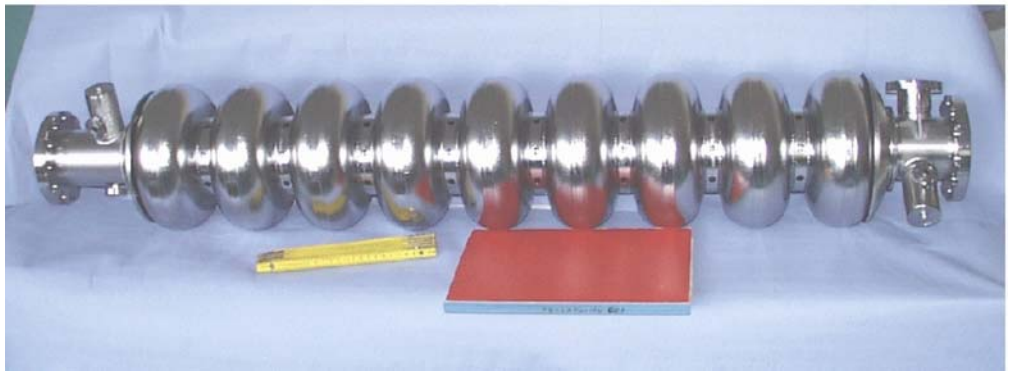
Which LC and Where

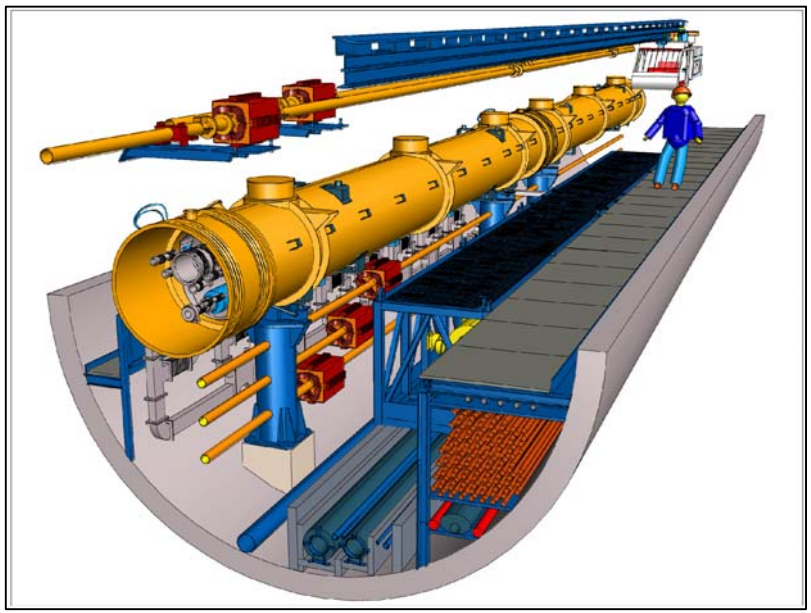
Ties Behnke, DESY Hamburg, Germany

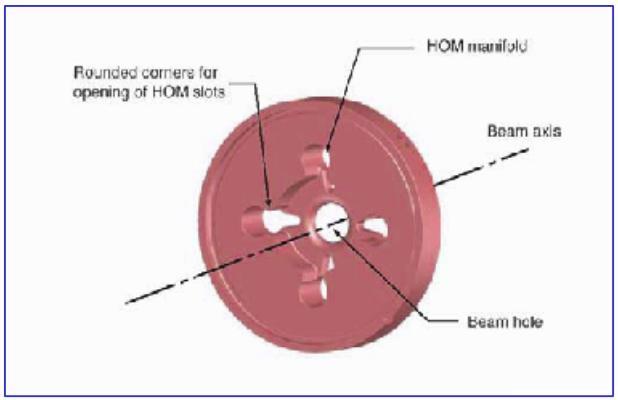
3.3.2004, La Thuile



- where are we
- what is Germany doing
- what is DESY doing

note: this is a personal view, be careful to over-interpret what I am saying. I am not a LAB director...



