Charge to the Workshop

Hitoshi Yamamoto

March 18, LCWS2005. Stanford

LCWS History

(Organized by WWS)

1. **Saariselka, Finland** - September 9 - 14, 1991
2. **Hawaii, USA** - April 26 - 30, 1993
3. **Morioka, Japan** - September 8 - 12, 1995
4. **Sitges, Spain** - April 28 - May 5, 1999
5. **Fermilab, USA** - October 24-28, 2000
6. **Jeju Island, Korea** - August 26-30, 2002
7. **Paris, France** - April 19-23, 2004
8. **Stanford, USA** - March 17-23, 2005

International activities on LC physics/detector are intensifying :

Every 2yrs → Every 1.5 yrs → Every <1 yr

LC Workshops Near Future

Including regional meetings

- ACFA 8, DaeGu, Korea, Jul 11-14/2005
- Snowmass (ALCPG with WWS), Aug 14-27/2005
  ~2 weeks working meeting.
  Held together with the ILC workshop.
- ECFA, Vienna, Nov 14-17/2005
- LCWS 2006, India, Feb~Mar/2006

ILC Parameters

"Scope document"
(http://www.fnal.gov/directorate/icfa/LC_parameters.pdf)

- **1st stage**
  - Energy 200→500 GeV, scannable
  - 500 fb^{-1} in first 4 years
    with option of x2 lum. in additional 2 years
- **2nd stage**
  - Energy upgrade to ~1TeV
  - ~1000 fb^{-1} in 3-4 years
- **Options**
  - $\gamma\gamma$, γe^-, e^-e^-, Giga-Z
- **2 IRs for 2 experiments**

- **Operating simultaneously with LHC**
  (to start ~2015 : not in the scope document)

International Consensus...

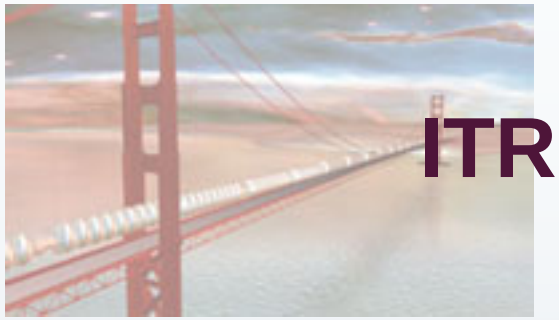
- Up to 2002, ACFA, ECFA, HEPAP reached the common conclusion that the next accelerator should be an electron-positron linear collider with an initial energy of 500 GeV, running in parallel with LHC, and later upgradeable to higher energies.
- 2003/11, US DOE Office of Science Future Facilities Plan: LC is first priority mid-term new facility for all US Office of Science
- 2004/1, ACFA, ECFA, HEPAP chairs reaffirmed their community's priorities for a 500 GeV linear collider operated in parallel with the LHC
- 2004/1, OECD Science Ministerial Statement endorsed the plan for global collaborative development of a linear collider.
- 2004/2, ICFA reaffirmed that the highest priority for a new machine for particle physics is a linear electron-positron collider with an initial energy of 500 GeV, extendible up to about 1 TeV, with a significant period of concurrent running with the LHC

...is overwhelming

Important development past year

ITRP
(International Technology Recommendation Panel)
Chair : Barry Barish

Set out to recomend LC technology between “warm” and “cold”.
After 6 months of intensive work...



ITRP Executive Summary

(excerpts)

Aug 19, 2004

- **We recommend that LC be based on super-conducting RF technology.**
  - ... we are recommending a technology not a design. We expect that the final design be developed by a team drawn from the combined warm and cold linear collider communities...

- **A remark:**
  - A TeV scale electron-positron collider is an essential part of a grand adventure that will provide new insights into the structure of space, time, matter, and energy. We believe that the technology for achieving this is now in hand, and that the prospects for its success are extraordinarily bright.

Things are now starting to roll...

