Industrial Involvement in EC Supported Accelerator R&D in the 6th Framework Programme and in Preparing Large Scale Accelerator Projects (TESLA)“

D.Proch, DESY

- EU support for accelerator R&D
  - An overview by a **non expert**
- Examples of EU supported R&D in I3 and design studies
- Involvement of Industry in planning for large projects: TESLA

Basic features of Framework Program 6 (FP6)

- **17500 M€** for the years 2002-2006
- Main objectives:
  - To contribute to the creation of the European Research Area (ERA) by improving **integration and coordination** of research in Europe which is far largely fragmented
  - Research will be targeted at strengthening the **competitiveness** of the European economy
- Three main blocks of activity

Framework Program 6: Groups of action

1. Focusing and Integrating Community Research (13345 M€)

7 thematic priorities (does not included subatomic physics)

Main instruments are ***Network of Excellence*** and ***Integrated Projects***

2. Structuring the European Research Area (2605 M€)

3. Strengthening foundations of the Eu. Research Area (320 M€)

ad 1. Thematic Priorities

1.1 Genomics and biotechnology for health
1.2 Information society technologies
1.3 Nanotechnologies & production processes
1.4 Aeronautics & Space
1.5 Food quality and safety
1.6 Sustainable development, global change
1.7 Citizens and governance in knowledge based society

Instruments:
Networks of Excellence
Integrated Projects
Specific Targeted Research Project
Co-ordination action

Framework Program 6: Groups of action

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Four categories of activity

1. Research and innovation
2. Human resources
3. **Research infrastructures**
4. Science and Society

3. Strengthening foundations of the Eu. Research Area (320 M€)

1. Support for the coordination of activities
2. Coherent development of research and innovation policies (evaluation, bench-marking, administration …)

ad 2.3 Support of Research Infrastructures

1. **Transnational Access**

2. **Integrated Infrastructure Initiative (I3)**

- **by supporting *Networking Activities* (good project mandatory to be accepted)**
- **by supporting *Transnational Access***
- **by supporting *Joint Research Activities***

3. **Communication Network Development (CND)**

GRID

4. **Design Studies (DS)**

- **by supporting *feasibility studies***
- **by supporting *technical preparatory work***

(development and testing of critical components, subsystems …)

Accelerator R&D

5. **Construction of New Infrastructures (CNI)**

(~10% of construction costs)

Joint Research Activities
JRA

- Joint research projects (e.g. joint research into higher performance techniques, instrumentation or technologies) aim at improving, in quality or quantity, the service provided by **existing infrastructures** in particular fields in Europe.
- Research projects should be **innovative** and explore new fundamental techniques underpinning the use of infrastructures in a given class...
- Networking activities are **mandatory** for I3 activities, i.e.for joined research activities.

Network activities

- Will help catalyze the **mutual co-ordination** and pooling of resources amongst the consortium of participants,
- Will aim at spreading good practice, promoting common protocols and interoperability, encouraging complementarity,...
- Will cover **co-ordinated implementation** and management of the whole I3 activity.

Design Studies

- Feasibility studies and technical preparatory work for those **new infrastructures** which have a clear European dimension and interest...
- **Feasibility studies** aim at laying the conceptional foundation of potential new or enhanced infrastructure
- **Technical preparatory work** will cover the development and testing of components, subsystems, materials or techniques that are critical for the future development of a new or enhanced infrastructure**.**

Construction of new infrastructures

- This scheme may provide **limited support** aimed at optimising the European nature of **key new infrastructure** of Europe-wide interest.
- Support may also be granted for a **major enhancement or upgrading of existing infrastructures,** in particular where this would constitute an alternative to the construction of a new infrastructure

Financial regime

- Community support will be in the form of a **“grant to the budget”** , (50% for RTD components of total costs)
- Paid as a contribution to actual costs
  - that are necessary for the project
  - that are recorded in the accounts of the participants
- Annually, each participant to provide a summary cost statement
  - **certified by an independent auditor**
  - **supported by a management-level justification of costs**

Maximum EU support

- JRA: **4 M€,** but consortium can propose several JRA`s
  - but only 50% of total cost
- Design study: **10 M€**
  - but only 50% of total cost
- New infrastructure: max **10 %** of total project

