Status and Plans of TESLA

Where do we stand?

Where do we go?

Amsterdam, 1 April 2003

Albrecht Wagner

What has Happened since 2001?

- ACFA, ECFA, HEPAP scientific recommendations
- TESLA TDR in March 2001
- OECD Global Science Forum (2002 and continuing)
- JLC Road Map in February 2003
- International Technical Review (2003)
- ILCSG and regional steering groups
- German Science Council recommendations
- German Government decision
- Discussion among funding agencies
- Discussion in CERN Council about CERNs role in a LC
- WGs on organisational matters
- GAN workshops
- etc….

The Scientific Case

…will be reviewed during this workshop. The theme:

Understanding Matter, Energy, Space and Time :
The Case for the e^+e^- Linear Collider

A world-wide consensus has formed for a baseline LC project in which *positrons* collide with *electrons* at energies up to 500 GeV, with *luminosity* above 10^{34} $cm^{-2}s^{-1}$.

The energy should be upgradable to about 1 TeV.

Above this firm baseline, several options are envisioned whose priority will depend upon the nature of the discoveries made at the LHC and in the initial LC operation.

The Scientific Case

We know enough now to predict with great certainty that fundamental new understanding of how forces are related, and the way that mass is given to all particles, will be found with a linear collider operating at an energy of atleast 500 GeV.

We are confident that the new physics that we expect beyond the standard model will be illuminated by measurements at both the LHC and the LC, through an intimate interplay of results from the two accelerators.

The physics investigations envisioned at the LC are very broad and fundamental, and will require a leading edge program of research for many years.

The Goals of Particle Physics in the 21st Century
Ulitmate unification, hidden dimensions, cosmic connections
(US 20 year road map, March 2003)

Members of the TESLA Collaboration

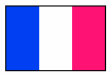
Yerevan Physics Institute, Yerevan

Institute for High Energy Physics (IHEP), Academia Sinica, Beijing

Tsinghua University, Beijing

Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas (CIEMAT), Madrid

Institute of Physics, Helsinki



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Hahn-Meitner Institut Berlin

Max-Born-Institut, Berlin

Technische Universität Berlin

Technische Universität Darmstadt

Technische Universität Dresden

Universität Frankfurt

GKSS-Forschungszentrum Geesthacht

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Universität Hamburg

Forschungszentrum Karlsruhe

Universität Rostock

Bergische Universität-GH Wuppertal

CCLRC-Daresbury and Rutherford Appleton Laboratory, Cheshire

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Istituto Nazionale di Fisica Nucleare (INFN), Rome II

Institute of Nuclear Physics, Cracow

University of Mining and Metallurgy, Cracow

Soltan Institute for Nuclear Studies, Otwock-Swierk

High Pressure Research Center, Polish Academy of Science, Warsaw

Institute of Physics, Polish Academy of Science, Warsaw

Polish Atomic Energy Agency, Warsaw

Faculty of Physics, University of Warsaw

Moscow Engineering and Physics Institute, Moscow

Budker Institute for Nuclear Physics (BINP), Novosibirsk

Budker Institute for Nuclear Physics (BINP), Protvino

Institute for High Energy Physics (IHEP), Protvino

Institute for Nuclear Research (INR) Russian Academy of Sciences, Troitsk

Paul-Scherrer-Institut (PSI), Villigen

Argonne National Laboratory (ANL), Argonne IL

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Cornell University, Ithaca NJ

