



Trigger Management & Planning

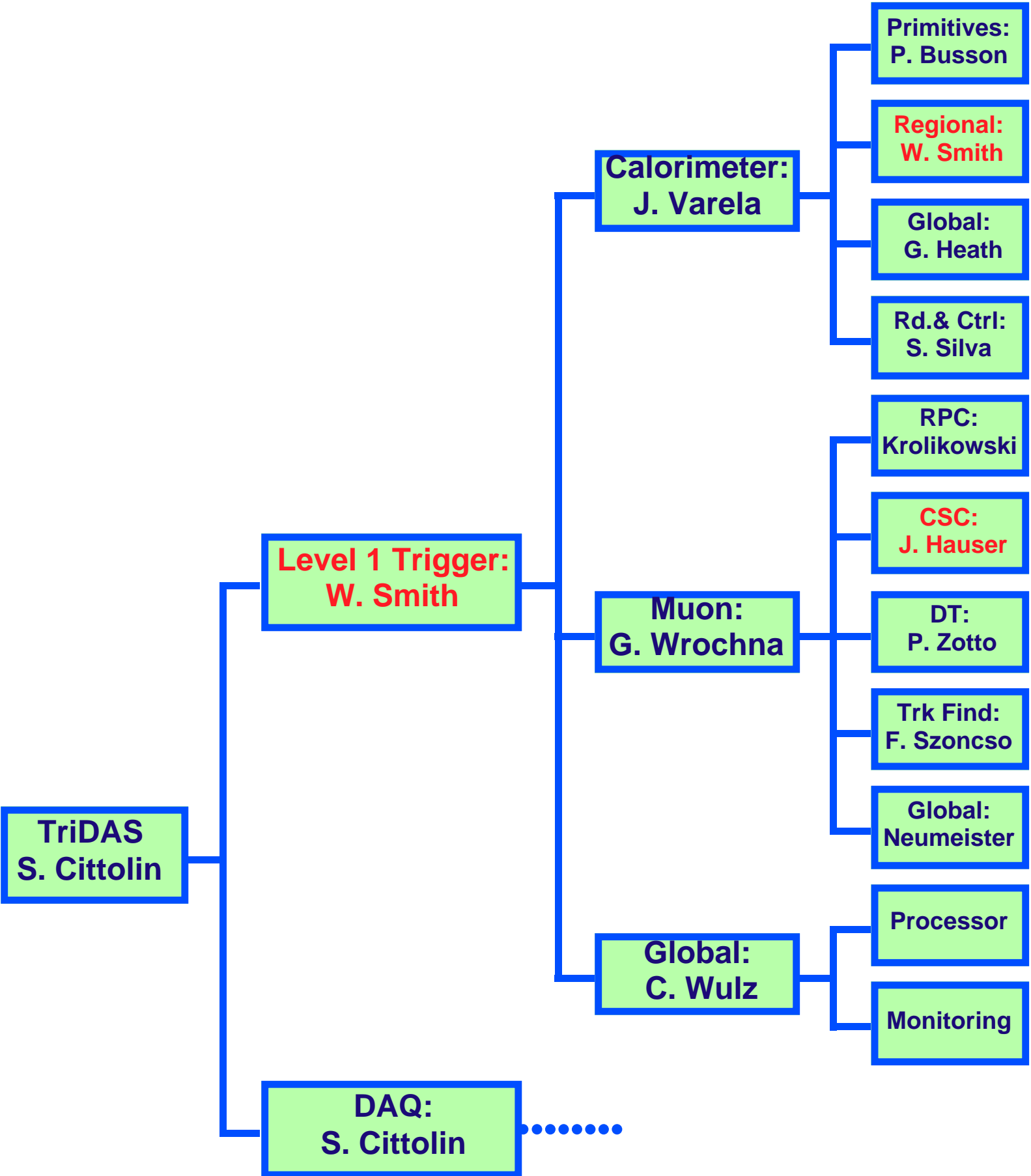
Wesley Smith, *U. Wisconsin*
CMS Trigger Project Manager

Outline:

- **Organization & Responsibilities**
- **Experience**
- **Management**
- **WBS Summary**
- **Schedule (MS Project) summary**
- **Manpower Profile**
- **Obligation Profile**
- **Cost Drivers**
- **Descoping Scenarios**



CMS Trigger Organization





CMS Institute Responsibilities

Muon Trigger:

RPC Trigger

Warsaw

Drift Tube Trigger

Padova

CSC Trigger

UCLA, Florida, Rice

ME1/1 CSC Trigger

Dubna

Muon Sorter

Bari

Track Finder

Vienna

Global Processor

Vienna

DAQ

Turino

Calorimeter Trigger:

Primitive extraction

Palaiseau, Lisbon

Optical Fiber Transmission

Helsinki

Regional Calorimeter Trigger

Wisconsin

Global Calorimeter Trigger

Bristol

DAQ & Control

Lisbon

Global Trigger:

Trigger Timing & Control

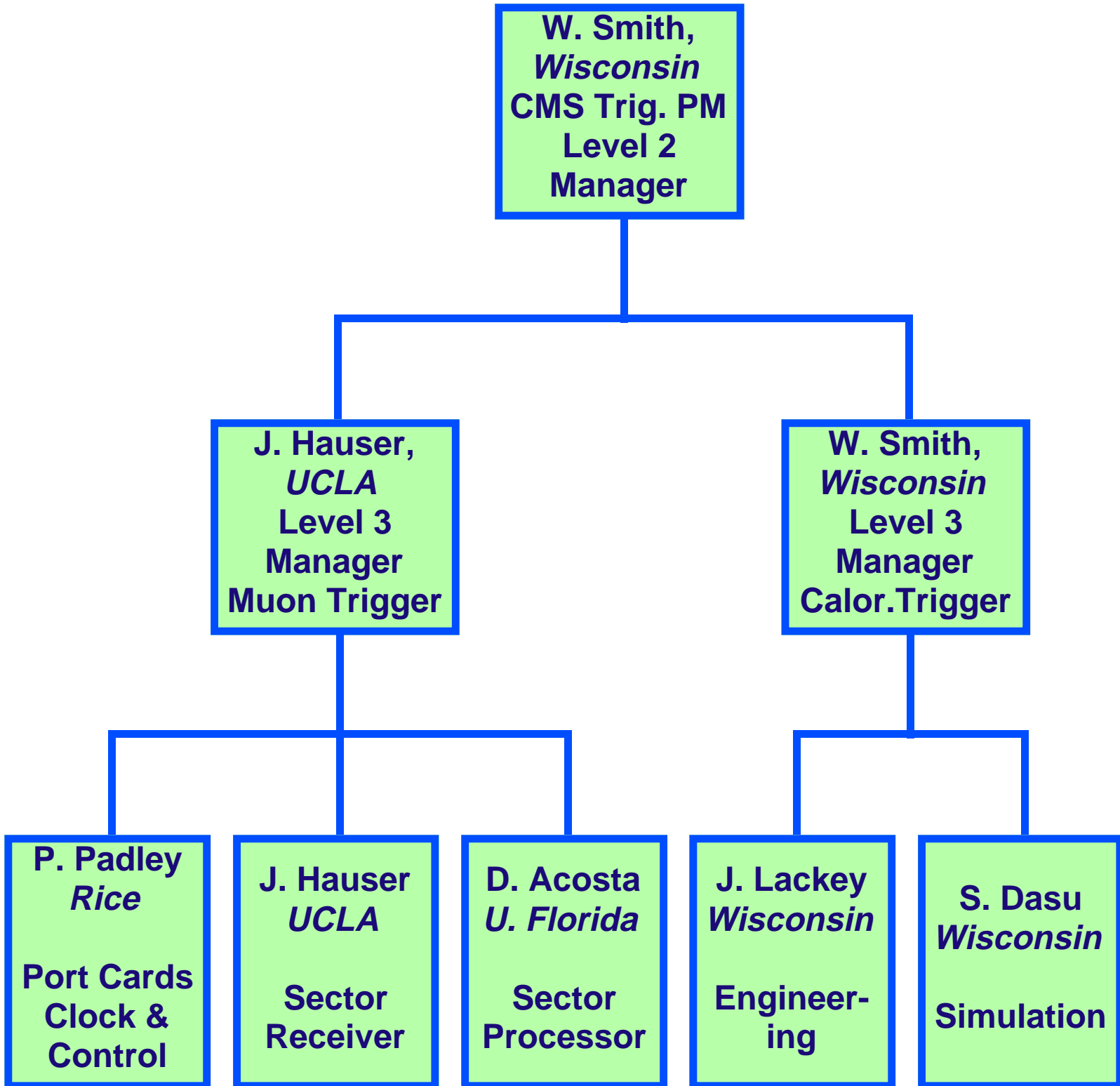
CERN

Global Processor

Vienna



U.S.Trigger Organization





Trigger Team Details

Engineers:

• Wisconsin:

- J. Lackey & M. Jaworski
- PSL Engineering Staff (P. Robl)

• UCLA: XXXX & Y. Shi

• Rice: N. Adams & M. Matveev

• Florida: TBD

Responsibilities for HEP Electronics:

• CDF:

- J. Hauser, Y. Shi, XXXX
 - PMT system, Run 0 L2 processor

• ZEUS (& SDC*):

- W. Smith*, J. Lackey*, M. Jaworski*, S. Dasu*, W. Badgett (WI), D. Acosta (FL)
 - Calorimeter L1 Trigger

• FNAL KTeV:

- XXXX, Y. Shi
 - FERA readout, shaper/splitter/drivers

• STAR:

- E. Platner
 - FE for ECAL, trigger barrel, TOF, MW endcap, SHmax

• Others:

- D0, FNAL E799, AGS E891 & E896, UA1, MKIII...



