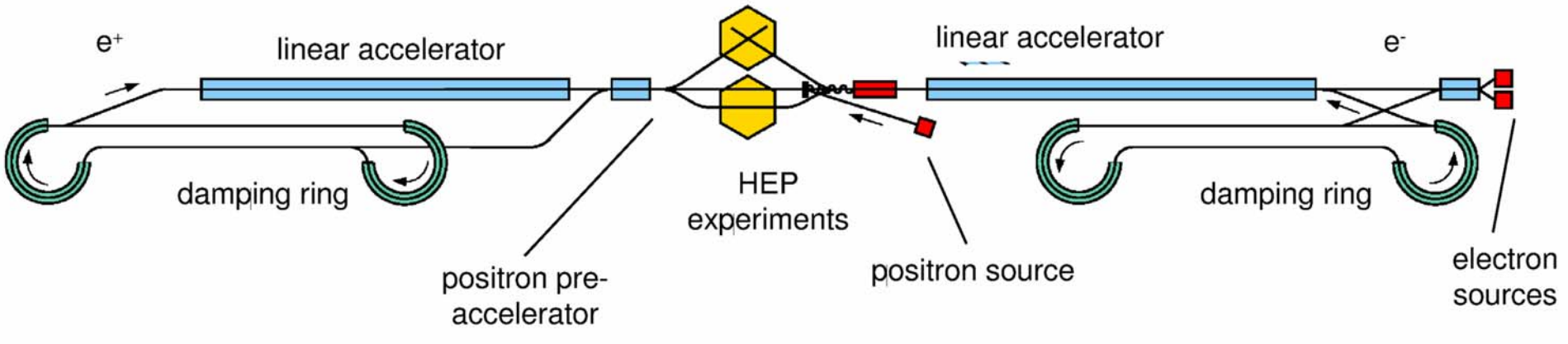
Activities at DESY within the ILC Project

The activities selected are very closely related to activities within the EUROTeV project

many of the transparencies were 'stolen' from Karsten Büßer; he has recently summarized DESY's activities / proposals foreseen within the Linear Collider activities over the next 3-4 years

ILC Overview ?



Historical Context

1992	TTF construction begins
03.2001	TESLA Collaboration published the TESLA Technical Design Report (TDR)
07.2001	US Snowmass HEP Workshop: consensus for e+e- LC in 500 GeV – 1 TeV range
Late 2001	ILC-TRC (Loew Panel) reconvened
2002	German Science Council evaluation of TESLA
01.2003	BMBF makes decision to support XFEL as separate project
Beg. 2003	Loew panels publishes 2nd ILC-TRC report
Mid 2003	International LC Steering Committees put in place
End. 2003	International Tech. Recommendation Panel (ITRP) chosen
01.2004	First meeting of ITRP
08.2004	ITRP makes a ‘cold’ decision: the ILC is born

Synergy

TTF / XFEL ⟷ ILC

at DESY

the worldwide linear collider project

- Linac, with its many (complicated) components

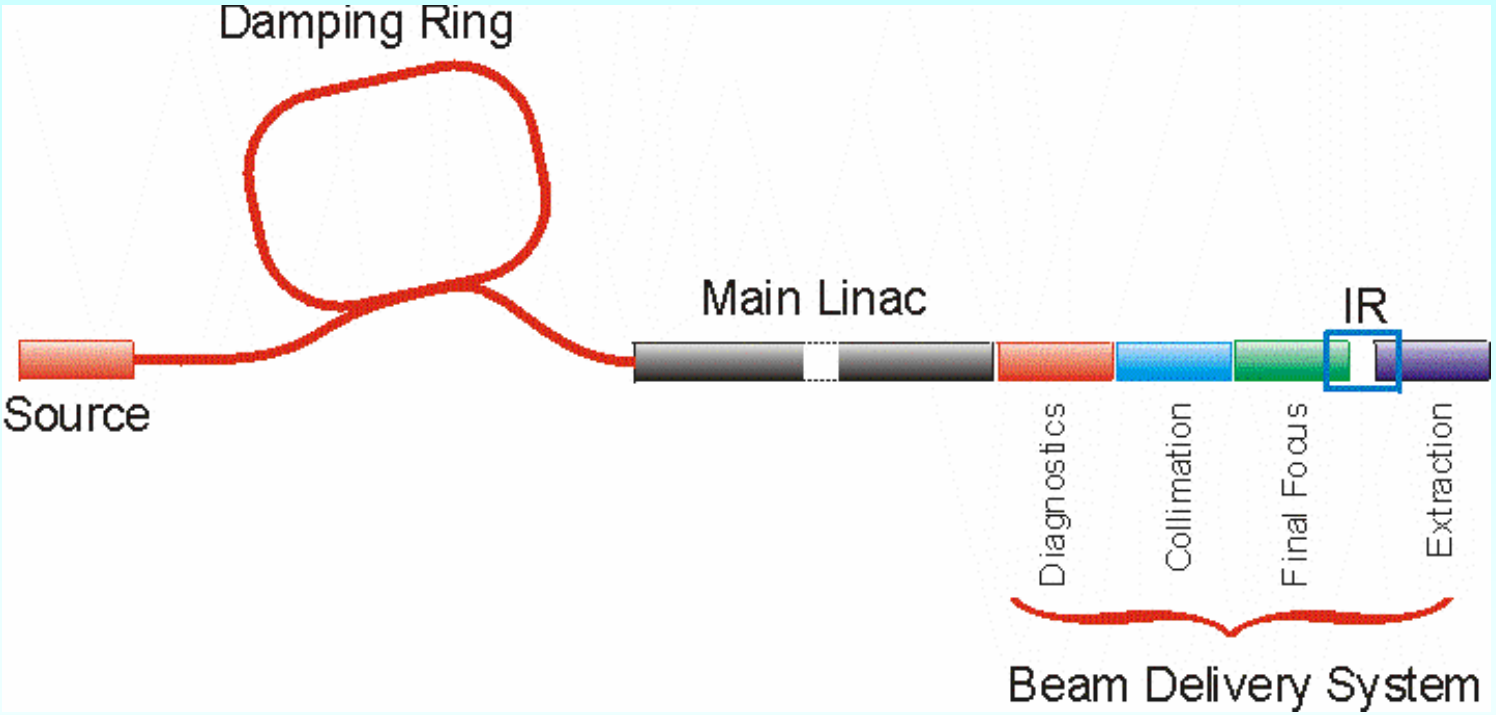
- Infrastructure (module test facility, cryogenics, survey, tunnel installation, utilities, ….)

…

connected to both streams

Other Areas of ILC R&D @ DESY

- R&D towards other sub-systems of the ILC will be within the context of the ***EUROTeV*** project.
- Main focus of rest of this talk



EUROTeV Proposal

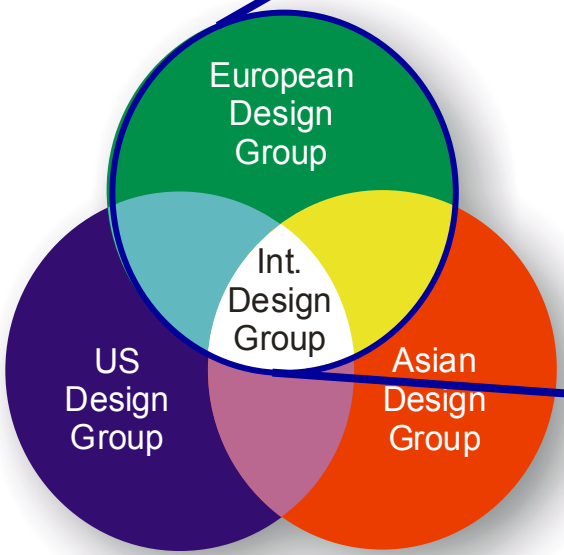
- Proposal has been submitted to EU FP6 in March 2004
  - 27 institutes
  - Coordinated by DESY: E. Elsen
  - 29.1 M€, with 11.3 M€ requested
- Referees saw "*an outstanding proposal, complete and compelling in every regard*"
  - Referees recommended 9 M€ EU support
- Contract negotiations with the European Commission have just been started
- Start of project: 01.01.2005
- Money will probably flow from mid February 2005

EU FP6 Design Study Proposal

Basis of the
European Design Team for the ILC

Initial focus on TRC tech.
Independent R&D

International
Linear Collider
Design Team
Concept



Damping Rings

Global Accelerator Network

Beam Delivery System

Integrated Luminosity Performance Studies

EUROTeV Work Packages

Diagnostics

Metrology & Stabilisation

Polarised Positron Source

Where DESY is involved

Basis of the
European Design Team for the ILC

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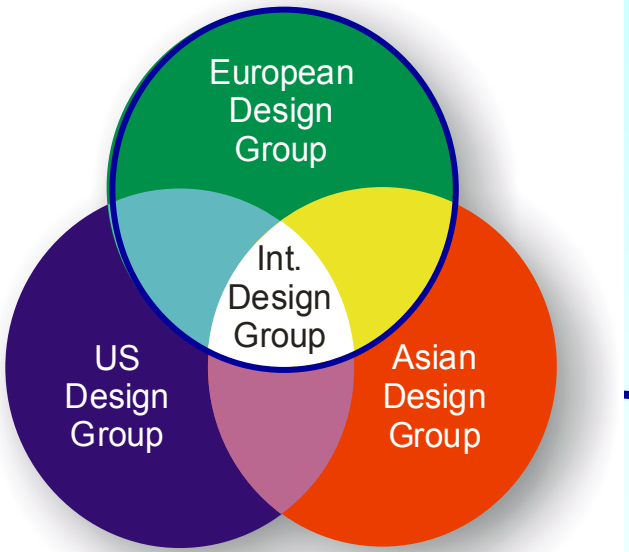
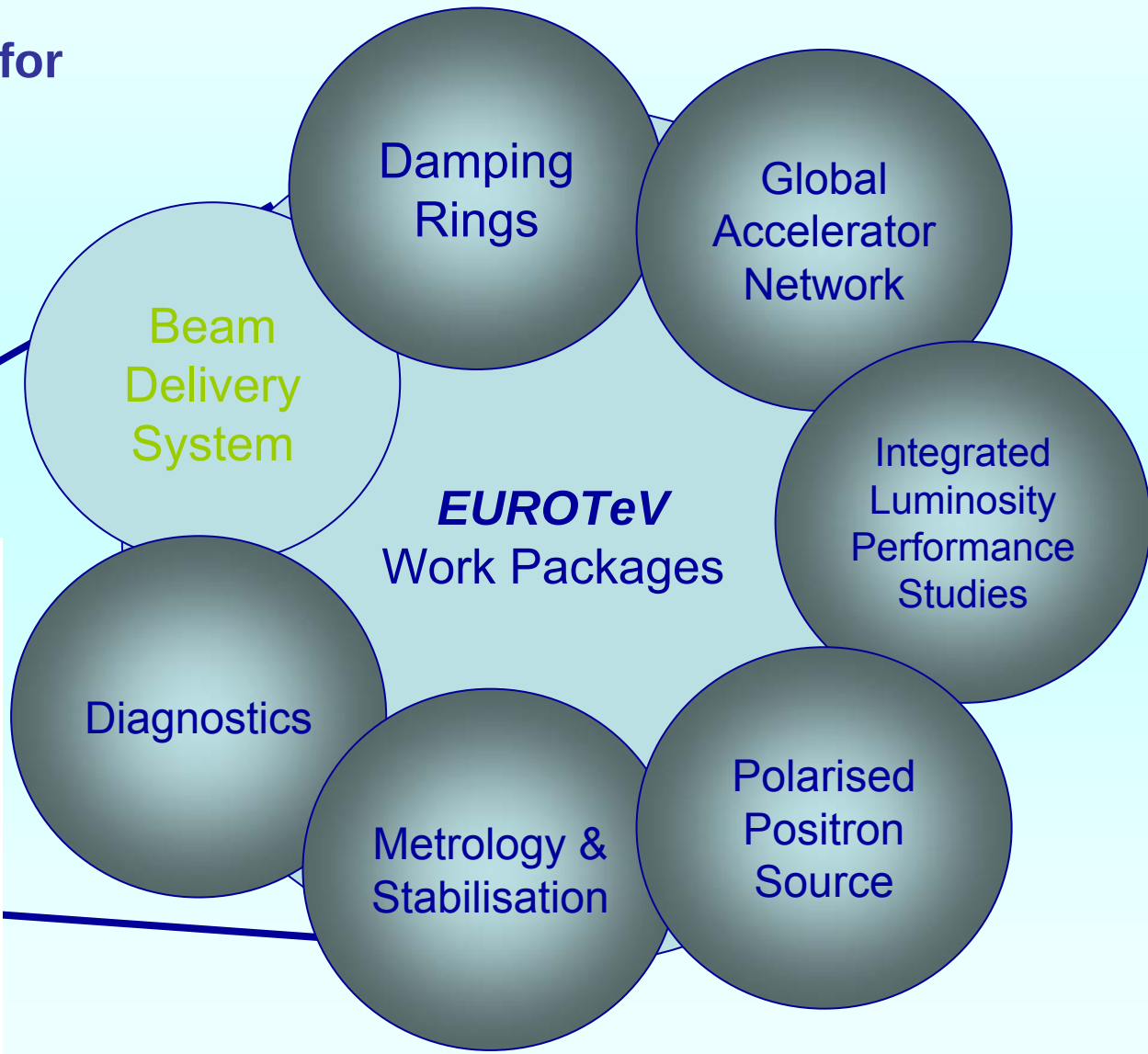
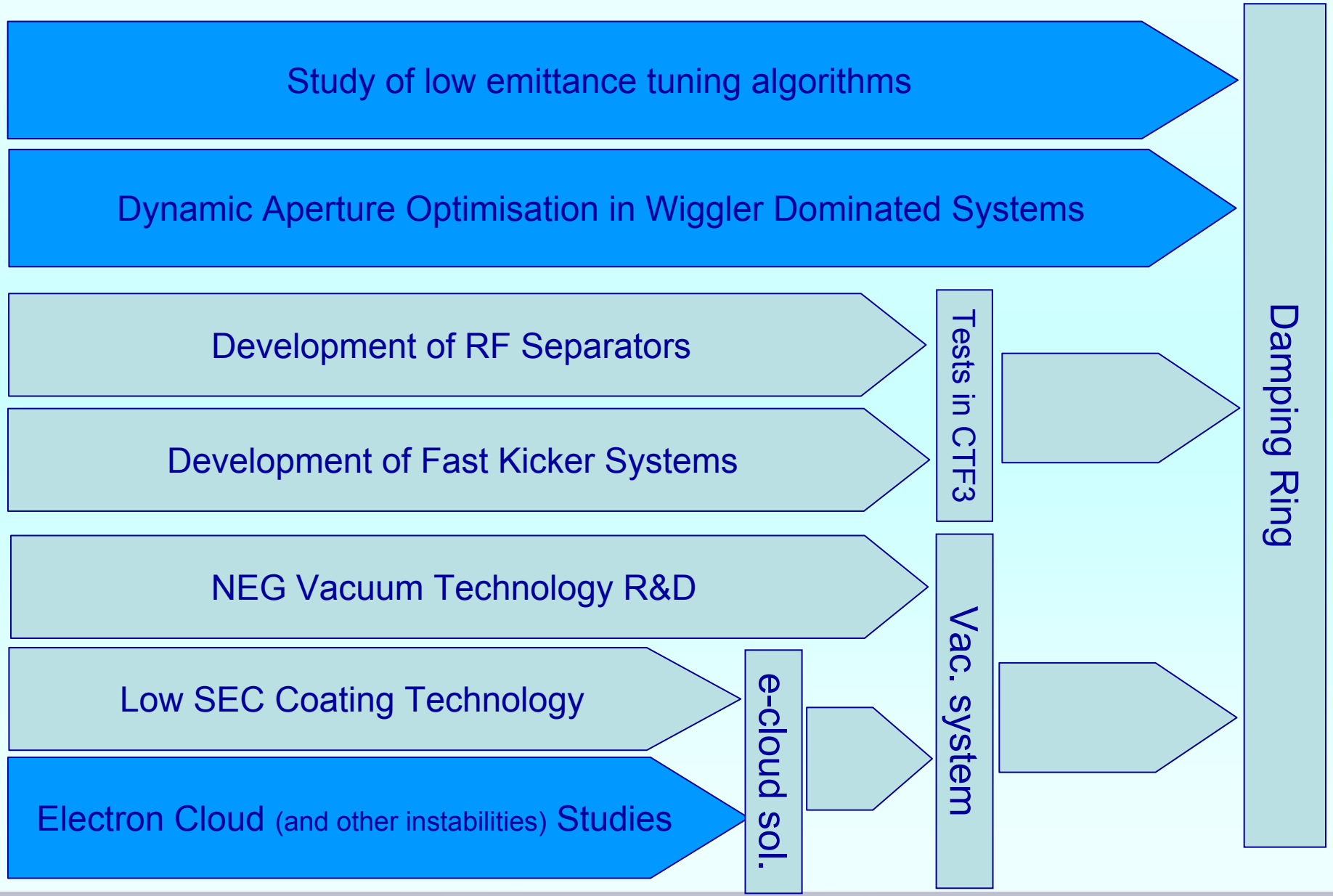
Concept



