Experiment DAQ and trigger
GMn
SBS Collaboration Meeting

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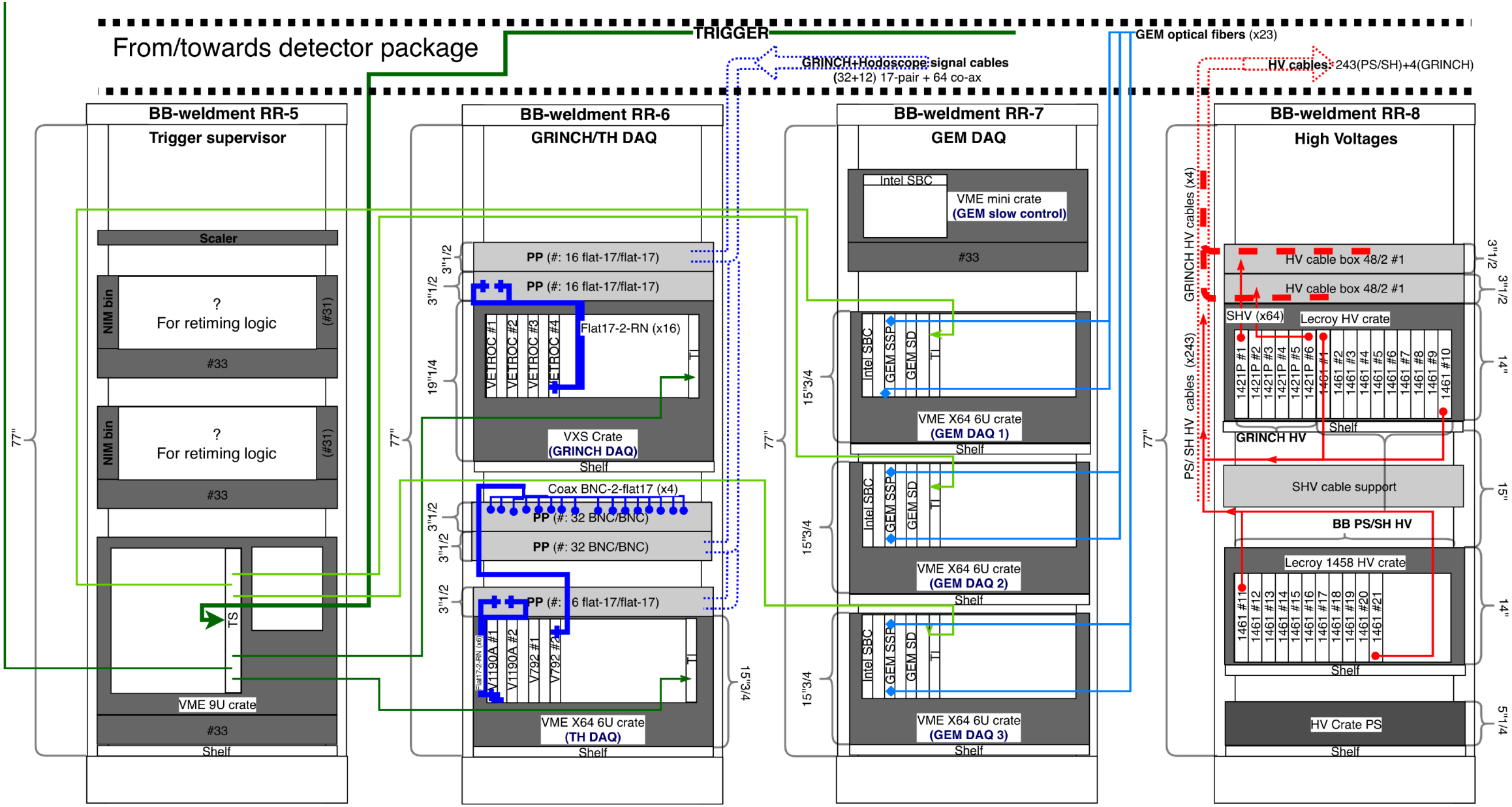
Outline