Trigger Project Management

CMS Annual Reviews

- **April: TriDAS Status**
 - Progress, draft R&D plans & expenses for next year
- **November: TriDAS Internal Review**
 - R&D Plans/Progress, Cost & Schedule, Milestones
 - Finalize R&D plans & expenses for next year
 - Internal CMS Review w/CMS referees
- **Internal Electronics Reviews by LHC Electronics Board CMS Reps.**
 - G. Hall (Imperial), G. Stefanini (CERN), W. Smith (Wisc.)
 - Reports to CMS Management Board (next trigger review in Fall '98)

US Reviews/Reporting

- **Monthly Video Conferences:**
 - Florida, Rice, UCLA, Wisconsin, Davis (sim)
 - Review Progress, milestones, simulation activities
- **Integration Meetings:**
 - Calorimeter Trigger: FNAL, Maryland, Wisconsin
 - Muon Trigger: Ohio, Florida, Rice, UCLA, Wisconsin, others.
- **Annual Site Visits:** Florida, Rice, UCLA



Calorimeter Trig. Costs at L4

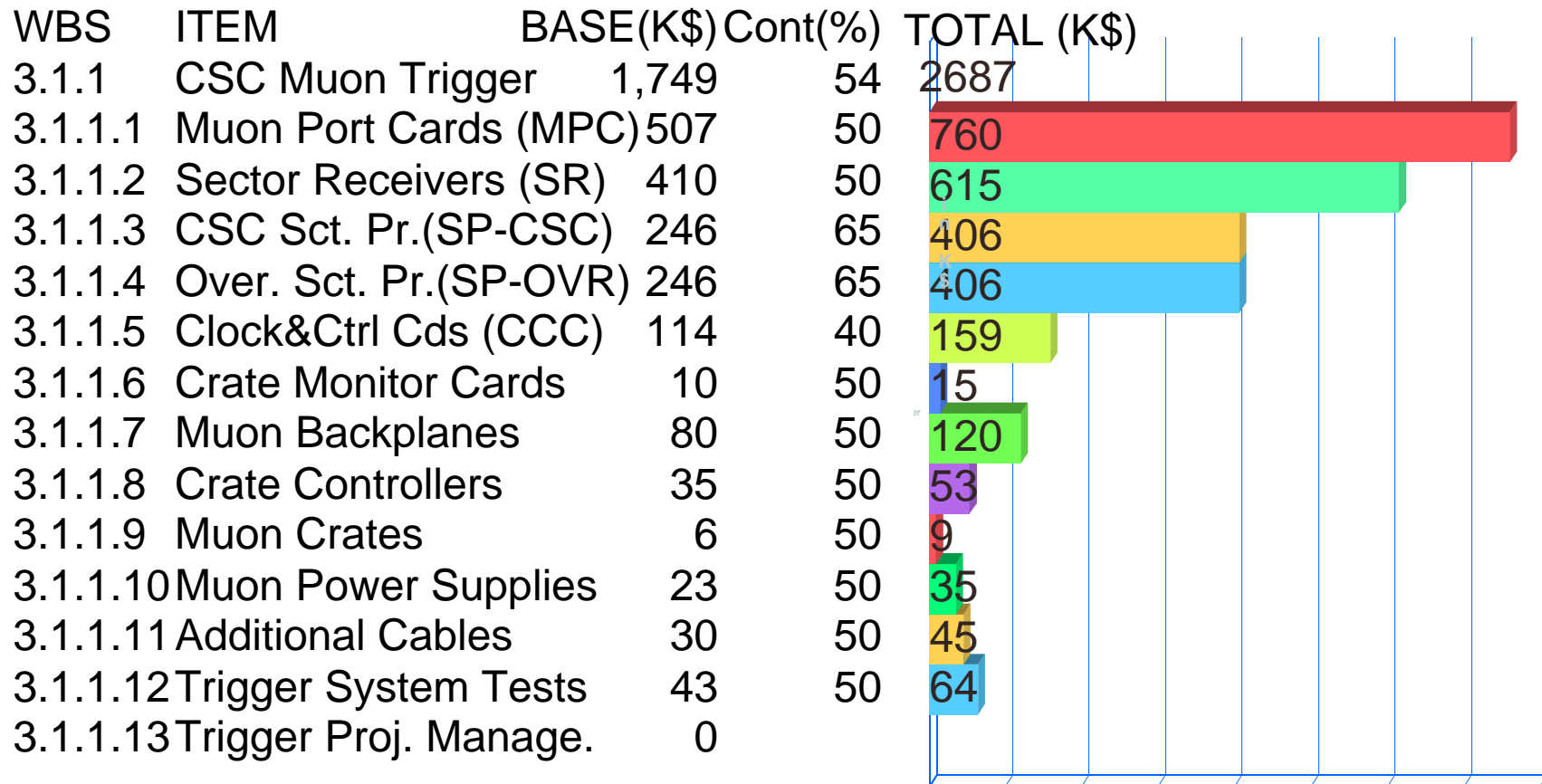
WBS	ITEM	BASE(K\$)	Cont(%)	TOTAL (K\$)
3.1.2	Cal.Regional Trigger	4,388	50	6581
3.1.2.1	Prototypes	441	46	643
3.1.2.2	Preproduction ASICs	553	47	811
3.1.2.3	Test Facilities	78	50	117
3.1.2.4	Power Supplies	82	30	106
3.1.2.5	Crates	35	30	45
3.1.2.6	Backplane	194	54	299
3.1.2.7	Clock & Control Card	132	40	185
3.1.2.8	Receiver Card	1,670	54	2571
3.1.2.9	Electron ID Card	744	50	1116
3.1.2.10	Jet Summary Card	170	50	254
3.1.2.11	Cables	7	30	9
3.1.2.12	DAQ Processor			
3.1.2.13	Crate Monitor Card			
3.1.2.14	Trigger Tests	282	50	423
3.1.2.15	Project Management			

Changes since last May 1997 Review:

- Contingency analysis performed at lowest level (increased from 39->50%)
- Bottoms-up recosting & new WBS (no substantial *net* cost change)
- Cost profile pushed back 6 months on average



