PRC closed session, 31th October 2002

Referee report to

R and D for the TESLA-Detector: Instrumentation of the very forward region (LAT, LCAL)

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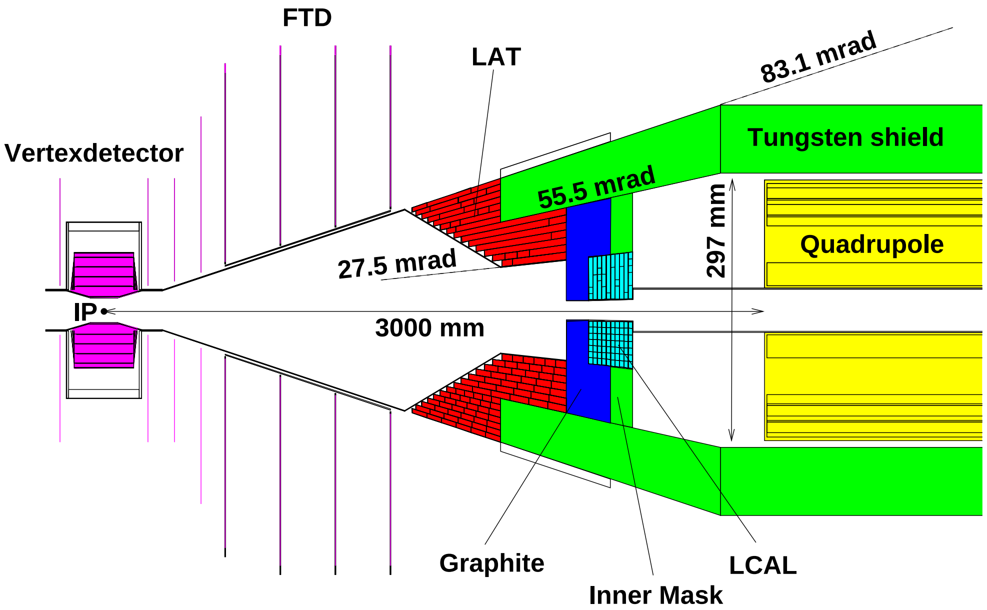
Comments to the paper (October 4th, 02, available to the PRC),
even if clarification/improvements in discussions with W. Lohmann (W.L.) and A. Stahl (A. St.)

this talk :

- **goals**
- **plans**
- **questions**
- **Conclusions**

Goals



LAT and LCAL

- shield against back scattering
- measure electrons $E \gtrsim 50$ GeV from physics (i.e. distinguish from beamstrahlung $\rightarrow$ high granularity)
- veto or measure hard electrons from 2γ events

mainly LCAL

- Fast feed back for beam optimisation by measuring beamstrahlung

mainly LAT

- luminosity by Bhabhas. Precision $\approx 10^{-4}$
- preferentially: distinguish photons/electrons

Plans and Intentions

in TDR: LAT and LCAL : Silicon-Tungsten sandwiches

presently considered:

LAT Silicon-Tungsten

to fix: shape (depends on TESLA optics) and segmentation

$\rightarrow$ prototype

Cracow

University of Mining...

Inst. of Nuclear Physics

Tel Aviv University

Prague Academy

Present Plans and Intentions, LCAL

1) Silicon-Tungsten or Diamond-Tungsten
(presumably better radiation hardness)
to fix: sensor and readout technique
→ **prototype**

DESY, Zeuthen
JINR, Dubna
NCPHEP BSU, Minsk
IHEP, Protvino

2) Heavy Gas (e.g. C_3F_8 Ionisation Chambers
to study: properties of gas mixtures, radiation aging
pad structures, cross talk, linearity, inhomogeneities
→ **prototype**

IHEP Protvino

3) Crystal Calorimeter (e.g. $PbWO_4$) with Fiber Readout
main point to study: readout for longitudinal segmentation
if problems solved → **prototype**

DESY, Zeuthen
JINR, Dubna
NCPHEP BSU, Minsk

4) Crystal calo with Ultra-thin Photo-triodes
main problem seen by the authors: radiation hardness.

University College London (?)

some detailed questions (most a subset of those from of 21.10.02)

Back scattering of beamstrahlung from LAT, LCAL into detector, an issue?

LAT

clear that background problems only for LCAL?

Distinction of γ and e possible with $\sim 1X_0$ graphite in front?

Understanding of leakage of 15% in **simulation**

Loss everywhere?

What are the fluctuations of 15% loss?

Explaining resolution of only $\approx 40\%/\sqrt{E}$?

What resolution expected for large SI-W calo without leakage?

Resolution seems not to depend on position, besides inner bin (Fig. 12).

As stated in paper, simulations not yet fully understood.

Can much be concluded from the simulations at present stage?

Angular reconstruction: no bias as function of energy,

how large the interest in view of bias as function of polar angle θ?

(i.e. value of Fig. 13 in view of Fig. 14?)

What are the physics requirements? What needed?

Requirements (LAT)?

Given: goal of 10^{-4} precision for lumi measurement. Why 10^{-4} ?

