



Muon Phase I Upgrades - Introduction

- **CSC Upgrades**

- ME4/2 build 72 new CSC chambers
- ME1/1 build 7x72 Digital CFEBs
 - and 72 each associated trigger (TMB), readout (DMB) boards

- **RPC Upgrades**

- Build another endcap station out to rapidity 1.6

- **DT Upgrades**

- Electronics issues to be addressed



Muon Phase I Upgrades - Issues

- **Infrastructure, e.g. shielding wall: will hear from Austin**
- **CSC Upgrades**
 - Keeping chamber costs under control (panels, assembly)
 - Can Digital CFEs be ready for installation in ME1/1 during the 2011 shutdown?
 - (Time scale for Project funding to appear)
- **RPC Upgrades - endcap**
 - Detailed plans (e.g. double station in RE2?)
 - What about low efficiency of endcap chambers?
 - (Work plan: who builds what, and financing)
- **DT Upgrades**
 - No major Phase 1 issues?
- **Simulations for high luminosity, e.g. neutron hits**
 - Crucial but severely limited by manpower



Schedule for remaining talks

- **A tight agenda – please keep talks short to allow discussion**
 - 10:10-10:30 Austin Ball – Infrastructure Issues for Forward Muon Upgrades
 - 10:30-10:50 Oleg Prokofiev - Update on ME4/2 Chambers and Tooling
 - 10:50-11:10 Ben Bylsma - Update on Digital CFEB
 - 11:10-11:30 Vadim Khotilovich – CSC efficiency studies
 - **20' coffee break (replace by ~30' lunch after Gilmore talk?)**
 - 11:50-12:10 Jason Gilmore - TMB Design Issues for ME1/1
 - 12:10-12:30 Piet Verwilligen **by EVO** - RPC Upgrade for Phase 1
 - 12:30-12:40 Pierluigi Zotto – Barrel DT Phase 1 Upgrades
 - 12:40-13:00 Discussion
- **Phase 2 muon upgrades 13:00-16:10**
- **Plenary summaries 16:00-18:00**

