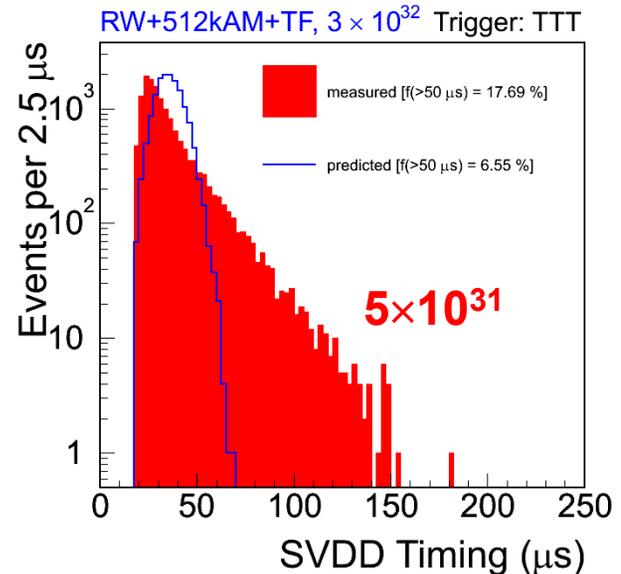


# **Silicon Vertex Trigger (SVT) Upgrade**

**M. Shochet**

# Why Upgrade?

- Trigger on  $b$  quarks based on lifetime.
- Important for both high- $P_T$  and  $B$  physics.
- Run IIb luminosity: **large level-1 trigger rates and SVT execution time  $\Rightarrow$  large deadtime**
- **Reduce SVT execution time.**
  - As luminosity  $\uparrow$ , SVX hit density  $\uparrow$ 
    - $\Rightarrow$  more track candidates to fit because of the number of hits in a road
  - **Reduce the road combinatorics by using narrower roads.**
    - $\Rightarrow$  Increase the number of roads.
  - **Reduce the fit execution time.**
    - $\Rightarrow$  Build a faster Track Fitter.
  - **Increase max L1 trigger rate by  $\times 2$**   
**(5% deadtime)**



# Specifically what are we doing?

- **Build a minimum of new hardware.**

**Use LHC design + new CDF Pulsar boards.**

- **New Associative Memory (more roads)**

- Chips based on LHC design.
- Sequencer firmware to be added to existing Road Warrior Pulsars.

- **New Hit Buffer (handle larger # of roads & faster)**

- Pulsar board with memory on mezzanine

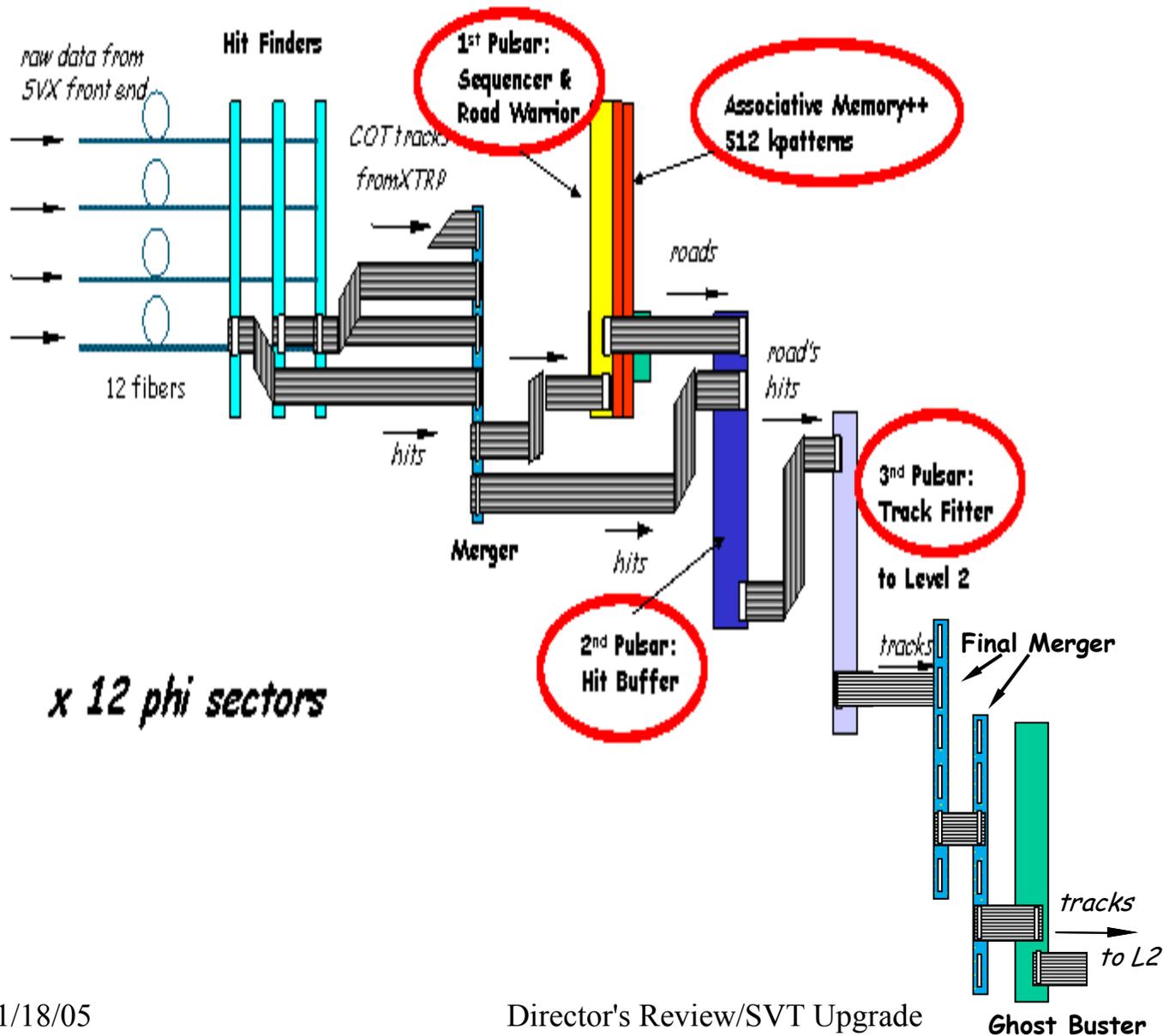
- **New Track Fitter (handle larger # of roads & faster)**