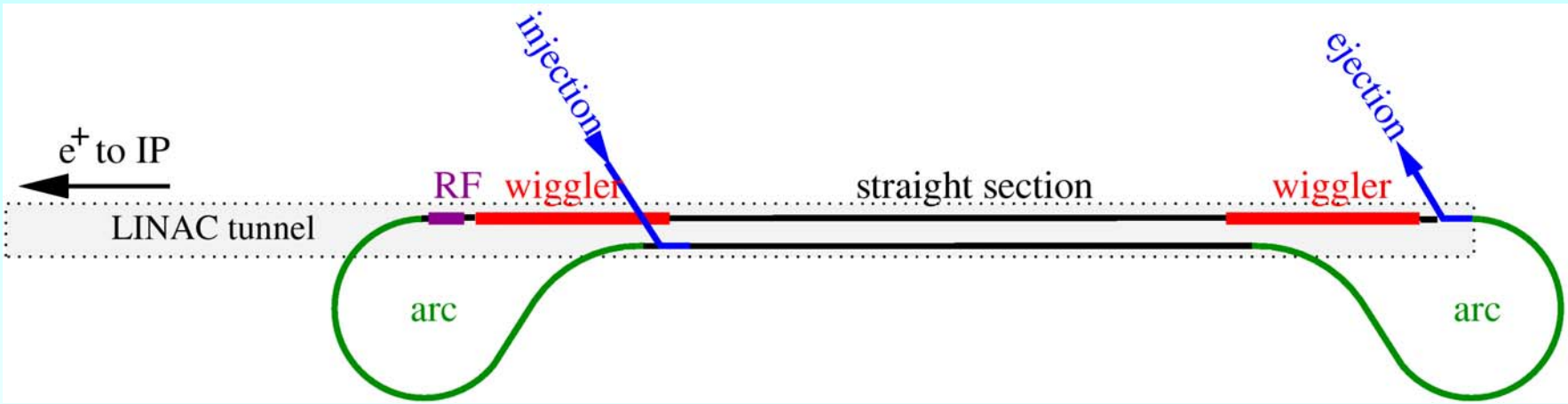


WP3 Damping Ring



TESLA Damping Rings

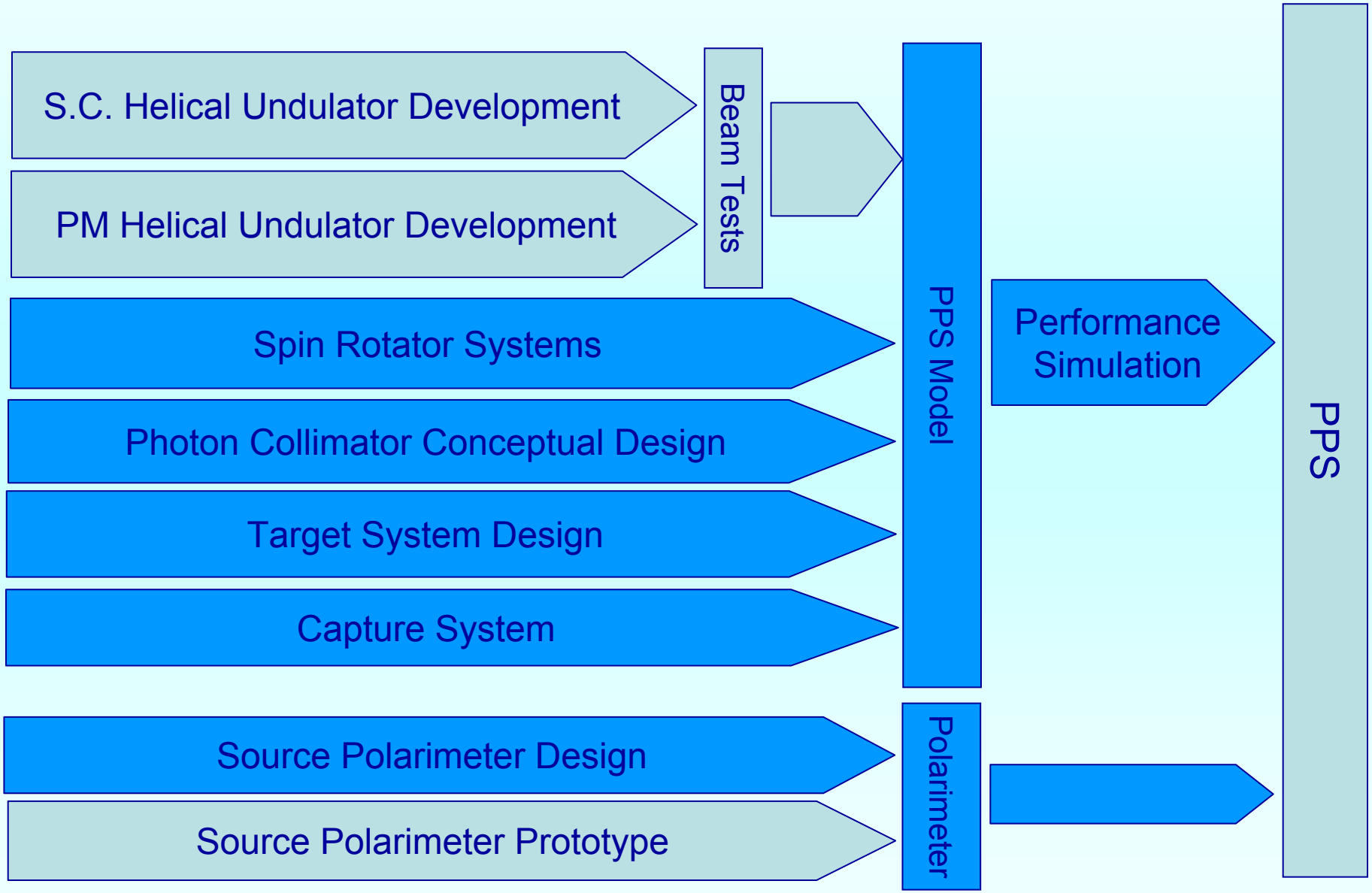
- Long pulse: 950ms $\times$ c = 285km!!
- Compress bunch train into 18km “ring”
- Minimum circumference set by speed of ejection/injection kicker (~20ns)
- Unique “dog-bone” design: 90% of ‘circumference’ in linac tunnel.



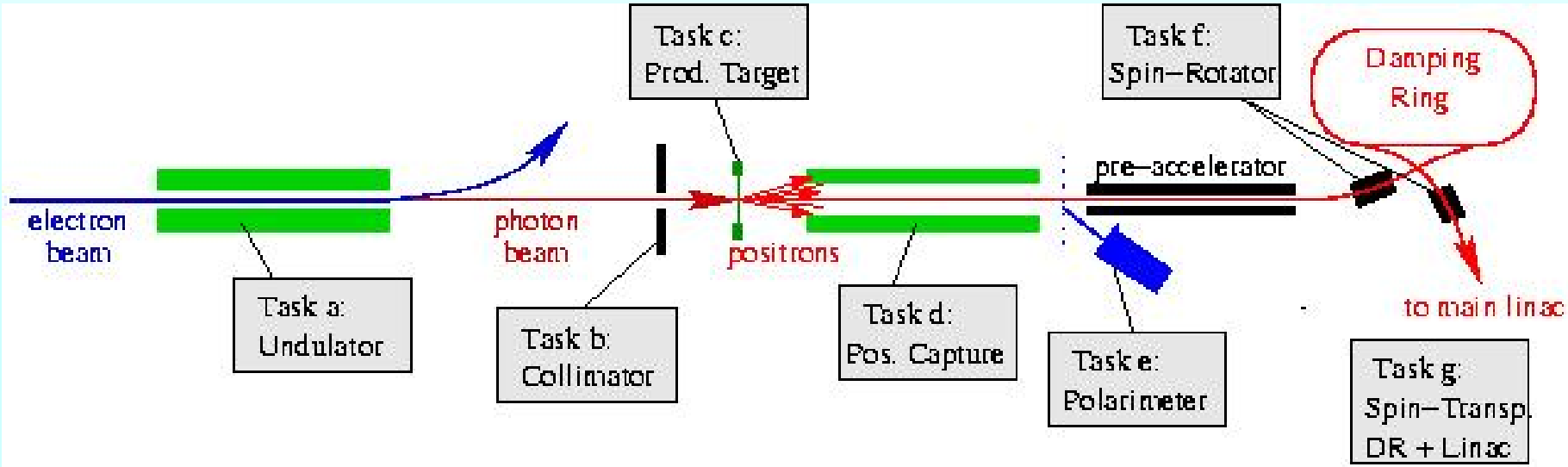
Dogbone Design is Controversial

- Its not round!
- New ideas for smaller (6km!) compact rings being investigated
- Fast kicker concepts become even more challenging
  - Many clever ideas from Frascati, Cornell, FNAL etc.
- Higher current in smaller ring
  - Many of these instabilities become more critical!
  - Will need to investigate effects for all ring designs before making final design decision
- (Fast kicker for DR also has synergy with XFEL ☺)

WP4: (Polarised) Positron Source

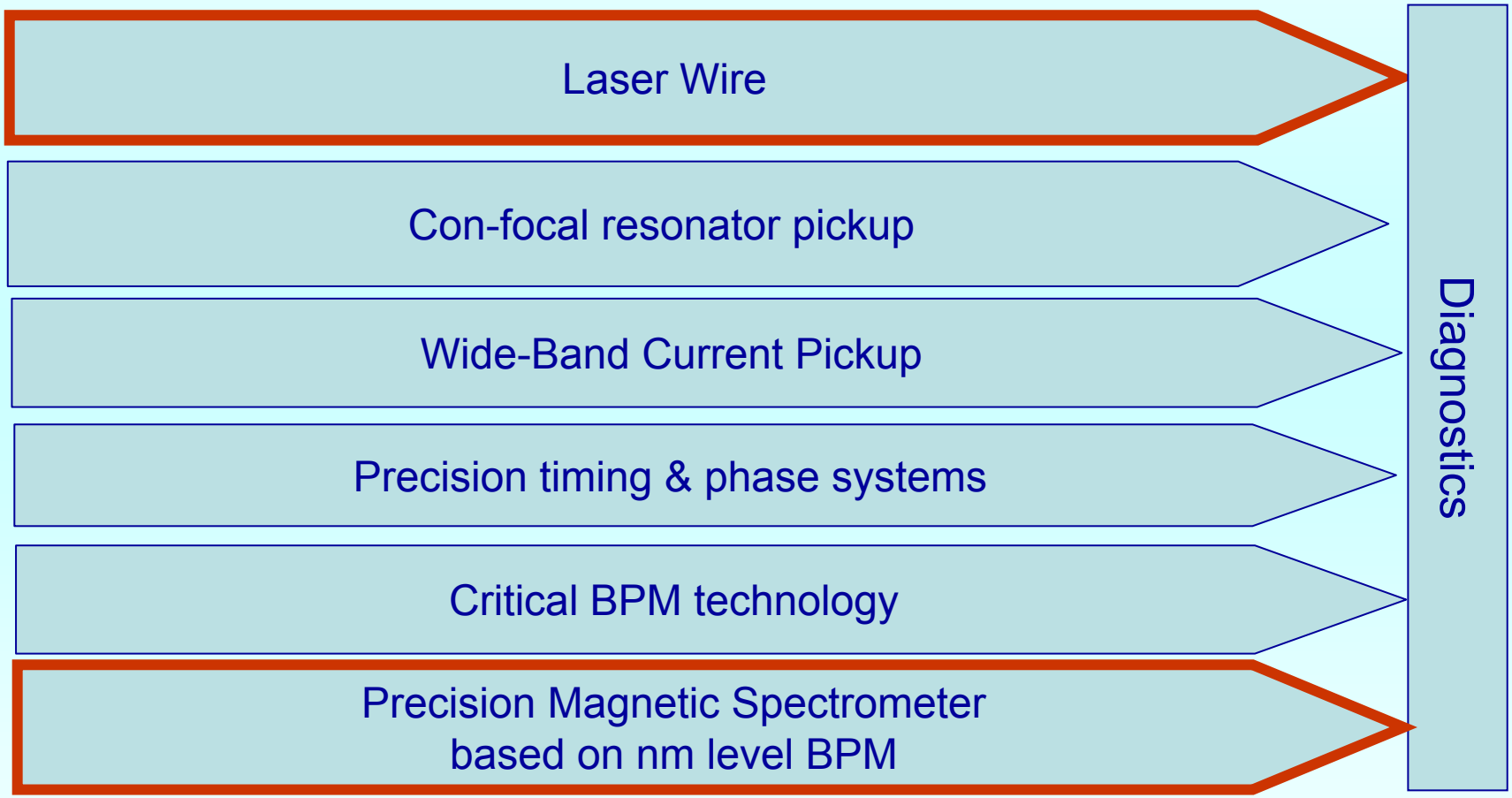


WP4: Polarized Positron Source

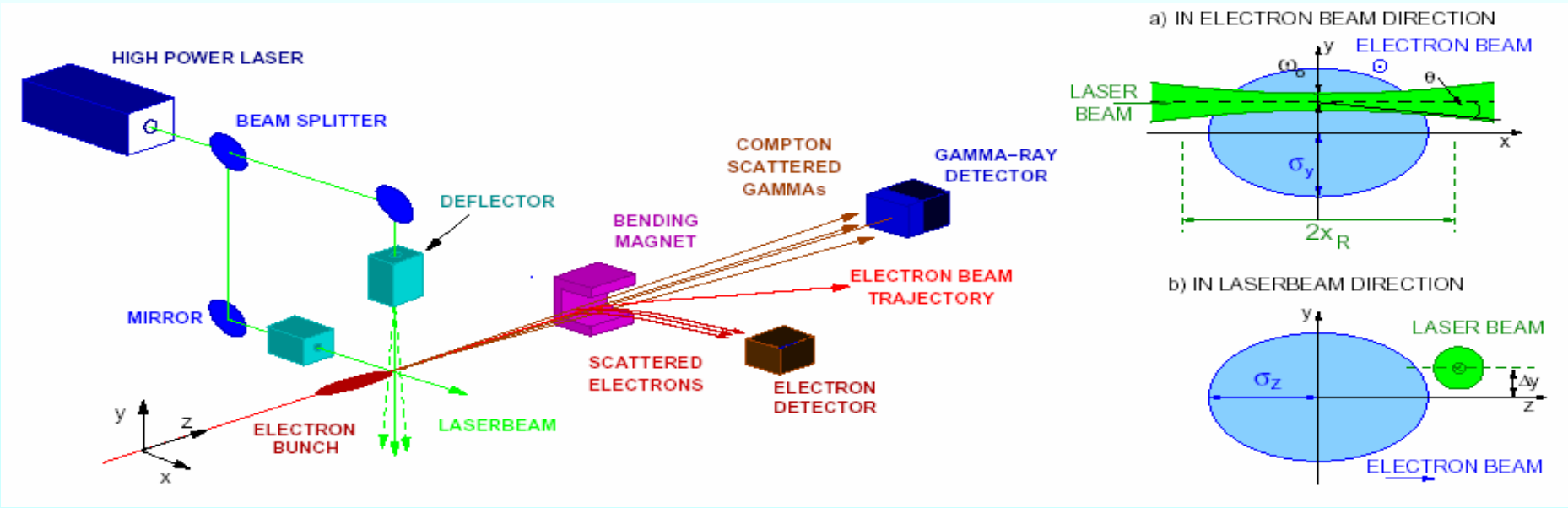


Designs exist (i.e. TESLA TDR)
Emphasis is on evaluation of performance, tuning and spin transport
Optimisation of system

