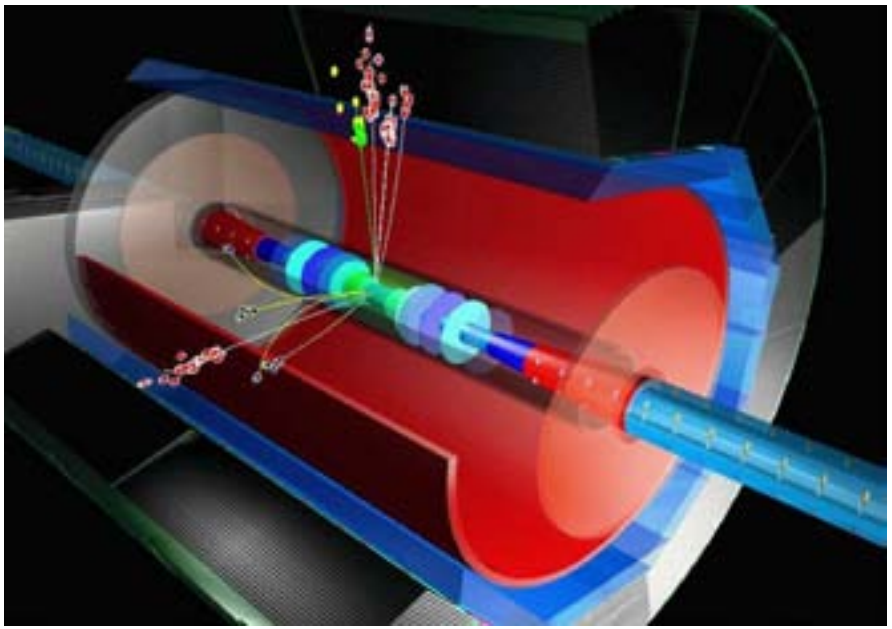
# Detector R&D for LDC

Ties Behnke, DESY, on behalf of LDC

LDC philosophy:

There are two main driving forces behind the LDC concept:



Particle flow: overall topological event reconstruction

Precision vertexing and tracking

The basic LDC concept is well developed, its expected performance is currently re-evaluated.
The detailed LDC concept is undergoing significant changes at the moment, in view of a much increased knowledge in particular on particle flow.

# Main R&D issues

There are a large number of technical questions (see later)

BUT

central (recurrent) issues:

Distribution of materials/ thinness of detectors

Real difference to previous detectors,
order of magnitude less than LHC detectors

Granularity – cost – performance triangle for the calorimeter(s)

# Detector R&D for LDC

Detector R&D for LDC is organised in very close collaboration with the detector R&D collaborations/ cooperations

The DESY PRC at the moment plays the role of a review body for most R&D for the LDC detector (open for everyone, not just LDC)

Most projects are not LDC specific, but general ILC detector R&D!

Projects currently under review:

| | |
|---|---|
| CCD VTX detector | LCFI |
| MAPS VTX detector | MAPS |
| DEPFET vertex detector | DEPFET |
| TPC | LC-TPC |
| Calorimeter for PFLOW: | CALICE |
| Calorimeter for PFLOW: | LCCAL |
| forward instrumentation | FCAL |
| Si tracking for the ILC | SILC |

# Other projects

R&D of relevance to LDC
but not formally reviewed by the DESY PRC:

- Several VTX technologies (SiO, HAPS, ...)
- Gas HCAL developments in the US and Russia
- Muon chamber developments in Italy

# VTX

Very active field
several detector R&D collaborations active (LCFI, MAPS, DEPFET, SiO, ...)

Main questions for LDC:

- re-visit VTX layout: only barrel, also end cap?
- Realistic material budget
- Inner radius: reality versus wishes?
- Question of electromagnetic interference with machine

Large overlap with other concepts, R&D is truly internationally shared

# SI tracking in LDC

Primarily the area of the SILC collaboration

- Redefine the role of SI-tracking in LDC
- How extensive should SI-tracking be?
- Realistic material budget
- Realistic support design and integration into overall detector

Some overlap with other concepts, in particular in the area of SI – ladder development,

but many questions are specific to LDC

# TPC

R&D work is done by the LC-TPC cooperation

a number of "sub-cooperations" exist within LC-TPC:

Orsay- Carlton – Berkely
Munich – Orsay – KEK
DESY – Hamburg – Aachen – Rostock
etc.

- Realistic resolutions?
- Technology optimization: Wires/ GEM's/ Micromegas?
- Realistic mechanical design, in particular the end plates
- Realistic material budget
- Realistic electronics

# Calorimeter

Particle flow calorimeter:

CALICE collaboration: SIW ECAL, Steel – scintillator or RPC HCAL

LCCAL: hybrid ECAL solution (finished)

- Improve mechanical designs, make it "detector enabled"
- Do proof of principle experiments for granular calorimetry (prototypes!)
- Do extensive MC tuning to enable further optimizations

The calorimeter and particle flow is at the core of the LDC program.
A serious optimization of LDC depends critically on the results from the CALICE collaboration R&D
and on the development of algorithms (PFA).
The proof of principle of a real, buildable and affordable PFLOW calorimeter will deeply influence the LDC design, philosophy, and cost.

# Forward Instrumentation

Mask instrumentation:

luminosity measurement
physics capabilities as far forward as possible
veto capabilities even further
fast beam diagnostics

- Do overall layout of the forward region as a function of machine design
- Do R&D into fast, radiation hard calorimeter techniques
- Do R&D into interface to machine, fast feedback etc

FCAL collaboration investigates these questions

Field is very much in flux, depends critically on machine design,
closely interrelated to questions like crossing angle etc.

# Magnet developments

LDC magnet design relies heavily on CMS magnet design.

Re-optimization will be done once the boundaries are better known

main open question:

how uniform should the field be (see contribution by D. Peterson on Monday)

Important interplay with the machine: DID, ...

# Muon system

Italian groups (M. Piccolo etal)

- Investigate the use of RPC for large area muon detectors

Probably not one of the high priority items,
but should not be forgotten.

Expect some results in addition to the dedicated muon system
also from the CALICE test beam effort: tail catcher

# Software

While not a traditional area of detector R&D:

Software plays an increasingly important role in the optimization of the detectors.

Need a serious effort to provide a usable computing and analysis environment for

- MC studies
- test beam efforts/ analysis
- algorithm development
- particle flow algorithm development

Software: data acquisition tools? Does it make sense to provide some central tools / systems/ help for DAQ for test beam efforts?

# Funding

Warning: my personal view!

Very difficult to provide a funding profile for ongoing or planned detector R&D

EUDET: Initiative to support a detector R&D infrastructure in Europe, open to everyone in the community:

This will inject some 7MEUR "new" money into the community between 2006 and 2010.

Naive needs: some 10-20% of detector cost:

might mean around 50-100 MEUR over the full period worldwide.
Is this realistic?

# Summary

LDC is well embedded into the existing detector R&D "collaborations"

Most relevant questions are being investigated by the R&D collaborations

For the optimization of LDC it is extremely important to
obtain as quickly as possible good results from the R&D collaborations

Areas of improvement:

continue to deepen ties between R&D efforts
in Europe, the US and in Asia

To keep the efforts on track, an independent review body is very important