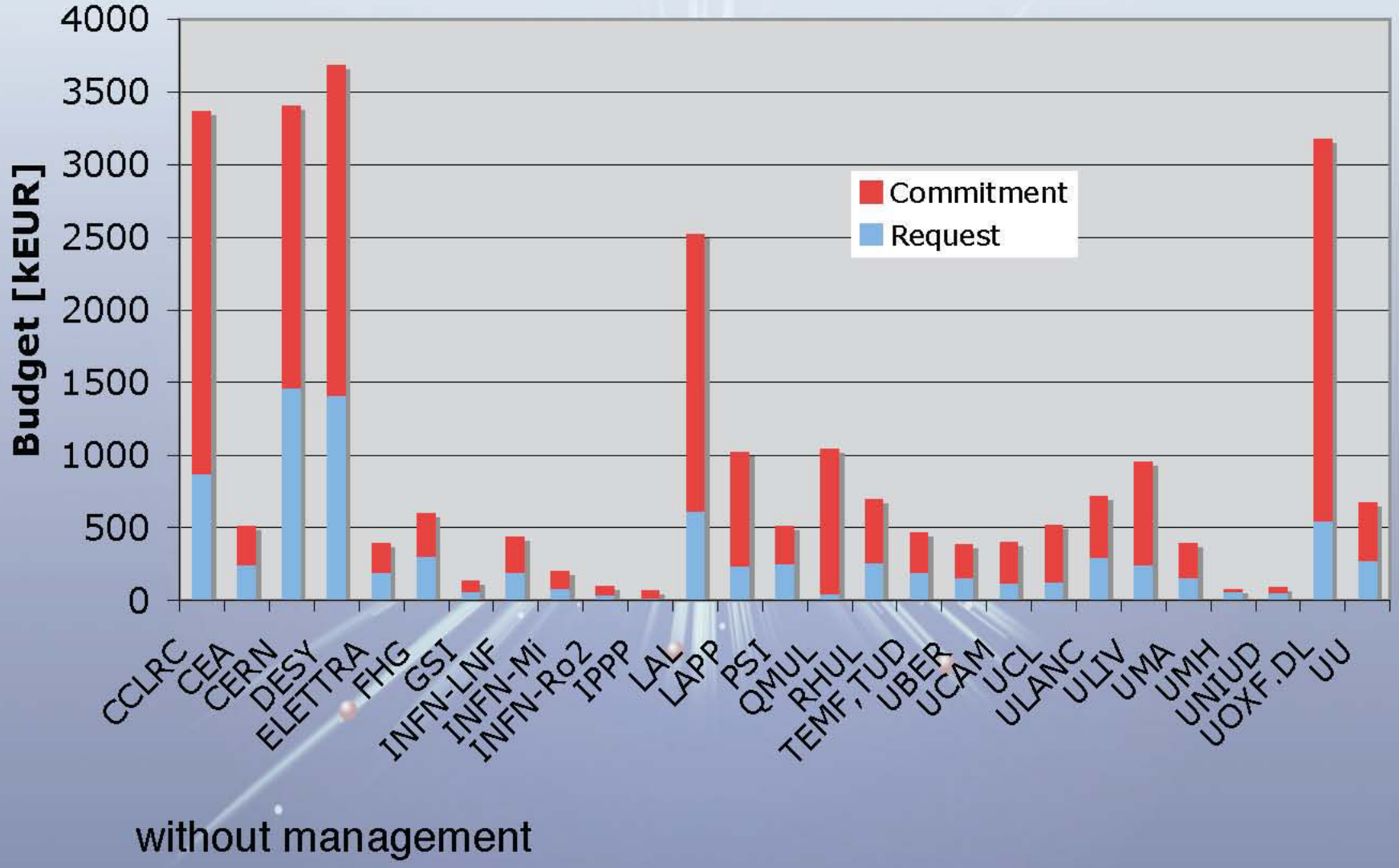
European Design Study Towards a Global TeV Linear Collider

2005-2007

Total Expected Budget (k€)	Requested EU Funding (k€)
27600	**9000**

328 persons·years expected **100 persons·years requested**

Scientific Involvement by Institute



without management

General Context

There is consensus that the next large accelerator facility is an e+e- linear collider, concurrently operating with the Large Hadron Collider p-p collider now being constructed at CERN and due to start operation in 2007.

