LVL2 TRACKING

Development of SiTrack

- **Cut optimization and tuning procedures**
- SiTrack pattern recognition proceeds by combining spacepoints in pairs, then in triplets, finally in full tracks: cuts are applied on the combinations at all the stages
- These cuts were designed to operate with pointing tracks from collisions
- In order to cope with displaced beamspot and cosmics we introduced a “robust” set of cuts and, for cosmics, we introduced additional cuts while greatly enlarging the standard ones
- It is now time to coherently re-think about all the selections applied in SiTrack, to optimize them and to cross-check the tuning between MC and real data
- We also want to define a correspondence between basic quantities (minimum reconstructible pT, maximum reconstructible d0, level of expected misalignment) and internal SiTrack cuts, so that the “user” can easily intervene on the tuning, when needed
- Requires: theoretical re-thinking on the cuts; implementation; development of tuning methods for both MC and real data; tuning; comparison of new code w.r.t. the standard one in terms of efficiency/fakes/timing
- Persons currently involved: Andrea F., Carlo
- Status: 10%
- Coverage: 100%
- Timescale: two months

Development of SiTrack

- **Combinatorial code optimization - logical layers**
- SiTrack combines spacepoints after grouping them in three “logical” sets of detector layers
- In the old “static” SiTrack operation mode the definition of the logical layers was written directly in the trigger configuration for each slice (egamma, muon...) and was adopted for all RoIs of that given type
- Information on dead modules will be available and SiTrack must then be capable of exploiying it; more physical layers are inserted in a logical layer if this lacks too many modules (can be decided in the configuration)
- The definition of logical layers is now dependent on eta; should use standard tools in the future
- This “dynamic” extension of SiTrack affects all the stages of reconstruction and increases their timing; this is partly unavoidable, and partly an interference of the new way of defining layers with the old design of the code
- More processing time could be saved by avoiding data access for unnecessary modules (e.g. modules which are not pointing to any track seed, during the extension process)
- Requires: re-design of the combinatorial process; re-implementation; comparison of new w.r.t. old
- Persons currently involved: Andrea F., Carlo
- Status: 30%
- Coverage: 100%
- Timescale: two months

Development of SiTrack

- **Combinatorial code optimization - noise robustness**
- SiTrack execution time strongly depends on the number of spacepoints in the region processed
- When confronted with very noisy cosmic events (for which the whole detectors are scanned), it was very slow and was finding a lot of fake tracks
- A cut on the maximum number of spacepoints per layer was applied inside SiTrack for cosmic operation
- This is acceptable for single tracks, but difficult to apply to jet reconstruction too
- A more sophisticated approach could foresee different module noise cut to be applied depending on the expected activity; e.g. a module with 30 spacepoints could be rejected during the extension of an isolated seed and used when extending a group of 5 seeds
- Modules disregarded in the first-pass pattern recognition should be then re-analyzed once full tracks have been identified; this should allow us to apply tight cuts on the first pass, while retaining full efficiency
- Requires: more thinking; implementation; test on noisy samples, like overlays of simulated jets with real noise
- Persons currently involved: Carlo, Andrea F.
- Status: 10%
- Coverage: 50%
- Timescale: three to four months

Development of SiTrack

- **Fit stability and resolution studies**
- SiTrack, as IDScan, provides a set of preliminary parameters for each track and then re-fits it with a common tool (developed by Dmitry E.)
- From our current experience it looks like the final fitter strongly depends on the rough input parameters
- This is hardly acceptable, as it makes resolution optimization very hard (difficult to disentangle the contribution of the rough fit and of the final re-fitting)
- The final re-fitter provides no information on outliers, chi-squared contributions for the individual spacepoints, etc, thus limiting the interaction between pattern recognition and fit
- We should investigate on this and, if needed, ask for optimization of the current fitting tool
- Alternatively, we could invest our efforts in producing an alternative final re-fitting tool, e.g. derived from offline
- Requires: extensive resolution tests; possibly the development of a new LVL2 fitter
- Persons currently involved: none
- Status: 0%
- Coverage: 0%
- Timescale: three to four months

MUON COMBINED TRACKING

Development of LVL2 muon slice

- **Correlation studies between SiTrack and muFast tracks**
- Both muFast and SiTrack algorithms have been run on recent cosmic data samples
- No correlation and matching studies have been produced so far
- As a first step, we should become capable of privately re-processing a limited cosmic data sample and re-producing MS and ID LVL2 tracks
- At this point we can study and possibly improve, on the ID side, the correlation between the tracks we find
- The next step is then to study possible matching criteria to be applied in order to correctly reconstruct a combined LVL2 track out of the input tracks
- These results are then to be compared with what obtained using muComb, the combined algorithm for LVL2
- Requires: small technical effort on re-processing; correlation studies; optimization of SiTrack if needed; study of possible matching criteria; comparison with muComb
- Persons currently involved: Andrea C., Carlo
- Status: 0%
- Coverage: 50%
- Timescale: three to four months

Development of EF muon slice

- **Development of MuTag/MuTagIMO porting for the EF**
- Offline code is equipped with standalone tracking algorithms (in the ID and MS), combined algorithms matching two independent tracks, segment tagging algorithms where and ID track is identified as a muon if matched to MS segments (track fragments), calo tagging algorithms
- The current EF muon slices adopt a combined tracking algorithm for high-pT selections (e.g. mu20) and a segment tagger (TrigMuGirl) for the low-pT B-physics case
- It was proposed to test also the use of MuTag/MuTagIMO (another approach to segment tagging, e.g. faster) at the EF; this could apply to both the high-pT case (to fill possible holes of combined reconstruction) and to lower pT selections relevant for B-physics
- We had a seminal involvement in this and should now profit of the long winter break to put more efforts in this development (mainly a reuse of offline code) and testing; once the basic development is over we can start performance studies, arguably related to the offline analyses; e.g. we could study if and how much a given channel can profit from this additional selection capability
- Requires: technical work on algorithm wrapping; optimization and validation
- Persons currently involved: Andrea C., Carlo
- Status: 0%
- Coverage: 25%
- Timescale: four months

Offline studies on cosmic data

- **Performance studies for offline algorithms**
- Data from recent cosmic runs will be re-processed in the near future; detailed plans still to be defined
- Furthermore, new overlay techniques became available, enabling e.g. to mix real noise with simulated events
- A lot of production/validation efforts are still needed to study all the possible combinations and the most interesting scenarios
- Once the overall coverage of these studies will be clear (within one week, presumably) we could embark on one of the “free” items
- In particular it would be interesting to choose a given signal sample in a given physics group and measure the performance of the different algorithms, studying how the analysis cuts must be differently optimized as a function of noise/pile-up/cavern background
- Requires: choice of a process; some technical expertise in offline data content and validation
- Persons currently involved: none
- Status: 0%
- Coverage: 0%
- Timescale: free