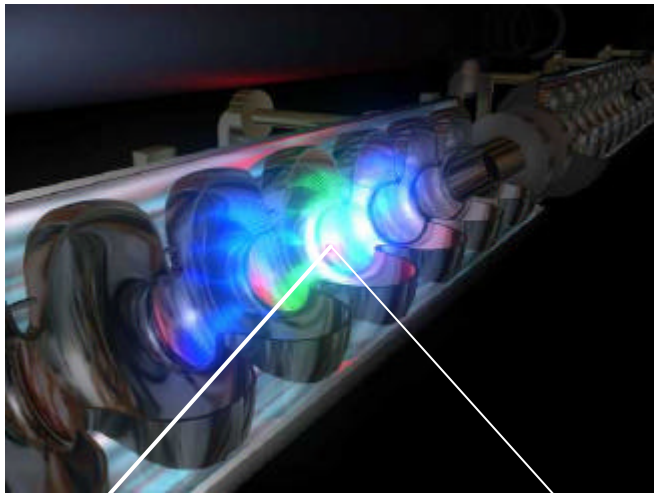
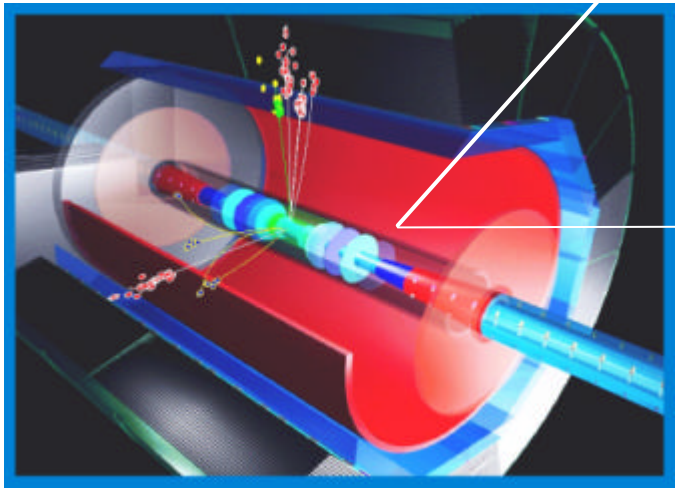
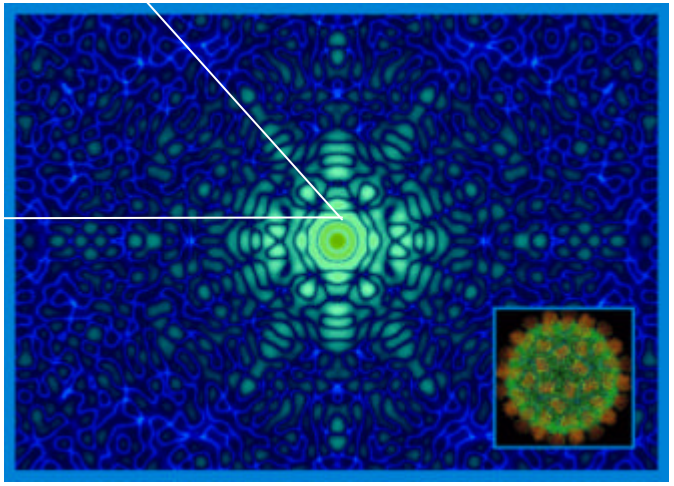
TTF/FEL Collaboration Meeting



Recent Developments



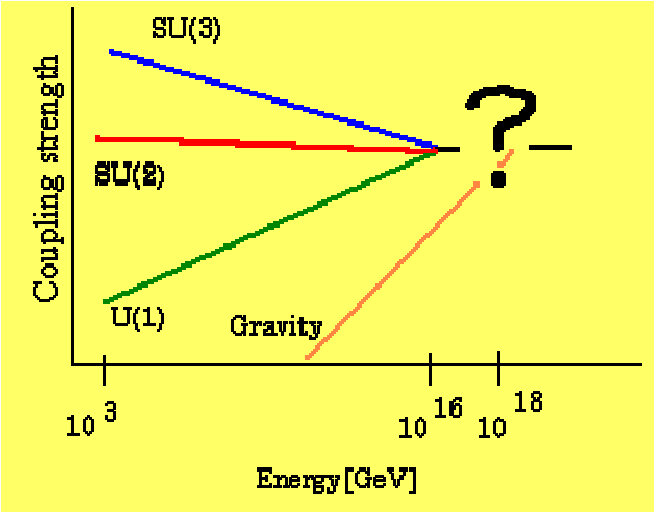


Albrecht Wagner

Frascati, 5 November 2001

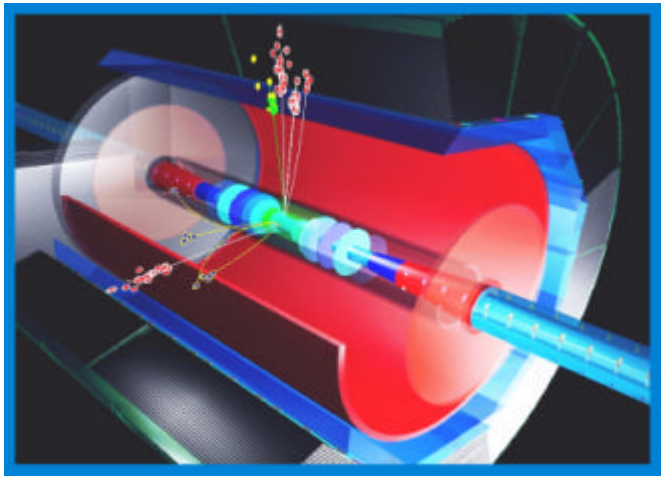
Original Motivation

Particle Physics needs an e^+e^- collider in the energy range around 500 GeV



i) to solve key questions of Particle Physics

- What is mass/matter ?
- Can the forces be unified?
- Can quantum physics and general relativity be united?
- Do we live in 4 dimensions?
- What happened in the very early universe ?



ii) as necessary complement to the Large Hadron Collider

Consensus

The scientific community world-wide has agreed (Europe, United States, Asia) that a Linear Collider

- has an excellent scientific potential in the energy range of 500 GeV and above
- is complementary to LHC
- is the next step on the road map of particle physics, but not the last
- therefore requires a timely realisation

Statement Europe

Report by the ECFA (European Committee for Future Accelerators) Working Group on "The future of accelerator-based particle physics in Europe":

"*The realisation, in as timely a fashion as possible, of a world-wide collaboration to construct a high luminosity e^+e^- linear collider with an energy range up to at least 400 GeV as the next accelerator project in particle physics; decisions concerning the chosen technology and the construction site for such a machine should be made soon*".

Approved in Budapest in July 2001

Europe cnt'd

The WG is convinced that the decision to construct such a machine should be taken soon, because (quote):

- its physics case has been established, its technical readiness has been demonstrated, and an international community of physicists is committed to its realisation;

- an overlap in time of the operation of the LHC and that of the Linear Collider would be extremely fruitful, given the complementarity of the two experimental approaches in the study of the same physics.