OECD ministers noted this worldwide consensus and agreed that:

- planning and implementation of such a large, multi-year project should be carried out on a global basis,

- and should involve consultations among not just scientists, but also representatives of science funding agencies from interested countries.

ICFA formed the International Linear Collider Steering Committee (ILCSC) to promote and coordinate the realisation of such an LC: attention to outreach, technology, and organisation of the project.

General Context (continued)

ITRP (International Technology Recommendation Panel) is currently considering which linac technology should be adopted, with a recommendation towards the end of 2004.

ECFA and HEP community expressed their strong support for the realisation of the LC. Physics will determine the path:

- **Sub-TeV LC crucial if Higgs Particle and Super-symmetry found at the LHC, as precision tool and lepton S-s partner source**
- **Extension to the multi-TeV range would eventually open the way to the energy scale of Grand Unification of forces and extra space-dimensions.**

EUROTeV activities are part of the Global Design Efforts towards a *world linear collider*.
EUROTeV will strongly connect to the existing linear collider network ELAN formed in the CARE proposal.

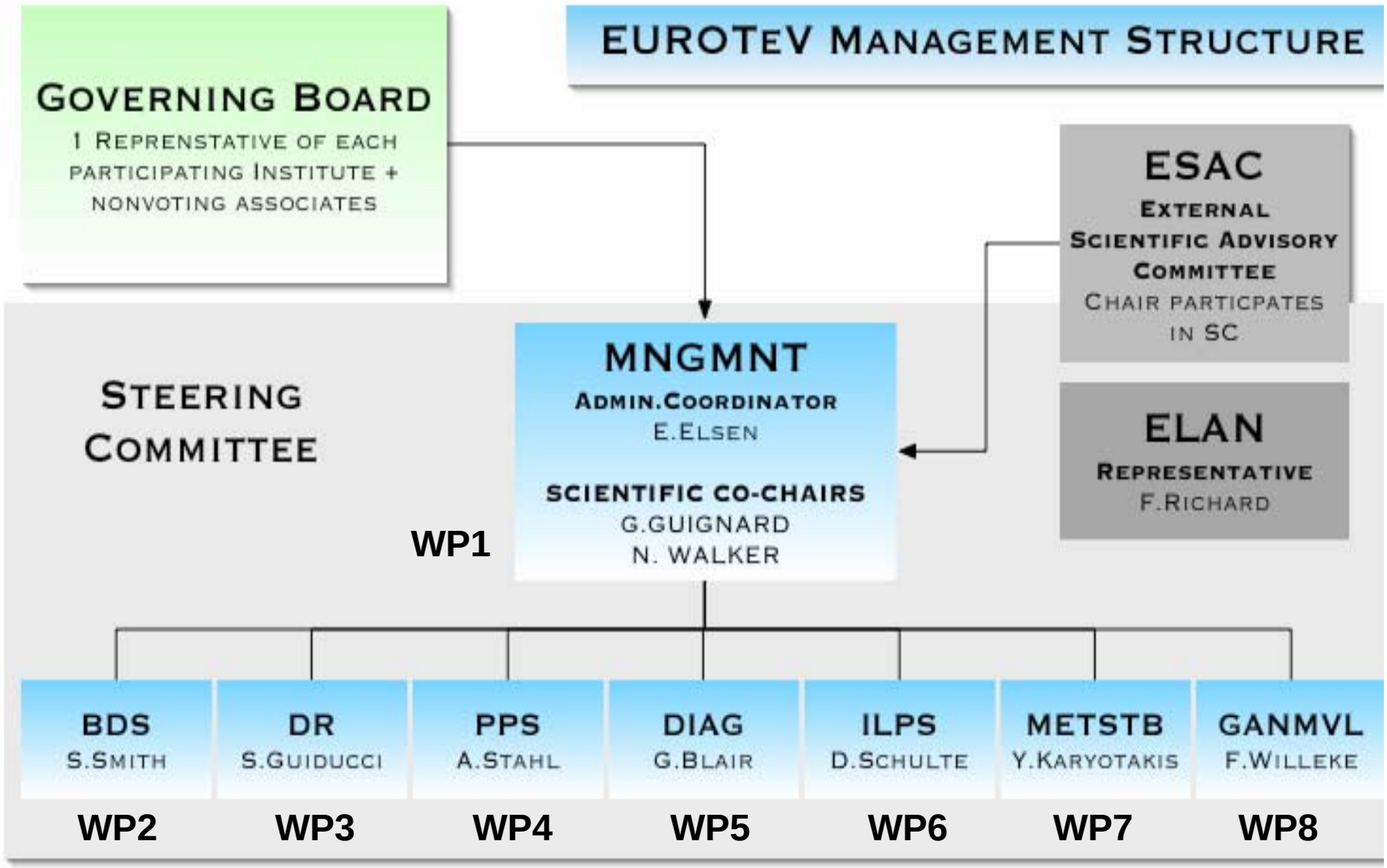
Design Study Objectives

ILC-TRC reviewed the existing LC designs and concluded – early 2003 –
- no fundamental technological grounds prohibiting any of the designs
- many critical R&D topics to be addressed before such a facility could be constructed.