Transformation into calorimetric requirements?

- Energy resolution?
- Long segmentation?
- Angular resolution and transverse segmentation?
- Small angle fiducial volume cut $\rightarrow$
  - Geometric mechanical precision and stability?
- Statistical precision per bunch, per minute or hour?
- Calibration properties, in situ possibilities?
- stability of calibration?

important:

Simulation of full Bhabha measurement, including backgrounds (so far single electrons).

Theoretical corrections understood on 10^{-4} level? (e.g. beam size effect negligible?)

LCAL questions

Again: what are the main calorimetric requirements?

Can a set be formulated quantitatively?

Crystal Calo with fiber readout:

Many options are planned to be studied.

”A detailed design of the calorimeter has to be made...” (p. 20):

not yet clear to me how to come in ~ 2 years to one design

(and in 3 years to a proto-type for the final LCAL having tested all options).

(proposal somewhat misleading, see below)

a detail: ”scintillating fibers preferred”: what about nuclear counter effect?

Crystal calo with ultra-thin photo diodes/triodes

in proposal just a line. Really pursued? (no resources listed)

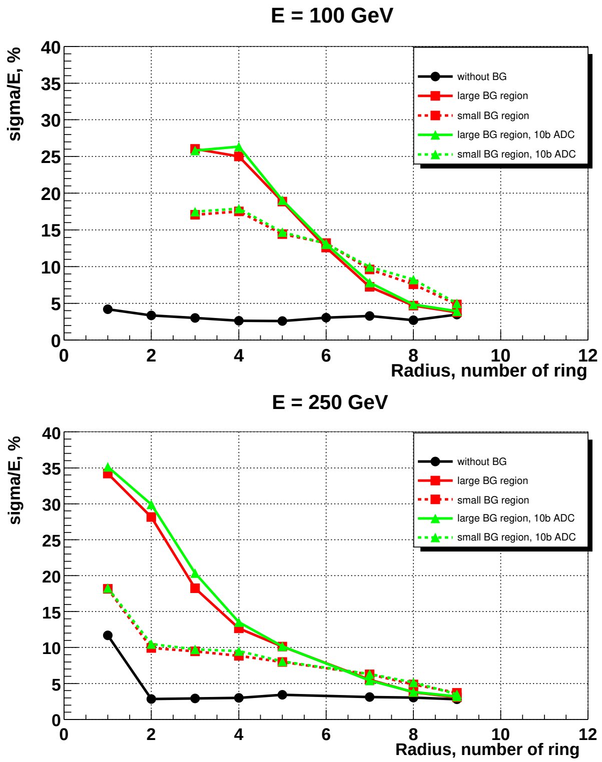
In all cases, radiation (up to 10 MGy/year) is a major issue and needs severe early tests

questions to LCAL simulations

background estimated by averaging over 10 bunches.

What variations from bunch to bunch can be expected?

Resolution



sandwich:

details:

what is band in Fig. 25? Resolution? (yes, W.L.,A.St.)

at large radii resolution improved by background?? (plot Fig. 26)

(“large BG region” has smaller BG at large radii, W.L.,A.St.)

also, with no BG, resolution seems not to improve with energy?

crystal:

Is in simulations a definite read out structure assumed?

interesting to see also here

Efficiencies to reconstruct true e with $E \gtrsim 50$ GeV?

Probabilities for fake reconstruction?

to 4, Requests, p 24

All options to be pursued?

How to reduce the number of cases?

” In ≈ 2 years we can present a technical design for both calorimeters in full detail.” (?)

Before that: ” construction of proto-types and measurements in test beam.”

For that ” resubmit this document”. At which stage?

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Plan appears rather tight in view of the many options, but paper is misleading.
(W.L., A. St. : 2 years for laboratory work: sensor and proto-type tests and simulations.
Then 1 or 2 proto-type calos for test beams)

Not yet obvious to me, how the various labs collaborate to reach specific mile stones
and how to come to the final calos.

Summary and Recommendations

- **I appreciate the promising activities and formation of collaborations.**
- **Several labs express intentions and show a potential for calo development.**
- **designs seem feasible**
- **I think this work should be supported.**

Seen a bit critical:

For both, LAT and LCAL, there is still a lack of criteria which the final design should fulfill.

What are the physics needs and how do they translate into calorimetric requirements?

Elaborations on these points could be two early mile stones.

Besides development of techniques, I strongly support **MC studies**

for potential performances and confrontation with requirements.

I suggest to update the paper soon

$\rightarrow$ more developed time plans

$\rightarrow$ formulate mile stones for sensor development

(such mile stones are just being formulated, W.L., A.St.)

Summary and Recommendations (cont'd.)

Tight schedule for decisions on proto-types (but paper somewhat misleading).

- **work on sensor structure in laboratories and simulations** **(2 years already, W. L., A. St.)**
- **construction of some proto-types for beam tests**
- **evaluation of results**
- **decision on final type**
- **full technical design**

  → update of schedule

  (general decisions on TESLA seem also to give more room)

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in my opinion: continuation to be encouraged