The Test-Beam @CERN in 2008

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On behalf of the SVT-SuperB Group

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Outline

- The demonstrator on the beam:
  - Reference Telescope
  - DUTS: MAPS and striplets
  - AM board provides L1 trigger capability to the DAQ
- Measurements to perform on the DUTs:
  - Resolutions (vs. angle, Vth)
  - Efficiency
  - Rate capability
- The chosen test-beam facility:
  - @CERN : PS, T9
  - Typical beam momenta, rates, …
- Effect of MS on resolution
- Manpower and related issues
- Conclusions

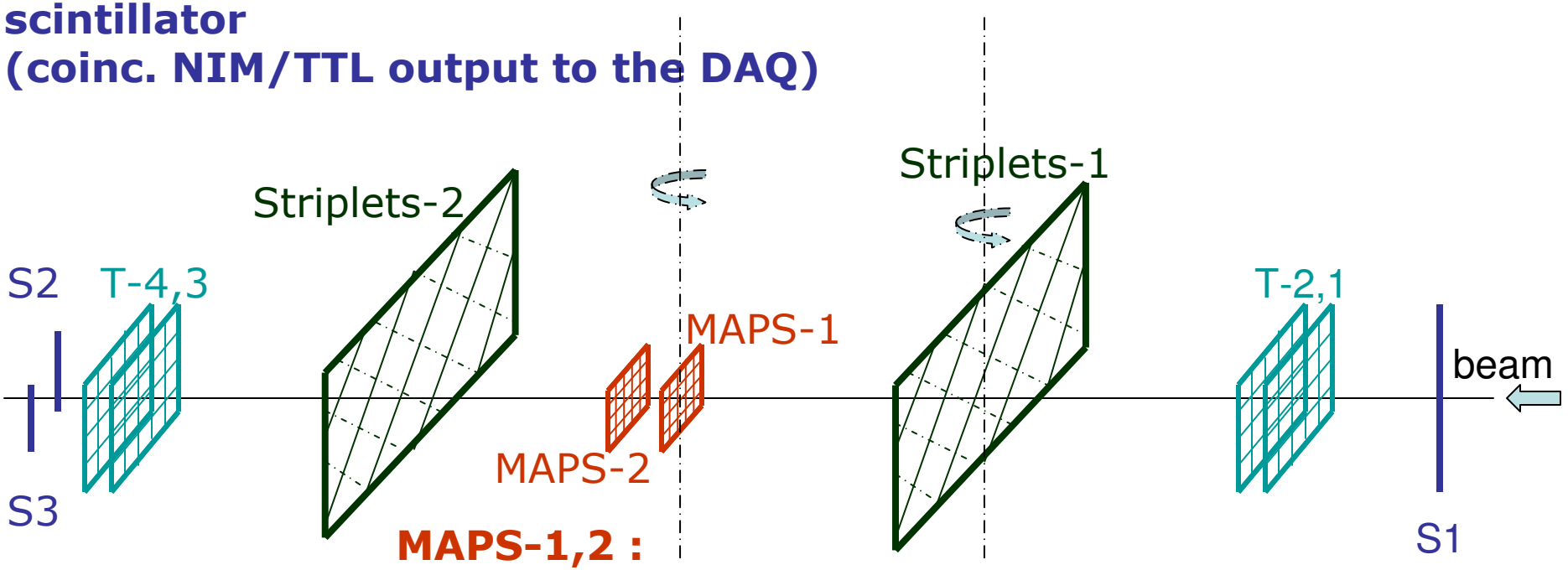
The SLIM5 Test-beam in 2008

- The aim of the SLIM5 R&D INFN project is to build and test on the beam the "demonstrator" for a low material budget silicon tracker.
- The silicon telescope is actually realized with the two CDR options for the Super-B layer0:
  - 2 MAPS detector (thinned down to 100 μm)
  - 2 double-side striplets detector (200 μm thick)
- An Associative Memory board connected to the DAQ system (developed with a data driven approach) will provide the demonstrator L1 trigger capabilities.

The "DEMONSTRATOR"

(conceptual)

S-1,2,3 scintillator (coinc. NIM/TTL output to the DAQ)



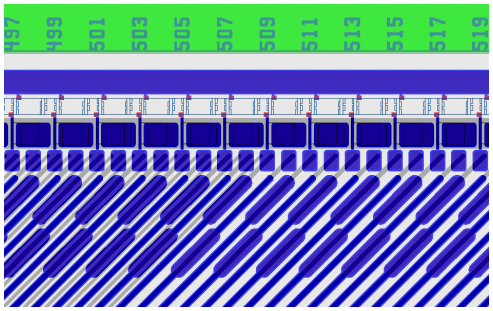
MAPS-1,2 :
active area ~10 mm²
Cell:50x50 μm² (300→100 μm-thick)

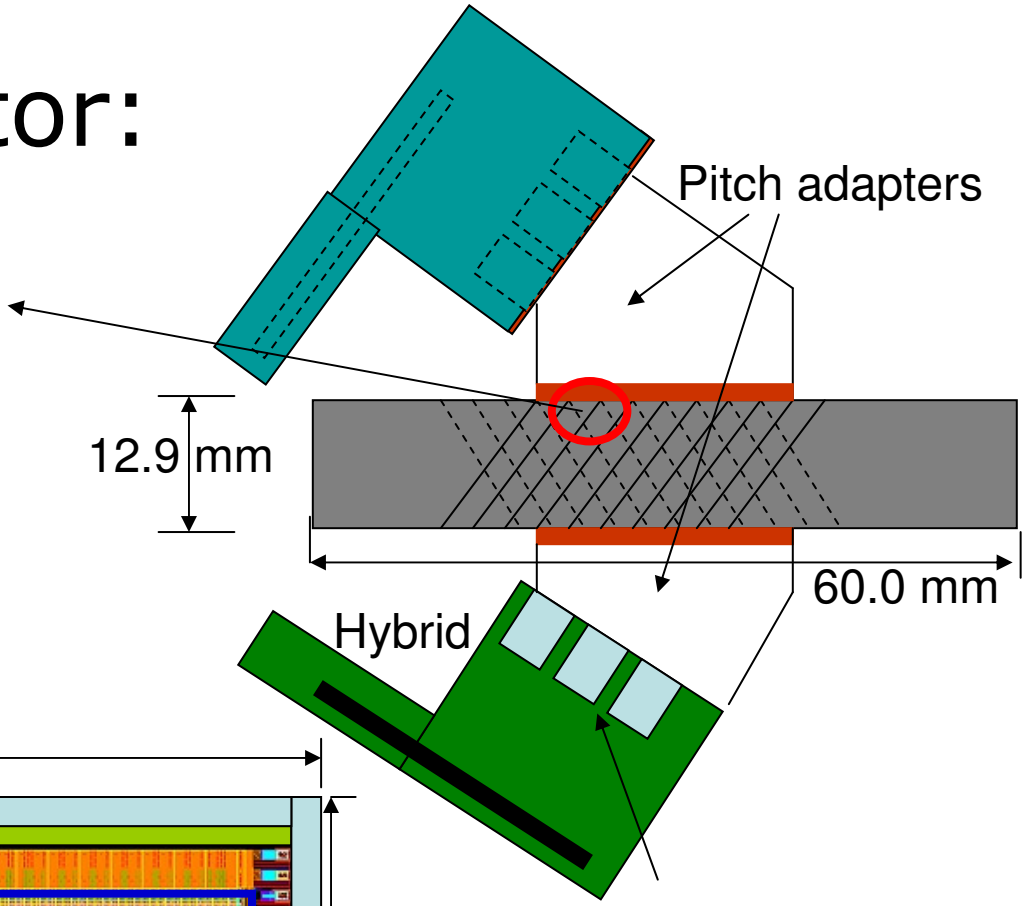
Reference telescope T-1,2,3,4:
area~2x2 cm²
DSSD 300μm thick
25 p-side, 50 n-side μm pitch
50 μm r.o. pitch
(3 chips FSSR2/side)

