May 6th, 1998 DAQ Meeting

SVT status

(Silicon Vertex Tracker)

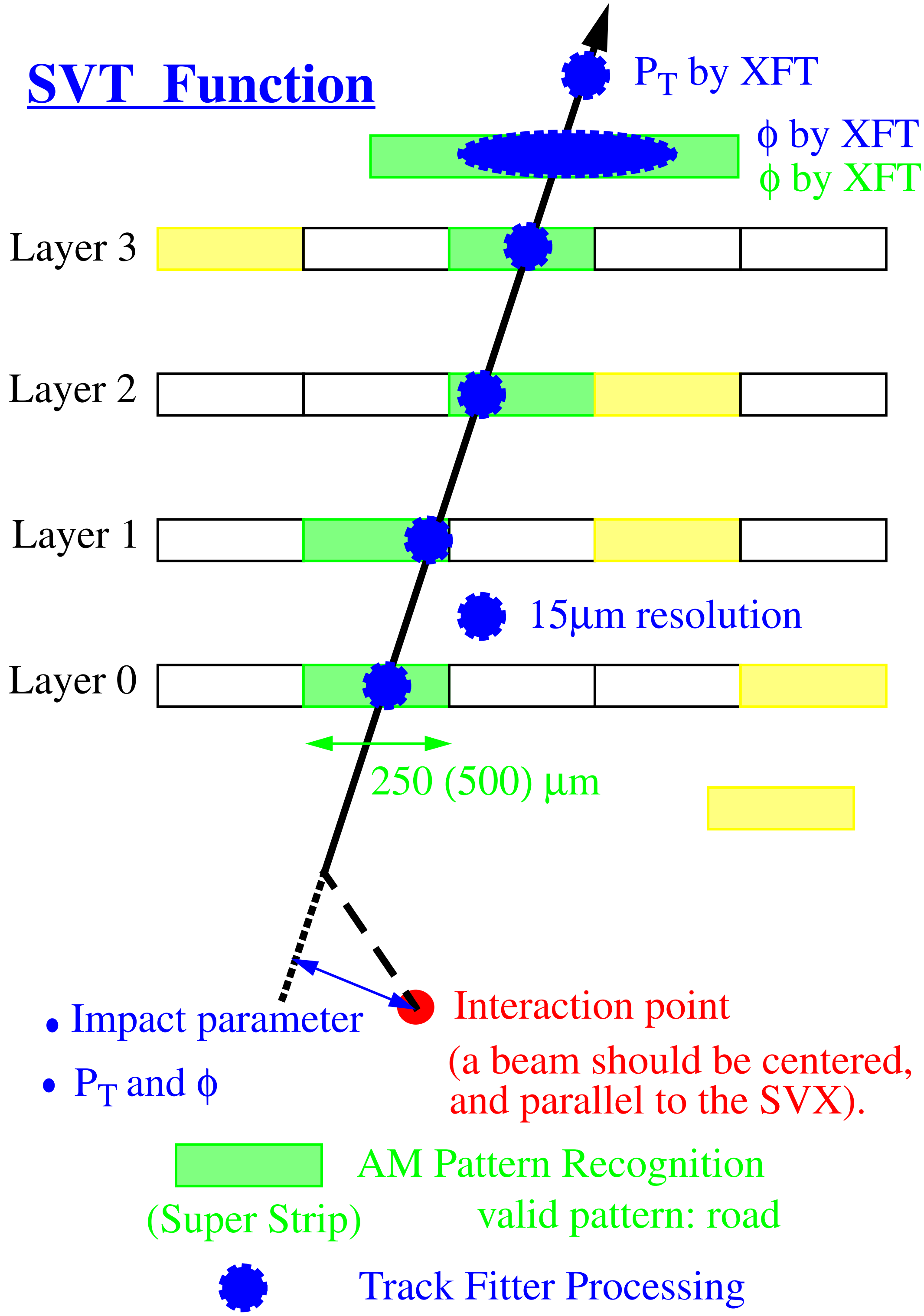
Impact Parameter L2 Trigger

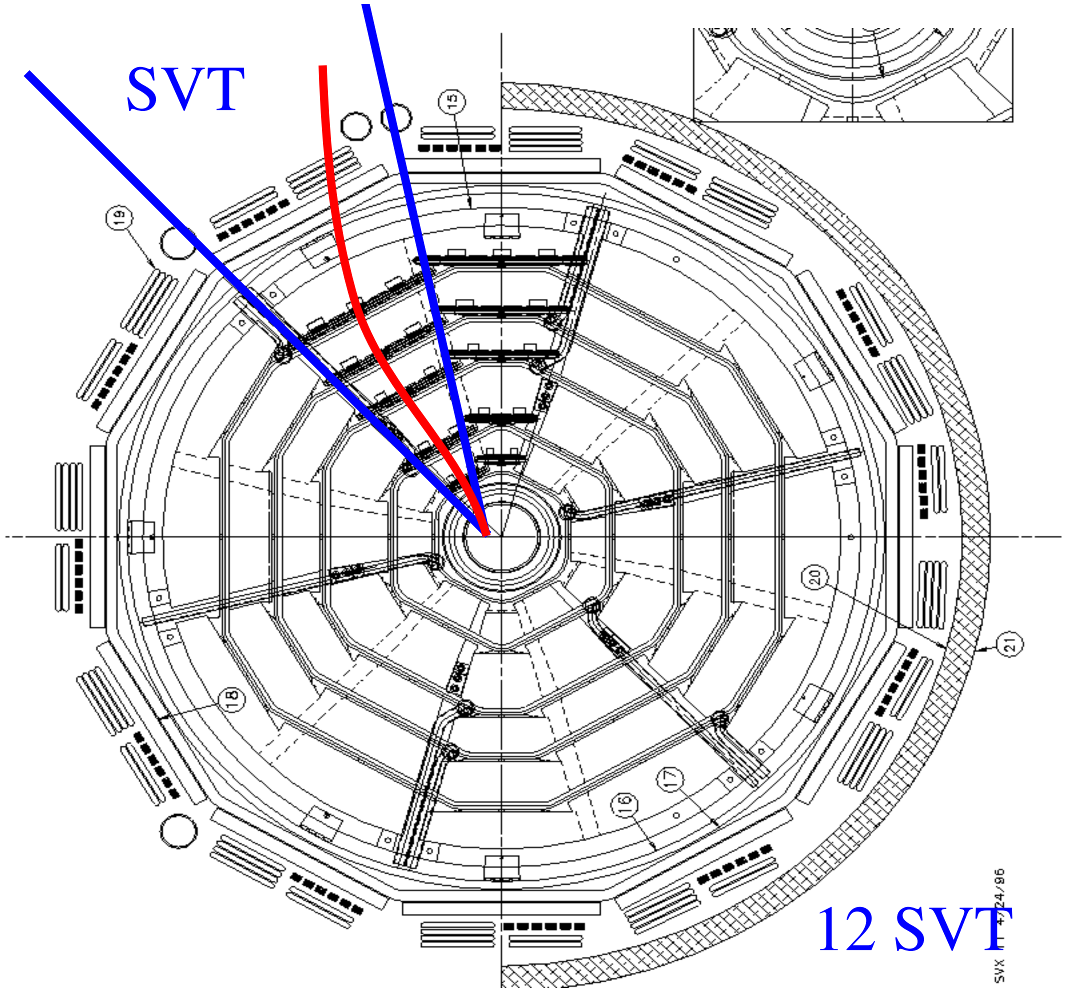
CHICAGO - GENEVE - PISA -TRIESTE

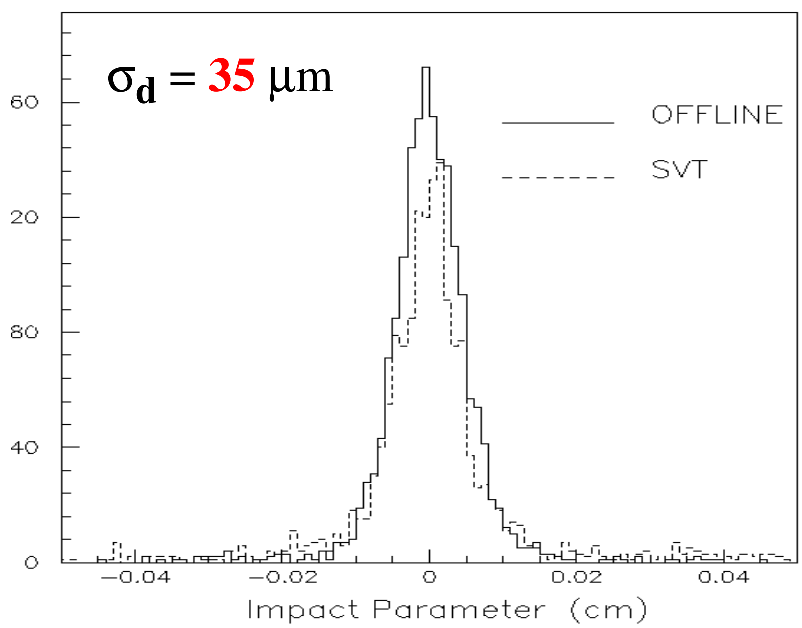
Tsuyoshi NAKAYA (U. of Chicago)

1. Introduction to the SVT
2. Status of Each Board
   - 2.1 Hit-Finder
   - 2.2 AM-system
   - 2.3 Hit Buffer
   - 2.4 Track Fitter
   - 2.5 Merger
   - 2.6 Others....
3. Software and some Studies...
4. Summary and Schedule

