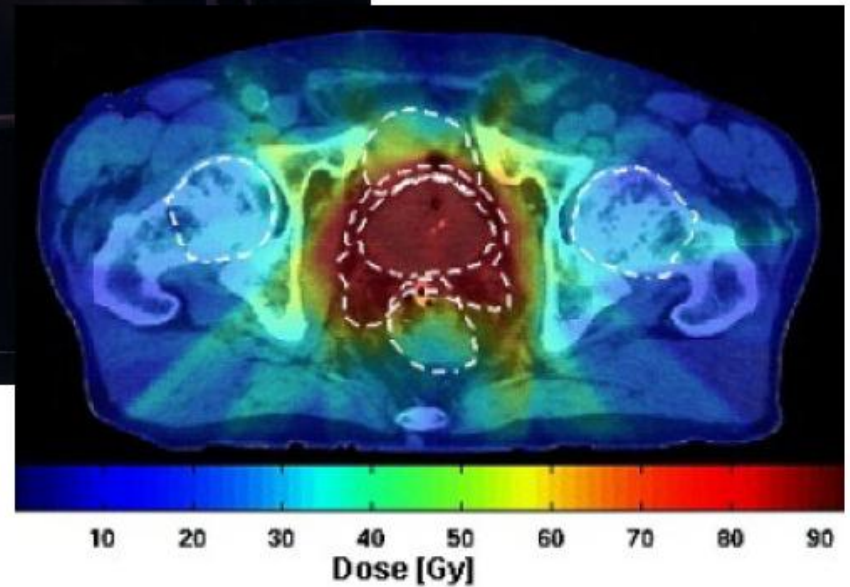
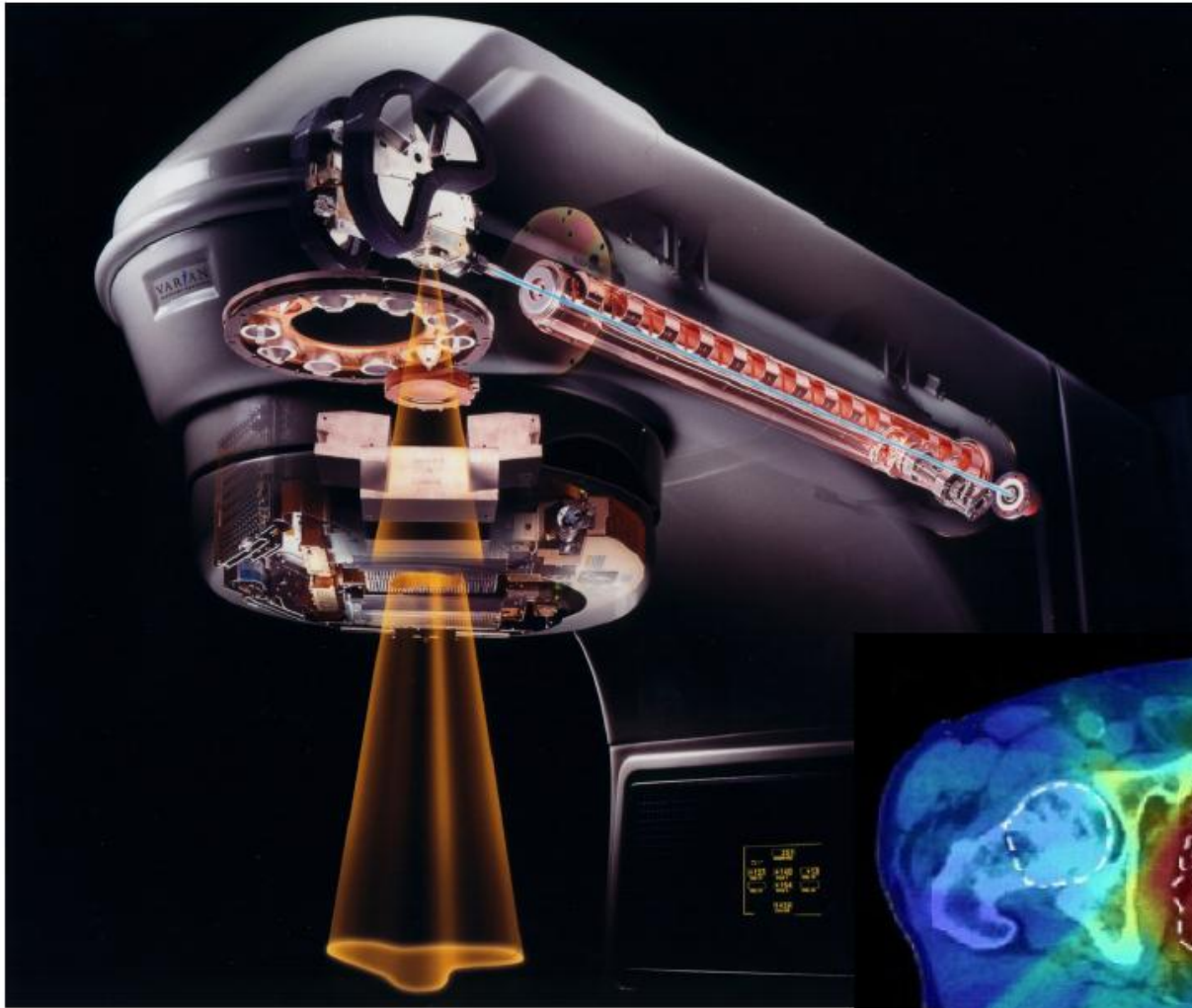
Introducing EGSnrc/BEAMnrc style variance reduction techniques into Geant4

