GEM TN-92-256

Calorimeter Newsletter #4

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(Editors)

December 24, 1992

Abstract:

The Calorimeter Newsletter contains contributions from different areas of calorimeter work.

From: BNLCL6::GORDONH "HOWARD GORDON OR VIA INTERNET "gordon@bnl.gov"" 24-DEC-1992 19:56:09.42
To: @CALALL
CC:
Subj: GEM Calorimeter Newsletter #4 (resent due to network problems)

CALORIMETER NEWS LETTER #4.

24 December 1992

1. Starting from this issue, the Calorimeter Newsletter will contain contributions from different areas of calorimeter work, and will be edited by Bill Wisniewski and Bill Willis. (by the way, it is hard to abbreviate those two: both Bill W's, both WJW's--shall we say Wis and Wil?) We will try to get on a regular schedule. Working Group reports will be particularly welcome.

Apologies for rather loose editing of this edition: lots of stuff only arrived today, and we want to get it out before the holiday.

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2. Update on Gem Calorimeter organization.

Cliff Eberle has agreed to act as Integration Engineer, Don Richied as Calorimeter Cryogenics Integration Engineer. The search for the Calorimeter PM continues apace! That the Working Groups are now functioning will be clear from their reports below in many cases.

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3. The muon tracking function in the scintillator calorimeter.

The fast response and low noise of the barrel scintillator, and its relatively well shielded position, give a potential for interesting capability in muon tracking. For example, the barrel covers the gap in muon coverage at the central detector support. Muons identified in the calorimeter could be picked up in the Central Tracker, in most cases.

Yuri Kamyshkov discussed these possibilities at the Muon group meeting 9 December. The Muon Group expressed interest, but noted that if the information were to be included in the trigger, the coverage would have to be complete. This is not a feature of the

design described in Baseline 2, and in fact can be rather difficult to achieve in the region of the barrelend cap transition. Issues of cost arise as well.

The question arose in the GEM Executive Committee meeting 11 December, where there was a consensus that the barrel scintillator should be designed to meet it hadronic calorimeter functions, and the muon tracking performance should then be evaluated. The calorimeter designs should not extend beyond the physical outlines shown in Baseline 2, to avoid integration conflicts, for example with the muon supports, where a new drawing should be available soon from SSCL indicating what space is left, for cables and junction boxes for example.

There is concern about the calorimeter cost, and functional enhancements are at increased cost are unlikely to be feasible.

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4. The Calorimeter R & D Budget for FY 1993.

The final allocation of R & D funds for GEM was not known at the time of the Executive Committee Meeting, but according to the provisional allocation, the amount available to the Calorimeter Group was $5M. According to the model proposed by Gary Sanders, and accepted after discussion, the amounts budgeted as independent of the Texas Commission. If they should give MORE than we have allocated for some particular work, well and good, but if they give less, we must still find a way to do the work we think necessary, ie from SSC funds. Conversely, if more is granted by Texas, we will keep the total budgeted at our value, since all the money must finally add up to our total project budget. Willis argued that the total of $5M is insufficient for the work we need to do. This claim of the Calorimeter work, as against the other GEM detector systems, is justified by two considerations: -the choice of a Hybrid Calorimeter means continued R&D on both liquid and scintillator systems; -some of the work proposed in FY 93 on the EM calorimeter is to produce the production tooling, as distinct from R&D.

I believe that there was definite sympthathy for these arguments. It was agreed to give the Calorimeter a claim on some effective Reserves, which although not budgeted, are expected to materialize. The figure which was presented as necessary was $6.55M. This is already a considerable reduction from reviewed requests. A major

impact of the $5M figure is to delay the start of a large scintillation calorimeter prototype. Gary Sanders will issue a detailed plan soon, once the real allocation is known.
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5. Surely some of you on this distribution will not have seen the agenda of the Calorimeter Simulation Workshop, which is appended below.

