European Network
EuroNNAc
for Novel Accelerators

EuCARD²

CAPACITIES

EuPRAXIA

European Plasma Research Accelerator with eXcellence In Application

EuCARD-2 is co-funded by the partners and the European Commission under Capacities 7th Framework Programme, Grant Agreement 312453

Agreed Scope of DS

- Goal is to design one operational facility at one location.
- Resources will be distributed to all partners:
  - Model of big particle physics detector: Many institutes team up to build one detector at one place, each contributing a part.
- Site study with the goal to propose the best site:
  - Existing infrastructure, host lab support, scientific user community, support from funding agency, …
- Facility will be devoted to provide for pilot users:
  - Ultra-compact X-ray FEL with broad application range and exploiting unique parameters of plasma-based e- beams
  - Ultra-compact GeV electron source for HEP detectors tests

What to Expect…

- The EU design study is our first step towards the ESFRI (European Strategy for Research Infrastruct.) roadmap.
- The EU design study is limited funding: 3M€ over 4 years. This maximum amount is reduced from previous calls.
- Once on the ESFRI roadmap, one can envisage a first "serious" plasma **accelerator** project: e.g. 200 M€, still much less than other proposals.
- Submission in 9/2014. If successful, expect project to run from roughly 1/2016 to 12/2019.
- Invest now and then really profit from 2020 onwards!

Competition: Risks

- ESGARD = European Steering Group for Acc. R&D
- Inside ESGARD three EU DS are on the table:
  - FCC = Future Circular Collider. CERN future project for 2030's. Asks 3M€. Resources discussed at 0.5 Post-Doc level.
  - ESS-nuSB = ESS based neutrino super beam. Upgrade to the planned ESS facility for the late 2020's and 2030's.
  - EuPRAXIA = our proposal.
- ESGARD finding our idea interesting and good. Encouragement to continue. Asks proposal draft by 15.7.
- Behind the scene: Worries that only 1-2 EU-DS might be successful. If we don't do it now: Next chance in 2-3 y.

Preliminary Parameters

Design Study Required to Identify Solution with Best quality

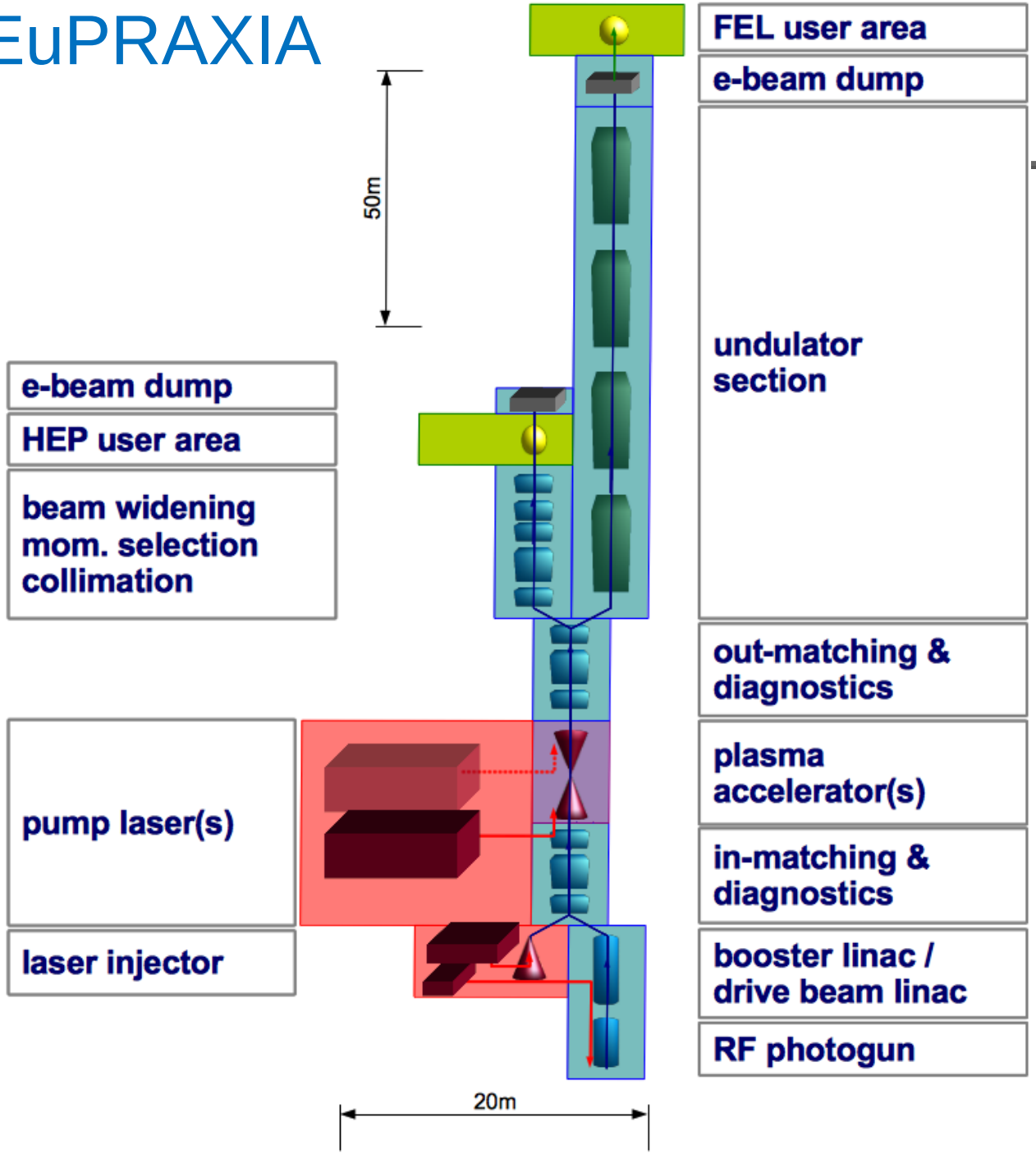
Parameter	Unit	Conventional undulators	Short period undulators	TGU option (Z. Huang)
Electron beam energy	GeV	5	1	1
Charge per bunch	pC	1 – 10	1 – 10	50
Repetition rate	Hz	10	10	10
Bunch length	fs	0.01 - 10	0.01 - 10	5
Peak current	kA	1 – 100	1 – 100	10
Energy spread	%	0.1	0.1	1 – 5
Norm. emittance	μm	0.01 – 1	0.01 – 1	0.1