WP5: Diagnostics @ DESY

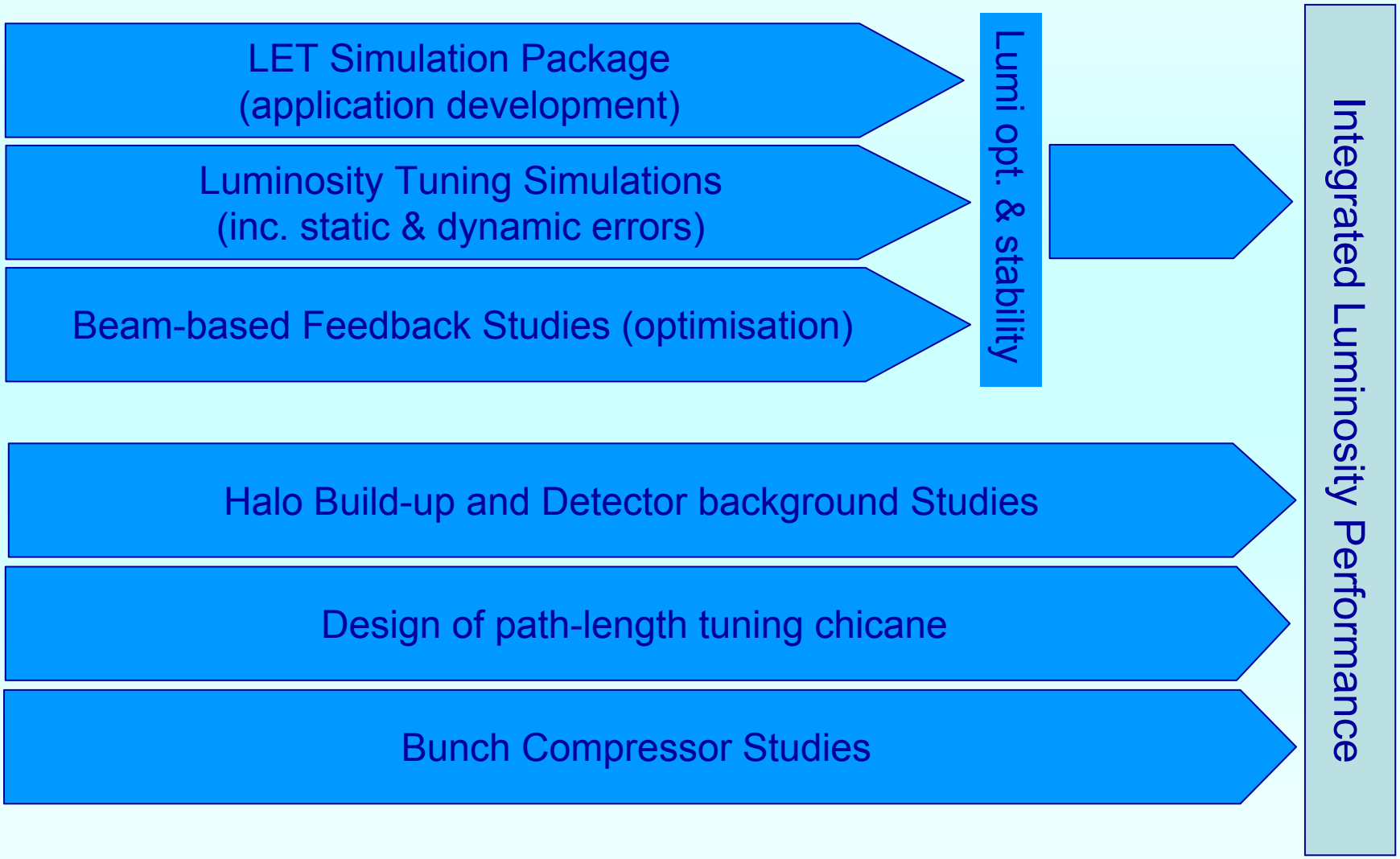


Laser-Wire (Grahame Blair, LBBD collaboration)



- **Scan finely focused laser beam through electron beam**
- **Detection of Compton photons (or degraded electrons) as function of relative laser beam position**
- **Challenges**
  - **Produce scattering structure smaller than beam size**
  - **Provide fast scanning mechanism**
  - **Achieve efficient signal detection / background suppression**

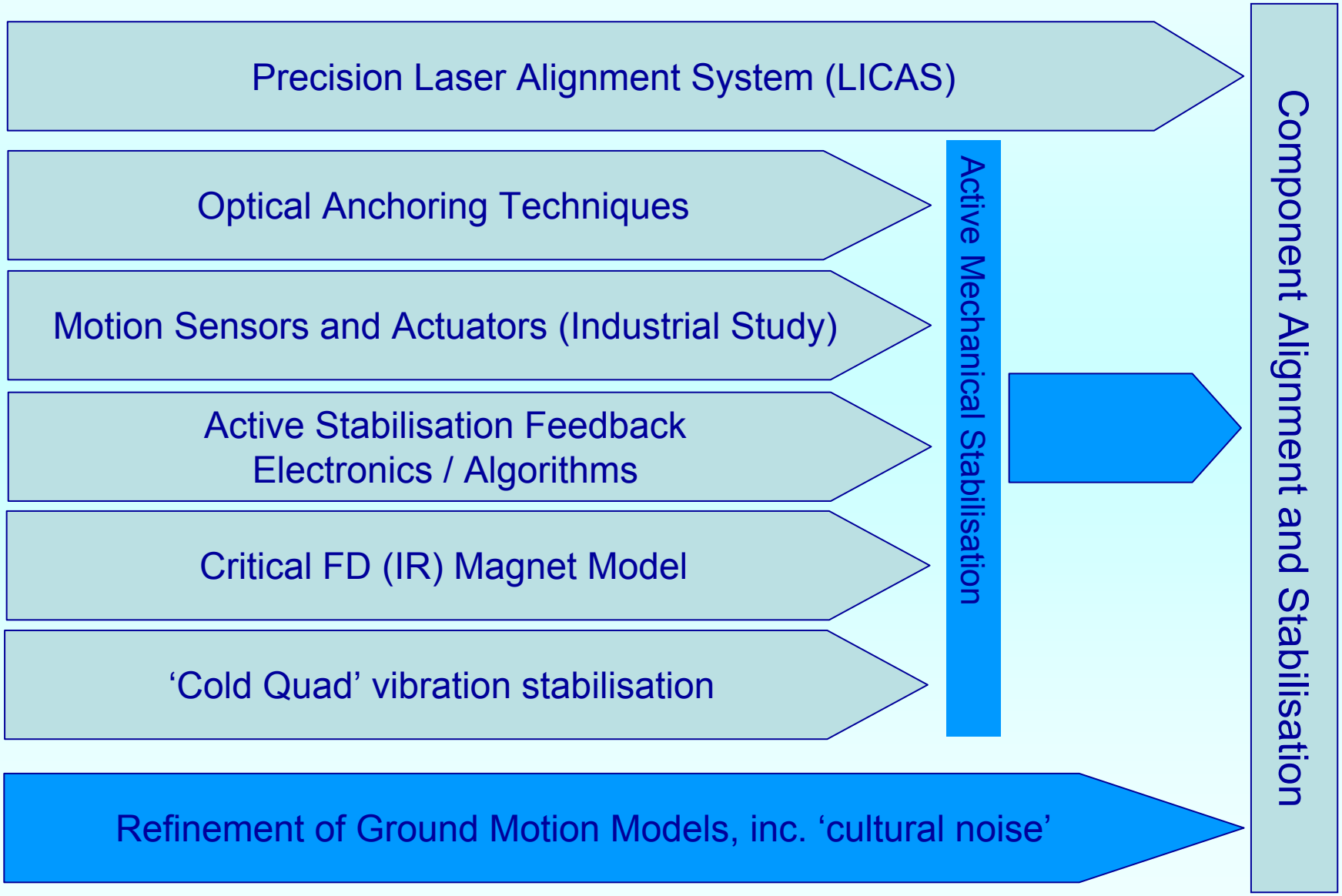
WP6: Integrated Luminosity Performance Studies



Modelling Collider Performance

- Towards a realistic simulation model of the collider
  - Spin rotation
  - Bunch compression
  - Main linac (acceleration)
  - Collimation
  - Final focus
  - Post IP extraction
- Need to include
  - Necessary beam dynamics (wakefields etc)
  - Ground motion models (inc. vibration)
  - Realistic errors
  - (fast) feedback system(s)
  - Tuning algorithms
  - Realistic models of diagnostics used for tuning
  - Lots more…

WP7: Mechanical Stabilisation and Metrology



WP8: Global Accelerator Network Multipurpose Virtual Laboratory (Ferdi Willeke, DESY)

Design and build a collaborative tool for

- far **Remote Observation** and
- far **Remote Control** of **accelerator** components or experiments at accelerators

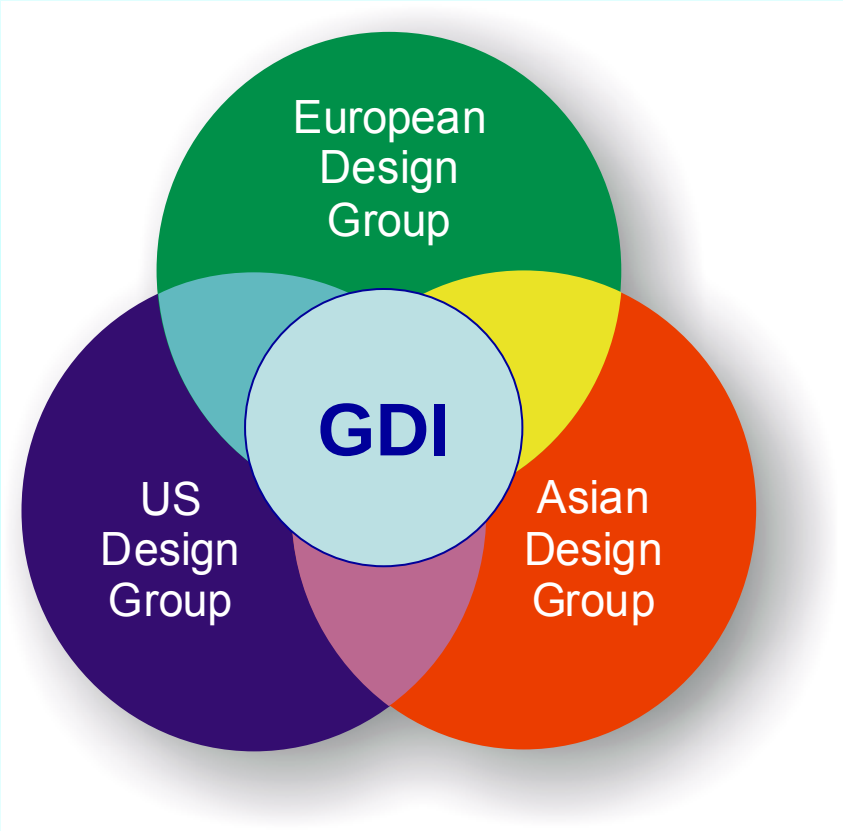
MVL will be a tool to demonstrate and gain experience that -

- accelerator components can be efficiently operated, maintained and repaired under the control of experts from remote sites
- geographically dispersed experts can work together in a virtual team