University of California, Los Angeles CA

Jefferson Lab, Newport News VA

Joint Institute for Nuclear Research (JINR), Dubna

March 2003

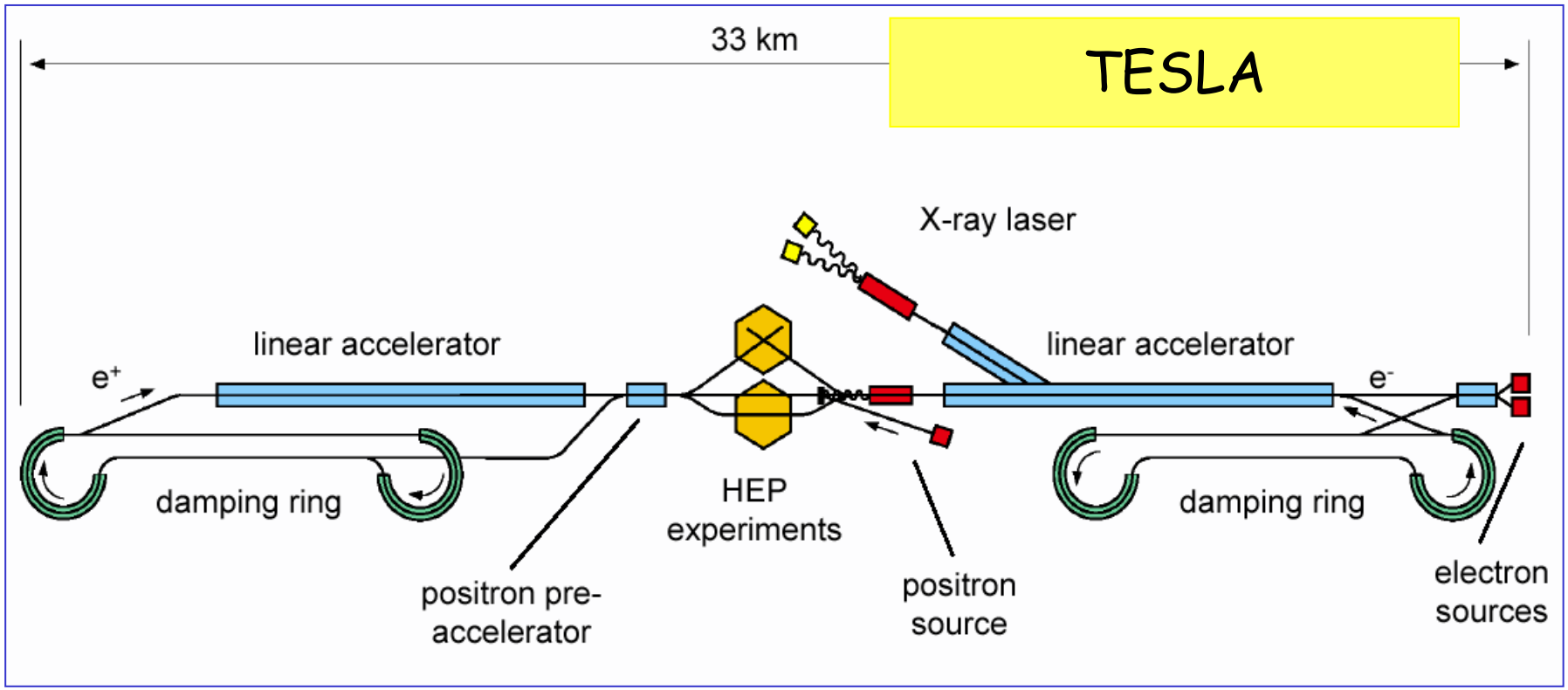
The TESLA Collaboration

- The TESLA Collaboration:

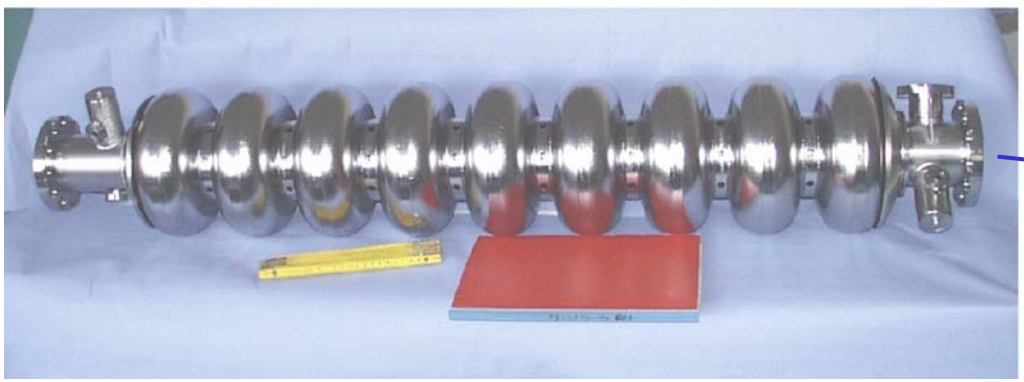
- at present 49 Institutes in 12 countries

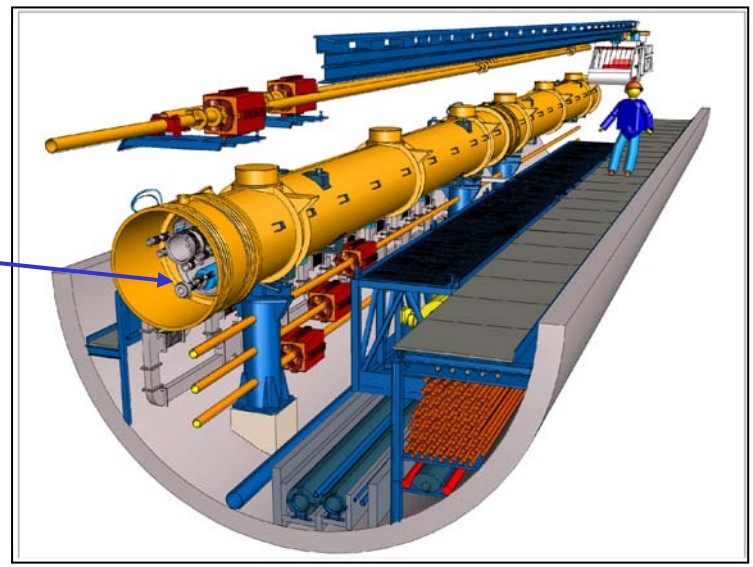
- major hardware contributions from abroad: France, Italy, USA

- Major help from CERN and KEK on SC cavities



Supraconducting RF Structures





Albrecht Wagner, DESY

TTF2 VUV FEL

TTF1 is at present being extended to reach 1 GeV in 2003 and become a user facility in 2004

~ 30 proposals submitted

TTF1

German Science Council-Recommendation concerning the X-FEL

The high luminosity and time resolution of the X-FEL promises a new quality of experiments for many areas of research in the natural, life, material and geo- sciences. Due to the high coherence of the photon radiation it will be possible for the first time to extensively analyse the structural and dynamic properties of matter. ...

... use of the TTF has led to key theoretical and experimental developments as well as sweeping technological innovations, a trend that is expected to continue in the future .

The Science Council requests the Federal Government to give its binding consent to German participation in the TESLA X-FEL project as soon as possible after the revised project proposal has been submitted .

