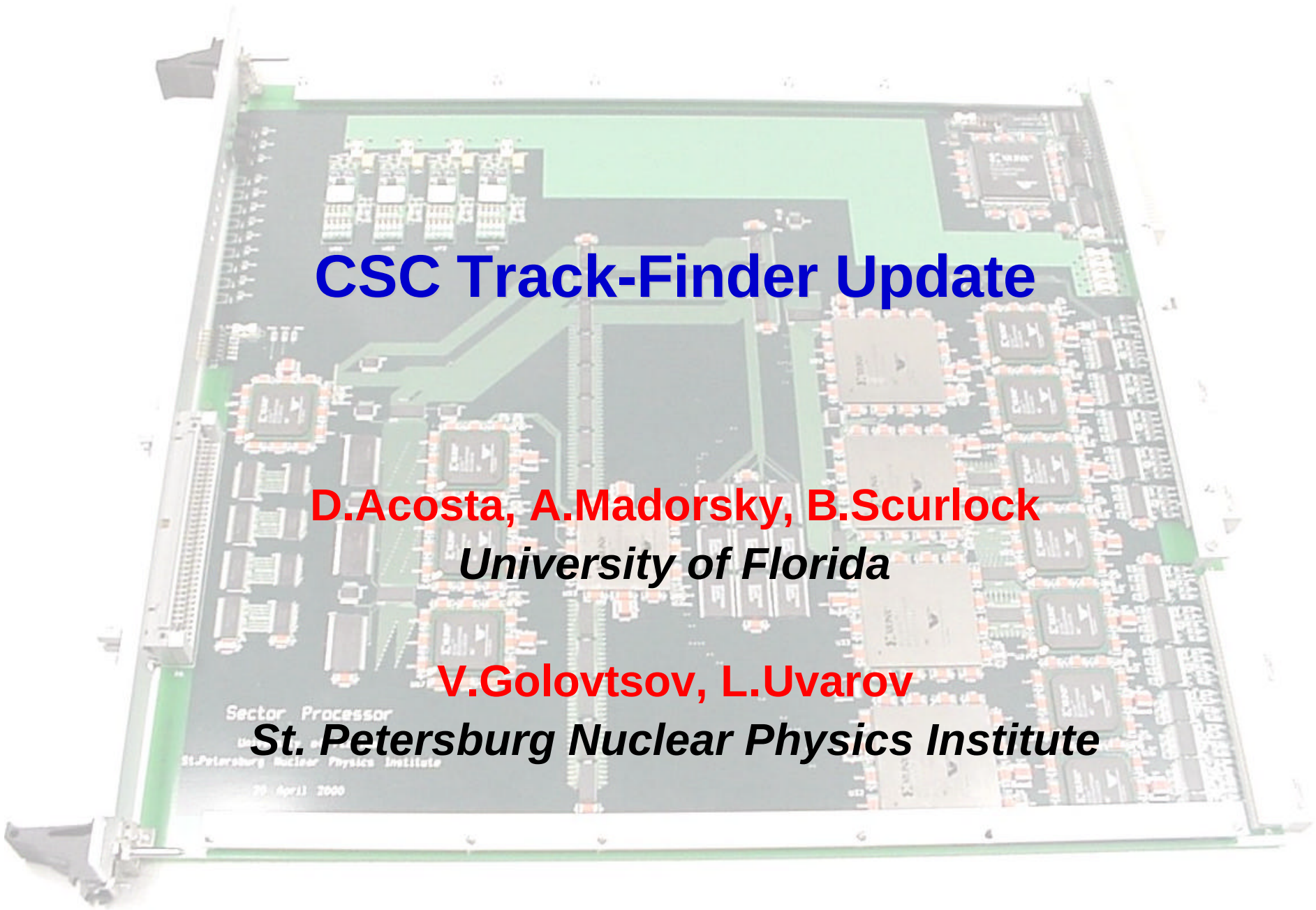


CSC Track-Finder Update

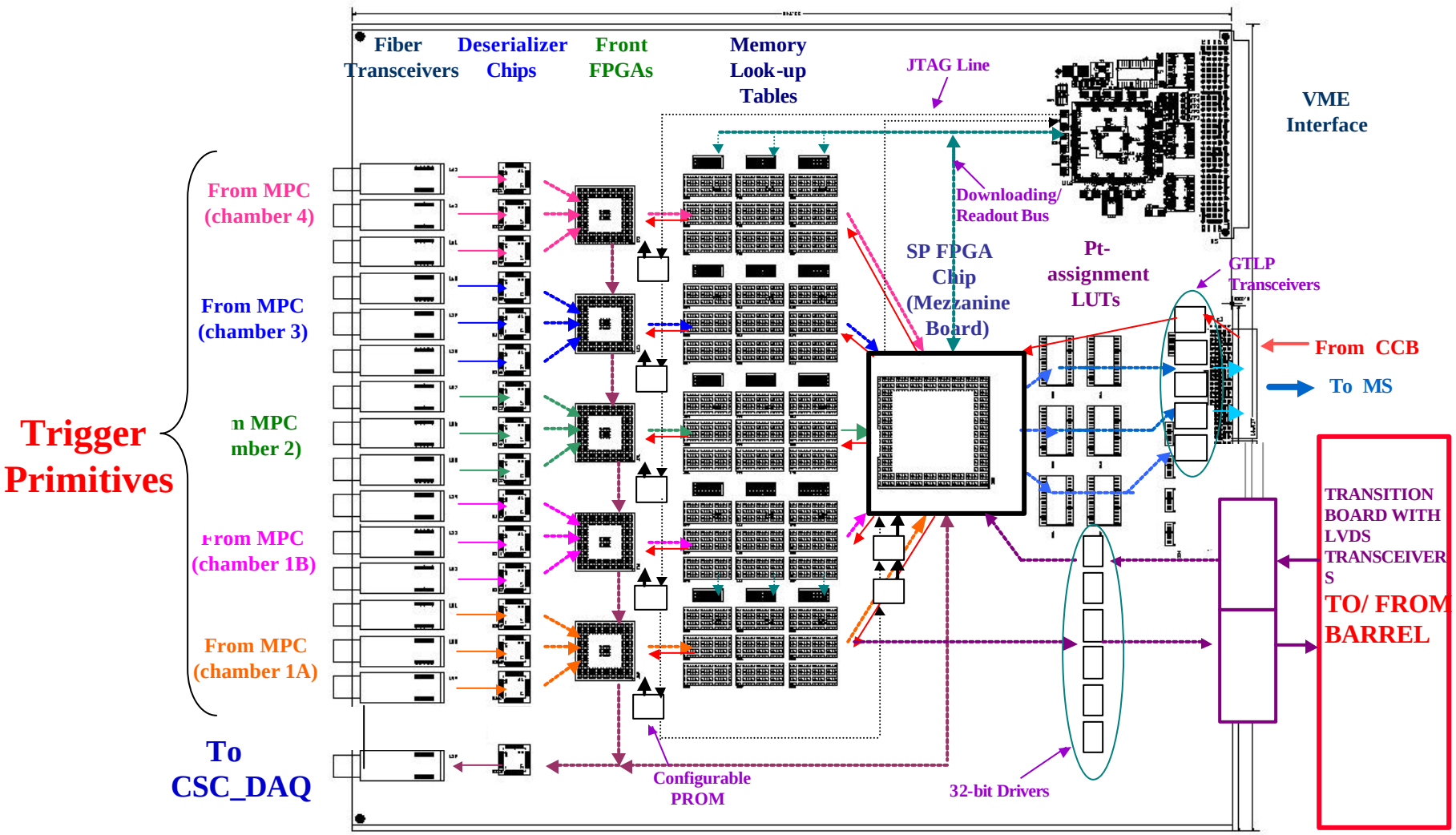
D.Acosta, A.Madorsky, B.Scurlock

University of Florida

V.Golovtsov, L.Uvarov

St. Petersburg Nuclear Physics Institute

SP Conceptual Layout

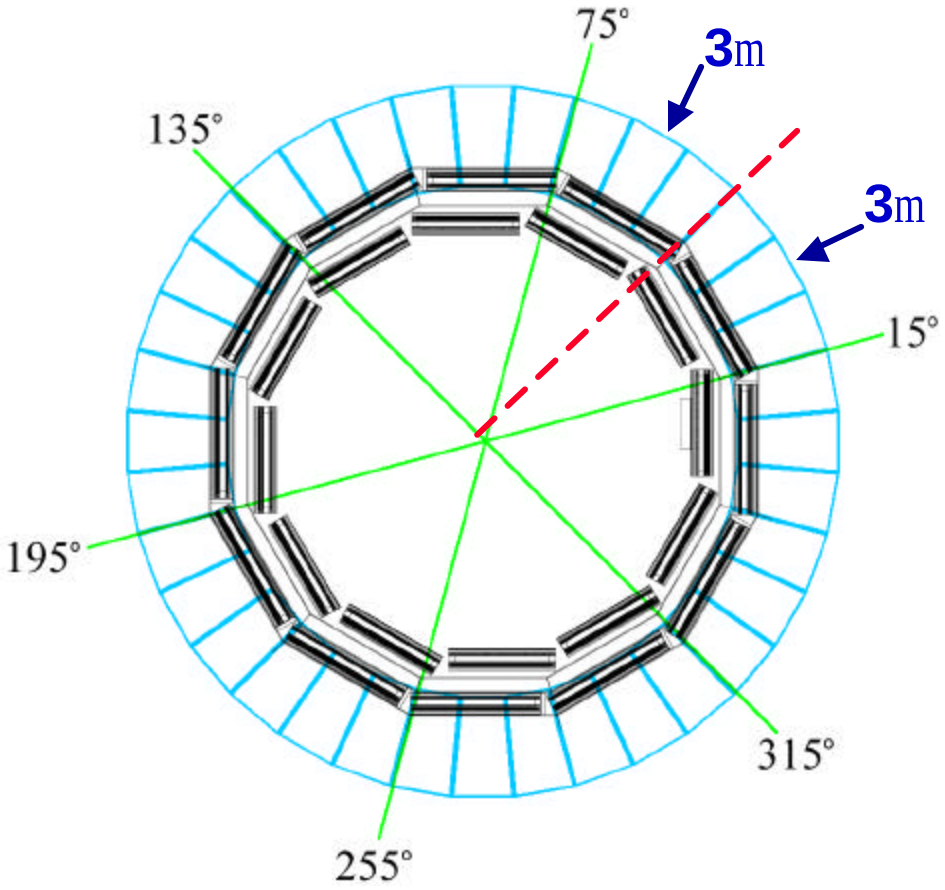


➔ **Currently specifying all interfaces**

UNIVERSITY OF FLORIDA

DT / CSC Interface – Cables

- ME 1/1a staging perturbs DT/CSC cable map because CSC trigger goes back to 3 muons per 30° rather than 2 per 20° (but still a total of 6)
- Send 3 muons to each DT SP
- Last design sent 4 to each, and the center 2 were duplicated



DT / CSC Interface – Bits

From CSC to DT TF:

40 MHz LVDS both ways

Signal	Bits / stub	Bits / 3 stubs (ME1: 30°)	Bits / 6 stubs (ME1: 60°)	Description
f	12	36	72	Azimuth coordinate