- The name is officially decided to be **ILC** (International Linear Collider)

- **GDE** (Global Design Effort) - the first stage of **GDI** (Global Design Initiative) - is being formed (see following talks)

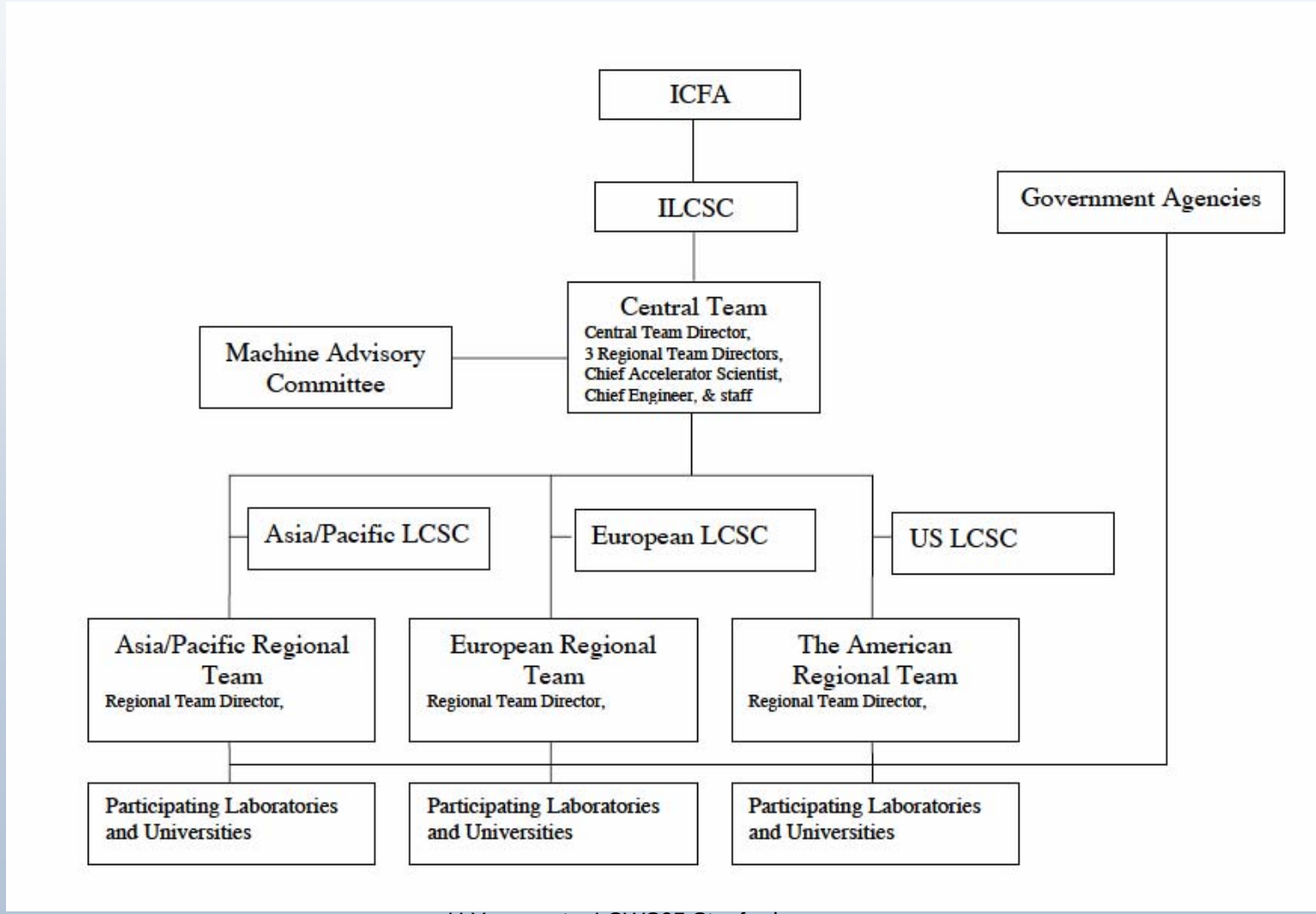
  • First ILC workshop : Nov 13-15 2004, KEK.

  • Second ILC workshop at Snowmass, Aug 2005.

The choice is fully supported by the whole LC community.

Demonstrates the ability of our community to unite behind an important project.