Muon Trigger Costs at L4

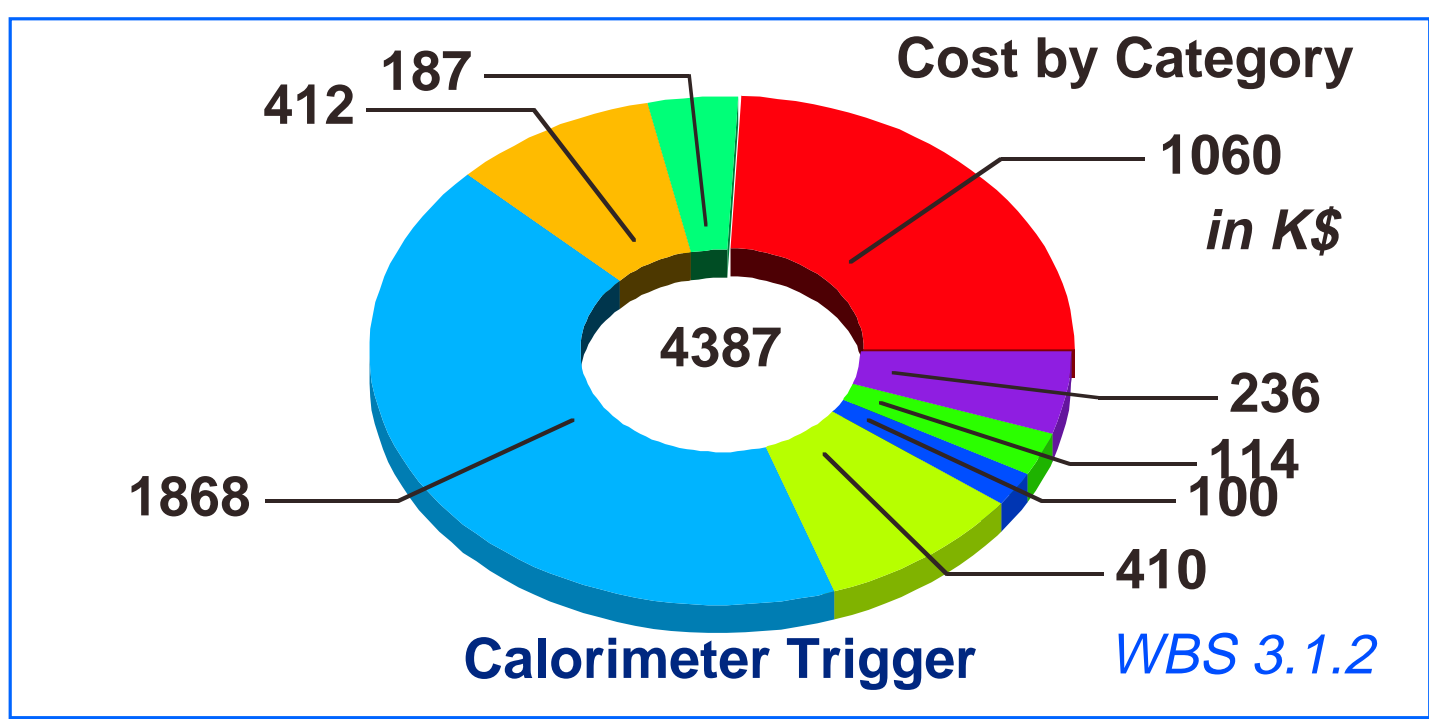
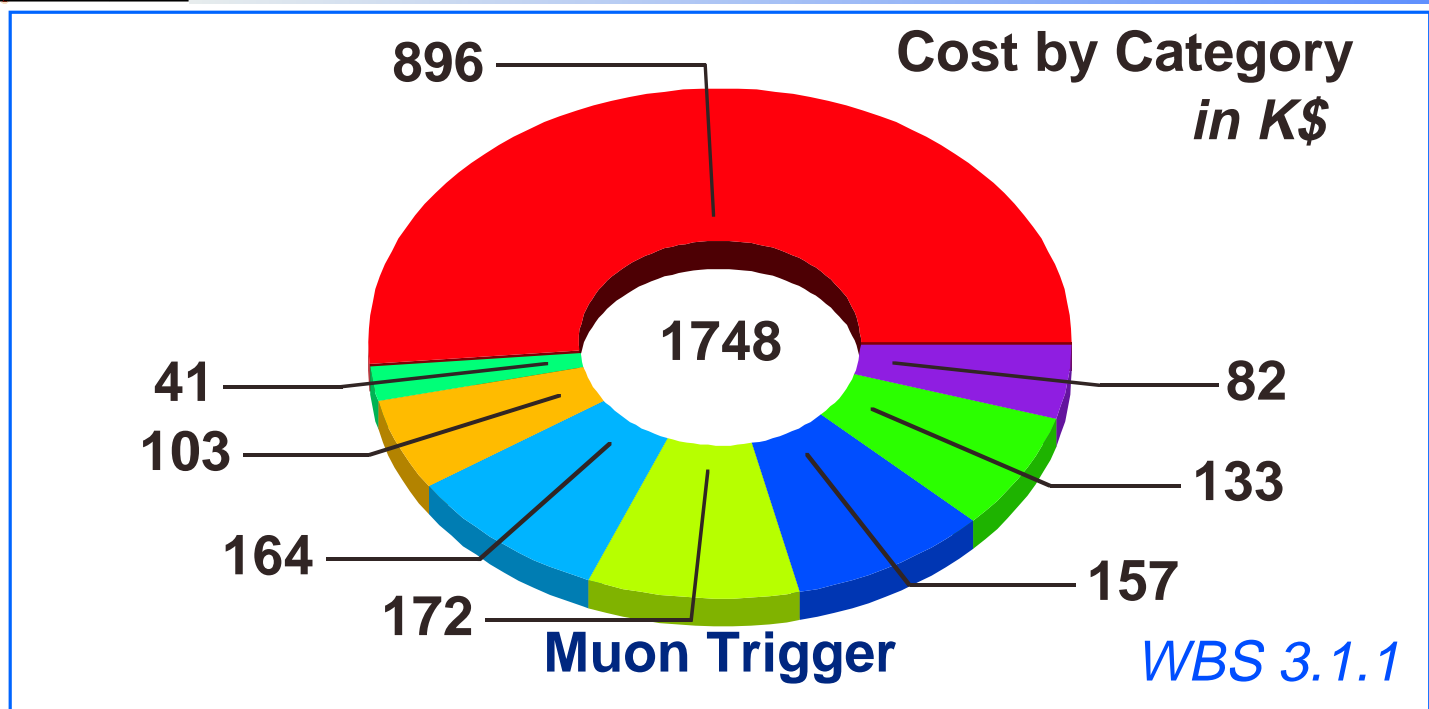


Changes since last May 1997 Review:

- Contingency analysis performed at lowest level (increased from 39->50%)
- New Architecture & removal of 4th station reduces cost (see next transp.)
- Bottoms-up recosting & new WBS (small cost reduction)
- Cost profile pushed back 6 months on average



Major Cost Drivers



WBS Number	Description	EDIA (k\$)	M&S (k\$)	Base (k\$)	Cont (%)	Total (k\$)
3.1.1	CSC Muon Trigger	937	812	1,749	54	2,687
3.1.1.1	Muon Port Cards (MPC)	215	292	507	50	760
3.1.1.2	Sector Receivers (SR)	202	208	410	50	615
3.1.1.3	CSC Sector Processors (SP-CSC)	170	76	246	65	406
3.1.1.4	Overlap Sector Processors (SP-OVR)	170	76	246	65	406
3.1.1.5	Clock&Control Cards (CCC)	78	36	114	40	159
3.1.1.6	Crate Monitor Cards		10	10	50	15
3.1.1.7	Muon Backplanes	60	20	80	50	120
3.1.1.8	Crate Controllers		35	35	50	53
3.1.1.9	Muon Crates		6	6	50	9
3.1.1.10	Muon Power Supplies		23	23	50	35
3.1.1.11	Additional Cables		30	30	50	45
3.1.1.12	Trigger System Tests	43		43	50	64
3.1.1.13	Trigger Project Management					
3.1.2	Calorimeter Regional Trigger	1,247	3,141	4,388	50	6,581
3.1.2.1	Prototypes	301	140	441	46	643
3.1.2.2	Preproduction ASICs	243	310	553	47	811
3.1.2.3	Test Facilities	18	60	78	50	117
3.1.2.4	Power Supplies	3	79	82	30	106
3.1.2.5	Crates	21	13	35	30	45
3.1.2.6	Backplane	64	130	194	54	299
3.1.2.7	Clock & Control Card	67	65	132	40	185
3.1.2.8	Receiver Card	109	1,561	1,670	54	2,571
3.1.2.9	Electron Identification Card	95	649	744	50	1,116
3.1.2.10	Jet Summary Card	67	103	170	50	254
3.1.2.11	Cables		7	7	30	9
3.1.2.13	Crate Monitor Card					
3.1.2.14	Trigger Tests	260	22	282	50	423
3.1.2.15	Trigger Project Management					



Calorimeter Trigger Unit Costs

WBS	Item	Unit Cost	Units	M&S
3.1.2	Calorimeter Trigger	-	-	3,140,520
3.1.2.1	Prototypes	-	-	140,380
3.1.2.2	Preproduction ASICs	-	-	310,000
3.1.2.3	Test Facilities	-	-	60,000
3.1.2.4	Power Supplies	3,600	22	79,200
3.1.2.5	Crates	600	22	13,200
3.1.2.6	Backplane	5,910	22	130,020
3.1.2.7	Clock & Control Card	2,960	22	65,120
3.1.2.8	Receiver Card	8,870	176	1,561,120
3.1.2.9	Electron Isolation Card	3,690	176	649,440
3.1.2.10	Jet Summary Card	4,670	22	102,740
3.1.2.11	Cables	7,300	1	7,300
3.1.2.12	DAQ Processor	-	22	-
3.1.2.13	Crate Monitor Card	-	22	-
3.1.2.14	Trigger Tests	-	-	22,000
3.1.2.15	Trigger Project Management	-	-	-