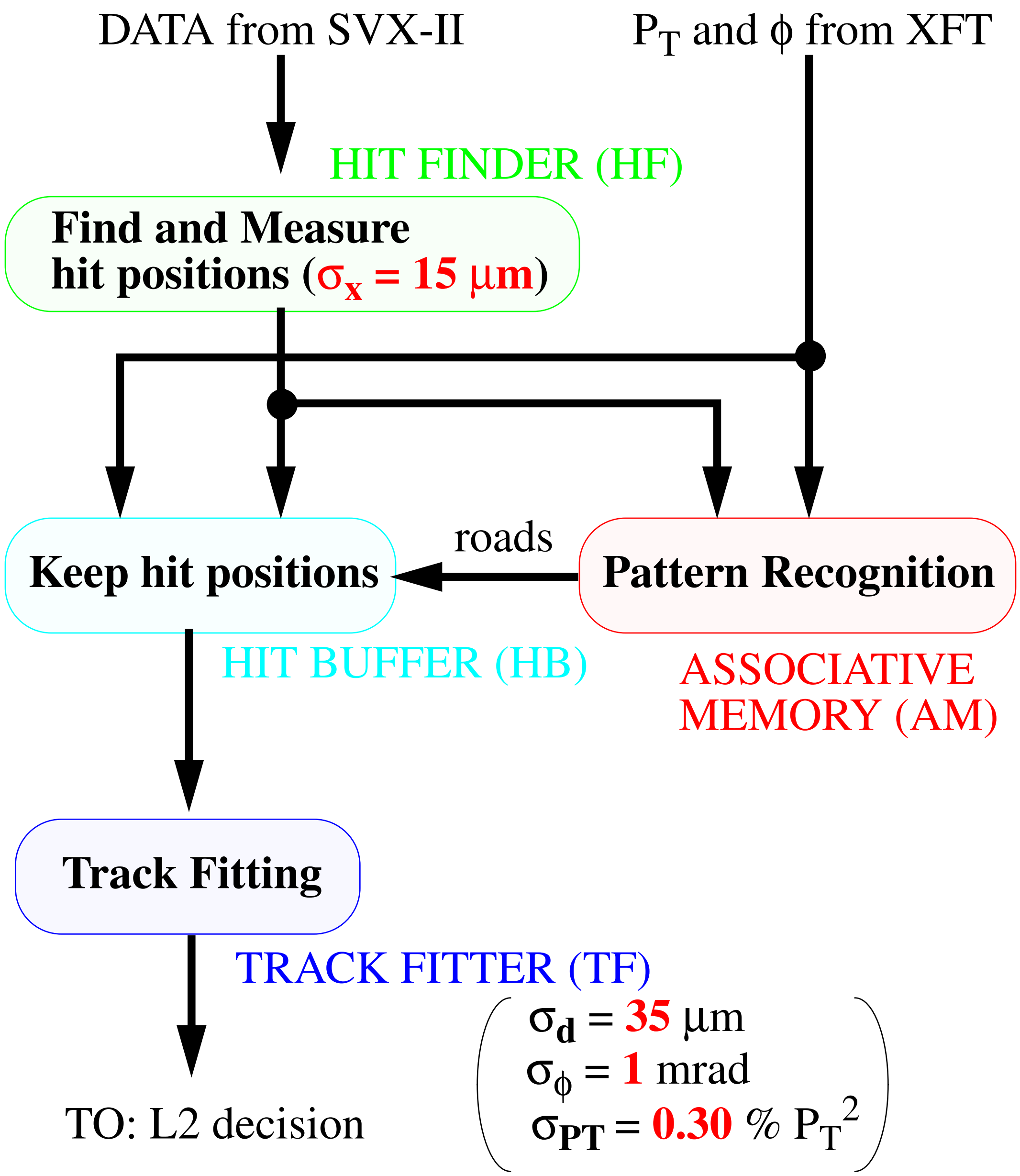
1.Introduction to the SVT



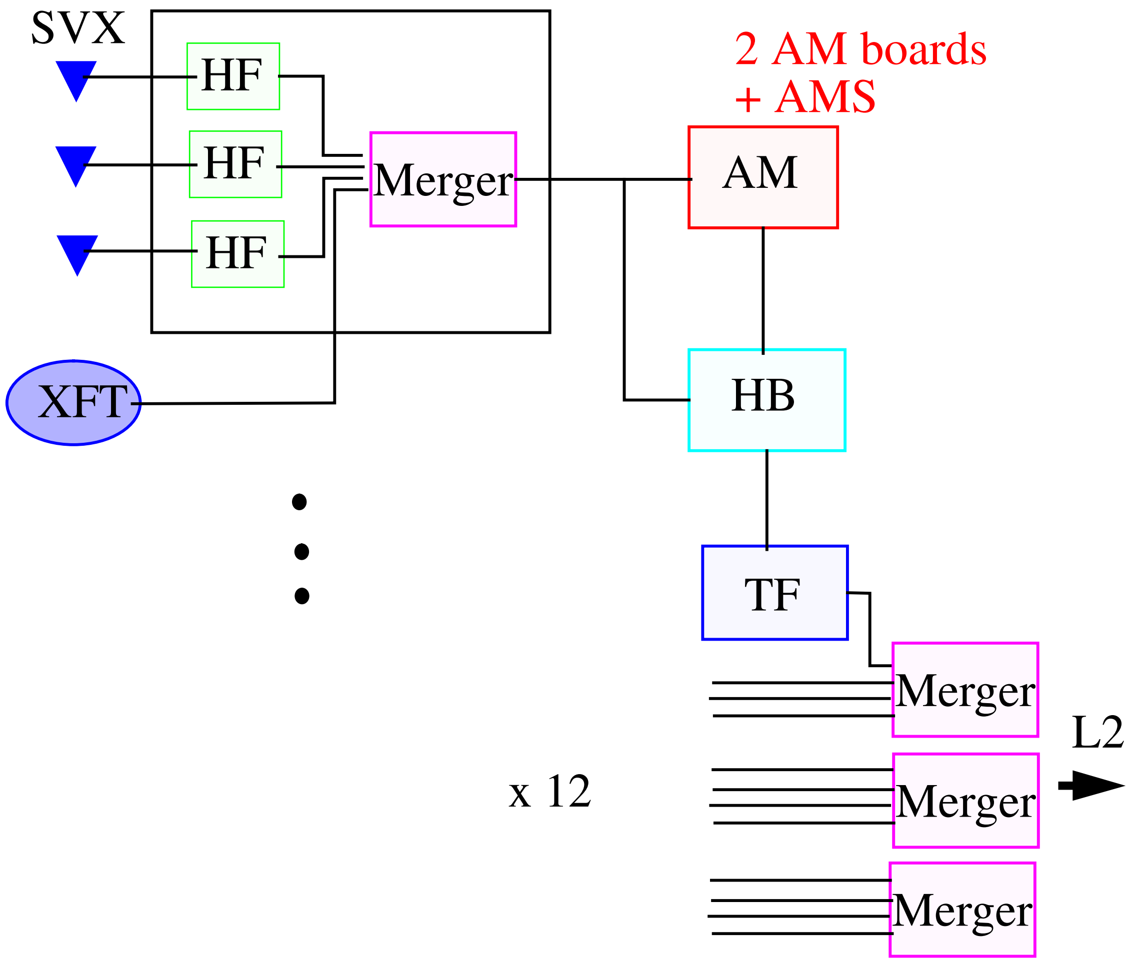

SVT
15
19
20
21
18
16
17
12 SVT

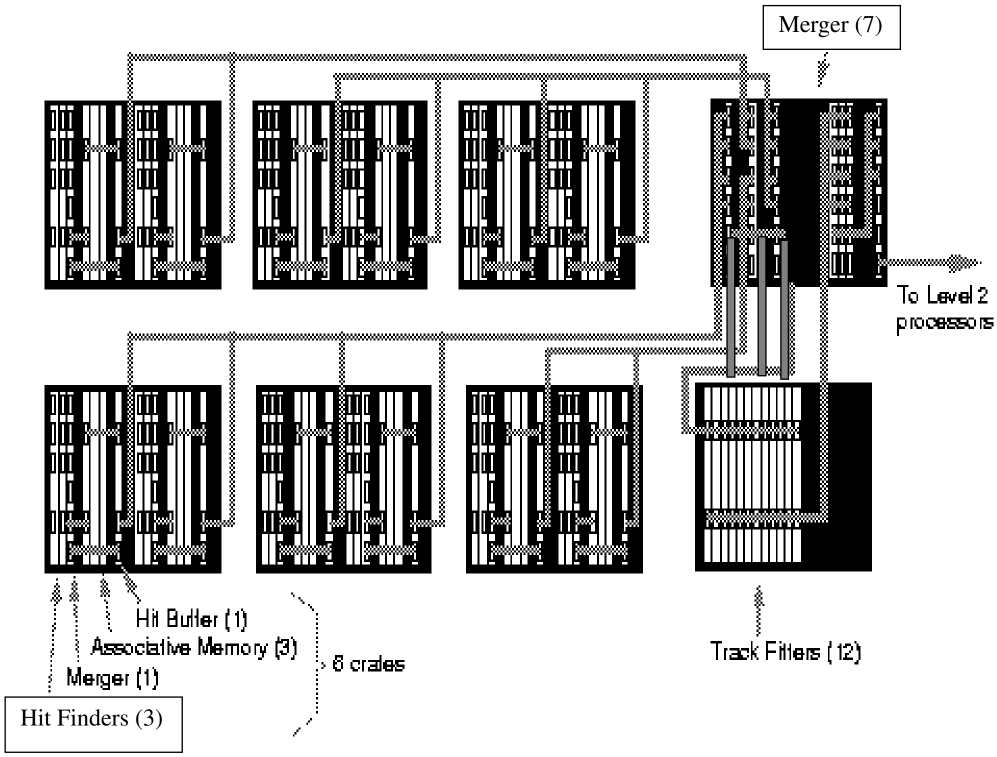

$\sigma_d = 35\ \mu m$
OFFLINE
SVT
Impact Parameter (cm)

SVT Diagram



DATA from SVX-II
P_T and ϕ from XFT
HIT FINDER (HF)
Find and Measure
hit positions (σ_x = 15 μm)
roads
Keep hit positions
Pattern Recognition
HIT BUFFER (HB)
ASSOCIATIVE
MEMORY (AM)
Track Fitting
TRACK FITTER (TF)
TO: L2 decision
σ_d = 35 μm
σ_ϕ = 1 mrad
σ_{PT} = 0.30 % P_T^2