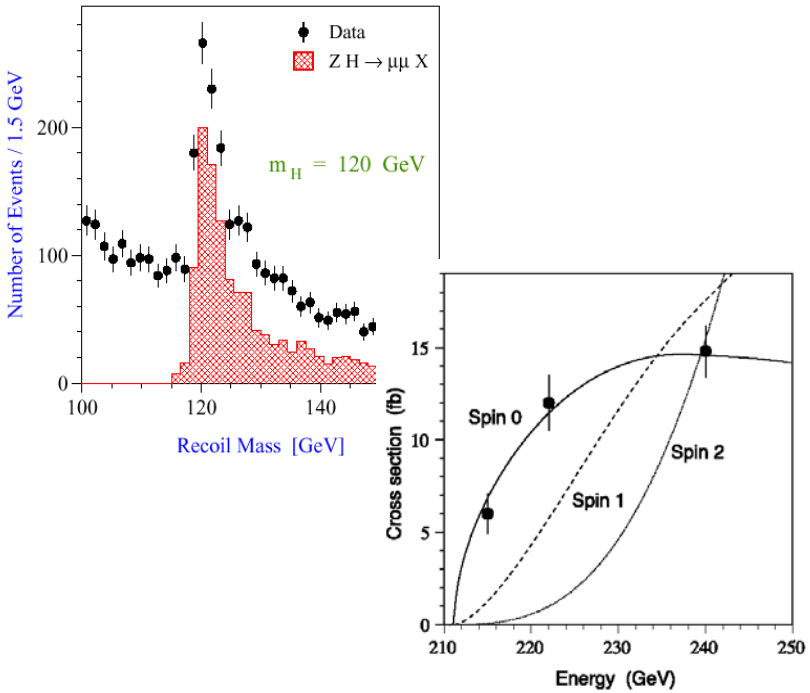


Microscopic - Telescopic

Physics at the Linear Collider:

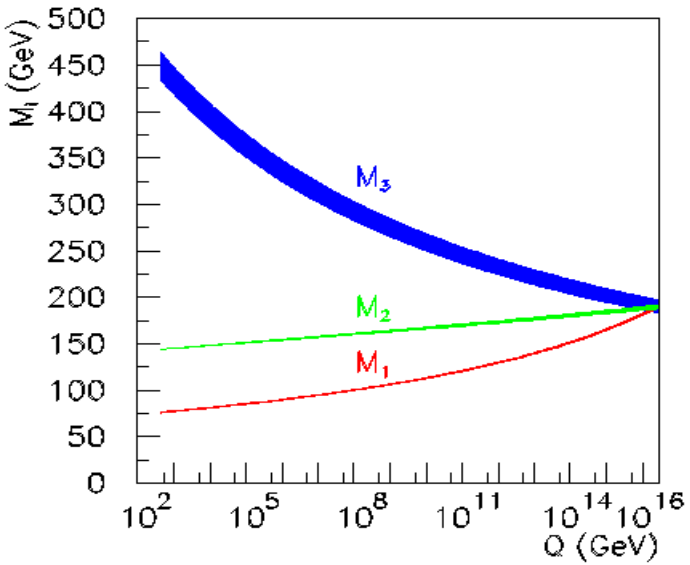
microscopic

study the detailed properties of new and known particles



telescopic

Study the known SM processes look for loop effects: experimental and theoretical precision needed



Experimentation at a LC

- Experimentation at an LC is not simple (some people still think it is...)

- Worldwide effort on detector and physics

  Cross regional R&D groups: CALICE (calorimetry), LCTPC, SILC, LCFI, ...

- Is experimentation different at cold or warm machines?