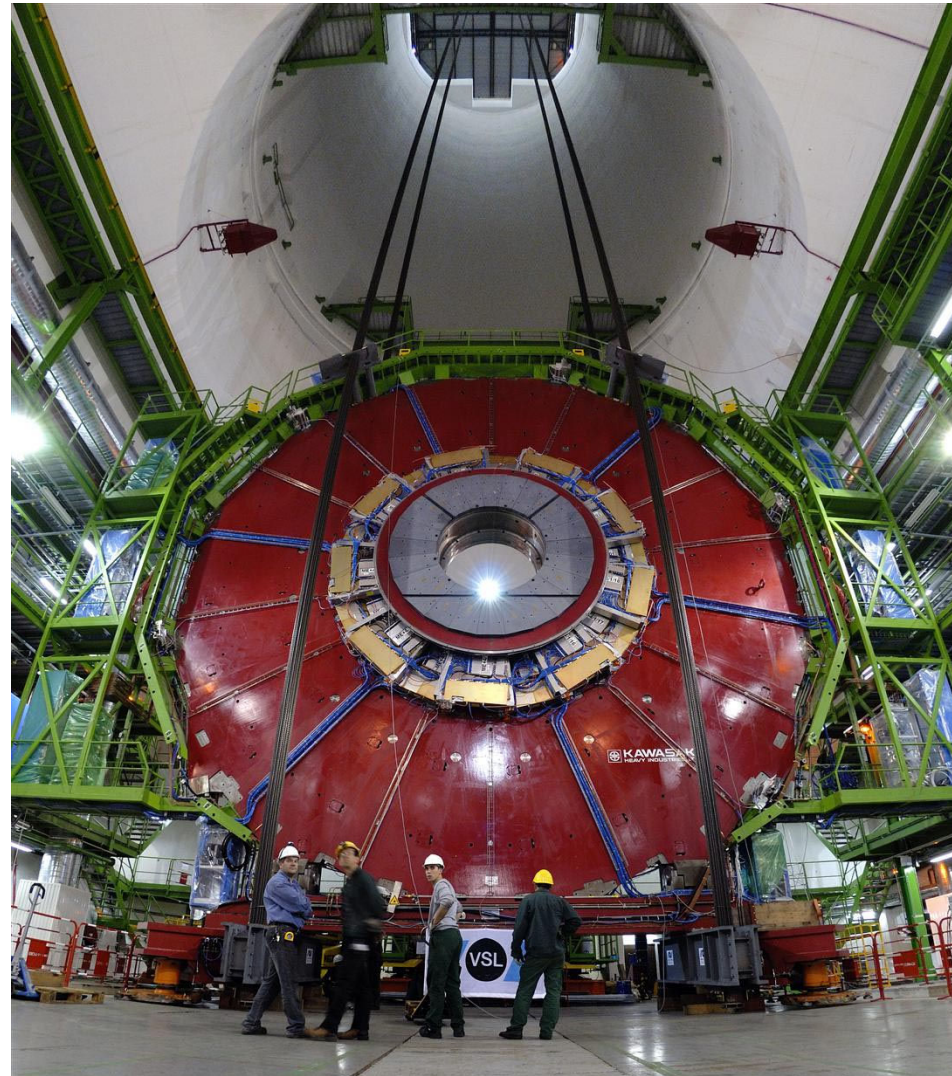
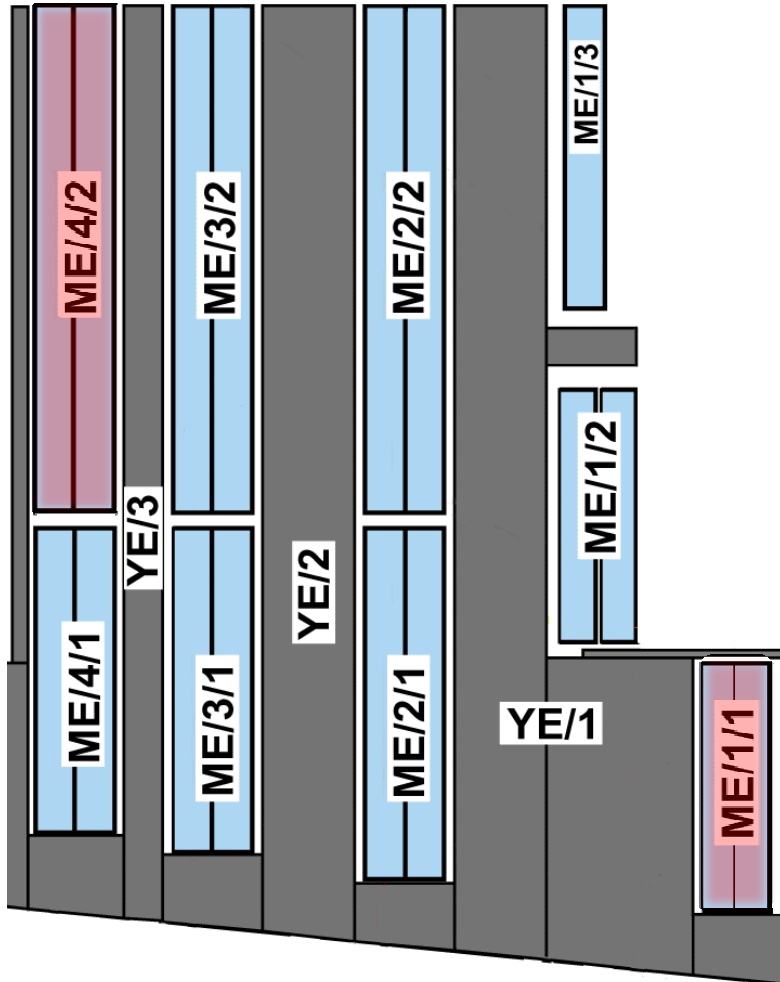


