

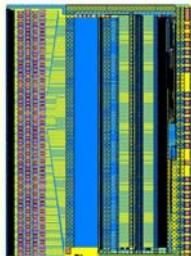
Status of FMD

Comprehensive Review
CERN, 23 March 2004

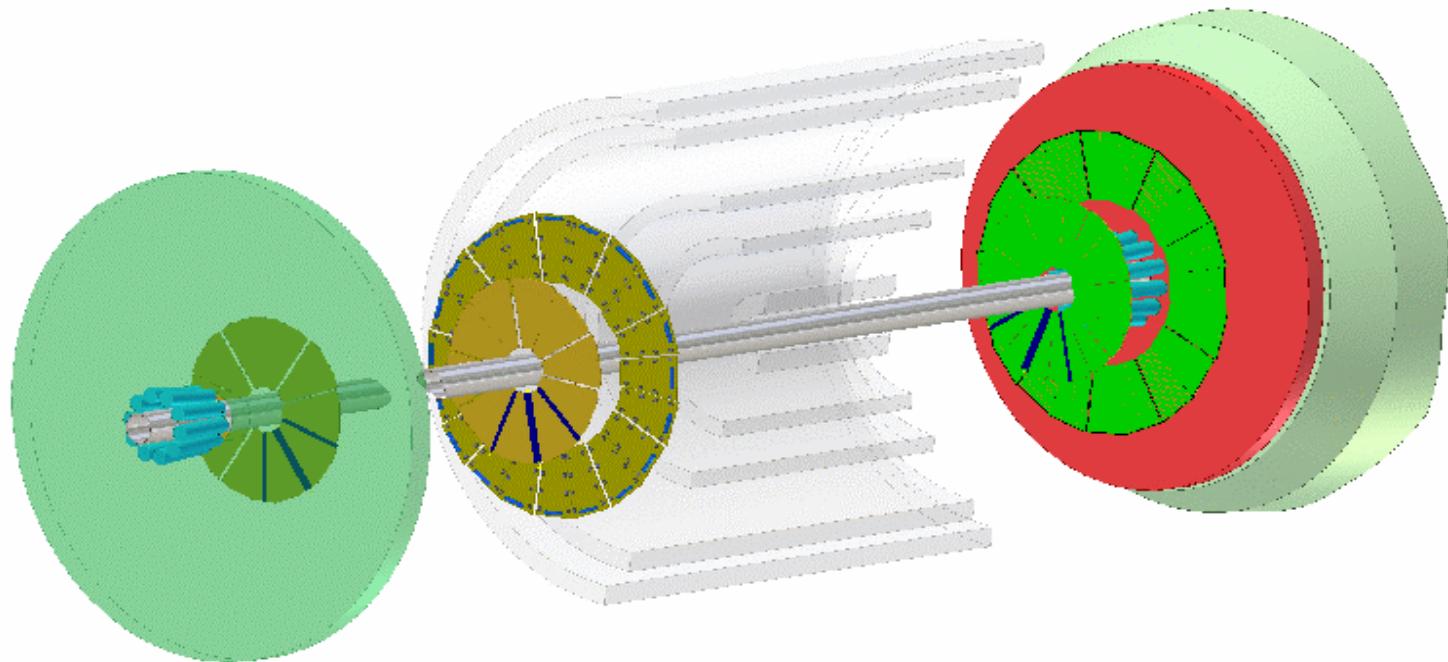
Jens Jørgen Gaardhøje
Niels Bohr Institute

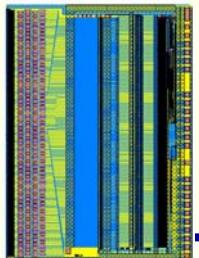


1. Integration and mechanical issues
2. Sensors
3. Preamp-shaper chips
4. Hybrids
5. Read-out strategy
6. FMD-TDR

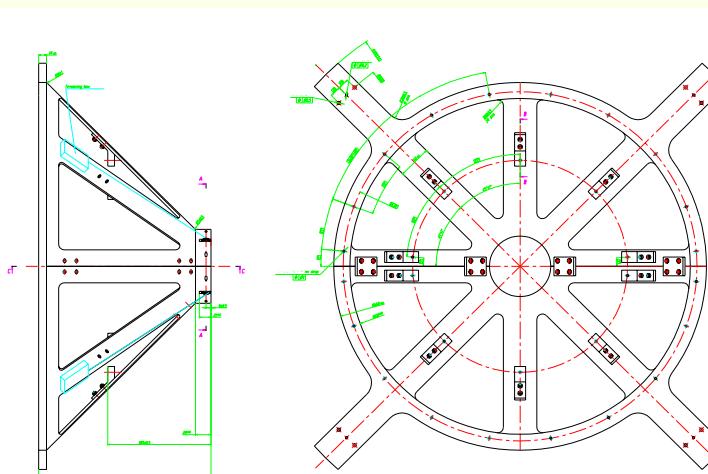
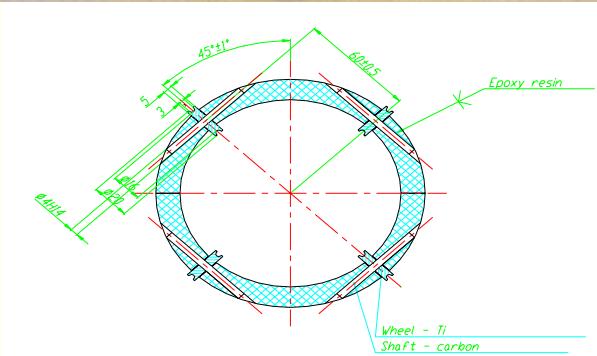
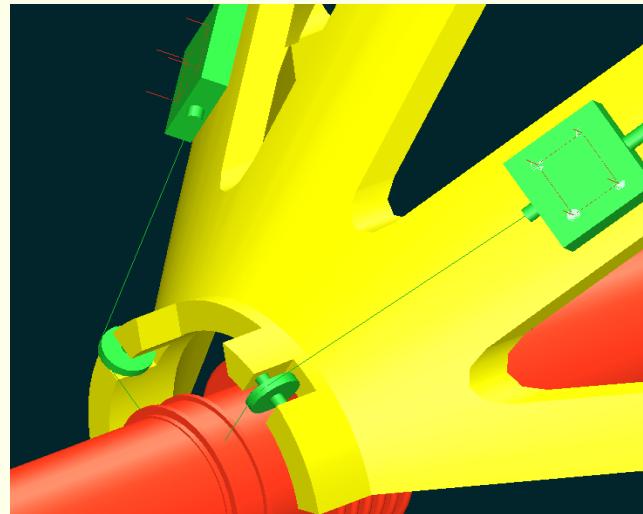