h	1	3	6	DT/CSC region flag
Quality	3	9	18	Computed by TMB
BXN	–	2	4	2 LSB of BXN
Total:	16	50	**100**	

← **DT format**

2 sets of 3 muons in 60° each BX

From DT to CSC TF:

Signal	Bits / stub	Bits / 2 stubs (MB1: 60°)	Description
f	12	24	Azimuth coordinate
f_b	5	10	ϕ bend angle
Quality	3	6	Computed by TMB
BXN	2	4	2 LSB of BXN
Synch/Calib	1	2	DT Special Mode
Muon Flag	1	2	2nd muon of previous BX
Total:	24	**48**	

← **CSC format? May be DT**

2 sets of 2 muons in 60° serialized in 2 BX

Add clock to both paths for synch? BC0 for CSC to DT?

SP ® CSC Muon Sorter Interface

80 MHz GTLP

Signal	Bits / m	Bits / 3 m (1 SP)	Bits / 36 m (12 SP)	Description
f	5	15	180	Azimuth coordinate
h	5	15	180	Pseudorapidity
Rank *	7	21	252	5 bits p_T + 2 bits quality
Halo Muon	1	3	36	Halo muon trigger
Charge	1	3	36	Muon sign
Valid Charge	1	3	36	Charge assignment OK? (8^{th} bit from Rank LUT)
BXN	–	2	24	2 LSB of BXN
Error	–	1	12	
Spare	–	1	12	
Total:	20	64	768	**(384 bits at 80 MHz, 32 per SP)**

Send on 1st frame

Requested changes for GT

Muon Sorter to GMT interface

Proposal for a common data link from the RPC, DT, CSC Regional Muon triggers to the Global MuonTrigger
vers 6.
A.Taurok, H.Sakulin
05.Dec 01

DT: M. Dallavalle; CSC: Mike Matveev, P.Padley, D. Acosta
RPC: M. Kudla; GlobMuon: A.Taurok, H.Sakulin

STATUS: 10.Nov.99: Discussion with P.Padley, D. Acosta, and M. Dallavalle
After a first agreement with CSC track finder (18.10.99) and
after Marco's D. comments about sorted muons and
after M.Kudla's proposal to add the CLOCK signal, that is used to put the data onto the wire.