European Commission

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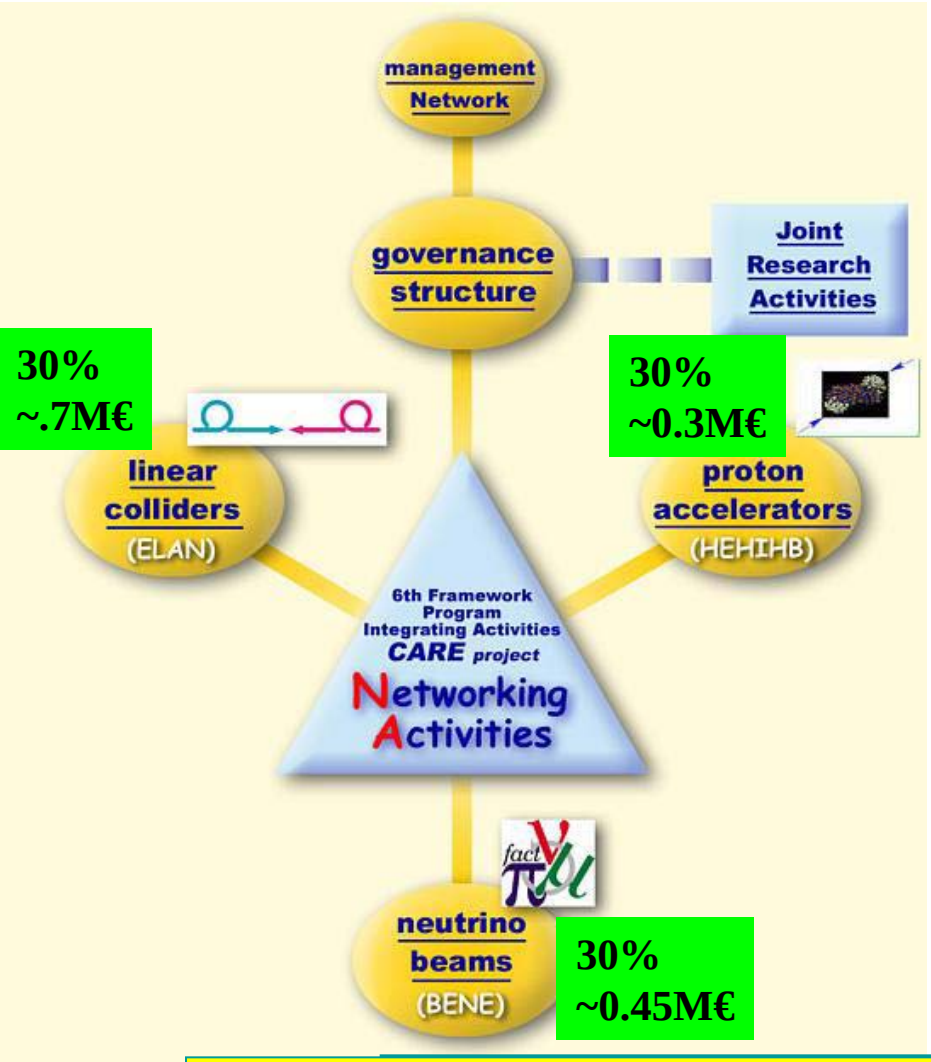
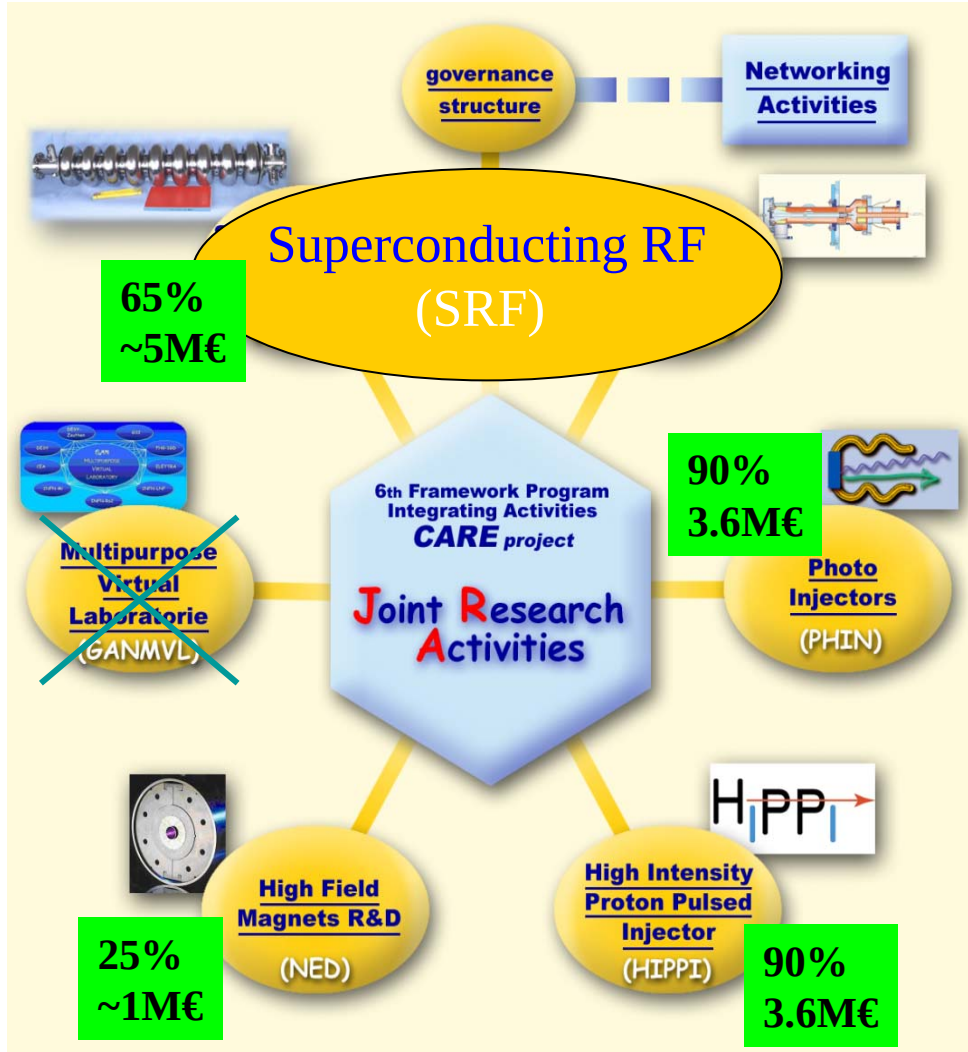
CARE included 3 Networks and 6 Joint Research Activities

CARE: Coordinated accelerator research in Europe





CARE is recommended for funding at the maximum level of 15.2 M€ (i.e. 52% of initial request) in the Evaluation Summary Report (ESR)

Involvement of industry as associated partners in JRA-SRF

(superconducting radio frequency)

EU project CARE

(coordinated accelerator research in Europe)

- Improved SRF accelerating system
  - Improvement of cavity fabrication
    - Evaluate and improve present design and fabrication of cavities: **ACCEL, ZANON**
  - Development of a SQUID scanner for Niobium sheet quality control
    - Higher sensitivity than nc eddy current : **WSK**

Involvement of industry as associated partners in JRA-NED

(next European dipol)