One might add, that this subject is perhaps the GREATEST CONCERN

of the PAC as expressed in their report of the 3 December meeting.

We need as much help in this area as possible!!

GEM Calorimeter Workshop Dec 7-8 at SSCL

from: MCFARLAN

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AGENDA
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The original purpose was to bring together as many as possible of the people in GEM working on calorimeter simulation to share experience on a variety of issues, and to have 'tutorials' on general issues.

The formation of the Calorimeer working groups will give a new purpose: the organization and formation of the Calorimeter Simulation Working Group. The intent is to prepare us as well as possible for the PAC presentation in July, and do design studies for the TDR.

One task is to address basic issues as well as particular GEM ones, and to address the issue of computing requirements. The workshop is deliberately planned NOT to overlap with the calorimeter group meeting so that simulators can attend both. Please feel free to attend and make presentations or lead discussions of topics. As a workshop, people should expect to share codes and demonstrate them, so 2 days seems about the right length.

Below are some topics that are expected be covered. Possible contributors are indicated. Where there are ?? please consider whether you have a contribution to make. It may be that there are

additional topics which should be addressed. Your advice is appreciated.

Since this is a workshop we expect the agenda to be somewhat flexible. The list below of topics below is a list of topics to be addressed in future meetings/workshops, if seen as important.

----------MONDAY DEC 7th----------

9:00 am. Goals of Workshop -- McFarlane, Womersley

9:15 am Discussion of Agenda and Workshop organization

Goals of simulation -- Group

Important effects (missing energy, resolution, backgrounds, pileup, pointing, pizero)

Simulation types: global, partial.

Physics: key processes

Time scales: TDR, PAC'93, future

Impact on other systems (e.g. muons -- trigger, dE/dx...)

10:15 SSCL/GEM approach -- I. Sheer

10:45 Impact on other systems

Tracker -- Jenny Thomas

Muon System -- P. Dingus

11:15 am GEANT:

GEANT 3.16 (what changes from 3.15) -- Lee Roberts

Volume search algorithm -- Lee Roberts Optimization strategies -- Lee Roberts, Mike Seman Speed of searching in different volumes -- ??

11:45 am CALOR89 interface -- Brent Moore

12:15 pm LUNCH

1:30 pm Existing SSCL/GEM simulations

SIGEM structure -- Yu. Fisyak (30 mins) gemfast structure -- T. Skwarnicki (30 mins)

Parameterizations:

(Parameterization in gemfast -- T. Skwarnicki)

H1 approach (latest version derived from gflash) -- ??

(Stefan Peters will come to a later workshop)

Mixture level descriptions (range of validity) -- ??

Shower parameterization (Range of validity) -- ??

Shower library techniques -- ??

2:30 pm Special Geometries

Accordion -- Seman/Lelchouk

Strips ('preradiator') -- H. Ma

Asymmetric segmentation -- ??

Plate -- ??

Axial fiber calorimeter -- ORNL person?
Simulating fibers in detail -- ??

Speed of simulations
Comparison of approaches (Gemfast, UAZMIX, SIGEM -- Authors)

Features
Massless gaps

6:00 pm Discussion of Working groups/Assignments

----------TUESDAY DEC 8th----------
9:00 am Data structures (HITs, DIGItizations information) -- Womersley

Data structures expected from DAQ and algorithms for finding energy and time from samples. -- Henk Uijterwaal

Algorithms
Weighting factors in heterogeneous systems -- ??
Clustering algorithms in gemfast and CLEO -- T. Skwarnicki EM
Pattern recognition/reconstruction -- ??
Pointing, pizero rejection
Jet finding -- ??
Jet energy reconstruction -- ??

Pile-up and noise
Simulation and parameterization techniques (10^33 and 10^34) -- A. Vaniachine
(Pulse shape parameterization -- ??)

Integration Strategy -- Womersley
GEM calorimeter simulation plans -- can we coordinate to maximize use of manpower, computing facilities and optimize results?
Descriptions of simulations at Columbia, BNL, ORNL, CalTech, Mississippi?