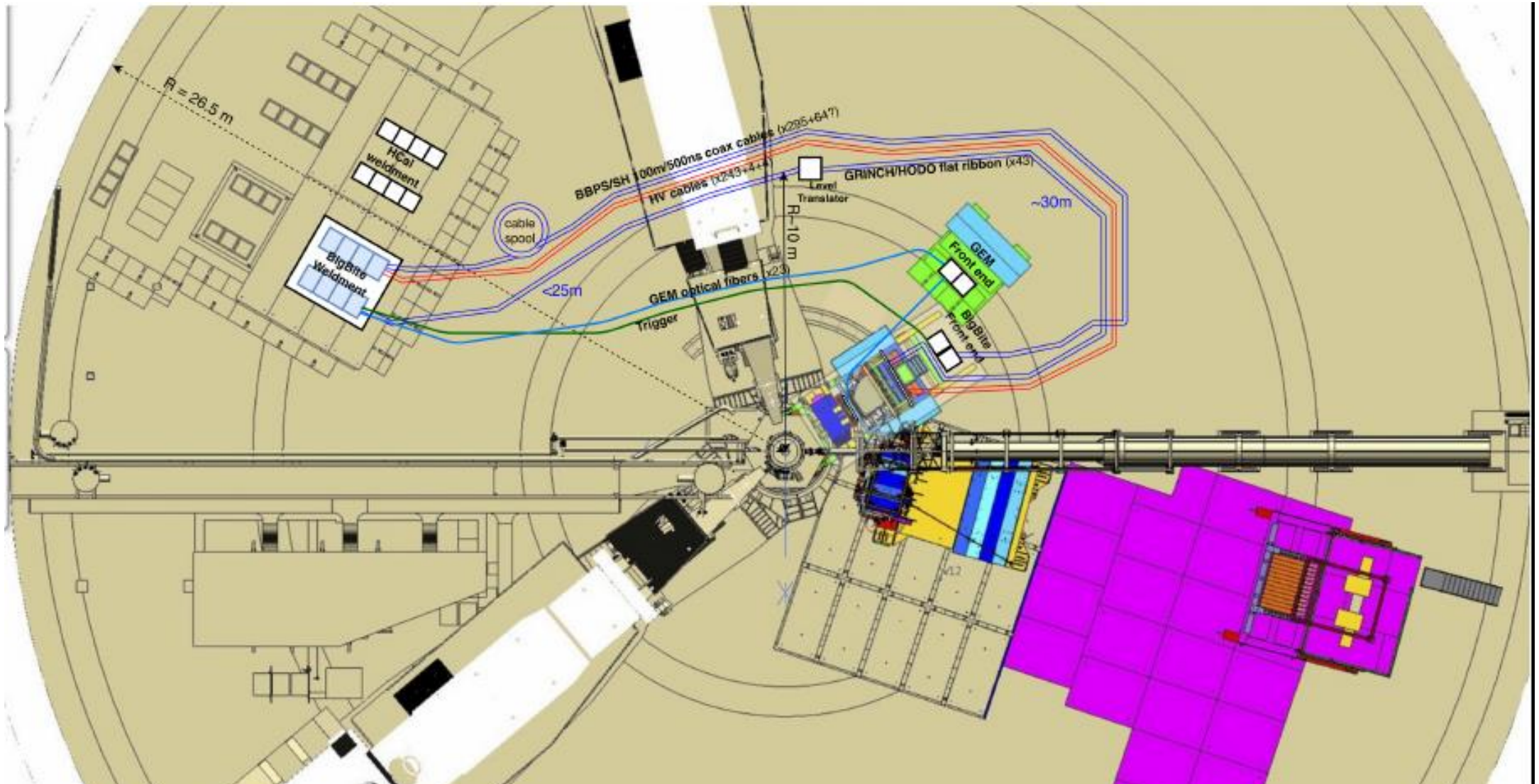
- GMn/Gen RP configuration
- GMn/Gen RP inventory
- GMn/Gen RP rates
- GMn trigger
- GEM readout
- Outstanding tasks
- Conclusion

SBS configuration GMn/Gen/Gen RP

		Channels	Modules	Nb modules
BigBite	Shower	189	1881	3
	Preshower	54	1881	1
	Scintillator	180	V1190	1
	Cerenkov	550	VETROC	6
	GEM INFN	14000	MPD	24
	GEM UVA	113000	MPD	77
BigBen				
	HCAL	288	FADC	18
	CDet	2520	1877	26
HRS				
	S2m	32	FADC	2
	S0	2	FADC	1
	Cerenkov	10	FADC	1
	PRL	68	FADC	4
	VDC	1536	1877	16
	Raster	4	FADC	1
	BPM	8	FADC	1
RP				
	Proton Large Angle	96	FADC	6
	Active analyzer	32	FADC	2
			TDC	1