Daren Sawkey

Varian Medical Systems

September 13, 2012





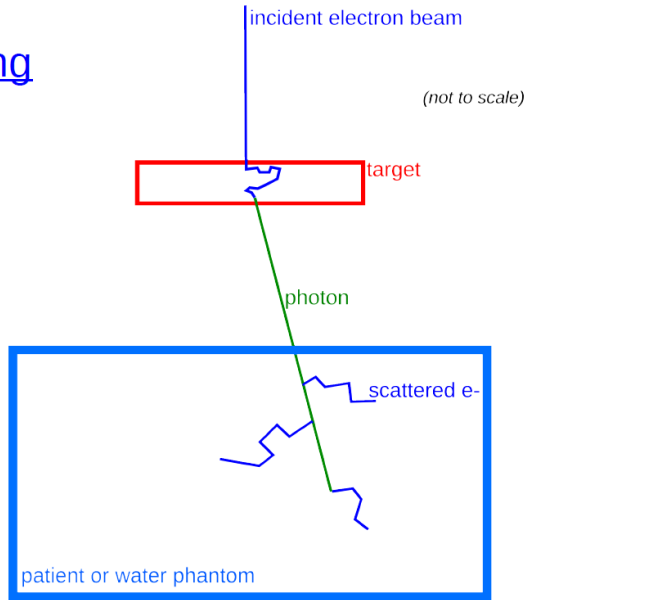
Trofimov et al IJROBP 2007

Introducing EGSnrc/BEAMnrc style variance reduction techniques into Geant4

motivation:

- physicist working alone with a few computers
- patient waiting for treatment (on table?)
- speed important
 - => many codes developed to do simulations more quickly
 - BEAMnrc, VMC++, Peregrine, MMC ...

No biasing

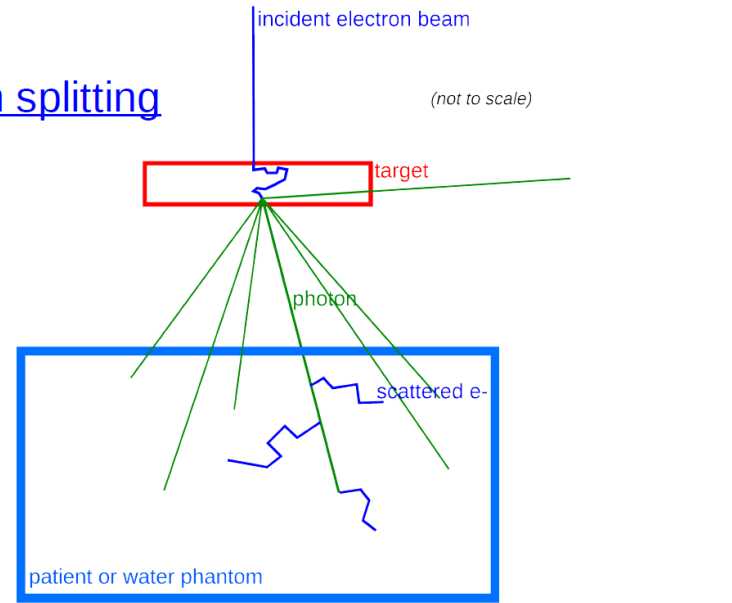


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Introducing EGSnrc style variance reduction ...