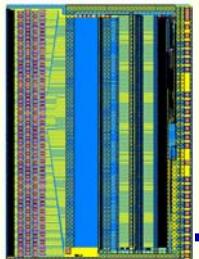
Forward detector overview



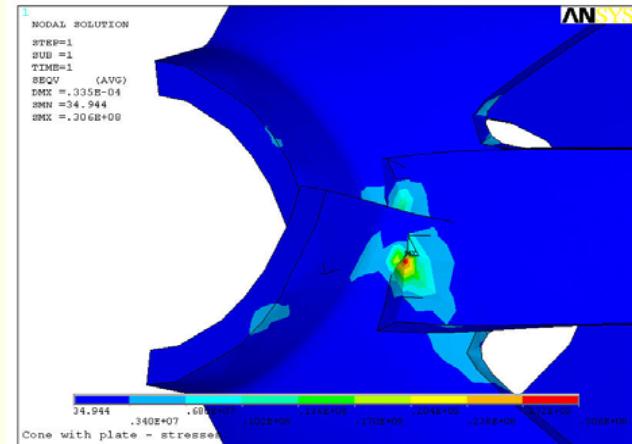
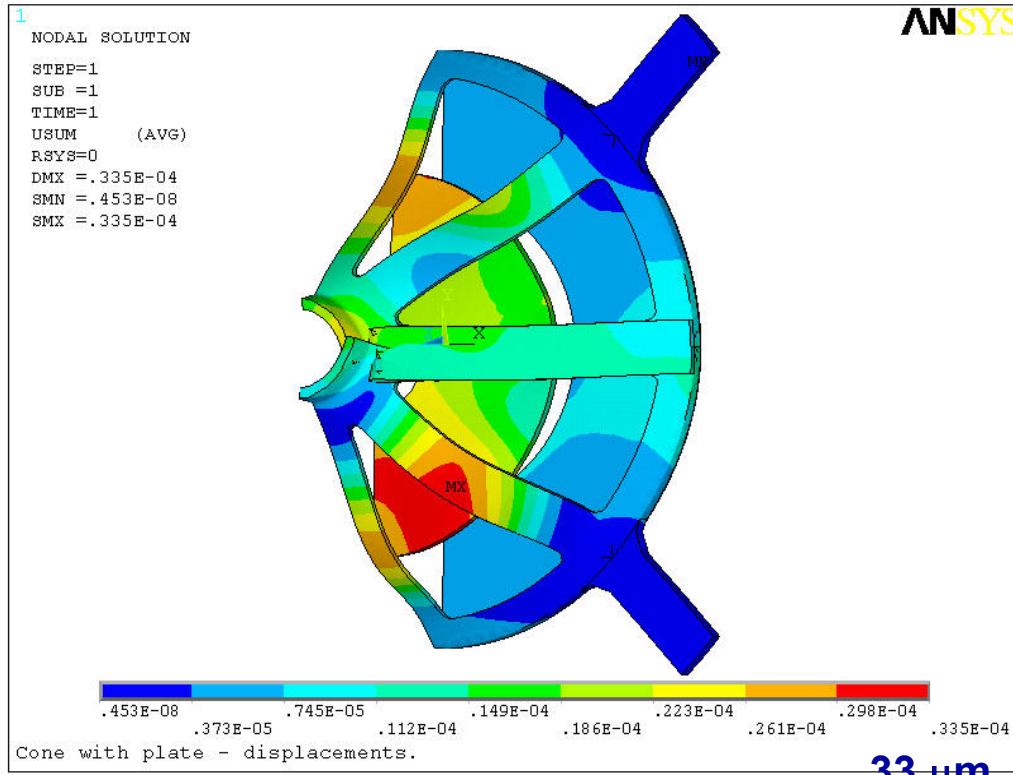