DESY Budget in EUROTeV

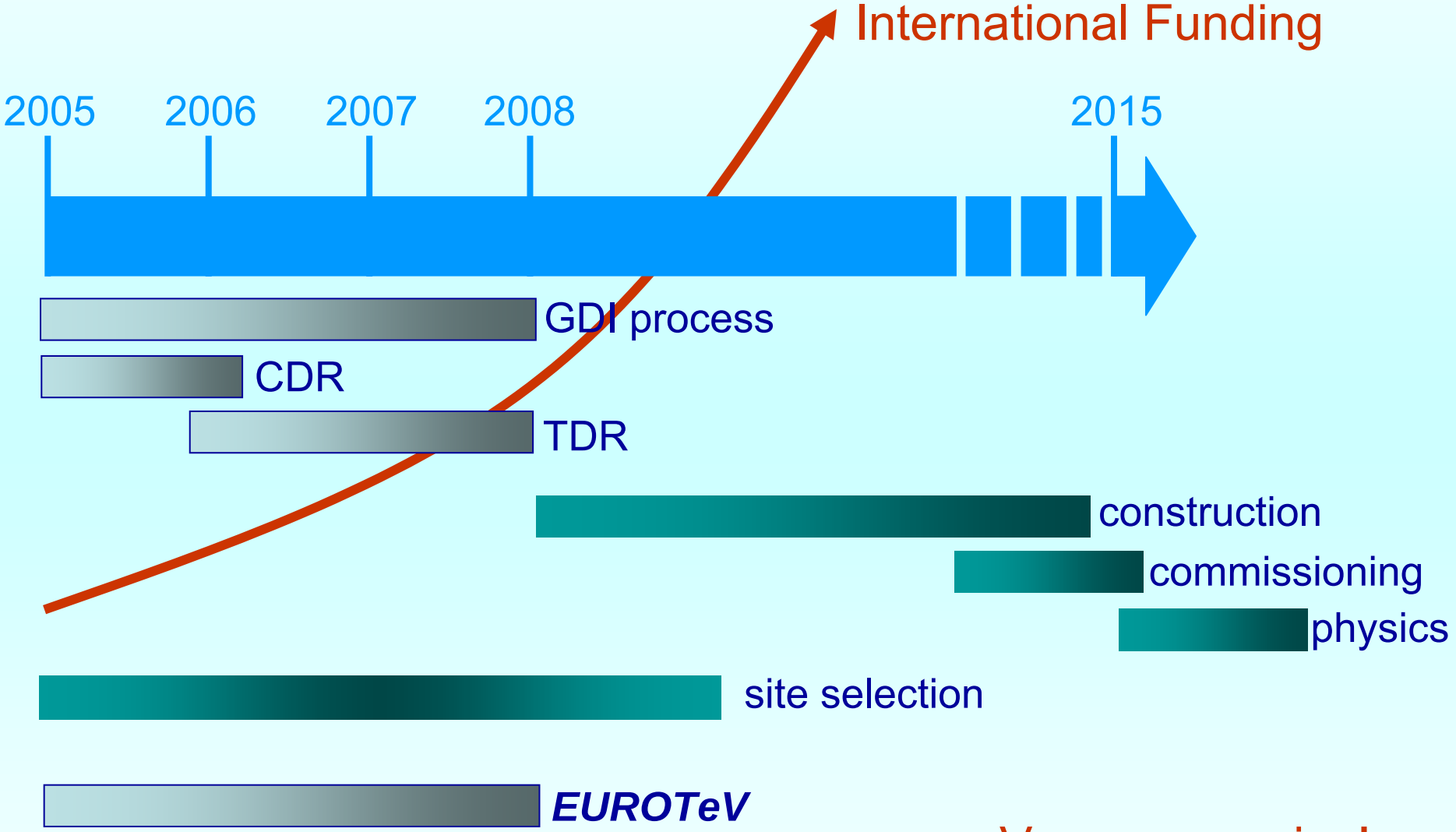
- EU Request: 1.7 Mio €
- (DESY Committment: 2.6 Mio €)
- Personnel:
  - 6 new postoc positions:
    - 0.5 (HH) in Management: Scientific Assistant to the Coordinator
    - 2 (HH) in Damping Rings:
      - E-Cloud Simulations
      - Low Emittance Tuning Studies
    - 1 (Z) in PPS
    - 1 (HH) in ILPS: Low Emittance Tuning Simulations
    - 1 (HH) in METSTAB: Ground Motion Measurements
    - 0.5 (HH) in GANMVL
- Equipment (260 k€):
  - Laser for Laserwire, Equipment for GANMVL
- Travel Cost (265 k€):
  - Travel cost for new postdocs (3 k€ per person per year)
  - Management travel cost: Mainly to invite External Advisory Board, Governing Board, external experts (International Developments!)

The Global Context



- ILC will be **designed** and **constructed** as a truly global project
- Initial phase (next 3 years) will see formation of the **Global Design Initiative** (GDI) supported by **3 regional design teams**

ILC Projected Time Line



Very aggressive!

In Summary

- DESY has been a major driving force in LC R&D for over 15 years
  - And with the choice of SCRF for the ILC and the construction of the XFEL will remain so (at least for the immediate future)
- R&D towards the S.C. Linac continues
  - Primarily through synergy with the XFEL project and
  - TTF-VUV FEL (the best ILC test facility that currently exists)
- Other areas of ILC R&D will be supported via the ***EUROTeV*** project
  - Damping ring studies
  - Polarised positron source
  - Diagnostics
  - Luminosity performance studies
  - Stabilisation
  - GAN
- DESY's future in the ILC endeavour looks secure!