- Pulsar board with memory on mezzanines

- **⇒ Build Pulsar mezzanine cards.**

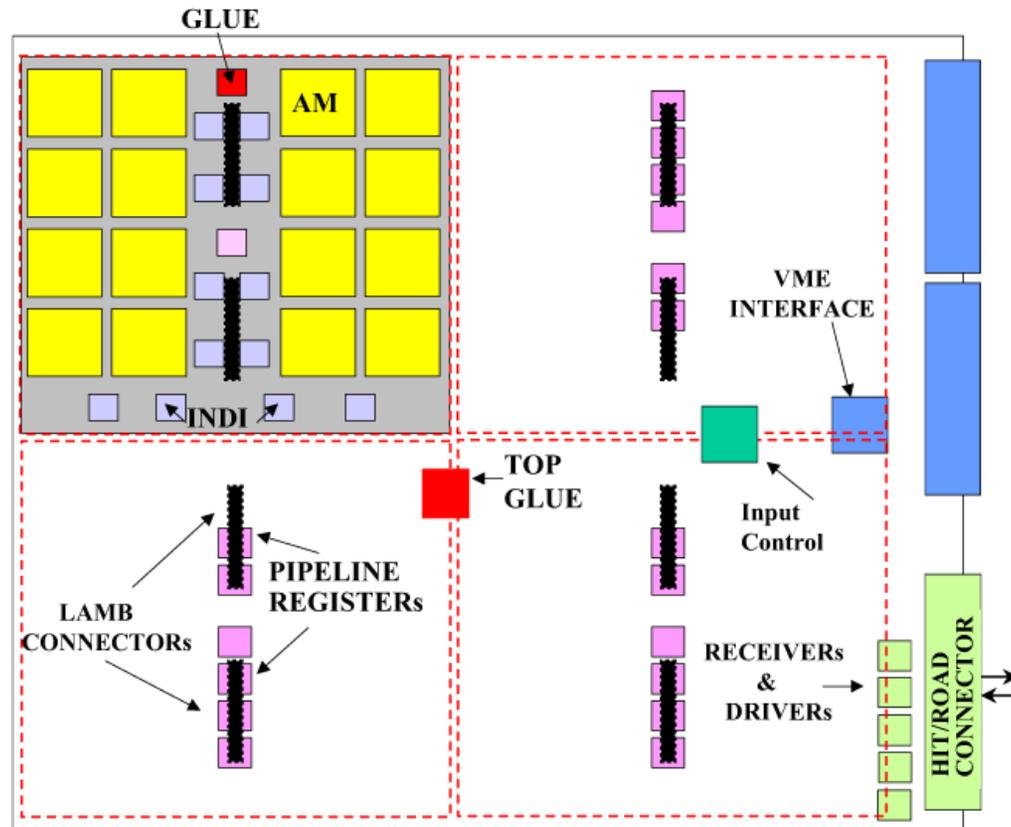
**Write Pulsar firmware based on existing functionality.**

**Upgrade online and offline software for new hardware.**



# New AM++ (fully funded by INFN)

- Track finding for all patterns simultaneously at high rate.
- AM chip: standard cell chip
- LAMB
- AM++



## AM++ Status

- **116 chips arrived from IMEC on Sept. 30. (multi-project run)**
  - Yield (flawless)  $\approx$  37% (IMEC expected: 68%) good chips
  - Yield (flawless + defective Patterns < 2)  $\approx$  53.5% ~good chips
  - Yield (flawless + defective Patterns < 5)  $\approx$  59.5% ~good chips
- **Obtained Italian funds for a pilot run (3000 chips)**
  - **What will the yield be? (tests at IMEC - March; chips delivered - April)**
  - **Can start SVT upgrade operation with 256 chips (80k patterns)**
  - **Can double the number of chips with a second run (\$26K)**
- **LAMB and AM++ boards:**
  - 1<sup>st</sup> prototype used for AMchip tests, 2<sup>nd</sup> prototype test underway in Pisa.
  - Production in March. Tests of produced boards in April-May

