

Auxiliary Track Information

Plenary 4 - Updates of Kernel, Geometry

Fermilab Geant4 Collaboration Meeting
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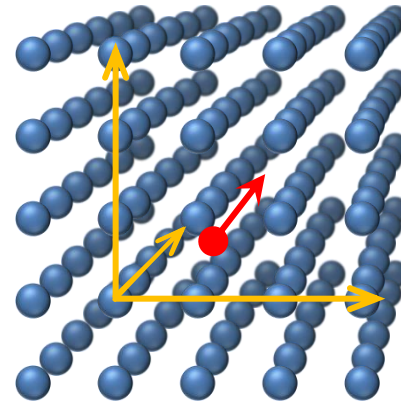
Introduction

- G4Track could already be extended by users with G4VUserTrackInformation.
- But no similar mechanism existed for kernel classes that would need more information to be associated with the G4Track.
 - Only processes look to be concerned by this need.
- Types of extra data considered are too diverse to just make the G4Track class (indefinitely) growing:
 - For example biasing, channeling, phonon/electron/hole processes and DNA need this sort of extra information.
 - But there is no commonality in information between these !
- Need a mechanism for optional addition of information to the G4Track.
 - Transparent to existing processes.
 - At nearly no extra cost for applications not using this.
- Such a “track extension” mechanism has been introduced in 10.2-beta.
- Explain here:
 - Some use cases
 - The solution adopted

(NON EXHAUSTIVE) USE CASES

Use Case in Channeling

- Today, channeling uses a `G4VUserTrackInformation` to store:
 - The position and the transverse momentum of track in the crystal reference system.
 - The modified density ratio : density “seen” by the track depending on its position and direction in the crystal reference system.
 - The modified density ratio is shared by (wrappers of) physics processes.



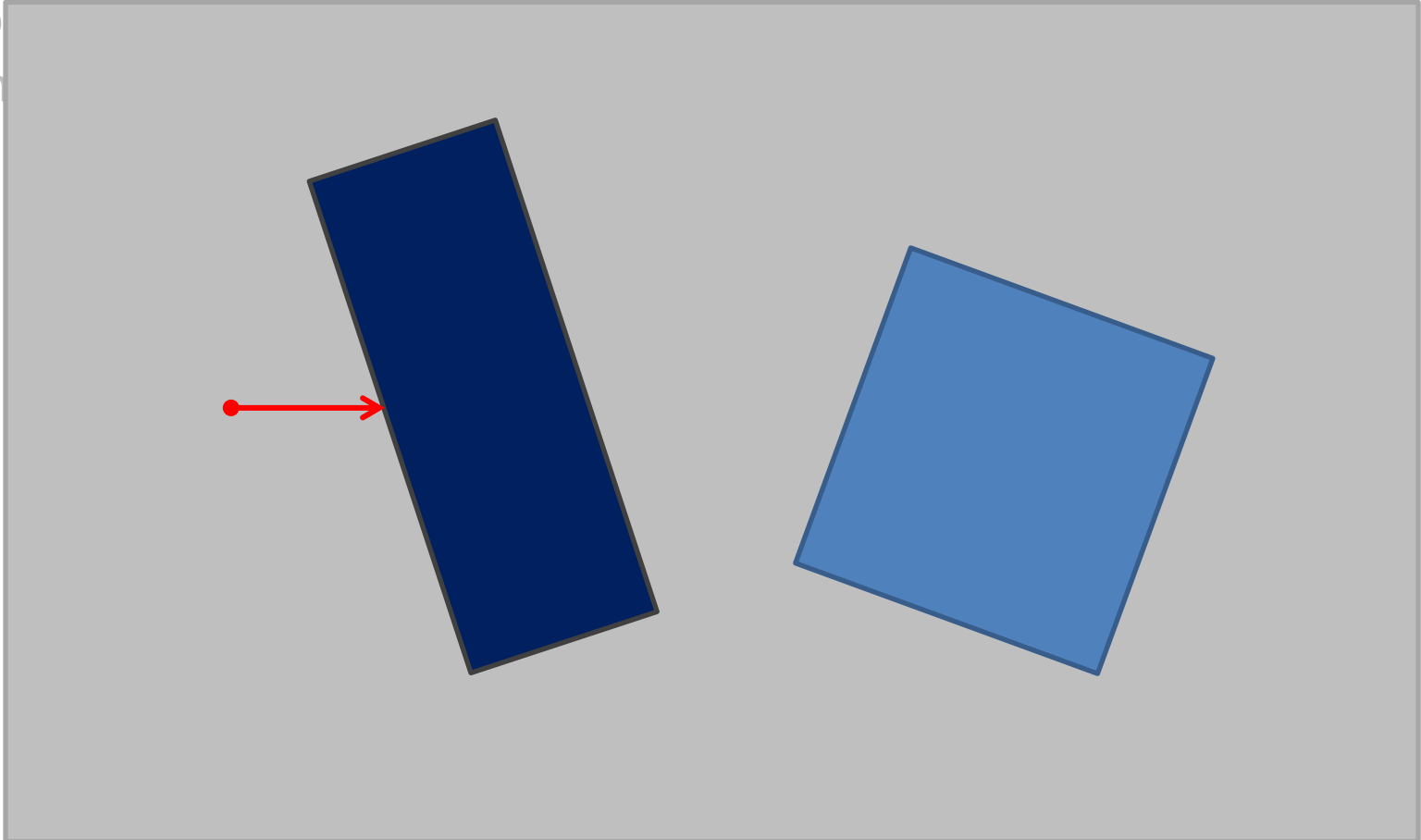
- Making use of `G4VUserTrackInformation` interferes with user’s code
 - Only a temporary solution
- Promoting channeling processes to the kernel level, requires that channeling does not depend on user classes.
- Need to transfer `G4VUserTrackInformation` content to a kernel class.