Strong support by German particle physicists (letter by Prof. Rückl)

HEPAP Subpanel

DRAFT REPORT

DOE/NSF HIGH-ENERGY PHYSICS ADVISORY PANEL

SUBPANEL ON LONG RANGE PLANNING FOR

U.S. HIGH-ENERGY PHYSICS

PRESENTED TO HEPAP

OCTOBER 29, 2001

Recommendation 3

RECOMMENDATION 3:

We recommend that the highest priority of the U.S.program be a high-energy, high-luminosity, electron-positron linear collider, wherever it is built in the world. This facility is the next major step in the field and should be designed, built and operated as a fully international effort.

We also recommend that the United States take a leadership position in forming the international collaboration needed to develop a final design, build and operate this machine. ....

We urge the immediate creation of a steering group to co-ordinate all U.S. efforts toward a linear collider.

HEPAP: LC Energy + Timing

The scientific case for the linear collider motivates a strategy of building the machine to

- 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.

The synergy between the LHC and the linear collider argues for an early start. The linear collider should be ready to begin construction in 2005. Results from 500 GeV operations and from the LHC would influence the timescale for converting to higher energies.

HEPAP Road Map

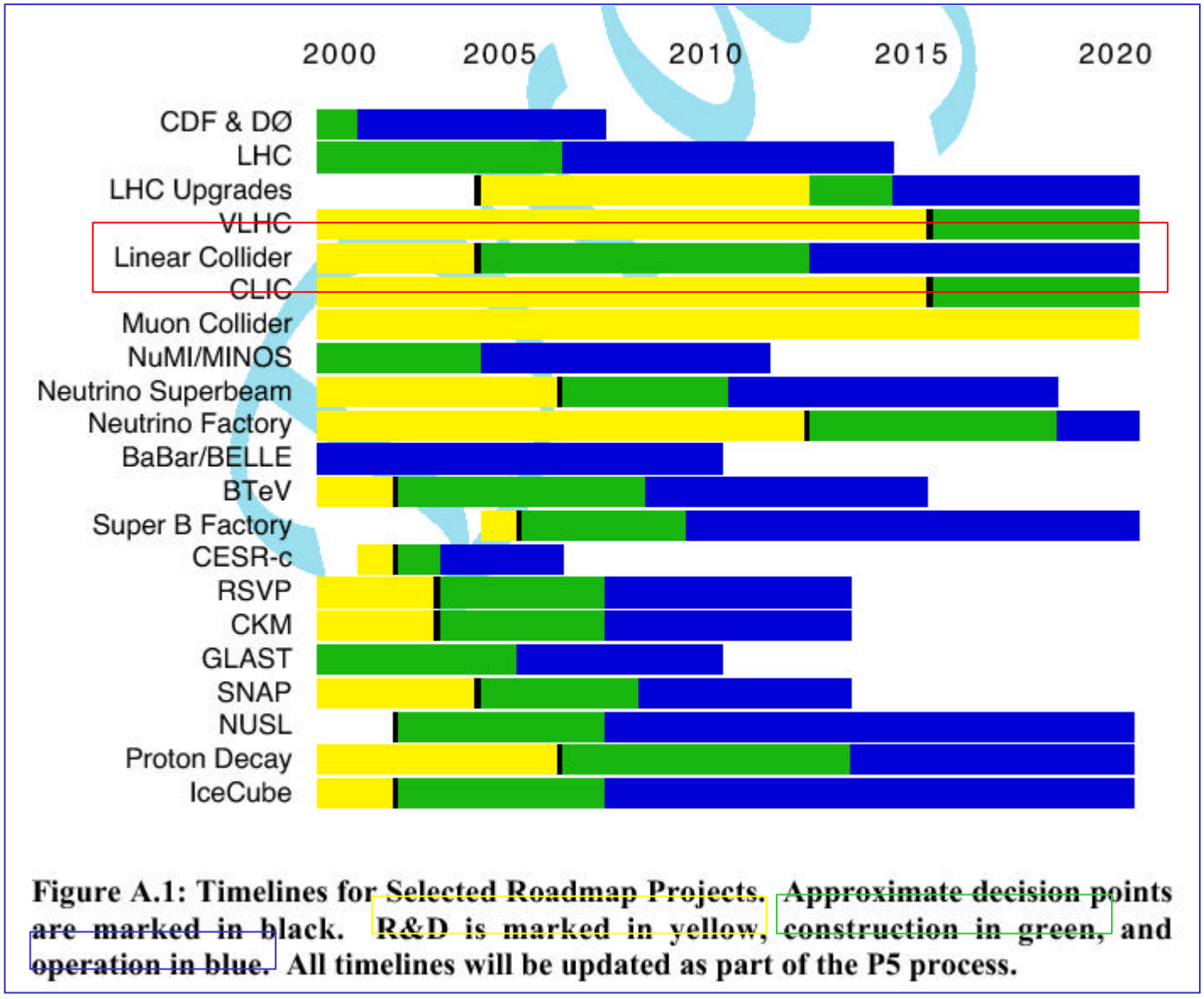


Figure A.1: Timelines for Selected Roadmap Projects. Approximate decision points are marked in black. R&D is marked in yellow, construction in green, and operation in blue. All timelines will be updated as part of the P5 process.

Recommendation 4

RECOMMENDATION 4:

We recommend that the United States prepare to bid to host the linear collider, in a facility that is international from the inception, with a broad mandate in fundamental physics research and accelerator development. We believe that the intellectual, educational and societal benefits make this a wise investment of our nation's resources.

We envision financing the linear collider through a combination of international partnership, use of existing resources, and incremental project support. If it is built in the U.S., the linear collider should be sited to take full advantage of the resources and infrastructure available at SLAC and Fermilab.

XFEL

In partnership with the broader scientific community, an X-ray free electron laser facility could be included in the project, providing a brilliant, coherent fourth-generation light source with femtosecond time resolution.Such a facility could open important new areas of research across many sciences, including the life and environmental sciences,as well as physics and chemistry.

HEPAP Onshore LC

Scenario with an Onshore Linear Collider

This scenario ensures the United States a leadership position in particle physics. The U.S.hosts one of the forefront scientific facilities of the 21 st century, and selectively participates in other important experiments in the field. The program includes:

- An electron-positron linear collider in the United States, with the U.S. contributing about 2/3 of the total project cost;
- Participation in the LHC and its possible upgrades;

.....

This scenario requires a net increase of about 30% in total funding to the field over twenty years.

HEPAP Offshore LC

Scenario with an Offshore Linear Collider

This scenario includes significant participation in an offshore linear collider, together with the LHC, and a vigorous and diverse domestic program. It includes:

- An electron-positron linear collider in Europe or Asia,with the U.S.contributing a significant share of the total project cost;
- Participation in the LHC and its possible upgrades;

.....

This scenario requires a net increase of about 10% in total funding to the field over twenty years.

HEPAP Cost

Although the cost of the linear collider is uncertain so early in the project, there is a detailed estimate for the TESLA project, ... as well as a preliminary cost estimate for the NLC, ... Continued R&D and value engineering are needed to refine the technology and fix the cost.

We assumed a total project cost of about $5-7B for the collider, in FY 2001 dollars, if it is built in the U.S. We estimated that $1-2B of the cost could be supported through sacrifice and redirection of the present U.S.program, taking advantage of resources already available in our laboratories and universities. We also estimated that another $1.5-2.5B, up to about one-third of the cost, could be contributed from non-U.S. sources.