Proposed GDE structure
(to be confirmed by the central team director)



Tasks for LC Physics/Detector Studies

- **Inputs to Machine Design (GDE)**
  - Options ($\gamma\gamma$, γe^-, e^-e^-, Giga-Z...) (K. Hagiwara)
  - Number of IRs : A task force being formed
  - MDI issues including : (T. Tauchi)
    - Crossing angle
    - Constraints from detector designs
- **Design and Build Detectors**
  - Establish detector concepts (T. Behnke)
  - Perform necessary R&Ds (W. Lohman)
  - Study physics/detector bench marks (T. Barklow, M. Battaglia)
- **Sharpen LC Physics Cases**
  - New Physics Models (S. Dimopolous)
  - LHC and LC (G. Weiglein)
  - Cosmology and LC (J. Feng)
  - Outreach (K. Buesser)

( ) : plenary talks this workshop.

WWS (WorldWide Study on Physics and Detectors for Future Linear Colliders)

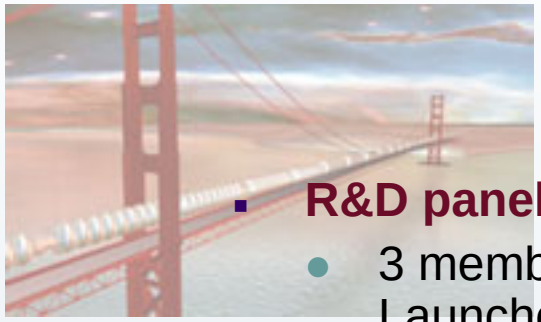
Organizes/coordinates international activities on LC Physics/Detector Studies, in particular (as endorsed by ICFA/ILCSC in summer 2004),

- Recognize and coordinate studies on whole detector concepts, and work toward interregional detector TDRs.
- Interface with GDI (Global Design Initiative), especially on MDI (Machine Detector Interface) issues.
- Keep a register of R&Ds relevant to LC experimental programs, identify those that are vital or missing, and ensure peer review of R&D proposals.
- Organize interregional meetings and workshops.
- Report to ILCSC and ICFA on the matters above.

Detector Timeline by WWS

Timed to machine benchmarks

(2004) ITRP tech. recommendation	Set up 3 panels (detector R&D, MDI, and costing)
(2005) Accelerator CDR	~ spring 2006, “Detector outline documents” submitted to WWS by concept teams
(2007) Accelerator TDR	WWS receives a detector CDR from each concept team
(2008) LC site selection	Collaborations form and submit LOIs for proposal to the global lab
Site selection + 1yr	Global lab selects experiments.



- **R&D panel**
  - 3 members from each region, balanced over expertice. Launched at this workshop.
    - C. Damerell, J.-C. Brient, W. Lohmann
    - H.J. Kim, T. Takeshita, Y. Sugimoto
    - D. Peterson, R. Frey, H. Weerts
  - Register the detector R&Ds (incl. MDI)
  - Evaluate them wrt detector concepts (document it ~Aug 2005)
  - Coordinate with regional review processes

- **MDI panel**
  - Liase with machine efforts (i.e. GDE)
  - Existing LCWS/WWS leadership of MDI acts as this panel for now

    (P. Bambade, T. Tauchi , M. Woods)