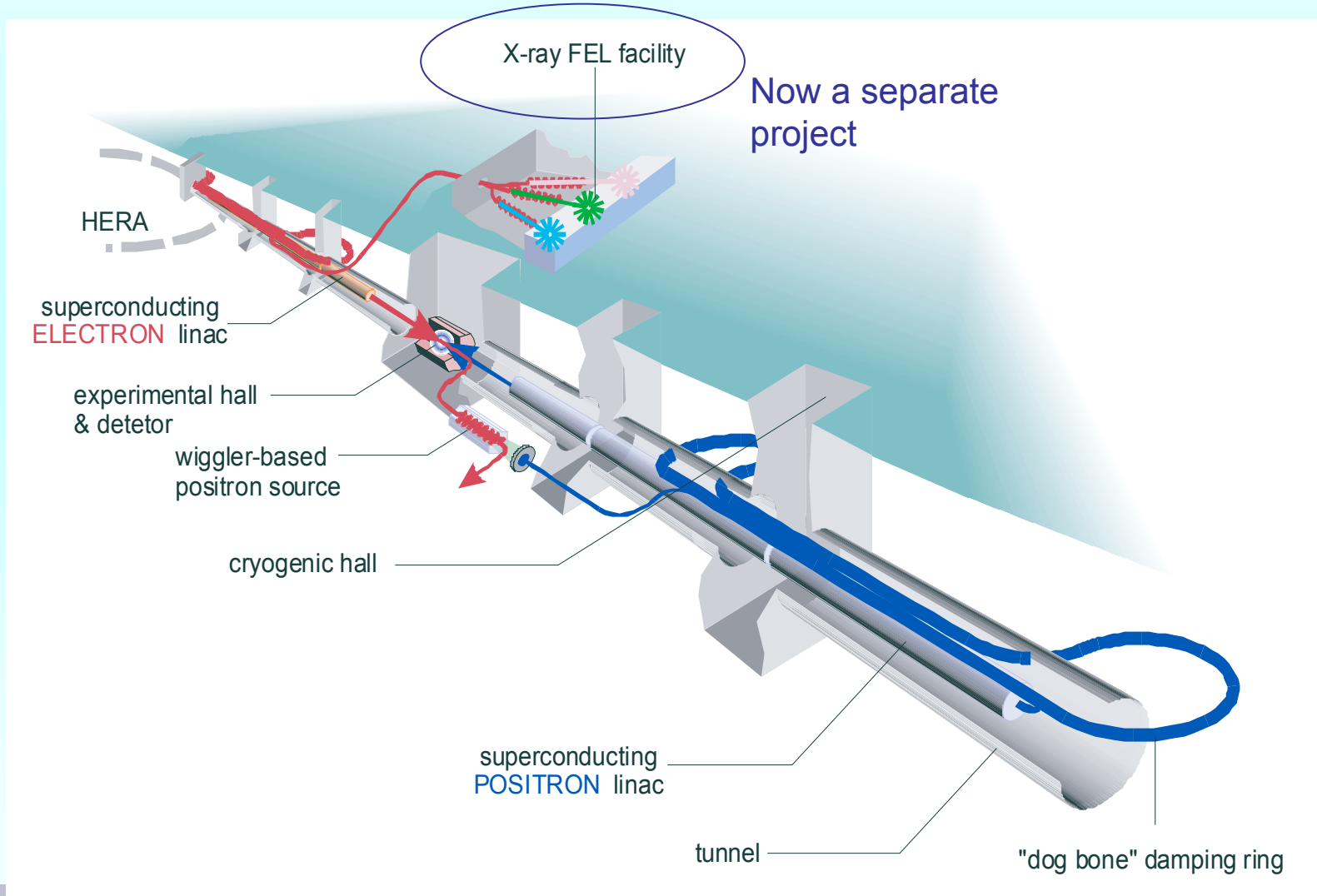
EUROTeV Activities at DESY

Karsten Büßer

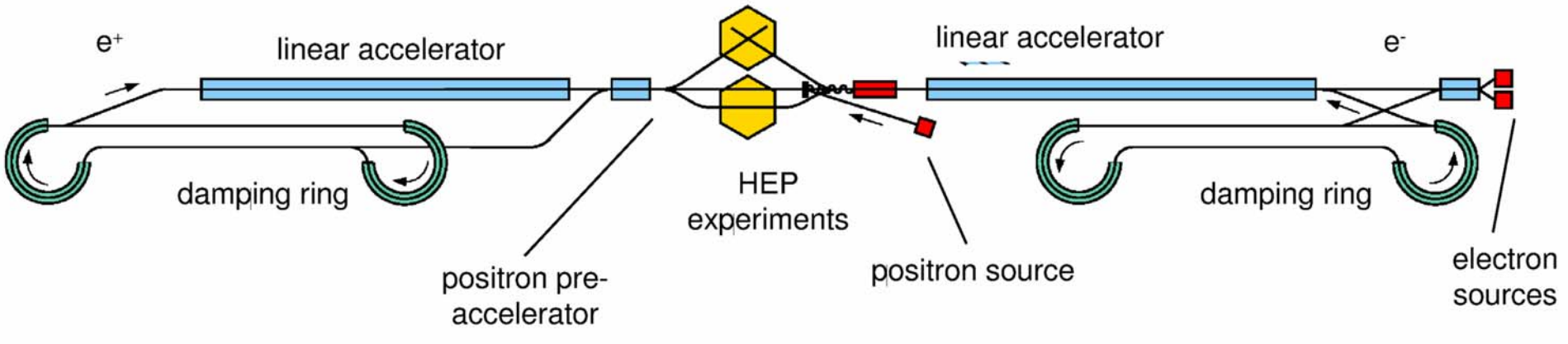
Hamburg-Zeuthen LC Meeting

18th October 2004

the TESLA linear collider

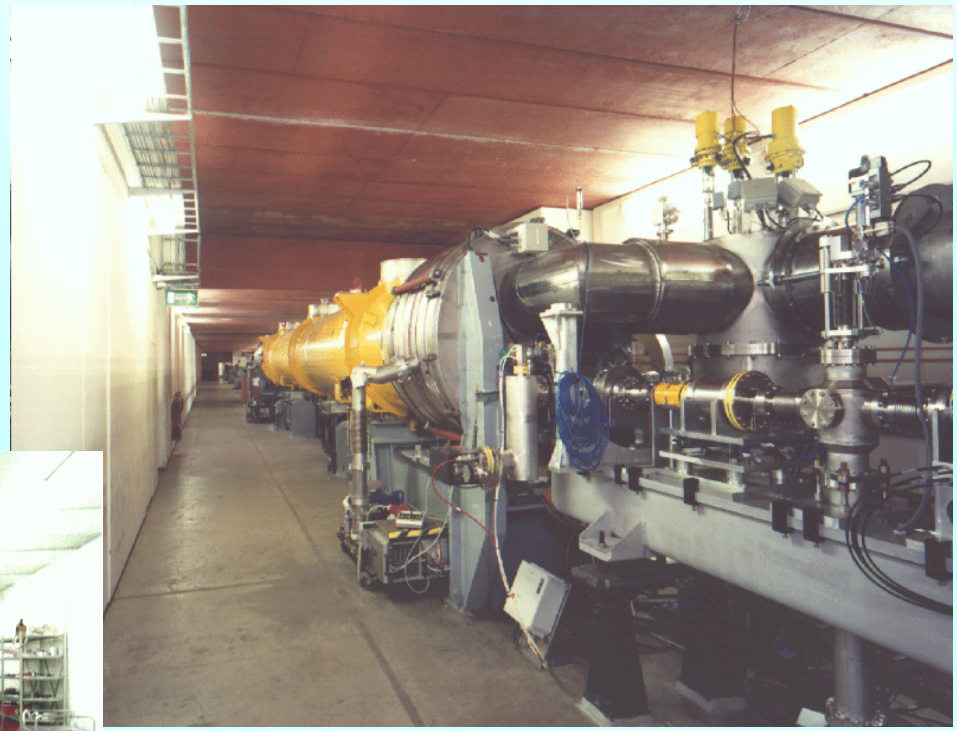


TESLA Overview



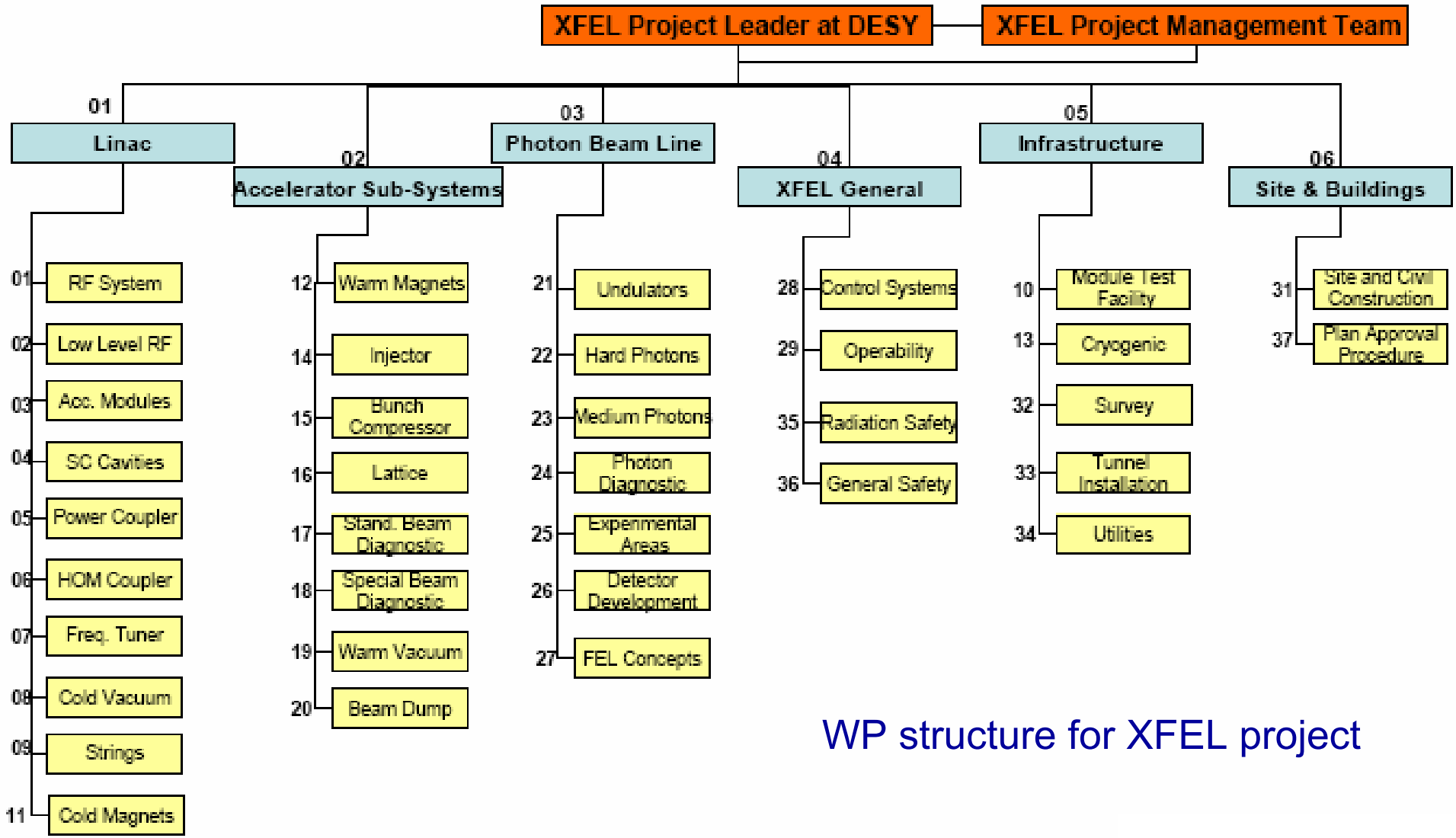
Most Visible LC R&D at DESY

TESLA Test Facility



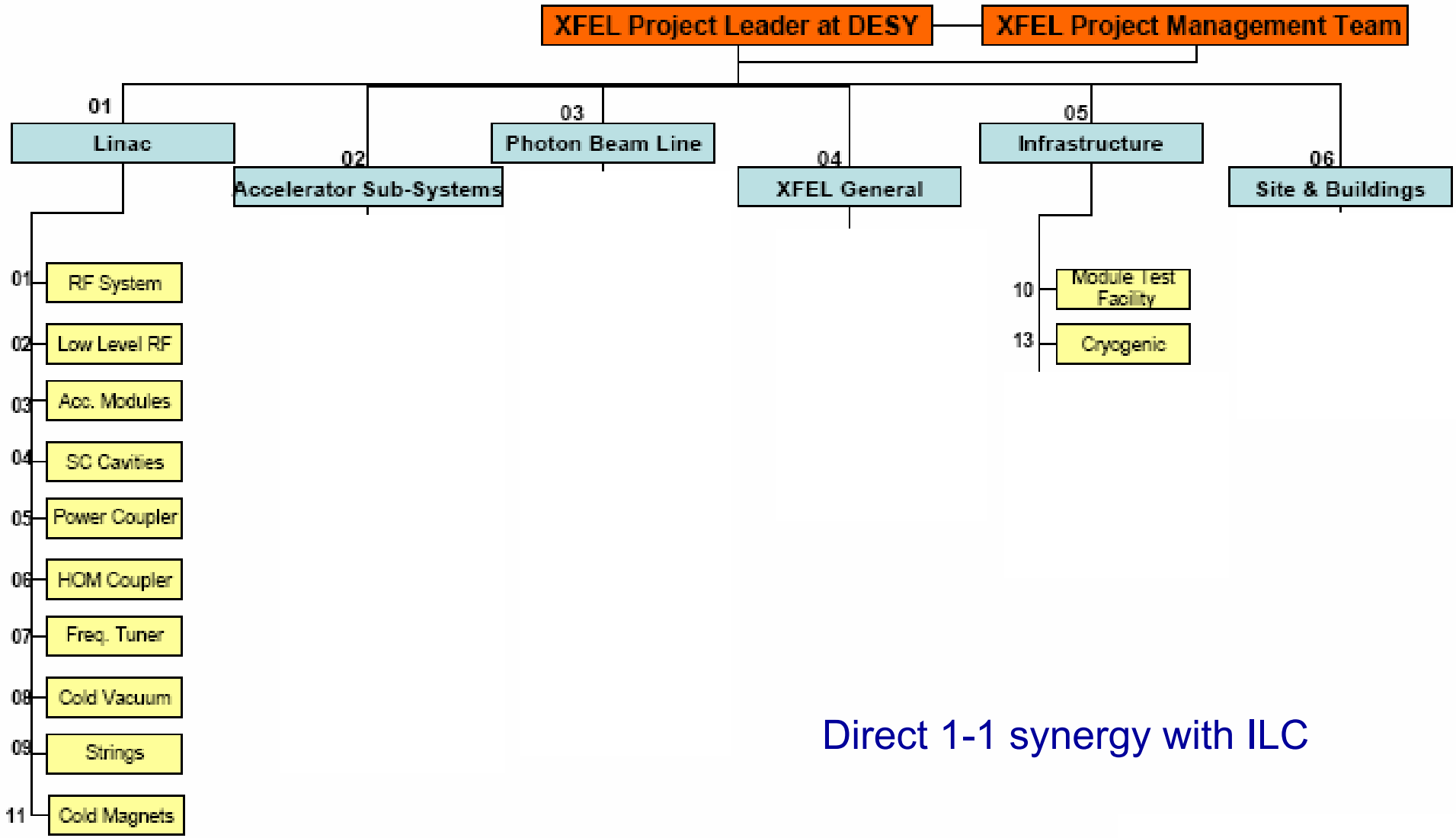
ITRP ‘cold’ decision means TTF and XFEL R&D will continue to be DESY’s major contribution to ILC R&D

XFEL Synergy



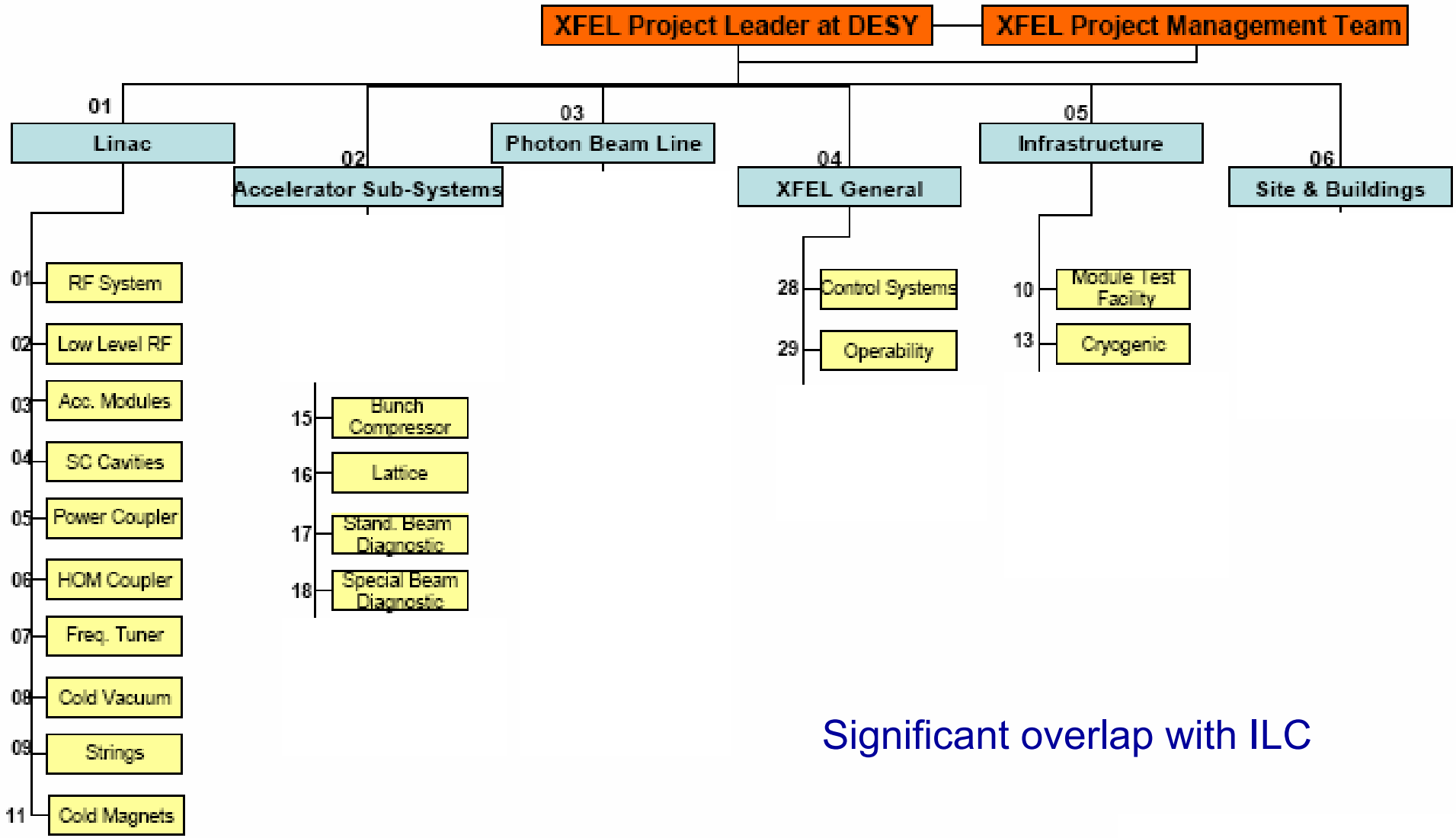
WP structure for XFEL project

XFEL Synergy



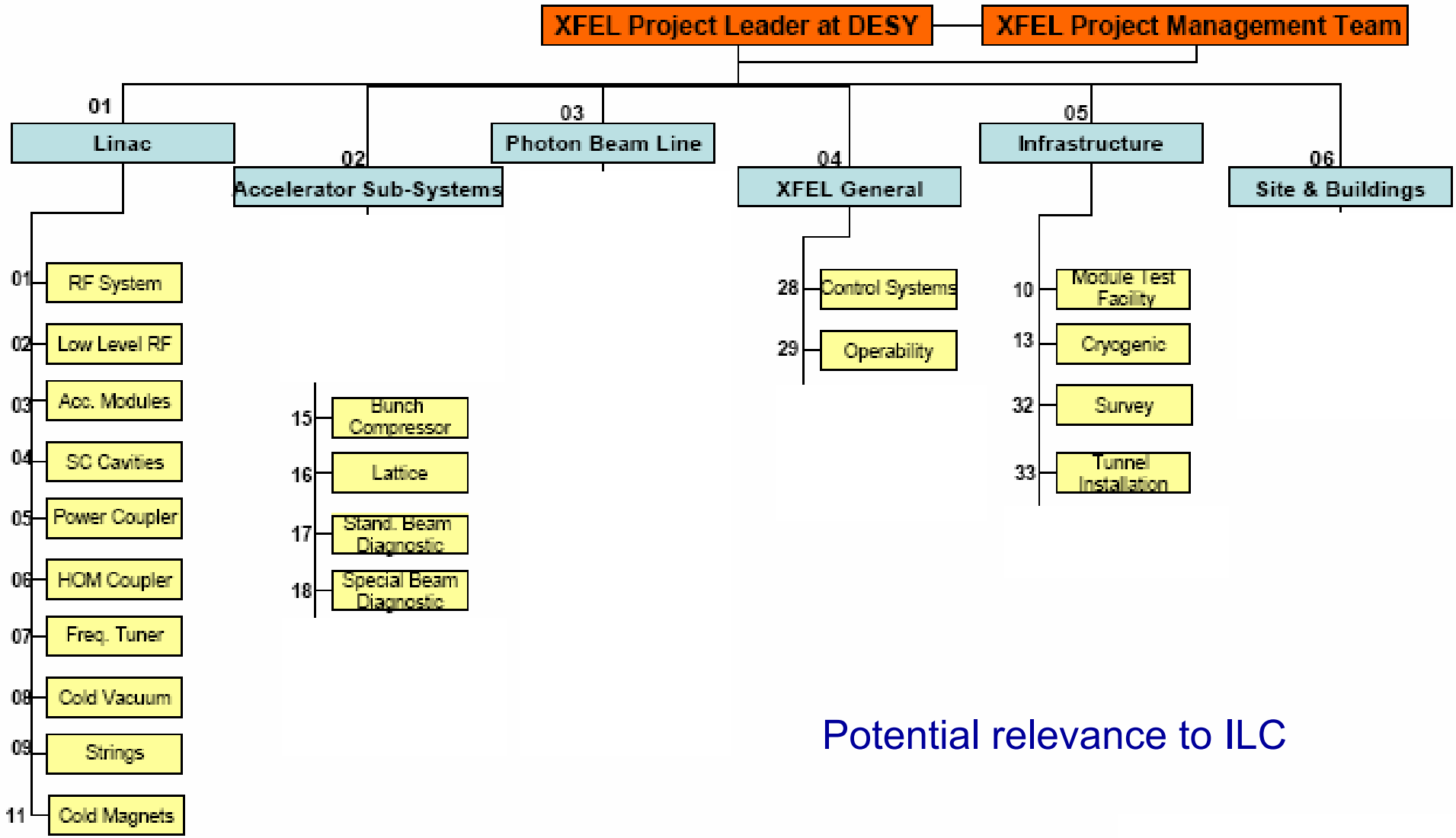
Direct 1-1 synergy with ILC

XFEL Synergy



Significant overlap with ILC

XFEL Synergy



Potential relevance to ILC

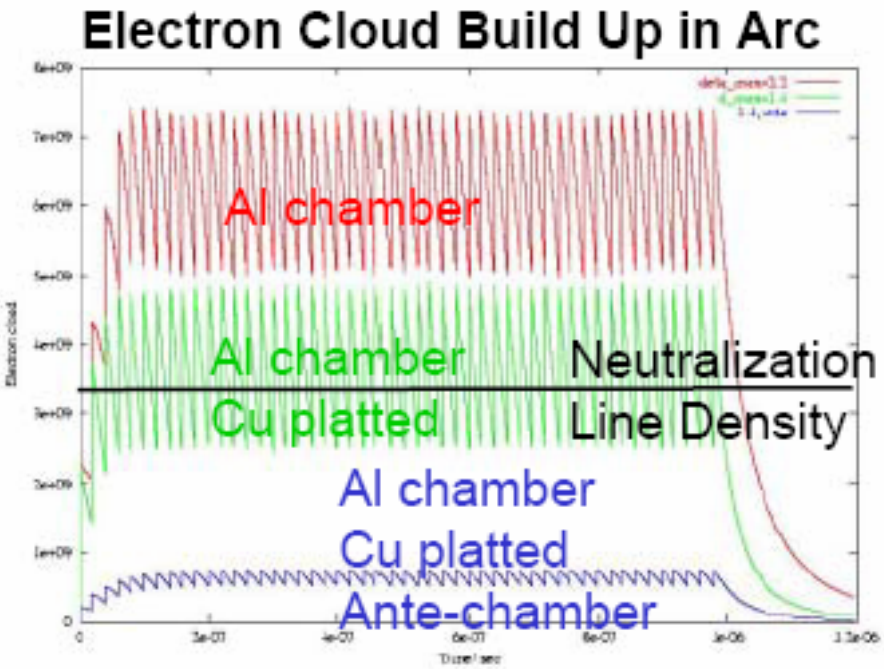
Participating Institutes

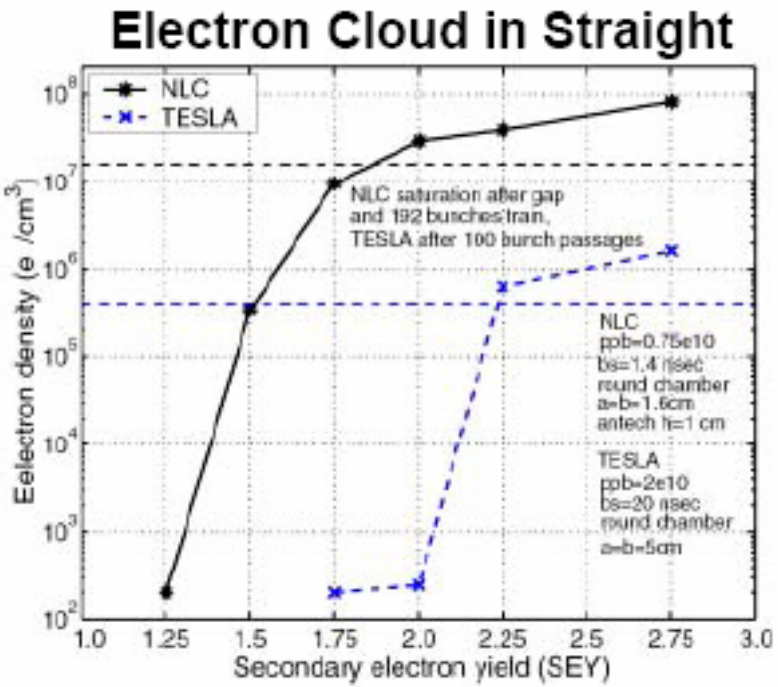
Participant	WP1	WP2	WP3	WP4	WP5	WP6	WP7	WP8
	MNGMNT	BDS	DR	PPS	DIAG	ILPS	METSTB	GANMVL
CCLRC	○	●	○	●			○	
CEA		○						
CERN	○	○	○	●	○	●		
DESY	●		○	○	○	○	○	●
ELETTRA								○
Fraunhofer								○
GSI								○
INFN-LNF	○		●					○
INFN-Mi								○
INFN-Ro2								○
IPPP				○				
LAL					○	○		
LAPP							●	
PSI						○		
QMUL		○				○		
RHUL	○				●	○		
Darmstadt		○						
HU Berlin				○				
Cambridge					○			
UCL					○			
Lancaster		○						
Liverpool				○				
Manchester		○				○		
Mannheim								○
Udine								○
Oxford					○		○	
Uppsala					○	○		

27! Institutes wishing to participate, reflecting **major European interest** in ILC project.