SVX
HF
HF
HF
Merger
XFT
2 AM boards
+ AMS
AM
HB
TF
Merger
Merger
Merger
L2
x 12



Comments :

As a default, the SVT works with P_T> 2 GeV/c and 4 SVX-II layers without allowing a missing hit, but

the hardware supports:

P_T>1.5 GeV and 5 SVX layers with allowing a missing hit.

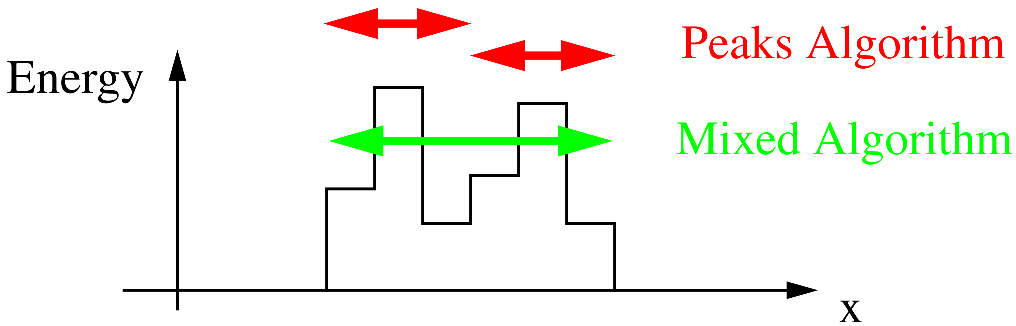
We need more studies to see which the total SVT processing time fits to the L2 time budget or not.

2.Status of Each Board

2.1 Hit Finder

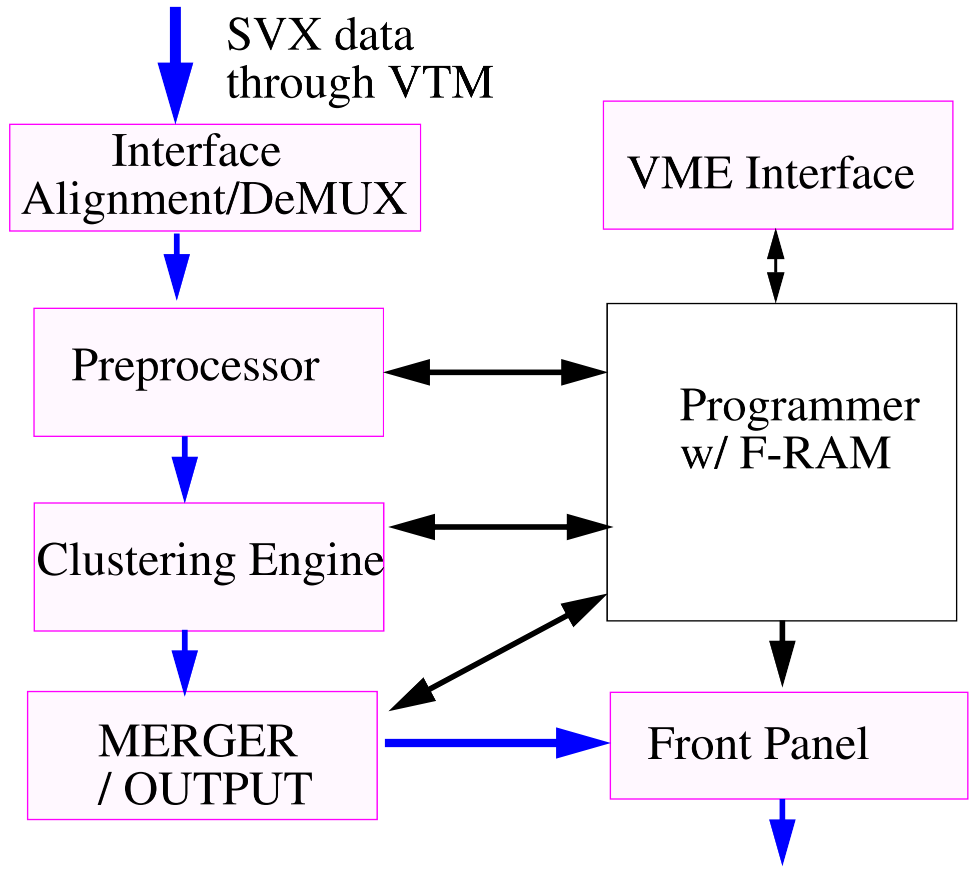
Conceptual design is complete.