Backup slides



ME4/2 and ME1/1 upgrades

R-Z cross-section

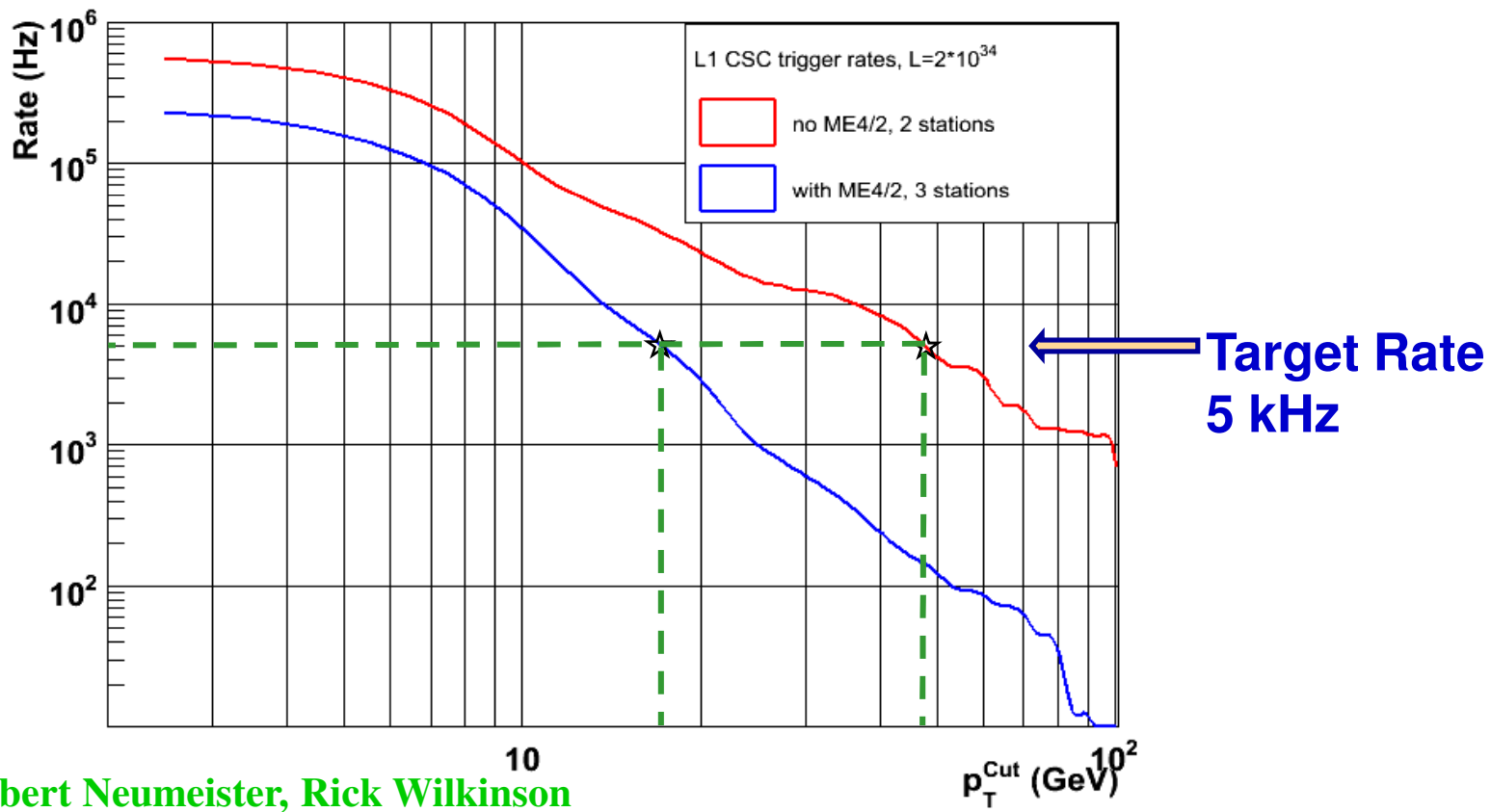


“Empty” YE3 disk ready for ME4/2



ME4/2 upgrade motivation

- **Triggering with & without the ME4/2 upgrade:**
 - The high-luminosity Level 1 trigger threshold is reduced from 48 \rightarrow 18 GeV/c