18.0ct. 01 AT/HS ***Halo bit, FineEta bit added***
24.Oct 01 HS ***Coding of eta, phi, pT added***
19.Nov.01HS ***RPC halo (=none), charge valid info updated***
5.Dec.01 HS ***discussion w. D.Acosta => CSC charge valid information and extra quality codes added.***

Open points:

Cable type and therefore if we will have 32 or 34 bits.
ETA-scale (have to agree, discuss zero bin / pseudo sign problem)
PHI-scale: how fine does the conversion from the fine to the 2.5 deg phi need to be?
Quality bits (include charge valid) – final definition

Please check the proposal and tell us your opinion or send us your proposal.
My e-mail addresses: anton.taurok@oeaw.ac.at or Anton.Taurok@cern.ch

Muon Sorter to GMT Bits

Each muon:

23 22 21 20		19 18 17 16		15 14 13 12	11 10 9 8	7 6 5 4	3 2 1 0
H	**S**	**ETA 5.....0**	**QU2,1,0**	**P_T 4.....0**	**7....PHI.....0**		

halo μ **charge**

Quality: including "charge valid"

Note:

- ➔ **p_T and quality must be decoded from 7-bit rank from SP**
- ➔ **phi computed by adding sector offset to** ϕ_{SP}

Di-Muon Trigger

Studies by the PRS/μ group show that the optimum balance between rate and efficiency for single and di-muon topologies has the di-muon trigger right at threshold (p_T>4 GeV)

This means that an accurate P_T measurement is less important for the di-muon trigger than for the single muon trigger

Thus, we can relax the track quality for di-muons (or other "mixed" objects) to increase the efficiency

However, we must keep the ghost di-muon rate low to keep the overall rate under control

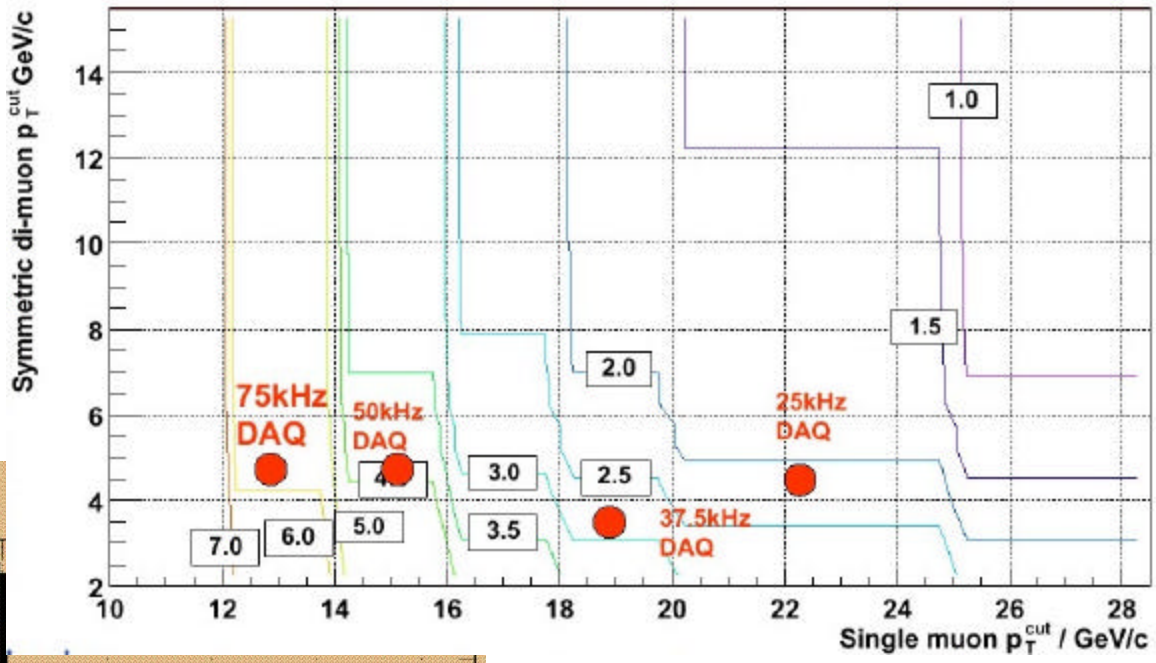
- **Ghosts occur when tracks cross sector boundaries**