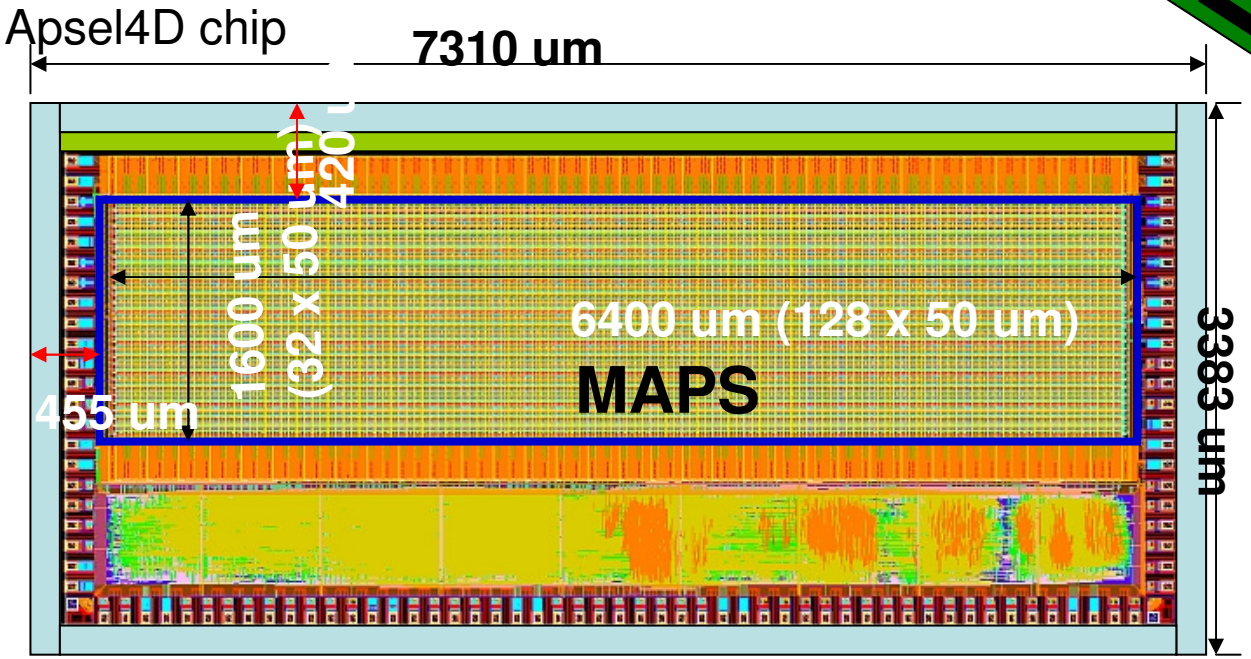
Striplets-1,2:
area 1.29x6.0 cm²
DSSD 200μm thick (∠45°)
25 p-side, 50 n-side μm pitch
50 μm r.o. pitch
(3 chips FSSR2/side)

The detectors of the demonstrator:

Striplets

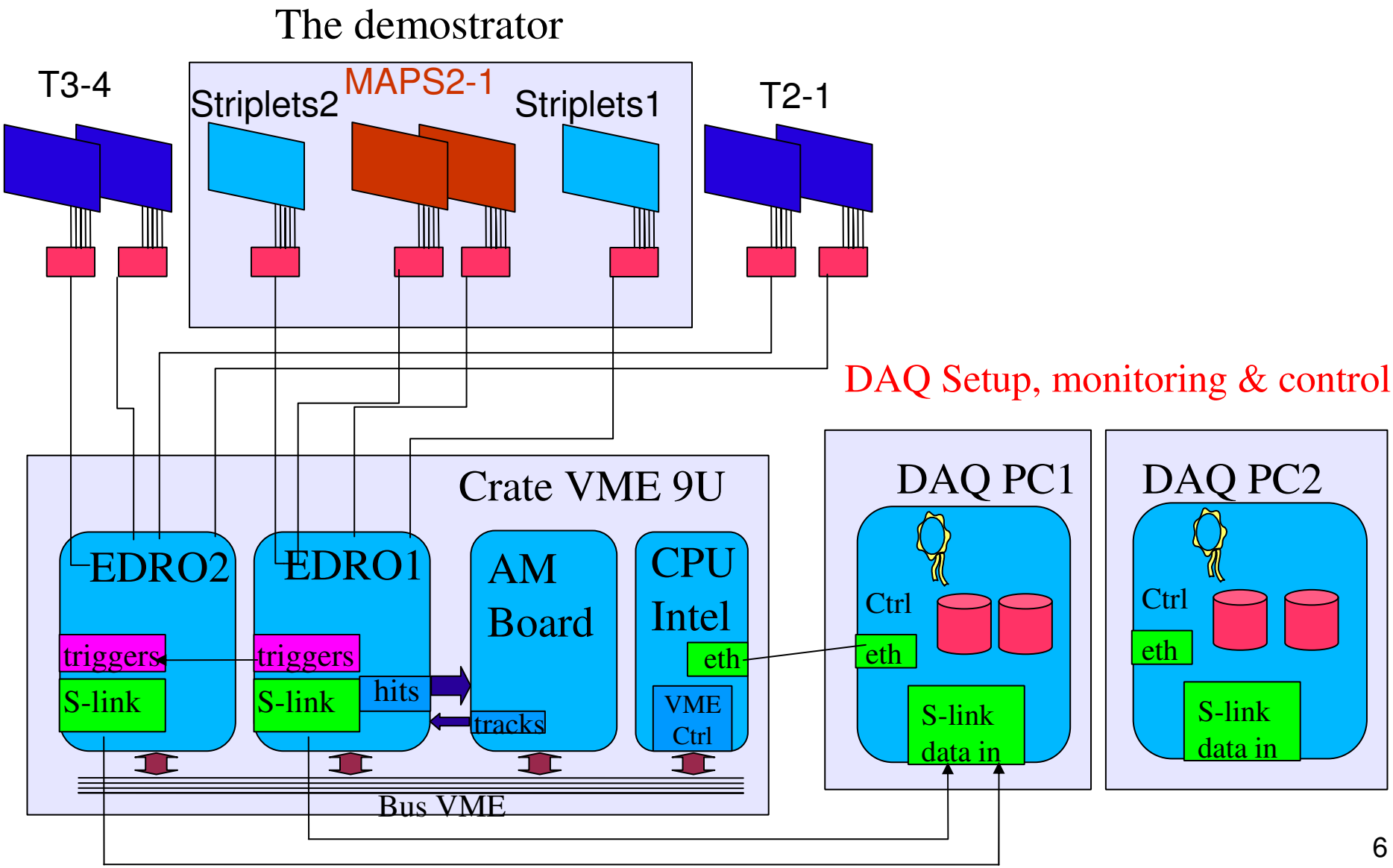






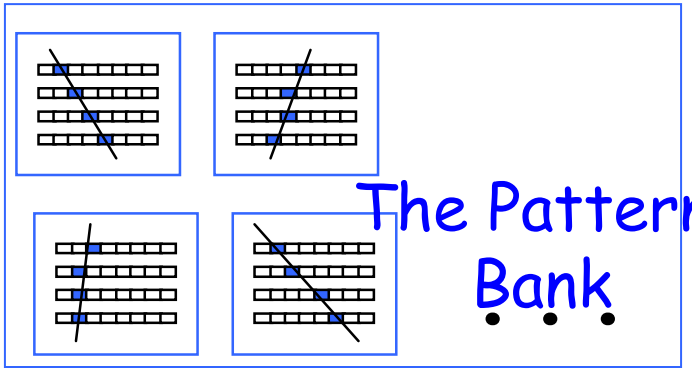
For more details on Telescope & striplets det's see Marco's talk

The Trigger-DAQ scheme

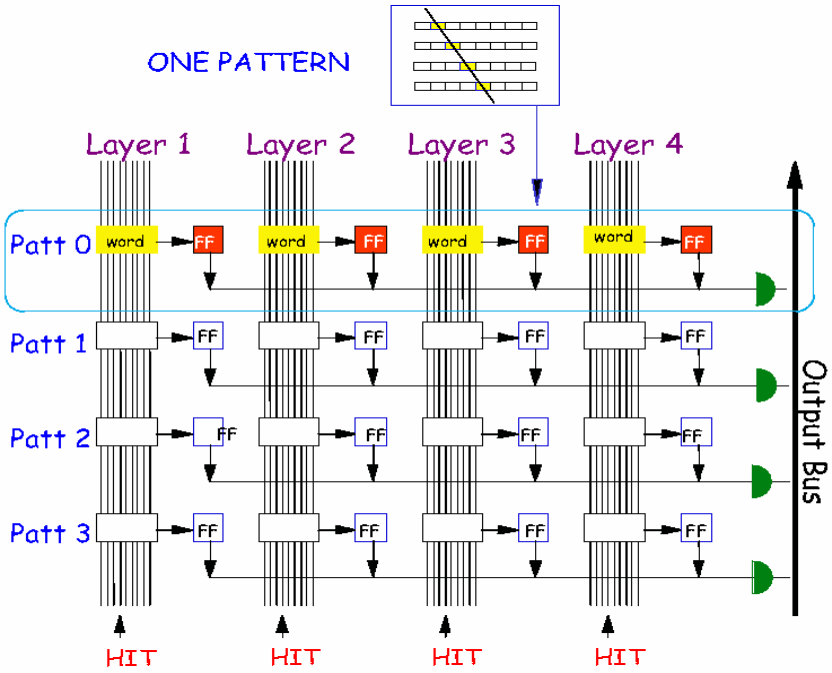


Associative Memories

- Pattern-matching "a la CDF":
  - AM loaded with the possible patterns



- Dedicated device →maximum parallelism
- Tracks found during detector readout and fed to the trigger logic.



Trigger Handler

In the first debug/start-up phase, the flexibility on the trigger is important.
Several trigger modes are available:

1) Burst mode: trigger on N *sequential* events
2) Prescaled MBtrigger: select an event every N
3) Sample Filled 1: select events having hits on N layers at least
4) Sample Filled 2: select events having at least N hits
5) Get external trigger (default EDRO2 mode)
6) AM Trigger with N tracks (N>=0)
7) Mode 2 Or Mode 6
8) Mode 3 Or Mode 6
9) Mode 4 Or Mode 6