● Coordinating institute

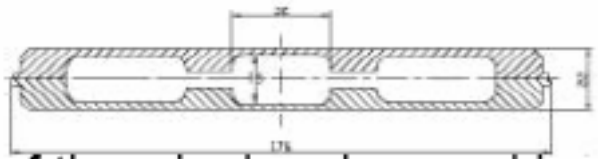
Electron Cloud build-up a problem for e+





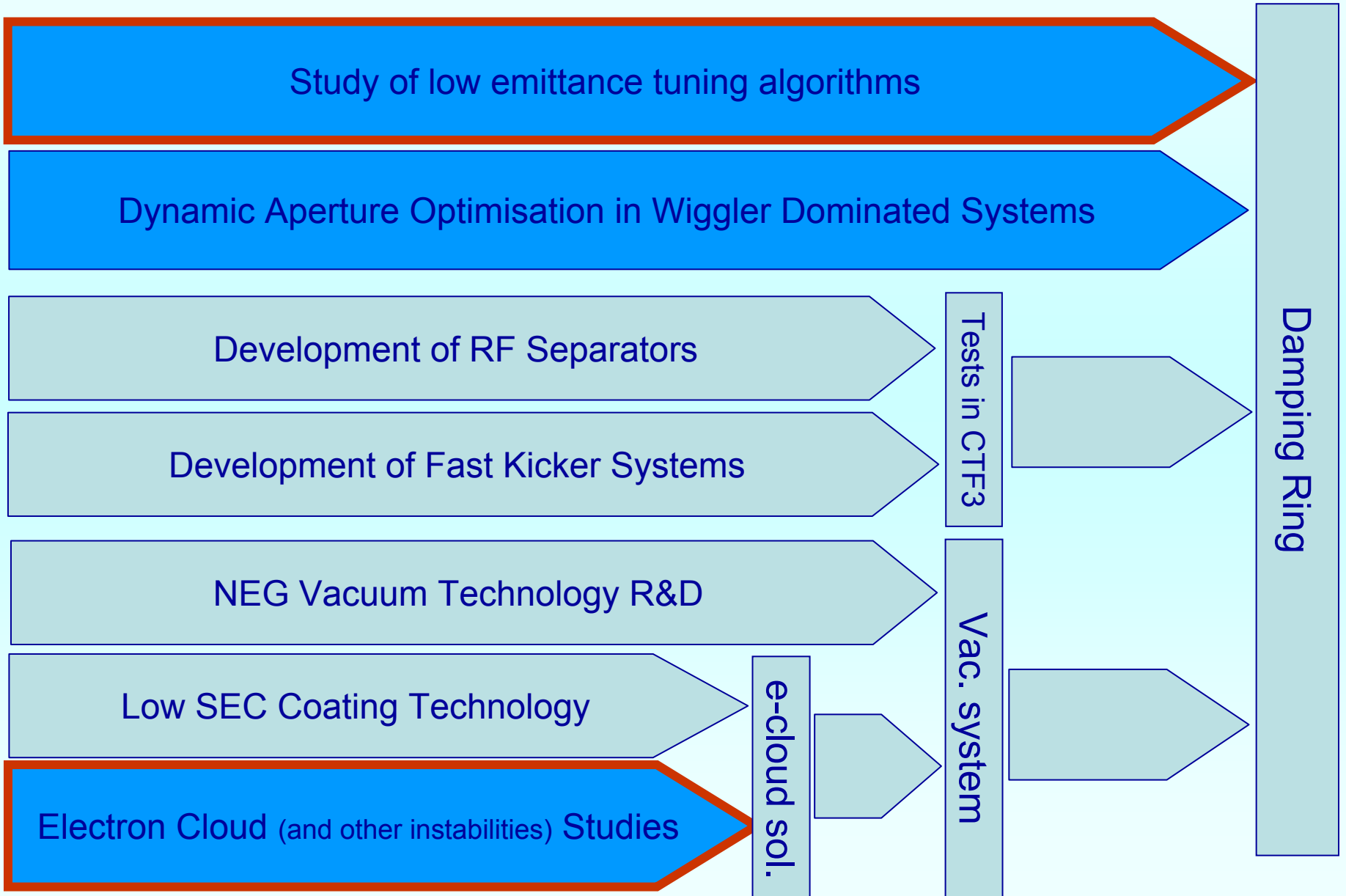
Wiggler Section

- Ante-chamber design in the TDR
- Trapping of electrons in some sections of the wiggler observed in some simulations