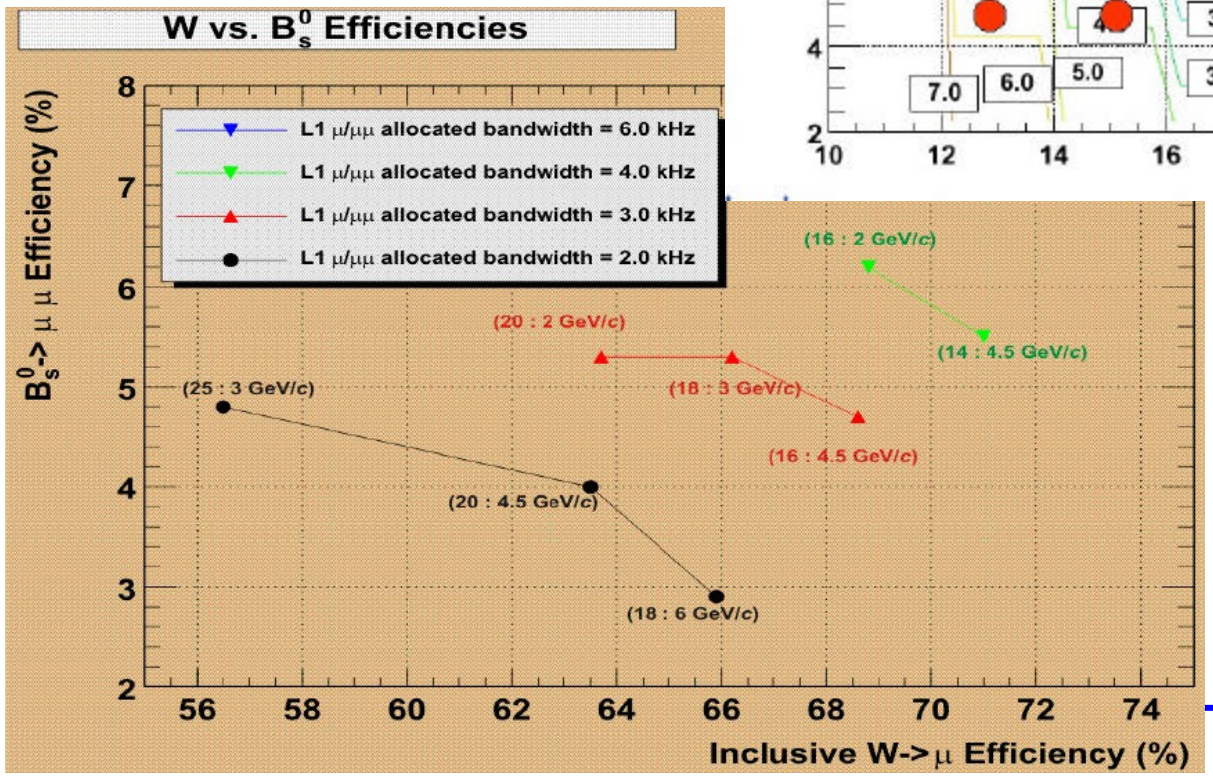
Di-μ vs. Single μ Rates & Efficiencies

H.Sakulin
M.Fierro

Rate

$L = 2 \cdot 10^{33}$

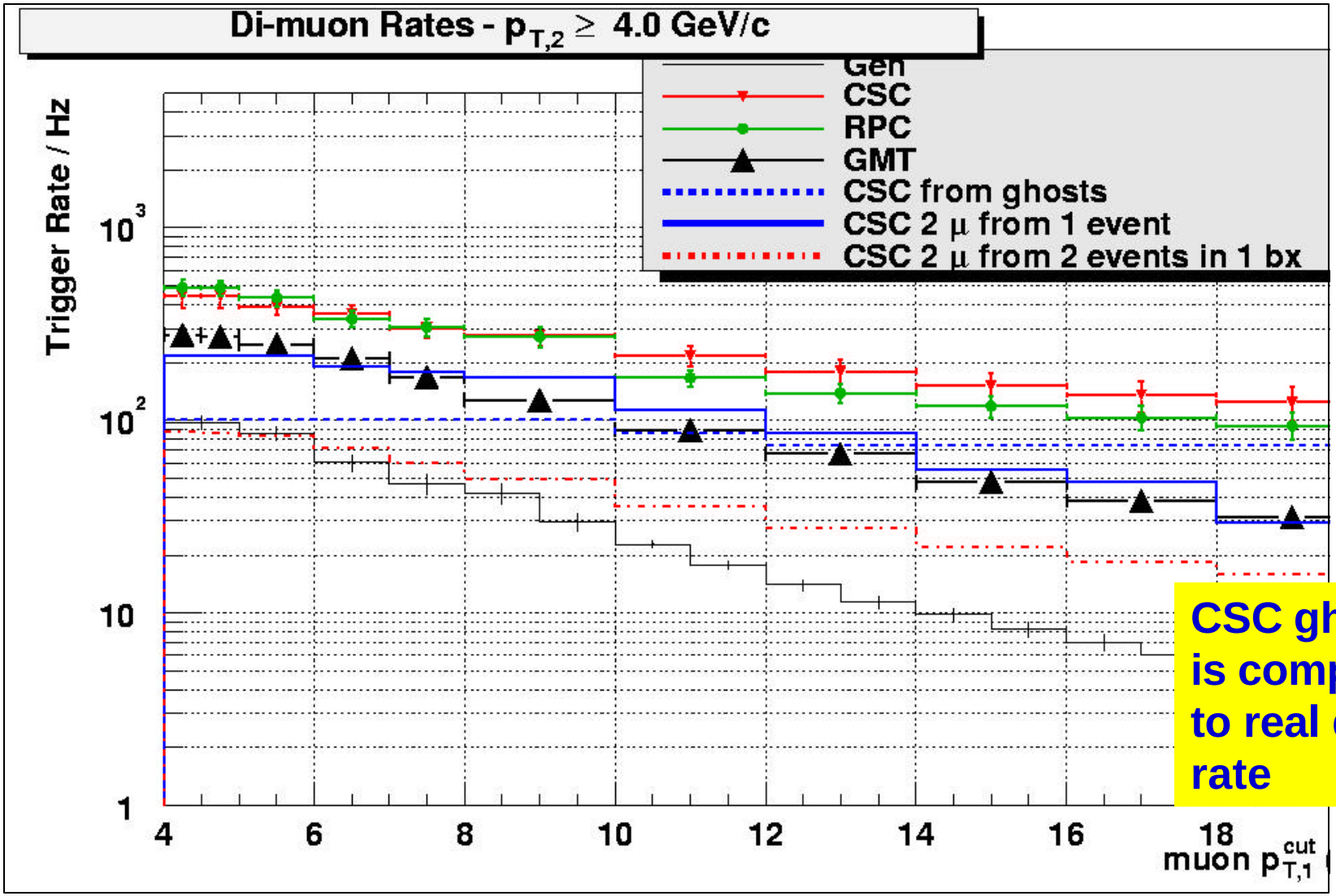




Efficiency

CSC Di-Muon rates

H.Sakulin



CSC ghost rate is comparable to real di-muon rate

Ghost-Busting in CSC Muon Sorter

The CSC Track Finder does not share information across sector boundaries

- ➔ Efficiency loss is negligible
- ➔ Ghost tracks are created and pose a problem for the di-muon trigger

Most ghosts stem from duplicate LCTs from overlapping chambers

- ➔ This can be solved in principle by suppressing the LCT trigger for one of the chambers in the 5-strip overlap