Coordination of fast, mix and full simulations -- ??
SIGEM and its data structures -- Yu. Fisyak
Common MATE, ROTM, GEOM, HITS definitions-- ??
GEM tracker and muon simulations -- J. Thomas/I. Sheer? and P. Dingus?

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6. The Scintillation Calorimeter Group has been moving ahead on several fronts. Design concepts are being reviewed, and their physics performance simulated. The different detector options are being evaluated. Finally, the engineering of the system is going ahead rapidly. A glimpse in the the last activity is given by the following contribution.

Date: Wed, 23 Dec 1992 15:39 EST
From: <REN@ORNLSTC>

Holiday report on scintillating calorimeter engineering:

1. At the request of Yuri and Larry we are doing preliminary layouts for three versions of the scintillating calorimeter:

   a. All passive with no up-grade capability
   b. 1)Minimal hadron measuring capability in barrel/passive end cap
      2)Minimal hadron measuring capability with active end cap
   c. Minimum muon measuring assistance with full coverage.

2. Rough costs are also being prepared to go along with these designs.

3. It is understood that physics analysis is being provided for each of the designs to give a basis for the decision process.

4. The three arrangements will be reviewed by the scintillating group at the SSCL on the 19th.

5. The arrangements (with emphasis on "b") will be reviewed in the engineering meetings on the 20th and 21st.

6. Clay and I will not be able to go on the China trip but look forward to visiting on a future trip. Yuri will be along and will present the "b" version for consideration.

7. Steve is helping the forward group with their analysis of the scintillator calorimeter. He is also changing the cost estimate format to match the new WBS. His preliminary cost analysis will be ready for the 20/21 review.

8. The Y-12 manufacturing group will begin a labor and machining analysis of the scintillating calorimeter the first week of January.

9. Cliff Eberle will provide a detailed labor analysis of the calorimeter installation. He will be supported by Anatoli Gordeev.

10. The detailed finite element analysis is underway and results will be available for the 20/21 meeting.

Mark Rennich

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8. The GEM Liquid Calorimeter Working Groups have started to meet on a regular basis. Due to time pressure, people might not have been informed of all the meetings. If you would like to be included on the mailing list of a specific working group please contact either the convener or Lissauer @ BNL.GOV.

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EM Working Group: Conveners: Bob McCarthy, Michal Seman.

Summary of 12/21/92 Meeting of EM Calorimeter Working Group

Bill Willis discussed the "Japanese Fan" approach to end cap calorimetry now under development at CERN. We reached a consensus that this approach did not seem promising to us, because of necessary variations in gap size and HV, so we will follow developments at CERN but will not work on this approach within GEM. We will actively pursue two options (1) current baseline (projective - but flattened curtain) and (2) a completely flat curtain.

Hong Ma discussed pointing in the current baseline end cap - focussing attention on phi-pointing, not required in the barrel. He found the phipointing to be substantially worse than theta pointing (factor of 1.6). Michal Seman will coordinate efforts to produce an end cap design for the TDR. Specific attention will be given now to the desired segmentation and resolution expected near the necessary supports in layer 1. Additional pointing studies will

continue.

Michal Seman discussed optimization of the barrel accordion. This work is in progress and will focus on the choice for (beta/delta) and the choice for segmentation. Misha Leltchouk's results on the resolution attainable using massless gaps indicates that we will not need to vary the thickness of lead as a function of rapidity.

Steve Belavia and Don Makowiecki discussed plans for the prototype production - which are progressing smoothly.

Bob McCarthy

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9. Hadronic Working Group: Conveners: Fred Lobkowicz, Paul Mockett.

The Liquid Calorimeter Hadronic Group met at Dallas on Dec. 10th and 11th and again at Columbia Univ. on Dec 17th.

