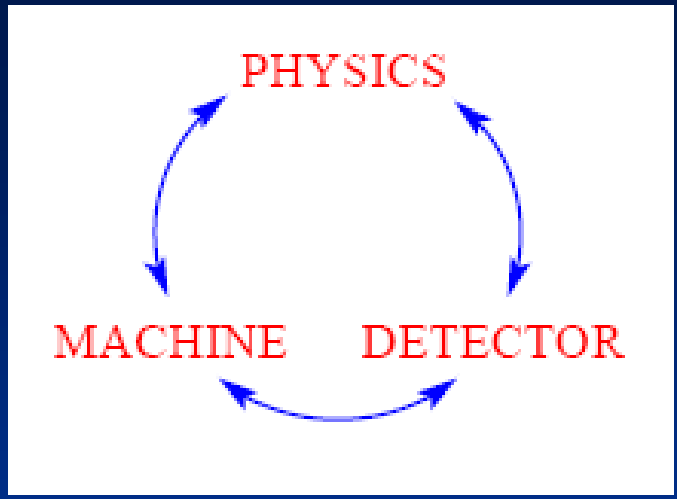
ILC Detectors and



Detector View of MDI

NANOBEAM'08

Advanced Beam Dynamics Workshop NANOBEAM-2008

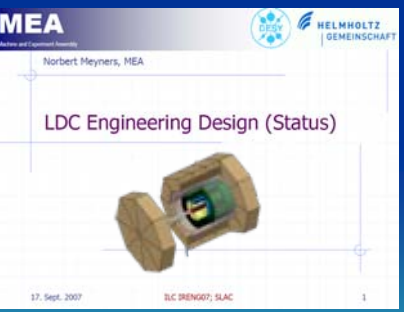
May 25-30, 2008, Budker INP, Novosibirsk, Russia

Worldwide Study of the Physics and Detectors for Future Linear e^+e^- Colliders

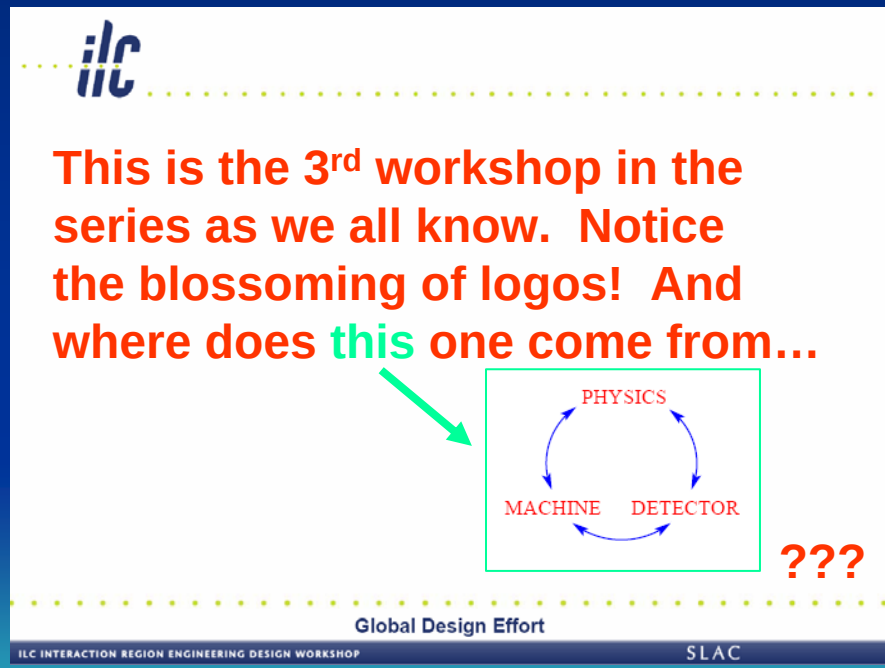
Max-Planck-Institut für Physik
(Werner-Heisenberg-Institut)


NANOBEAM 2002
26th Advanced ICFA Beam Dynamics Workshop on Nanometre Size Colliding Beams
September 2-6, 2002, Lausanne, Switzerland
E-mail: nanobeam@cern.ch
http://www.cern.ch/nanobeam