Beam and FMD support cone RB26 side



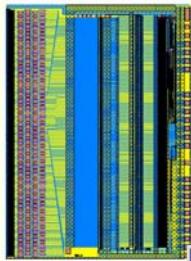


Finite element calculations of beam pipe support



stresses

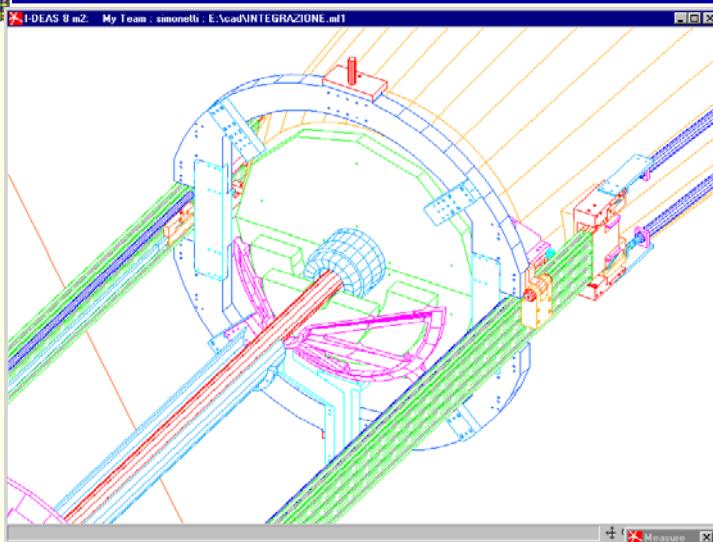
Prototype beam-pipe
support structure
(crucial for LHC)
in construction at NBI