brem splitting

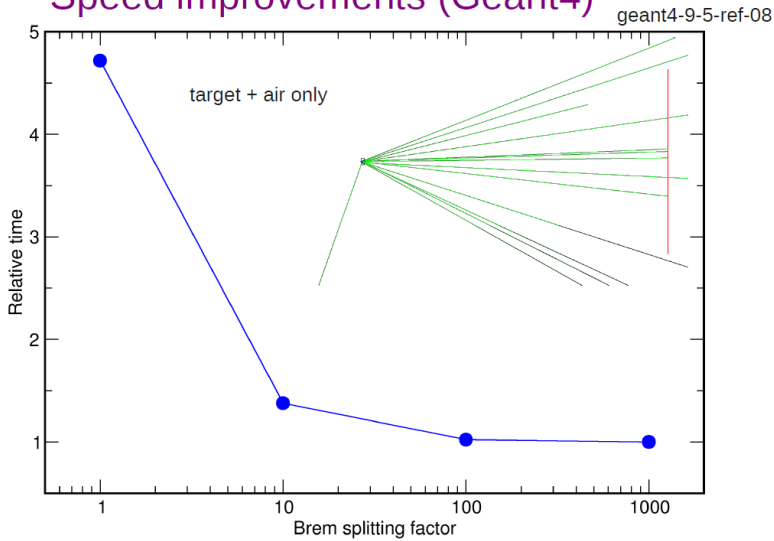


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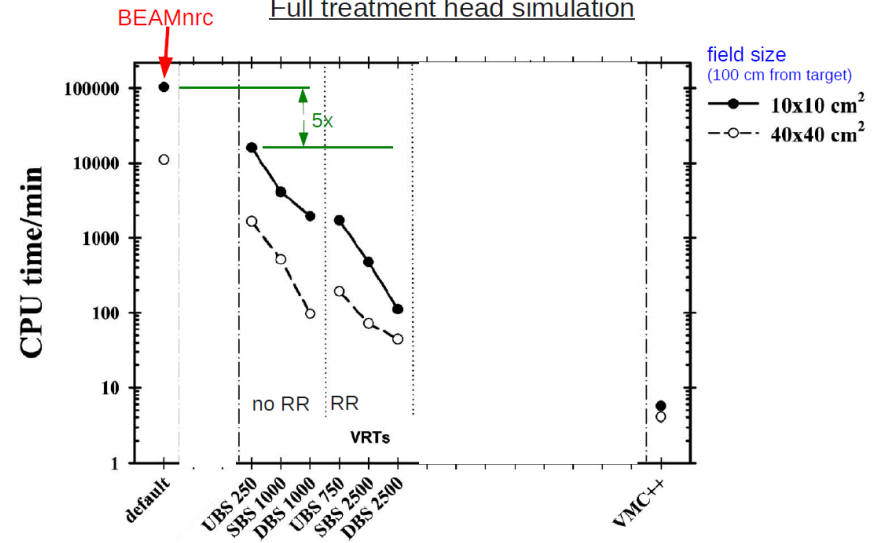
Introducing EGSnrc style variance reduction ...