NANOBEAM 2005
36th ICFA Advanced Beam Dynamics Workshop
October 17-21, 2005
Uji Campus, Kyoto University
(Courtesy of Byodoin / English information)
The symmetric building is reflected by the water to show the further symmetry. The building can be found also on the ten yen coin. The temple was registered in the UNESCO world heritage list in December 1994. "Byodo" can be translated as "equality" or "impartiality", which means that the Budda's help goes out to all beings equally.
The workshop is hosted by
Institute for Chemical Research, Kyoto University,
High Energy Accelerator Research Organization(KEK) and
Yukawa Institute for Theoretical Physics.
The workshop is sponsored by
Center for Diversity and Universality in Physics(CDUP) and


MEA
HELMHOLTZ GEMEINSCHAFT
Norbert Meyners, MEA
LDC Engineering Design (Status)
17. Sept. 2007
ILC IRENG07; SLAC
1


Center for Diversity and Universality in Physics
ICFA


This is the 3rd workshop in the series as we all know. Notice the blossoming of logos! And where does this one come from…
PHYSICS
MACHINE
DETECTOR
???
Global Design Effort
ILC INTERACTION REGION ENGINEERING DESIGN WORKSHOP
SLAC

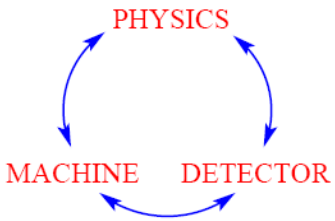
It started at the LC92,LC93 workshops in Garmisch-Partenkirchen,SLAC to emphasize the correlation between the three, and ended up in a contribution to Nanobeam02…

INTERACTION-REGION ISSUES

Ron Settles*, Max-Planck-Institut für Physik, 80805 Munich, Germany

Abstract

The jobs at hand concern everybody in the LC business. Establishing and controlling the e^+e^- luminosity at a level



of $10^{34}\,cm^{-2}s^{-1}$ in the interaction region (IR), i.e., from the final quadrupoles to the interaction point (IP), will require a sophisicated interplay of several technologies dealing with gymnastics on nanometer-sized colliding beams. An overview of the issues is given in this contribution to Session[4] of the Nanobeam Workshop[1]-[9].

…and I shall follow the circle clockwise for this talk:

0-Machine…

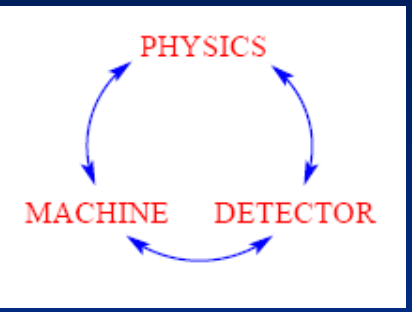
1-Physics…

2-Detector…

3-MDI…

In addition to my own, I have borrowed some slides from several colleagues for this talk, to give a better feel for the activities…Thanks to them!

Now to the detector. We want:



Physics → Detector Goals

- vertexing
  e.g. $t\bar{t}$
  $\delta(\mathrm{IP}_{\phi,z}) \lesssim 5\mu\mathrm{m} \oplus \frac{10\mu\mathrm{m}\mathrm{GeV}/c}{\mathrm{p}\sin^{3/2}\theta}$
- tracking
  e.g. Higgs
  $\delta(1/\mathrm{p_t}) \lesssim$ Now 2x10-5/(GeV/c)
- fwd. dirn
  e.g. lumi, t–ch.phys.
  $\delta(1/\mathrm{p_t}) \lesssim 3 \times 10^4 \mathrm{GeV/c}^{-1}$,
  $\delta(\theta) \lesssim 2 \times 10^{-5}, \cos\theta \lesssim 0.99$
- jet energy
  from Particle Flow
  $\delta(\mathrm{E/E}) \lesssim$ Now 0.25/√E @ Zpeak
- hermeticity
  for $\not{E}$ meas.
  $\sim$ 5 – 10 mrad for beampipe, only hole
- backgrounds
  robustness
  min. material inside Ecal, $\vec{\mathrm{B}} \gtrsim$ 3T, granularity