- **Costing panel**
  - To be formed in time for serious work by this summer

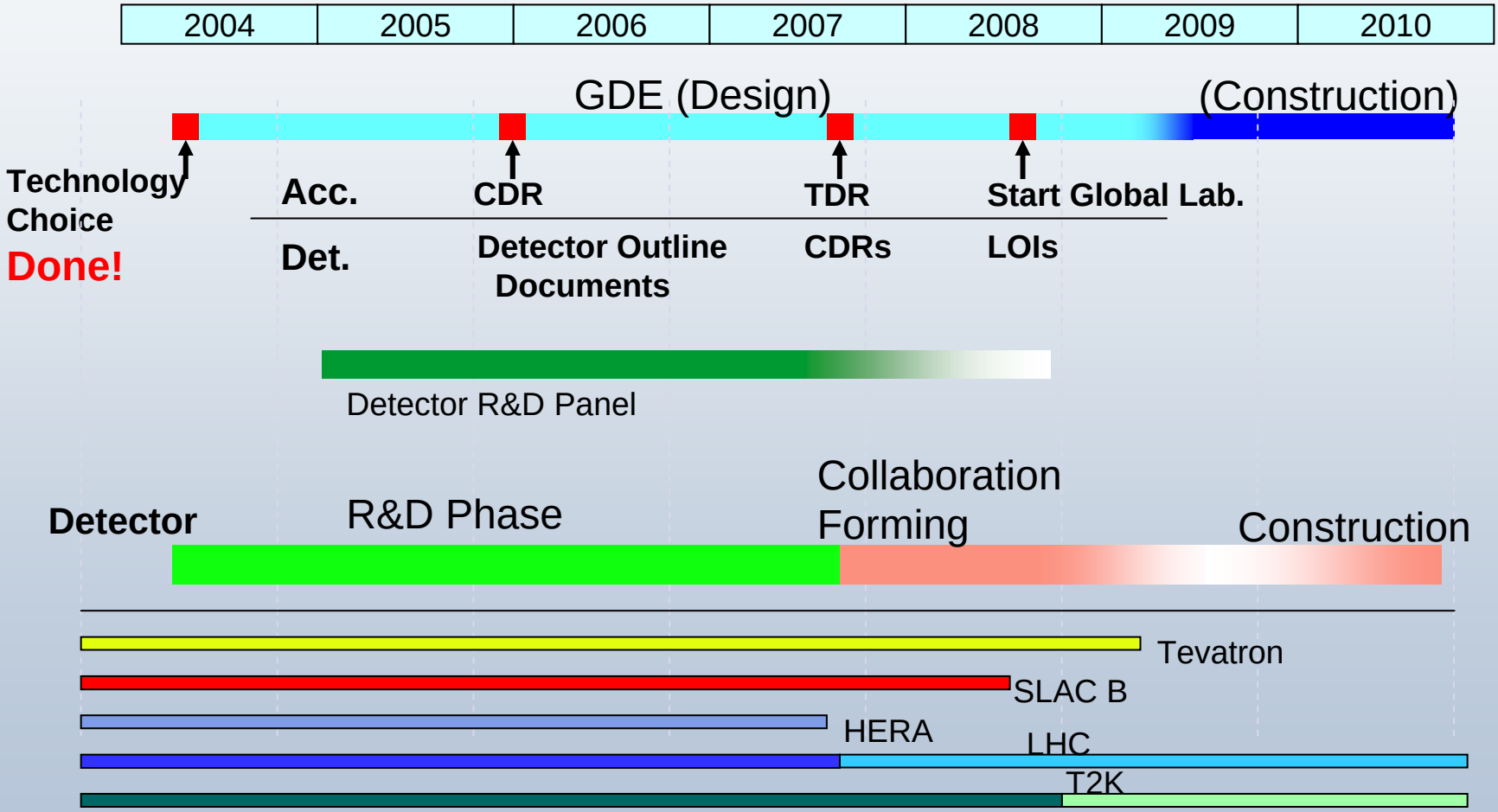
Detector Outline Documents

- To be completed in Spring 2006 by each detector concept team, and submitted to WWS.

- Contents
  - Description of the detector concept
  - Performance estimates wrt physics benchmarks
  - Required R&Ds and their status
  - Rough costing estimate

- Real detector CDR not far away (in 2 years)

Milestones of ILC (by sugimoto)



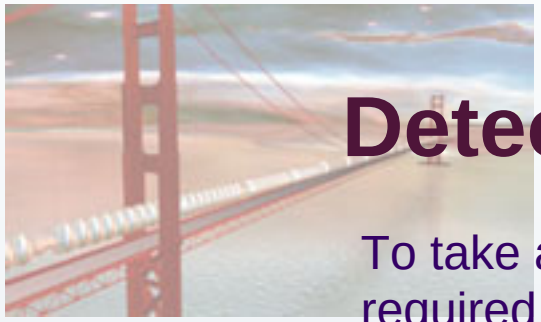
LC Physics

Precision and sensitivity

- **Just one example of LC physics:**
  - 5σ discovery of SM Higgs
    - 1 year LHC = 1 day LC
    - LC can discover Higgs-like particle even if rate is 1/100 of SM.