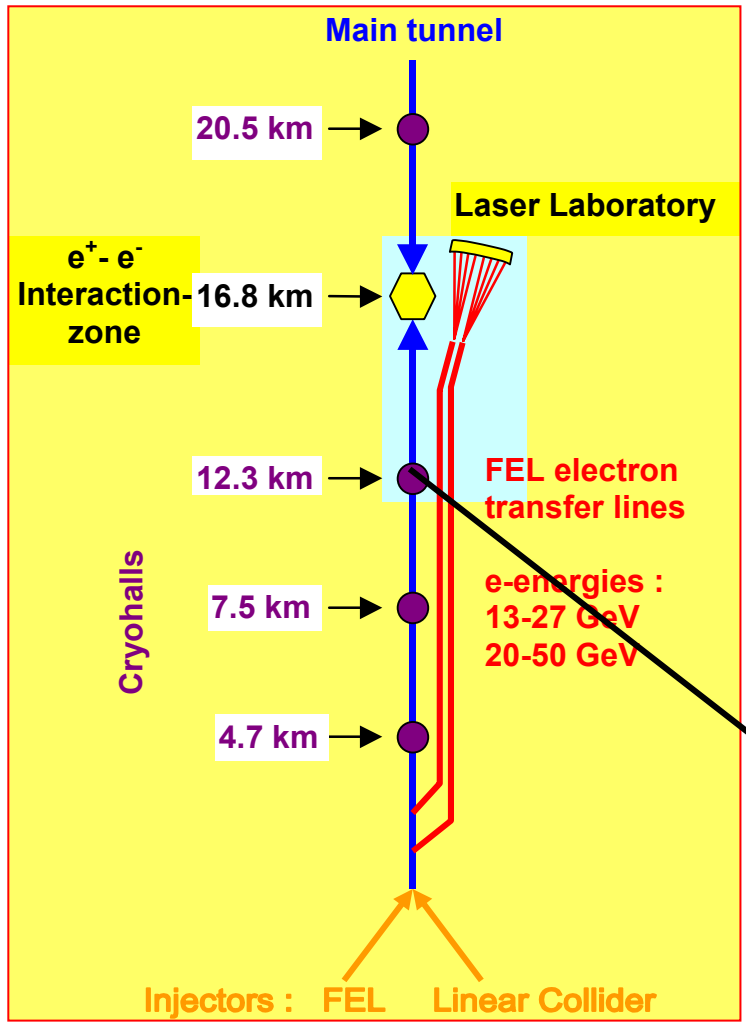
X-FEL Layout

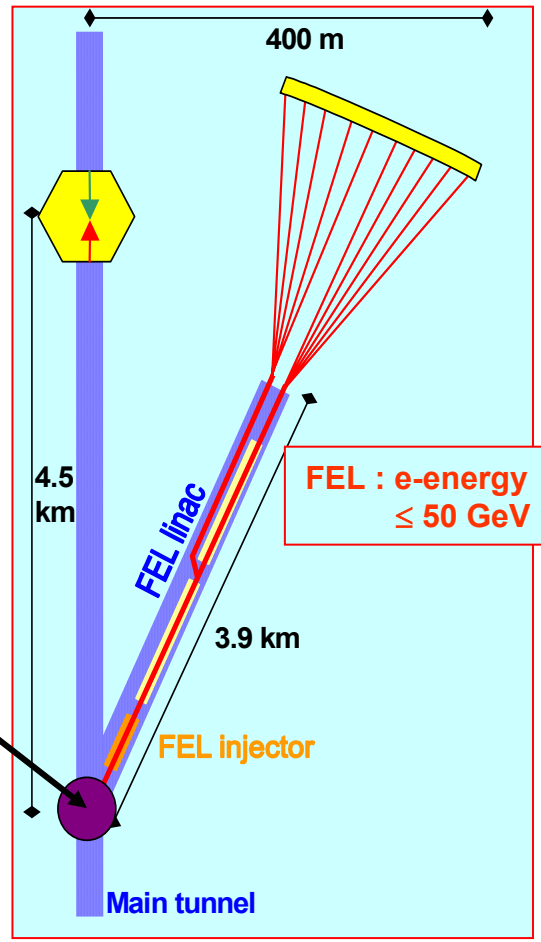
TDR:

Collider and FEL use jointly the first section of the SC linac.

This minimises the cost.

It leads however to a coupling of the LC and the FEL during all stages of the project





Alternative implementation

Government Decision on X-FEL

The decisions of the German Ministry for Education and Research concerning TESLA was published on 5 February 2003:

DESY in Hamburg will receive the X-FEL

Germany is prepared to carry half of the investment cost.

Discussions on European cooperation will proceed expeditiously, so that in about two years a construction decision can be taken.