Two Clustering algorithms:



Handle a wider (more than 3 strip) cluster

Hardware design status:

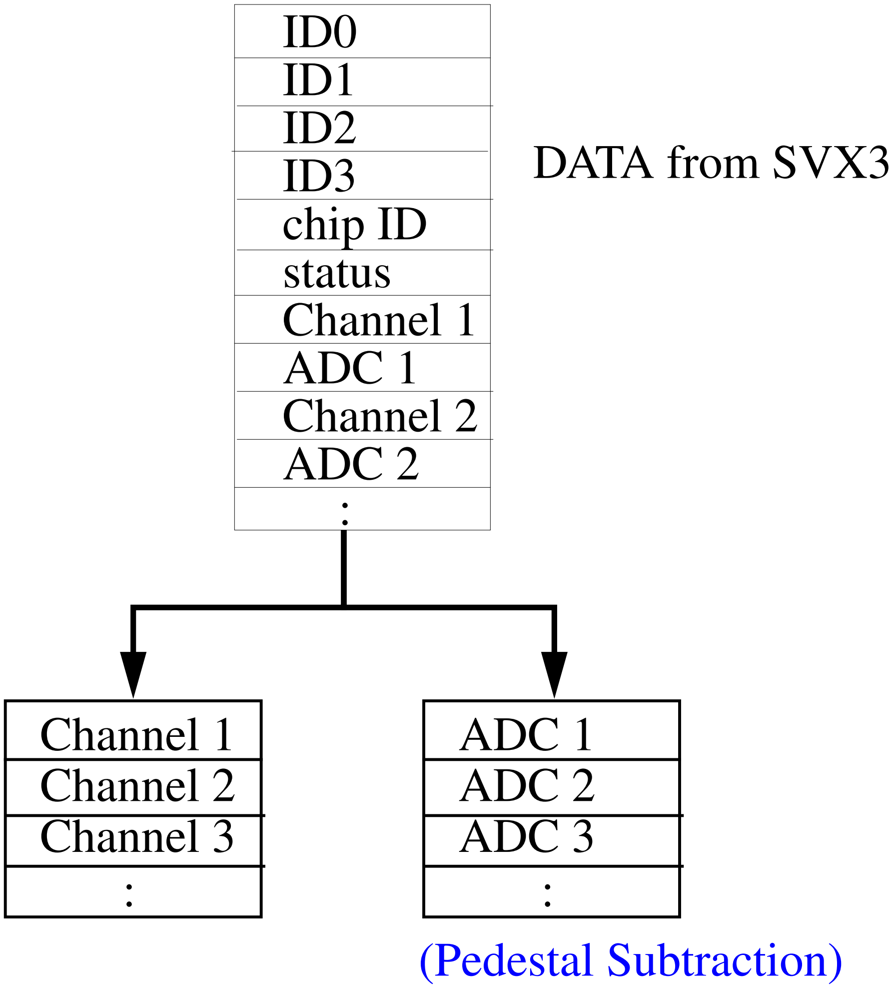


The programing of all chips has been done except for one used for programming other chips.

The schematic design of the board is underway.

- Preprocessor

  Chip design is complete.