R & D, prototyping to shoot for these goals

Andrei Seryi at IRENG07 : Detector - machine interfaces

- The two complementary detectors for ILC IR may have different design, sizes, etc.
- Differences of their interfaces to the machine should be understood, and if possible, unified

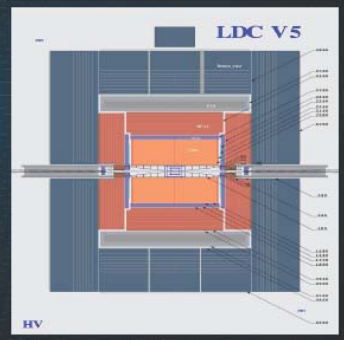
Borrowed from Henri Videau at a CLIC workshop; we are discussing with them about the detector (ILC has done a lot of work on the detector)…

25

LDC

A large detector with
1.6 m tracker radius and 4T
12.4m x 12m

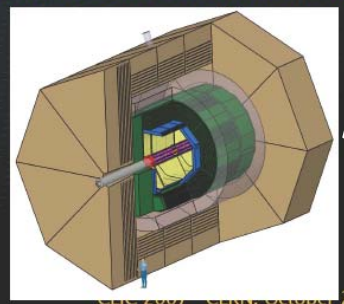
A TPC for tracker



with an eight-fold symmetry in ϕ

A highly granular W-Si 25 mm² 80M ch
electro-magnetic calorimeter
and hadronic calorimeter read
analogically 9cm² or digitally 1cm²
in iron or brass

A HCAL in the very forward

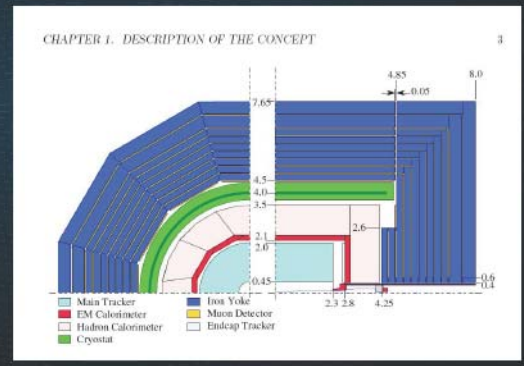


Henri Videau LLR-École polytechnique

CLIC 2007 CERN, October 2007

24

GLD



The largest detector with a 2m tracker radius and a 3T field
16m x 15.3m

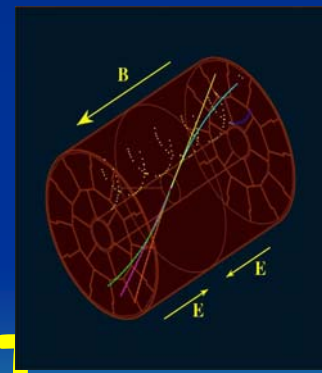
The innermost detectors are similar in the different concepts
but for the inner radius of the Vdet dictated by the field

A TPC for tracker

A large yoke to provide an adequate B field in the TPC
and a small stray field at the level of the quads.
A granular calorimetry in scintillator by fear of the silicon cost
fo[illegible]h a size W then Pb for 5.7 λ

Henri [illegible] LLR-École polytechnique

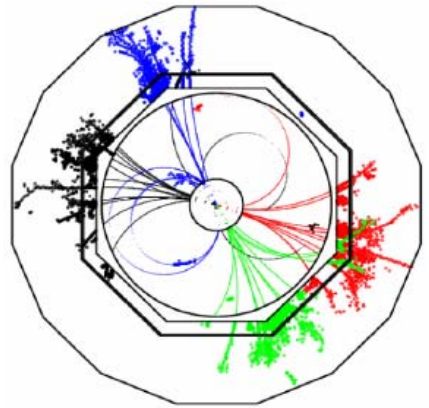
CLIC 2007 CERN, October 2007



Joined to 'ILD' for LOI

P-flow performance today

from Mark Thompson, CALICE-UK, Cambridge



several algorithms are being developed
today best performing:
PandoraPFA (M. Thompson)