EU project CARE

(coordinated accelerator research in Europe)

- Development of high performance **Nb3Sn wire** & of a parametric design of a large-aperture, high-field **Nb3Sn dipole magnet**
- Industriel partners
  - **European Advanced Superconductors**
  - **Alstom/MSA**
  - **Kriosystem**

Work package in new Design Study EUROFEL

Studies on industrial assembly procedures

CLR string assembly

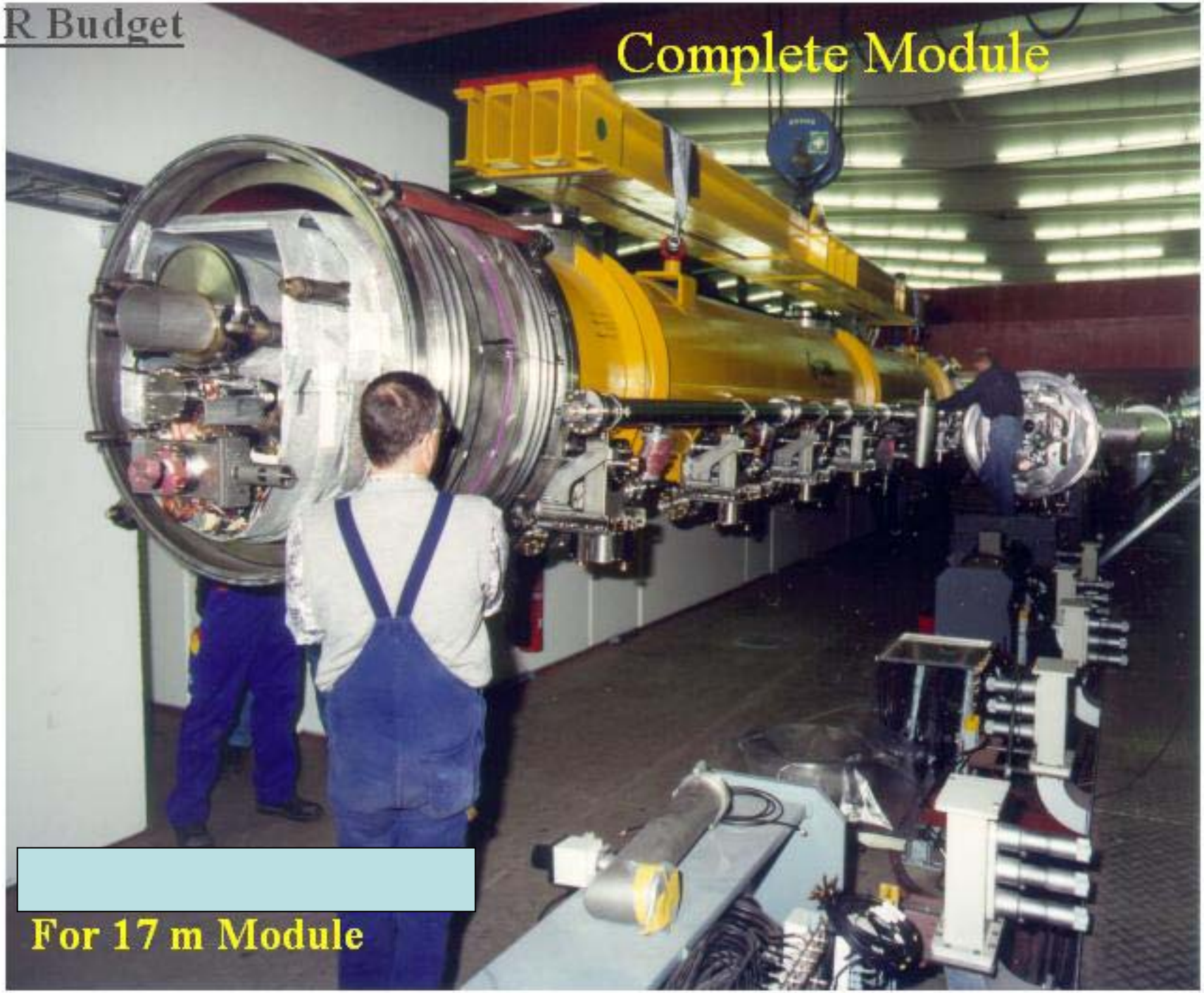
Preserve performance of cavities !

Save assembly costs !