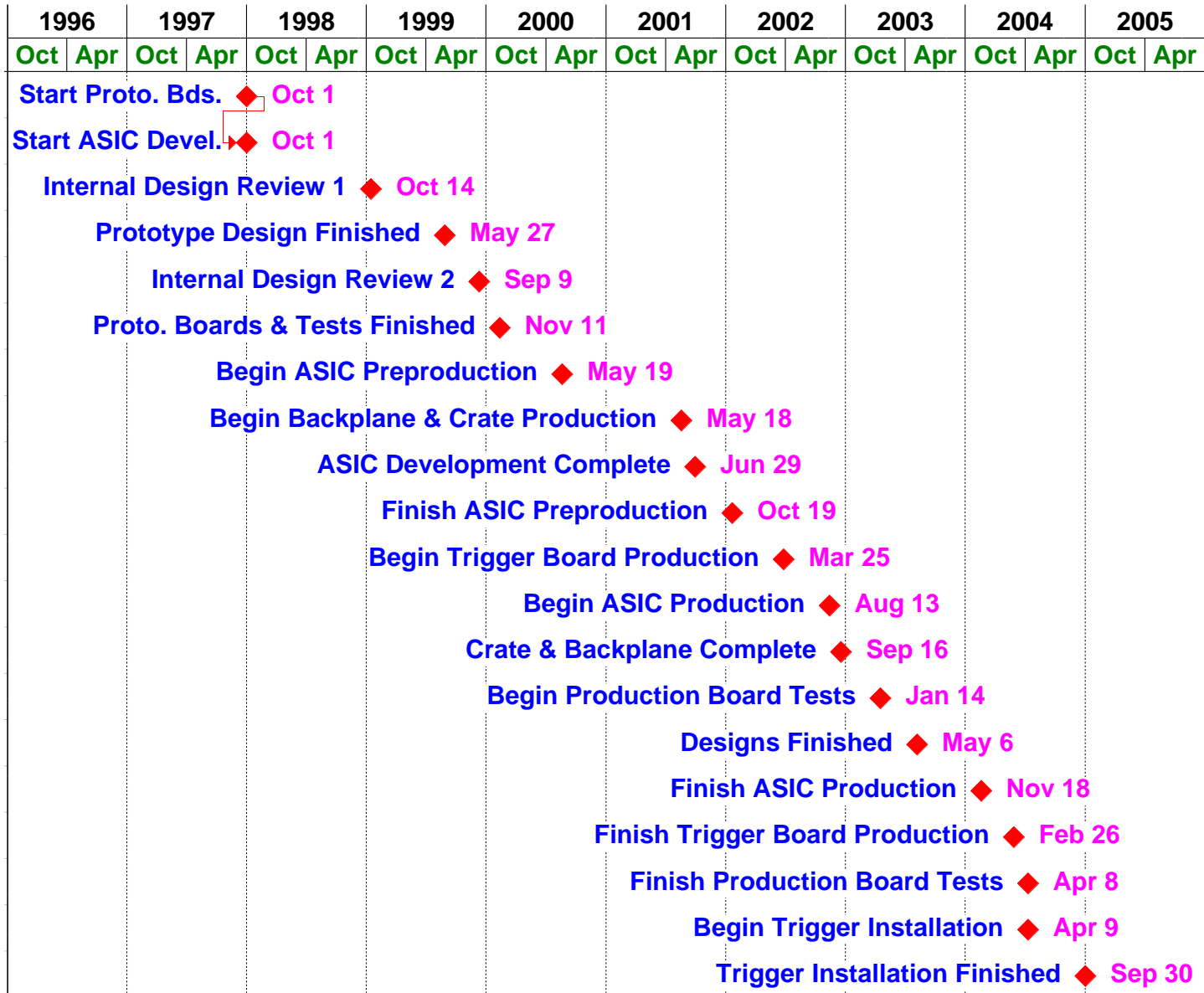


Muon Trigger Unit Costs

WBS	Item	Unit Cost	Uts	M&S
3.1.1	CSC Muon Trigger	812,038	1	812,038
3.1.1.1	Muon Port Cards (MPC)	5,311	55	292,079
3.1.1.2	Sector Receivers (SR)	3,714	56	207,994
3.1.1.3	CSC Sector Proc. (SP-CSC)	5,065	15	75,973
3.1.1.4	Overlap Proc. (SP-OVER)	5,065	15	75,973
3.1.1.5	Clock&Control Cards (CCC)	3,580	10	35,800
3.1.1.6	Crate Monitor Cards	1,000	10	10,000
3.1.1.7	Muon Backplanes	2,000	10	20,000
3.1.1.8	Crate Controllers	3,545	10	35,450
3.1.1.9	Muon Crates	600	10	6,000
3.1.1.10	Muon Power Supplies	2,300	10	23,000
3.1.1.11	Additional Cables	-	-	29,770
3.1.1.12	Trigger System Tests	-	-	-
3.1.1.13	Trigger Project Management	-	-	-