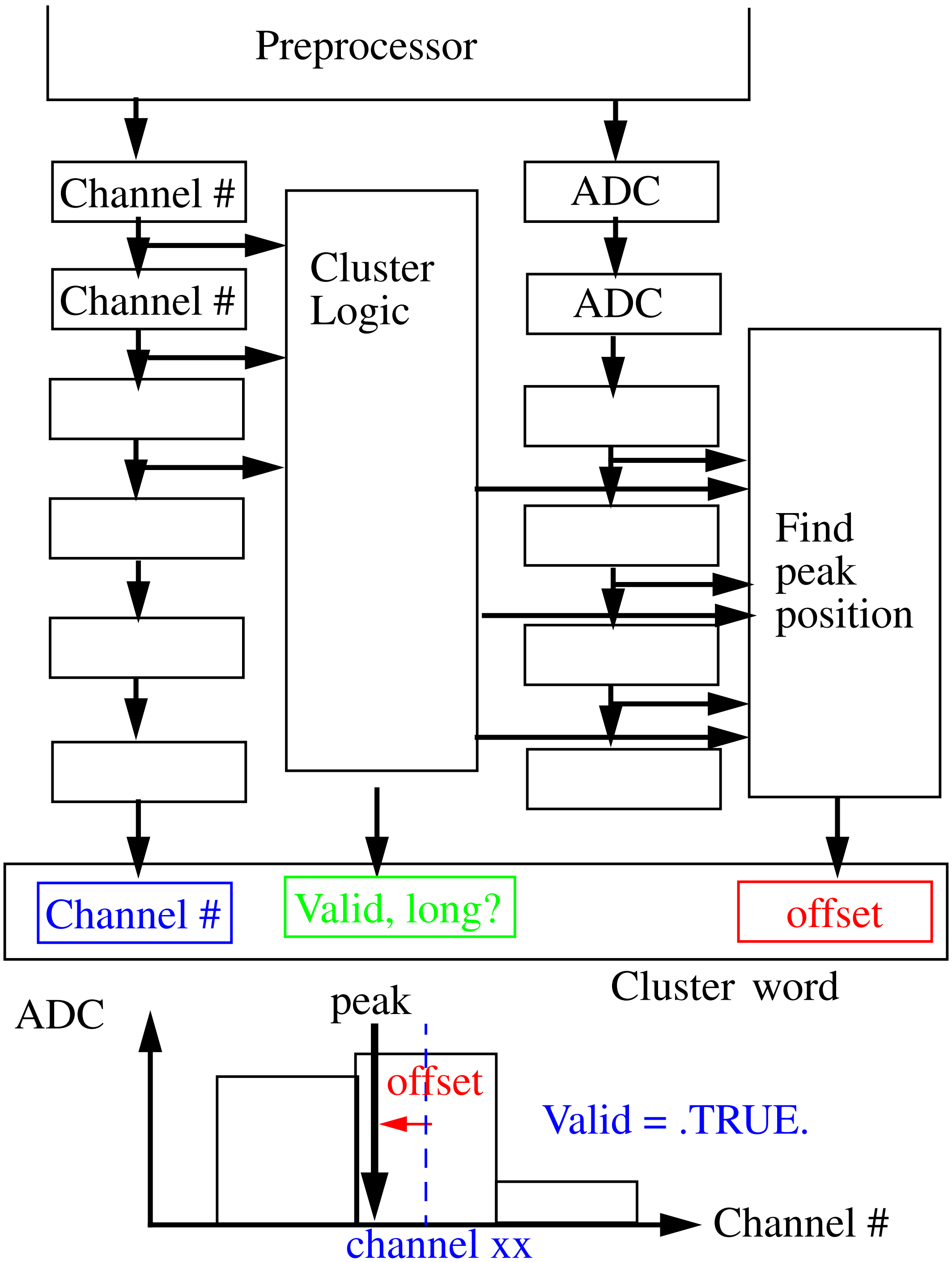


- Clustering Engine

  Finds adjacent strips

  Calculate centroids

  output cluster words



2.2 AM System

2 AM boards + AM Sequencer (AMS)

2.2.1 AM board

Store 16 k patterns with 128 AM chips.

NEW! NEW! (tested with only 8 chips before).

A full proto-type is built and is under testing at PISA at full speed (30 MHz).

So far, it works fine with known problems.

2.2.2 AM chip

Store 128 patterns/chip with 6 planes, and find a road in real time.

4 prototype versions have been built.

v2 (300 chips in hand) : used in the AM board now.

There is a (minor) timing problem .

- miss one address bit out of 12 in the SS map.
- 2k out of 16k address area have an error

14k patterns are used with 128 (not 64) µm SS LSB.

v3 :

Fixed the timing problem.

There is a minor problem in the plane 5.

v4 : Submitted, and expected to be delivered in June.

All above problems are fixed.

2.2.3 AMS (Interface to the AM board)

Convert hit to the SS (Super-Strip) map, drive the AM board, and get the result.

A prototype was built and was tested up to 32 MHz with P3-backplane and the AM board.

New Schematics have been done.

Layout of new pre-production prototype will start within a month. Expect new prototype by the end of summer.

2.3 Hit Buffer

- Keeps hits in special database.
- Receive roads from AMS, and fetches data belonging to each road to send data to the Track Fitter.

A prototype was built and tested up to 32 MHz.

With minor change, the pre-production prototype is expected by the end of this year.

2.4 Track Fitter

Conceptual design is complete.

Linear Fitting (works in 30^o in ϕ):

$$p_i = \vec{a}_i \bullet \vec{x} + b_i$$

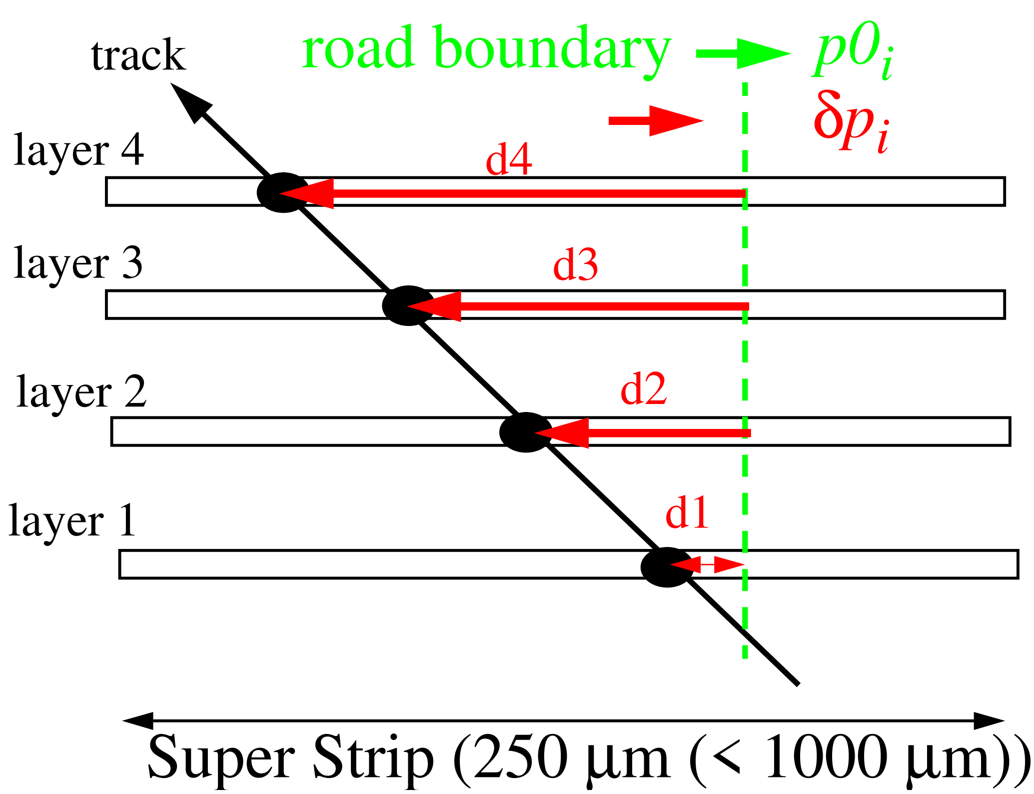
$$p0_i + \delta p_i = \vec{a} \bullet (\vec{x0} + \vec{d}) + b_i$$

$p0_i$: Memory Lookup for AM roads (32k).