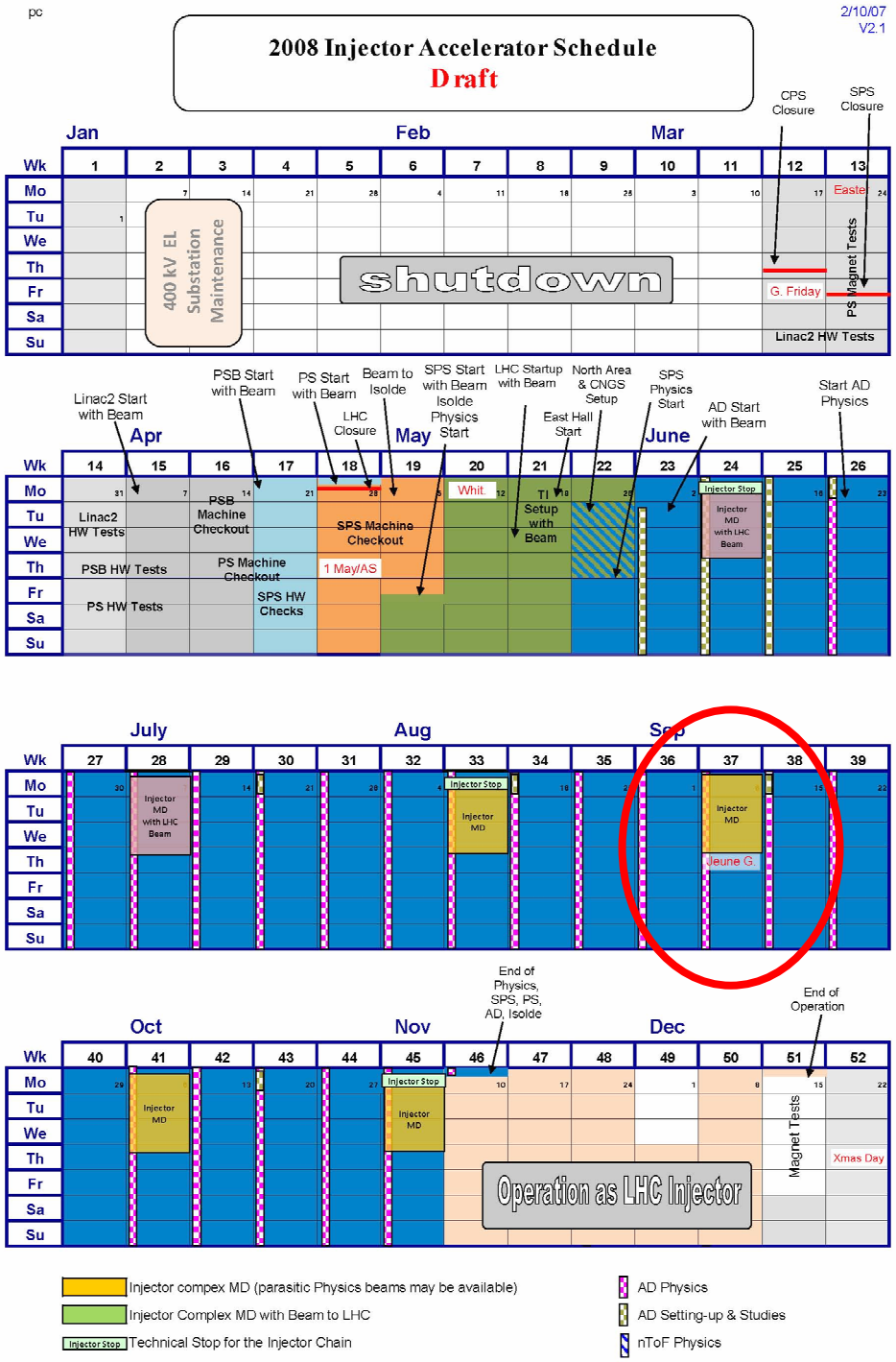
So far, all (except #5) the Trigger have been simulated and verified.

Test-beam aims

- Test the RATE capability (max. trigger rate, efficiency & data reduction) of the system.
- Possible to start using the data from the ref. telescope, then using all the det's of the demonstrator
- Performances DAQ:
  - DAQ rate (#ev/s)
  - Data through-put (MB/s)
- Measurements (on a single DUT):
  - the efficiency of the MAPS (vs. thresholds)
  - resolutions of MAPS & striplets vs. incident angle of the track (and vs thresholds)

The test beam facility: T9 PS (CERN)

- The selection criteria for choosing “our” best site:
  - needed 2 weeks for system debug/test & data taking
  (all the parts of our system never saw the beam!)
  - possible high particles rates, up to ~ O(MHz/cm2)
  - momentum: enough not to be MS dominated (>10 GeV)
  - logistically “easy”
- Requested and officiously allocated time by CERN (to be officially approved by the CERN Research Board):
  [3rd ,17th] Sept. 2008 at PS east area T9 (15 GeV)
- 2008 is the year of the start@CERN of LHC start, but …
  - The scheme for fast super-cycle changes has been optimized to provide beam to LHC and CNGS,FT and test-beam facilities with minimal switching time (hours instead of weeks!).
- Beam structure:
  - At the PS the flat top is ~400 ms long
  - The repetition rate remains to be defined, but two starts of flat top are at least 2.4 s apart and there will probably be one or two per 48 sec, not equally spaced at all. No finer time structure for the beam at T9.



Beam Requests for 2008

@ PS

East Hall (Meyrin site, Switzerland)

4 test beam lines

(T7, T9, T10, T11) Emin - Emax =

1 - (10, 15, 7, 3.6) GeV/c.

Requested 65% of available time

45% (33 weeks)by LHC exp.

@ SPS

North Area (Prevessin site, France)

4 test beam lines

(H2, H4, H6, H8) Emin - Emax =

10 (2) - 400 (450) GeV/c

Requested 100% of available beam time

55% (52 weeks) by LHC exp.

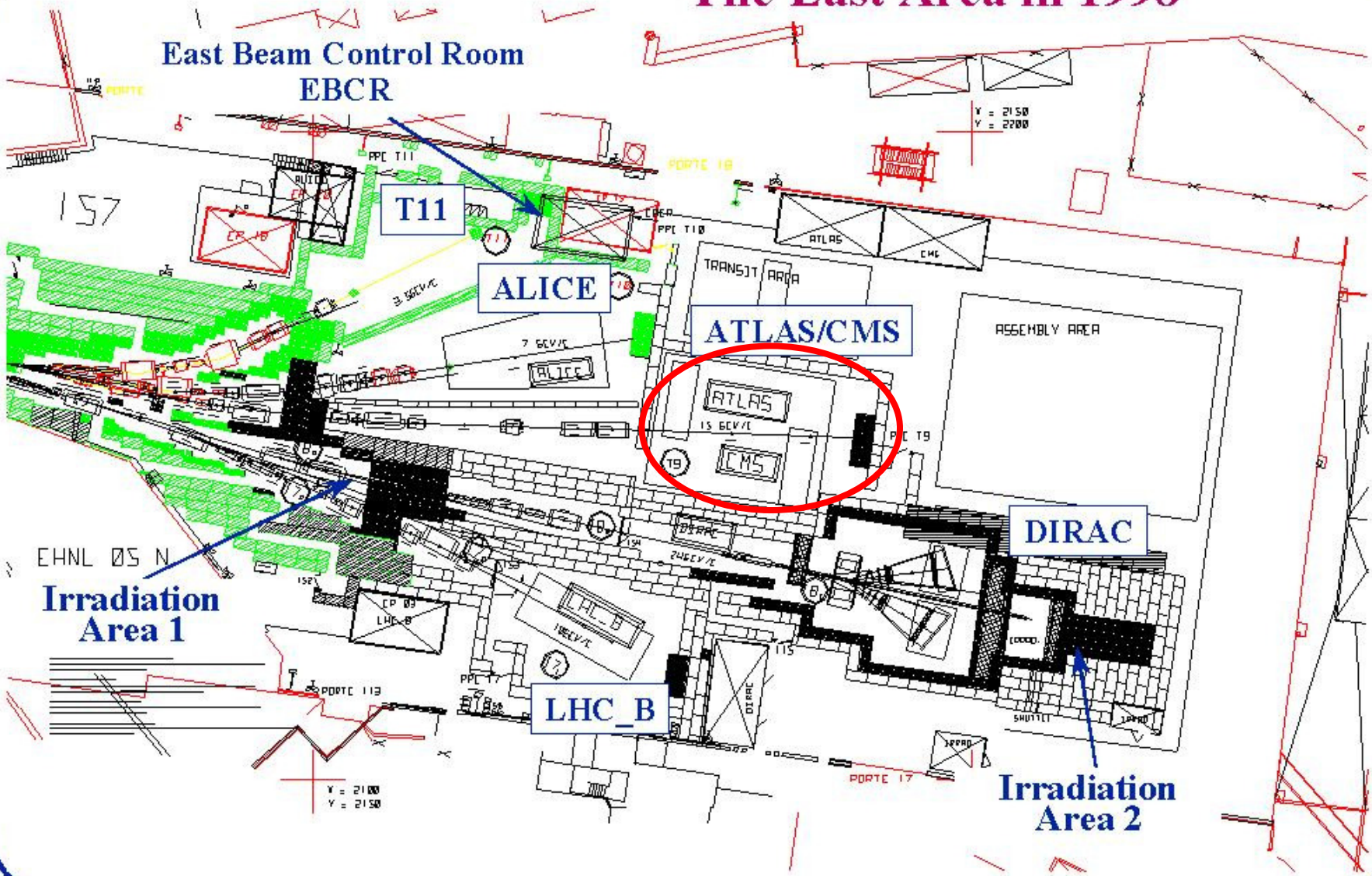
Maximum time can be requested:

PS Eat Hall: 2 weeks /(year group)

SPS North Area: 1 week /(year group)

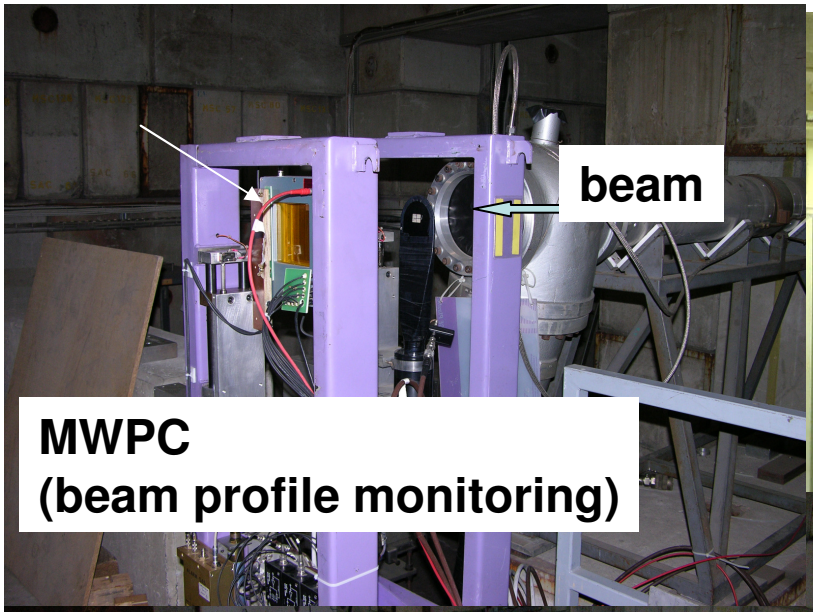
For more time need to submit a proposal for the CERN Scientific Committee approval.