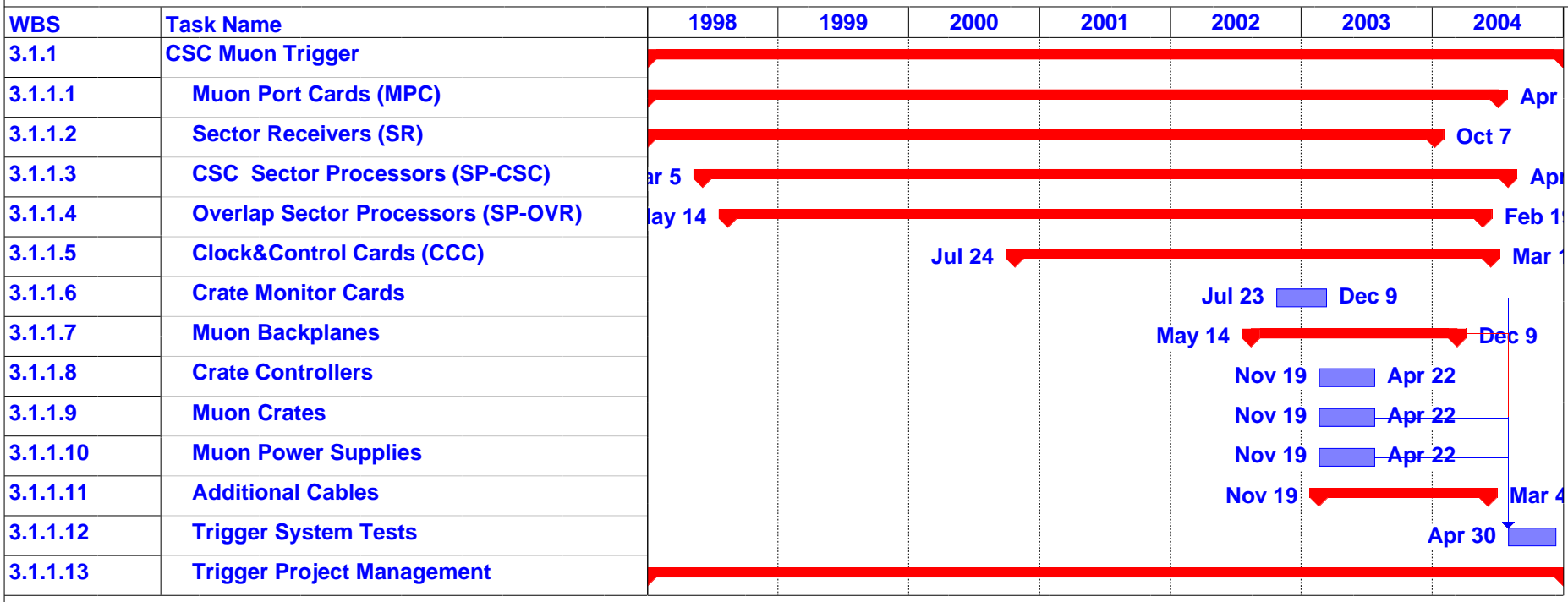
Cal. Trig. Schedule & Milestones

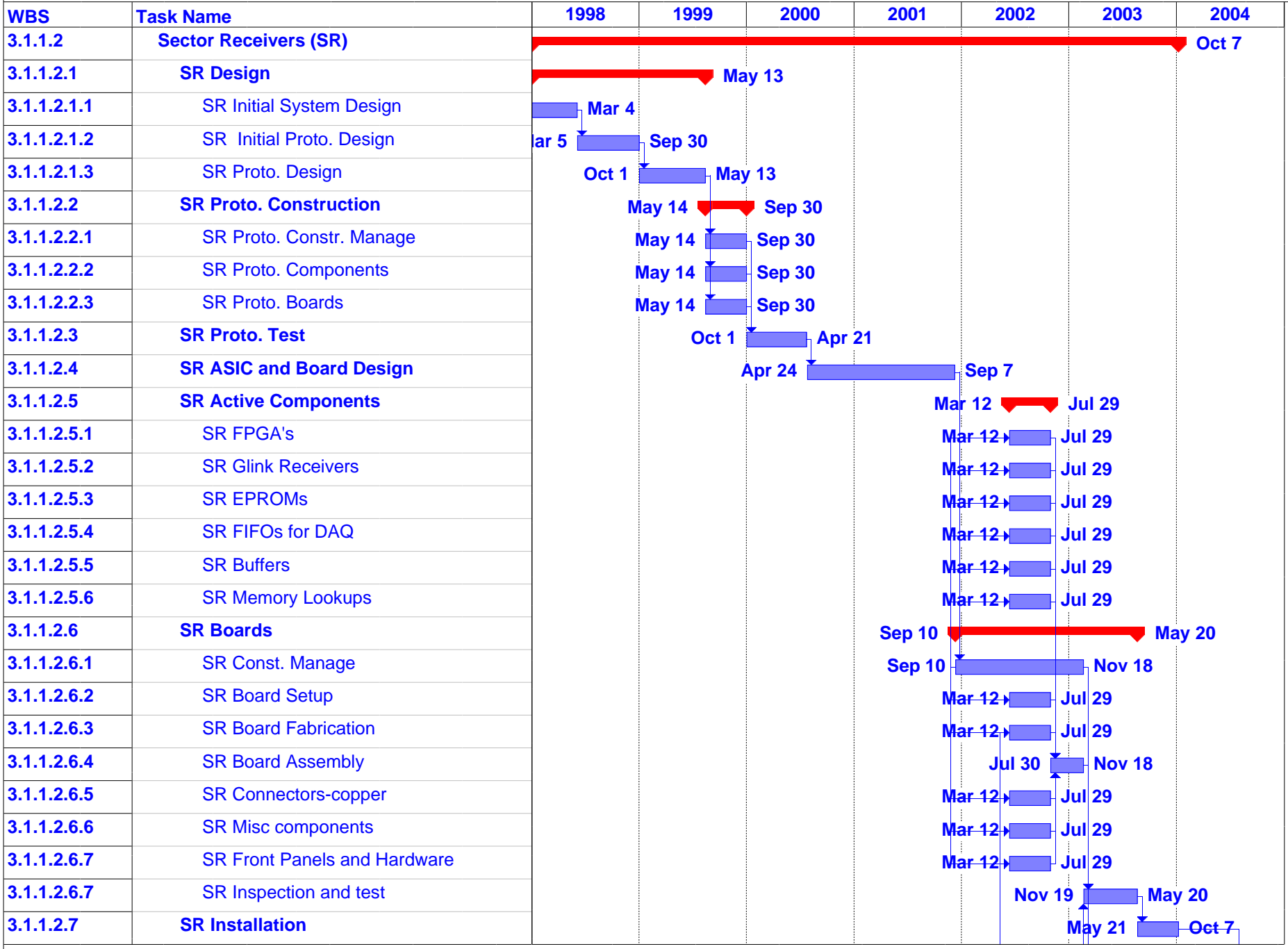


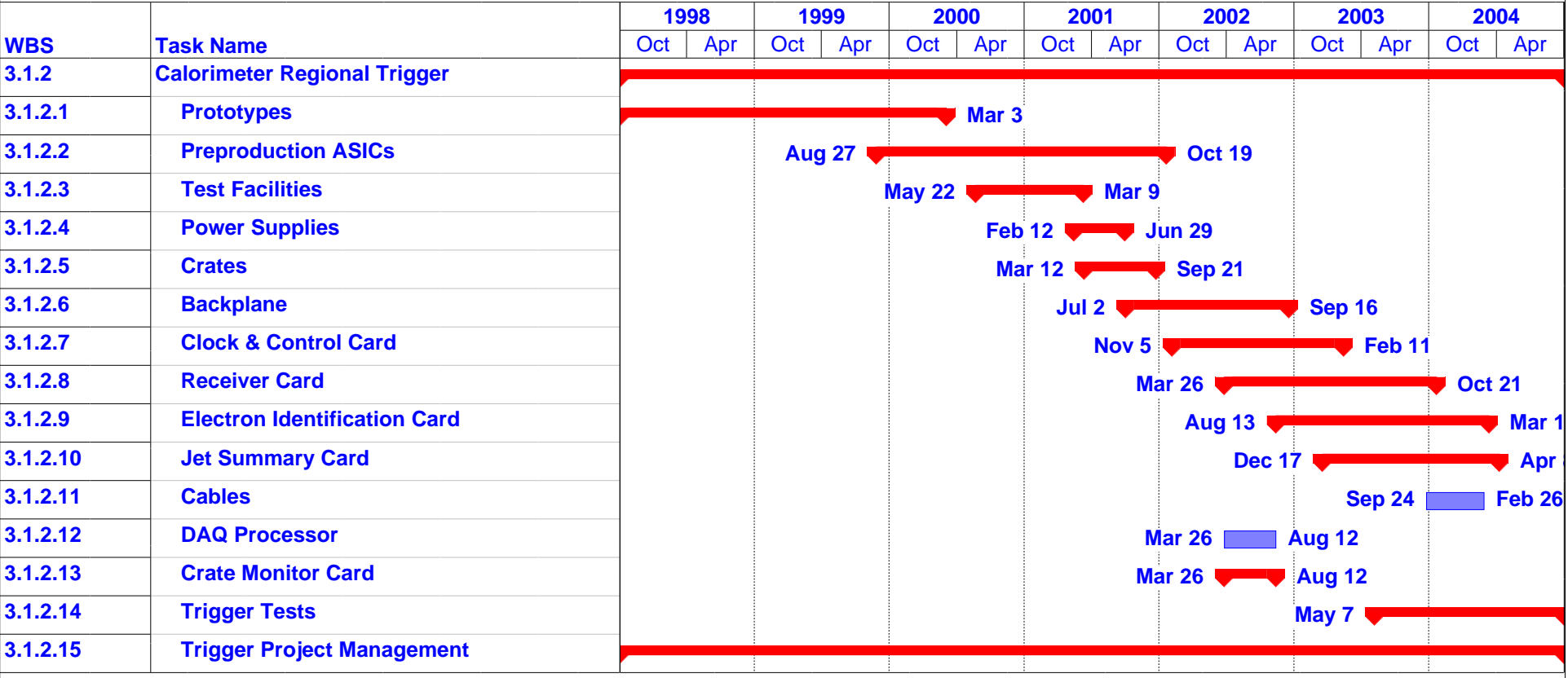


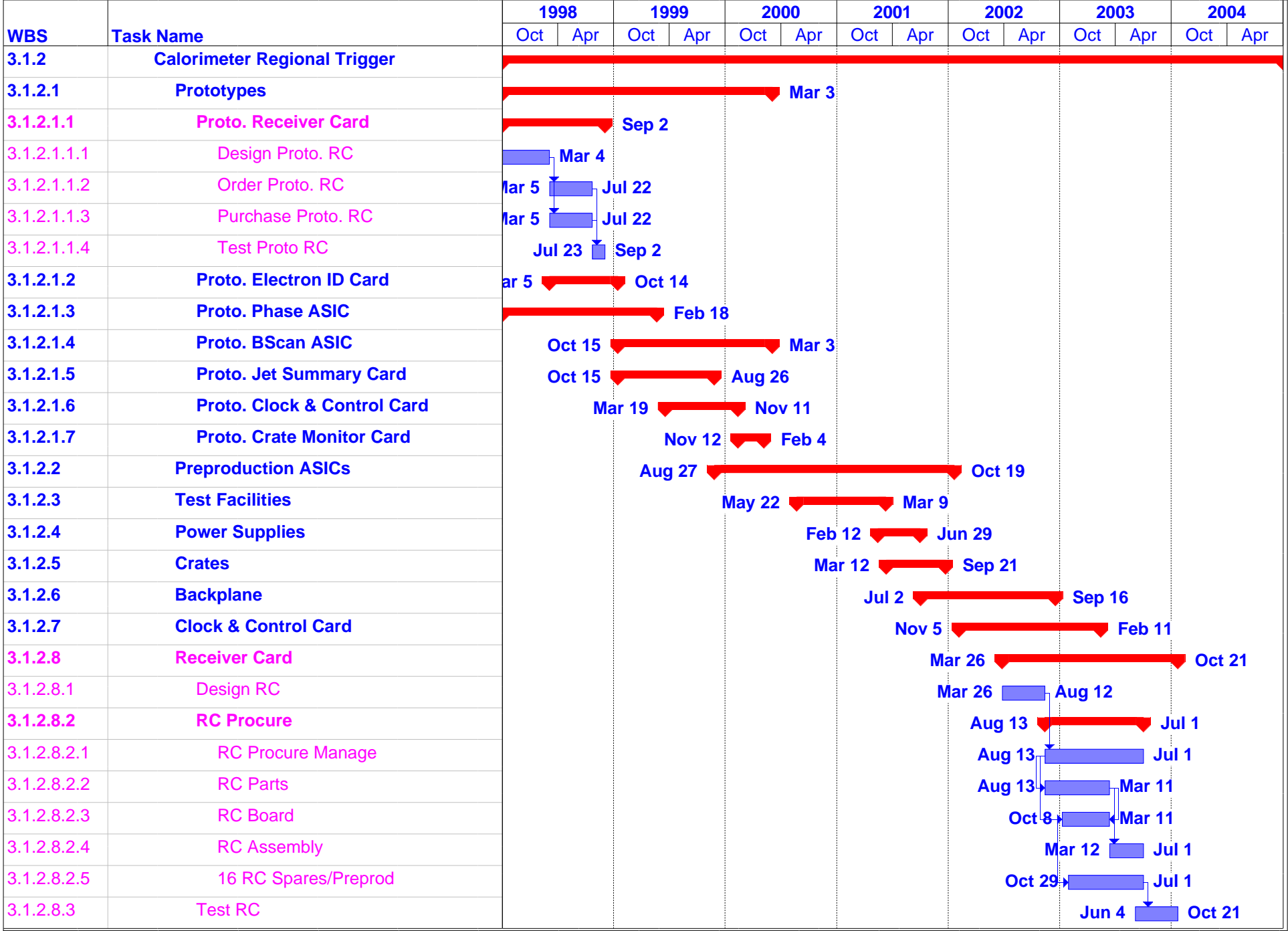
Muon Trig. Schedule & Milestones

1996		1997		1998		1999		2000		2001		2002		2003		2004		2005	
Oct	Apr	Oct	Apr	Oct	Apr	Oct	Apr	Oct	Apr	Oct	Apr	Oct	Apr	Oct	Apr	Oct	Apr	Oct	Apr
Finish Initial Design ◆ May 13																			
Begin Prototype Design ◆ Oct 1																			
Finish Prototype Design ◆ May 13																			
Begin Prototype Construction ◆ Apr 2																			
Finish Prototype Construction ◆ Sep 30																			
Begin Prototype Test ◆ Aug 20																			
Finish Prototype Test ◆ Jul 21																			
Begin Final Design ◆ Jun 12																			
Finish Final Design ◆ Jul 22																			
Begin Production ◆ Jan 22																			
Finish Production ◆ Nov 25																			
Begin Installation ◆ Aug 20																			
Finish Installation ◆ Apr 29																			
Begin Trigger System Tests ◆ Apr 30																			
Finish Trigger System Tests ◆ Sep 9																			