HEPAP: LC R&D

For TESLA, the remaining R&D will be mainly devoted to proving that results on accelerating field gradients are applicable to the fully integrated system and to increasing the gradient from 23 MV/m to 35 MV/m, necessary for the 800 GeV upgrade.

In addition, the collaboration is investigating a potential cost reduction by powering a pair of nine-cell cavities using one coupler. This would save on the length of the machine and halve the number of RF couplers. This program should have conclusive results by 2003.

We emphasise the importance of making an early technology choice for a linear collider. This will require a focused and intensified R&D program, which must be given very high priority within the U.S.program.

Technology Choice

The International Committee for Future Accelerators (ICFA) is carrying out a technical assessment of the two competing technologies (room temperature and superconducting). A report from ICFA 's study should be forthcoming within a year.

However, it appears that either technology could be used to construct a linear collider, and that the actual technology choice will depend on many factors.

The international collaboration that will build the linear collider must decide on the optimum technology for a given site and proposal. That decision must be based on sufficient R&D so that all relevant issues have been addressed in enough detail to support the decision. For the case of a U.S.-hosted machine, we recommend developing a process for making this decision as early as possible, to focus the development work on the technology to be employed.

Technical Review

ICFA has set up a Technical Review Board

Goal:
review the features of the different accelerator technologies

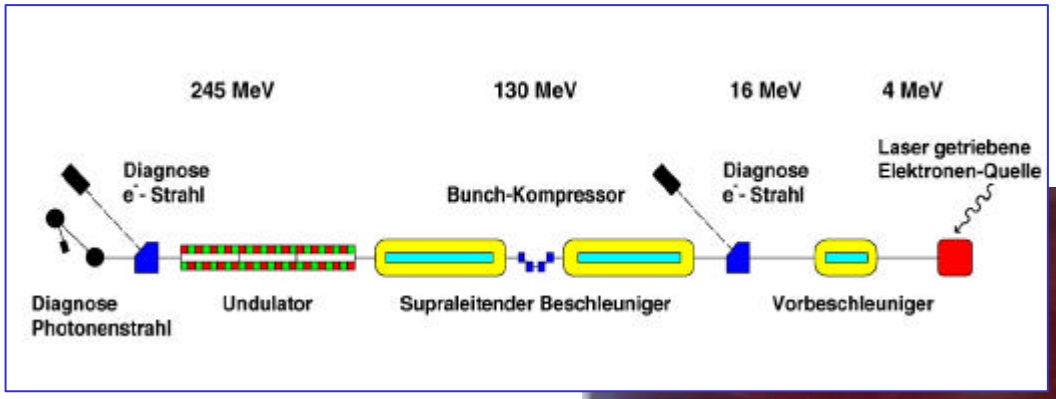
Chair: G.Loew
Steering Group: R. Brinkmann, G. Guignard, T. Raubenheimer, K. Yokoya

Two Working groups:
- Energy performance: D. Boussard
- Luminosity performance: G. Dugan

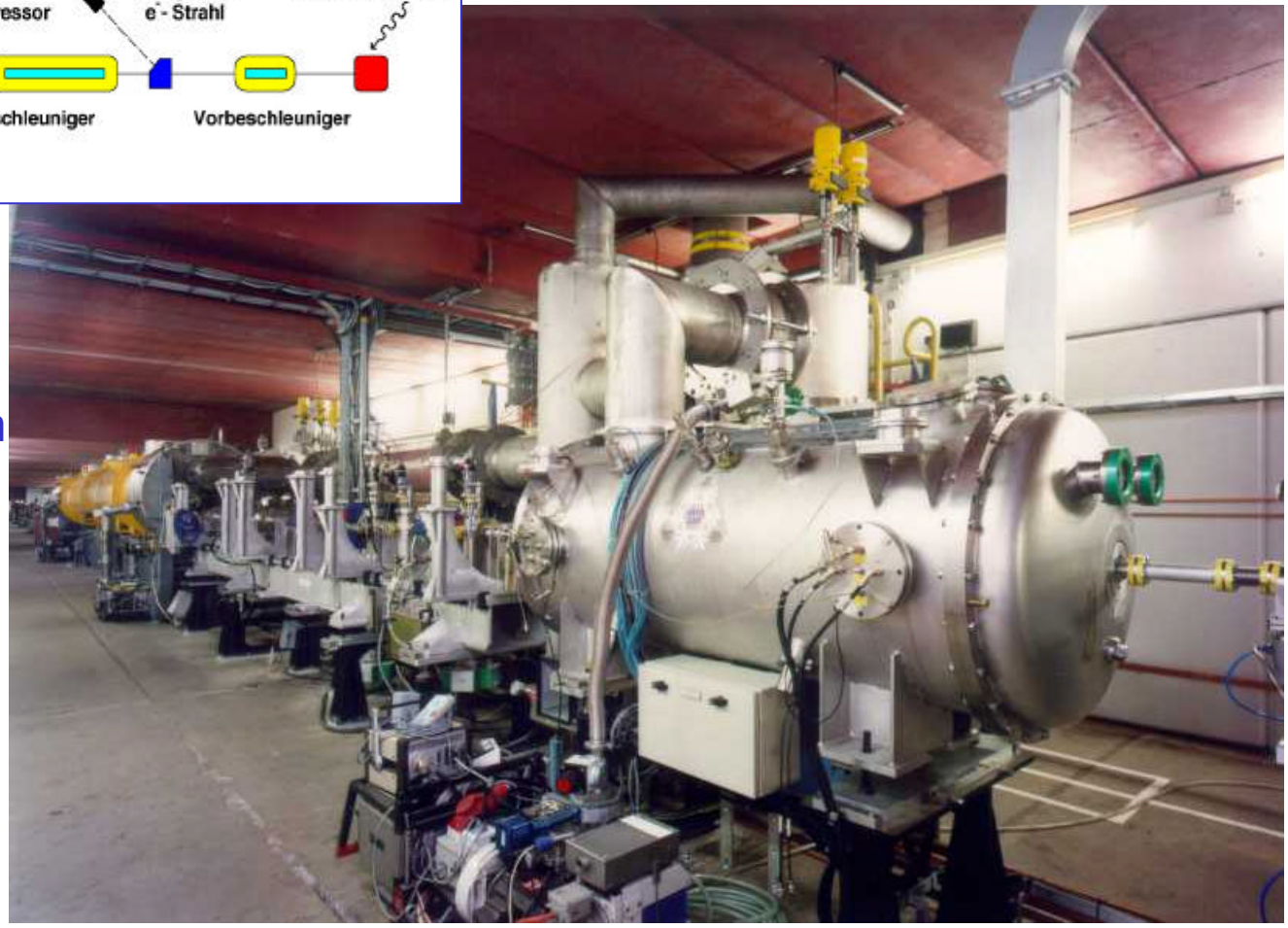
Already intense discussions in working groups at Snowmass

First report due in July 2002

The TESLA Test Facility



Construction of a prototype accelerator:



Tasks:

Test of all components

Operation for > 10 000 h

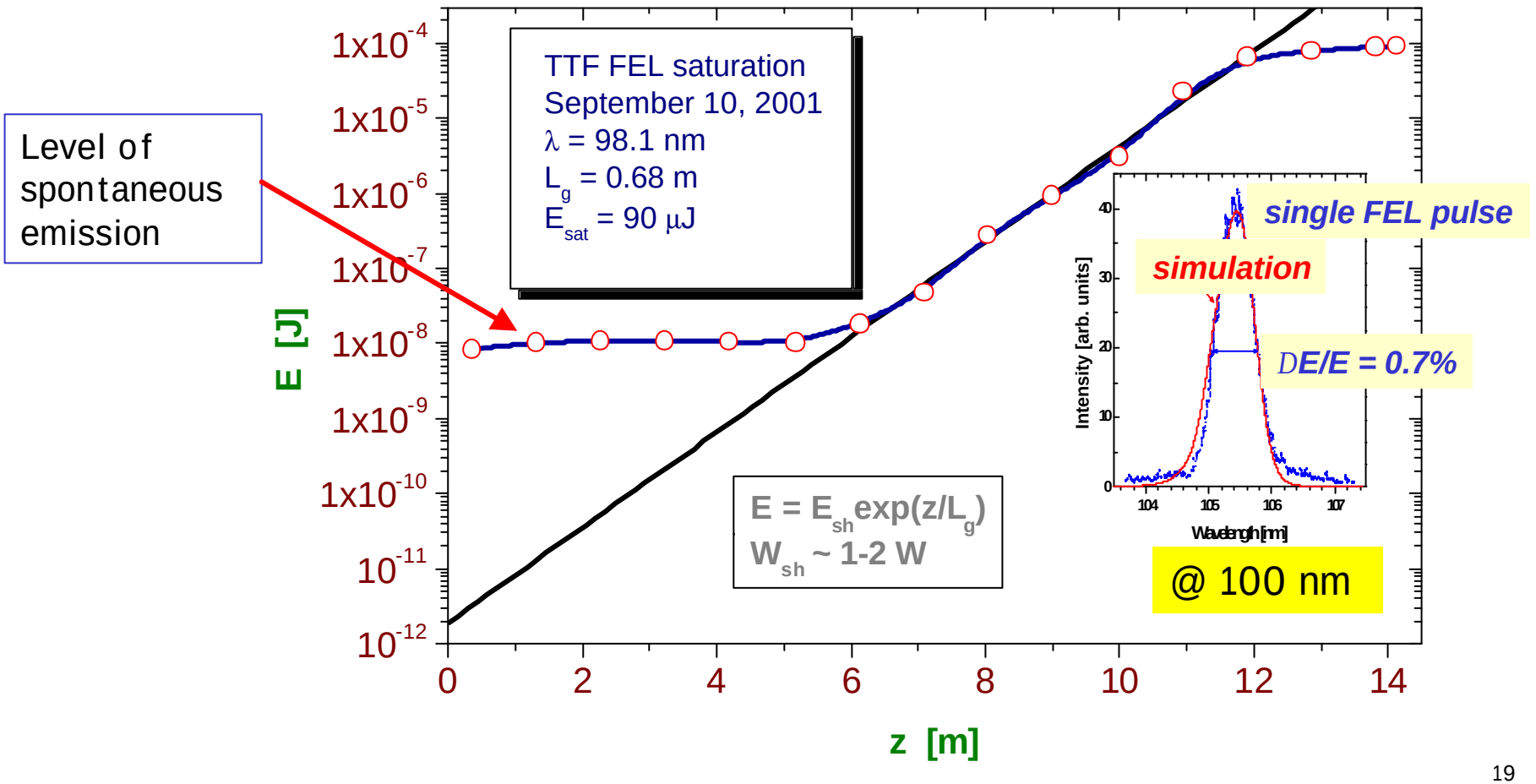
Base for costing

Conclusion:

The technical readiness has been demonstrated

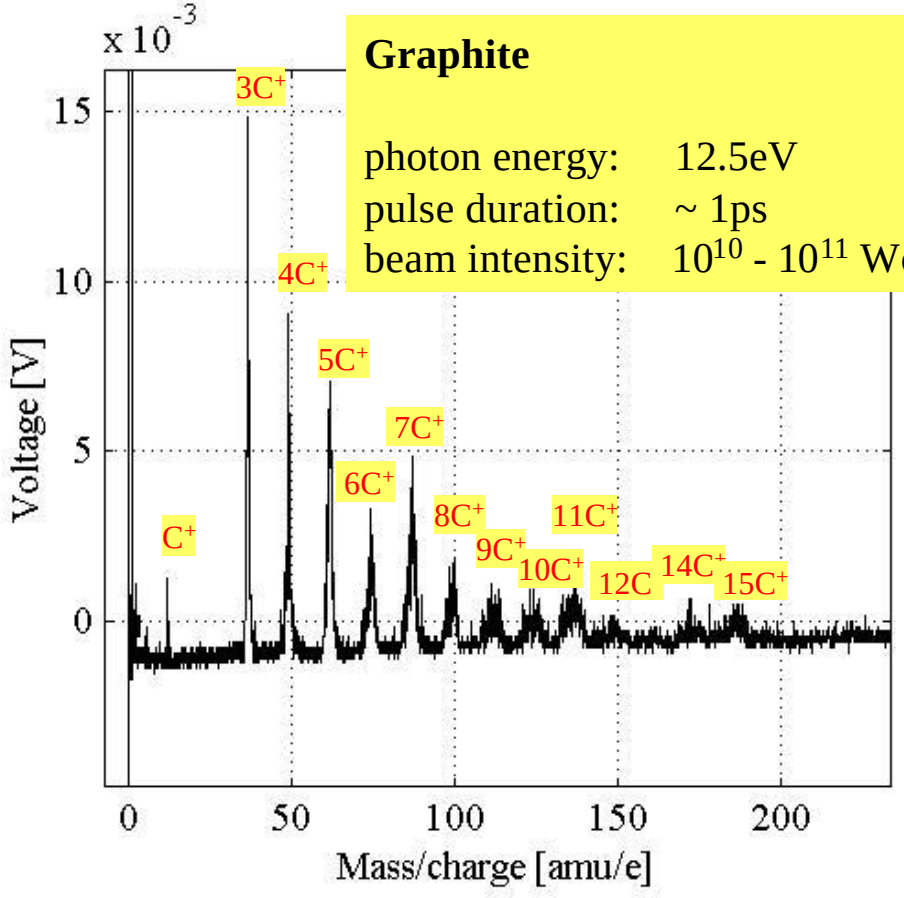
The Laser Proof of Priciple

All measured features of the laser agree with the theoretical predictions, e.g. saturation (gain: 10*10^6)