Speed improvements (Geant4)



D

Full treatment head simulation



Fragoso Med Phys 2009

UBS: Uniform Brem Splitting
DBS: Directional Brem Splitting

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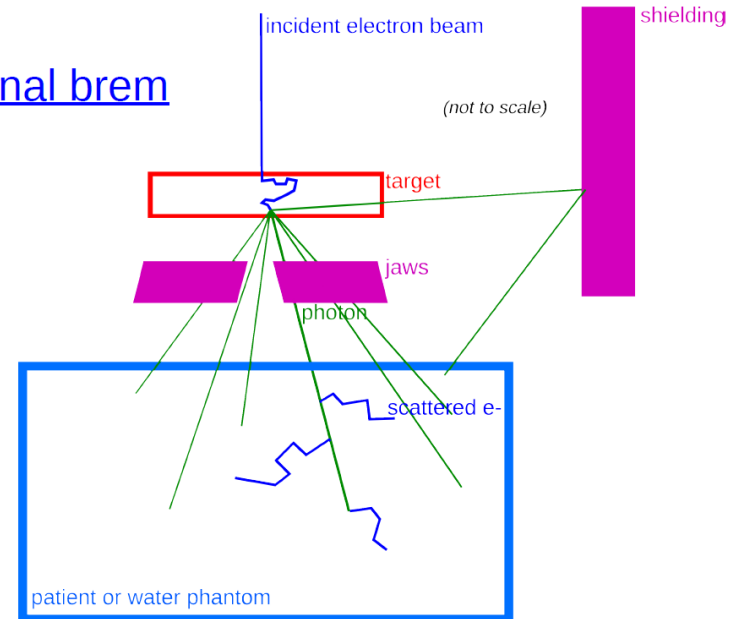
Introducing EGSnrc style variance reduction ...

Introducing EGSnrc/BEAMnrc style variance reduction techniques into Geant4

to do:

- documentation
- automatic testing
- directional brems splitting
- electron splitting
- etc. (e.g. brems cross section enhancement)
- request for forced interaction at a point (kernels)

Directional brems splitting



Geometrical Event Biasing Facility

1. **Geometrical Event Biasing**
2. **Space User experience**
3. **“Smart” Biasing Facility**
4. **Discussion**

Alex Howard ETH, Zurich
Geometrical Event Biasing Facility
Geant4 Collaboration Meeting, Chartres

Geometric Biasing

The purpose of geometry based event biasing is to save computing time* by sampling less often the particle histories entering “less important” geometry regions, and more often in more “important” regions.

- Importance sampling technique
- Weight window technique

*** But what about development time?
(including debugging/doing something crazy)**

Smart Biasing Solution?