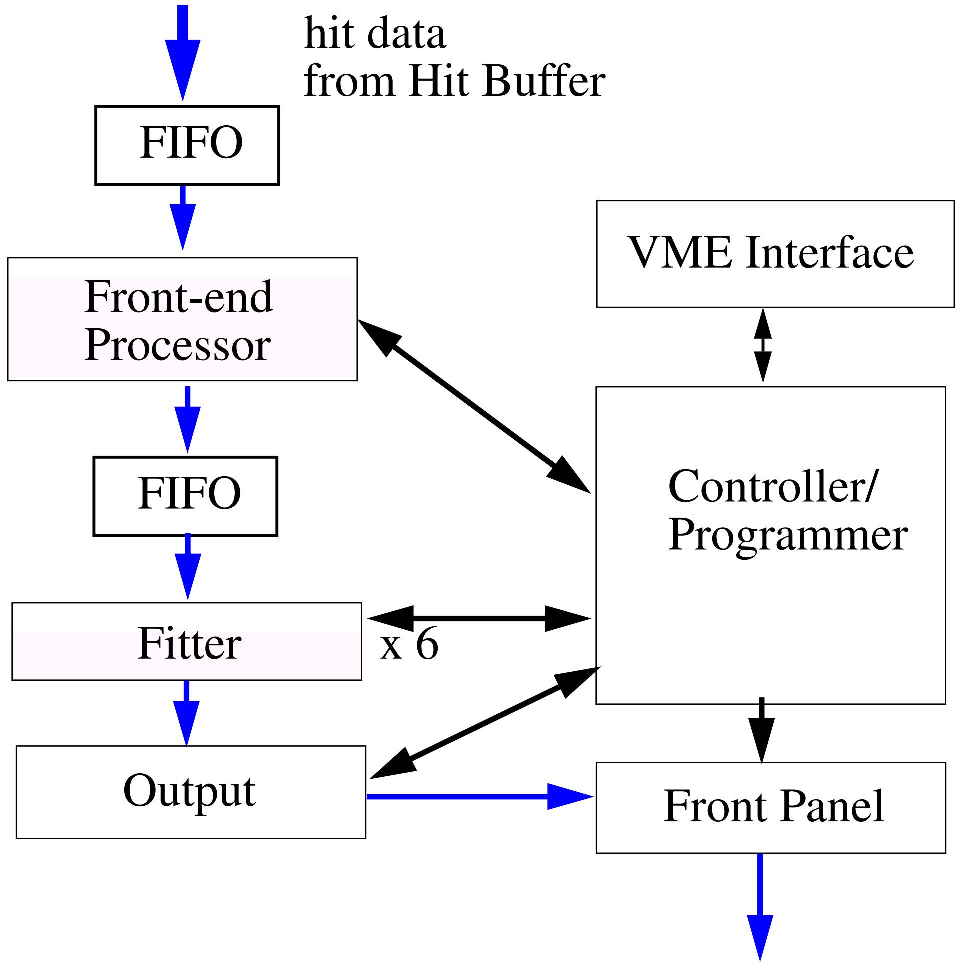
δp_i : Calculate in the TF.

[p_{i} : P_T, d, ϕ, and 3 χ^2 constraints.
$\vec{x}$: 5 SVX hit positions and (PT, ϕ) for XFT]

6 parameters calculated with 7 coordinates.



Hardware design status:



The schematic design of the board will start soon.

- Front End Processor

Chip design is almost complete (90% done)

x0
x1a
x1b
x2
x3
x4a
x4b
XFT-1 (ϕ)
XFT-2 (PT)
road
:

DATA from Hit Buffer

x0 (14 bits wide)

↓

x’0 (8 LSBs of x0)

up to 1000 μm

permute hits
to all combinations
of a track candidate

↓

x’0, x’1a, x’2, x’3, x’4a, ϕ’, PT
x’0, x’1a, x’2, x’3, x’4b, ϕ’, PT
x’0, x’1b, x’2, x’3, x’4a, ϕ’, PT
x’0, x’1b, x’2, x’3, x’4b, ϕ’, PT