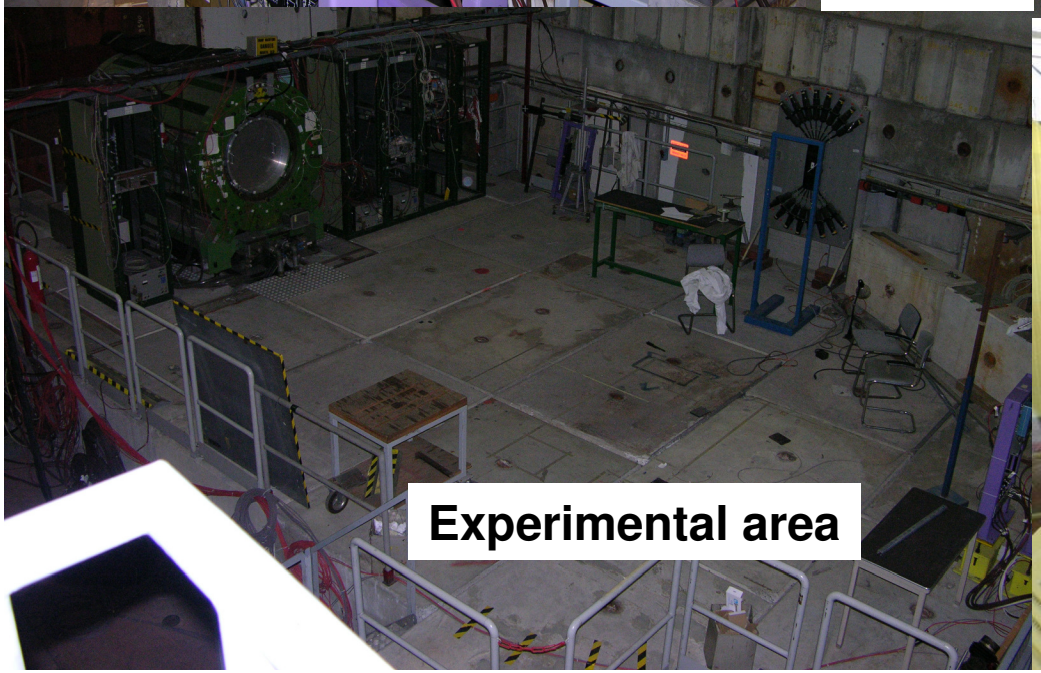
The East Area in 1998

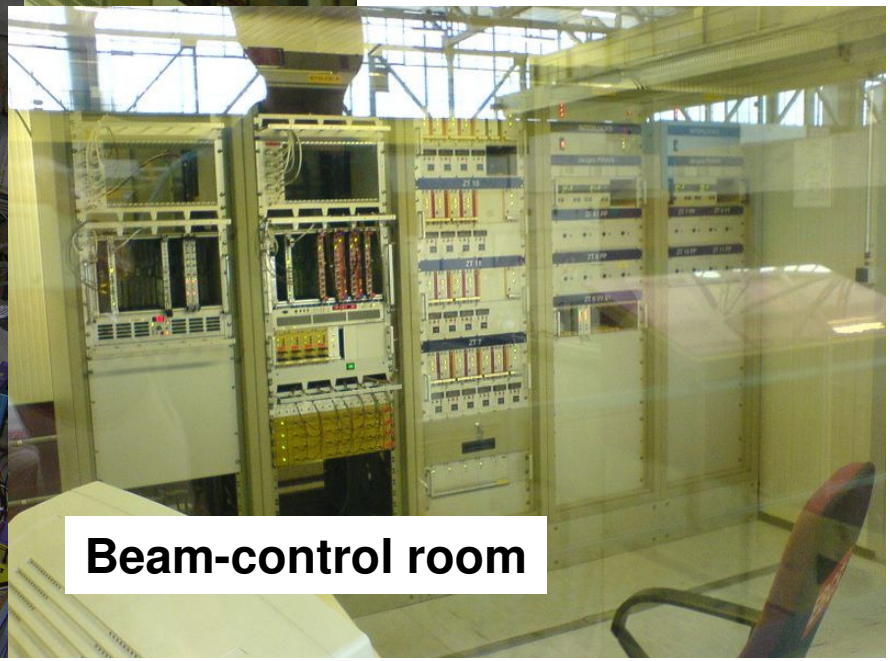


D. Gueugnon PS/OP; J.-P. Riunaud PS/CA

Some snapshots of T9







PS/PA Note 93-21
D.J. Simon, L. Durieu

Secondary Beam Intensity

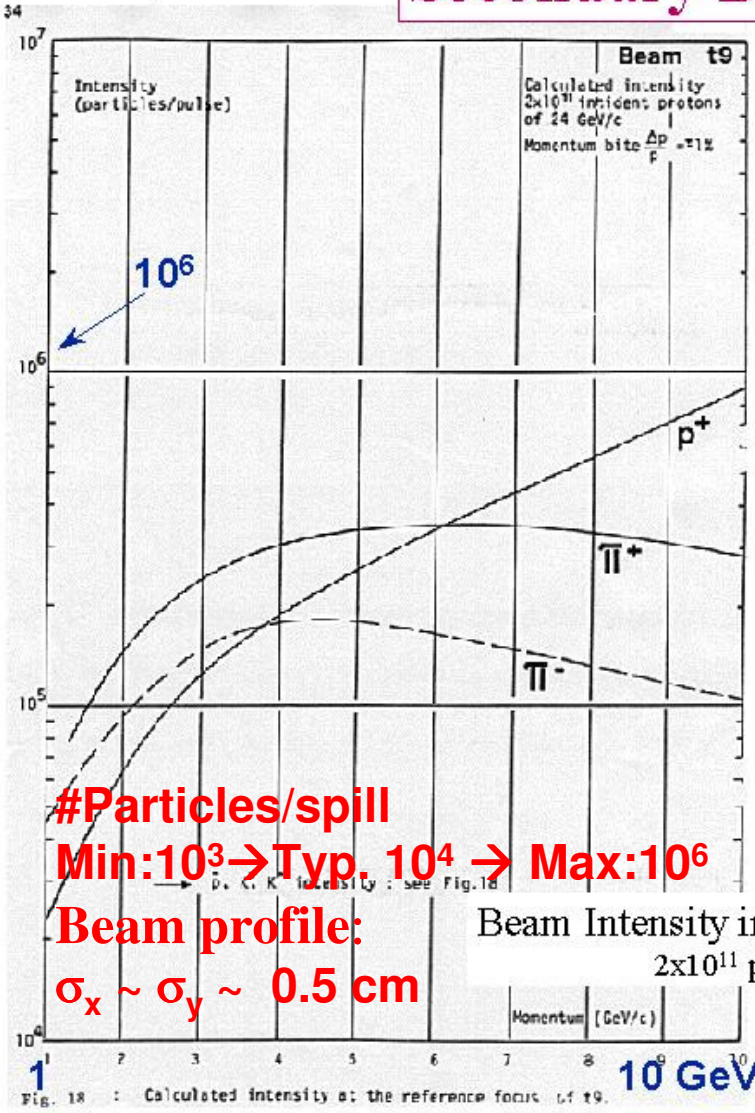


Fig. 18 : Calculated intensity at the reference focus of t9.

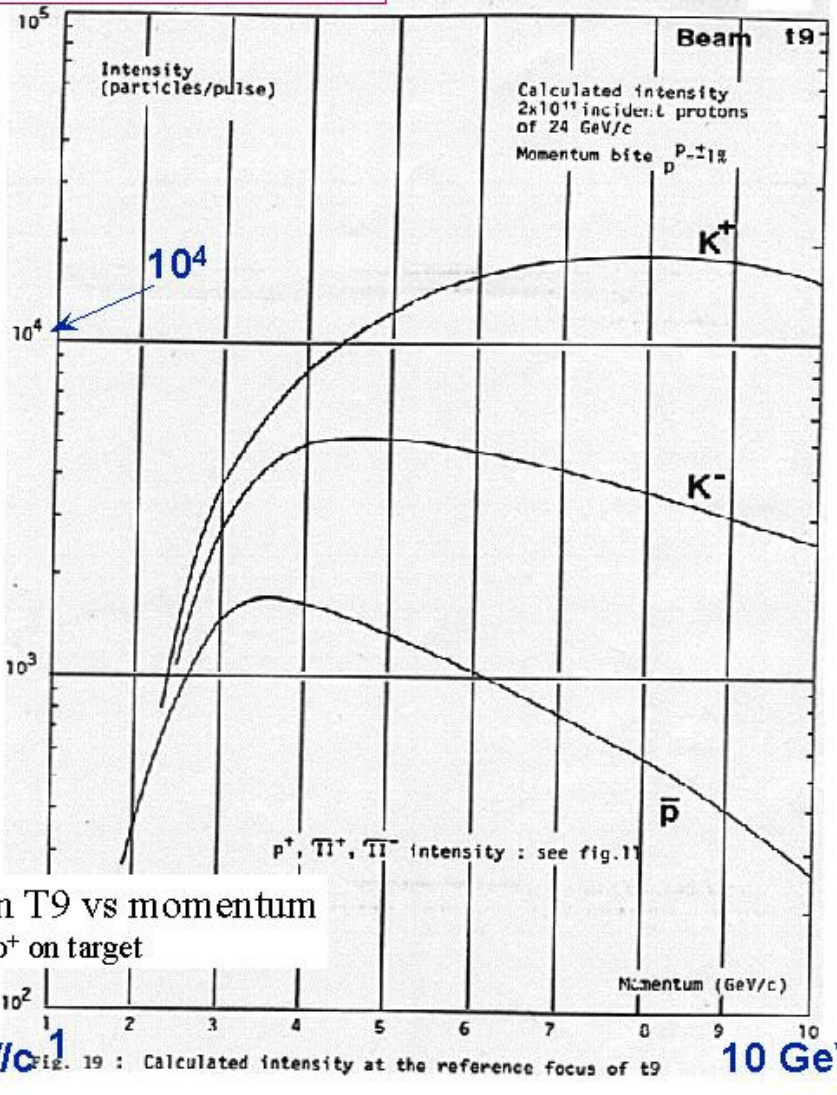


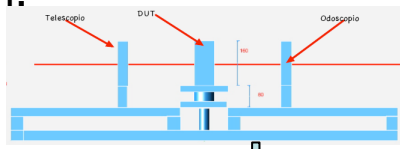
Fig. 19 : Calculated intensity at the reference focus of t9