- **Power of precision/sensitivity:**
  - WMAP→dark matter/energy
  - Precision measurements on Z→ # ν,Higgs mass...
  - Direct/indirect CPV in B decays by B factories
  - ....

- LC is a precision machine
- LC is a high-sensitivity machine
- **LC is a discovery machine**



Detector Performance Goals

To take advantage of LC, high detector performances are required (not luxuries) - and possible in LC environment

- **Vertexing,** b,c tags, ... (coloq. by C. Damerell))
  - 1/5 $r_{beampipe}$,1/30 pixel size wrt LHC :

$$\sigma_{ip} = 5\mu m \oplus 10\mu m / p \sin^{3/2}\theta$$

- **Tracking,** tagged Higgs ...
  - 1/6 material, 1/10 resolution wrt LHC :

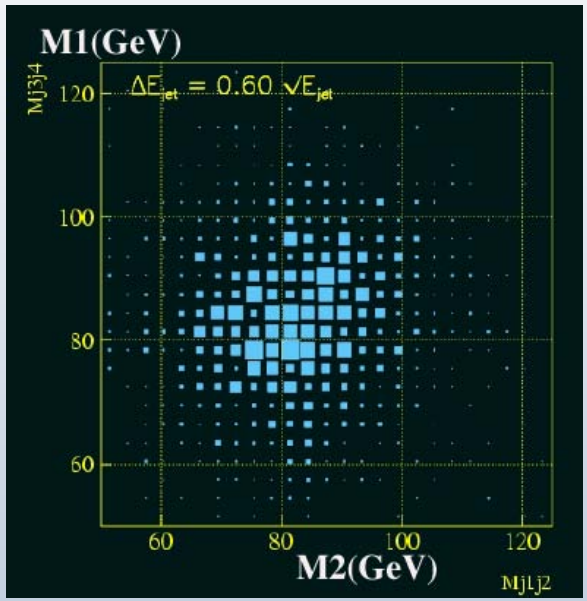
$$\sigma(1/p) = 5 \times 10^{-5} / \mathrm{GeV}$$

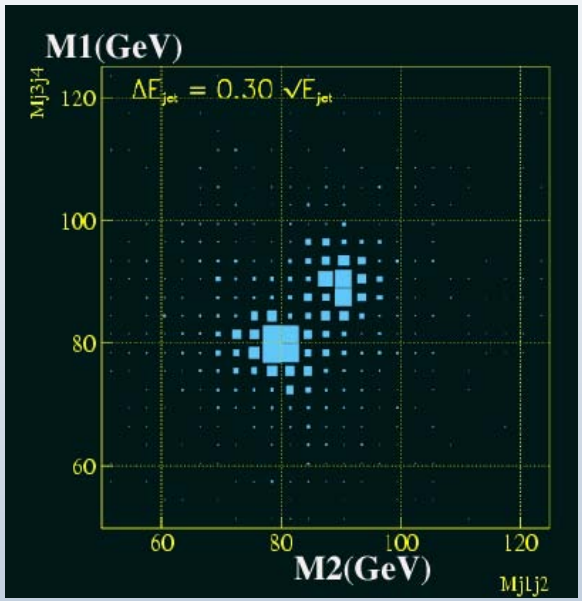
- **Jet energy** (quark recon.) W,Z rec./separation...
  - PFA→1/2 resolution wrt LHC :

$$\sigma_E / E = 0.3 / \sqrt{E(\mathrm{GeV})}$$

e.g. Jet(quark) reconstruction

$$e^+e^- \to \nu\bar{\nu}WW, \nu\bar{\nu}ZZ \qquad W/Z \to jj$$





$$\sigma_E/E = 0.6/\sqrt{E(\mathrm{GeV})} \qquad \sigma_E/E = 0.3/\sqrt{E(\mathrm{GeV})}$$

- With $\sigma_E/E = 0.3/\sqrt{E}$, Z/W→jj can be reconstructed and separated

Detector Concept Studies

- SiD
  - Silicon tracker, 5T field
  - SiW ECAL
  - 4 ‘coordinators’:

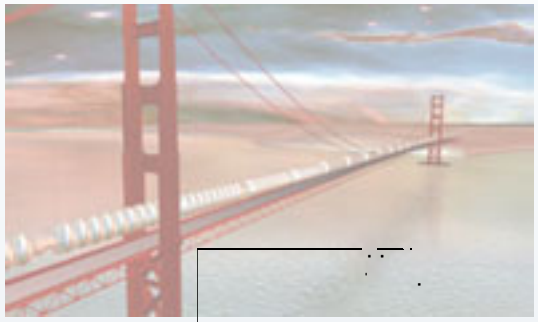
    J. Jaros, H. Weerts, H. Aihara, Y. Karyotakis

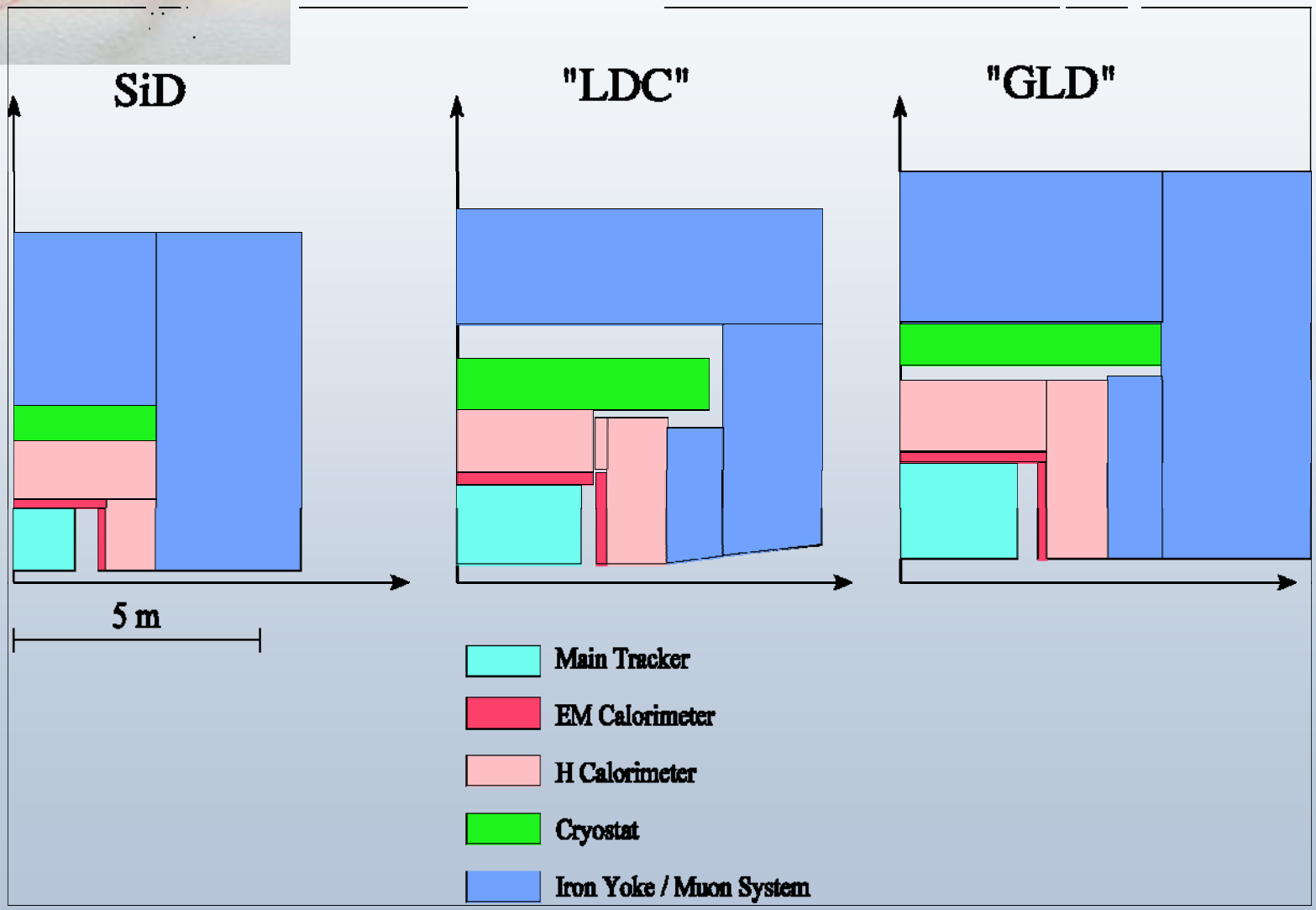
- “LDC”
  - TPC, 4T field
  - SiW ECAL (“medium” radius)
  - 6 ‘contact persons’:

    T. Behnke, H. Videau, D. Karlen, M. Battaglia + 2 from Asia being selected.

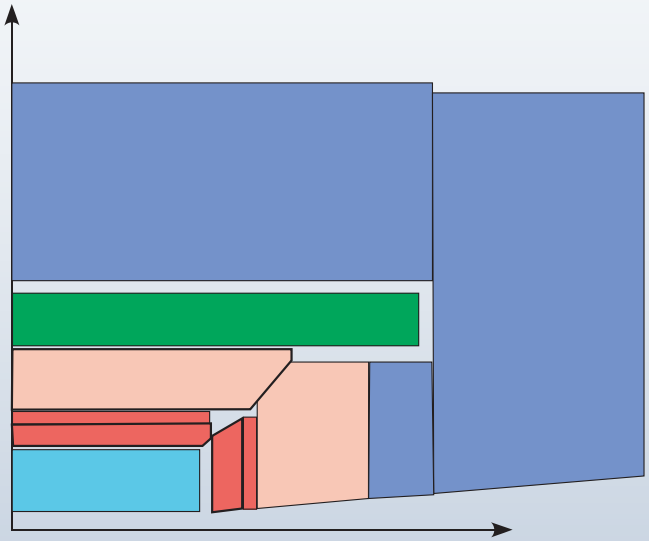
- “GLD”
  - TPC, 3T field
  - W/Scintillator ECAL (“large” radius)
  - 6 ‘contact persons’:

    H.B. Park, H. Yamamoto+ 4 from Americas/Europe being selected.

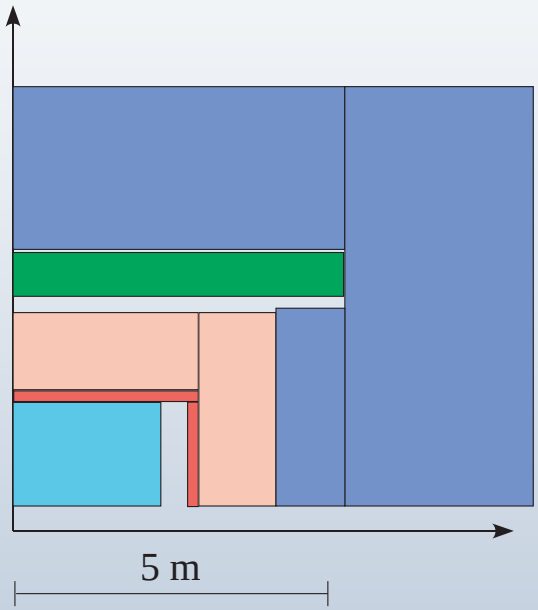



SiD
"LDC"
"GLD"
5 m
Main Tracker
EM Calorimeter
H Calorimeter
Cryostat
Iron Yoke / Muon System