Cost: 450 MEuro for accelerator part (including personnel)

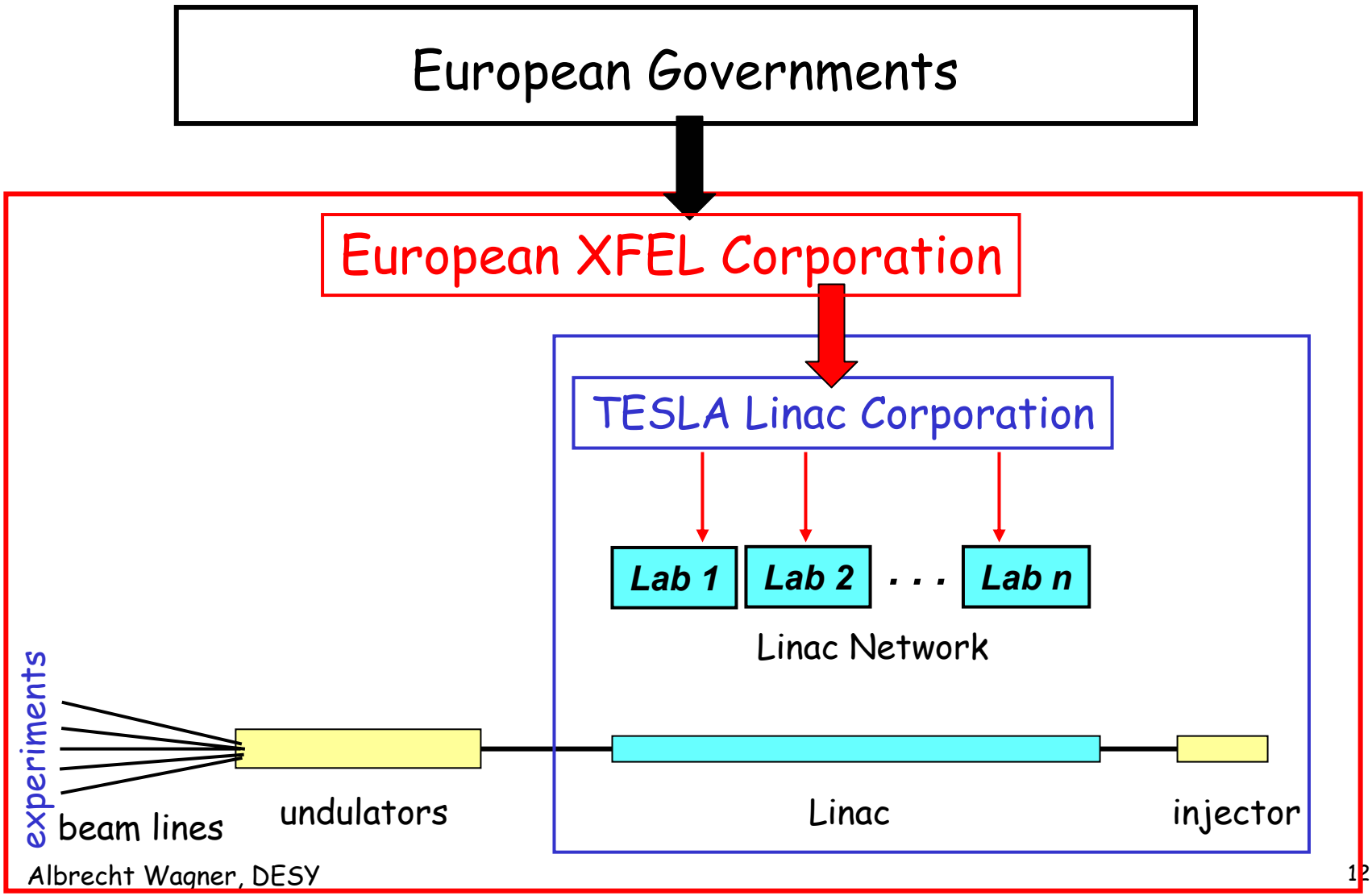
240 MEuro for XFEL laboratory (including personnel)

Next Steps

- Discussion with European partners interested in the construction of the linear accelerator and the laser facility
- Formation of a planning group with members from all countries interested in the participation in the construction of the linear accelerator and the laser facility
- Analysis of the present concept for the linear accelerator and the laser facility by the planning group
- Adaptation of the project parameters to include the findings and recommendations of the planning group
- Continuation of the R&D work on the linear accelerator, undulators, beam lines and experiments of the X-FEL laboratory

- The design work on the XFEL accelerator will be largely applicable for the main accelerator of a cold LC

A Model for a European X-FEL Laboratory



German Science Council-Recommendation concerning the LC

The German Science Council recommended in November 2001:

The Science Council believes that an enormous amount of knowledge about fundamental questions concerning the micro- and macrocosmos will be gained from the scientific questions that will be examined using the TESLA linear collider.

... The general feasibility of superconducting accelerator technology was convincingly demonstrated by the test accelerator (TTF) installed at DESY . ...

The Science Council requests the Federal Government to give its binding consent to German participation in the project as soon as possible after the project proposal has been submitted with specific details concerning international funding and international cooperation

Government Decision on LC

Today no German site for the TESLA linear collider will be put forward.

This decision is connected to plans to operate this project within a world-wide collaboration

DESY will continue its research work on TESLA in the existing international framework, to facilitate German participation in a future global project

Thereby, the government played the ball back into the international particle physics community

Statement of the Ministry to Parliament

BMBF report to Parliament commission on Research:

- DESY will remain a world-wide leading centre of particle physics. Today, Germany is not proposing a site for the TESLA Linear Collider.
- DESY will continue its R&D work, which is done in international collaboration, in order to assure a German participation in a global project.
- The decision to not propose a site today is not meant as a reduction of the importance of particle physics in Germany.