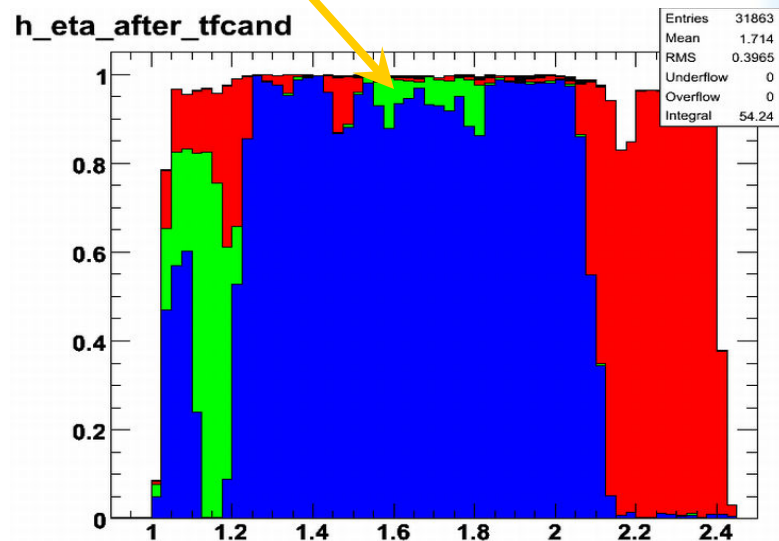
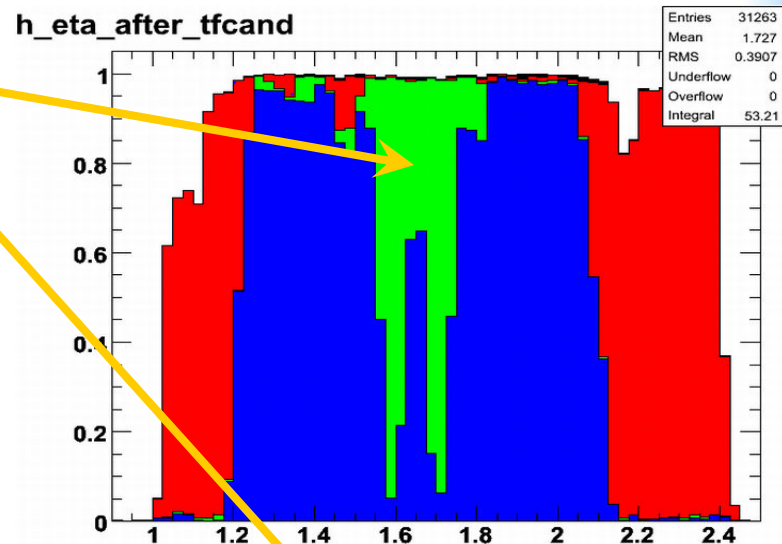


Ingo Bloch, Norbert Neumeister, Rick Wilkinson

CSC Simulation result (May '09)

(Vadim Khotilovich, Alexei Safonov)

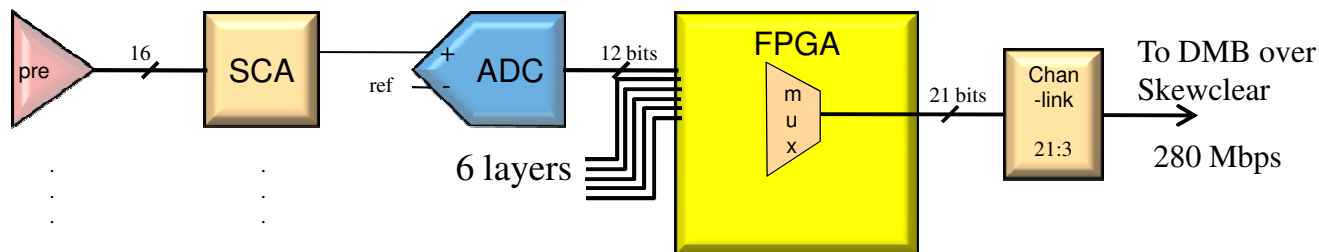
- Efficiency gaps for good quality TF tracks disappear with addition of ME4/2
- ME4/2 will be included by default in 31X
- Back-porting to 22X took a considerable amount of effort
 - Thanks to the experts: Rick Wilkinson, Tim Cox, Oana Boeriu and Slava Valuev!