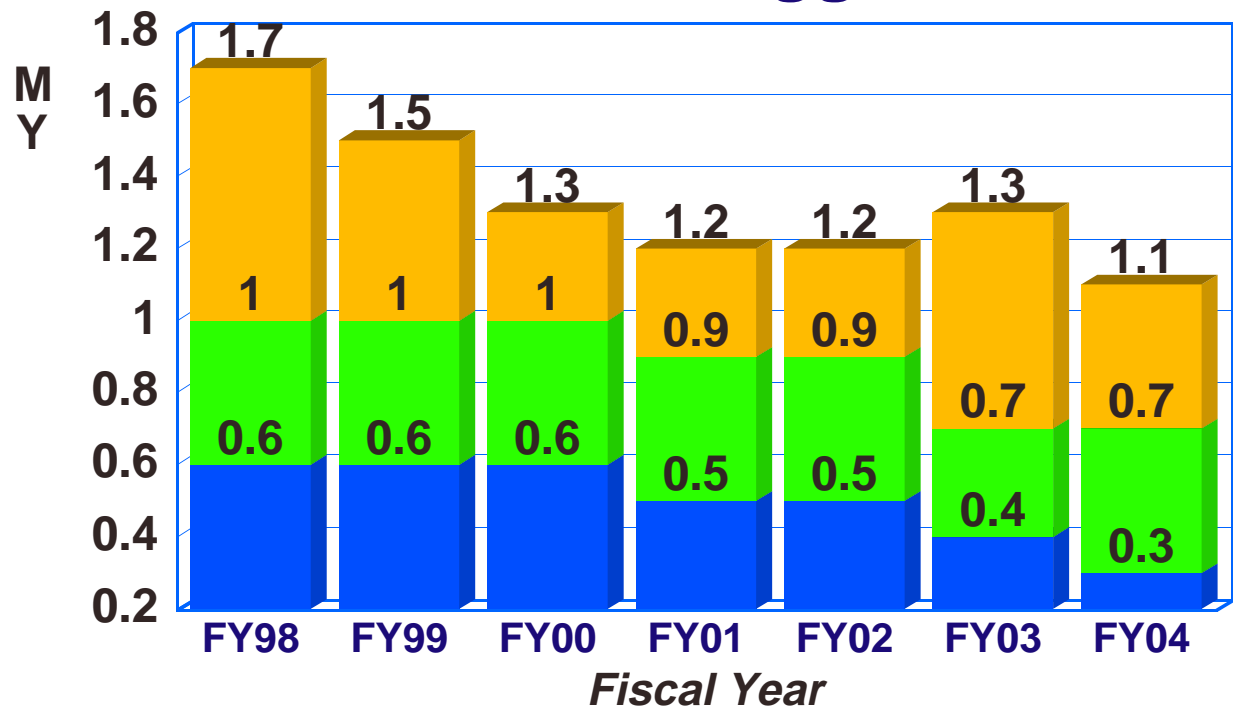




Peak Engineering Level

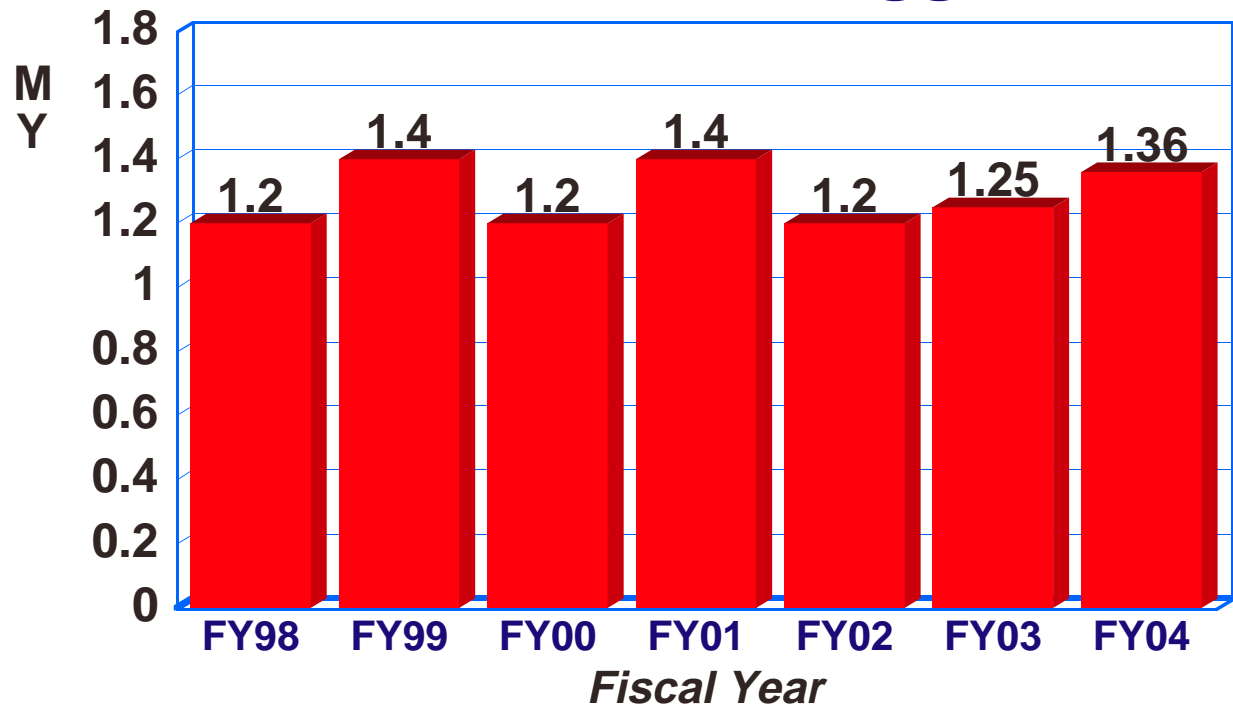
Muon Trigger

WBS 3.1.1



Calorimeter Trigger

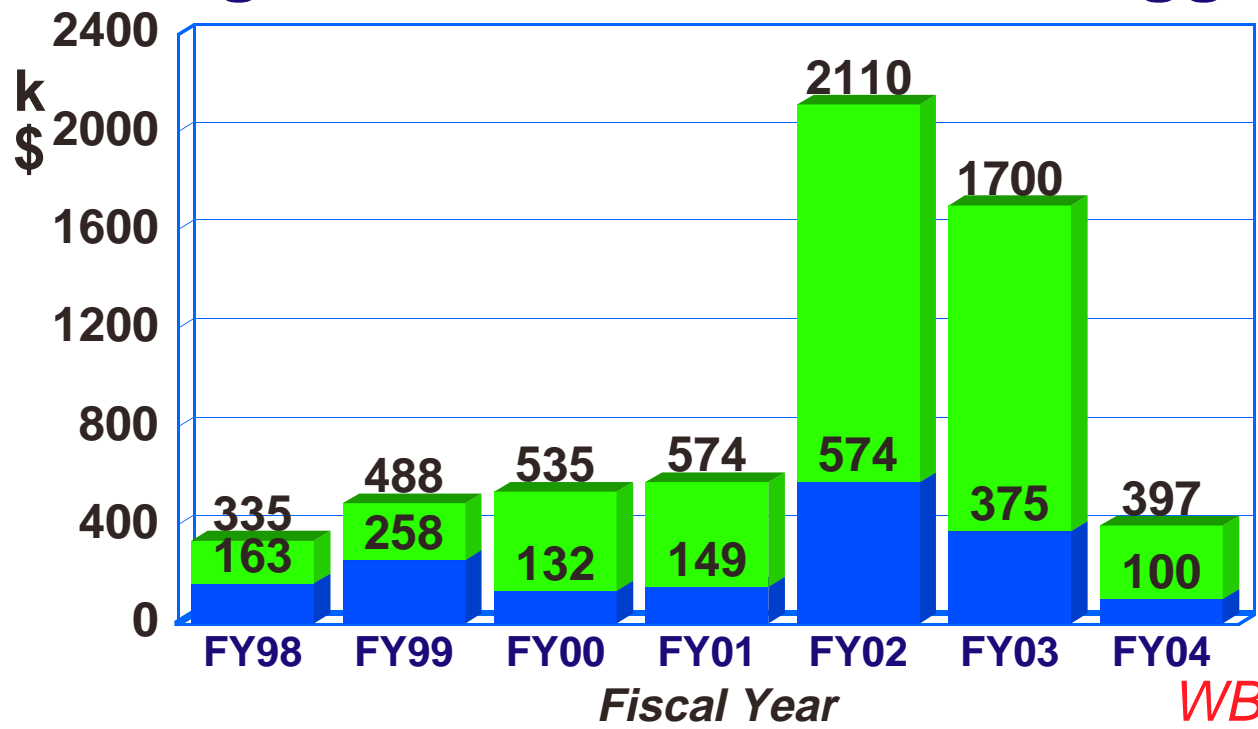
WBS 3.1.2



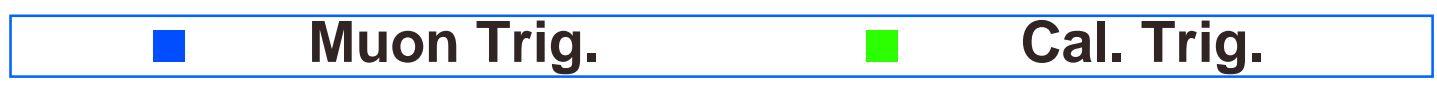


Obligations Profile

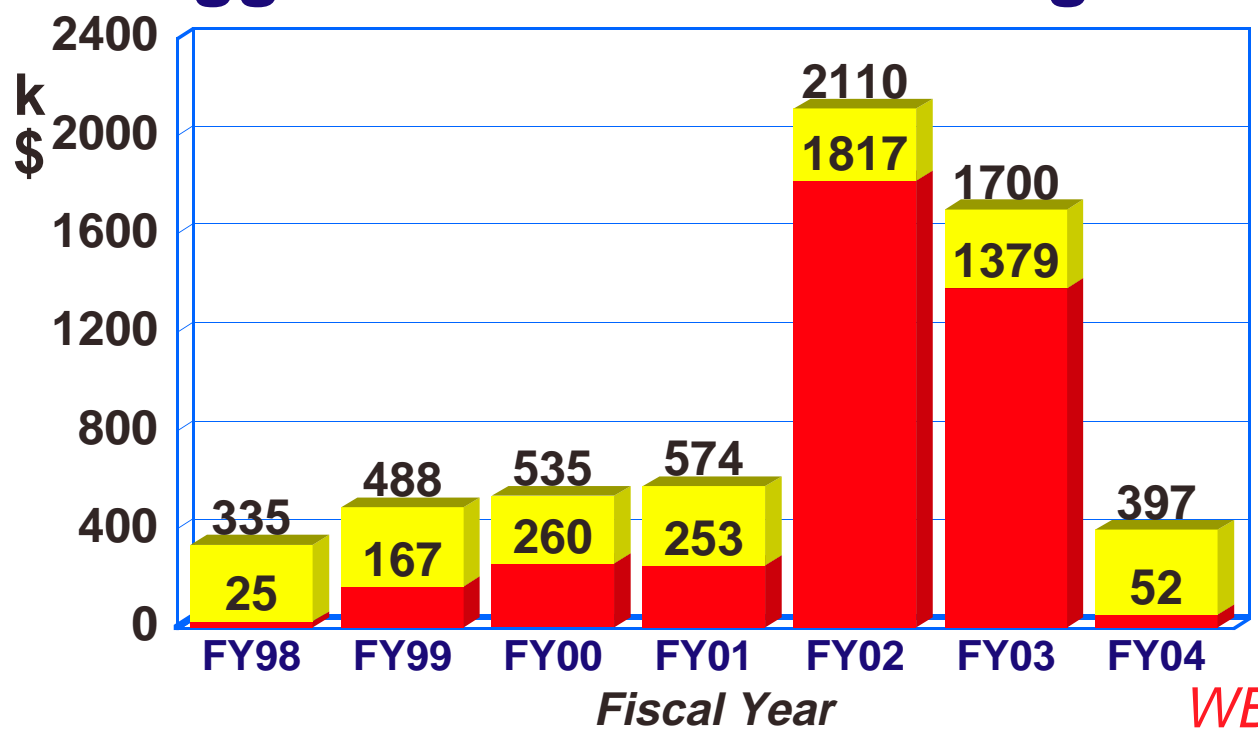
Obligations for Muon & Cal Triggers



