The SCT Module development programme 96

A. Carter and Y. Unno
(Draft by the module convenors)

1) Forming the MODULE Design and Engineering Team

It is time to make a close collaboration between the engineers (and related physicists) in the institutes to unify SCT engineering for the module development. Ideally, we should achieve very good communications, and work within a single SCT project. Below is the list of engineers so far identified. Please contact the convenors if you or your institute have engineers who are able to contribute in this field.

Design and Engineering Team:

Name(Engineering)	Institute	e-mail	FAX#
G. Tappern	RAL/UK	GJRT@IB.RL.AC.UK	+44-1235 44 6863
T. Kohriki	KEK/Japan	kohriki@kekvax.kek.jp	+81-298-64-2580
W. Miller	Hytech/UCSC/US		? ?
O. Bystrom	Uppsala	bystrom@tsl.uu.se	?
E. Perrin	Geneve	eric.perrin@cern.ch?	?
?	NIKHEF	?	?
P Sutcliffe	Liverpool	?	?
?	Munich	?	?

Contact:

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Hytech/UCSC/US	H. Sadrozinski	hfws2@scipp.ucsc.edu	+1-408-459-3043
LBNL/US	C. Haber	chaber@lbl.gov	?
Uppsala	?	?	?
Geneve	A. Clark	clarka@afsmail.cern.ch	?
NIKHEF	?	?	?
Liverpool	T. Jones	JONEST@hep.ph.liv.ac.uk	+44-151-7943444
Munich	G. Lutz	?	?

We would propose that Geoff Tappern leads the engineering team. To aid smooth communications within project clusters we identify the contacts in each. The most reliable method of the communication is via FAX (for the moment). However, we also request to produce electrical form as much as possible so that the information can be posted on the WWW (Y. Unno is maintaining the SCT module page in the atlasinfo.cern.ch machine.)

2) Module work programme 96 (BARREL)

2.1) The modules

The module concepts, "end-tap" and "centre-tap", have variants of cooling schemes (2 pipes or 1 pipes) and heat conductors (Beryllia or PG(Pyrolytic Graphite)). In the case of 2 cooling pipes, Beryllia would suffice the cooling job, while PG would be required to cool with single cooling pipe. In order to reduce the number of combinations, the following modules will be engineered:

(a) End-tap module

(a.1) Beryllia and 2 cooling pipes
(a.2) PG and 1 cooling pipe

(b) Centre-tap module

(b.1) Beryllia and 2 cooling pipes
(b.2) PG and 1 cooling pipe

The support scheme would be conceptually the same for both end-tap and centre-tap modules, but would be expected to be (slightly) different in details when fully engineered.

2.2) Milestones

The primary goal of the programme is to reach the decision on the final SCT barrel module at the December 96 review meeting. In order to come to this decision, we require design, prototyping, FEA analysis, and measurement. The following list gives the general milestones:

Noise measurement (end-tap, centre-tap, Z)	**Sep. 96**
Understanding of the noise with simulation	**Sep. 96**
Design & Engineering of module	**Sep. 96**
Thermal FEA (static and runaway)	**Sep. 96**
Construction of thermal module	**Sep. 96**
Measurement of the thermal modules	**Sep. 96**
Thermo-mechanical distortion FEA	Dec. 96
Measurement of Distortion	Dec. 96

Construction of electrically working module	Dec. 96
Design & Engineering of the supports	**Some by Sep. 96** Full by Dec. 96
Prototyping the supports	Dec. 96
Evaluation of assembly procedure, rad length	Dec. 96
Beam tests of the working module	Feb. 97 (at KEK) May-Jul. 97 (at CERN)

2.3) Work sharing

The following is a suggestion from the convenors for the work sharing, amongst the institutes and individuals who are personally known to us. Please let us know if others are wishing to contribute, and if the suggested people are willing and able to take on the proposed commitments.