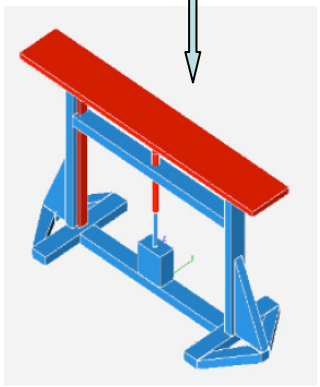
#Particles/spill
Min:10^3→Typ. 10^4 → Max:10^6
Beam profile:
$\sigma_x \sim \sigma_y \sim$ 0.5 cm

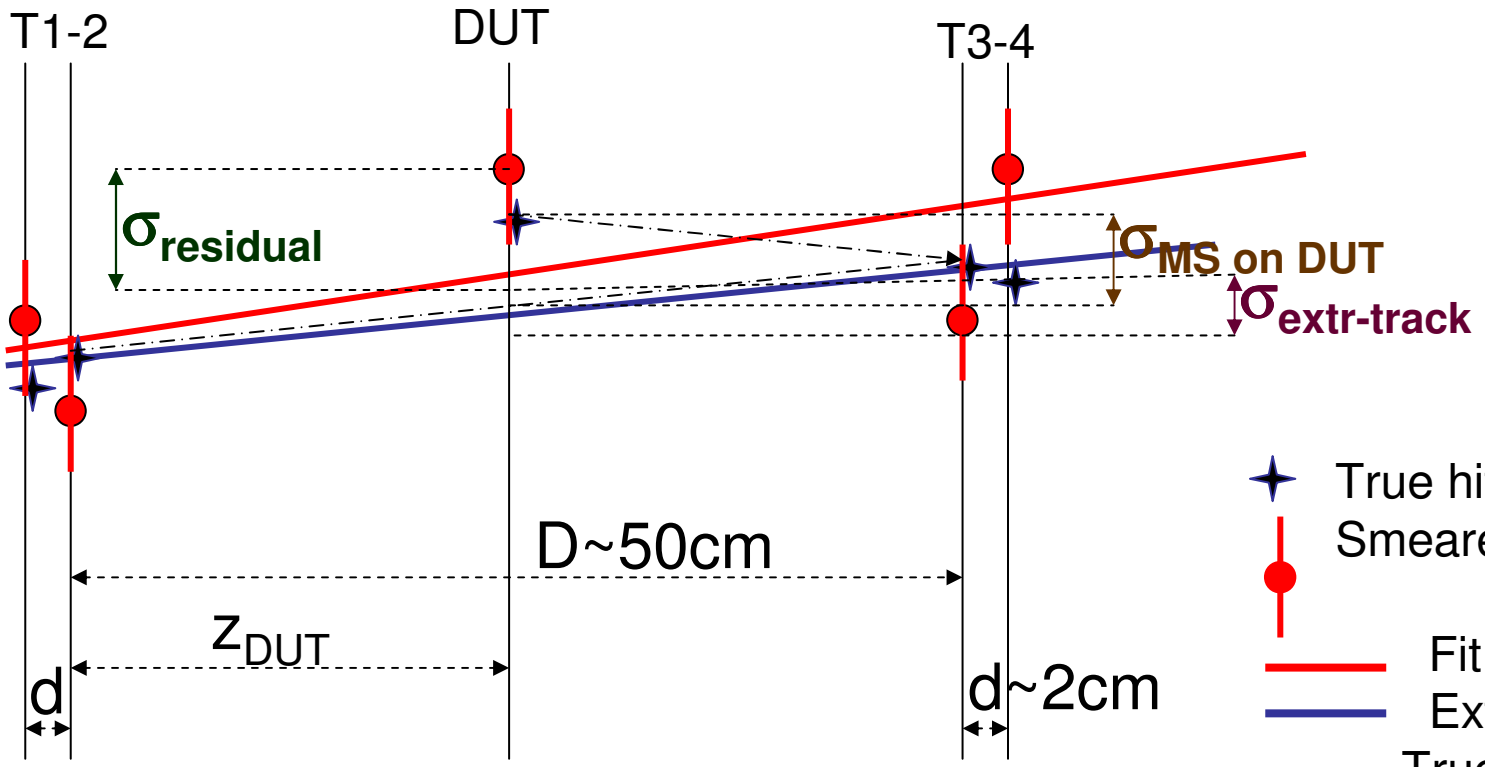
Beam Intensity in T9 vs momentum
$2x10^{11}$ p^+ on target

THE RESOLUTION ON THE DUT

The demonstrator will be put on a movable table. Possible to modify the geometry to minimize the effect on the DUT of the MS while studying the resolution.