-> Assembly procedures can be verified only in module tests

assembly outside CLR

XFEL-cryomodule technology transfer

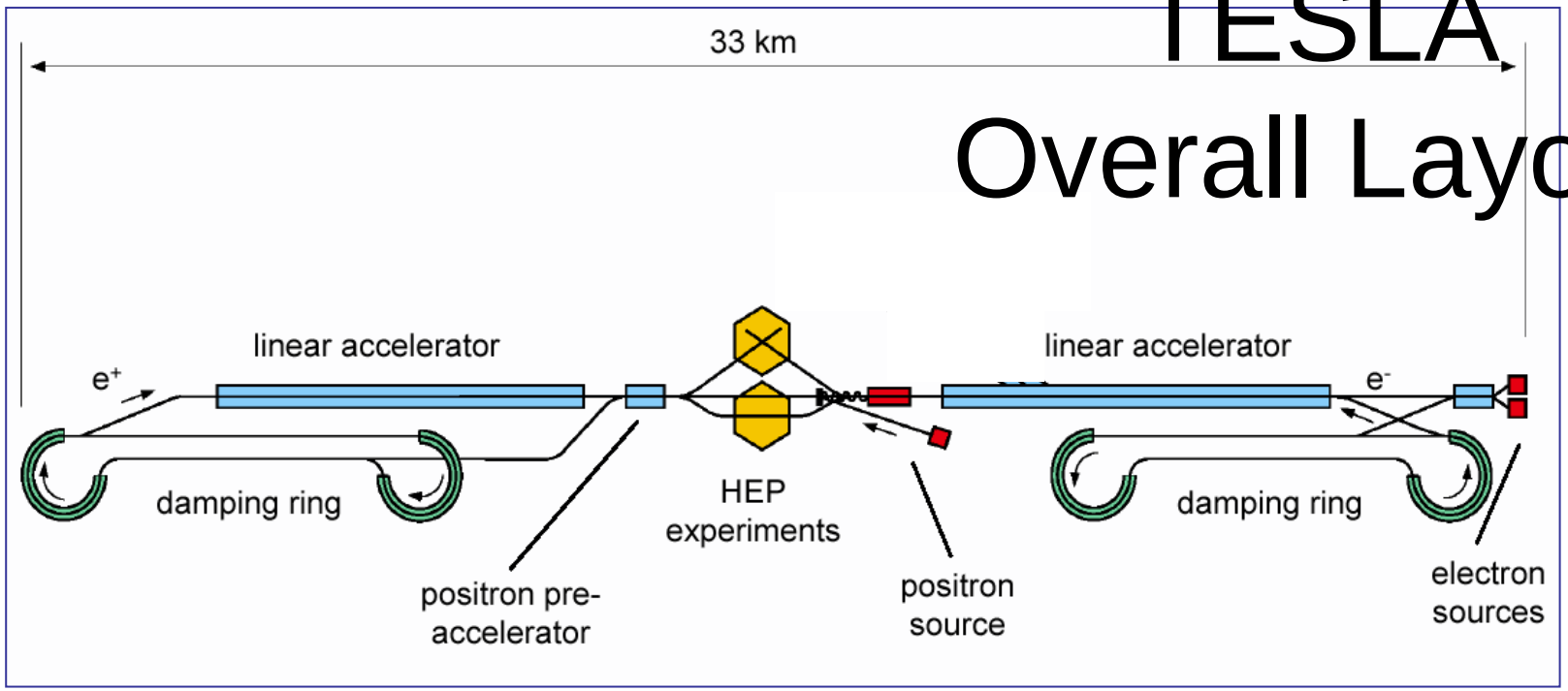

Complete Module
For 17 m Module

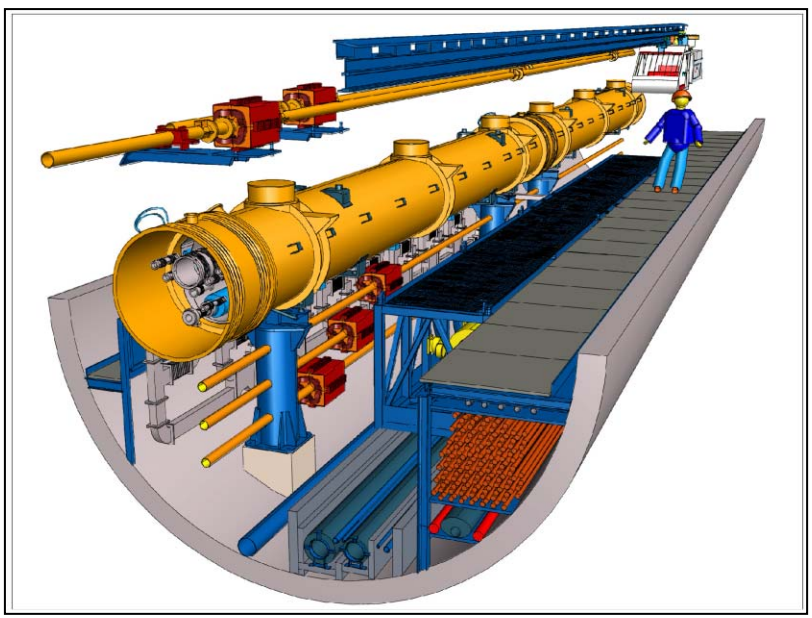
Work package in new Design Study EUROFEL

Development of a pulsed to cw high power RF source

- Flexible „pulsed to CW“ rf source for XFEL to enable high macropulse duty cycle/lower bunch frequency
  - Based on IOT or CW Toshiba klystron
  - **Involve industry in designing principle tube layout**
  - Concept for power supply
  - Cost estimates