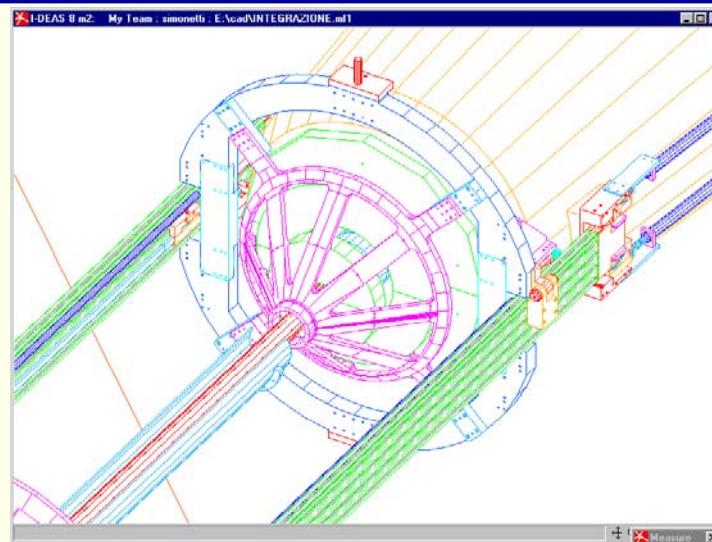
Installation Sequence



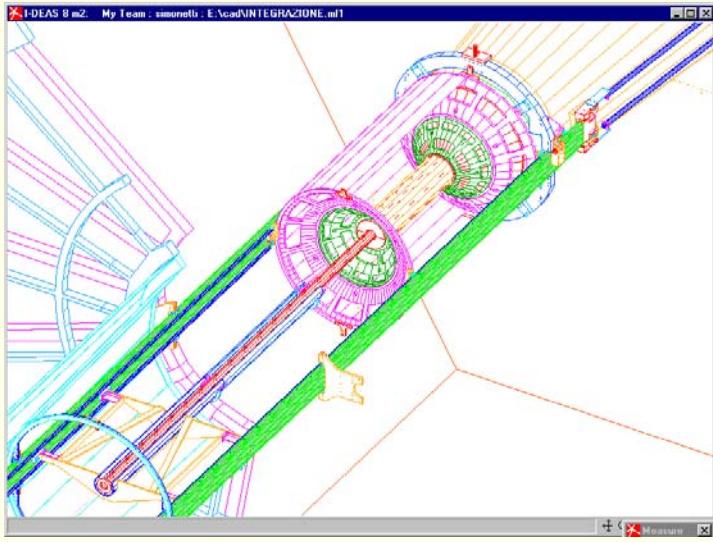
1



2

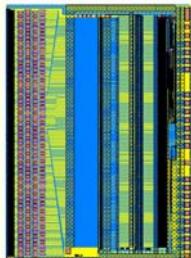


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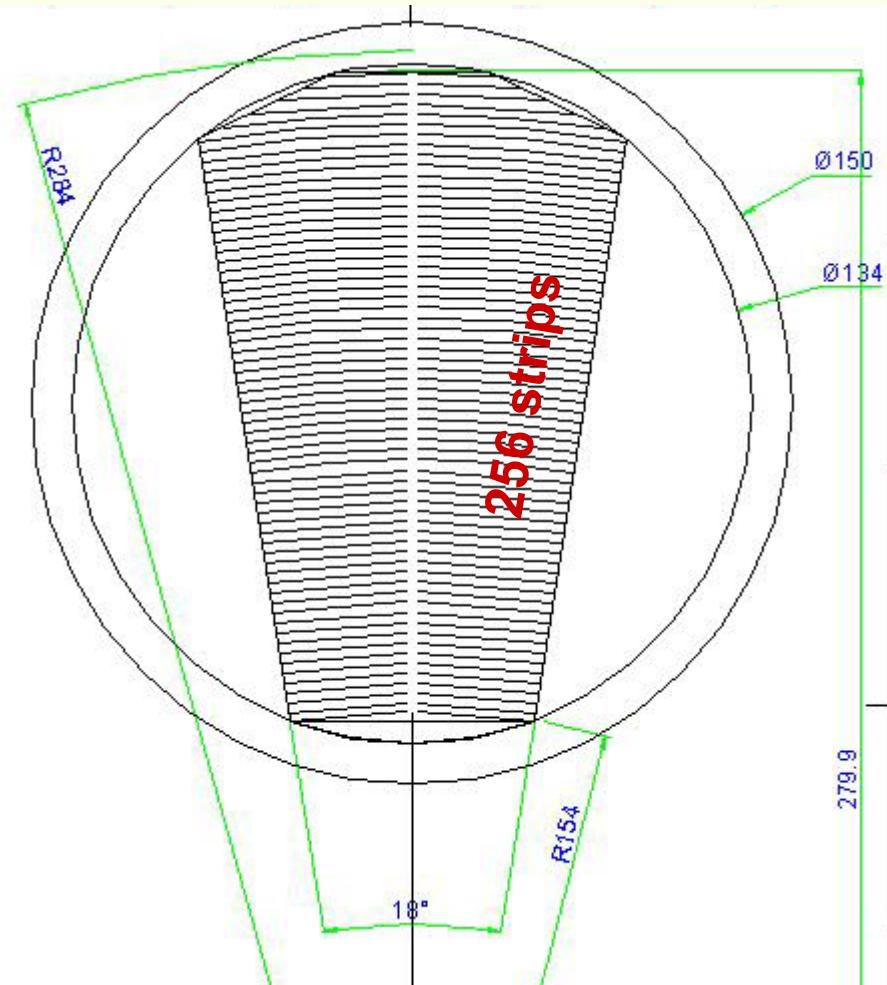
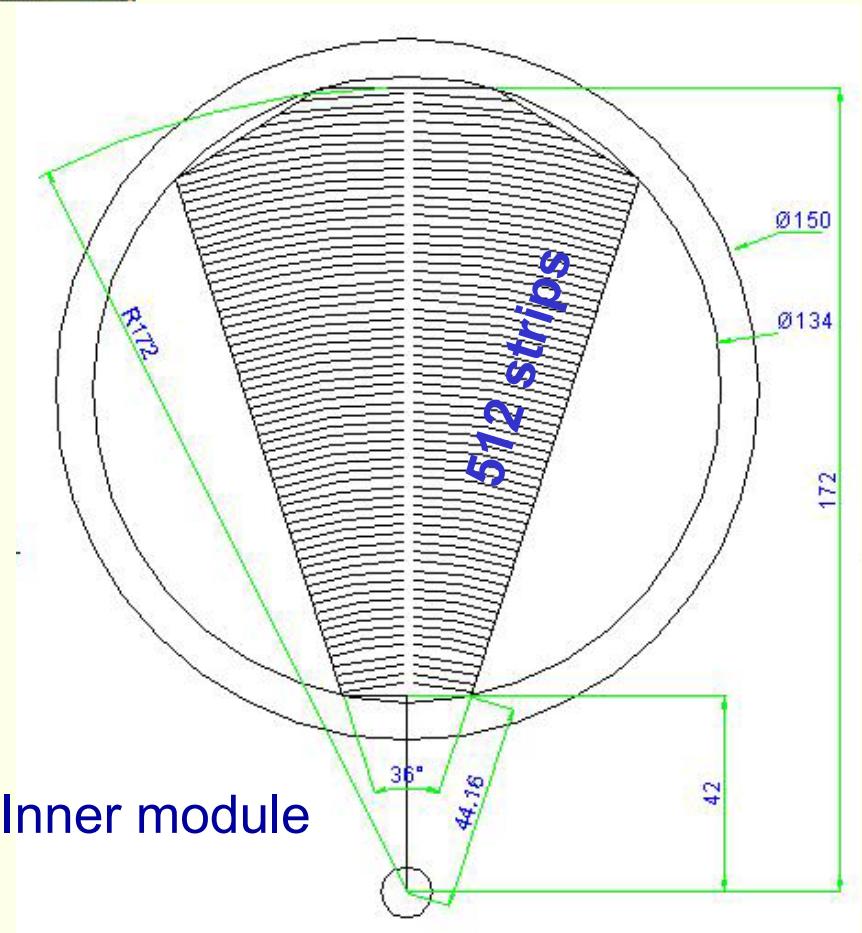


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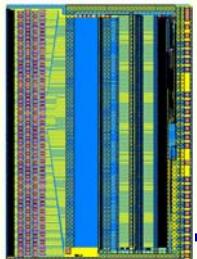




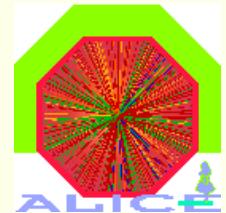
FMD sensors



Final negotiations with
(Micron/Hamamatsu) ongoing.