CMS



GLD



Main Tracker

EM Calorimeter

H Calorimeter

Cryostat

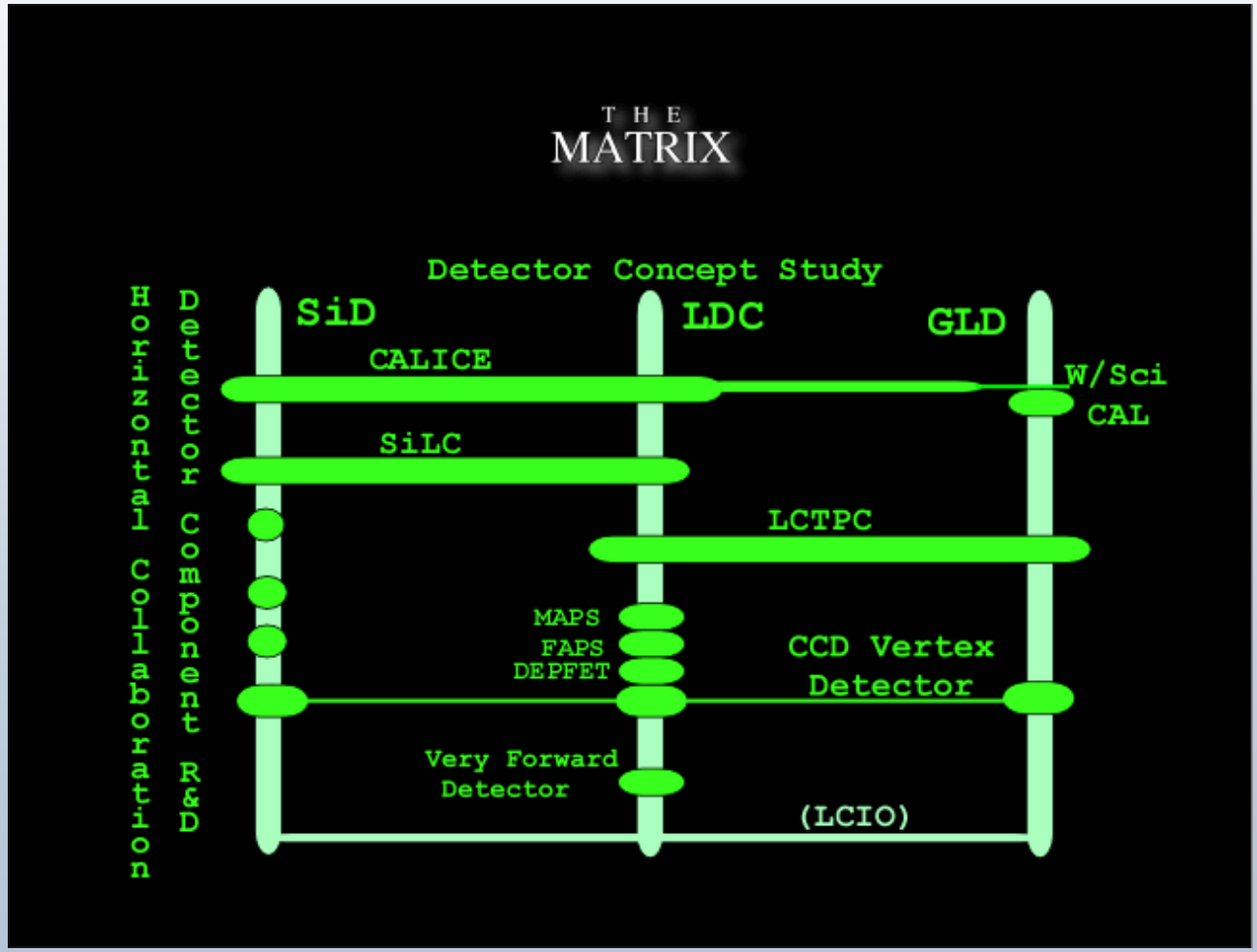
Iron Yoke / Muon System

LHC detectors are still larger

On Detector Concept Studies

- They are inclusive, not exclusive.
  - An individual can sign multiple concept studies.
- The parameters of 3 detector concepts are not final.
  - Optimization - bench marks
- New ideas for detector concepts not excluded
- Many studies are common to concept studies.
  - “Horizontal collaborations” on subdetectors are already strong and encouraged.
  - Simulation tools and bench mark studies also.

Horizontal and Vertical collaborations
It is something like this : (detail may not be accurate)



Summary and Charges

- After ILC technology decision, concrete detector design efforts are now starting worldwide

- ILC accelerator design needs inputs from physics/detector studies
  - Collision options, #IR, crossing angle, MDI issues...

- Never stop sharpening physics cases of LC
  - New physics, LHC/LC, cosmology, outreach

- Intensive R&D efforts needed for the next ~3 years
  - High detector performances are necessities (not luxuries)
  - Need to prove such detectors can be built at reasonable cost

- Next important benchmark is Snowmass Aug 05.
  - Need to start preparing now in order to maximize the outcome.
    (http://alcpg2005..colorado.edu : registration is now open)