

Planned Geant4 developments for ATF2 @ LLR

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Presentation

- ▶ I am new to the ATF-2 project
 - My actual work will start beginning 2007
 - Working on BaBar now
- ▶ Member of the Geant4 collaboration
 - Kernel, shower parameterization framework, parallel geometry facility,...
- ▶ Post-doc position proposed, starting beginning 2007, for two years, to work on this background computation issue.

Introduction

- ▶ Goal/desire to compute/estimate background levels in sensitive parts of ATF-2
 - Beam monitor devices for example
- ▶ Background estimations can be difficult to realize as main contributions may come from complicated “topologies”:
 - (Multi)back-scattering from beam dump
 - Particles in beam halo, interacting with collimators, beam pipe wall, elements,... leading to lost particles traveling in the tunnel, etc...
- ▶ Facing difficulties with statistics
 - Large productions performed to get usable statistics in the regions of interest
- ▶ Could we estimate the background levels in other ways ?
 - We propose to study the “event biasing” technique
 - This is a variance reduction technique

Variance reduction ?

(my understanding !)

- ▶ Assume we want to measure a mean value m of some quantity x and that we have a (say unbiased) estimator for it, E_1 :
 - This estimation of m with E_1 comes together with a variance V_1
- ▶ Making a variance reduction is to find an other (unbiased preferably) estimator, E_2 , for m , of smaller variance V_2 .
 - Easy on the paper only.
- ▶ Properly said, the variance is not “reduced”
 - but the quantities of interest are estimated from estimators of smaller variances (than the “brute force” ones).
- ▶ In practice, this means “try to put more computing power where needed and less where not needed”.
 - How this could be ?

Event biasing technique examples

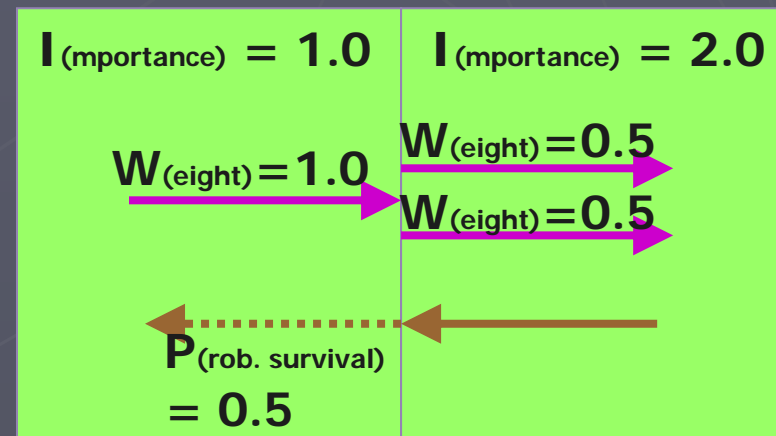
(existing in Geant4, not exhaustive)

- ▶ Leading particle biasing:
 - Useful to estimate a shield thickness, without simulating full showers