TESLA
Overall Layout





Superconducting RF, 1.3 GHz

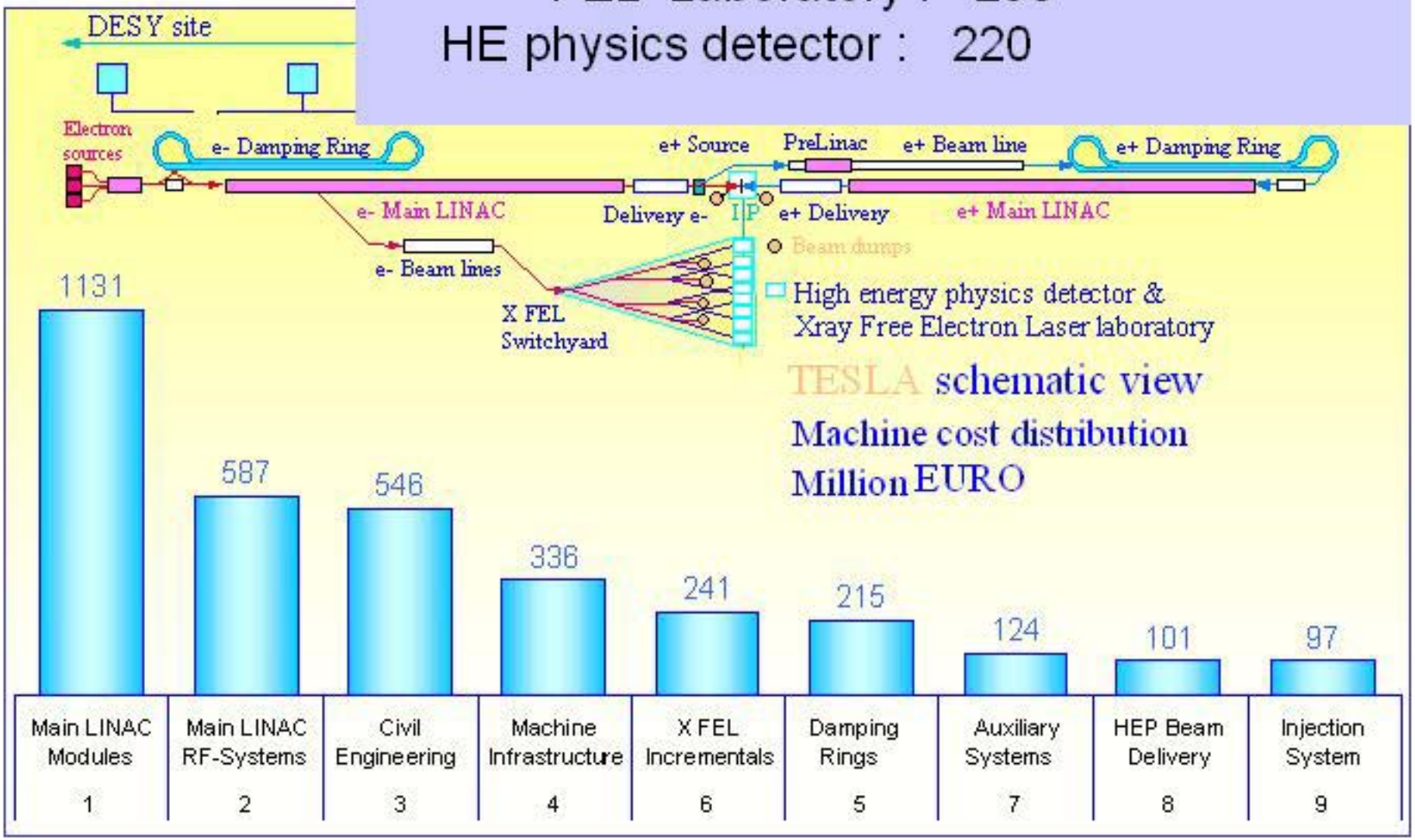
Loaded gradient up to 35 MV/m

For site length 33 km: E_{cm} = 800 GeV

The Technical Design Report incl. cost was published in March 2001

The costs

Total cost LC: 3136 Mio Euro
additional FEL: 241
FEL Laboratory : 290
HE physics detector : 220



Contracts to industry in cost evaluation (“industriel study”)

- **Analyze present production of TTF components**
  - Describe present fabrication process
  - Determine cost drivers, critical procedures
  - Define core technology, outsourcing possibility

- **Implementation of mass production methods**
  - Evaluate investment of machinery, tooling, roboting
  - Cost optimize flow of fabrication
  - Describe layout for “core tech” factory

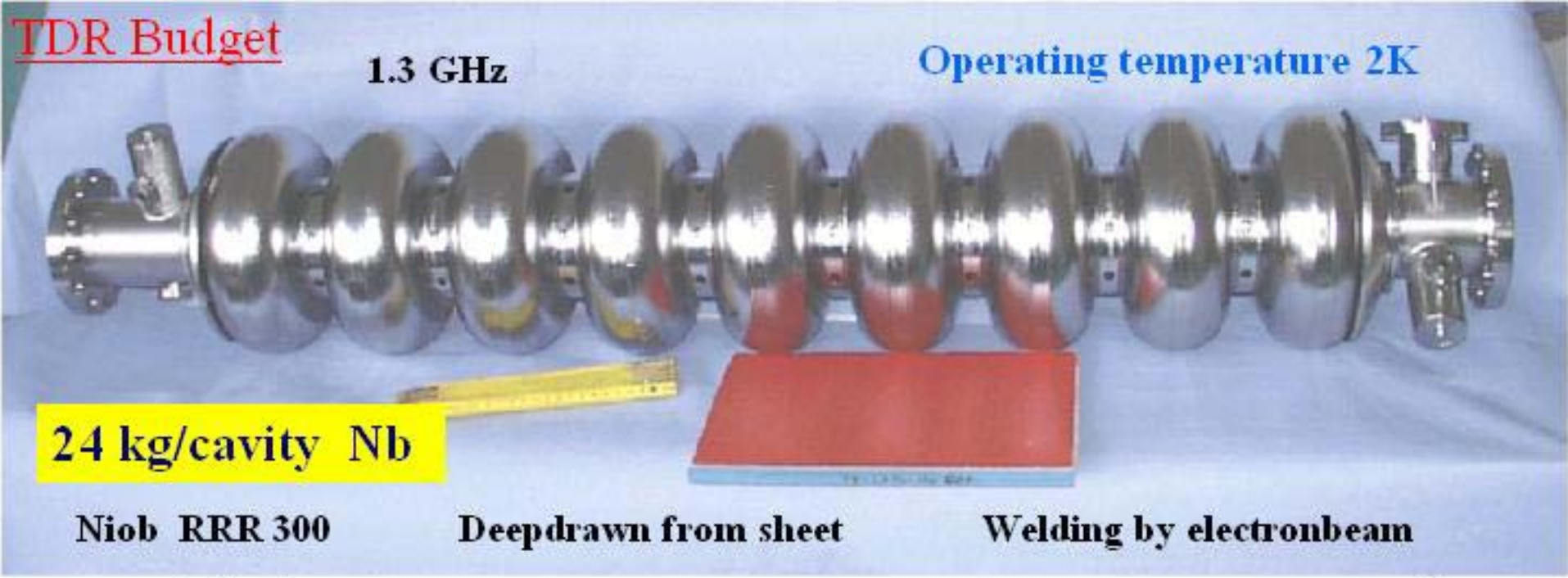
Contracts to industry in cost evaluation, (“industrial study”),cont.