Noise:

Measurement/comparison of End-tap and Centre-tap:

	Hamamatsu det + Binary	UCSC
	Others?	
Simulation:	CERN(W.Dabrowski), LBL(I.Kipnis), UCSC(N.Spencer), RAL(D.White)	
Z-modules:	Geneve, MPI	

BARREL Module:

Topology	**Centre-tap**		**End-tap**	
Material	BeO	PG	BeO	PG
Cooling	2 pipes	1 pipe	2 pipes	1 pipe
Design&Eng.	RAL/KEK	RAL/KEK	RAL	RAL
Thermal FEA				
Static	RAL	RAL	RAL	RAL
Runaway	KEK/UCSC	KEK/UCSC	KEK/UCSC	KEK/UCSC
Distortion FEA	RAL	RAL	RAL	RAL
Simple module	KEK/RAL	KEK/RAL	RAL/KEK	RAL/KEK
Bonded module	?	?	?	?
Thermal module	KEK/UCSC	KEK/UCSC	RAL/KEK	RAL/KEK

	/RAL	/RAL		
Metalized det	KEK	KEK	KEK	KEK
BeO	RAL	--	RAL	--
PG	--	UCSC/KEK /RAL	--	RAL/KEK /UCSC

Electrical working module (using current chip set: LBIC+CDP+HAC)

Detector	UK/Japan	UK/Japan	UK/Japan	UK/Japan
BeO hybrid	UK	UK	UK	UK
AlN hybrid	?	LBNL	?	?
Kapton hybrid	KEK/UCSC	KEK/UCSC	KEK/UCSC	KEK/UCSC

Assembly procedure
Radiation length

	RAL/KEK	RAL/KEK	RAL/KEK	RAL/KEK

Support&Layout

Design&Eng	RAL?	RAL?	RAL	RAL
Prototype	KEK/RAL	KEK/RAL	RAL/KEK	RAL/KEK
Power tapes	?	?	?	?

Work on PG

Data compilation	W.Miller, G.Tappern, etc.
WWW listing	Y. Unno
Applications	RAL, UCSC, Geneve, KEK, ...
Baseboards	
Hybrid backing	

Note:

(1) Thermal static FEA: cross-check by T.Kondo(KEK) and W.Miller (Hytech/UCSC)

(2) "Simple module" is just a mechanical module to learn feasibility. "Bonded module" is the module with wire bonding to learn construction technique in which the wire-bonding is the critical one. "Thermal module" is the module which has heaters embedded and to measure (static) thermal properties.

(3) The proposed "job sharing" is to encourage interchange of module items, and ultimately modules, between groups who share in the fabrication of components. One such example is the proposal that RAL fabricates BeO components, while KEK fabricates Al-metalized dummy detectors for thermal modules (numbers are all subject to the cost).

(4) All hybrids are for the current chip set: LBIC bipolar + CDP CMOS-buffer + HAC communication chips. BeO hybrid is with thin (3 micron) Gold on BeO substrate. LBL has AlN hybrid for the current chip set for evaluation of the irradiated detectors and modules for this Summer, and wishes to fabricate a double-sided AlN hybrid for the next chip set of CAFE + ABC's next year.

3) Module work programme 96 (FORWARD)

(Draft by N. Jackson)

3.1) The modules

There are currently three possibilities for the forward module. The first two modules are of the end-tap variety. One design using single sided detectors is being developed in the UK while a second design using double sided silicon detectors has been proposed by Munich. Finally the centre-tap R-phi module as developed for the barrel remains a possibility if this concept becomes the adopted solution in the barrel.

a) Module using single sided detectors

- The module will use Hamamatsu fan geometry detectors to make a stereo module.
- The module uses a BeO hybrid with thin gold tracks. The cooling spine will initially be BeO but may be upgraded to PG when the viability of the material has been demonstrated. The module is designed for binary readout. The aim is to use one connection to the cooling pipe.

b) Module using double sided detectors

- This module relies on a PG frame for support and cooling.
- The hybrid proposed uses aluminium on AlN.
- The module is designed for analogue readout.
- The aim is to connect the module to the cooling pipe at a single point.

c) R-phi centre-tap module

- This module will use Hamamatsu fan geometry detectors with the appropriate barrel binary hybrids.