Summary of decisions and discussions of barrel hadronic modules -

1) The hadronic modules will be using lead in the tiles, with copper for the ground plates. There will be two sections in depth. Going to lead from copper increases the absorption length by 13.6%, but we probably have to use lead to reduce the e/h ratio.

2) The design shown was too loose - one should try to increase the number of absorber cells keeping the overall radial distance the same.

Comment as of Dec 21: The number of cells has been increased. There will be a total of 12 cells (6 + 6), with a transformer ratio of 3:1. With this arrangement each cell has approx 0.348 lambda at 90 degrees. There is an additional 0.05 lambda in support structures if the strongbacks are made of aluminum; this increases to ca 0.2 lambda if strongback and bottom plate are made of brass.

3) Not included in the absorption length count are cryostat walls,

nor the shell between EM and hadronic barrel calorimeter.

4) The hadronic modules will be approx 180-184 cm long. The exact length can only be determined after one knows tolerances, space required for the EM cables going by at one end, etc. The present assembly scheme assumes that when the hadronic modules are being installed, the central washer and the two cryostat inner endplates are already in position. The hadronic modules are brought in radially. There will be guide rails at each long end of a module to locate it during mounting. The modules will be bolted to the central washer, and restrained by a pin (or possibly just by the guide rail) at the other end.

5) The strongback, endplates etc will be made out of an aluminum alloy. This means that longitudinally the whole structure shrinks upon cooldown like aluminum - same as the cryostat. (Note however that brass shrinks nearly exactly like aluminum. The cost of going to brass is being investigated.)

6) There will be a solid aluminum cylinder between the EM and the hadronic section, with penetrations for cables and possibly cooling. Between the two hadronic sections there will be individual stays to hold the cryostat ends. These will have to be tubes approx 2" in diameter, if one wants to prevent buckling when pulling vacuum on the inside.

7) The outer hadronic section modules will have to become thinner near the ends (near eta=1), if one wants to accommodate a conical cryostat wall as is presently shown on the "official" cryostat sketch. This conical shape of the cryostat is required if the feedthrus are mounted on the outer shell. The location of the feedthrus is to be reconsidered, since the present location makes the assembly rather difficult and time consuming.

Summary done Dec 21 F.L.

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10. The Feedthrough / Cable working group:

Conveners: Don Makowiecki, Fred Lobkowicz:

Summary of discussion at Dallas Dec 10-11 re IBM-type feedthrus (Cyberflex), where the (microstrip) cable is directly

epoxied into the feedthru.

It was generally agreed that they presented a viable option, which in principle might be more cost effective than the (more conventional) arrangement of separate glass/metal feedthrus. It was decided that for the moment one would proceed with both options with Lobkowicz talking with IBM, Mockett worrying about the glass/metal version. There may be some hope that by the time the TDR is ready (April 30), the decision between the two options might be clear.

The following comments were made:

1) One needs guaranteed and tested vacuum tightness at cryogenic temperatures, with one side in LKr or LAr. LN2 tests might be enough for testing purposes - this needs further evaluation. Anyway, each feedthru would have to be tested to be accepted.

2) The 5 mW/line thermal loss looks impressive. However, it is not clear what "little or no slack" means as far as length is concerned. More exact numbers are required - the distance between cryogenic and warm flange could be kept as small as 10 cm. So how long would the cable between the two feedthrus be? How flexible is the cable? Will this reduce the achievable signal density?

3) The vacuum flange has to be weldable. Does this affect the signal density of 0.017 sq inch/signal? What makes the feedthru flanges so heavy? (is it the gasket or the required pressure on the epoxy?) One will need somewhere a transition SS-Alu. Should one contemplate one per feedthru? We need to talk to the welding experts.

4) Is the 0.5 ohm/foot resistance for the "5 mw loss" cable? If not, what is the value?

5) Connected to 4): Should one make full length cables (that is extending ca 3 feet on either side of the feedthru) or does one need to make soon a transition to a heavier cable? What would be the connectors?