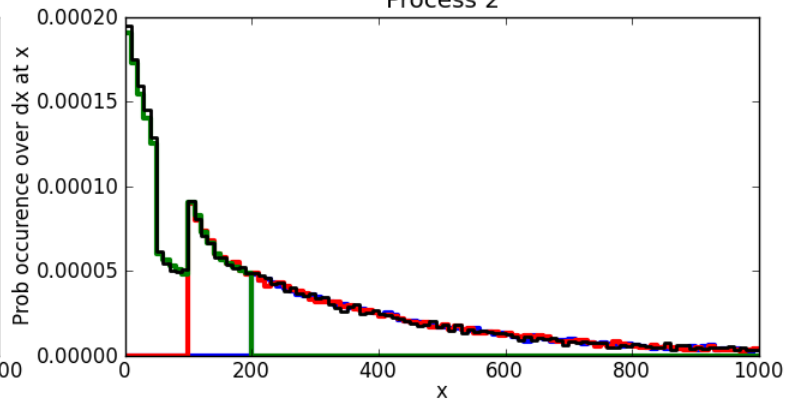
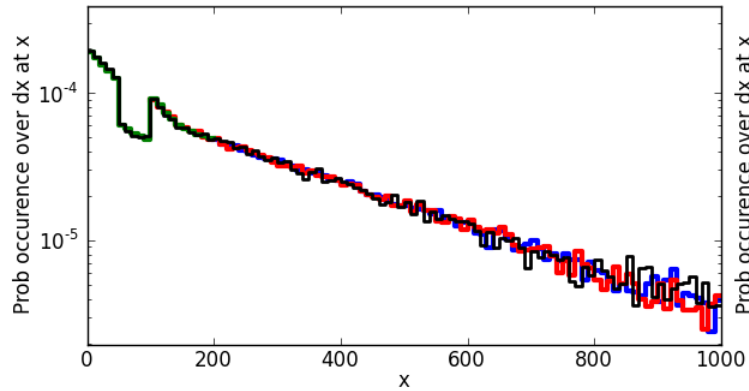
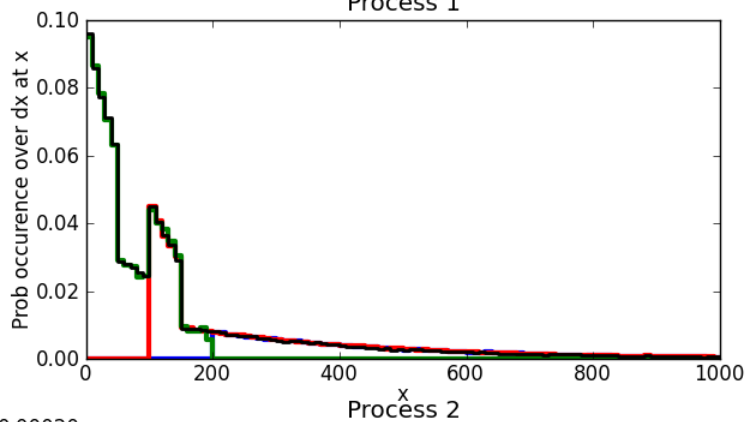
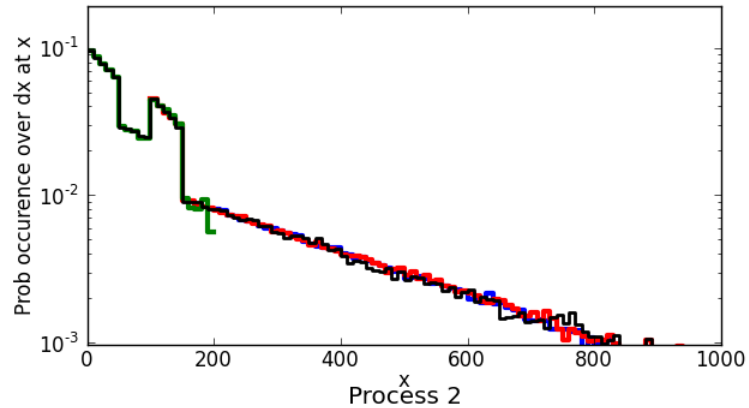
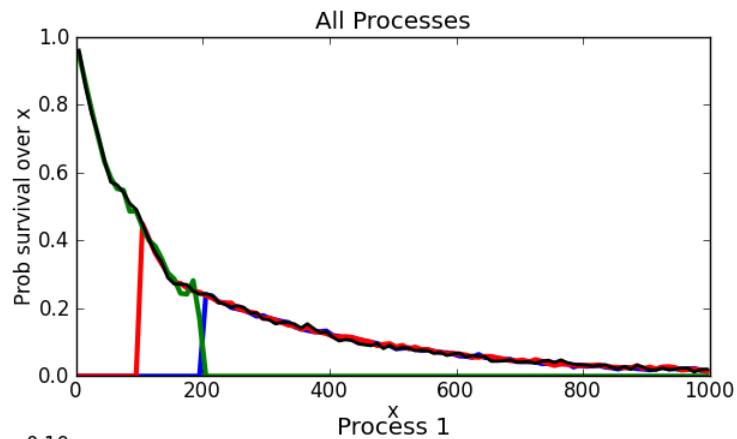
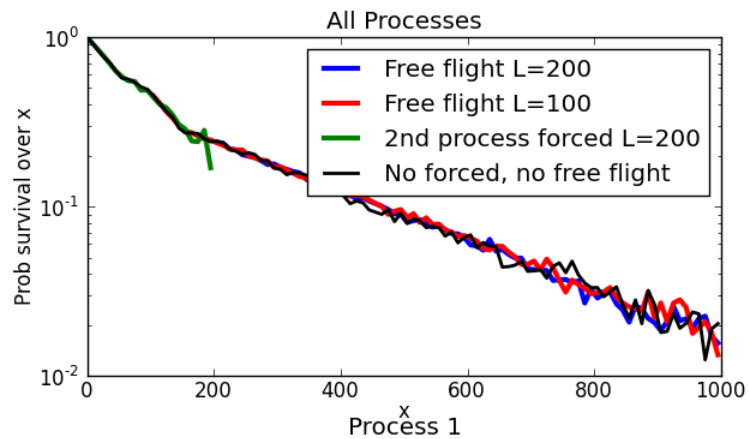
- Easy solution: Create parallel geometry attached to region of interest/mass geometry?
- Important biasing activated through simple UI commands
 - Geant4 takes care of matching the mass geometry (co-ordinate and envelope coincidence)
 - User has option to define directionality, granularity and weight settings
- Aside: Could we have a common interface/implementation with Reverse Monte Carlo?