First Experiments at FEL

Ablation experiment

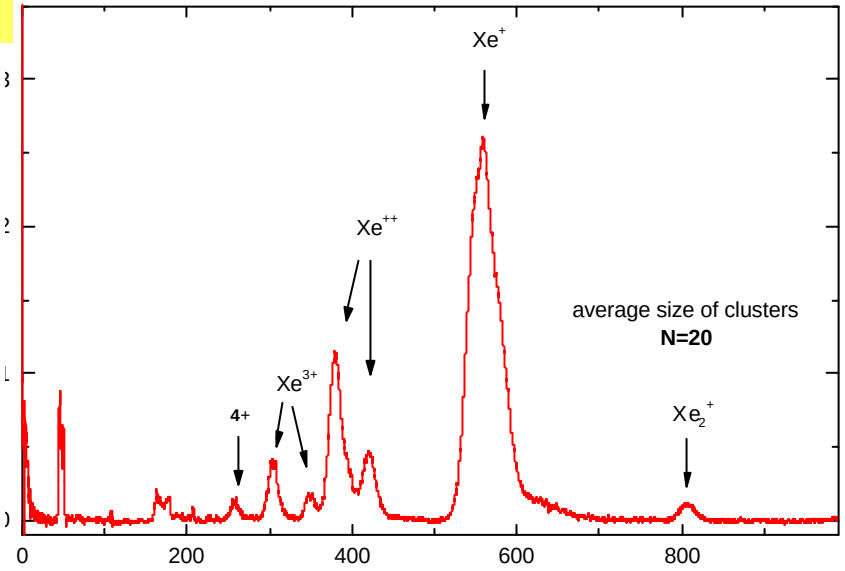


Graphite

photon energy: 12.5eV
pulse duration: ~ 1ps
beam intensity: 10^{10} - 10^{11} Wcm^{-2}

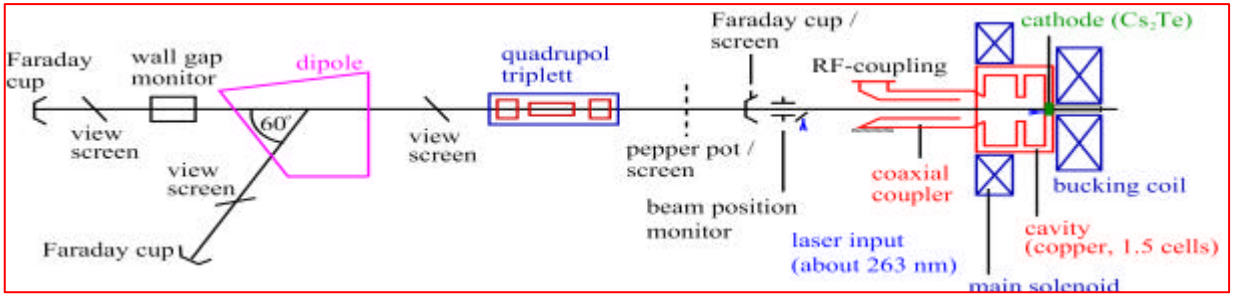
Time-of-flight Cluster experiment

ejection energy



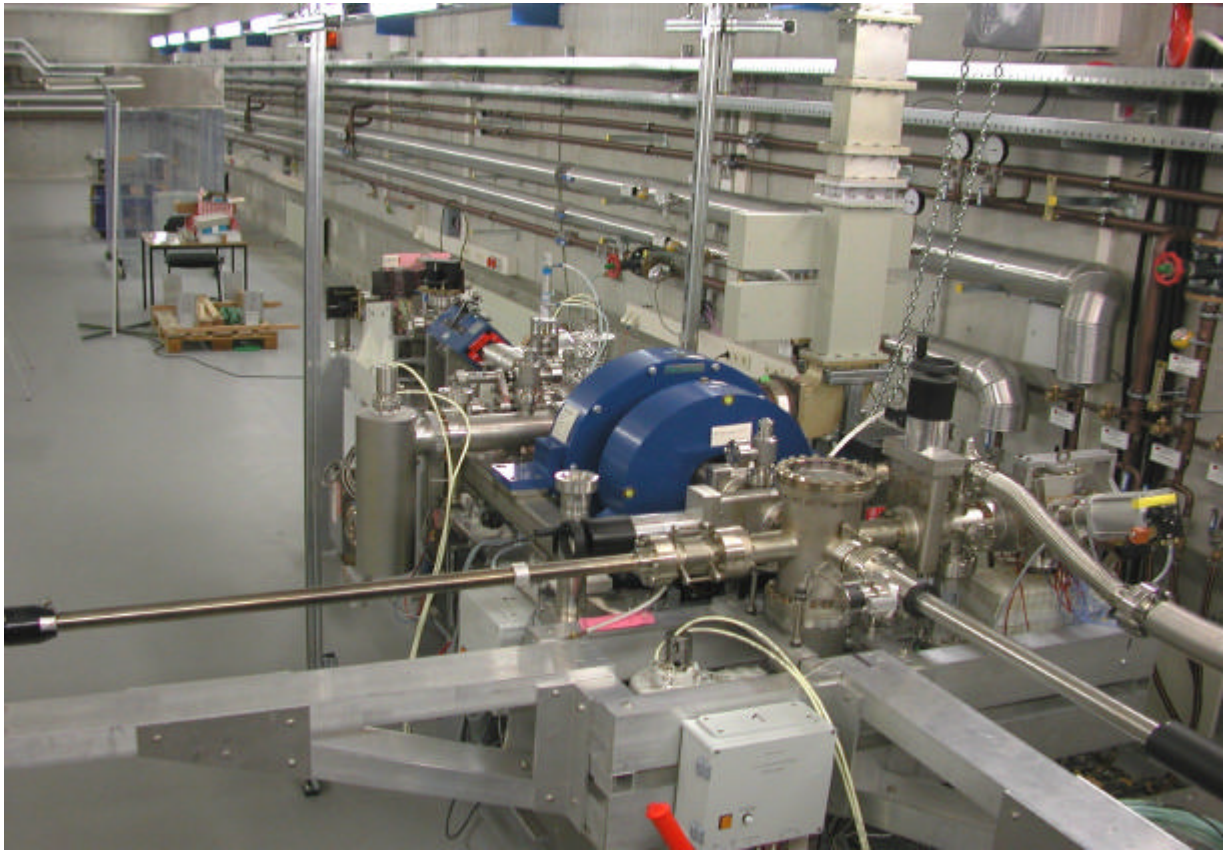
time of flight [nsec]