↓

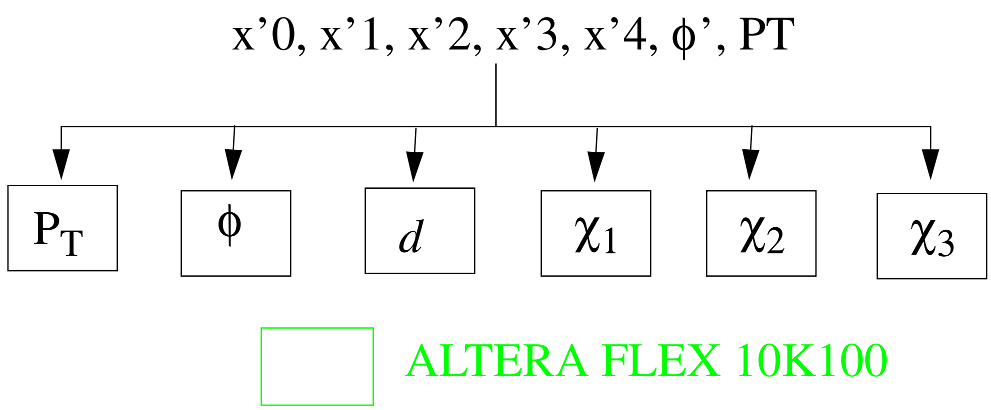
Fitter

~30 MHz w/
ALTERA
FLEX10K100-1

- Fitter

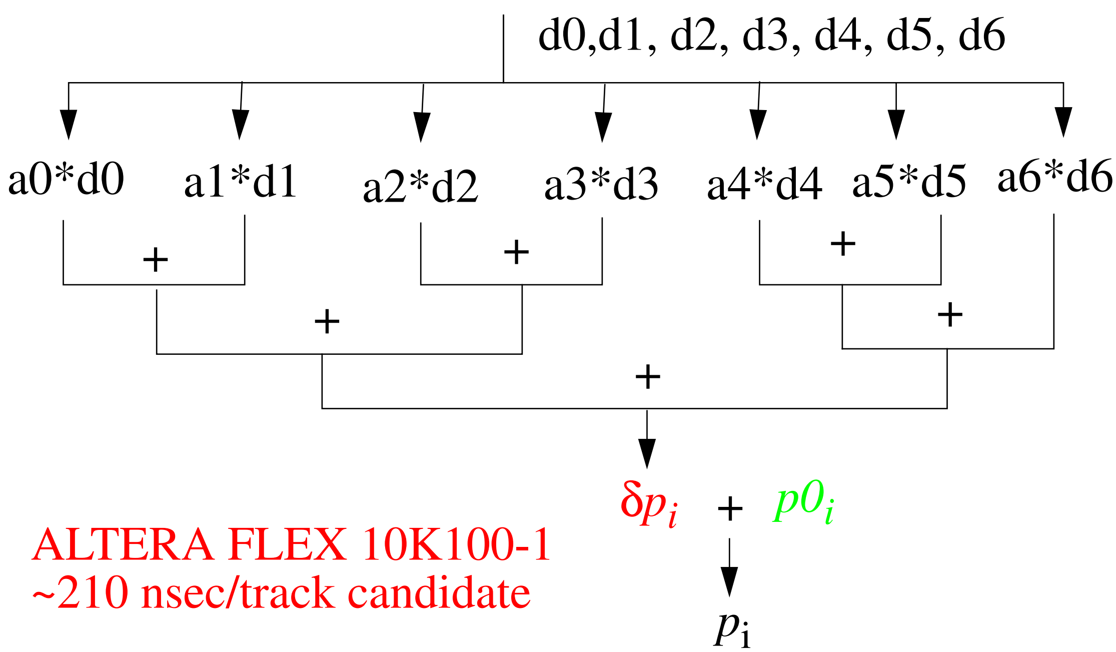
All core functions have been programed and tested (70% done).

(1) In a TRACK FITTER board



(2) In a CHIP

Subtracting the road boundary at first, and.



2.5 Merger

Combines 4 SVT data streams into one.

A prototype was built and is used for the test of AM and HB at full speed (32 MHz).

New prototype is under design.

Schematics are 80% done, and programing of the chips' internal logic is 50% done.

The pre-production prototype is expected by the end of this year.

2.6 Others

SPY Control :

Handle the internal SVT errors by watching the error from each board.

Chip programing is complete. The board schematics are 50% done.

Beam Monitor :

Find a beam position by using the TF output.

We start studying the performance to estimate the computing power and to make the conceptual design.

3.Software and some Studies

3.1 Online Software

We will use CDF VME-II, but are using the VIBE based software developed by THOMAS (GENEVE) to test the boards currently at PISA.

3.2 Offline (Simulation) Software

The SVTSIM V1_3 is ready for public use both on VMS and UNIX.

Currently, the code only supports some specific runs because of instability of the beam position and the tilt of the beam.

3.3 Study of the AM road patterns.

The optimized SS size has been studied to give higher efficiency with a fixed number of AM patterns by Giovanni.

With the optimized SS size, we need 20% less patterns to keep 90% efficiency.

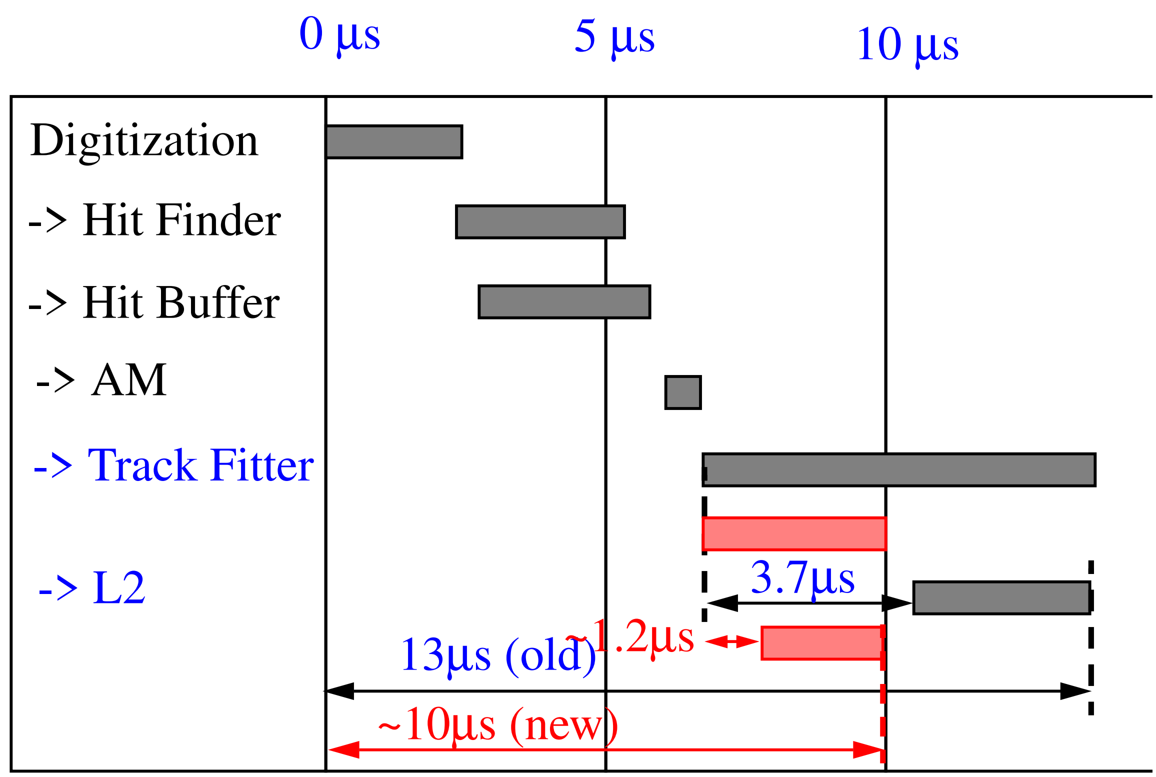
(250mm, 250mm, 250mm, 250mm, 50mrad

-> 364mm, 249mm, 249mm, 364mm, 23.7mrad)

With the lower P_T threshold of 1.5 GeV/c, we need 15% more patterns to keep 90% efficiency.

Other options are under study!

3.4 SVT Timing



4.Summary and Schedule

- A top GOOD news in the SVT project is the success of the full AM board prototype with 128 AM chips.
- Conceptual design of all boards is done.
- Hardware design of most of the boards is close to completion except for a few.
- All the new (pre-production) prototypes will be ready at least by the end of this year.