Use Case in Biasing

- Some techniques must correlate several track fates
- An example is the “force collision” scheme à la MCNP

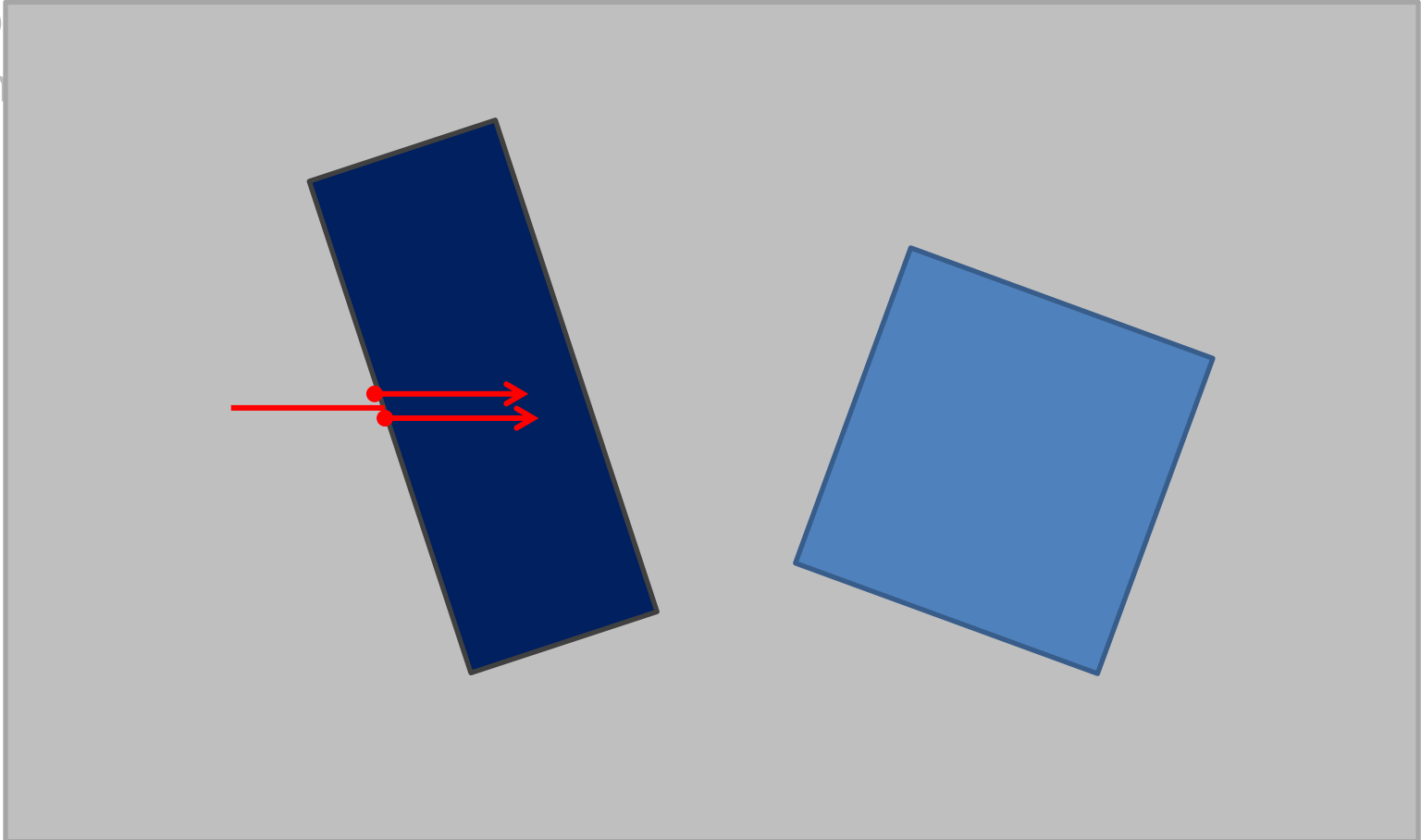
Use Case in Biasing

- So
- An



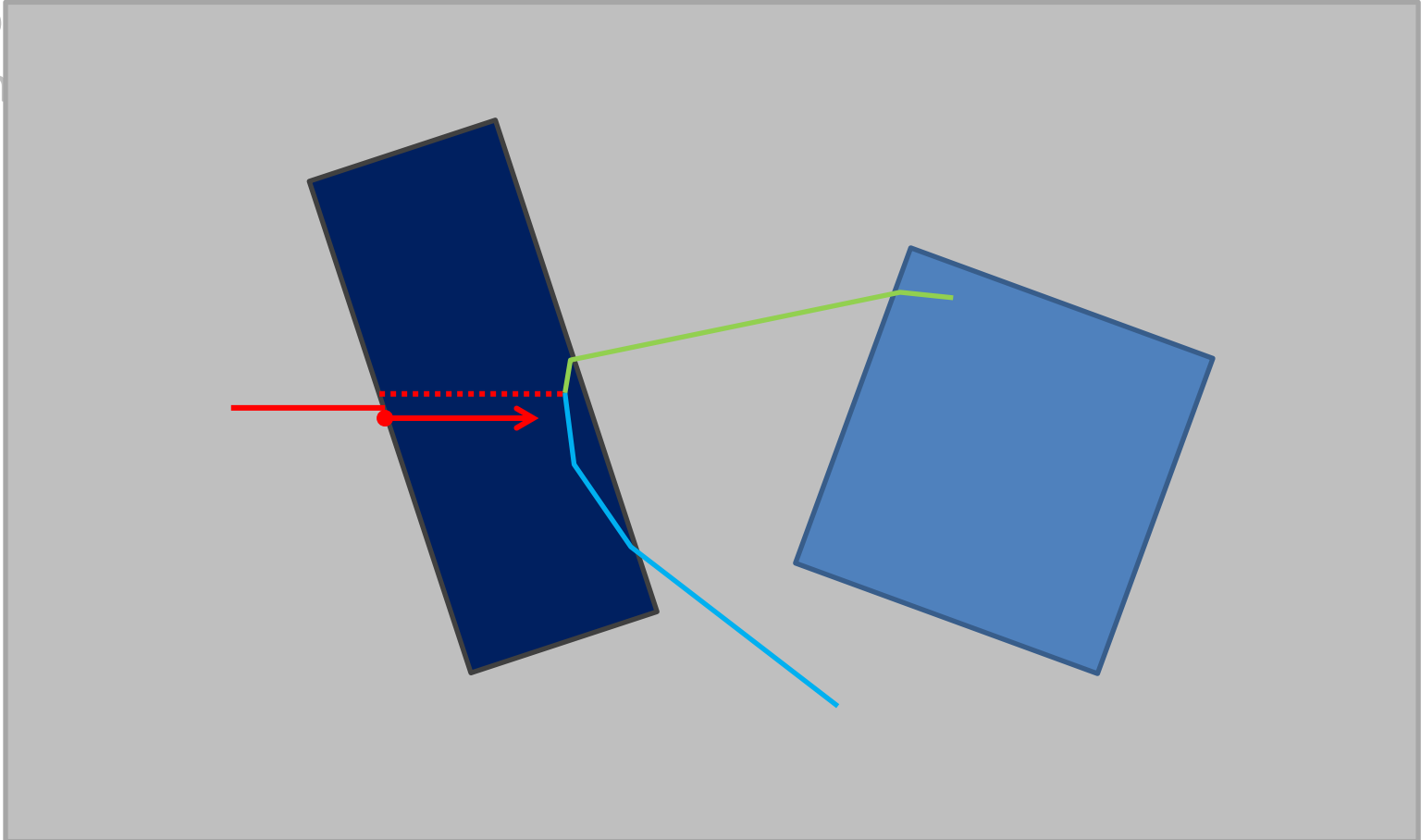