Ministry followed recommendation of German particle physicists

Consequences for the LC

The path chosen by TESLA to move towards approval:

- plan and develop the project jointly with many partners,
- convince one country to make a financial commitment and a site proposal,

to be followed by

- commitments of other countries,
- joining of new partners to the project and
- joint review of all aspects of the design before moving into the construction phase

This approach was recommended by the German Science Council and is generally considered to be the fastest one.

Future Direction for LC

Community will now take the other path used for international projects (e.g. ITER):

- unite first behind one project with all its aspects, including the technology choice, and then
- approach all possible governments in parallel in order to trigger the decision process and site selection.

Important to note: The statement by the German government

- is positive on a linear collider in general,
- approves continued R&D on TESLA,
- encourages the German participation in a global project,
- but leaves the site selection open for the time being.

International Coordination of the LC

Many activities are coordinated between America, Asia and Europe:

- Regional and international working- und co-ordination groups (Physics, accelerator, detector, management)
- direct collaboration in many areas

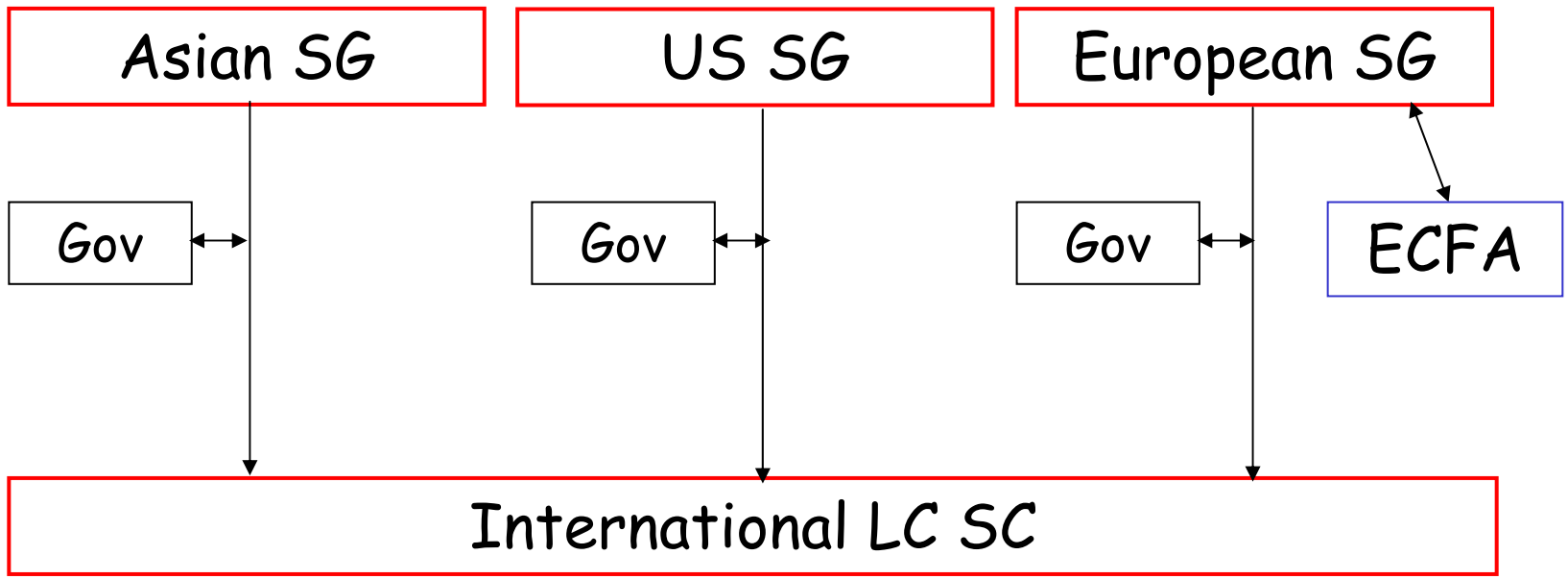
OECD Global Science Forum analysis of particle physics (Juli 2002):

- agrees with the world-wide consensus on LC
- recommends continuation of consultations in preparation of the meeting of the OECD science ministers in 2004. Meeting took place (March 2003)

… see talks by B. Foster and D. Miller

LC Steering Groups

ICFA initiative for an international co-ordination:



First proposed Feb. 2002 (J. Dorfan), very active since Aug. 2002

International Technical Review Committee

Set up by ICFA, report endorsed by ICFA in February 2003:

"TESLA has essentially demonstrated its main linac rf performance specifications for 500 GeV c.m. By the end of 2003, one will hopefully know if TESLA can reach 800 GeV c.m. by testing of the cryomodules at 35 MV/m."

"By the beginning of 2004 the two machines (TESLA, NLC/JLC) will be on an equal footing from the point of view of their rf systems for the main linacs.

If at that time the HEP community wanted to make a choice between these two technologies, it could do so by weighing all the technical differences between the two machines and the challenges presented by the remaining tasks."

Ranking 1 R&D

R1: R&D needed for feasibility demonstration of the machine.

The objective of these R&D items is to show that the key machine parameters are not unrealistic.

In particular, a proof of existence of the basic critical constituents of the machines should be available upon completion of the Ranking 1 R&D items.

TESLA at 500 GeV

The Energy Working Group considers that a feasibility demonstration of the machine requires the proof of existence of the basic building blocks of the linacs.

In the case of TESLA at 500 GeV, such demonstration requires in particular that s.c. cavities installed in a cryomodule be running at the design gradient of 23.8 MV/m.