6) 130 conductor cables are fine, but we may want multiples of 24 or multiples of 32 or so. Any problems there? (Probably not)

And finally:

7) Can IBM provide a budgetary cost estimate by Jan 12? [based on 120-140k feedthru signals, cable width to be provided later (effect on cost??) with connectors on both ends]

8) How does IBM concretely plan to proceed? Are there development costs to be paid in advance? What would be costs of prototypes?

These comments have been transmitted to IBM and a speedy response is anticipated.

Summary done Dec 15, 92 F.L.

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11. Collaboration with RD3- Visit to CERN.

We plan to test press three 2 meter absorber plates in the CERN bending machine and in the molding machine at Orsay. Also a small group of physicists qnd engineers will have detailed discussions with their counterparts in RD3/ATLAS at both Orsay and CERN. We will be interestested in both EM and hadronic module details for the barrel and endcap: electrodes, support, overall fabrication and assembly plans, cooling preamps, cables, feedthroughs, etc.

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12. REPORT ON THE GEM TEST BEAM MEETING AT FNAL

A meeting of the GEM Calorimeter (& Muon) Test Beam Working Group was held on December 18, 1992 in the MWEST Conference Room at Fermilab. Attending were: Jim Dunlea (Rochester), Sandor Feher (Stony Brook), George Ginther (Rochester), Howard Gordon (BNL), Tom Haelen (Rochester), Jon Kotcher (SSCL), Chris Lirakis (Northeastern), Fred Lobkowicz (Rochester), Bob Miller (MSU), Paul Mockett (Washington), Yasar Onel (Iowa), Ram Shivpuri (Delhi), Paul Slattery (Rochester), Jim Sullivan (MIT & Boston), Bill Wisniewski (SSCL) and George Yost (SSCL).

The agenda included guided tours of the D0 test beam facility in the FNAL NWEST area and the MWEST experimental hall and beam line. A brief visit to the MP area was also provided. Carlos Hojvat, of

the Fermilab Directorate with responsibility for serving as Liaison Physicist for all test beam activities (SDC, GEM, CDF, D0), provided initial Laboratory feedback on GEM's test beam proposal, which has been assigned number P869. We were informed that (Deputy Director) Ken Stanfield has appointed a committee to review GEM's and SDC's test beam proposals, with the intent of meeting with representatives of the two experiments in mid-January. The goal is to assign specific areas (presumed to be MWEST and MP) to each of these activities after the next FNAL PAC meeting in February. It was clear from Carlos' remarks that the Fermilab management is well-aware of the excellent match between MWEST and GEM's test beam needs, but is concerned about the cost asymmetry between the two areas -- an SSC test beam program mounted in MWEST will be considerably less expensive than one carried out in MP from an infrastructure perspective.

The meeting featured initial discussions of a variety of topics of importance to GEM's test beam activities, with the goal of identifying and framing issues for future refinement. These topics included: An overview of GEM's proposed FNAL-based test beam program, a comparison between the D0 test beam calorimeter transporter and the corresponding device utilized by SLD, a conceptual design for an MWEST calorimeter transporter that combines features from both of these earlier devices, the status of plans to involve SSCL in providing the GEM test cryostat, SCIGEM's test beam needs, the GEM Muon Group's test beam requirements, a review of existing E706 (MWEST) and E704 (MP) tracking chambers and associated readout electronics that could be redeployed for GEM's test beam program, the possibility of employing the existing Fermilab Gerber routing facility in building the GEM barrel calorimeter hadronic prototypes, the history and goals of the CERN-based RD3 calorimeter testing program, the potential relationship between the FNAL test beam program and the planned SSCL MEB-based program, and FNAL data acquisition considerations.

While most of these topics will obviously need to be carried over to the agendas of future Test Beam Working Group meetings, the outline of the 1994-96 FNAL-based GEM test beam program could already be discerned from this initial meeting.