The Photo-Injector in Zeuthen



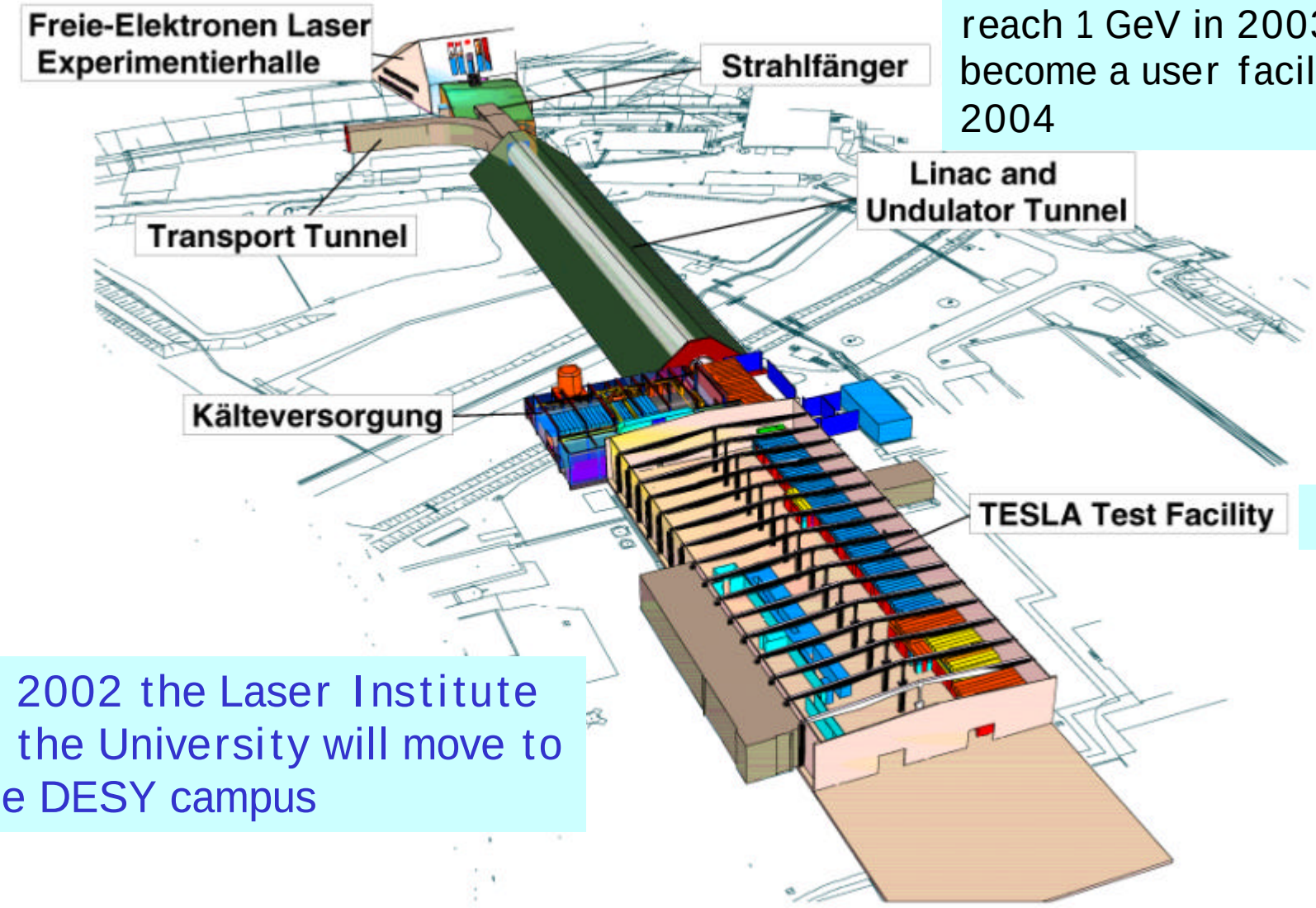
In collaboration with BESSY, MBI, TUD

Preparations nearly completed



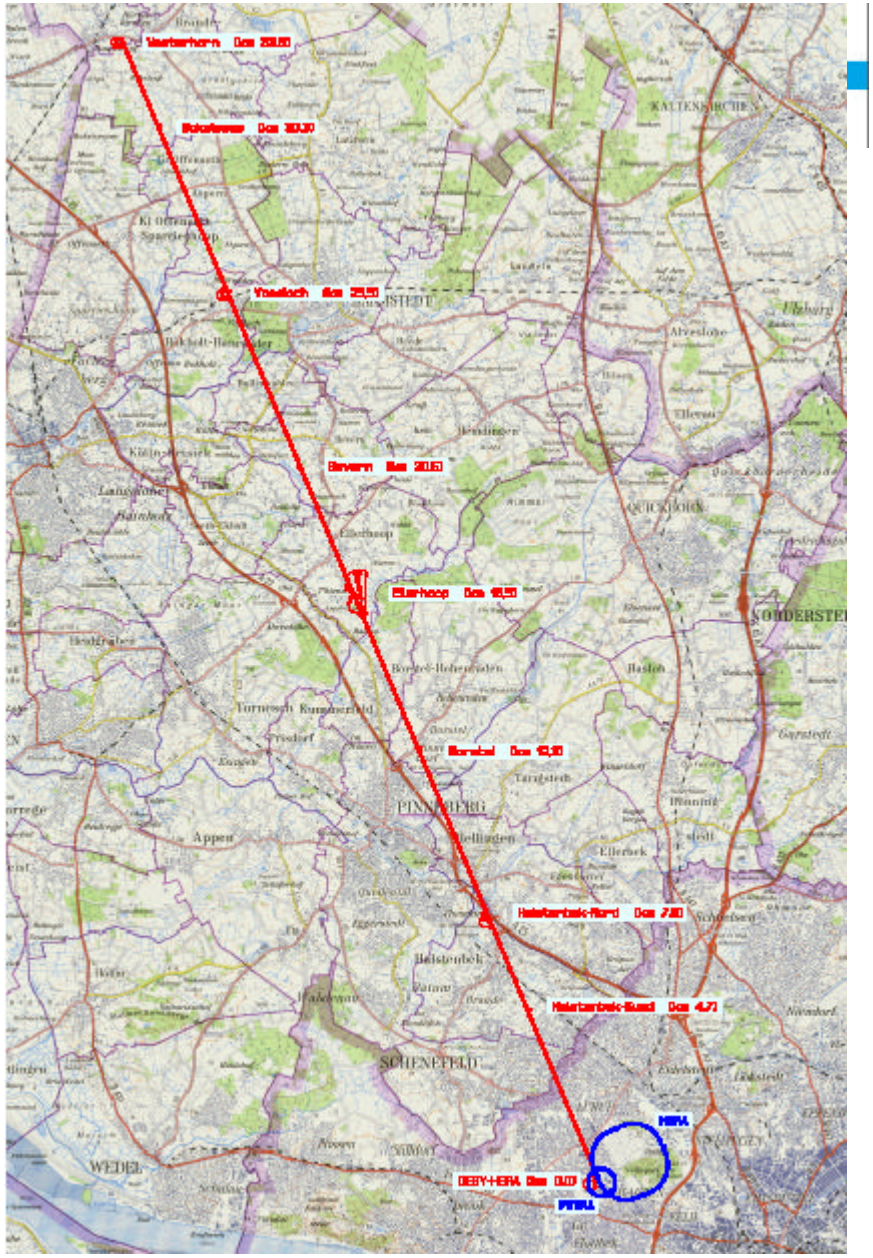
TTF2 VUV FEL

TTF1 will be extended to reach 1 GeV in 2003 and become a user facility in 2004



TTF1

In 2002 the Laser Institute of the University will move to the DESY campus



Site Planning Status

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

Environmental impact study is completed. It includes

- noise protection evaluation
- electro-smog evaluation
- 2 radiological studies *
- hydro-geological study

* 'The evaluation comes to the conclusion that, in spite of several uncertainties, the project can be realised in a way which ensures the radiation protection of the population. Technical means exist which can compensate the effects of the remaining uncertainties' (Öko-Institut e.V.).