Parameters assume a commercially available laser driver or a custom built electron beam driver.

Parameters give access to an FEL in the EUV to X-ray regime (1 – 15 nm).

Parameters give access to short electron pulses with high brightness for HEP detector tests (requiring dilution?), material tests and other applications.

EuPRAXIA



Preliminary Conceptual Layout

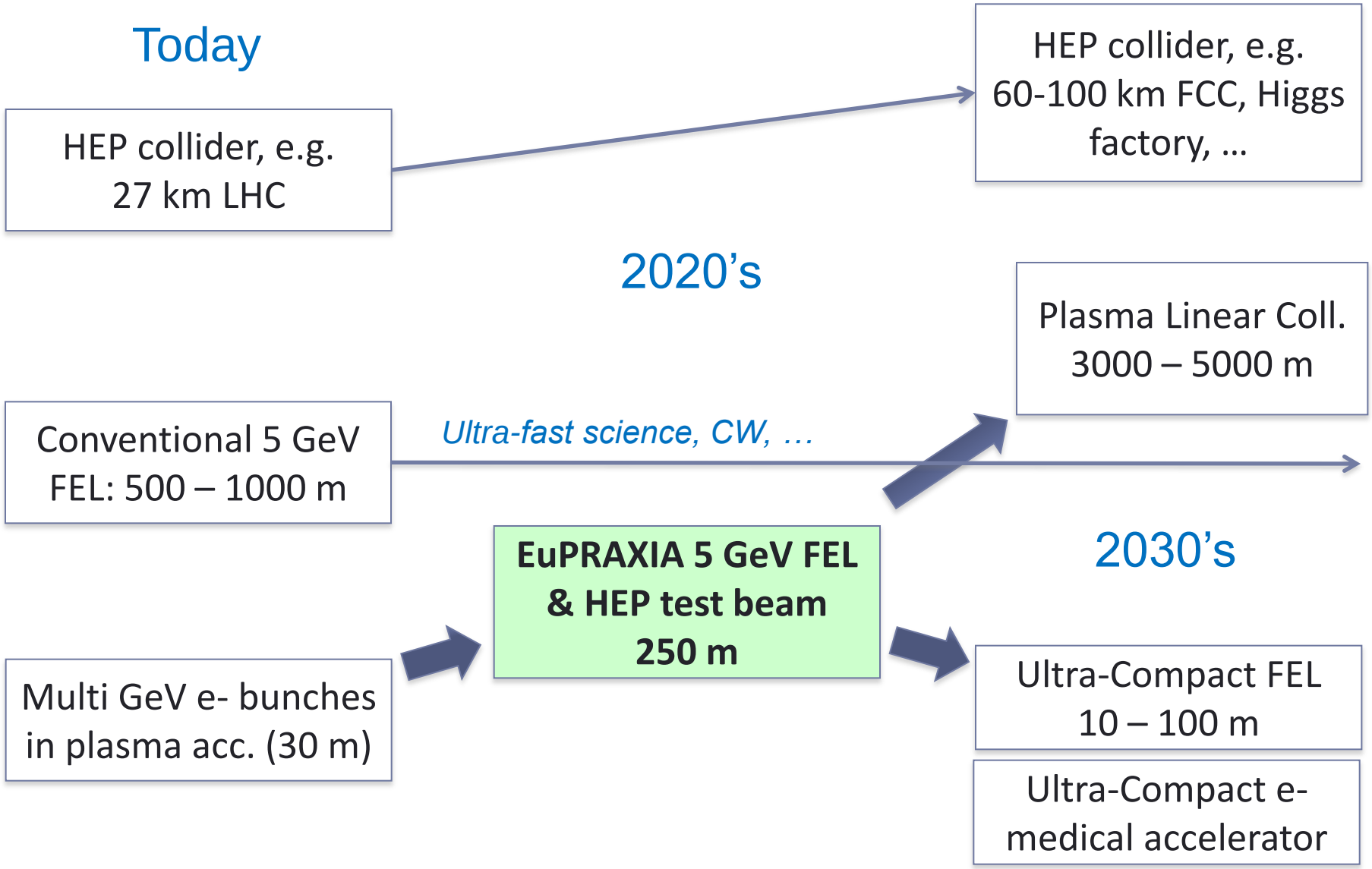