PFS

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13. FORWARD CALORIMETRY

Here is a brief summary of where we are vis a vis forward calorimetry as determined at recent meetings.

For the TDR the GEM FCal design will consist of an "EM" section of the liquid argon tube electrode design within the endcap cryostat followed by a spaghetti hadronic section outside the endcap cryostat. The hole through the "EM" section will be 12 cm diameter to accommodate an 8 cm beam tube, some space for alignment inaccuracies, and some space for thermal isolation of the beam tube from the cryostat. The hole through the hadronic section will be smaller, about 8 cm diameter. This leaves no alignment clearance if the beam tube is 8cm diameter. This dimension must be resolved later.

Detailed Monte Carlo calculations by Mike Shupe show that this configuration marginally meets our physics goals. Further Monte Carlo work will show how much farther we must push on the beam tube size to more comfortably satisfy our physics needs.

The technology for the hadronic FCal is not yet specified and options may be listed for the TDR. At the last FCal meeting we took a close look at the quartz fiber option. Two different Monte Carlo results were presented. Both suggested the performance was marginal but might work. They also differed from each other in significant ways. The differences were identified and the authors (BU and ORNL) will seek agreement. At the next FCal meeting we hope to take a close look at the liquid scintillator option and understand the R&D issues for the next year.

We also considered the high pressure gas option at the last meeting. The SDC proponents for high pressure gas presented their status. It appears that high pressure gas is not an option for GEM if the FCal is at 5 m from the IP. At this distance it is not possible to achieve the required lambda of less than 12 cm and, at the same time, an acceptable sampling fraction with high pressure gas. If the GEM FCal is located at 10 m from the IP then the required lambda is relaxed and then high pressure gas becomes an option. The SDC proponents did not entirely agree with this assessment and will work out the details for themselves. They are invited to convince us that high pressure gas can indeed meet our specs at the 5 m distance.

Arguments were presented, pro and con, for longitudinal

segmentation of the FCal. There are considerable advantages for having such segmentation as in the TDR design. Test beam plans for BNL next summer were sketched out. Arizona will take the responsibility for coordinating this work.

John Rutherfoord

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14. Meeting with Minister Lin.- Columbia Univ.

The Leading Committee which has been established by the Chinese government to coordinate the collaboration with the SSC and its experiments has as its Executive member the Minister of Aerospace, Minister Lin Zontang. He and his delegation visited the SSCL on the 14th and 15th December, and met with the Calorimeter Group on the 18th, and the Muon and Electronics Groups on the 18th.

The calorimeter group met with Minister Lin from China to discuss the manufacturing of the GEM calorimeter in China. We presented in some detail over six hours of intensive discussion:

a) Overview- D.Lissuaer
b) Scintillator Calorimeter - Larry Sulak/Mark Rennich.
c) Liquid Engineering Overview - Lyle Mason.
d) EM Prototype construction- Don Makowiecki and Steve Bellavia
e) Hadronic Modules - Fred Lobkowicz.
e) Forward Calorimeter - Mark Rennich.

At the end of the day there was a review of the GEM detector given by Barry Barish. We have transfered to the Chinese deligation written drafts of the construction specifications for the calorimeter components. A small calorimeter group will be visiting China at the beginning of January to carry on the discussion and visit potential factories capable of manufacturing the calorimeter in China. The members of the GEM delegation are expected to be Wisniewski, Kamyshkov, Sulak, Lissauer, Makowiecki, Mason and Digiacomo.

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15. A. Onuchin visited SSCL and BNL for several weeks. He discussed possible participation in the construction of the GEM

calorimeter and other systems by the BINP in Novosibirsk, and we had important discussions on the acquistion of the LKr for GEM. It was emphasized that purchase from a number of sources is probably optimum, to minimize new capital investment required. It will also minimize costs to forsee the purchase over a number of years. We noted that a substantial quantity will be required already for our beam tests at the end of 1994.

end!