Use Case in Biasing

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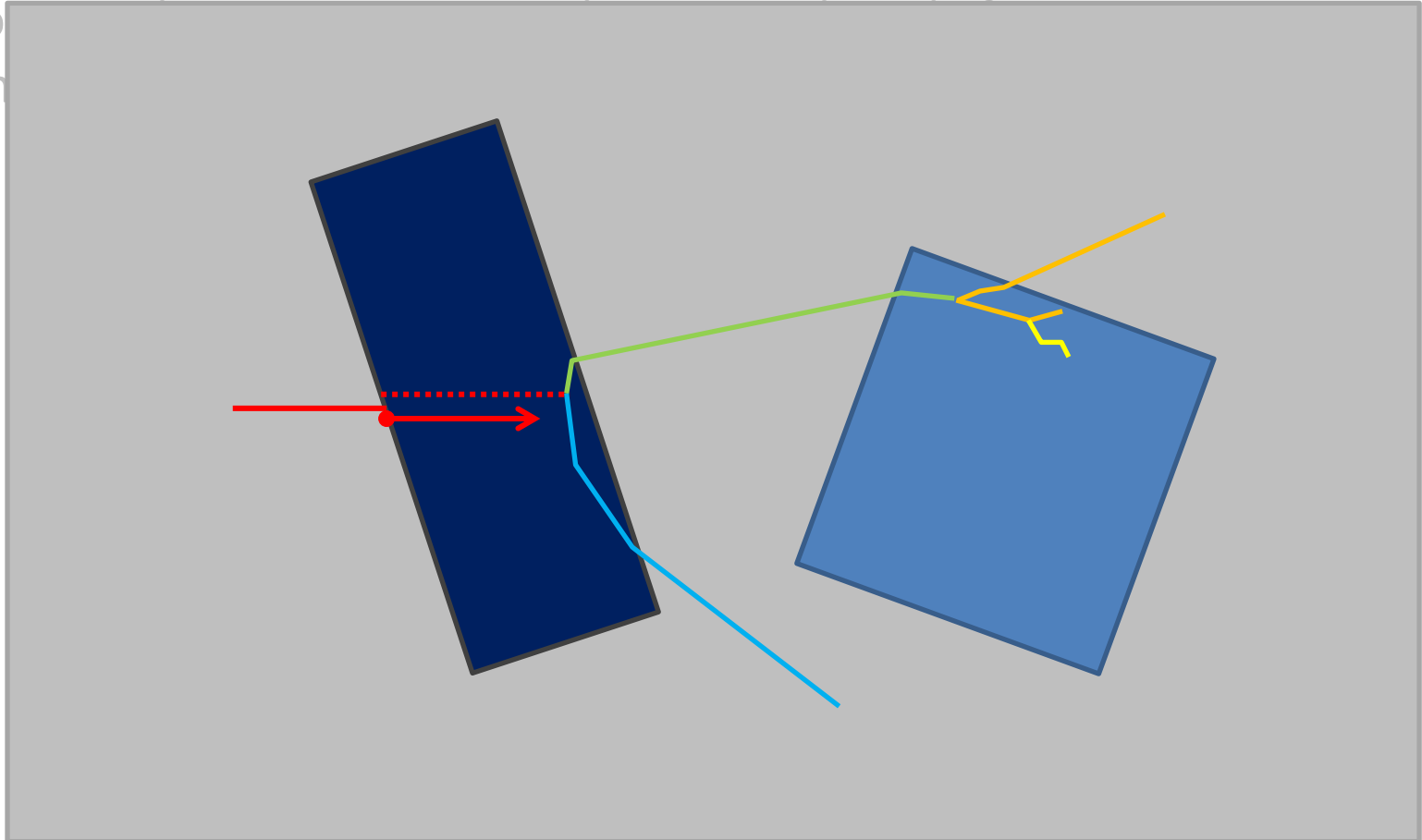
Use Case in Biasing