Quality and beam handling takes active measures, namely magnets, colli-mators, instrumentation, correctors, test beams and feedbacks.

These active measures require space and budget. We know this very well from conventional accelerators. Users also require space.

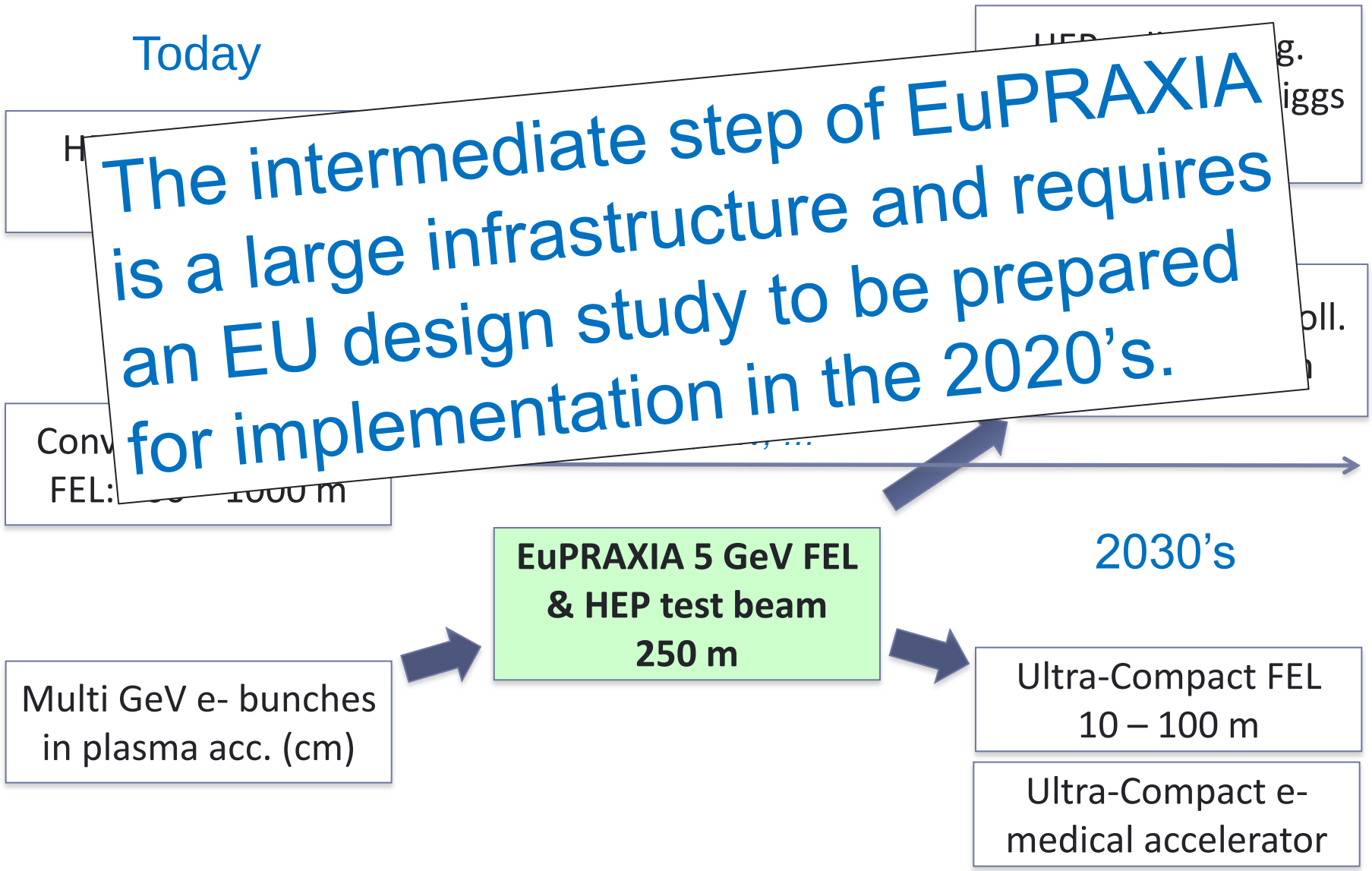
EuPRAXIA should still be smaller and much less expensive than a conventional acc.