ILC-TRC identified many critical R&D items, common to all designs, and *largely independent* of the choice of linac technology (sub-systems excluding the main linacs):

Source (specifically e+);
Damping Rings;
Bunch Compression;
Beam Delivery System;
Novel Diagnostics systems,
Computer modelling (simulations) of the luminosity performance.

EUROTeV proposal focuses on these high ranking topics.


EUROTeV MANAGEMENT STRUCTURE
GOVERNING BOARD
1 REPRENSTATIVE OF EACH PARTICIPATING INSTITUTE + NONVOTING ASSOCIATES
ESAC
EXTERNAL SCIENTIFIC ADVISORY COMMITTEE
CHAIR PARTICPATES IN SC
ELAN
REPRESENTATIVE
F.RICHARD
STEERING COMMITTEE
MNGMNT
ADMIN.COORDINATOR
E.ELSEN
SCIENTIFIC CO-CHAIRS
G.GUIGNARD
N. WALKER
WP1
BDS
S.SMITH
DR
S.GUIDUCCI
PPS
A.STAHL
DIAG
G.BLAIR
ILPS
D.SCHULTE
METSTB
Y.KARYOTAKIS
GANMVL
F.WILLEKE
WP2
WP3
WP4
WP5
WP6
WP7
WP8

WP2 subdivision in tasks
1. BDS Lattice Design
2. Crab Cavity RF System Design
3. Fast Beam-Based Feedback System Design
4. Spoiler Wake-fields & Mechanical Design
5. Superconducting Final Doublet Technology R&D

Beam Delivery System - BDS

WP3 subdivision in tasks
1. Studies of Electron Cloud and other Instabilities
2. Application of RF Separators to DR
3. Low Emittance Tuning Simulations
4. Wiggler Field Modelling and Impact on Dynamic Aperture

Damping Rings - DR

WP4 subdivision in tasks
1. Helical Undulator R&D
2. Photon Collimator Design
3. Conversion Target Design
4. Source Performance Modelling
5. Spin Rotation and Flip System Design
6. Spin Transport Studies
7. Low-Energy Polarimeter R&D

Polarised Positron Source - PPS

WP5 subdivision in tasks
1. Confocal Resonator BPM
2. Laser-Based Beam Profile Monitor
3. Precision Cavity BPM
4. Precision Energy Spectrometer
5. Precision High-Energy Polarimetry
6. Timing & Phase Monitoring
7. Wide-Band Current Monitor
8. Fast Luminosity Monitoring

Diagnostic - DIAG

WP6 subdivision in tasks
1. Failure Mode & Effect Simulations
2. Halo Collimation Simulations
3. Halo Related Background Studies
4. LET static beam-based alignment and tuning studies
5. LET Dynamic Feedback Studies
6. Fully Integrated LET Studies
7. Halo and Tail Generation
8. Bunch Compression Design
9. Post-Collision Diagnostics Lattice
10. B-B Simulation Code Development