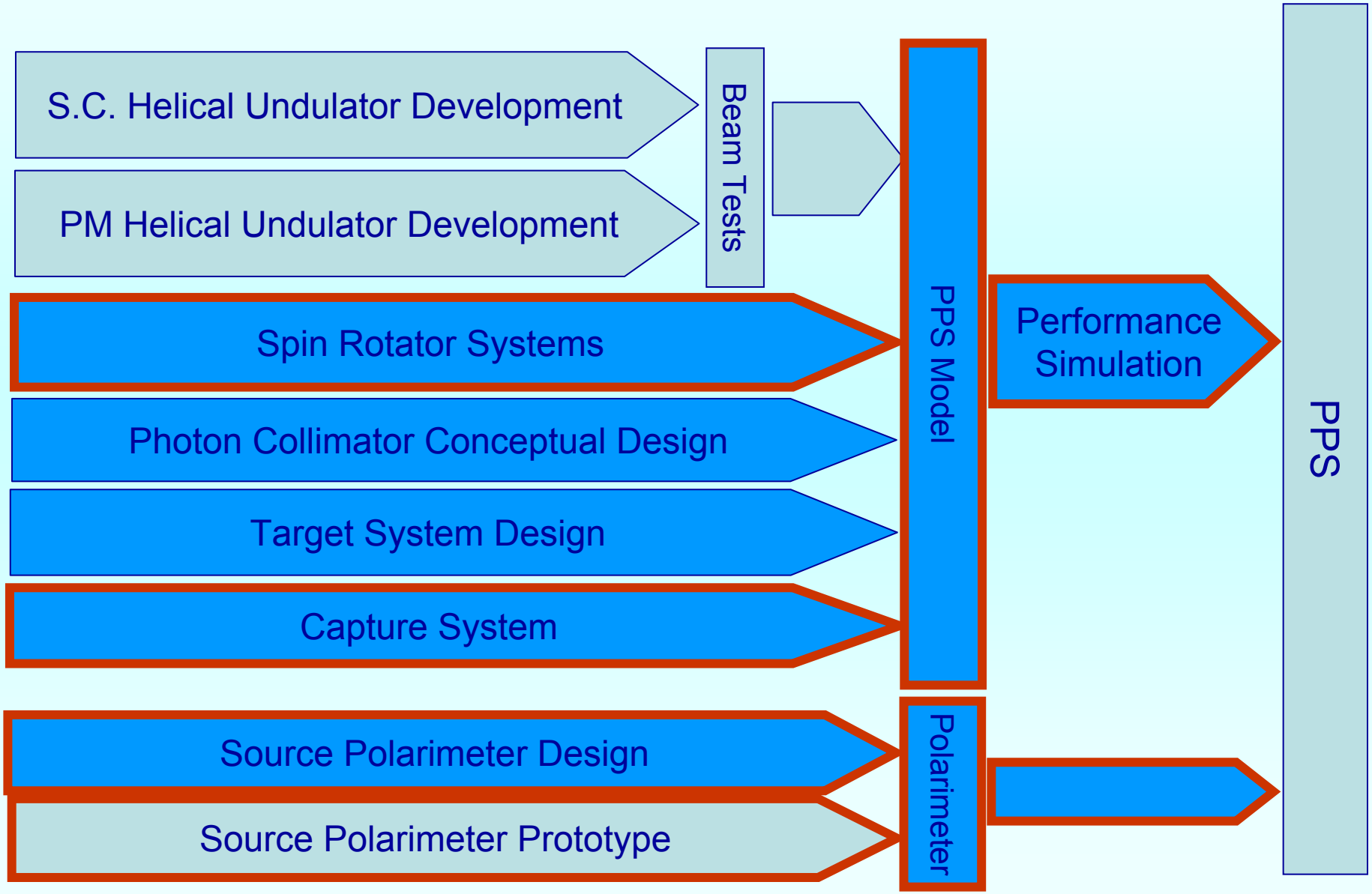


W. Decking (DESY ITRP meeting)

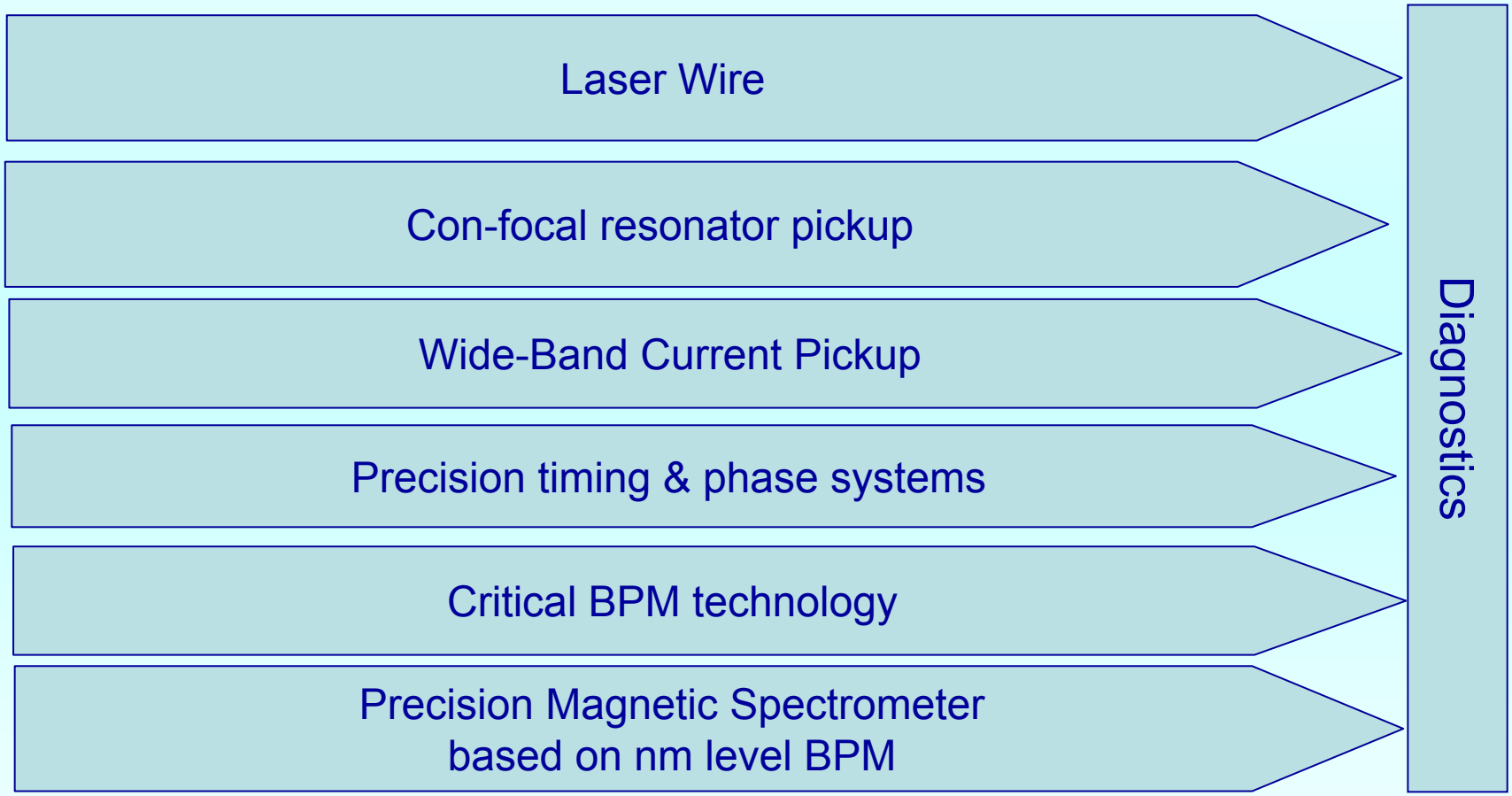
WP3 Damping Ring @ DESY



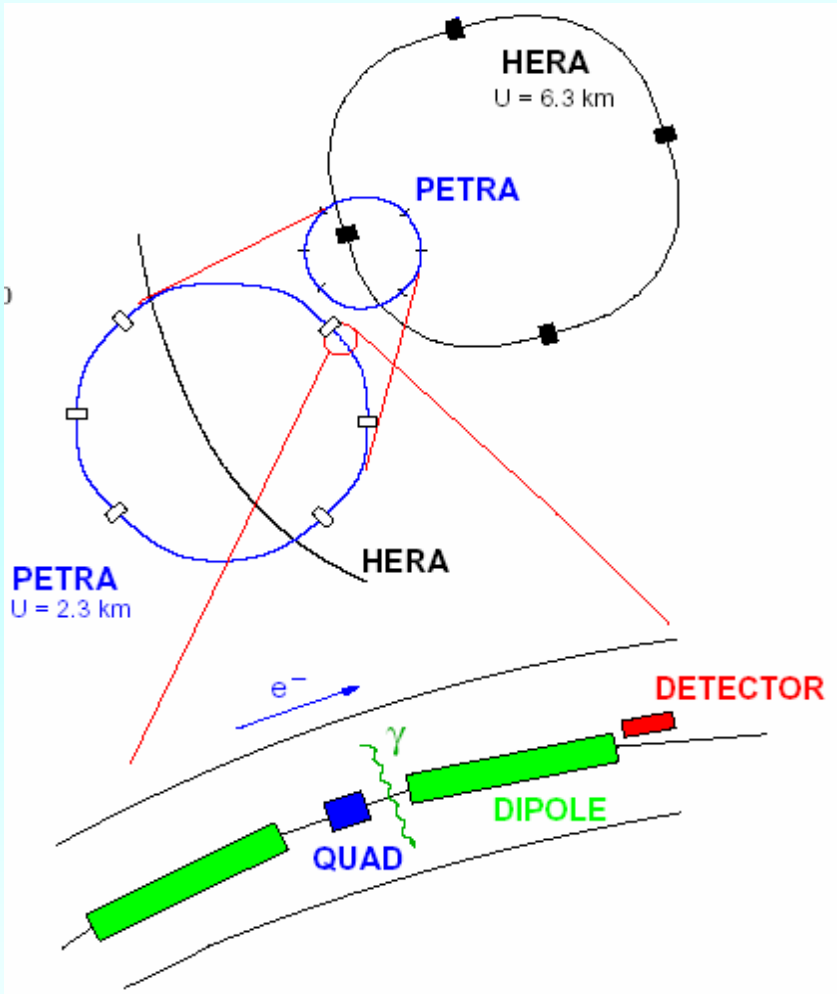
WP4: Polarised Positron Source @ DESY

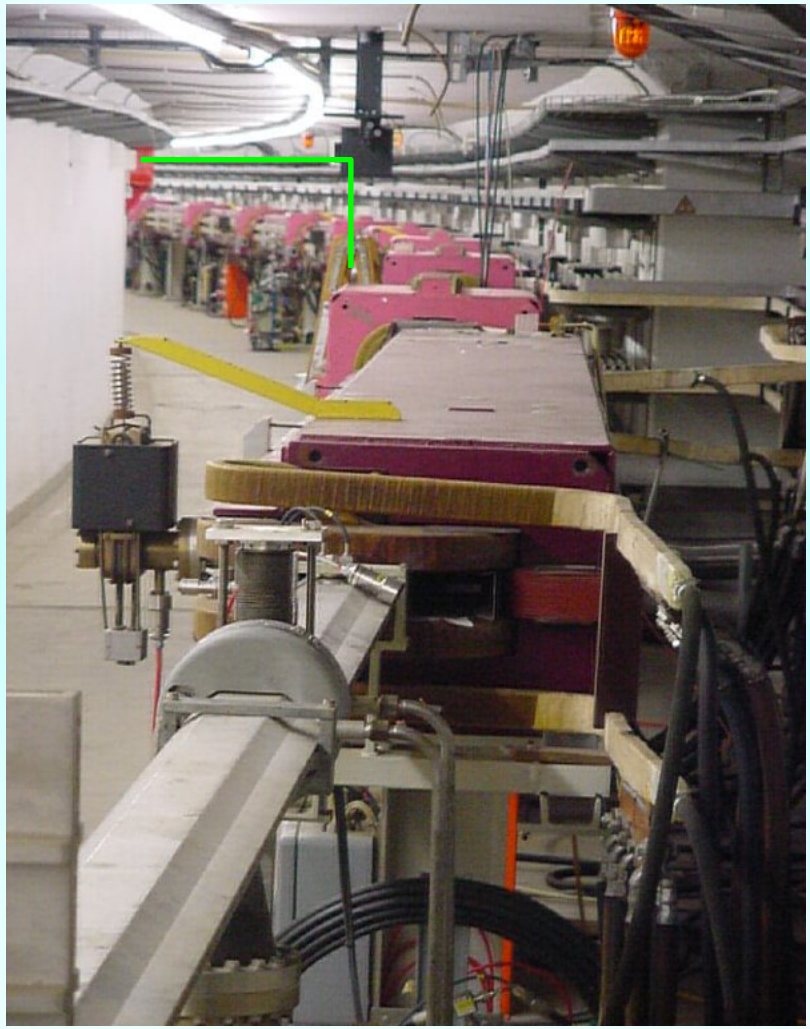


WP5: Diagnostics

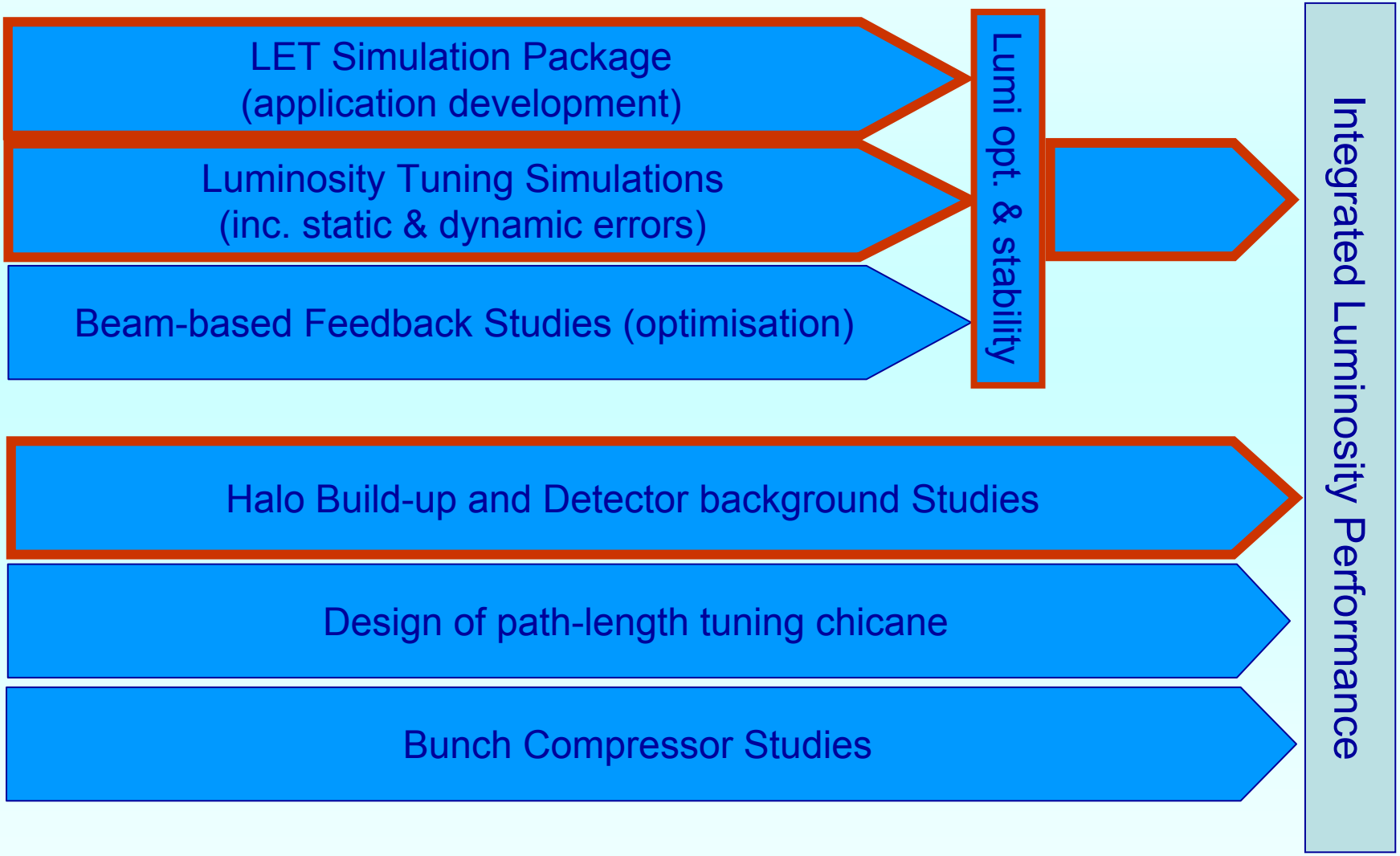


Laserwire for PETRA



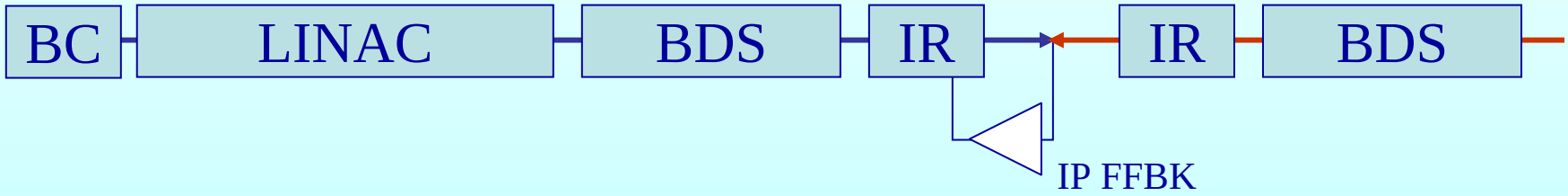


WP6: Integrated Luminosity Performance Studies



Example: Simulating the Dynamic Effect

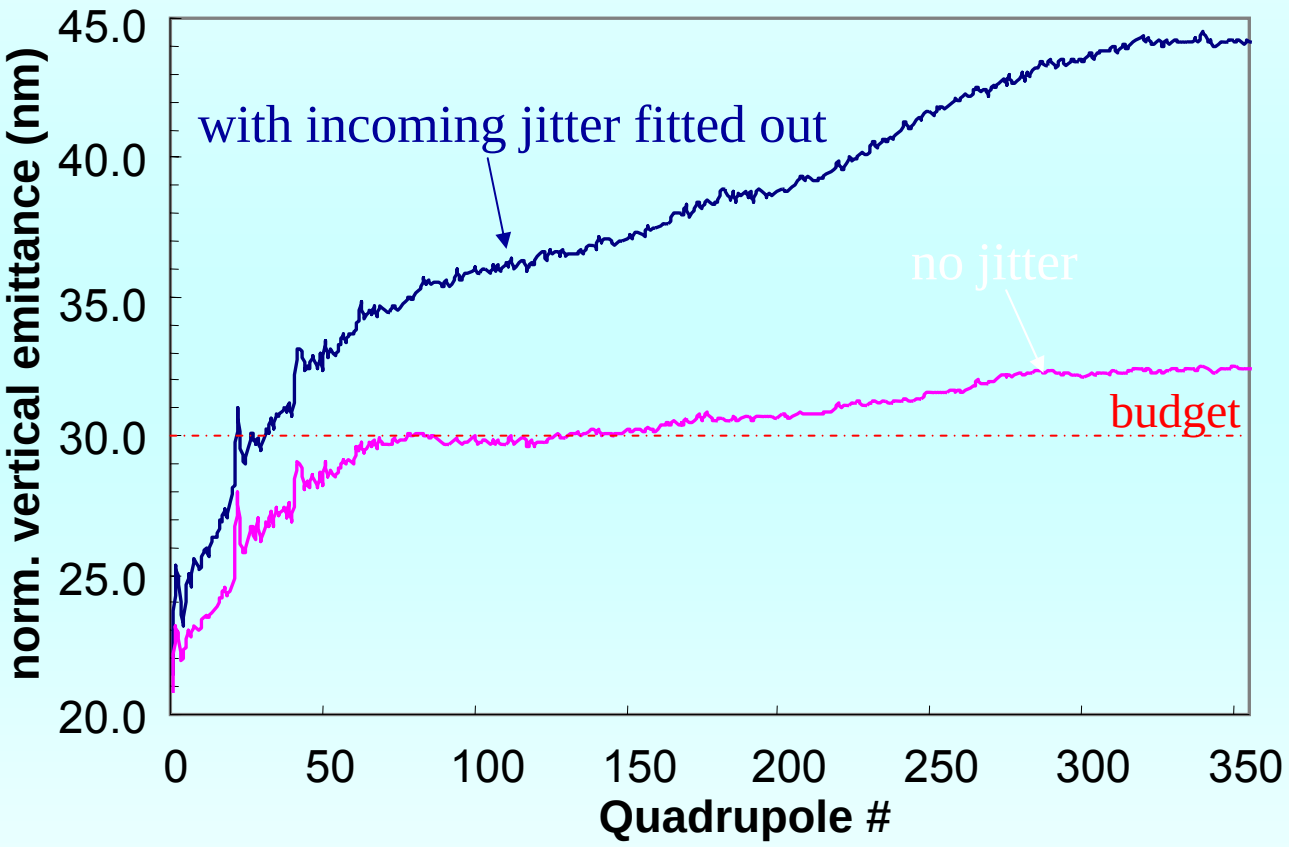
‘start-to-end’ simulations



- Realistic simulated ‘bunches’ at IP
  - linac (PLACET, D.Schulte)
  - BDS (MERLIN, N. Walker)
  - IP (GUINEAPIG, D. Schulte)
  - FFBK (SIMULINK, G. White)
- bunch trains simulated with realistic errors, including ground motion and vibration

All ‘bolted’ together within a MATLAB framework by **Glen White (QMC)**

DFS for TESLA



The effect of upstream beam jitter on DFS simulations for the TESLA linac.