  Main difference probably is bunch distance: **1.4ns** at NLC, **337ns** at TESLA

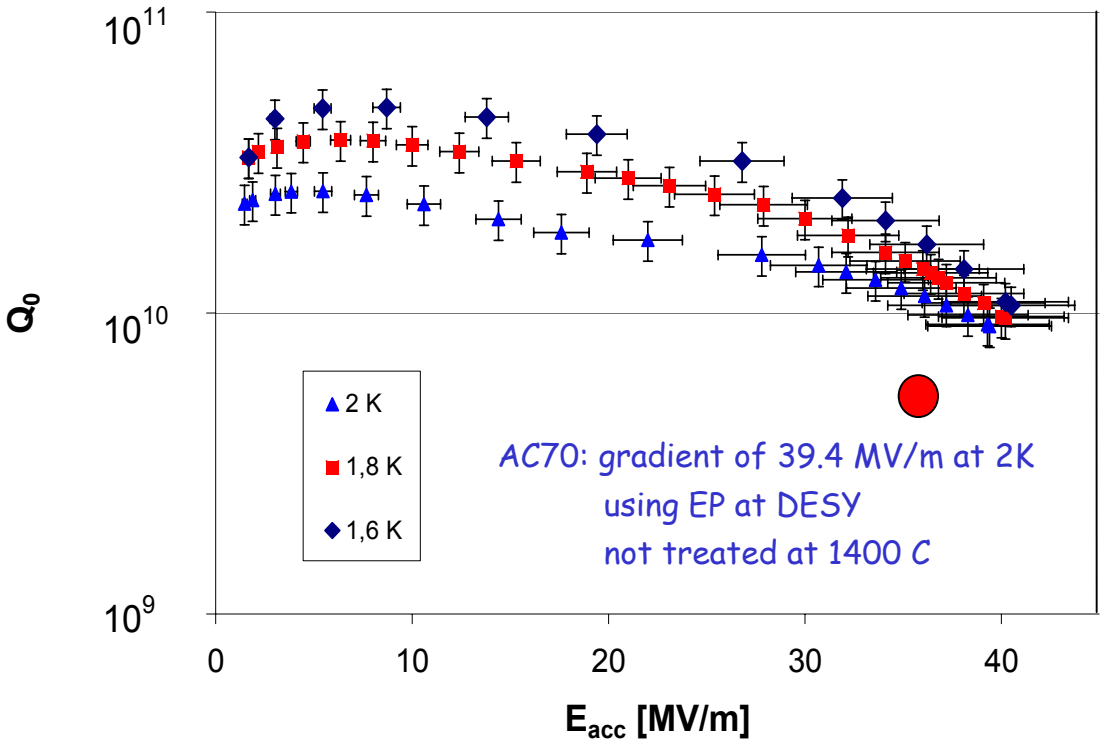
  Experimentation at warm is more challenging, but deemed possible.
  Quantitative conclusions are being worked on in close collaboration between the regions.

The cold (TESLA) technology

TESLA collaboration: international collaboration to advance the cold technology

During the last year(s): intense high gradient program to address TRC R1 question for TESLA(800)

Recently great progress towards 800 GeV operation of TESLA



Test of 1/8th of a TESLA cryomodule at 5 Hz, 500 μs fill, 800μs flat-top

->35 MV/m

with no interruption related to cavity-coupler-klystron for more than 1000 hours

No field emission

TESLA facility

TESLA TDR published in 2001: complete design of the facility

assuming location in Hamburg, Germany

- Detailed costing of components included, close collaboration with industry
- Detailed studies included on mass production etc of components (done with industry)
- Detailed engineering included for infrastructure etc.