German Science Council

Site visits

LC: 17.-19. October

Pühler, Lüth, Haarer, Junker, Boussard, Davier, Hübner, Lykken, Skrinsky

X-FEL: 24. October

Mayr, Lüth, Herzig, Donhauser + external experts

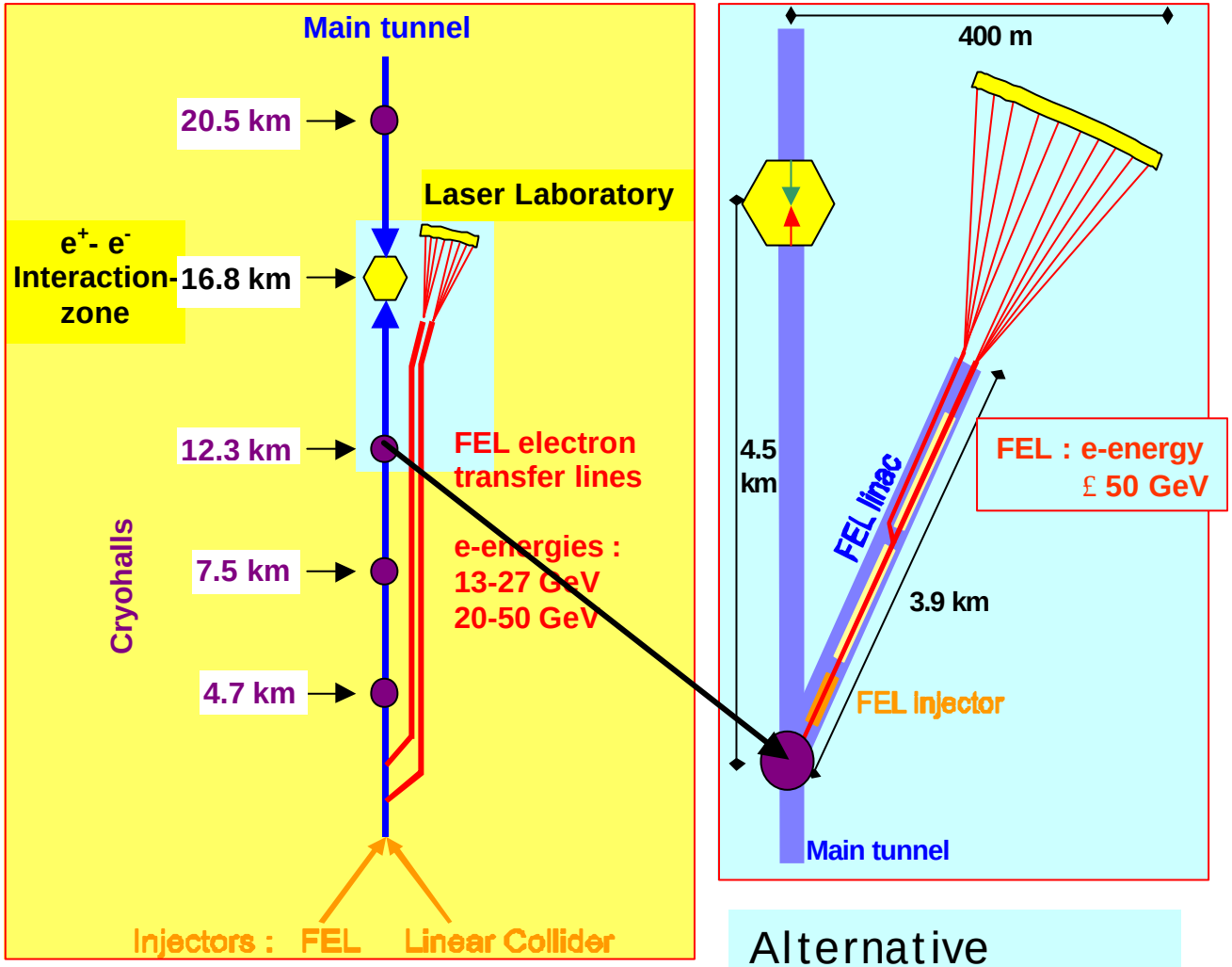
X-FEL in TDR

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

Alternative Option for Implementation

An alternative option for implementing the FEL has been presented which

- decouples the constraints of a combined operation
- adds additional flexibility to both parts of the project
- maintains the synergy

However, this additional flexibility leads to higher costs (~ 220 MEuro).

This assessment assumes that Linear Collider and FEL are realised within a similar time frame and approval process, and that both projects profit from the same economic and time benefits of mass production.

The advantages of a separate accelerator for the FEL have to be compared with and balanced against the corresponding additional cost.

Results of Review

TESLA Linear Collider:

The LC answers key questions, is complementary to LHC, is next accelerator to be built

The technical preparation is excellent, TTF is impressive and a great engineering achievement. TTF is not only a test of components but of a system.

Recommendation: 35 MV/m should have highest priority

Strong support for concept for international realisation

X-FEL: (evaluated together with VUV FEL by BESSY)

Scientific potential excellent.

Impressed by technical preparation and results

DESY and BESSY should plan next steps jointly

QECD Consultative Group

OECD Consultative Group on High Energy Physics
Presentation to the HEPAP Subpanel - August 16, 2001

Consultative Group on High Energy Physics: Mandate

- Provide a venue for discussions among senior science policy officials and program managers about the future of HEP.
- Strengthen international networks of lab administrators and govt. officials.
- Formulate a global vision ("road map") with special emphasis on the opportunities offered by international co-operation on a global scale.
- Exchange information about national and regional priorities, programs and plans.
- Examine options for the organizational/administrative/financial arrangements for international co-operation, based on past collaborations in HEP and other fields. Anticipate obstacles that could impede future collaborative projects.

etc

GSF 2

OECD Consultative Group on High Energy Physics
Presentation to the HEPAP Subpanel - August 16, 2001

Consultative Group on High Energy Physics: History/Timeline

* First proposed in January 2000 by the delegations of the United Kingdom and the United States.
* April 2000 (London): Workshop on whether to establish Working Group.
* June 2000: Global Science Forum authorizes Consultative Group on HEP.
* November 2000 (DESY): First meeting.
* June 2001 (CERN): Second meeting.
* *November 2001 (KEK): Third meeting.*
* *February 2002 (SLAC): Fourth meeting.*
* *June 2002: Final report to the Global Science Forum (Ministers?)*

Consultative Group on High Energy Physics: Current Status

- At CERN, the Group received updates from the various community bodies, discussed the "Global Accelerator Network" concept, heard about arrangements for the ALMA project, held a preliminary discussion about motivation and timing of a linear collider, considered the DG's views on the future of CERN.
- In preparation for the next meeting, three Working Groups were established:
  1. Examine high-level organizational issues within the GAN concept: types of agreements; roles of governments, agencies and laboratories; role of host country; funding mechanisms.
  2. Examine management issues for possible future collaborations: project management, financial accountability, staffing, procurement, etc.
  3. Begin preparing Road Map, drawing on community input.

Consultative Group on High Energy Physics: Next Steps

- At KEK in November, the Group will discuss reports from ICFA, ECFA, ACFA, Snowmass.
- Based on material from the three Working Groups, will try to develop consensus on main topics, and an outline of the final report to governments.
- Additional studies may be commissioned.
- At SLAC in February, further discussions will be held, followed immediately by a meeting with ICFA.
- Will attempt to circulate draft final report in March/April 2002.

GSF 5

Consultative Group on High Energy Physics: Final Report

- Report will offer a consensus view of the next ~20+ years of HEP from a government perspective.
- Central feature of the report will be a Road Map containing:
  - Outline of scientific goals (including links to other sciences and other govt. priorities);
  - Tools that are likely to be required and the associated R&D needs;
  - Approximate costs and timescales;
  - Possible decision points.
- Report will present generic transnational issues that governments need to know about as they consider the role of international co-operation in their future HEP plans.