Table-top comes after such a demonstration machine. Miniaturize it once it works!

Towards the Ultra-Compact FEL and HEP Plasma Collider



Towards the Ultra-Compact FEL and HEP Plasma Collider



Design Challenges

- Proposal relies on proven concepts. No risk here.
- User applications require high beam quality and reliability.
- Accelerators have an 80 year history of providing optimized beams to science and other users, from Lawrence to the LHC!
- We know from the LHC that it is the quality that is difficult and costs space, effort and budget!
- Design challenges for a European Plasma Accelerator are here:
  - Reduce energy spread or develop robust method to use higher energy spread beams.
  - Improve shot to shot reproducibility → feedbacks on laser, plasma chamber, beam, …
  - Correct unavoidable imperfections → correction algorithms
- EU DS will foster progress here.

Implementation: Partial Funding 1

- It is requested from us that only a fraction of resources spent is asked for reimbursement from EU. As the financial support for an EU design study is very limited (3M€) it is also realistic that more resources are spent than paid for. The big benefit will be realized in medium term: The EU design study is the necessary step to big funding (100M€+). See e.g. ELI.
- The partial funding can be done in two ways.
  - (1) Partial reimbursement with full reporting. This is heavy workload and discouraged at DESY.
  - (2) Only some WP's are included officially and reporting is done on these. Other WP's are used to show total effort. No reporting on these.

Implementation: Partial Funding 2

- Here: Possibility (2) is adopted. Persons involved in a not included WP should also be involved in another WP to get EU resources. E.g. J. Osterhoff on beam-driven plasmas gets post-doc funding through electron beam design or simulation.
- Included WP's have been chosen such that core themes are included (FEL + HEP applications) and focus is put on laser-driven plasmas. This makes it easier to present a coherent package to EU. However, other options are explicitely included and supported (see above). Logic: Give a focus but keep the final design for 2019 open, to be decided on achievements until then. Activities with existing EU funding (e.g. all ERC grants) are in WP's which are not included. This avoids criticism on double funding.