Is it possible? / Which “helper” classes?

- How much would the user have to define?
 - E.g. GRAS vs. MULASSIS solutions
 - Start and end co-ordinates with direction?
- Can Geant4 be smart?
 - Take information from particle gun and sensitive detector?
 - Get cross-section table from physics list
- Can the biasing process be smart?
 - The instantiation, initialisation and implementation are crucial
 - Had some difficulties with GRAS (custom RunManager, detector constructor etc....)
 - Things must occur at the right time
- How to check the result?
 - Convergence testing? Sub-running/optimisation?
- Is it worth the effort? Users? Advanced knowledge?

Progress on occurrence biasing:
formalism, ToyMC validation, case of
varying cross-sections

Laurent Desorgher

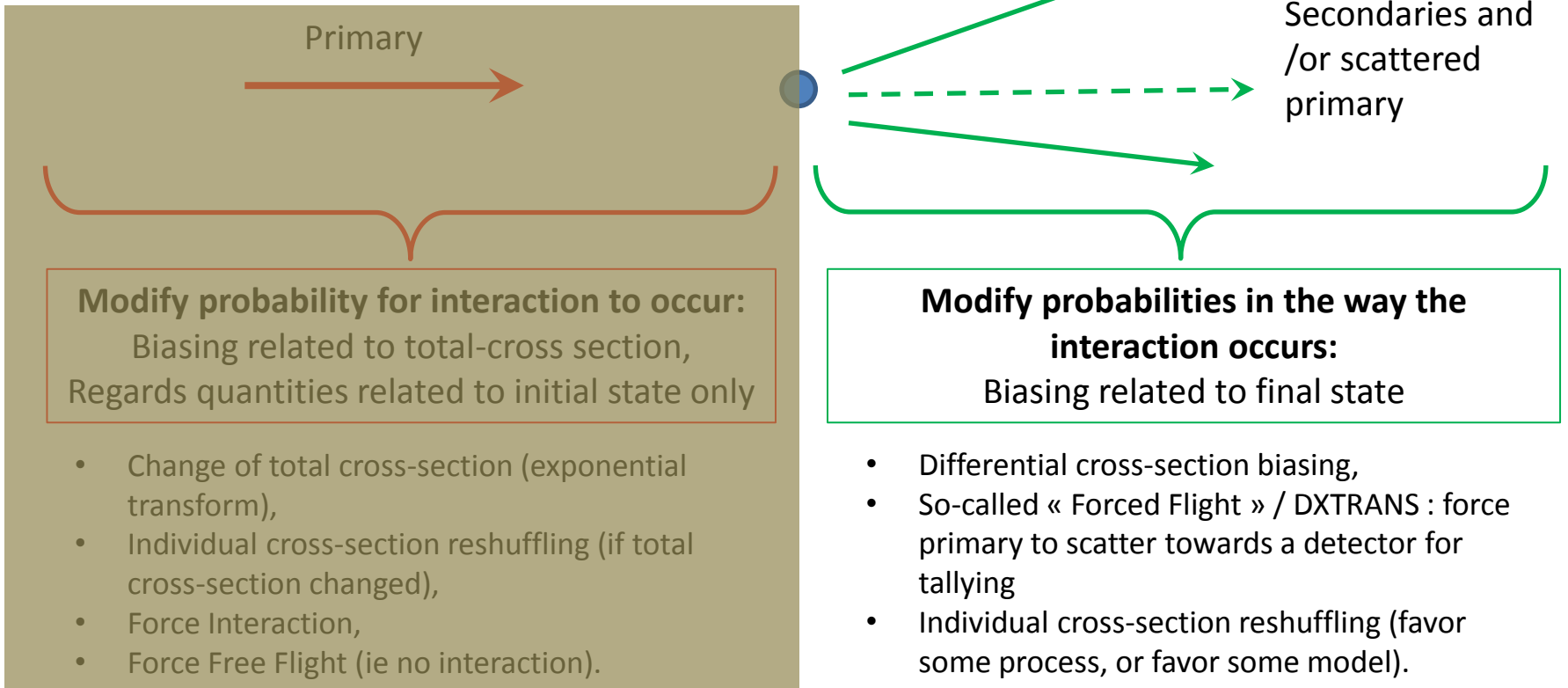


Final State Biasing

Discussion start

Introduction

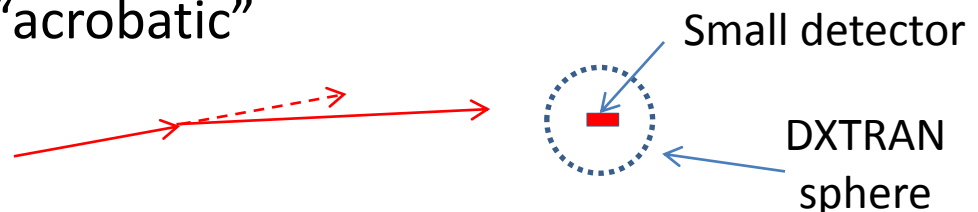
- Final state biasing :



- Anything that modifies the description of the interaction once it occurred.

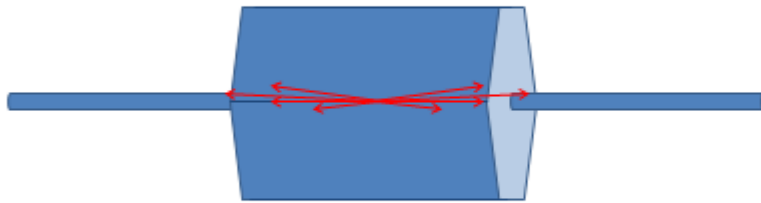
Introduction

- We have some final state biasing in the “splitting” mode:
 - Bremsstrahlung splitting
- But none in the “importance sampling” one
 - Where we do change the physical laws
 - Note we have however on the paper the individual process force/enhance cross-section option that is a final state biasing.
- Not much final state biasing options exist (to my knowledge). The only one I heard about is the “DXTRANS” = deterministic transportation
 - The track is forced to scatter towards a “DXTRANS” sphere without interaction up to this sphere