Integrated Luminosity Performance Studies - ILPS

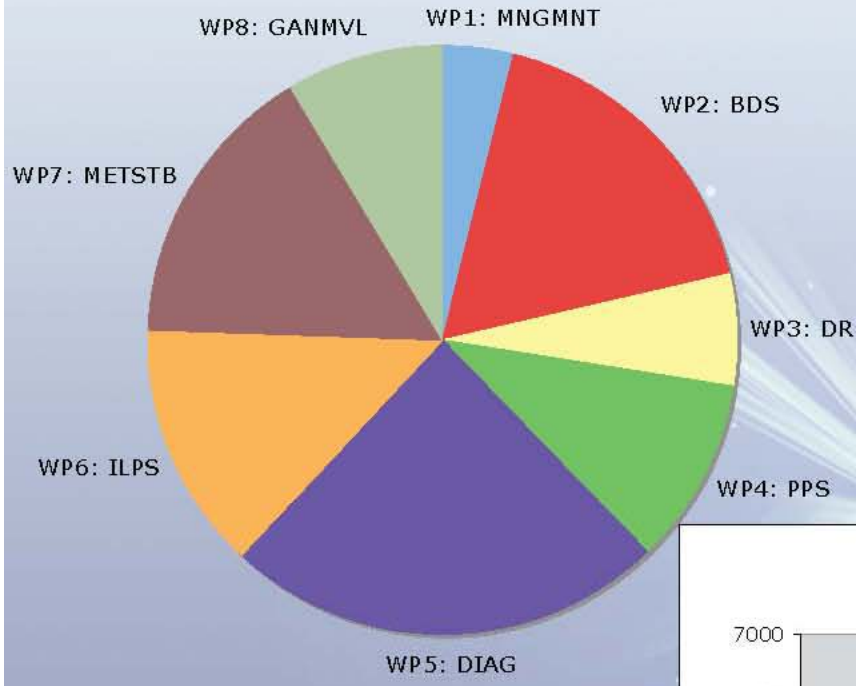
WP7 subdivision in tasks
1. Rapid Tunnel Reference System
2. Mechanical Stabilisation Technology
3. Precision Ground Motion Spectra

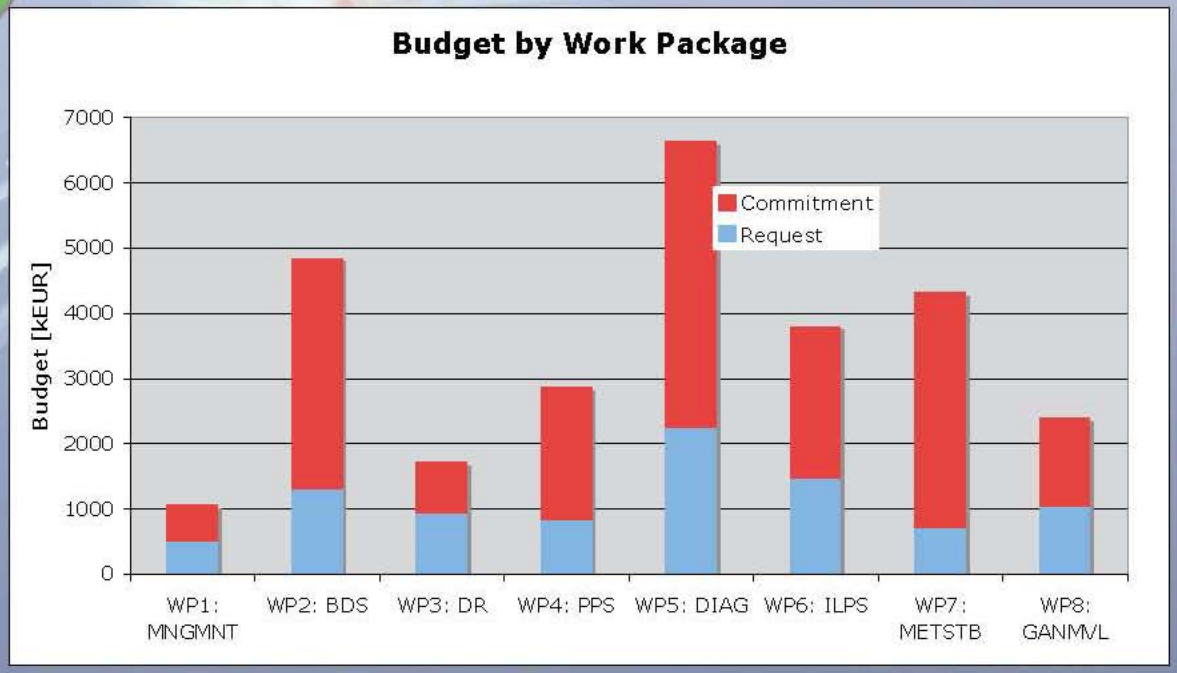
Metrology and Stabilisation - METSTB

WP8 subdivision in tasks
1. Overall Design and Integration
2. System Components
3. Mechanical and Electrical Design
4. Demonstration of GAN and Far Remote Operation