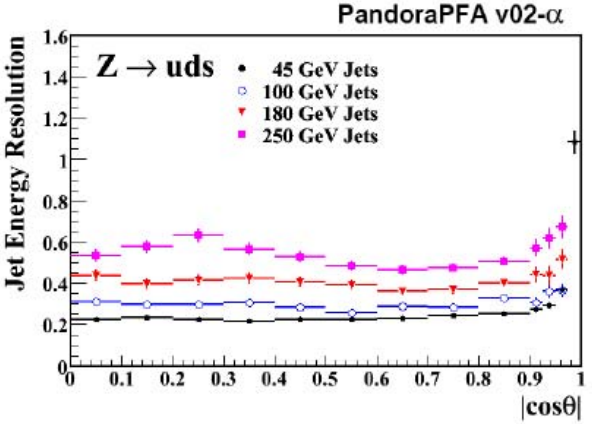
PandoraPFA v02-α

E_{JET}	$\sigma_E/E = \alpha/\sqrt{E_{jj}}$ $\lvert\cos\theta\rvert<0.7$	σ_E/E_j
45 GeV	0.227	3.4 %
100 GeV	0.287	2.9 %
180 GeV	0.395	2.9 %
250 GeV	0.532	3.4 %

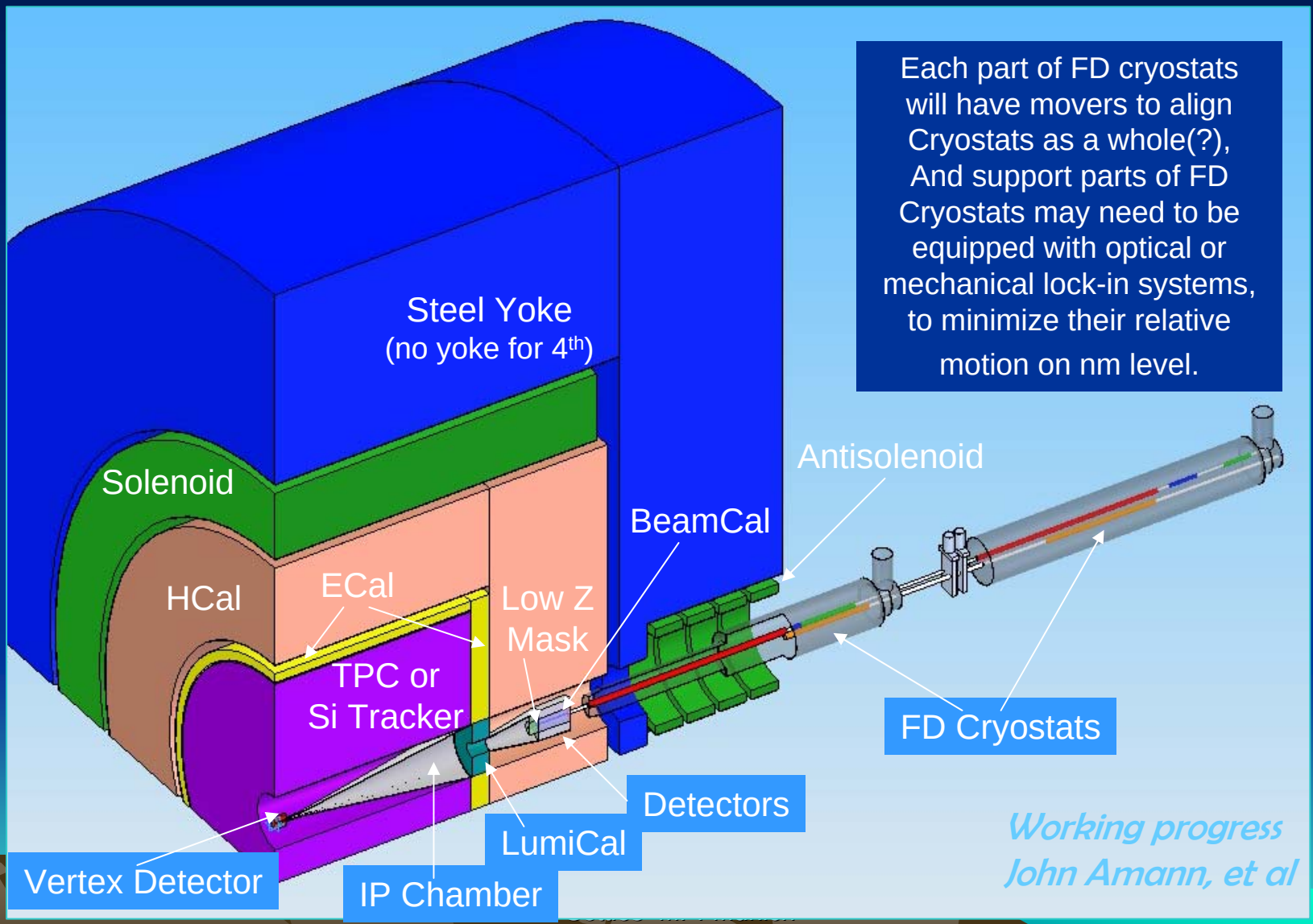
★ For 45 GeV jets, performance now equivalent to