- ➔ But not done currently in ORCA simulation, PRS rate studies

However, ghosts also can be cancelled in the CSC Muon Sorter, which receives all CSC information

- ➔ Less challenging technically than trying to share information between Sector Processors
- ➔ "Small" additional logic to Sorter chip, and hopefully minimal impact on latency
- ➔ Compare η, ϕ between muons from neighboring sectors (not all) and cancel lower quality candidate
  - Current resolution is 2.5° in ϕ and 0.05 in η

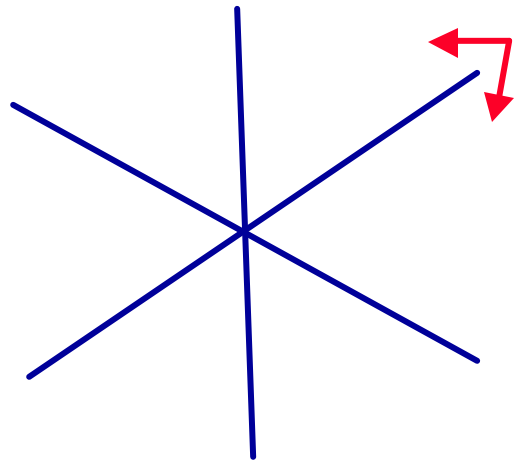
Ghost Cancellation Logic

Cancellation logic involves comparisons of 5-bit h and f words. For example:

- **if ((phi1==5 || phi1==6) && (phi2==5 || phi2==6) && (abs(eta1-eta2)<=1)) { …cancel…}**

Comparisons done between muons of neighboring sectors (not between all muons)

- **(2 endcaps) ´ (6 sectors) ´ (3m ´ 3m) = 108 comparisons**

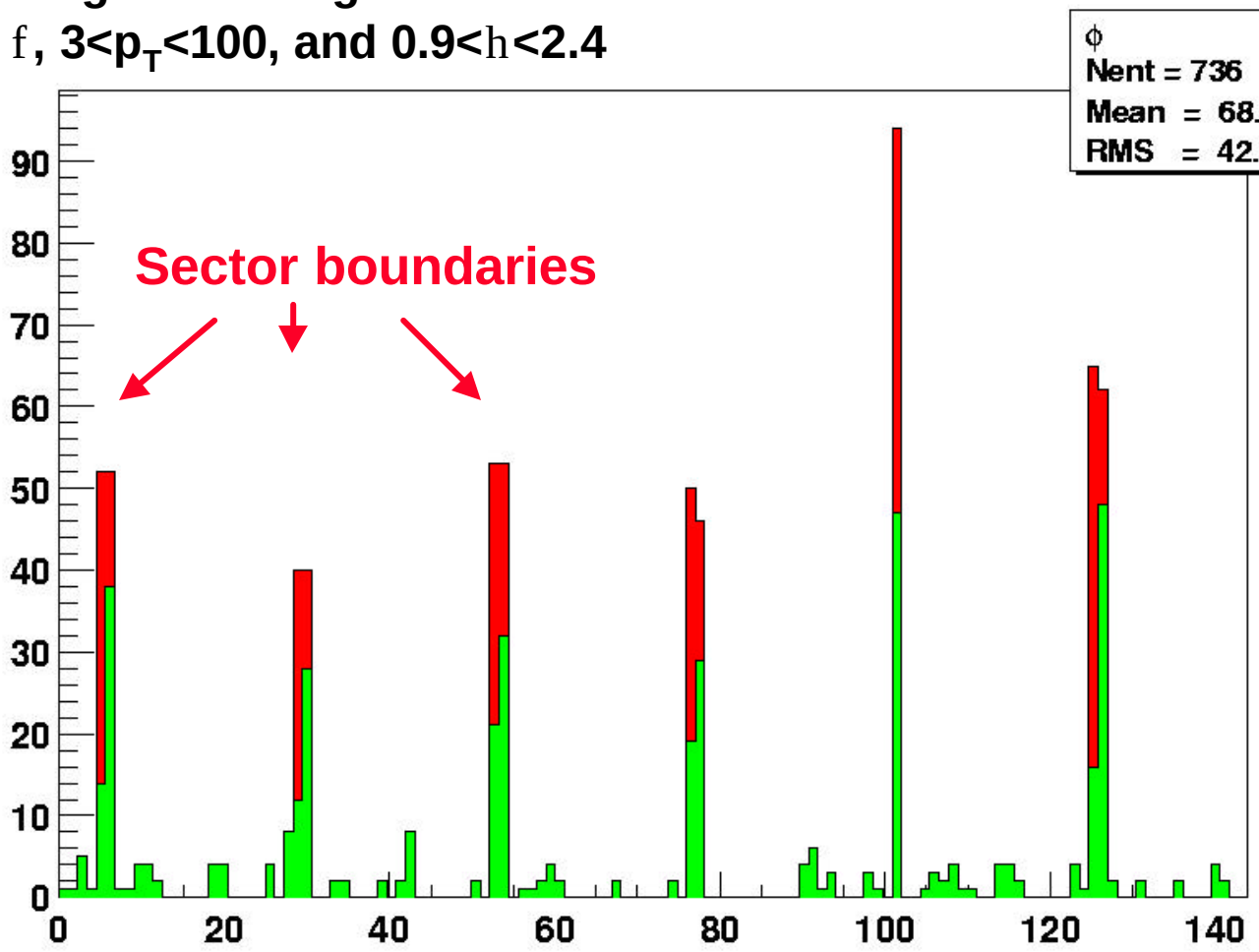


Ghost Cancellation

Plot f of di-muon candidates, *all* track qualities

B.Scurlock

Single muons generated flat in f, 3<p_T<100, and 0.9<h<2.4