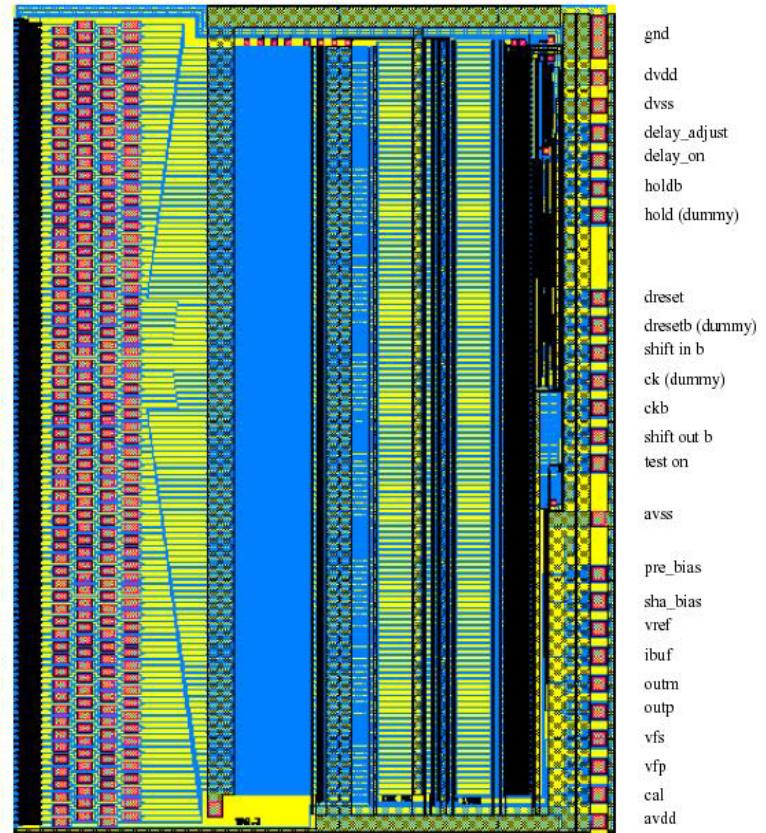


Custom preamp-shaper chip

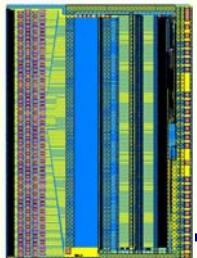


VA1_ALICE

50 μm input pitch



Radiation hardness	> 500-1000 krad
Peaking time	0.7-2.0 μsec (optimised at 1.2-1.4 μsec)
Noise (ENC)	< 500 e- (= 0.02 MIP)
Capacitance matching	5-25 pF
Dynamic range	0-20 MIPS (or ± 10 MIPS)
Highly integrated	128 channels per chip
Read-out speed	~ 10 MHz
Test and calibration circuits	included
Power consumption	0.6 mW per channel
Compatibility with ALTRO	requires level shift
Early prototype	VA1' useful
Affordable cost	yes
Channel count	51,200 (400 chips à 128 channels)