ECFA/DESY Study

The third study has begun at Cracow in September,

strong attendance, a lot of new work is being done

Next meeting in France (St. Malo next spring)

DESY review of Detector R&D proposals:

- Vertex Tracking (CCD, CMOS..)
- Main Tracking (TPC)
- Calorimetry

The European Discussion on Lasers

The German SR community (KFS) strongly supports FELs

Study by a multidisciplinary expert group (F, D, E, I, UK) on:

Future requirements for large scale experimental facilities for the fine analysis of matter:

Synchrotrons, neutron sources, high intensity lasers, high field NMR

Recommendation:

➡ FEL activities in Europe should be supported by the EU

Automobilforum

Unter den Linden

Volkswagen AG

TESLA Exhibition

TESLA – Licht der Zukunft

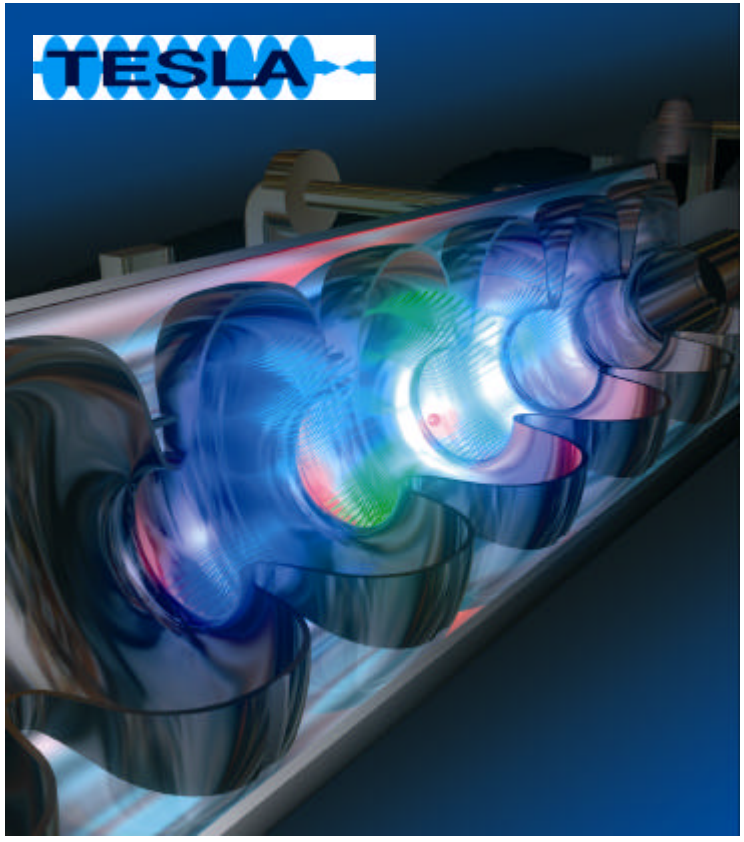
Entdeckungsreise zum Ursprung der Materie -

Einblick in die atomare Dimension des Lebens

15 January - 17 February 2002

in Berlin

24 January 2002: Scientific Attachees



Weil Weltbilder nicht nur im Kopf entstehen

Das Forschungszentrum DESY erschließt technologisches Neuland und plant gemeinsam mit internationalen Partnern den Bau von TESLA.

Der 33 km lange supraleitende Beschleuniger eröffnet neue Möglichkeiten, die Kollision von Elektronen mit ihren Antiteilchen bei höchsten Energien zu studieren.

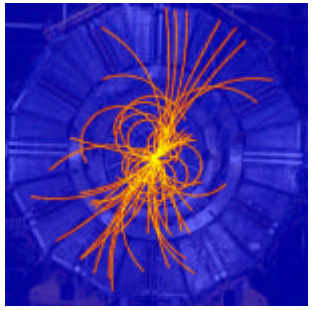
Gleichzeitig dient er als Quelle für Röntgenlicht mit einzigartigen Eigenschaften.

Das Deutsche Elektronen-Synchrotron DESY und

das Automobil Forum der Volkswagen AG

laden Sie zur festlichen Eröffnung der Ausstellung

TESLA - Licht der Zukunft

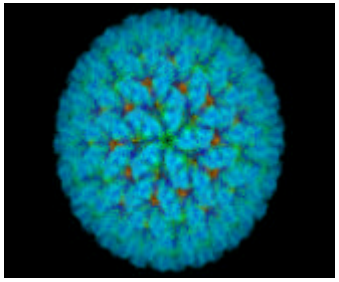


Der kleine Urknall im Labor

TESLA bringt Licht in die Bausteine der Materie sowie in den Ursprung der Kräfte und der Masse im Universum.

am Dienstag, dem 15. Januar 2002 um 19 Uhr

im Automobil Forum Unter den Linden Berlin ein.



Atome im Blitzlichtgewitter

Der TESLA-Röntgenlaser liefert Lichtblitze von bisher unerreichter Intensität und Kürze, die erstmals das Filmen chemischer und biologischer Prozesse erlauben.

Gabriele Vera Heider	Prof. Dr. Albrecht Wagner	Dr. Ulrich Gensch
Leiterin des Automobil Forums	Vorsitzender des DESY Direktoriums	Leiter des DESY Zeuthen
Forschungsbereiches		

Comment on Cost Estimates

CERN: Difficulties with LHC

Die ZEIT, referring to TESLA: 'Who still believes its cost'

TESLA: Cost estimate based on known component costs for TTF and industry analysis of cost reduction through mass production

PETRA: 98,5 MDM

within budget, estimated construction time reduced by 9 months

HERA: Estimate 1,334 MDM,

certified by General Accounting Office

Costs: 1,372 MDM (2.8% cost overrun)

Looking forward to joint review next week

Summary

The TDR has triggered a lot of enthusiasm

The science case for LC and FEL are very strong

There is a unique consensus concerning the LC

Where to go from here?

We must work out the priorities for the next two years

We must move as fast as possible towards one technical solution and one collaboration, to join forces and get the job done


TESLA

Results TESLA (1)

Oral Statements:

A Linear Collider (LC) is considered to be a very important tool for particle physics and a necessary addition to the LHC. The scientific questions addressed by the LC are of central importance for the development of the field, well defined predictions exist for the accessible energy range. The LC clearly complements the LHC. TESLA finds itself in an excellent starting position. The LC as planed by the TESLA collaboration is the right tool to answer the open questions and is therefore the next accelerator to be built.

Results TESLA (2)

The project has been very well prepared. The test facility and the results obtained with it are impressive. It represents a great engineering achievement. The test facility is not only a test of components, but a fully functional system test. This facility should be maintained and extended. The collaboration has demonstrated that a acceleration gradient of 23.4 MV/m can be reached, thus creating great confidence that a LC can be built. The sub-group recommends to do everything to assure that 35 MV/m can be reached, and thereby an energy of 800 GeV. This goal should have the highest priority. Other R&D projects should be pursued in parallel (e.g. the combination of the present modules into so-called 'superstructures').

The proposal to build the LC as a truly international project, e.g. in the framework of the Global Accelerator Network, is strongly supported.