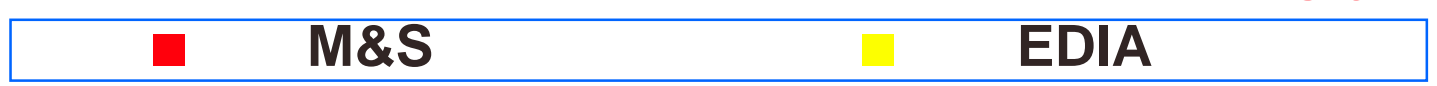
WBS 3.1



Trigger M&S and EDIA Obligations

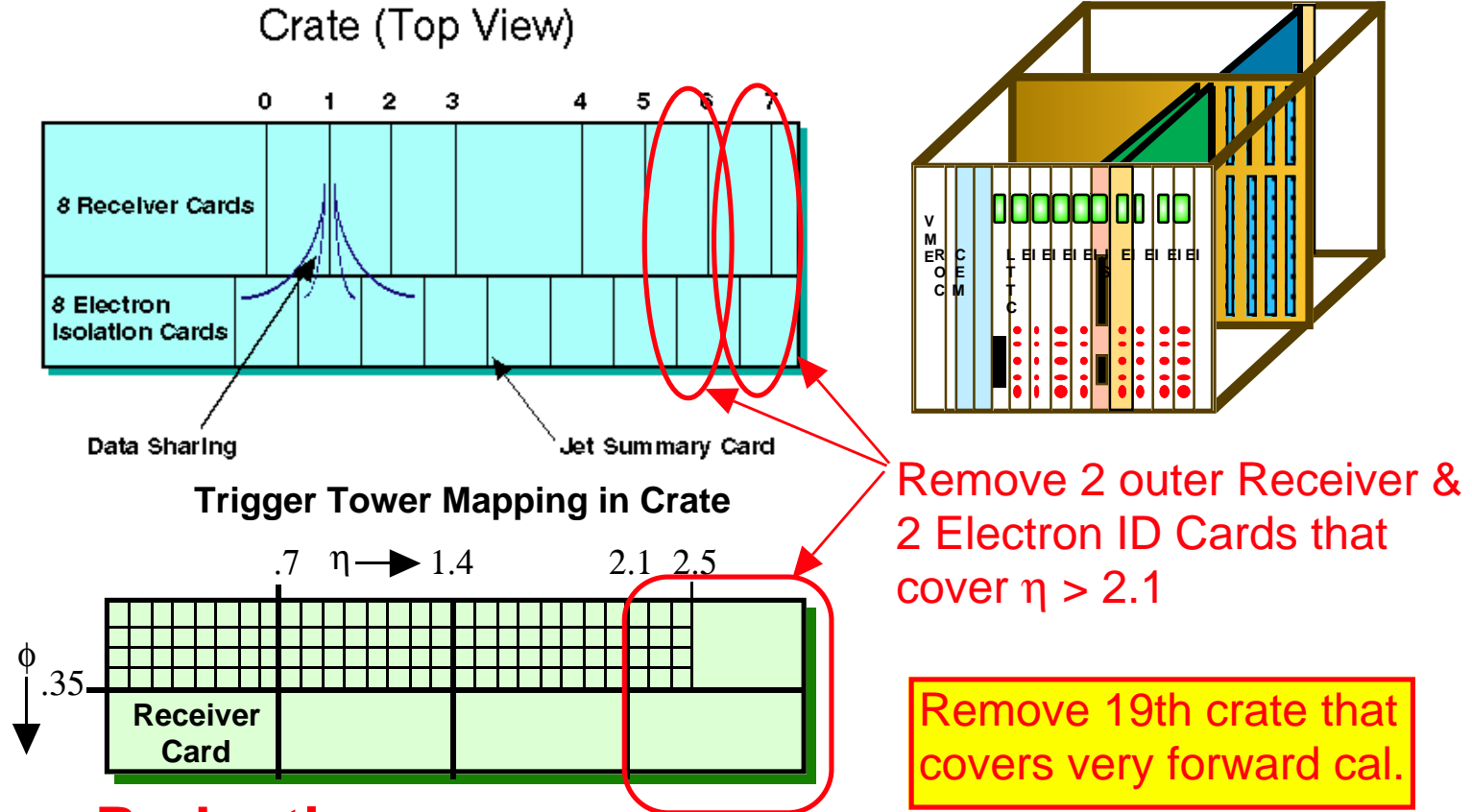


WBS 3.1





Option: Rescope Cal. Trig.



Reductions:

- Receiver & Electron ID Cards: 176 to 132
- Jet Summary Cards & Crates: 22 to 21
- Base Cost reduced by 590K

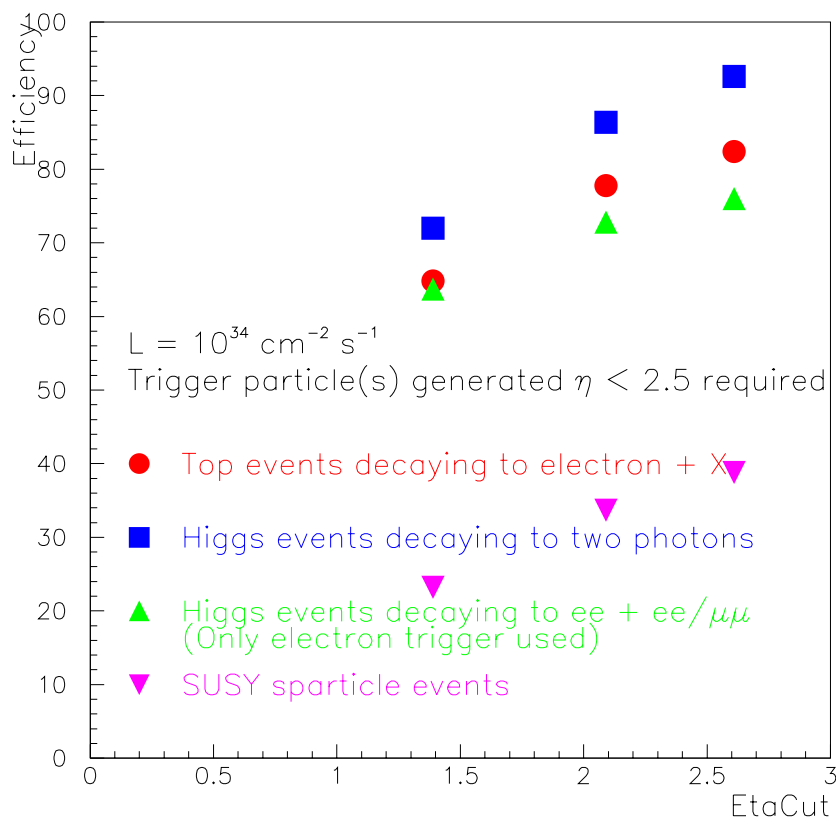
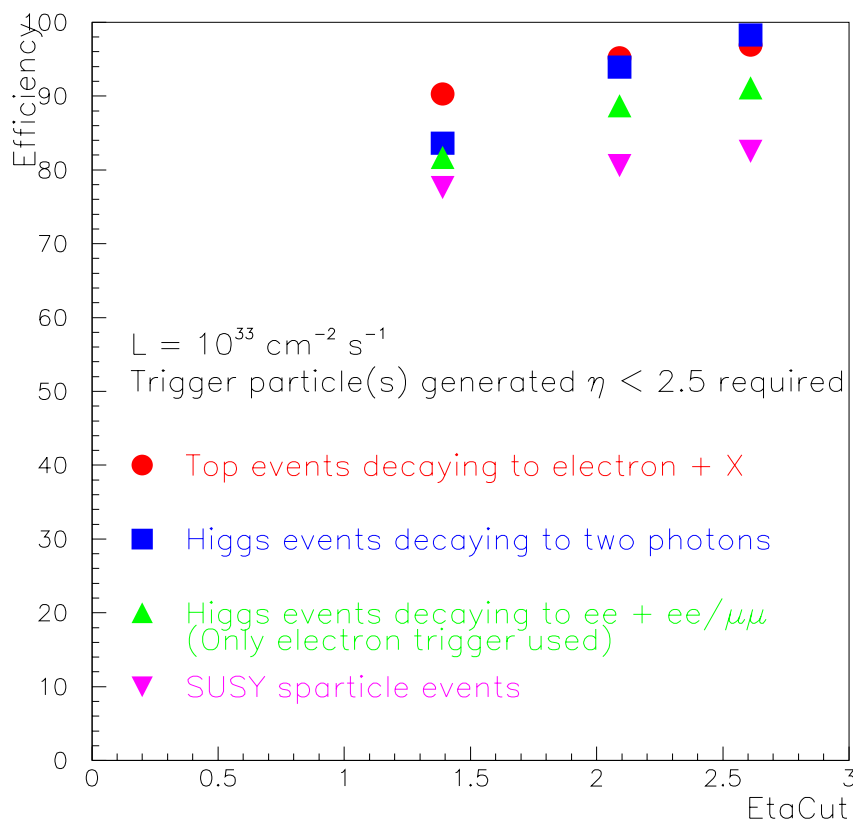