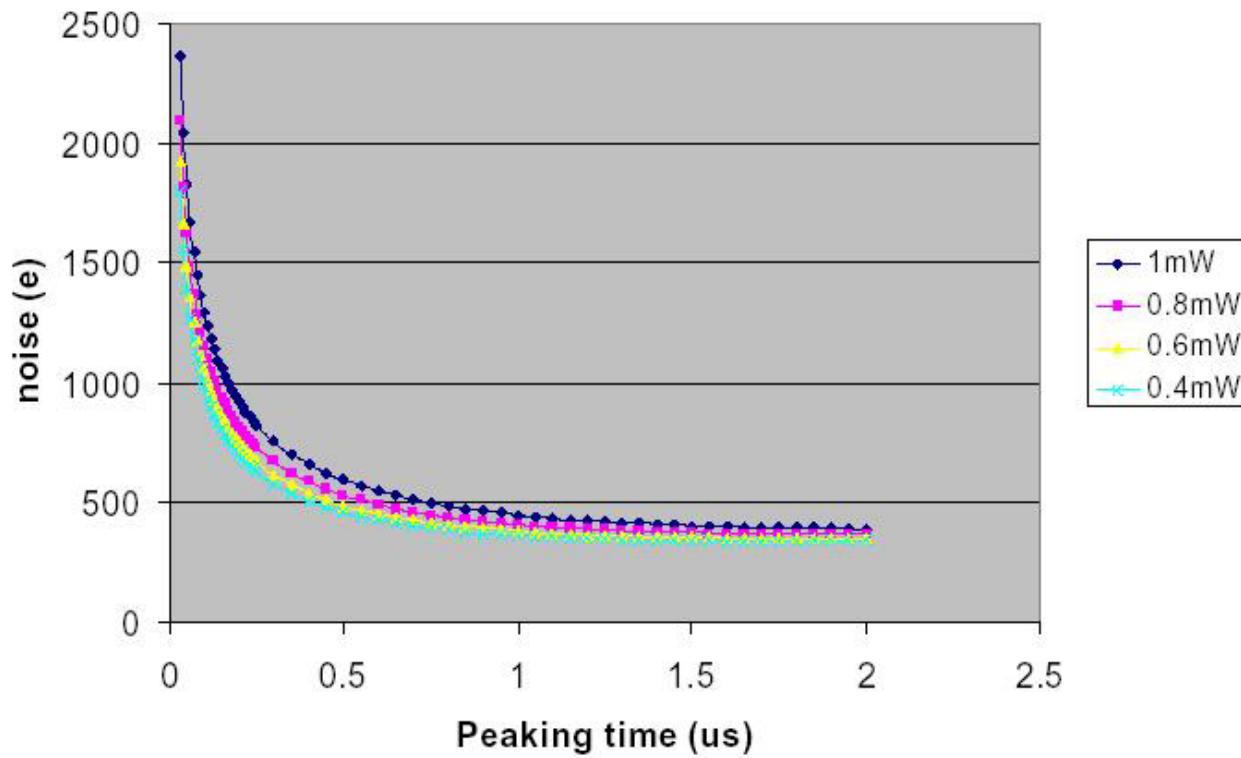


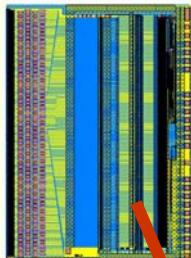
VA1_ALICE noise simulations



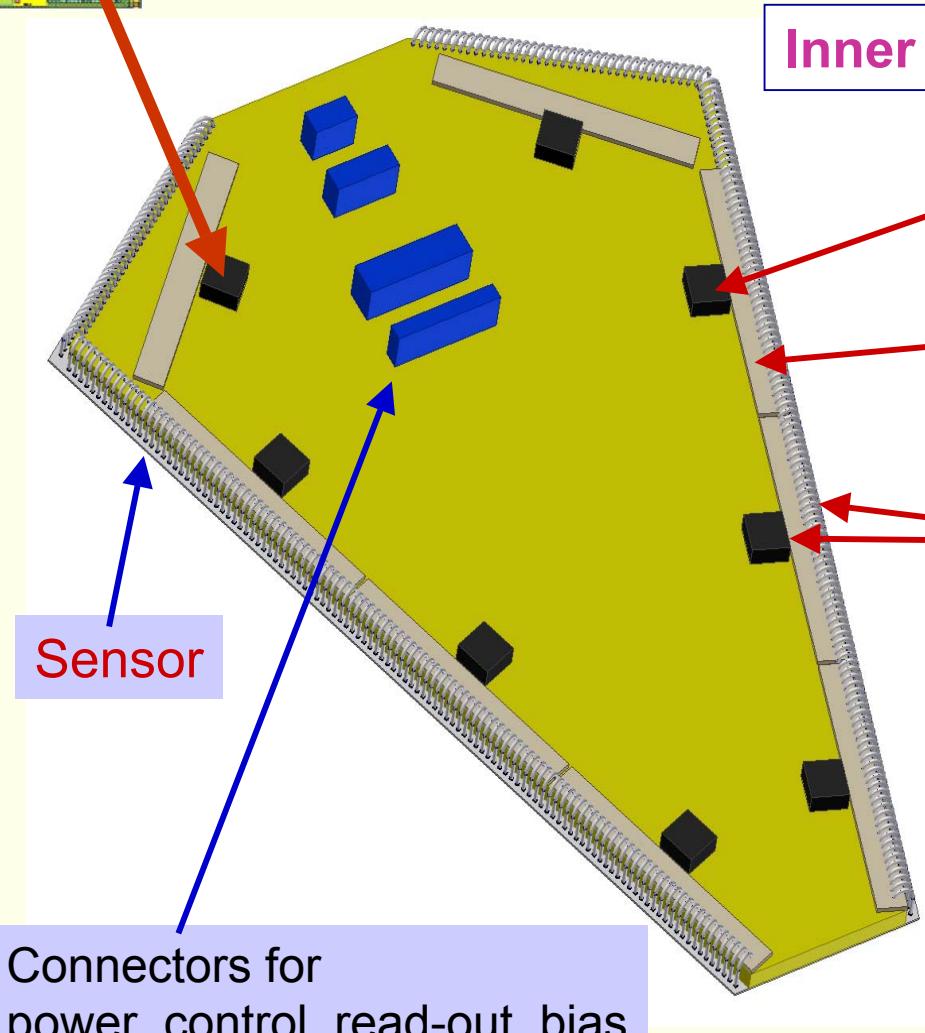
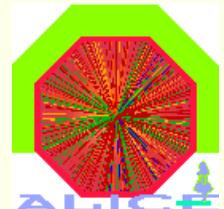
ENC noise for 4 different preamplifier power consumptions

Leakage current 3nA
Detector load 25pF





Hybrids



Sensor

Connectors for
power, control, read-out, bias

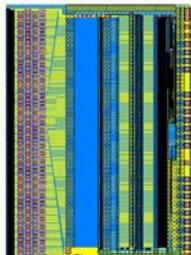
Inner module

VA1_ALICE (128 channels)

pitch adapter (ceramics)

bonding (CERN)

- Custom production of adapted VA1
- Hybrid design settled with IDEAS.



Radiation environment



Doses and Fluences in Central ALICE (10 years running):

FMD:

4.2 cm



28 cm

SSD2

TPC(in)

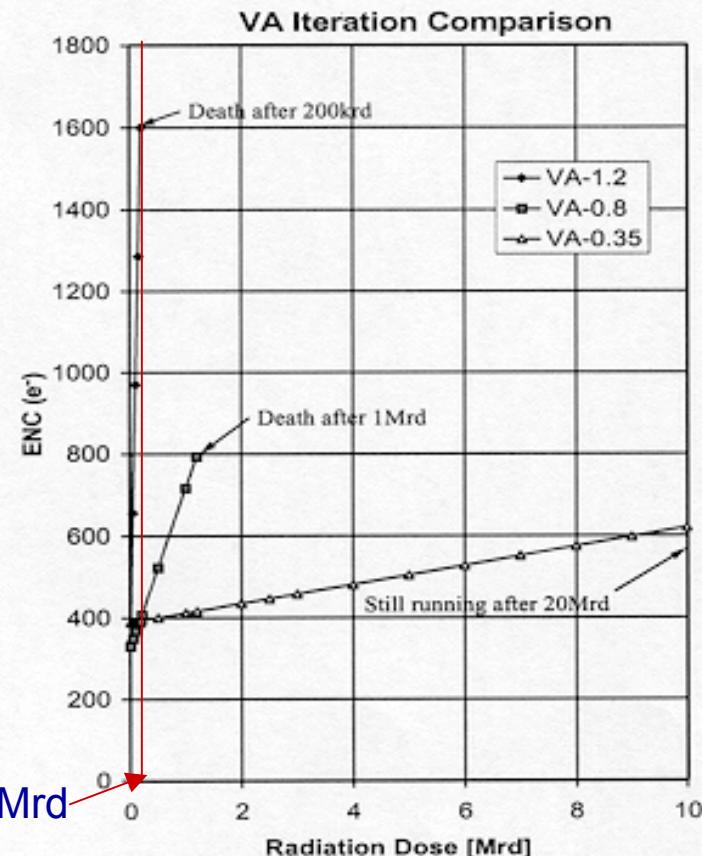
Radius [cm]	Dose [Gy]	Neutrons [cm ^{**-2}]	h-Φ [cm ^{**-2}]
3.9	2450	8.2E+11	3.5E+12
7.6	560	5.7E+11	1.3E+12
14	200	4.6E+11	5.5E+11
24	100	4.3E+11	3.2E+11
40	40	4.1E+11	2.3E+11
45	26	4.0E+11	2.0E+11
78	13	3.6E+11	1.5E+11