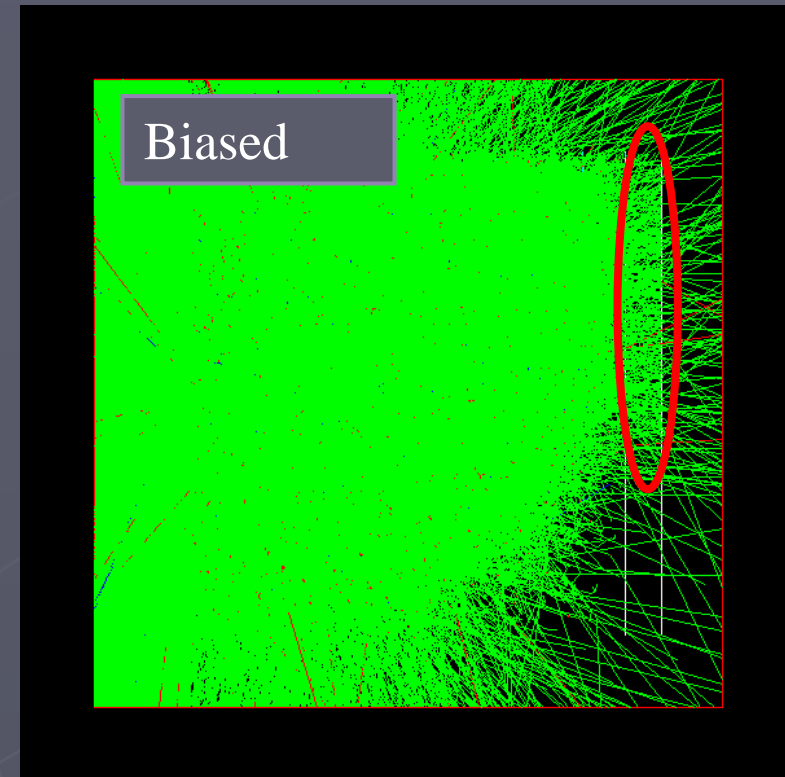
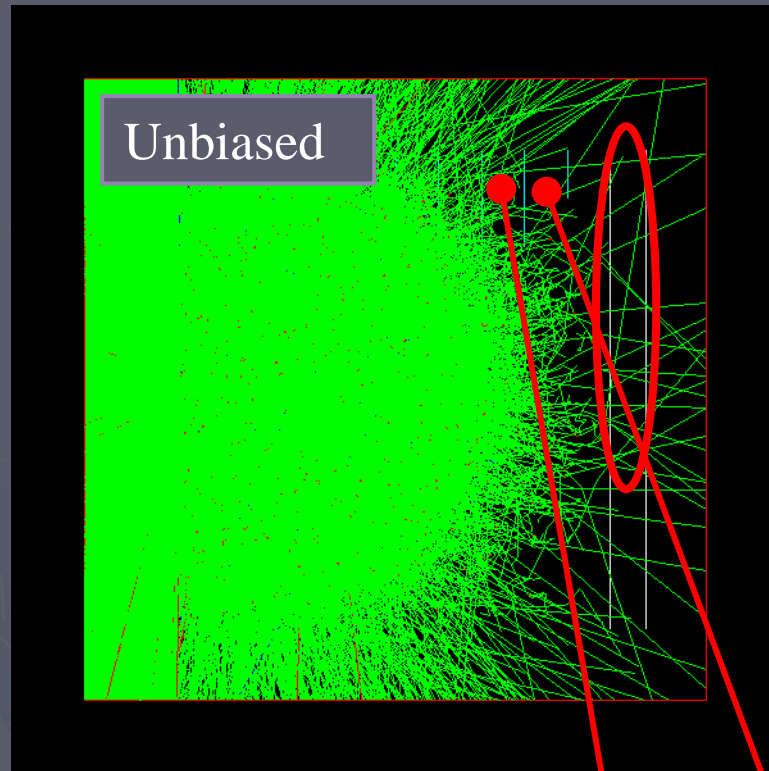
Only for hadronic processes in G4

- ▶ Geometrical biasing:
 - Define geometrical importances
 - Duplicate[kill] tracks accordingly
 - ▶ Propagate track weight



- ▶ Physics biasing:
 - Biasing secondary production in terms of particle type, momentum distribution, cross-section, etc.

Example of “Biased” events



- ▶ Low probability configurations have been enhanced by a “geometrical biasing” technique
 - From left to right, volume importance multiplied each time by 2 when going from slice i to slice $i+1$
 - In biased case, workable statistics obtained in the deepest slice

Roadmap

- ▶ Delicate techniques to handle !
- ▶ Assess the validity and usefulness of such techniques for the case of the background computation in ATF-2
- ▶ We will need to:
 - Learn more about these techniques
 - Prototype, on low complexity setups
 - Move to realistic ATF-2 description(s) if results are satisfactory

Help...

▶ We will need help on:

- BDSIM
 - ▶ Both from the technical, and physical (beam physics, etc...) point of views
- Computation on the GRID(s)
 - ▶ Olivier's work
- ATF-2 setup description
 - ▶ Geometry, materials
 - ▶ Monitors
 - ▶ But also beam and beam related features (halo, vacuum, etc...)

▶ We will have vital needs for discussions:

- Understand needs in terms of background estimation
 - ▶ Background levels, nature, tolerance on estimation...
 - ▶ Related schedules of these background estimations
- Background monitors and measurements
 - ▶ Foreseen or to be foreseen
 - ▶ Commissioning ?
- Other ... ?