23 % / √E

energy range > 100 GeV still problematic
but … work in progress !



For CLIC: separation of particles within a jet difficult due to high density
P-flow can work for separations of jets


Each part of FD cryostats will have movers to align Cryostats as a whole(?), And support parts of FD Cryostats may need to be equipped with optical or mechanical lock-in systems, to minimize their relative motion on nm level.
Steel Yoke
(no yoke for 4th)
Solenoid
HCal
ECal
TPC or
Si Tracker
Low Z
Mask
BeamCal
Antisolenoid
FD Cryostats
Detectors
LumiCal
IP Chamber
Vertex Detector
Working progress
John Amann, et al

Combination of detector and machine elements."Detector view of MDI"? Nanobeam02 paper…

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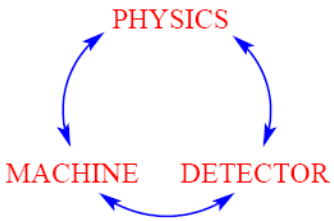

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Many very correlated tasks!!

1 INTRODUCTION

One way to break down the tasks at the IR is to categorize them according to: **V**ibration, beam **O**ptics, **I**nstrumentation, **B**ackgrounds/masking and **E**ngineering, as illustrated in Fig.1. The tasks are highly correlated as evidenced by the repetition in the descriptions below.

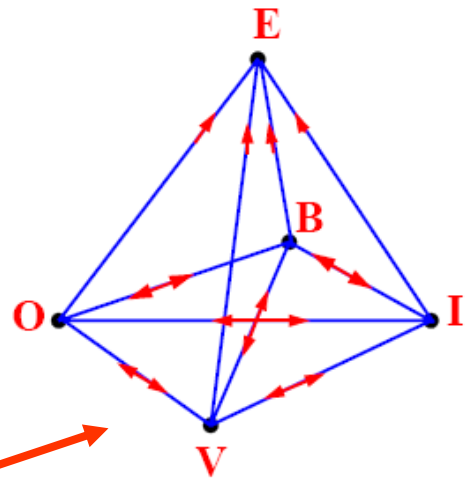

Figure 1:

A detailed account of the LC technological status, including topics in this paper, has been prepared by the International Linear Collider Technical Review Committee (ILCTRC) chaired by Greg Loew[8].

Combining MDI/Integration makes a lot of sense, as the IRENG07 workshop, the ILD task list and Andrei's/Toshiaki's lists today show, maybe something like:

- Vibration—det&hall design to avoid unwanted (μm-mm!) vibrations
- Optics—machine, BDS design/layout (details in Andrei's and Toshiaki's talks today)
- Instrumentation/diagnostics—fast feedback,beamcal e.g.
- Background—beam induced bgrd,inner detector design
- Engineering—
  - Detector design/integration
  - MDI magnets (antiDID)
  - IR hall/push-pull design (Andrei's talk today)
  - Shielding
  - Etc…

No Conclusion

- Many correlated/challenging issues
- Nevertheless progress by our excellent and highly motivated machine physicists is evolving well
- Iterating on engineering designs
- W.I.P., 'interface' (='integration'?) document April 2009 will be very significant (will it give 'Master Lists'?)