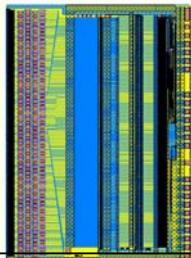
Doses in FMD:

	Dose [Gy]	h-Φ [cm ^{**-2}]
FMD1	80-1300	8.6-13.0E+11
FMD2	40-2100	1.3-6.1E+11
FMD3	900-3100	2.2-5.2E+11

=0.31 Mrd

Belle measurements

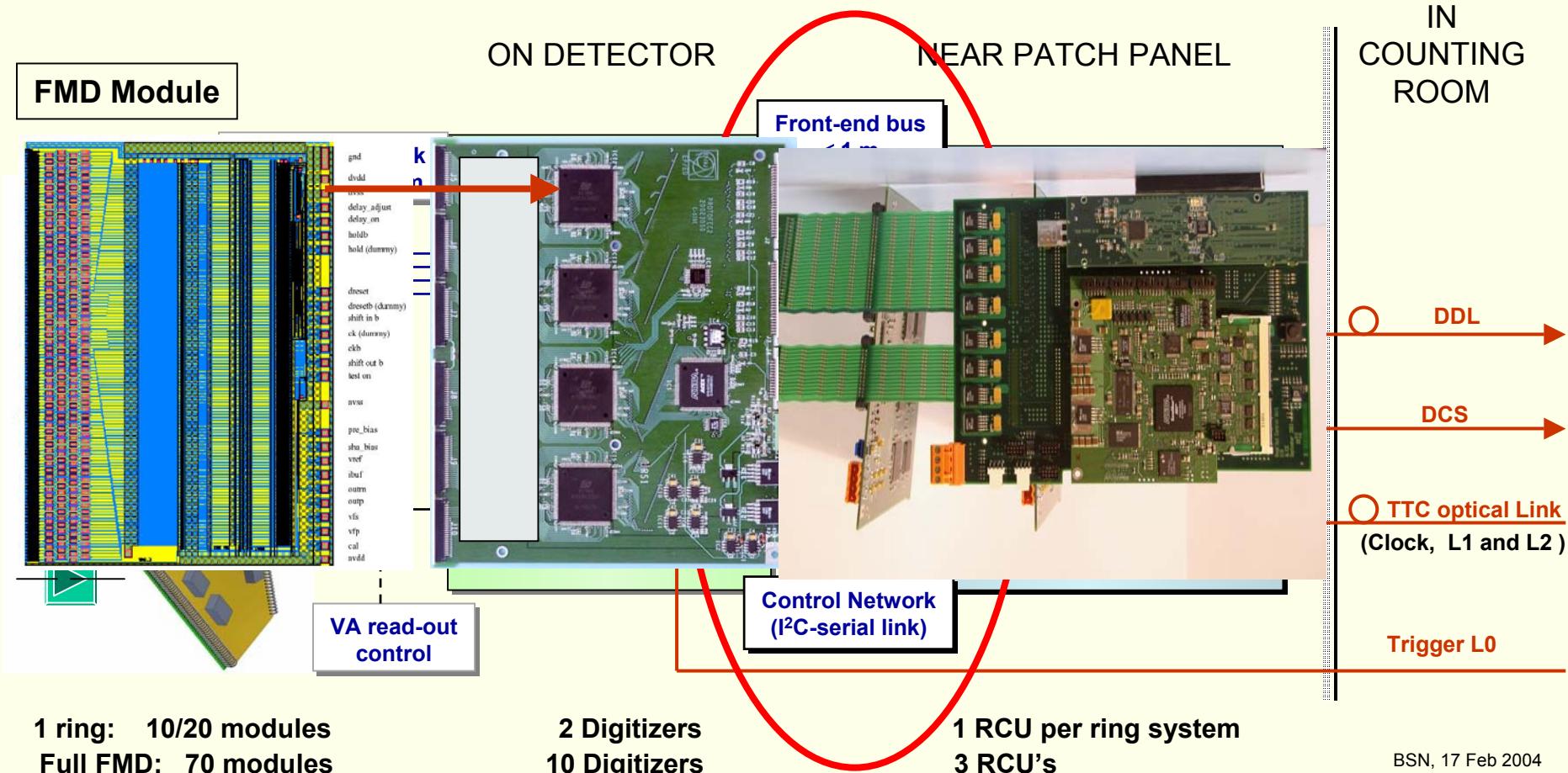


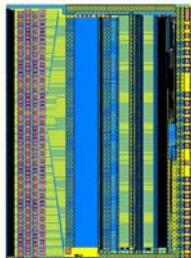


New read-out strategy

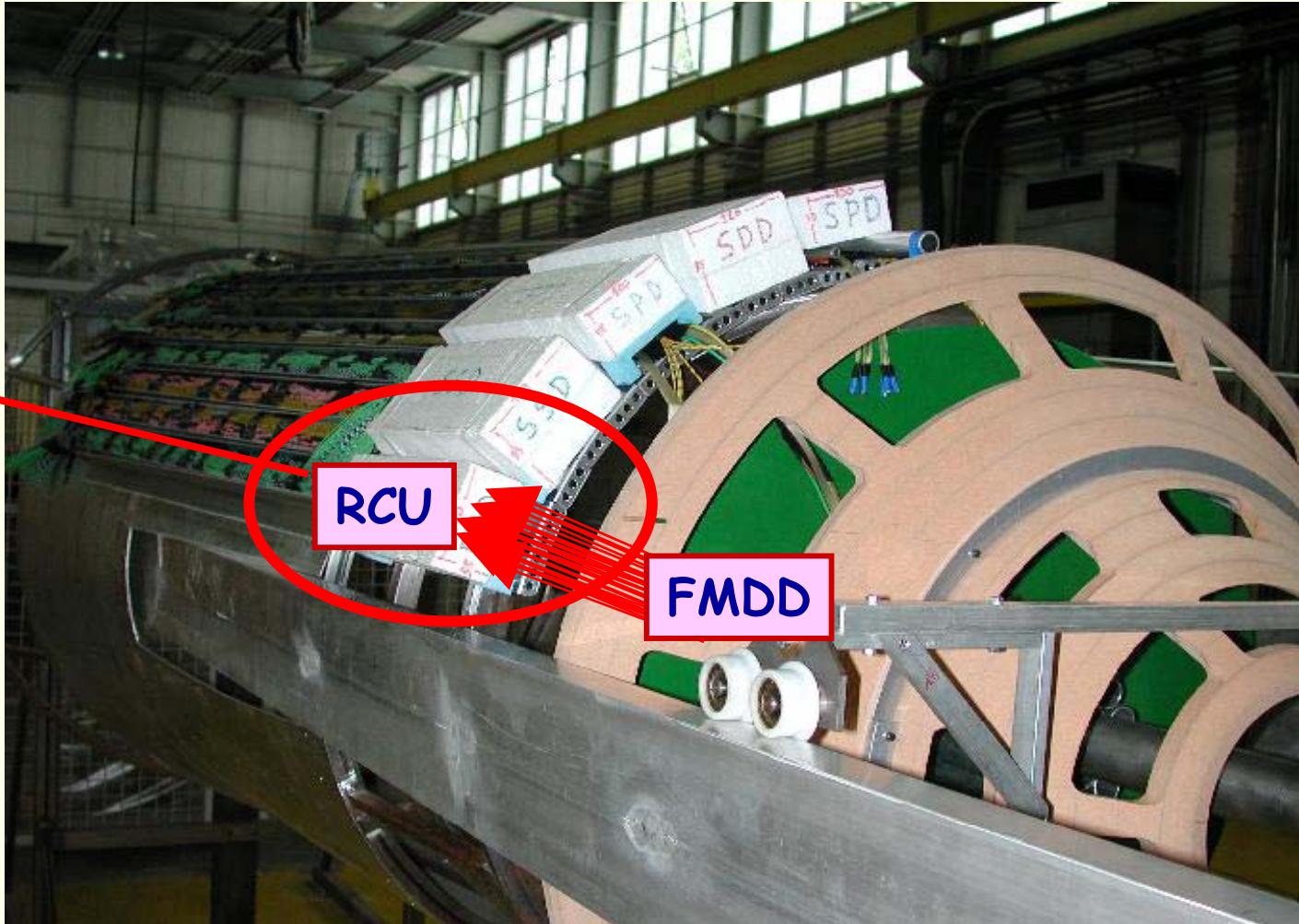


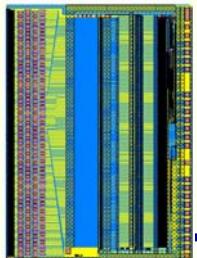
FMD Read-Out and Control Electronics





New RCU location



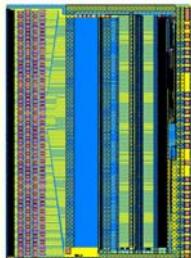


Estimates of SEU



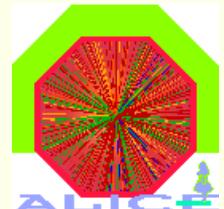
High Energetic Hadron Flux (@ TPCin): 250 - 550 hadrons / sec • cm²

Error rate per run (4 hours) per device	
FEC	$3 \cdot 10^{-4}$
RCU	$1.5 \cdot 10^{-2}$
DCS	$3 \cdot 10^{-2}$

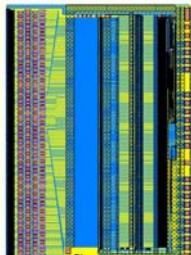


FMD and TDR milestones

Detailed schedule for 2004



Date	FMD project	FMD-TDR	TDR-overall
March 2004	Decide RCU placement	Basic text available	Basic FMD text available
April 2004	Decide Si manufacturer Design digitizer test board Order Si prototype	Rework figures Expand text	Basic TO and V0 text available.