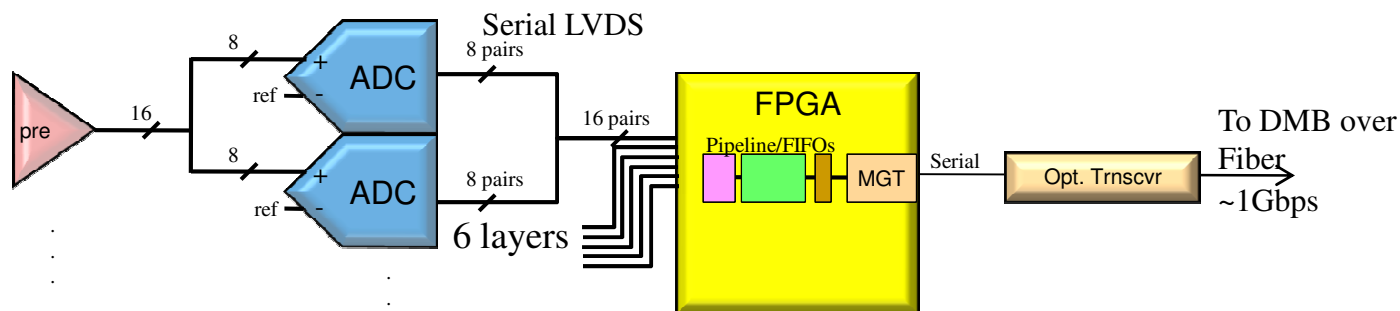


“Digital CFEB” cathode board

- **CSC principle: digitize cathode charges to ~1%, interpolate for fine position**
- **Current CFEB: the ADC is multiplexed 16:1**
 - Requires analog charge storage ASIC (SCA)
 - Serial digitization after L1A



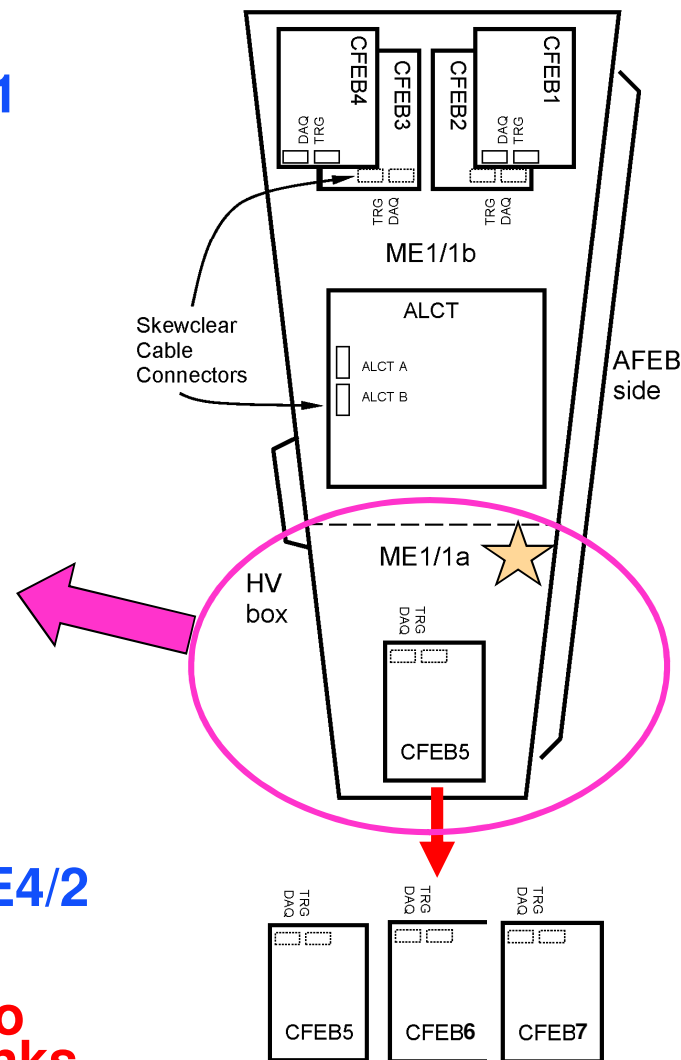
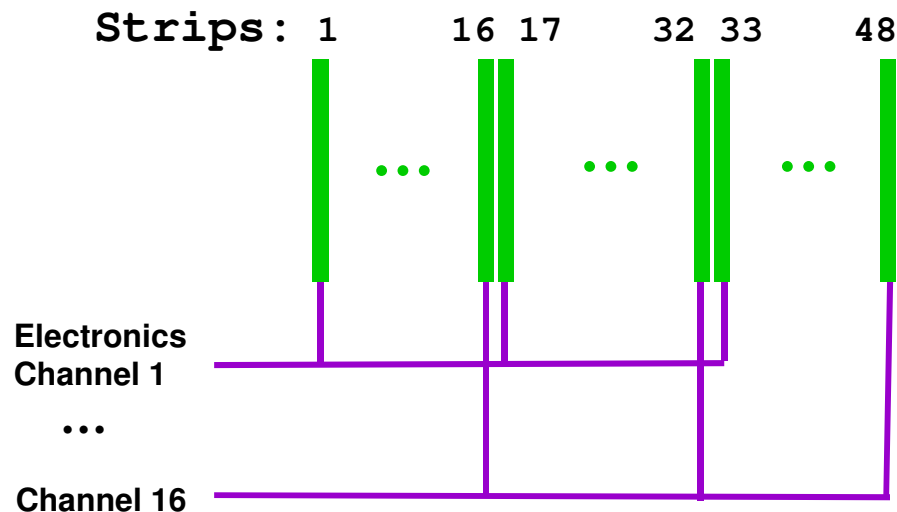
- **Digital CFEB uses Flash ADCs:**
 - Continuous and deadtimeless digitization