- **Complete planning of new “core tech” factory**
  - Determine costs for buildings, investment, man power, ramp up & production & ramp down, overhead, consumables, QC,…
  - Get bits for outsourced parts
  - Sum up total cost of component fabrication

TDR Budget

1.3 GHz

Operating temperature 2K

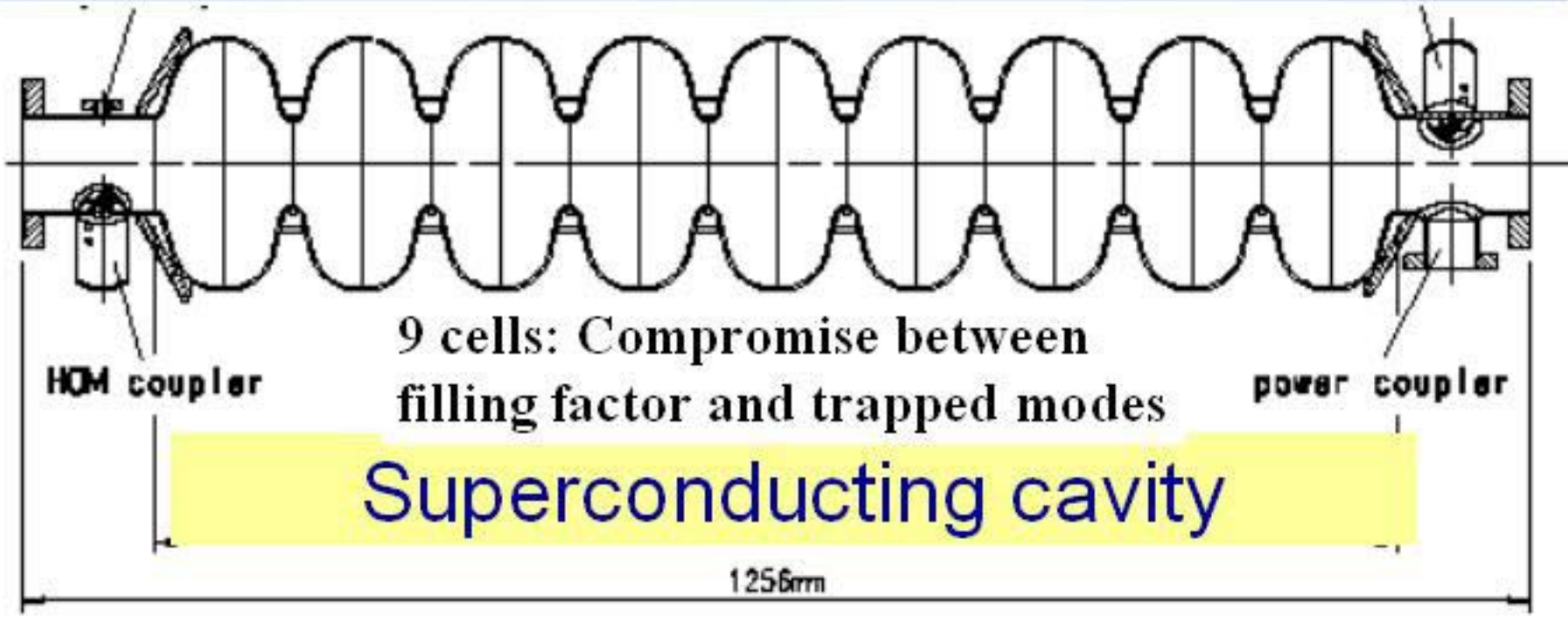


24 kg/cavity Nb

Niob RRR 300

Deepdrawn from sheet

Welding by electronbeam



9 cells: Compromise between filling factor and trapped modes

Superconducting cavity

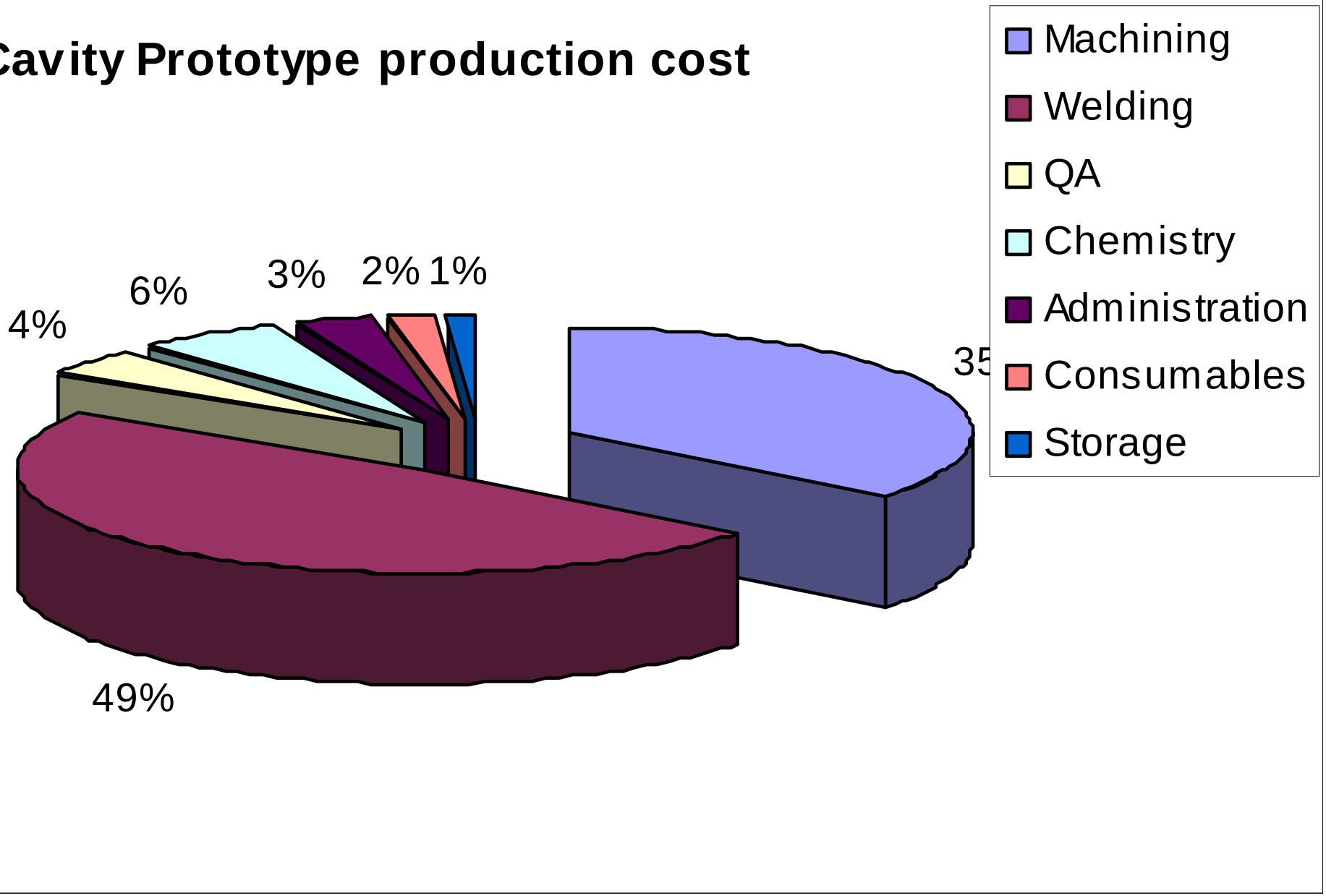
TDR Budget

Cavity production

Industrial study based on present fabrication technology adjusting tooling and procedures to production of 20000 cavities