May 2004	Start digitizer test board construction Order Hybrid prototype	Finalize text and figures.	Completed FMD text. Work on TO, VO text and figs
June 2004	Delivery hybrid prototype Test hybrids	FMD text and figures completed	TO,VO,FMD text and figures completed
July 2004	Test hybrids and digitizer board prototypes		Editing of TDR, proof reading etc.
August 2004	Delivery Si prototype New Post. Doc for the project.		Final proof reading. Decide layout/cover/photos
September 2004	Gluing Si + hybrids Bonding at CERN		Printing of TDR
October 2004	Test: Si+hybrid+digitizer+RCU		
November 2004	Tests in-beam: 680MeV		
December 2004	Decide on final order Si+hybrids		



Overall schedule 2004-2006



Date	FMD project
Spring 2004	Order Si and FEE Hybrid prototypes (IDEAS) Design and construct Digitizer board (NBI)
Fall 2004	Bonding Prototype Si and Hybrids Test: Si+Hybrid+digitizer+RCU with e- beam
End 2004	Decide placement of final order
Jan 2005	Test with HI beam at RHIC Place production order
May 2005	Delivery of all Si and hybrids
August 2005	Gluing Si+Hybrids at NBI or CERN
Fall-winter 2005	Bonding at CERN, system assembly and commission at NBI
February 2006	Ready to ship to CERN
June 2006	Ready to install in ALICE