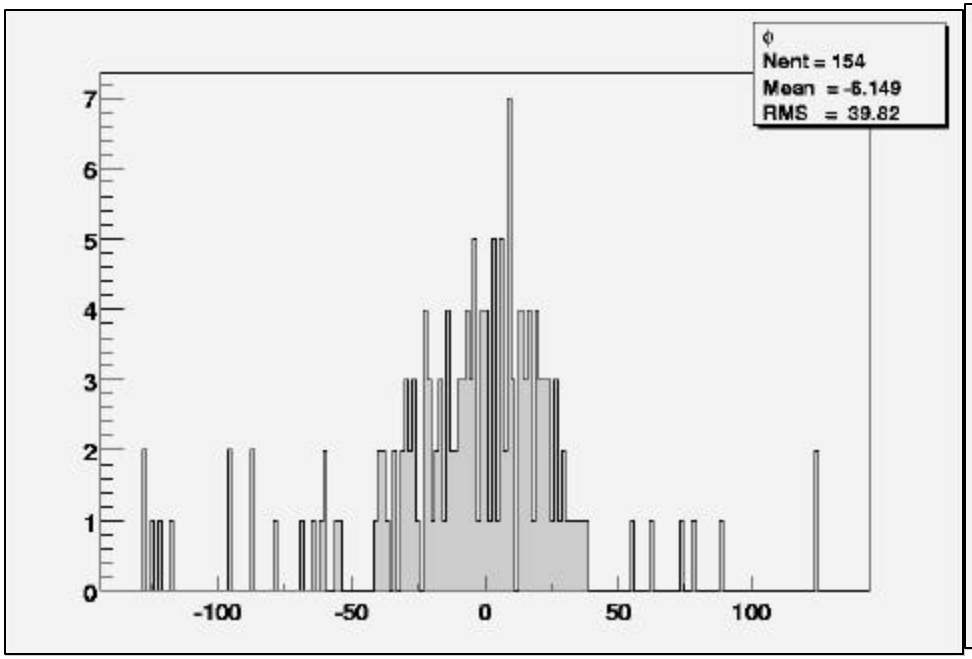
368 fake di-muons (1.5%)

Cancellation:
If 2 muons within ± 1 bin in f and h on boundary, kill lower quality candidate

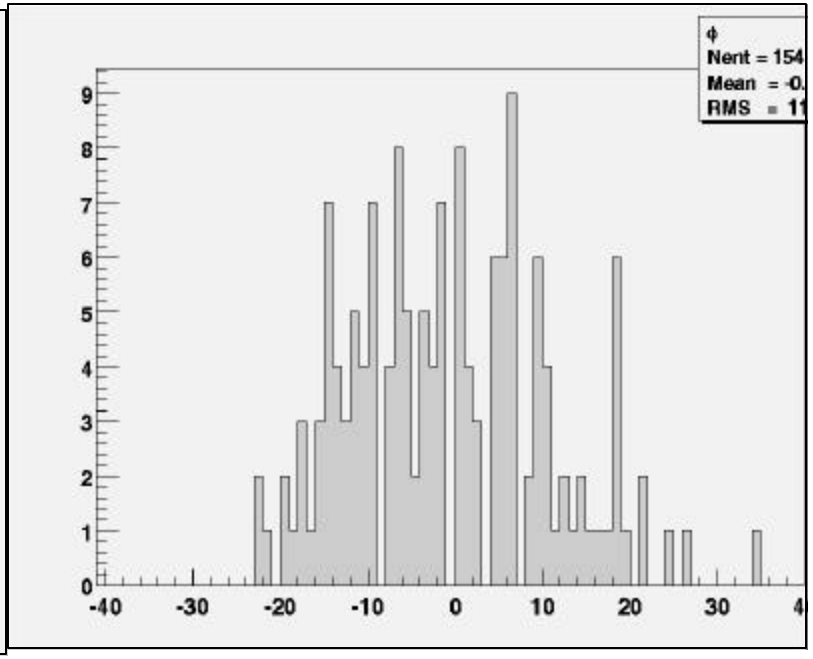
Can cancel 303/368 Þ 6X reduction

Integer j [0,143], one entry per muon

Di-Muons From J/Psi Decays



f difference (integer)



h difference (integer)

Only 8/154 have $\Delta\phi \leq 1$, but none on sector boundary
So ghost cancellation is safe on J/Psi