From/towards detector package
TRIGGER
GRINCH+Hodoscope signal cables
(32+12) 17-pair + 64 co-ax
GEM optical fibers (x23)
HV cables: 243(PS/SH)+4(GRINCH)
BB-weldment RR-5
Trigger supervisor
Scaler
NIM bin
?
For retiming logic
(#31)
#33
NIM bin
?
For retiming logic
(#31)
#33
TS
VME 9U crate
#33
Shelf
77"
BB-weldment RR-6
GRINCH/TH DAQ
PP (#: 16 flat-17/flat-17)
PP (#: 16 flat-17/flat-17)
VETROC #1
VETROC #2
VETROC #3
VETROC #4
Flat17-2-RN (x16)
TI
VXS Crate
(GRINCH DAQ)
Shelf
3"1/2
3"1/2
19"1/4
Coax BNC-2-flat17 (x4)
PP (#: 32 BNC/BNC)
PP (#: 32 BNC/BNC)
3"1/2
3"1/2
PP (#: 16 flat-17/flat-17)
Flat17-2-RN (x6)
V1190A #1
V1190A #2
V792 #1
V792 #2
TI
VME X64 6U crate
(TH DAQ)
Shelf
15"3/4
77"
BB-weldment RR-7
GEM DAQ
Intel SBC
VME mini crate
(GEM slow control)
#33
Intel SBC
GEM SSP
GEM SD
TI
VME X64 6U crate
(GEM DAQ 1)
Shelf
15"3/4
Intel SBC
GEM SSP
GEM SD
TI
VME X64 6U crate
(GEM DAQ 2)
Shelf
15"3/4
Intel SBC
GEM SSP
GEM SD
TI
VME X64 6U crate
(GEM DAQ 3)
Shelf
15"3/4
77"
BB-weldment RR-8
High Voltages
GRINCH HV cables (x4)
PS/ SH HV cables (x243)
HV cable box 48/2 #1
HV cable box 48/2 #1
3"1/2
3"1/2
SHV (x64)
Lecroy HV crate
1421P #1
1421P #2
1421P #3
1421P #4
1421P #5
1421P #6
1461 #1
1461 #2
1461 #3
1461 #4
1461 #5
1461 #6
1461 #7
1461 #8
1461 #9
1461 #10
Shelf
GRINCH HV
14"
SHV cable support
BB PS/SH HV
Lecroy 1458 HV crate
1461 #11
1461 #12
1461 #13
1461 #14
1461 #15
1461 #16
1461 #17
1461 #18
1461 #19
1461 #20
1461 #21
Shelf
15"
14"
HV Crate PS
Shelf
5"1/4
77"

Hall Layout


R = 26.5 m
HCal weldment
BigBite Weldment
cable spool
BBPS/SH 100mv/500ns coax cables (x295+64?)
HV cables (x243+4+4)
GRINCH/HODO flat ribbon (x43)
Level Translator
~30m
R~10 m
<25m
GEM optical fibers (x23)
Trigger
GEM Front end
BigBite Front end

Cdet weldment

- 9 Fastbus crates
- 26 TDCs : 3 per crates
- Can add BB ADC there

Procurement

- All fibers,optical transceivers ordered
- Most hardware on hand using ECAL/RHRS
- 3 VXS crates ordered, need 3 SDs (6K$) and 3 TIs (7.5 K$)
- Inventory of standard VME crates for GEMs (need 6 and spares)
  - DVCS IOC, DVCS crate, RHRS bogie, 2 old Compton,1 WM, 2 RHRS

Expected trigger rates GMn

Preferably single electron trigger to avoid biased in neutron detector

Q^2 GeV^2	n+p QE xsec fb	L(per atom) 10^38/cm^2/s design	QE rate Hz	Beam time Hours	Total Hz
3.5	6700	0.35	235	12	2100
4.5	1015	0.7	70	12	1400
5.7	97.9	1.4	13.5	18	140
8.1	47.4	1.4	6.6	18	390
10.2	31.6	0.7	1.5	24	210
12	5.04	1.4	0.7	36	200
13.5	6.25	1.4	0.87	96	100

Maximum trigger rate 2.1 KHz, assume factor 2 safety margin for 4.2 KHz for low Q^2

less than 500 Hz at high Q^2

Single electron trigger is a good option

(possibility to add Cerenkov in the trigger if needed)

High trigger rate capabilities : rates high for 2 low Q2 points
rates are modest for other points

Expected trigger rates GMn

Preferably single electron trigger to avoid biased in neutron detector

Q^2 GeV^2	QE rate Hz	Beam time Hours	Total Hz	Max data rate MB/s	Expected data rate MB/s
3.5	235	12	2100	300	150
4.5	70	12	1400	130	65
5.7	13.5	18	140	13	6.5
8.1	6.6	18	390	36	18
10.2	1.5	24	210	19	9.5
12	0.7	36	200	18.5	9.5
13.5	0.87	96	100	9.15	4.6

High trigger rate capabilities : rates high for 2 low Q2 points
rates are modest for other points

Trigger

- Baseline L1 (500 ns delay about 25 meters trigger cable)
  - Bigbite shower trigger
  - Coincidence BigBite shower and HCAL analog sum
- L2 triggers
  - HCAL cluster sum