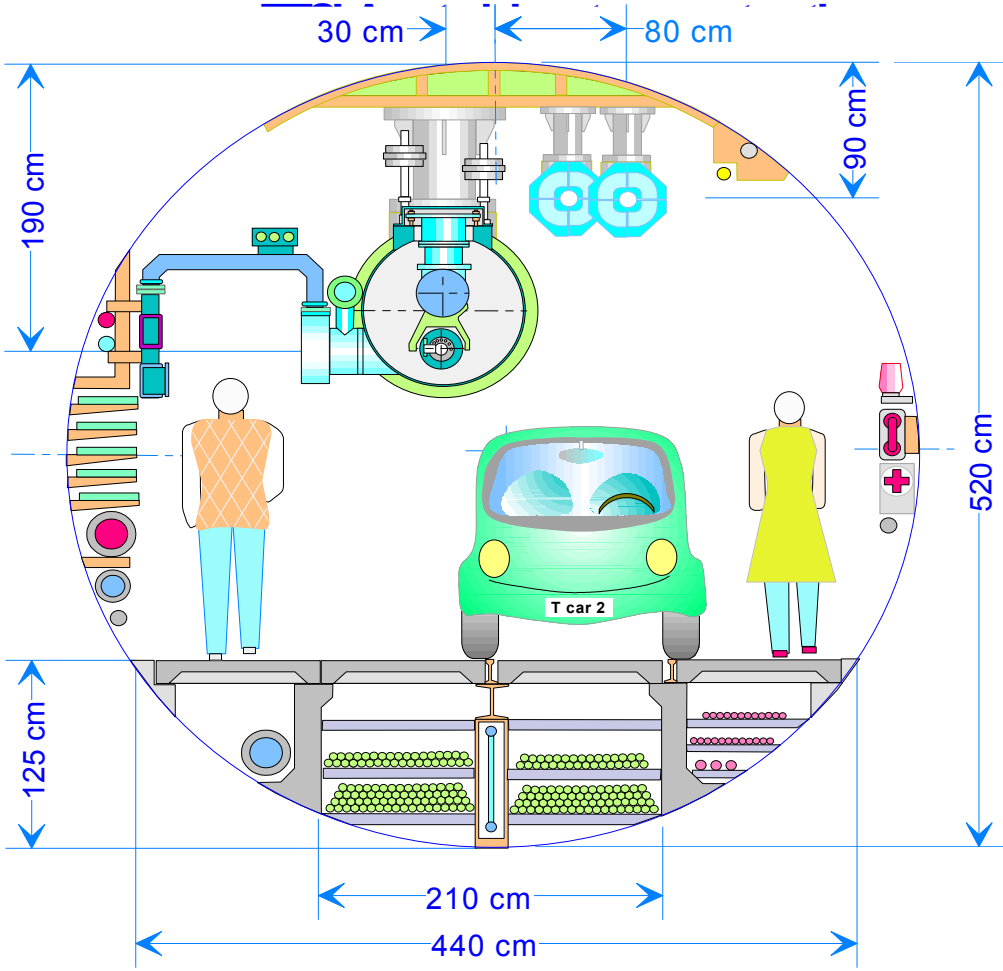


Figure 5. Fast access, use of small commercial vehicles

Germany and the LC

this is my personal view, and does not represent an official statement!

- past and present: DESY hosts the TESLA collaboration
- DESY plays a central role in the cold technology development
- Germany plays a strong role in detector and machine R&D

- statement by German education and science ministry:

"The (German) government is the first one to have announced to be principally committed to participating in the project."

Dr. Schunck, BMBF, EPS Aachen 2003

Cold Technology: the route

- TTF1: 100m cold test accelerator, **150 MeV** — **Run for many 10000 h**
- TTF2 (VUV-FEL): 200m long cold accelerator, **2 GeV** — **Commissioning in 2004**
- X-FEL: 3km long, TESLA technology, **20 GeV** — **Conditionally approved, start possibly 2010-2012?**

Series of very realistic tests for the cold technology, including long long term running and large scale fabrication: gain lots of confidence in the cold technology

Note of caution though: FEL's only test part of the LC, things like damping rings etc are not included.

DESY's "5 year plan"

DESY recently formulated and reviewed its scientific plans for 2005-2010

- exploit HERA with highest priority till 2007
- advance and prepare the linear collider

  "priorities" from R. Klanner, DESY research director:
  - linear collider is DESY's future project wherever it is built
  - we would prefer a cold machine
  - and it would be beautiful if it is in Hamburg

- In the next years Synchroton light research clearly wins
  in importance at DESY (FEL)
  but tremendous synergy if technology decision is cold!