Study Cavities

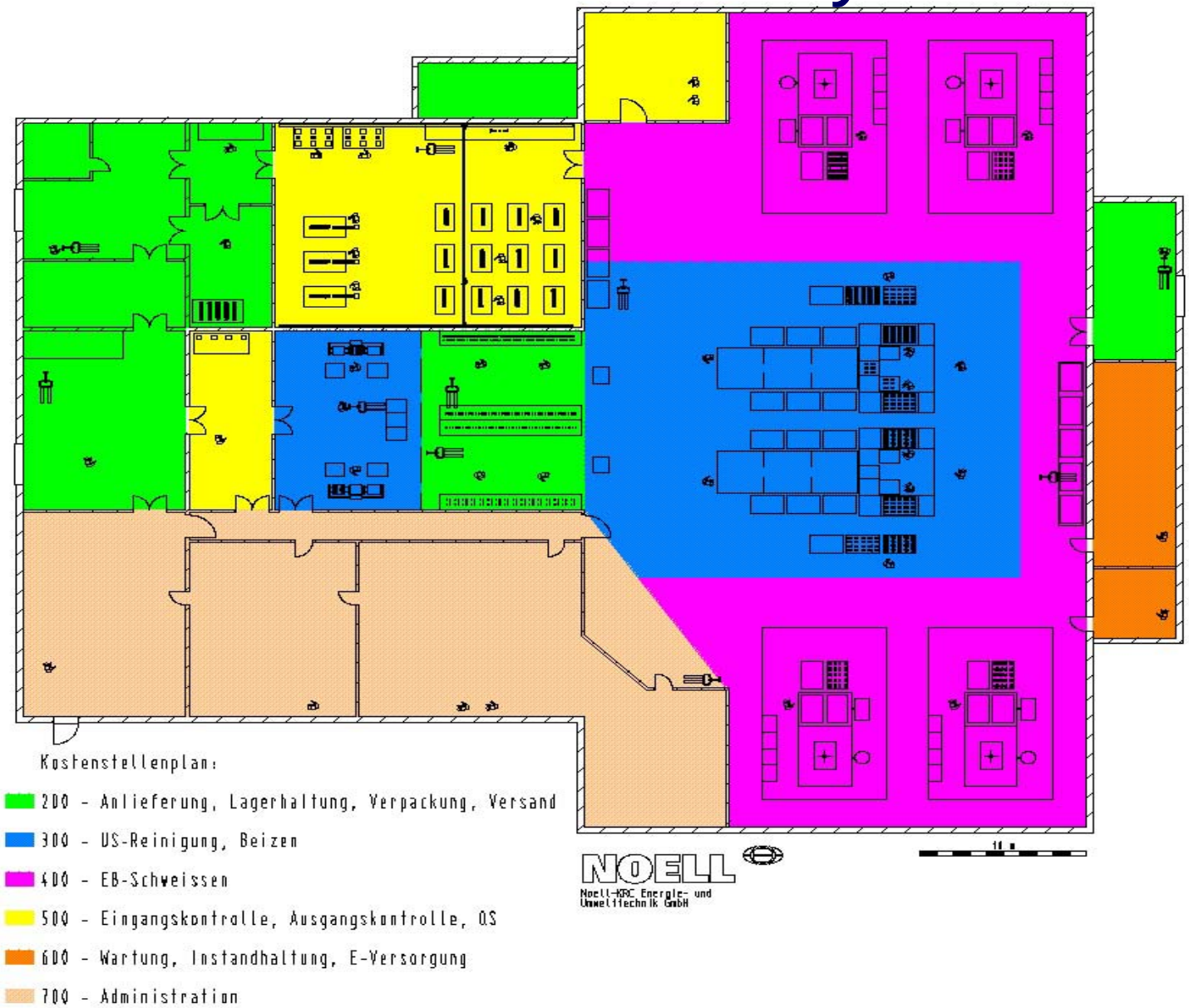
Cavity Prototype production cost

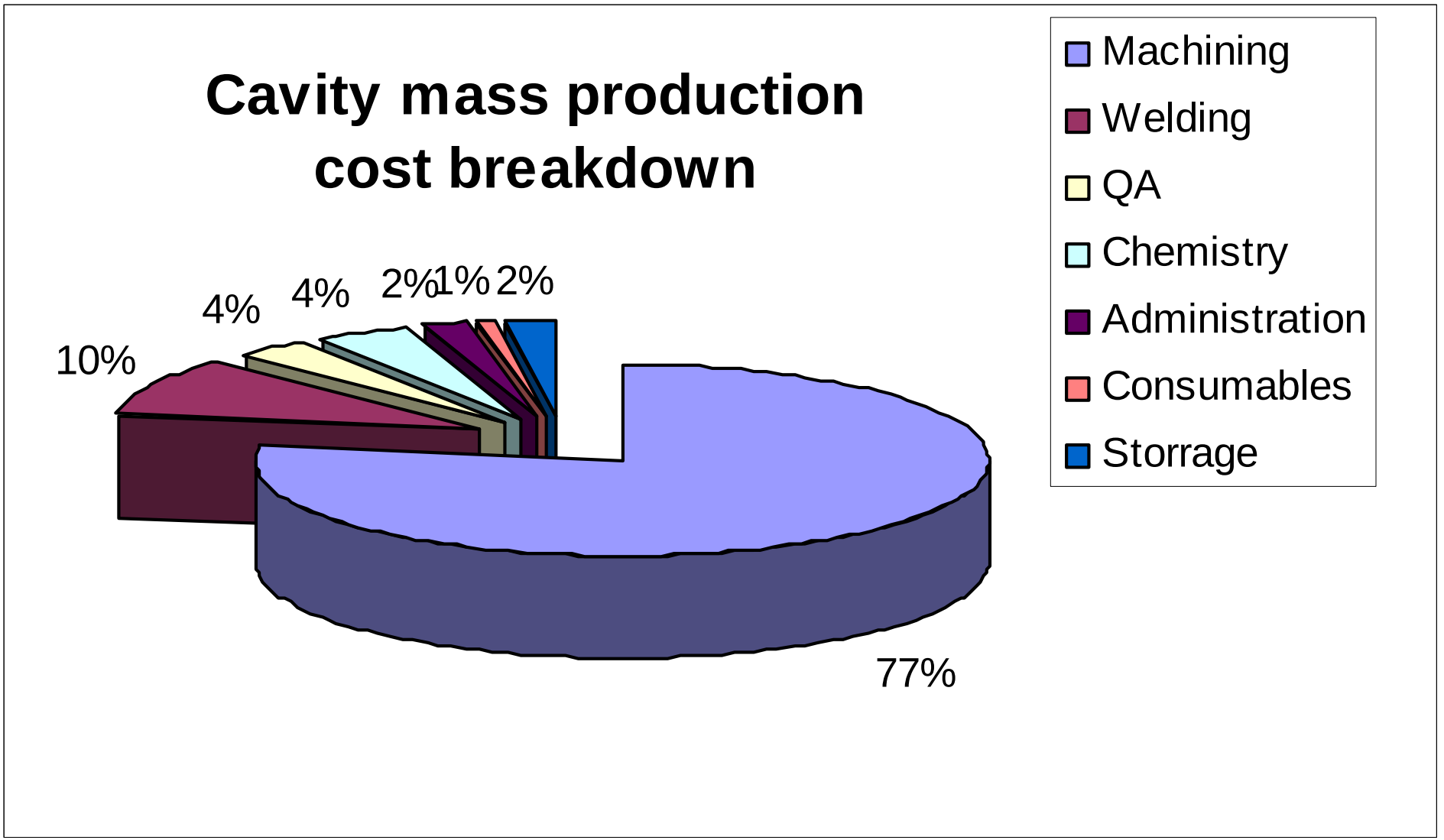


Reduction of fabrication cost

- **3 chamber welding machine:**
  - Pump down and cool down in separate chamber
  - Welding in middle chamber
- Tooling for welding many parts in one cycle
- **Outsource machining of parts**

Production facility




Cavity mass production cost breakdown
10%
4%
4%
2%
1%
2%
77%
Machining
Welding
QA
Chemistry
Administration
Consumables
Storrage

Overview on Industrial cost evaluations for TESLA

- **Niobium production for TESLA**
  - Noell (W.C.Heraeus)
  - H.C.Stark (under test sheets production)
- **Cavity fabrication (welding) for TESLA**
  - Noell (Dornier- Astrium),
  - ZANON
- **Cavity preparation, module assembly for TESLA**
  - Noell,
  - ACCEL
  - Zanon

Industrial investigations for TESLA

- **Prototype development** of klystrons
- **Coupler production** for TESLA
  - Thomson-Thales
- **Coupler production**, ideas for cost savings
  - CPI, IN2P3

Klystron

Prototype development of 10 MW tube for TESLA by:

Thales,

CPI,

Toshiba

(My personal) Summary

- **Competent and cooperative EU industry partners**
  - Much stronger than in USA
  - But more intensive in Japan
- **Very supportive EU financial contributions**
  - Was strong in nuclear physics/synchrotron light
  - growing support for high energy physics
  - Very helpful in hiring (non permanent) staff
- **Administrative effort for EU support is high**
  - Help by experts is inevitable
  - Try to use professional management tools from the very beginning

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