This has been practically demonstrated at TTF1 with cavities treated by chemical processing.

The other critical elements of a linac unit (multibeam klystron, modulator and power distribution) already exist.

For TESLA 500 all R1 criteria have been met

But a number of R2 ..R4 criteria need still to be met (see talk by Nick Walker)

TESLA Upgrade to 800 GeV

R1 criteria to be met for TESLA 800:

The feasibility demonstration of the TESLA energy upgrade to about 800 GeV requires that a cryomodule be assembled and tested at the design gradient of 35 MV/m.

The test should prove that quench rates and breakdowns, including couplers, are commensurate with the operational expectations.

It should also show that dark currents at the design gradient are manageable, which means that several cavities should be assembled together in the cryomodule.

Tests with electropolished cavities assembled in a cryomodule are foreseen in 2003.

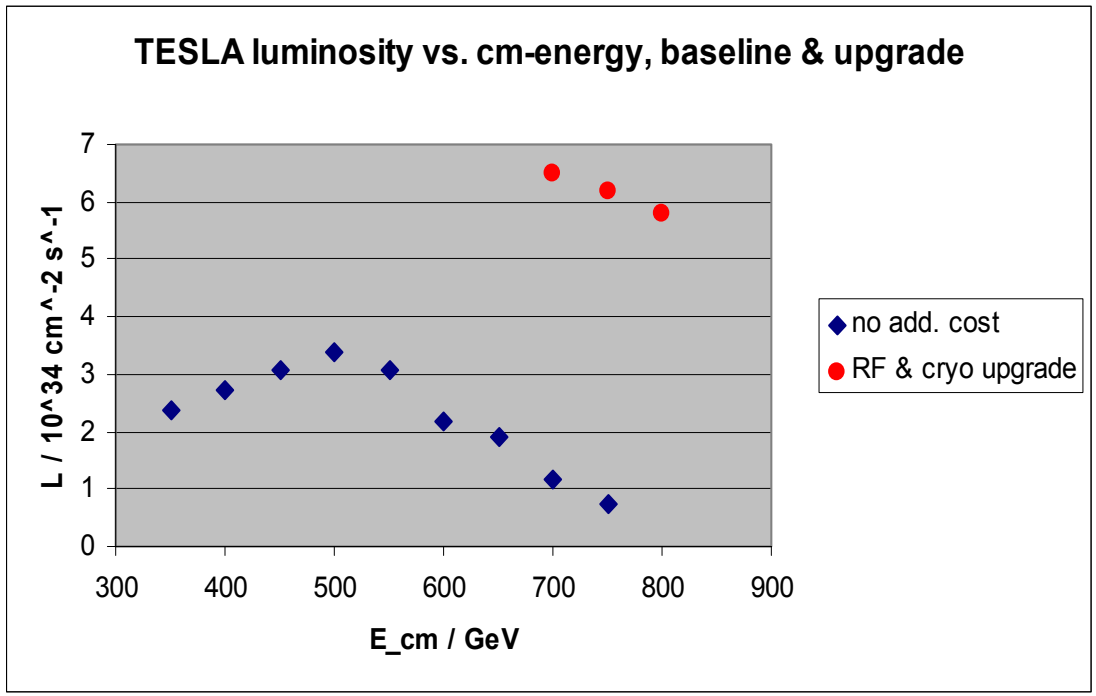
TESLA Energy Strategy

TDR (March 2001)

Base line design for 500 GeV, upgrade possibility outlined

- initially operate at an energy of about 500 GeV, to explore the Higgs and related phenomena, and then
- increasing the energy to 800-1,000 GeV, to more fully explore the TeV energy scale.

Assuming that cavities will reach 35 MV/m:



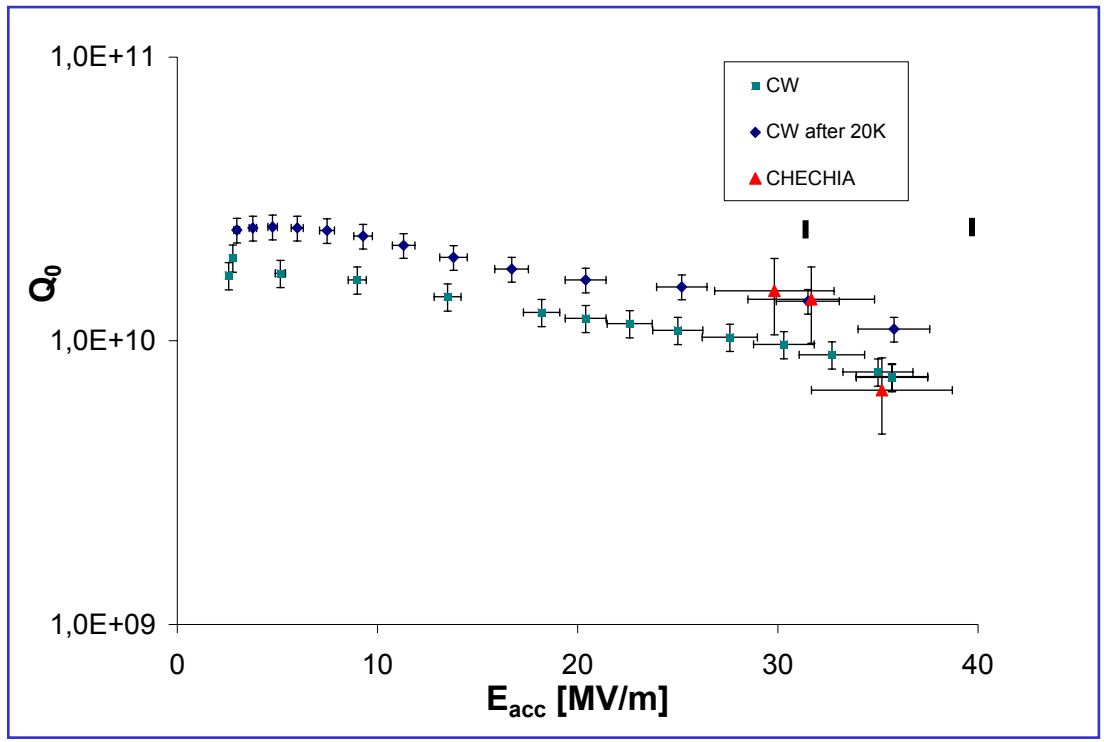
Progress on TESLA Collider Technology

Due to the XFEL DESY and partners will focus in preparation of collider on linac related issues (industrialisation, reliability, high gradient programme)

First high power test of an electro-polished cavity

Completely new final preparation sequence (no etching after tank welding)

very good result, similar to vertical test



Technology Recommendation

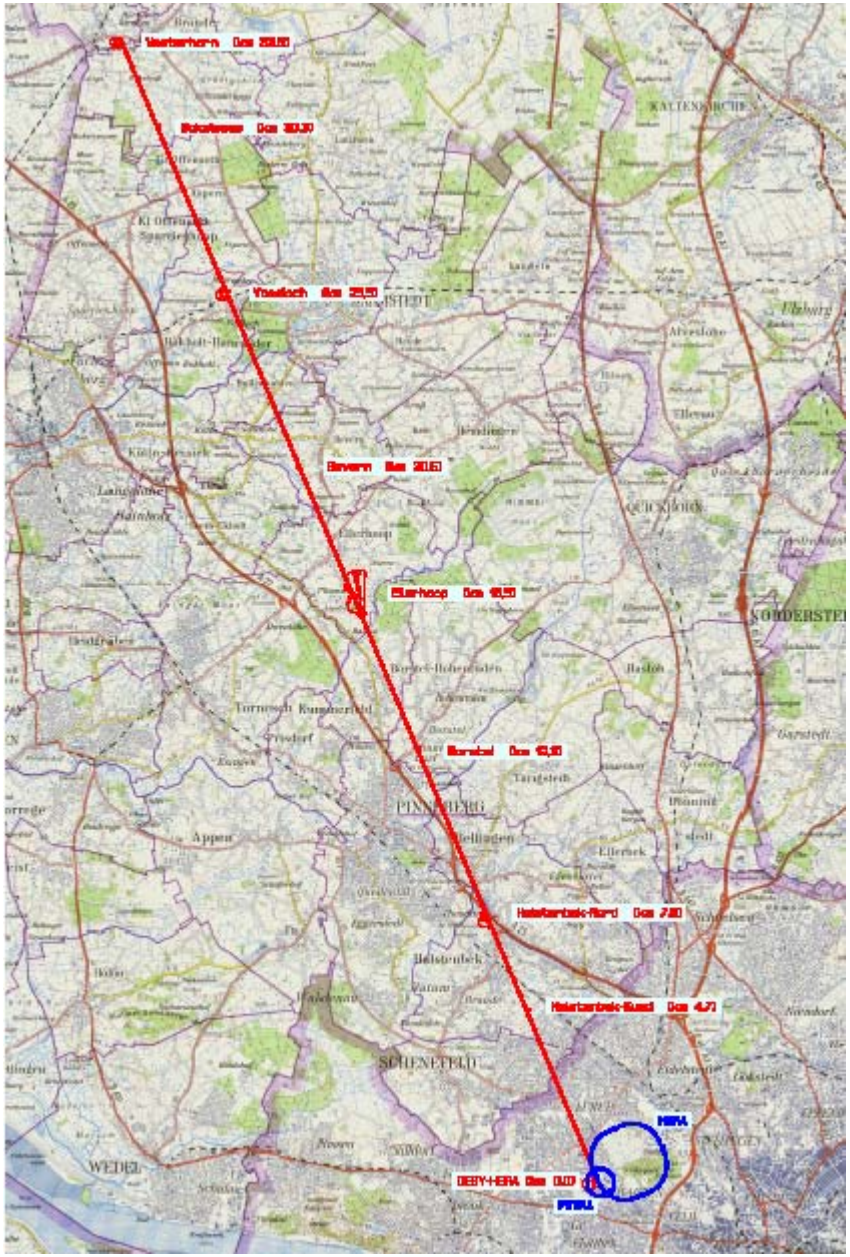
Aim at joint selection of one technology in 1 year.

How:

- Gather a committee of wise persons, who use criteria to be developed by the ILCSC, to recommend a technology choice to the ILCSC.
- The regional steering committees will each nominate 4 persons from which the ILCSC will choose three from each list for a total of 9 wise persons.

First discussion of the make-up of the committee in August.

Advice in this will be widely sought from the community.