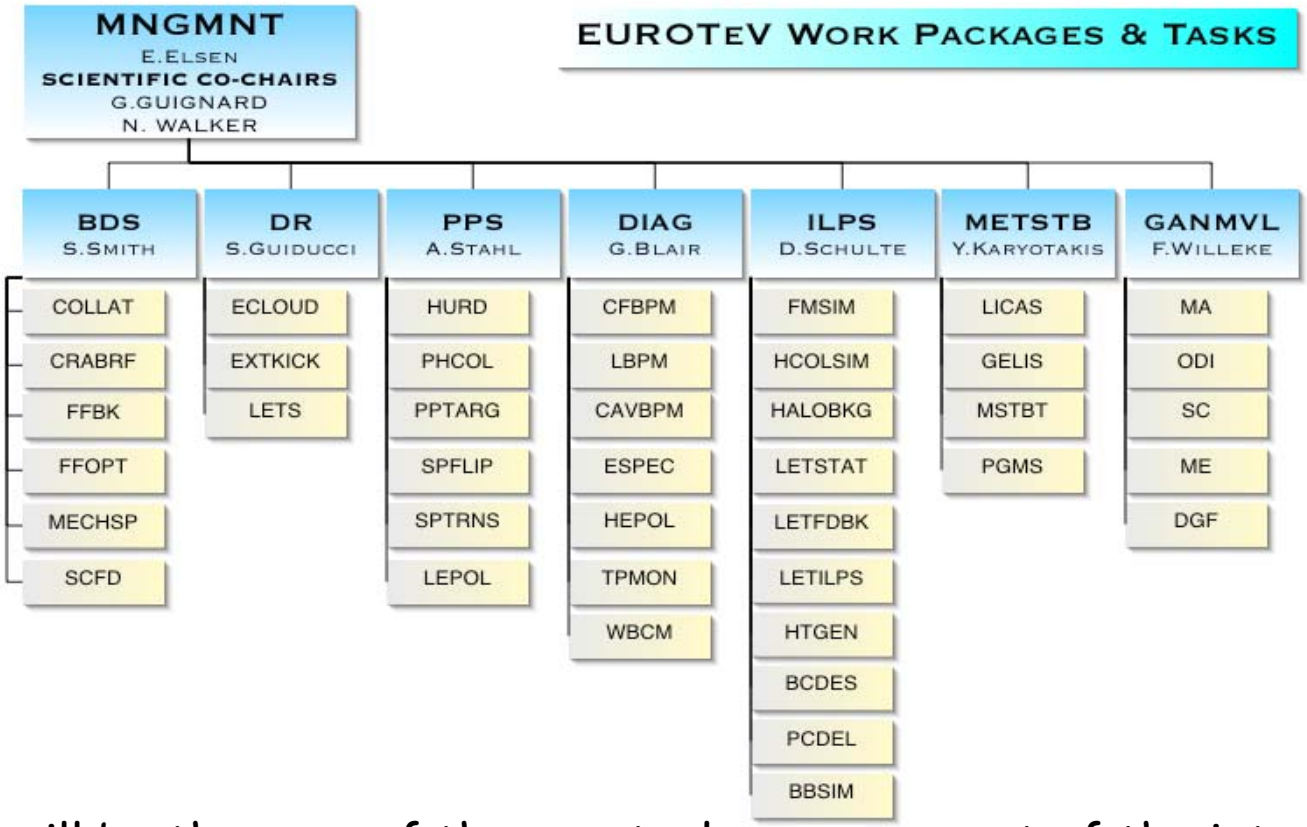
Program was evaluated in several steps by international advisory bodies

Program was strongly supported

EUROTeV: European Design Study

DESY participates strongly in EUROTeV

essential for preparation of WW design study after technology choice, EUROTeV is technology blind!



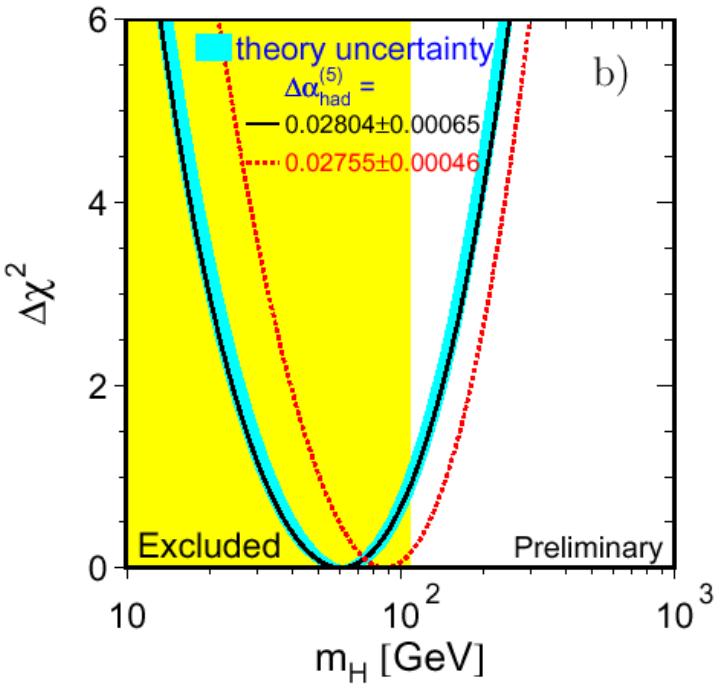
Eurotev: will be the core of the eventual european part of the international linear collider design study