3.2) Milestones

The primary goal of the programme is to reach the decision on the final SCT barrel module at the December 96 review meeting. In order to come to this decision, we require design, prototyping, FEA analysis, and measurement. For the forward region the added problem of non-uniform irradiation needs to be considered when studying thermal runaway. The following list gives the general milestones:

Delivery of first full scale wedge detectors	**Sep. 96**
Evaluation of Hamamatsu detectors in H8	Oct. 96
Noise measurement	Nov. 96
Design & Engineering of module	Nov. 96

Thermal FEA (static and runaway)	**Sep. 96**
Construction of thermal module	**Sep. 96**
Measurement of the thermal modules	Oct. 96
Thermo-mechanical distortion FEA	Dec. 96
Measurement of Distortion	Dec. 96
Construction of electrically working module	Dec. 96
Design & Engineering of the supports	Dec. 96
Prototyping the supports	Dec. 96
Evaluation of assembly procedure, rad length	Dec. 96
Beam tests of the working module	Feb. 97 (hopefully at KEK) May-Jul. 97 (at CERN)

3.3) Work sharing

The following is a suggestion from the convenors for the work sharing, amongst the institutes and individuals who are personally known to us. Please let us know if others are wishing to contribute, and if the suggested people are willing and able to take on the proposed commitments.

The forward module programme has many items in common with the barrel programme such as the centre-tap R-phi module and the noise simulation. Accordingly some of the relevant studies will not be repeated but results will be taken from the work in the barrel.

Noise measurements:

Hamamatsu det + Binary	LIVERPOOL, MELBOURNE, VALENCIA
GaAs + binary	FREIBURG, GLASGOW, LANCASTER, SHEFFIELD
MPI det + Felix	CERN, DORTMUND, MPI

FORWARD Module:

Topology	**End-tap single**	**Dnd-tap double**	**Centre-tap**
Material	BeO	PG	BeO
Cooling	1 pipe	1 pipe	2 pipes

Design&Eng.	RAL/LIVERPOOL	MUNICH	MELBOURNE
Thermal FEA			
Static	RAL/LIVERPOOL/ NIKHEF	MUNICH/NIKHEF/ LIVERPOOL	RAL
Runaway	LIVERPOOL	MUNICH?	UCSC
Distortion FEA	RAL/LIVERPOOL/ NIKHEF?	NIKHEF?	RAL
Simple module	MANCHESTER /RAL	MUNICH	KEK/RAL
Bonded module	LIVERPOOL	MUNICH	MELBOURNE
Thermal module	RAL	MUNICH	RAL/KEK
BeO	RAL	--	RAL
PG	--	MUNICH	--
Electrical working module (using current chip set: LBIC+CDP+HAC)			
Detector	MELBOURNE/ UK/VALENCIA	MUNICH	UK/JAPAN
BeO hybrid	LIVERPOOL		
Kapton hybrid	--	--	KEK/UCSC
AlN hybrid		MUNICH	
Assembly procedure			
Radiation length			
	RAL/LIVERPOOL/ NIKHEF	MUNICH/NIKHEF	RAL/KEK
Support&Layout			
Design&Eng	RAL/NIKHEF?	RAL/NIKHEF?	?
Prototype	?	?	?
EPower tapes	?	?	?
Test Beam	LIVERPOOL MANCHESTER VALENCIA	MUNICH DORTMUND? CERN?	MELBOURNE SYDNEY?

Note:

(1) "Simple module" is just a mechanical module to learn feasibility. "Bonded module" is the module with wire bonding to learn construction technique in which the wire-bonding is the critical one. "Thermal module" is the module which has heaters embedded and to measure (static) thermal properties.

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SCT module web page:

http://atlasinfo.cern.ch/Atlas/GROUPS/INNER_DETECTOR/SCT/module/SCTSGmod.html

Or,

ATLAS Welcome page -> Subdetectors ...-> Inner detector -> SCT ->
SCT module