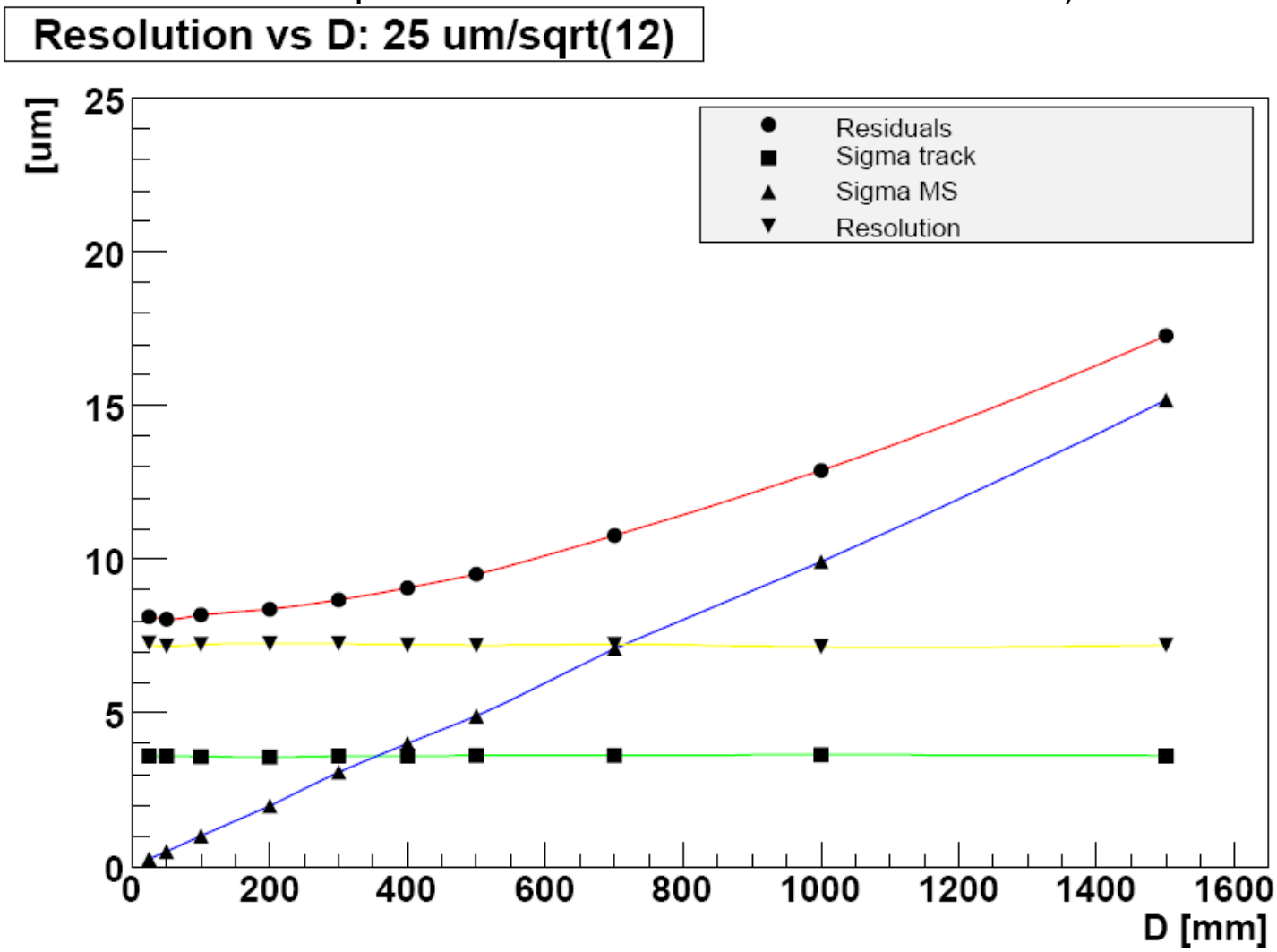
$$\sigma^2_{resolution} = \sigma^2_{residual} - \sigma^2_{extr\text{-}track} - \sigma^2_{MS\ on\ DUT}$$

depends on (z_{DUT}, $reso_T$, MS_T)

depends on (z_{DUT}, MS_{DUT})

TOY MonteCarlo Output

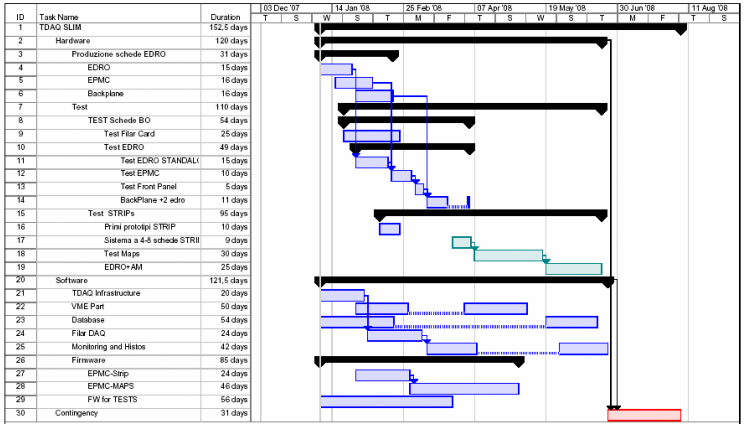
(see the effects of telescope resolution and the MS on the DUT)



Greater momentum will be better, but still acceptable (D<20cm).

For this first test-beam, we preferred having a stable set-up @PS (2 weeks) instead of moving to SPS (P→450 GeV/c) after one week.

Organization & ManPower



ID	Task Name	Duration
1	TDAQ SLIM	152,5 days
2	Hardware	120 days
3	Produzione schede EDRO	31 days
4	EDRO	15 days
5	EPMC	16 days
6	Backplane	16 days
7	Test	110 days
8	TEST Schede BO	54 days
9	Test Filar Card	25 days
10	Test EDRO	49 days
11	Test EDRO STANDALO	15 days
12	Test EPMC	10 days
13	Test Front Panel	5 days
14	BackPlane +2 edro	11 days
15	Test STRIPs	95 days
16	Primi prototipi STRIP	10 days
17	Sistema a 4-8 schede STRII	9 days
18	Test Maps	30 days
19	EDRO+AM	25 days
20	Software	121,5 days
21	TDAQ Infrastructure	20 days
22	VME Part	50 days
23	Database	54 days
24	Filar DAQ	24 days
25	Monitoring and Histos	42 days
26	Firmware	85 days
27	EPMC-Strip	24 days
28	EPMC-MAPS	46 days
29	FW for TESTS	56 days
30	Contingency	31 days

- The schedule of the test-beam has been worked out in some detail, finding the items on the critical path.

- The number of people involved is O(20); experts dedicated to each item (DAQ, AM, boards MAPS, board FSSR2, Telescope det's, Power-Supplies/ILK, Monitoring, movable table …).
- Important contributions of the designers of the chips & det's in fixing problems and understanding the det's behavior.
- 2 weeks of 24h shifts.
- In our case all the parts (including the ref. telescope) not yet tested with beam. We must be well prepared to solve problems.

- A working group on the simulation/reconstruction SW just started working:
  - Geometry, reconstruction, online monitoring, alignment

- Scheduled bi-weekly meeting to follow the evolution of the works.

- A pre-test of the system as a whole foreseen in mid-july (@home).

Conclusions

- We are preparing the test-beam in sept.2008 with a demonstrator based on the two det's options of the Super-B CDR.
- In a data-driven approach for the det's, we will test the L1 trigger capability of the tracker endowed by an AM board and study the efficiency/resolution of the MAPS & striplets detectors.