GEM readout

- SSP based readout
- 3 + 1 VXS crates, SSP, TI and SD (3 TI and 3 SDs to be ordered)
- 101 MPDs
- 4 SSPs
- Ordered MPD transceivers and fibers

- System testing this August

Outstanding tasks

- SSP readout 32 MPDs per SSP (1 month)
- HCAL trigger with two crates (1 month) (not really needed for GMn)

SSP readout (Ben Raydo)

- 1) Run previously working SSP firmware that supports 4 MPDs (sanity check to make sure things work before we make changes)
- 2) Run SSP firmware the scales to 8 MPDs (another sanity check to make sure scaling is working as expected - tests firmware/driver/decoder)
- 3) Update SSP to use Paolo's re-ordered APV data format from MPD, still testing with 8 MPD (this reordering is required so SSP can next scale to 32)
- 4) Update SSP to handle 32 MPD

- 1,2) can happen anytime you're ready (I'm available to support testing this now).
- 3: will only take a few days for me to implement and test the SSP part, but testing with the full setup/MPD may have issues that take longer to figure out (could be days or more depending on if Paolo/MPD side of things need to be addressed)
- 4: will take 1 week for me to implement and test the SSP part, testing with the full setup should be fast (but plan on as much time as we can to optimize)

- About 1 months

HCAL trigger

- Need 2nd VXS crate
- Single crate trigger available
- Need transfer two FADC through VTP optical link
- About 1 months after GEM readout complete

Conclusion

- Most hardware already available thanks to SBS funding and RHRS
- Decided to order 3 VXS crates for GEM, need 3 TI and 3 SD
- L1 trigger: Bigbite shower or coincidence BB shower and HCAL sum
- L2 trigger : HCAL cluster sum
- To do this August : finalize GEM readout
- Later HCAL cluster sum for 18 FADCs (not absolutely needed for GMn but will be available)
- After finalize GEp5 GEM readout

Backup

	Channels	Modules	Nb modules	On hand	
Shower	189	1881	3	3	Ecal
Preshower	54	1881	1	1	ECal
		SFI	3	3	BigBite
		TI	3	3	ECal
		Intel CPU	3	3	ECal
		Fastbus crates	3	3	BigBite
Scintillator	180	V1190	2	2	Glasgow
		VME64X	1	1	Glasgow
		TI	1	1	Ecal
		SD	1	0	
		Intel CPU	1	1	ECal
Cerenkov	550	VETROC	6	6	Hall A + Compton
		VXS	1	1	Hall A + Compton
		SD	1	1	Hall A + Compton
		TI	1	1	Hall A + Compton
		Intel CPU	1	1	Hall A + Compton
GEM INFN	14000	MPD	24		INFN
GEM UVA	113000	MPD	77		UVA
		VXS	4		UVA+3 ordered
		SD	4	1	
		SSP	4	3	3INFN + 1 Hall A Ben setup
		TI	4	4	Ecal
		Intel CPU	4	4	Ecal (ordered)
		Transceiver	101	101	ordered
HCAL	288	FADC	18	18	Hcal
		VXS	2	2	Hcal + UVA
		TI	2	2	Hcal
		SD	2	2	Hcal+UVA
		VTP	2	2	Hcal
		Intel CPU	2	2	Hcal
CDet	2520	1877	26	26	Cdet
		Fastbus	9	9	Cdet
		SFI	9	9	Cdet
		TI	9	9	Cdet
		Intel CPU	9	9	Cdet
		ATC	9	9	Cdet
		GAC	9	9	Cdet
S2m	32	FADC	2	2	RHRS
S0	2	FADC	0		RHRS
Cerenkov	10	FADC	1	1	RHRS
PRL	68	FADC	4	1	LHRS
Raster	4	FADC	1	1	LHRS
BPM	8	FADC	1	1	LHRS

		VME64X	1		RHRS
		SD	1		RHRS
		TI	1		
		Intel CPU	1		RHRS
VDC	1536	1877	16		LHRS
		Fastbus	2		LHRS
		SFI	2		LHRS
		Fastbus	2		LHRS
		TI	2	2	Ecal
Proton Large Angle	96	FADC	6	6	Hall C
Active analyzer	32	FADC	2	2	Hall C
		TDC	1	1	Hall C
		VXS	1	1	Hall C
		SD	1	1	Hall C
		TI	1	1	Hall C
		Intel CPU	1	1	Hall C
		VXS	1	1	TS crate
		SD	1	1	TS crate
		TD	2	2	TS crate
		TS	1	1	TS crate
		Fibers	14	14	ordered
		Total TI	24	23	
		Total SD	11	6	