Site Planning Status

Agreement between the states Schleswig-Holstein and Hamburg for joint legal procedure

Environmental impact study is completed. It includes evaluations of

- noise protection
- electromagnetic pollution
- radiological risks
- hydro-geology

Preparation nearly completed, but process presently stopped

Site remains an excellent choice

Global Linear Collider Center

All (ILCSG) agree that it would be highly desirable to form a precursor to the Global Linear Collider Center:

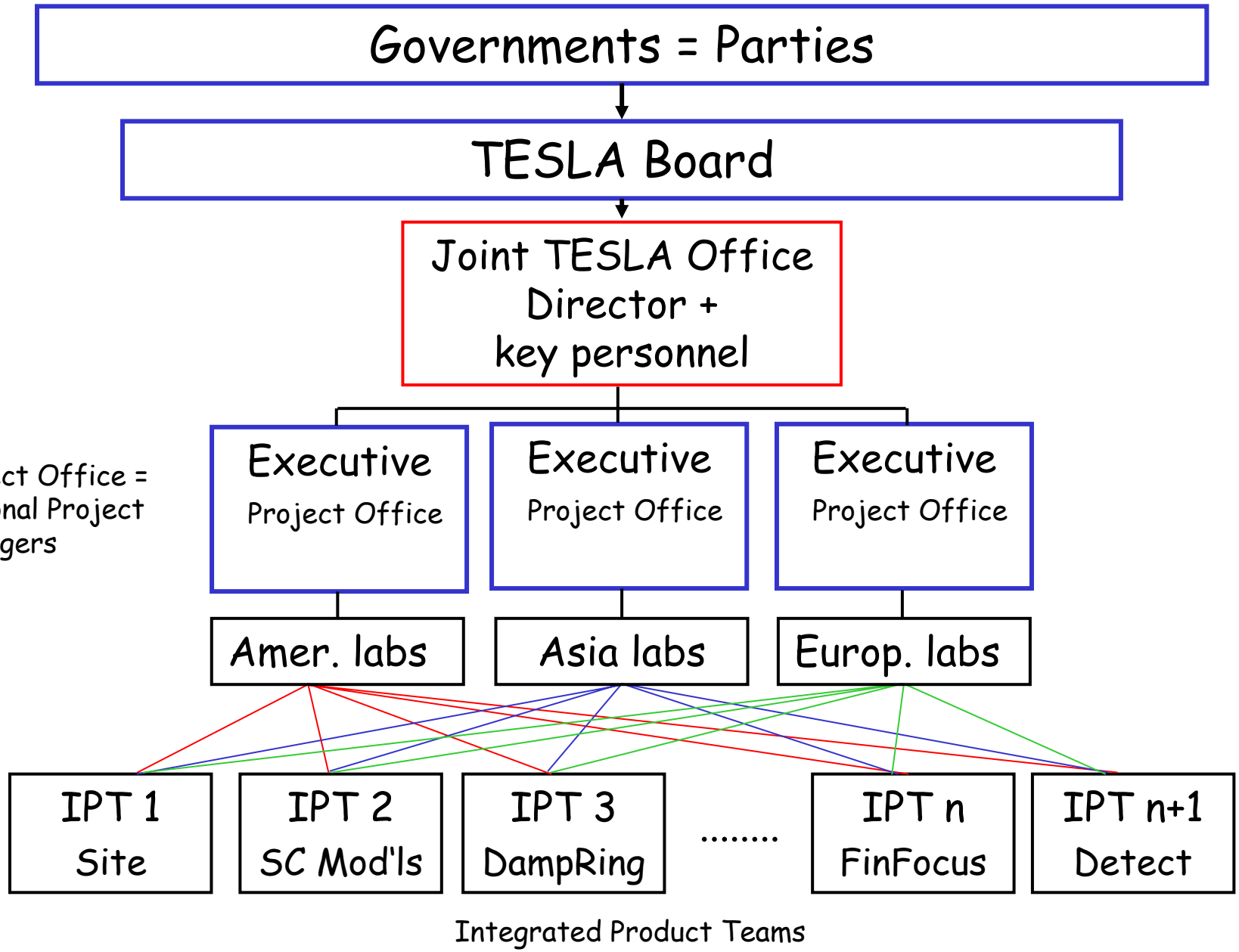
Core group to begin making an international design, based on accumulated work to date, but reexamined in a completely international context.

ILCSG aims at the technology recommendation before the GLCC starts to work

In parallel to the work of the design group:

preparation of political decision, definition of organisational structure, site analysis

Aim at approval of LC around 2006/2007


Governments = Parties
TESLA Board
Joint TESLA Office
Director +
key personnel
Project Office =
Regional Project
Managers
Executive
Project Office
Executive
Project Office
Executive
Project Office
Amer. labs
Asia labs
Europ. labs
IPT 1
Site
IPT 2
SC Mod'ls
IPT 3
DampRing
.....
IPT n
FinFocus
IPT n+1
Detect
Integrated Product Teams

GAN

Remote operation will very likely be of key importance for the future operation of large facilities.

Key issues:

- social aspects

Tests in this area are ongoing or planned

ICFA will sponsor future GAN workshops and has set up a group to deal with this matter

Conclusion

We have a convincing scientific case and a world consensus on the importance of a LC and on its timing w.r.t. the LHC

We have at least one technology at hand which will be further developed for the X-FEL

We are developing detector technologies to do the physics

We have a great dynamics in the international coordination and are gaining political attention

We need to make the technology choice soon to meet our goals

The future of the LC is largely on our hands, lets make it happen