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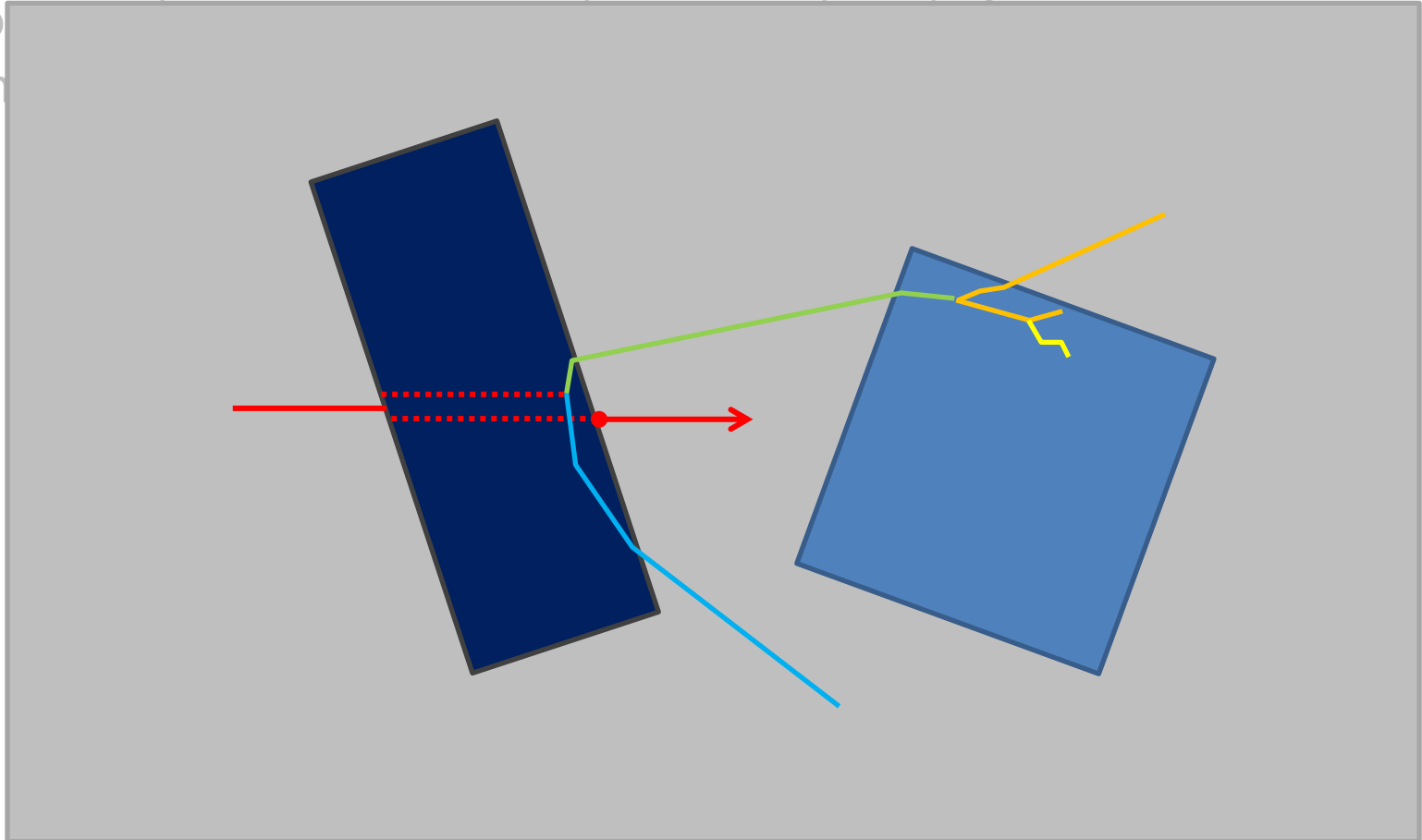
Use Case in Biasing