ME1/1 Restoration of η 2.1-2.4

- **High- η section of ME1/1**
 - Cathode strips are currently ganged 3:1



- **Plan:**
 - Install DCFEB boards on ME1/1
 - Move existing CFEBs from ME1/1 to ME4/2
 - Takes ~2.5 months per endcap
 - **72 new TMB and DMB boards needed to accommodate additional inputs, optolinks**



Overall ME4/2 schedule (if 2011 start) - installation constraints not taken into account

WBS	Task Name	Duration	2011					2012				2013				2014		
			tr	tr	tr	tr	tr	tr	tr	tr	tr	tr	tr	tr	tr	tr	tr	
1	Emu ME4/2 upgrade	796 days	[Gantt bar spanning from start of 2011 to end of 2013]															
1.1	ME4/2 Procure mechanical parts and panels	260 days	[Gantt bar in 2011]															
1.2	ME4/2 Panel production	390 days	[Gantt bar spanning 2011 and 2012]															
1.3	ME4/2 Chamber assembly and shipping	455 days	[Gantt bar spanning 2011 and 2012]															
1.4	ME4/2 Procure electronics parts (non-CFEB)	325 days	[Gantt bar in 2011]															
1.5	ME4/2 Produce electronics boards (non-CFEB)	325 days	[Gantt bar spanning 2011 and 2012]															
1.6	Pre-production DCFEB	260 days	[Gantt bar in 2011]															
1.7	ME4/2 Final assembly and test (FAST) at CERN	390 days	[Gantt bar spanning 2012 and 2013]															
1.8	Procure DCFEB parts	260 days	[Gantt bar spanning 2011 and 2012]															
1.9	Produce DCFEB boards	325 days	[Gantt bar spanning 2012 and 2013]															
1.10	Ready for start of ME4/2 chamber installation	0 days	[Milestone diamond at end of 2013, labeled 3/29]															
1.11	Installation of ME4/2 chambers (earliest date)	15 days	[Gantt bar in 2014]															
1.12	Cabling and services for ME4/2 (earliest date)	65 days	[Gantt bar in 2014]															
1.13	(Upgrade of ME1/1 with DCFEB, earliest date)	130 days	[Gantt bar in 2014]															
1.14	Install CFEBs on ME4/2 chambers (earliest date)	15 days	[Gantt bar in 2014]															



ME4/2 Upgrade Schedule

$t_0 + 0$ months	CD2 approval, money flows, begin work on Bldg 904
$t_0 + 3$ months	orders sent out for all parts
$t_0 + 6$ months	production tooling shipped to CERN and assembled in Bldg 904
$t_0 + 9$ months	chamber parts delivered, shipped to CERN
$t_0 + 12$ months	production begins at Bldg 904 at 2 CSCs/month
$t_0 + 15$ months	production ramps to 4 CSCs/month
$t_0 + 18$ months	FAST site begins assembly & testing at CERN (Bldg 904?), spare CFEB boards installed on ME4/2s
$t_0 + 24$ months	42 CSCs finished and tested -- ready for installation of 1st endcap, recover 200 CFEB boards from ME1/1s
$t_0 + 33$ months	all 76 CSCs finished
$t_0 + 36$ months	final 36 chambers ready for installation on 2nd endcap