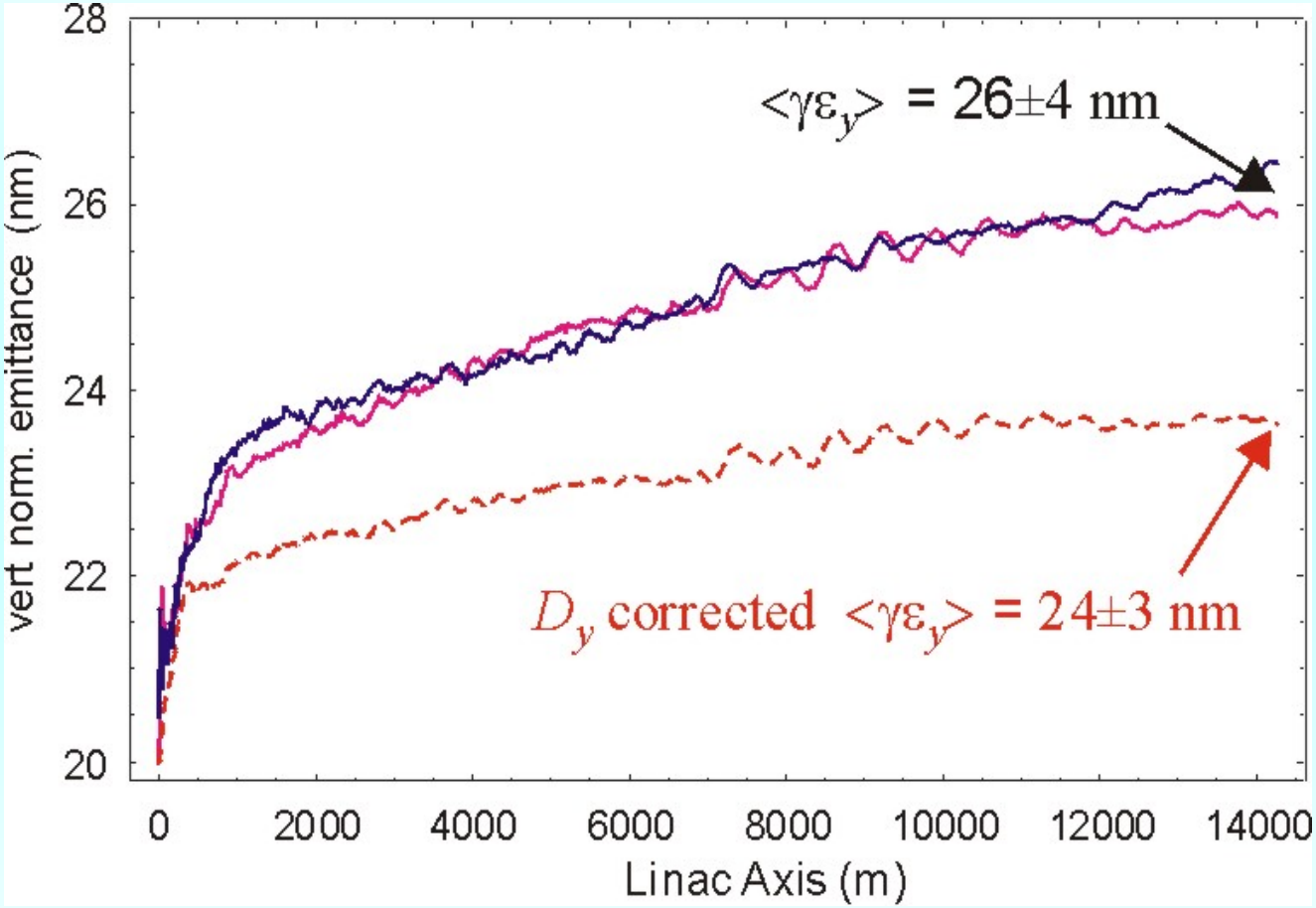
1 σ_y initial jitter

10 mm BPM noise

uncorrected cavity tilts cause problems for TESLA

average over 100 random machines

Ballistic Alignment



Less sensitive to
- model errors
- beam jitter

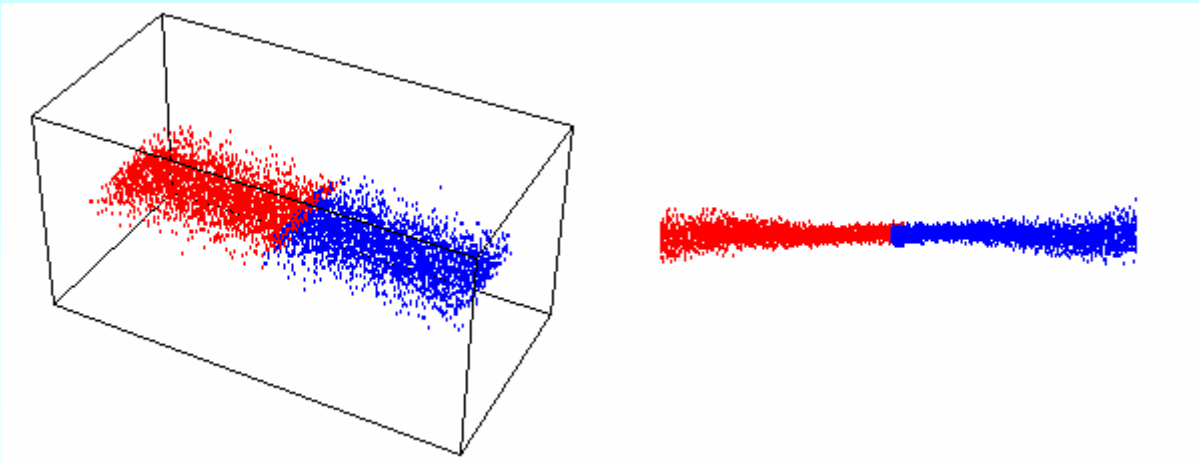
average over 100 seeds

Bananas

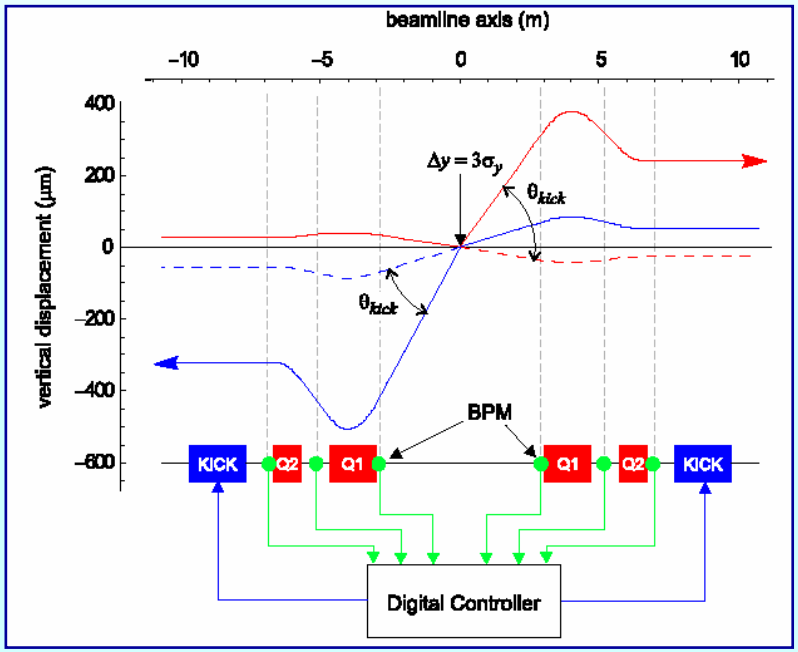
TESLA: high disruption regime:

long. correlated emittance growth causes excessive luminosity loss (‘banana’ effect)

Brinkmann, Napoly, Schulte, TESLA-01-16



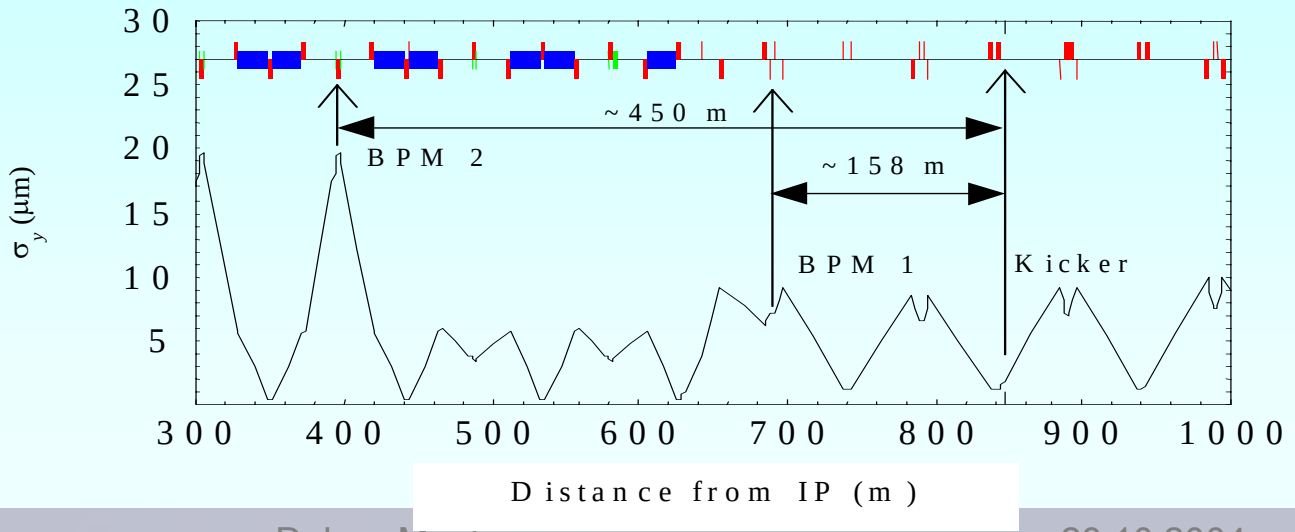
Simulating the Dynamic Effect



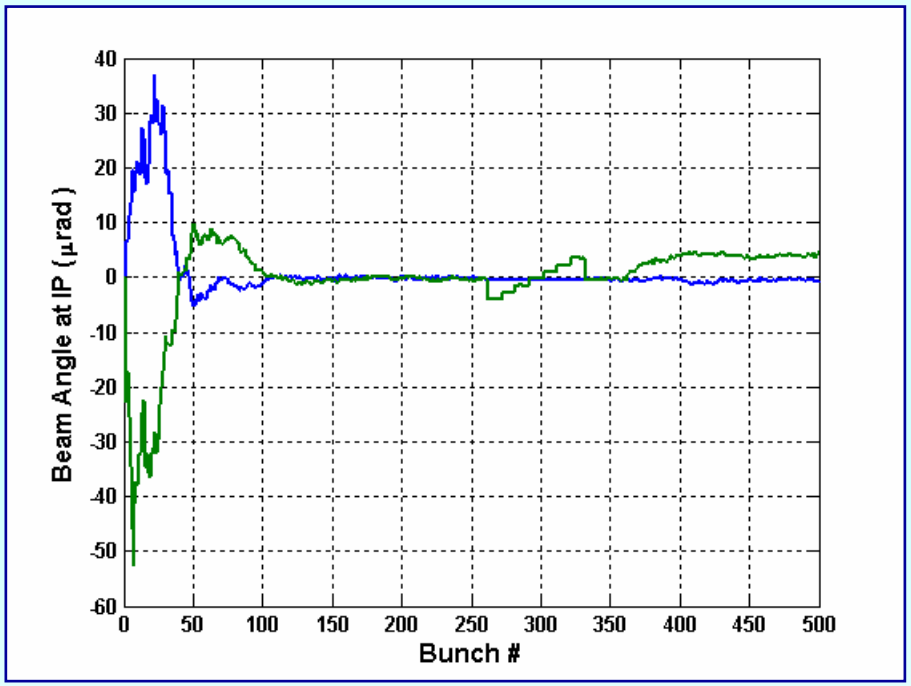
Intra-train fast feedback modelled realistically using

- bunches from PLACET+MERLIN simulations
- realistic beam-beam simulation using GUINEAPIG

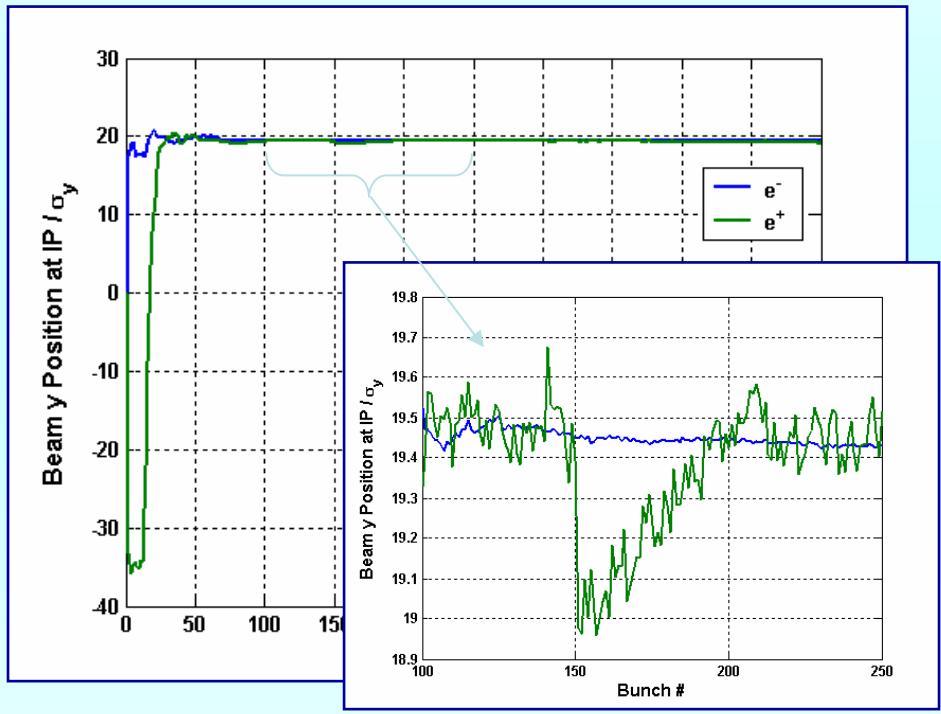
Angle feedback kicker modelled correctly in MERLIN



Simulating the Dynamic Effect

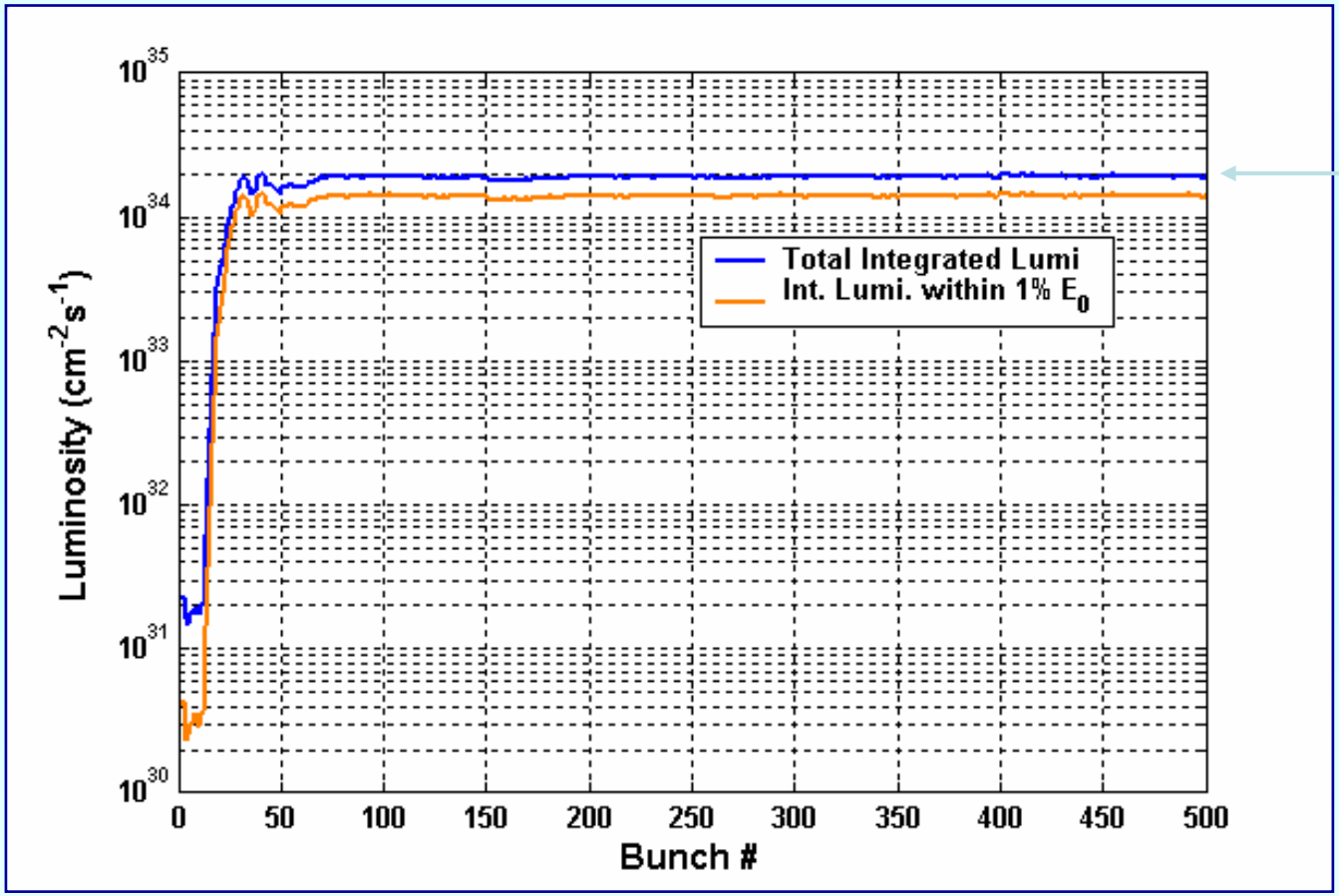


IP beam angle



IP beam offset

Simulating the Dynamic Effect



2×10^{34} cm^{-2}s^{-1}

Only 1 seed: need to run many seeds to gain statistics!

(Further) Development of Software Tools

MERLIN C++ class library

- Used to simulate
  - Bunch Compressor
  - Main Linac
  - BDS
  - DR (A. Wolski, LBNL)
- Models:
  - Single-bunch wakefields
  - Full 3D alignment errors
  - Girders and complex geometries
  - Diagnostics & tuning algorithms
  - Thin-spoiler scattering (used for halo and collimation studies)
  - Synchrotron radiation
  - Control system-like interface

http://www.desy.de/~merlin

WP7: Mechanical Stabilisation and Metrology