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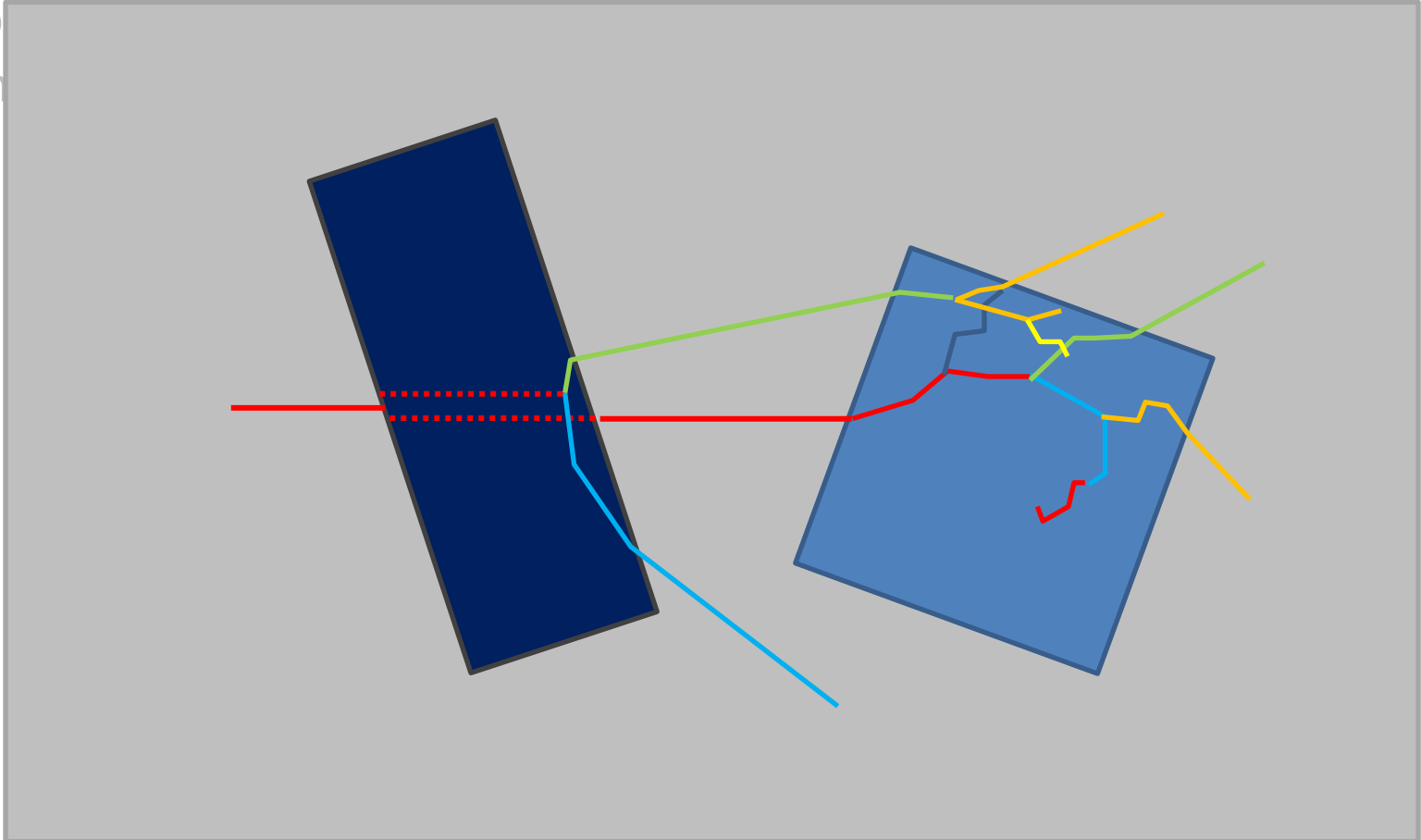
Use Case in Biasing