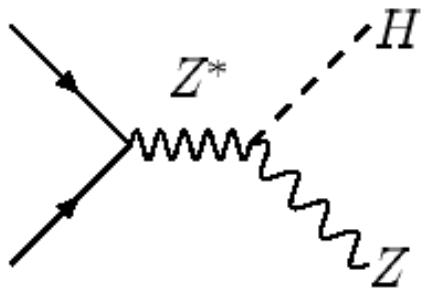
Summary of Situation

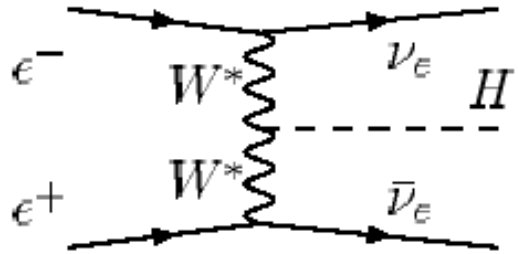
- World consensus: WE HAVE IT!
- The scientific case for the LC(500-1000) is strong. The complementarity with LHC is strong, as is the discovery potential of the LC by itself.
- Broad support exists in the community (workshops, working groups, YPP's, ...): must be maintained in the interests of the future
- The results from LHC and LC will tell us what the next energy scale beyond 1 TeV is going to be (CLIC, VLHC, ...???).
- Due to the long lead, construction and exploitation time, HEP needs to develop a "world strategy" for future accelerators.
- DESY is committed to the linear collider, independent of technology or site.
- The German government has explicitly stated its willingness to be a part of the international linear collider

Backup slides

Higgs: The key to mass





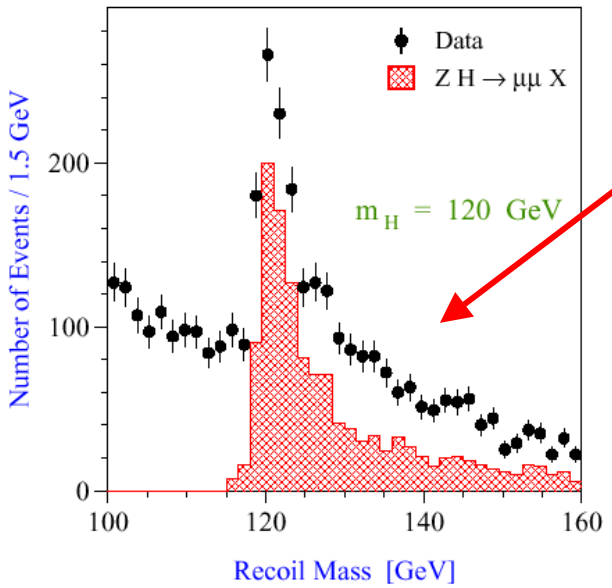


from precision tests of the SM we deduce:

114 < m(H) < ~200 GeV (95 % CL)

New input on m_{top} from Tevatron is important

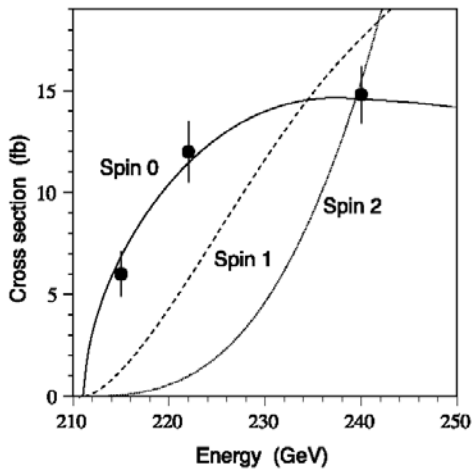
Detection independent of final state BRs