# AM Sequencer + Road Warrior

- **Pulsar board with firmware to be sequencer for AM system.**
- **Road Warrior function done before Hit Buffer. (speed)**
- **Needs mezzanine cards with memory.**
- **AMS functionality:**
  - **Firmware is written and thoroughly tested.**
  - **Will be modified to use the mezzanine cards.**
- **RW functionality:**
  - **Architecture fully defined, based on existing RW.**
  - **1<sup>st</sup> version of the firmware: by the end of this month**

# Hit Buffer

- Hits stored with full resolution by superstrip.
- Roads received from AMS/RW are sent out with raw hits attached.
- **Personnel changes: now a full-time firmware engineer**
- A 25-page detailed specification document has been written.
- C board simulation written
- Firmware writing will begin in the next few weeks.
- There is time to get it written and tested for the vertical slice.
- **But it is tight. We will report monthly at Trigger Hardware meetings.**

# Track Fitter

- **Receives a road and forms track candidates (combinations).**
  - Calculates  $d$ ,  $c$ ,  $\varphi$ , and fit  $\chi^2$  using a linear approximation.
  - Transmits tracks that pass a  $\chi^2$  cut.
- **The firmware was largely complete several months ago.**
- **Rewritten VME code to use standard Pulsar libraries.**
- **Full compilation done.**
- **Next: detailed board simulation**

# Pulsar Board Construction

- **Boards for SVT upgrade, XFT upgrade, & spares (34 total) were ordered in mid-December.**
  - **Delivery of first 2 boards:**
    - **9 weeks for parts**
    - **3 weeks for construction**
    - **⇒ mid-March**
  - **Following our approval of the boards, the remaining 32 boards will be delivered in 3 weeks.**
    - **⇒ all boards here by early May**
  - **The price is 11% higher than for the previous batch we had built last year (\$13K for SVT boards).**

# Mezzanine Cards

- **Need:**
  - AMS/RW: 1x4M, 1x512K
  - HB: 1x4M, 1x512K
  - TF: 2x4M, 2x512K
  - More spares & prototype quotes  $\Rightarrow$  cost increase by \$22K
- **Prototype 4Mx48-bit PC boards and parts in hand (10)**
  - 2 stuffed and being tested (low speed finished, full speed in progress)
  - As soon as tests are complete:
    - order remaining boards (54)
    - stuff those on hand (for Pulsars, 4M can be used as 512K)
- **512Kx24-bit board**
  - 1 month of work to complete design, simulation, art work, bid
  - few weeks to produce & stuff prototypes (10)
  - few weeks to produce & stuff remaining boards (54)
- **All mezzanine cards will be here when the Pulsars arrive**

# Software

- **Existing software has to be modified for the new hardware.**
  - **board simulation, creating roads and fitting constants, online diagnostics, online operating code (initialization), readout code, offline tools, infrastructure (e.g. database code)**
- **We have a detailed list of tasks, personnel, and estimated time needed for each task.**
- **With current work focusing on hardware and firmware, the software tasks were falling behind.**
- **We are instituting a software management structure to oversee the timely modification of all of the software.**

# Integration

- **New boards will initially be tested in a test stand.**
- **Each piece of the upgrade can then be tested with real data prior to the summer shutdown.**
  - **We need an extra crate installed for the upgrade. It can initially be used for a vertical slice test.**
  - **Duplicate hit data can be input to the crate.**

# Summary

Name	Forecast	Baseline	Variance	2004				2005				2006			
				Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2		
Begin AMS Design Work	8/2/04	9/1/04	-4.4 wks				★◆								
Begin Track Fitter Design	8/2/04	9/1/04	-4.4 wks				★◆								
Begin Ampchip Production	11/22/04	1/10/05	-5.8 wks					★◆							
Begin AMS Mezzanine Card Production	11/11/04	1/14/05	-8.2 wks					★◆							
Hit Buffer Firmware Complete for Board Test	6/14/05	6/23/05	-1.6 wks											◆	
Track Fitter Firmware Complete for Board Test	3/31/05	6/28/05	-12.6 wks								◇			◆	
AMS Firmware Complete for Board Test	4/14/05	8/19/05	-18 wks								◇			◆	
SVT ready for installation	8/9/05	8/25/05	-2.4 wks											◆	
Ready for Accelerator Shutdown 2005	7/27/05	8/8/05	-1.4 wks											◆	
Finish Run 2b Trigger DAQ project	9/22/05	9/30/05	-1 wk											◆	
Data Acquisition and Trigger Upgrades Ready for	9/22/05	1/17/06	-15 wks											◇	◆

- ◆ Baseline Date
- ◇ Forecast Date
- ★ Actual Date