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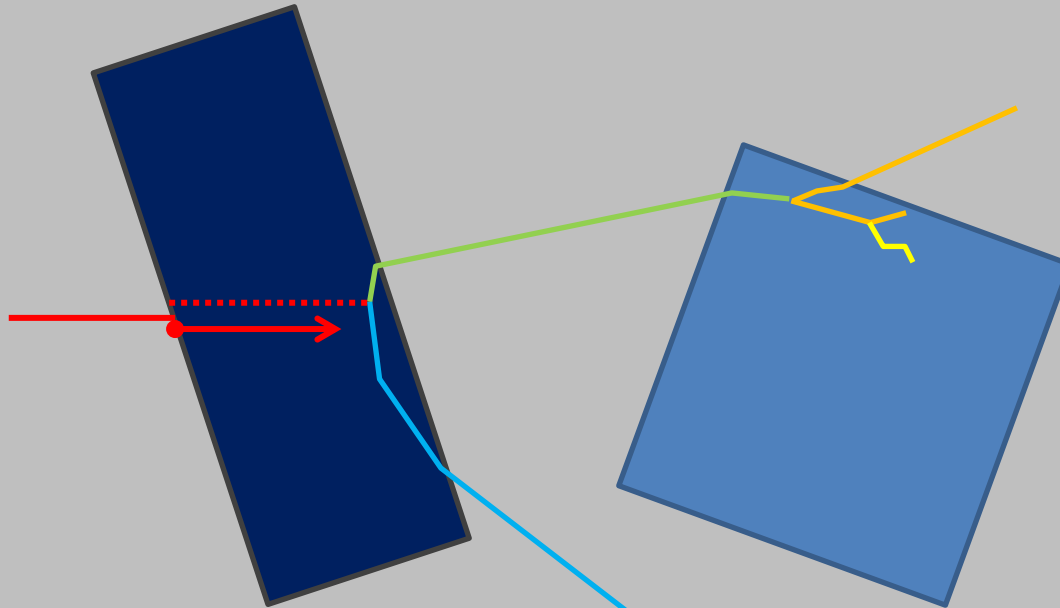
Use Case in Biasing

- So
- An



Use Case in Biasing

- So
- An



At this stage : track on stack, no track ID yet, no way to identify it unambiguously, even with its track pointer.

If it disappears (eg : stacking action), biasing can't know.

Use Case in Biasing

- Some techniques must correlate several track fates
- An example is the “force collision” scheme à la MCNP
- Need:
 - To “remember” that a track has to undergo a specific biasing operation
 - To make sure that no one (eg : stacking action) will delete this track in between
 - Biasing would be unaware that this deletion happened !
- Today, biasing stores the track pointer:
 - But this is a fragile mechanism
 - If a deletion happens, likely an other track with same pointer will be created !
 - Causing a mess...
- Keeping information in the track itself would be a robust solution.

SOLUTION ADOPTED

G4VAuxiliaryTrackInformation (1/2)

- Initial proposal (Enrico Bagli and myself):
 - Have a mechanism to identify clients for track extension with an ID:
 - ID associated with a name for readability
 - ID values defined at initialization time
 - Have a track extension abstract class
 - To inherit from and in which information are stored
 - Make a map of above, kept in the G4Track
 - The G4Track deletes extensions, if any, at track deletion.
 - Next to zero cost if no extensions are defined.
- Respond to use cases:
 - Channeling & DNA : extra data can be stored
 - Biasing : idem + if undesired track deletion happens, destructor of extension can take action.

G4VAuxiliaryTrackInformation (2/2)

- Proposal iteration and implementation:
 - Makoto proposed that the mechanism to generate ID's should be provided by the G4PhysicsModelCatalog.
 - ID obtained by, eg:

```
ChannelingID = G4PhysicsModelCatalog::Register("channeling");
```
 - Call made in process PreparePhysicsTable(...)
 - Ensure that ID's will be common to threads.
 - Makoto proposed to make the <ID, track information> map mutable
 - And he made the implementation.
- Class for extension is G4VAuxiliaryTrackInformation
 - In track category
- Track receives extra information by:

```
SetAuxiliaryTrackInformation(G4int ID, G4VAuxiliaryTrackInformation* info)
```
- Functionality provided in 10.2-beta.
- Soon exploited in channeling, biasing, phonons and DNA.