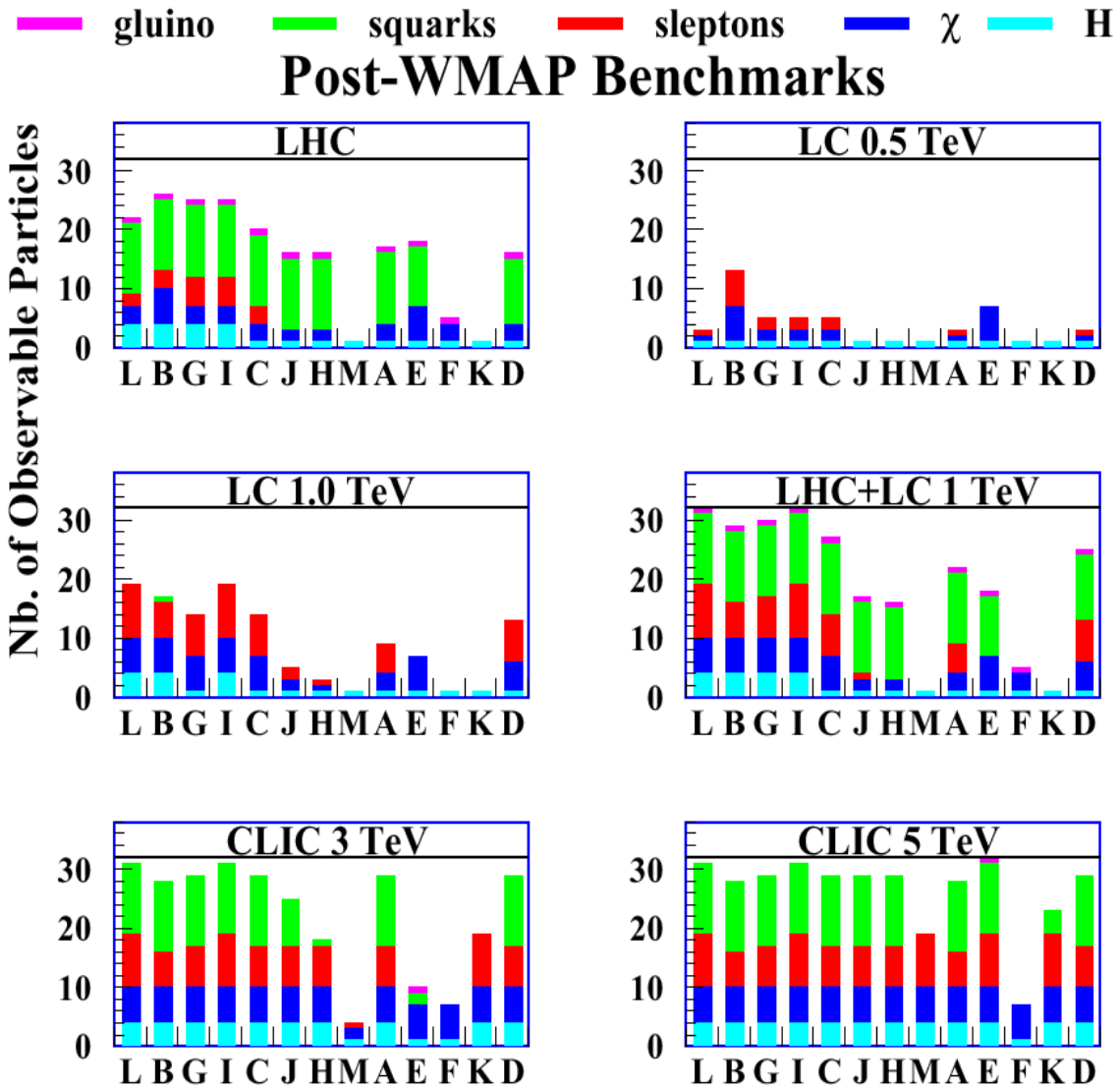
A Linear Collider measures:

- mass
- Spin, CP
- lifetime
- Couplings/branching ratios

= test the mechanism of mass generation



Discovery vs. Energy



"Numbers of MSSM particles detectable at various accelerators in benchmark scenarios.

Capabilities of the LHC and of LCs are largely complementary.

Mass and coupling measurements at LC usually much cleaner, more precise than at HC, where it is not known how to distinguish the light squark flavours."

Strategy: Events since 2001

- ACFA, ECFA, HEPAP scientific recommendations (2001)
- TESLA TDR (March 2001)
- Snowmass meeting (summer 2001)
- OECD Global Science Forum (2002 and ongoing)
- German Science Council recommendation (Nov 2002)
- JLC Road Map (Feb. 2003)
- German Government decision (Feb 2003)
- International Technical Review (2003)
- ICLSC and regional steering groups
- Discussion among funding agencies
- Discussion in CERN council on CERN's role in a LC
- WG's on organizational matters
- GAN workshop
- US 20 year outlook
- ...

The Electron Positron Linear Collider

Worldwide consensus: LC should be next big machine

Which machine ? ICFA LC parameter document (Heuer et al)

The baseline:

- $e^+ e^-$ LC operating from M_Z to 500 GeV, variable energy (threshold scans)
- polarized e^- (80 %)
- at least 500 fb^{-1} in the first 4 years
- upgradeable to ~ 1 TeV 500 fb^{-1} /year

a lot of flexibility!

Options :

- e^+ polarization (60%), transverse polarization
- GigaZ (high lumi running at M_Z)
- e-e-, □□ e□

2 viable technologies NLC/GLC (warm) and TESLA (cold)

Which detector ?