 - This sphere contains the scorer of interest
 - Weight correction is “acrobatic”



Other final state biasing ?

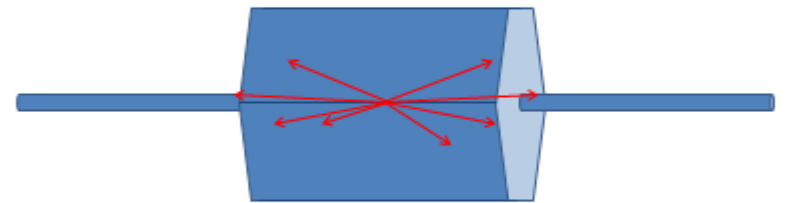
- Dose computation off-axis:



- EM physics processes peaked forward
- Make final state more open

Other final state biasing ?

- Dose computation off-axis:



- EM physics processes peaked forward
- Make final state more open

General Discussion

Discussion

- Review of the design for occurrence biasing (cross-section change, forced interaction, forced free flight)
 - Design based on wrapper process confirmed
 - Solves the physics handling aspect
 - Need to make progress on facilities proposed to user
 - How to propose cross-section change, forced interaction, etc. so that a user may combine them to customize his/her biasing setup
 - Toolkit approach
- Do not expect to deliver something in 9.6 for occurrence biasing
 - But 10.0/X is the target
- To do / agreed:
 - Need to make progress on final state biasing
 - Lack of differential cross-section facility shared by processes is an important difficulty
 - Need to analyze issue, and make a decision on it.
 - Limit to only some processes ? (eg brem)
 - Targeted for 10.0/X
 - Agree to define and share a set of simulation setups that cover most use-cases to exercise designs and implementations
 - Neutrino tunnel, Brem splitting in Linac, nuclear interaction in mirco-elec. , forced interaction (thin volume)
 - Manpower is an issue.
 - Cross-category activity
 - Will be pushed by regular meeting