Global Accelerator Network - GANMVL

Programme by Work Package





Choice of CERN Contributions

- Technology independent items with CERN expertise
- Generation and transport of low emittance beams, sources and damping rings
- Beam Delivery and IP issues, related to small beam sizes, collimation and stabilization
- Advanced instrumentation for bunch-train and single-bunch characteristics and timing
- Modeling, code development, tuning procedure and feedbacks

ILPS Integrated Luminosity Performance Studies (<->DIAG)

- **Analysis of the performance obtained by tuning, using realistic assumptions for the static and dynamic imperfections, critical study for all LC.**

  - tuning strategy from damping ring to beam dump, integrated simulations

  - develop simulation tools, identify/specify diagnostics (reference codes exist at CERN)

  - tuning performance in realistic conditions

  - revision of tuning procedures as required

ILPS Integrated Luminosity Performance Studies (<->DR)

- **Study of electron clouds, which is a very critical problem in all linear colliders, damping rings, and for other accelerators like LHC**

  - Study code reliability for e-cloud build-up, benchmarking with experimental data from existing machines (PS, SPS, KEKB), build-up in wigglers
  - Similar study for the e-cloud interaction with beam

  - Use both codes to predict effects in ILC-DR
  - Benefit from the ongoing work on it in LHC (existing codes, extended to DR, confirmed at KEK)

ILPS Integrated Luminosity Performance Studies (<->BDS)

- **Collimator system study, valid for any LC**

  - Development of a potential nonlinear collimation system

  - Design of collimation system and evaluation of performance with errors

  - Evaluation of beam based feedback and fast luminosity feedback, dynamical simulations

  - Modeling spoiler wake-fields and benchmarking codes

ILPS Integrated Luminosity Performance Studies

- **Build-up of beam halo is a concern for all linear colliders**
  - Study the potential halo sources to identify the most important ones
  - Study the most important loss mechanisms either analytically or by numerical simulations
  - Halo collimation, efficiency and impact on tuning.
  - Explore benchmarking possibilities

Diagnostics (<-> ILPS)

- **Diagnostics are crucial for ILC and deserve strong development, improvement and tests as part of the generic advanced research**

- Wide-band current monitor

  - development of a bunch charge monitor capable to accurately resolve single bunch charge and timing in a bunch train -> in injectors, linac and DR

  - design and construction of a prototype

  - beam tests in CTF3

Precision Phase Reference

- Develop a phase reference system with high stability over long distances -> tests with beam (CTF3)
- Precise phase stability of the main beam with respect to the RF is required for LC.
- XFEL requirement is 10fs → Spin-off
- But differences for LC because of colliding beams and damping rings
- Best demonstrated in accelerator environment [1]:
  - Fiber link jitter 250fs
  - RF/beam phase measurement jitter 300fs

[1] J. Frisch, D. Brown, E. Cisneros: “The RF phase distribution and timing system for the NLC”

Diagnostics <-> DR,ILPS

- Precision beam position monitor (PBPM) applicable to BDS and Damping Ring

  - study design of an inductive pick-up, less sensitive to beam halo than RF and strip-line PU, working for a large range of bunch spacing and allowing to observe fast beam movement.

  - design of PBPM with 100nm resolution, 100µm precision, rise time of 15ns (evolution from LIL and CTF3 PU design)

  - fabrication of prototype

  - beam tests in CTF3

Task in the WPs	Total manpower	Requested manpower	Total Material	Requested material	Traveling	Requested traveling	Total needed	Total Req.
WP1 Management	2	-	-	-	29	6	293	6
WP2 Collimation system	2.9	1.5	-	-	10.44	5.4	246.24	140.4
WP3 e-cloud simulation	3.5	-	-	-	9	-	427	-
WP5 Phase reference	4.5	2.5	240	120	16.2	9	745.2	354
WP5 Current Monitor	1	-	168	84	3.6	-	303.6	84
WP5 Precision BPM	4	2.5	168	84	14.4	9	605.4	318
WP5 Test profile monitor	0.3	-	36	-	1.08	-	76.68	-
WP5 Sub-total	9.8	5	612	288	35.28	18	1729.88	756
WP6 Integrated simulation	5.35	2.5	-	-	19.26	9	431.56	234
WP6 Halo sources & losses	4	2.5	-	-	14.4	9	437.4	234
WP6 Collimation simulation	1.2	1	-	-	4.32	3.6	120.72	93.6
WP6 Sub-Total	10.55	6	-	-	37.98	21.6	1083.18	655.2
Totals of all tasks	28.1	12.5	612	288	121.7	53	**3686.8**	**1464**