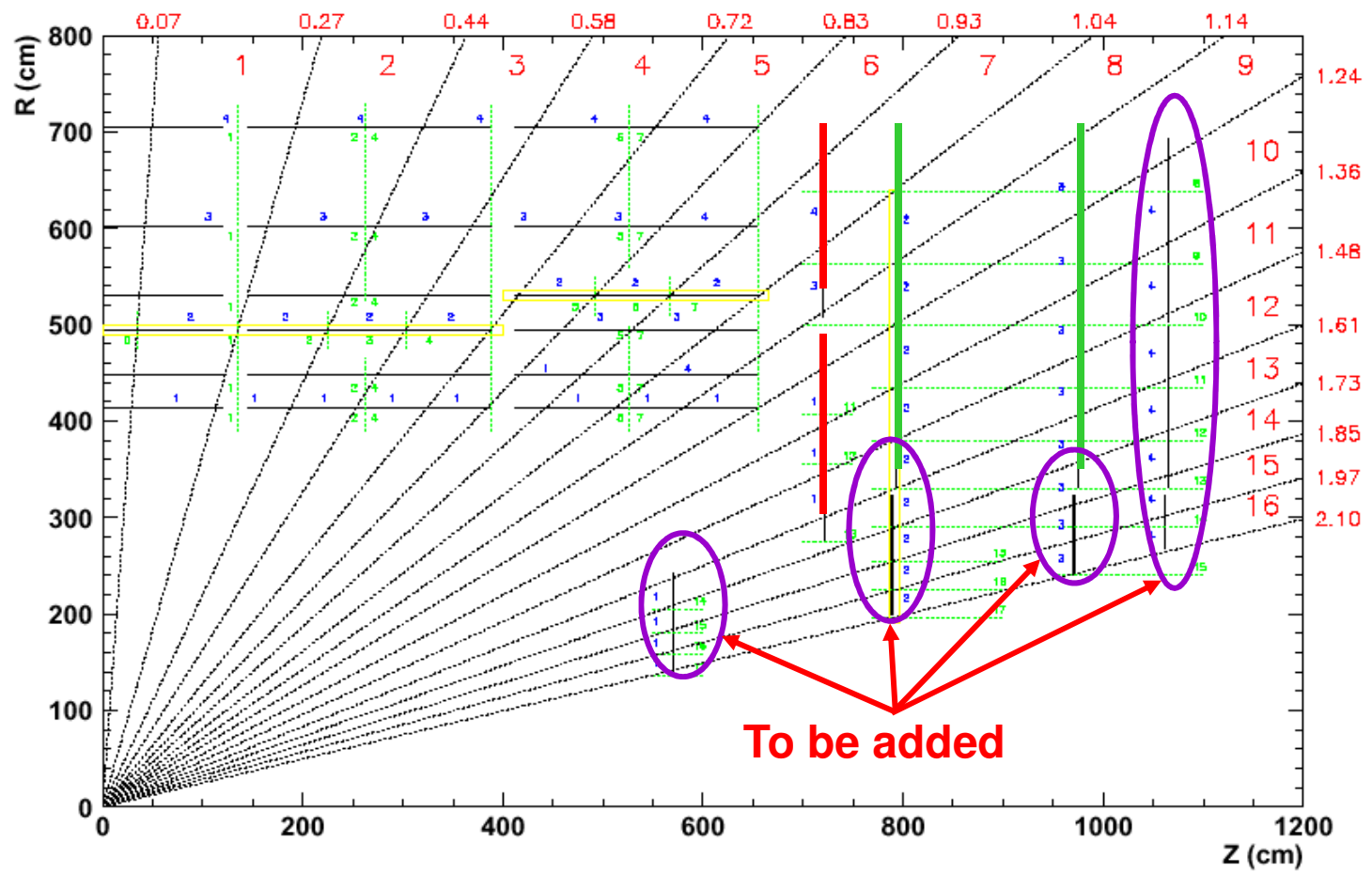


RPC Endcap: Restoration of the TDR System

- η coverage of Current system:
 ≥ 4 stations up to ~ 1.24 ; only 3 stations up to ~ 1.6



RPC Trigger Segmentation (new)