Impact of Cal. Trig. Rescope

Low Luminosity:

High Luminosity:

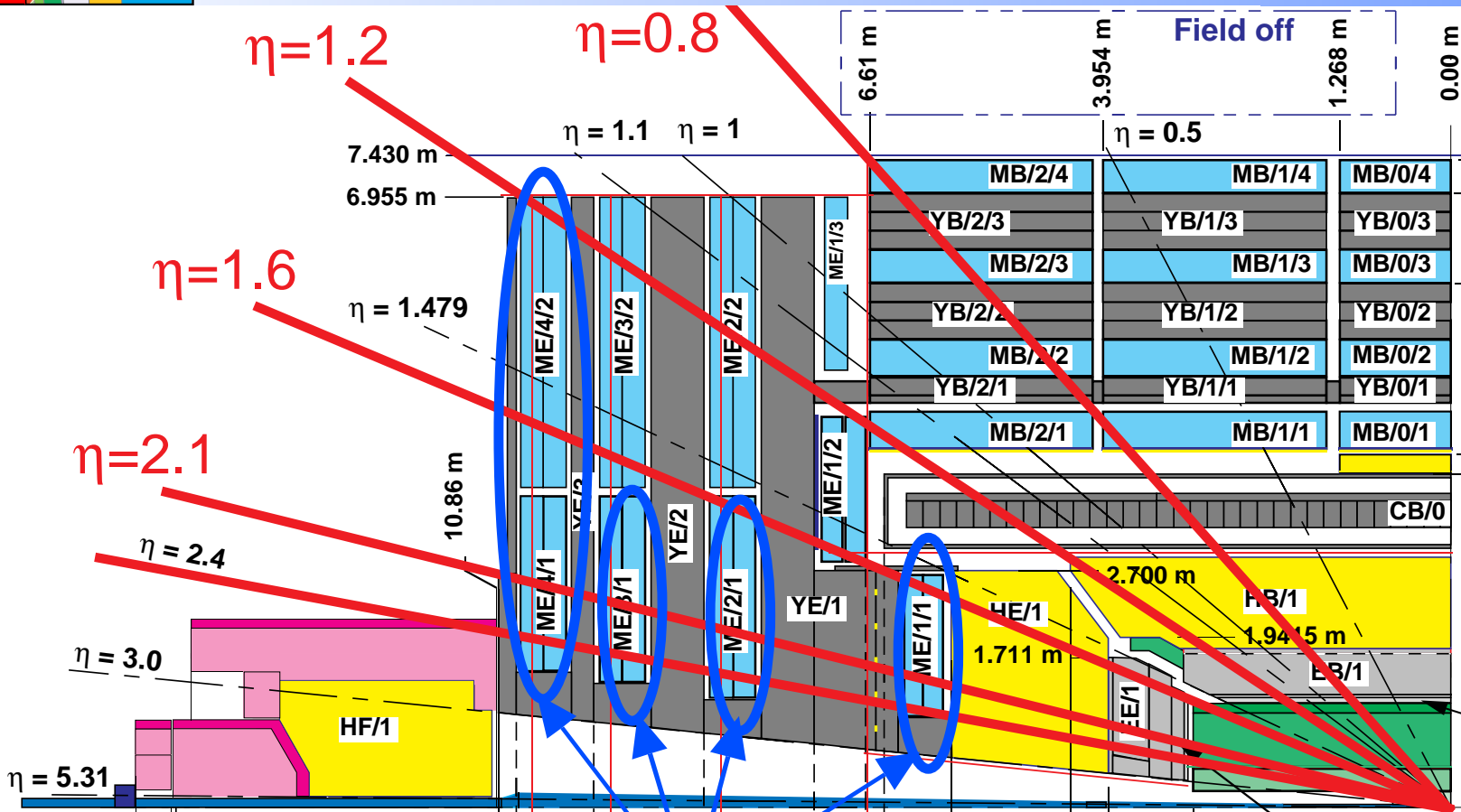
Efficiency versus eta cut for trigger descope



CMS Decision: Do not rescope Cal. Trig.



Option: Rescope CSC Trigger



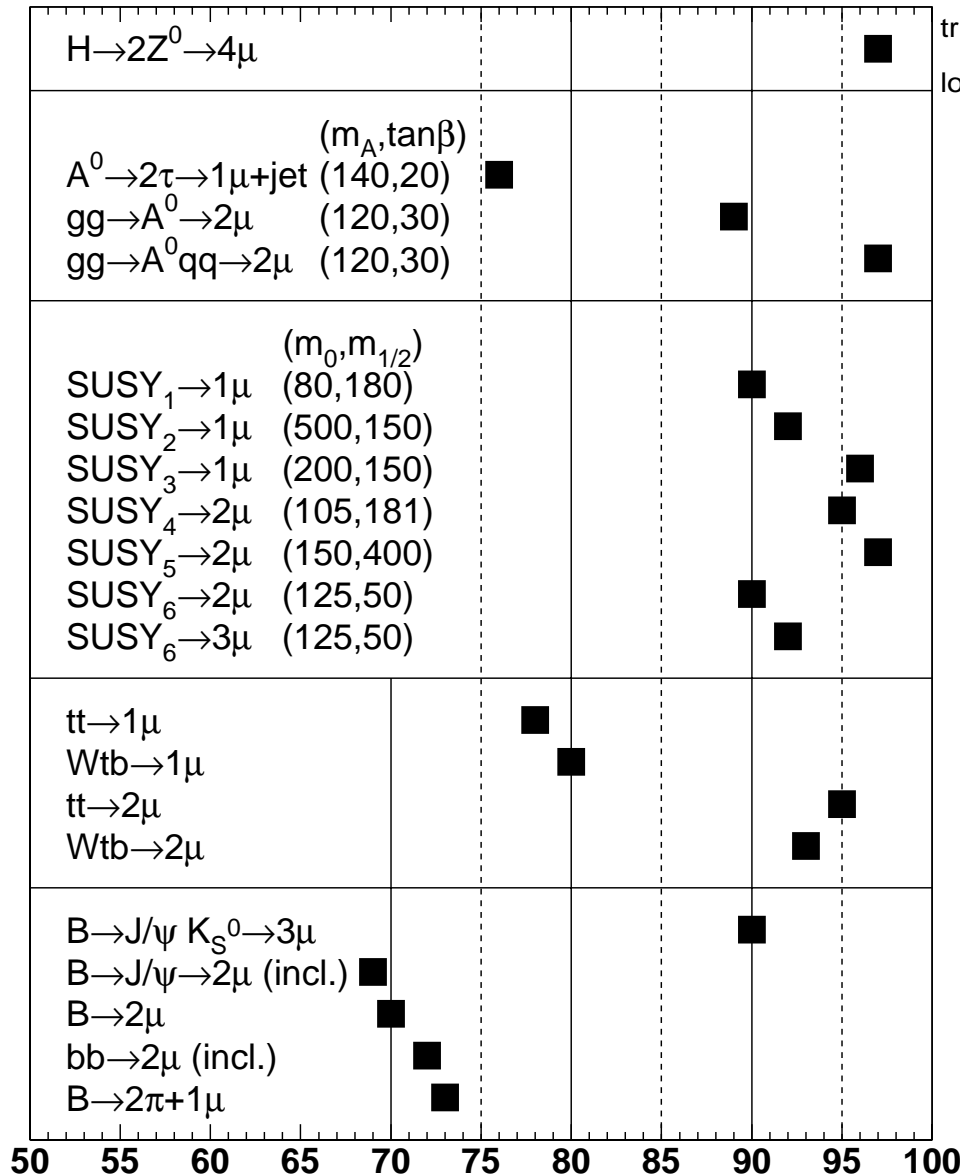
Remove:

- ME*/1 & ME4 processing (cut trigger at $\eta > 1.6$)
- 5 of 7 Fibers/Port Card (only 1 stub per 60°)

Base Cost reduced by 404K (incl. new design)



Impact of CSC trig. rescope



trigger acceptance for $|\eta| < 1.6$ / acceptance for $|\eta| < 2.4$ (%)

low lumi. trigger thresholds - $p_{t1\mu} = 7$ GeV, $p_{t2\mu} = 4$ GeV

Ratio of descopeed CSC to previous baseline muon trigger efficiency for low luminosity running.

CMS Decision: Do not descope in η but approve other changes:

- **Fourth Station Removed**
 - small loss in efficiency
- **New Architecture**
 - 60° port cards (fewer)
 - keep links/port card
- **New SR/SP design**
 - fewer SR's, SP's
 - fewer Crates

New Base Cost:

- **Reduction by 230K**