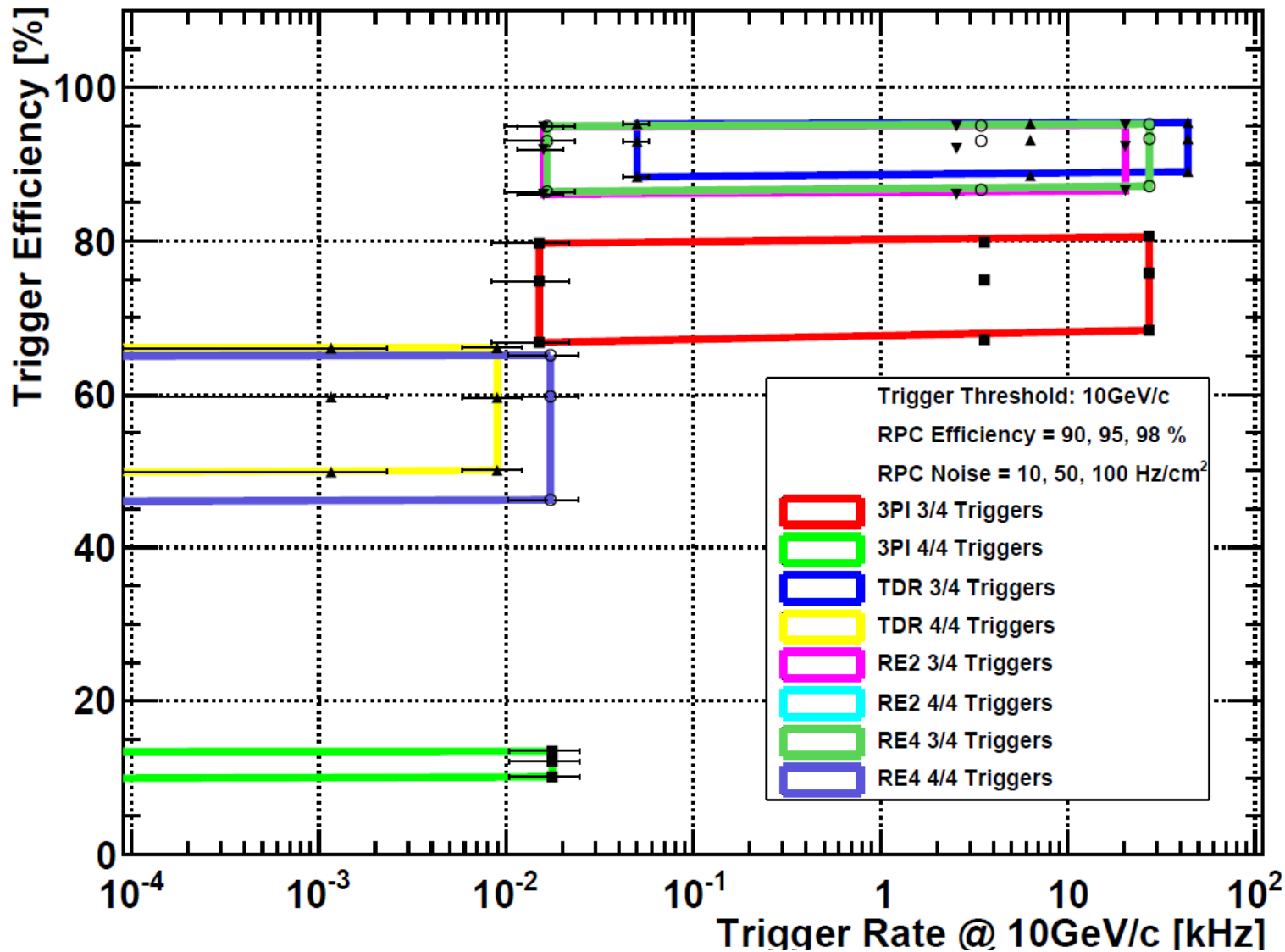
More layers for
less chamber
noise

To be added

Loveless, for
van Doninck

Fake trigger rate : single muon + noise

preliminary





CSC Electronics discussion items I

- **DCFEB**

- Buckeye-FADC voltage levels – is there a solution?
- DCFEB optical links - what are they? What protocol do they need on the other end (new DMBs and TMBs)? Are they synchronous (for trigger)?
- Any other news on DCFEB?
- Plan is to produce the prototype in 2010 some time - when?
- Radiation test ideas?
- How crazy to accelerate to 2011 installation (LHC-off year)?

- **ME1/1 DMBs:**

- What are the plans for prototyping?
- Manpower?



CSC Electronics discussion items II

- **ME1/1 TMBs:**
 - How to design and build them most effectively?
 - New ME1/1 TMBs: what great new FPGA features are out there that we could make use of?
- **ALCT mezzanine upgrade:**
 - left out of the Phase 1 plans so far, but...
 - NB Easy replacement when ME1/1 CFEBs replaced.
 - Could a *cheap* FPGA upgrade be found?
 - Plug for asynchronous trigger at this point?



CSC Electronics discussion items III

- **Preparation for Phase 2:**
 - What will replacement for TTC system mean for peripheral crates?
 - We need to make sure new DMBs and TMBs for ME1/1 are going to be fully compatible.
- **Peripheral crate changes?**
 - Do we need to change the meaning of backplane signals to deal with "independant" inner and outer sections of ME1/1?
 - Do we want TMB to send more than 2 LCTs?
 - What needs to be done so that MPC sends all muons (no data funnel)?