Assumptions

Post-Doc duration (years)	3	
Post-Doc cost per year (€)	€ 60'000.00	
Number of travels per year per person	3	(2 EuPRAXIA meetings, 1 conference)
Cost per travel (€)	€ 1'000.00	

Official Duties

- EU WP (Work Package) Leader or Deputy: Formal reporting to EU, prove the contractual effort, responsible for contractual deliverables
- WP Leader or Deputy: Participate to EuPRAXIA meetings, coordinate WP, informal reporting to EuPRAXIA on results, participate to EU WP to obtain EU resources (travel + post-doc).
- Technical: Participate to EuPRAXIA meetings, informal reporting to EuPRAXIA on results, participate to EU WP to obtain EU resources (travel).
- Associated partner: Participate to EuPRAXIA meetings, contribute various ideas and concepts, …

Beneficiaries and Members 1

#	Country	Institute	#Ben	Name	Official duty	Topic interest	Travel money	EU Post-Doc
1	UK	Cockcroft	1	C. Welsch	WP Leader	DLA, e-beam diagnostics, simulation studies	€24'000.00	1
2			1	J. Clarke	Technical	FEL scheme testing at CLARA	€12'000.00	0
3		Strathclyde	2	B. Hidding	WP Deputy	Underdense Photocathode Trojan Horse Bunch Source	€24'000.00	1
4			2	D. Jaroszinsky	Technical	Plasma Undulator Radiation Sources	€12'000.00	0
5			2	Z.M. Sheng	Technical	Plasma Undulator Radiation Sources, Trojan Horse	€12'000.00	0
6		JAI	3	N.N.	EU Deputy		€24'000.00	1
7	Germany	DESY	4	R. Assmann	EU WP Leader	short bunches, WFA, beams, diagnostics, FEL's, HEP	€24'000.00	1
8			4	J. Osterhoff	WP Leader	beam-driven PWFA, beam handling	€24'000.00	1
9			4	U. Dorda	WP Leader	short bunches, WFA, beams, diagnostics, FEL's	€0.00	0
10			4	B. Marchetti	WP Deputy	short bunches, WFA, beams, diagnostics, FEL's	€0.00	0
11		University Hamburg	5	A. Maier	EU WP Deputy and WP Deputy	LWFA, FEL's, Applications	€24'000.00	1
12			5	F. Grüner	Technical	LWFA, FEL's, Applications	€12'000.00	0

Beneficiaries and Members 2

#	Country	Institute	#Ben	Name	Official duty	Topic interest	Travel money	EU Post-Doc
13	Italy	CNR Pisa	6	L. Gizzi	EU WP L/D	Laser	€24'000.00	1
14			6	L. New Labate	Technical	Laser	€12'000.00	0
15		INFN Frascati	7	E. Chiadroni	EU WP Leader	Beams	€24'000.00	1
16	Portugal	IST	8	L. Silva	EU Deputy	Physics and Simulations	€24'000.00	1
17			8	J. Vieira	Technical	Physics and Simulations	€12'000.00	0
18	France	CEA	9	A. Mosnier	EU WP Leader	Physics and Simulations	€24'000.00	1
19			9	Chance	EU Deputy	Beams	€24'000.00	1
20		CNRS	10	A. Specka	EU WP Leader	LWFA, Staging, HEP	€24'000.00	1
21			10	B. Cros	EU WP Leader	LWFA, Staging	€24'000.00	1
22			10	V. Malka	WP Leader	LWFA, start-to-end-simulations, FEL's	€24'000.00	1
23			10	F. Mathieu	EU WP L/D	Laser	€24'000.00	1
24		Soleil	11	M.E. Couprie	EU WP Leader	undulators, novel FEL's, LWFA	€24'000.00	1
1	*CERN*						*€12'000.00*	*0*
2	*ELI*						*€12'000.00*	*0*
3	*Hungary*						*€12'000.00*	*0*
4	*US*						*€12'000.00*	*0*
5	*Japan*						*€12'000.00*	*0*
	Total						€516'000.00	16
	Value							#####
	Total allocated						€3'396'000.00	
	Available						-€396'000.00	

Associated Partners

Notes on Person & Resource Table

- 11 beneficiaries: very good scope. Not too big not too small.
- Total 24 scientists (if 10% each → 2.4 FTE/y) plus 13.5 FTE/y post-docs at 100% for 3 years.
- Only post-doc time will be paid from EU. Staff time is our investment.
- Total manpower: 50.1 man-years.
- Travel resources equal per person: 516 k€ total.
- A 50 man-year project for preparation of a conceptual design report is a believable effort!
- Manpower and persons must be assigned to work packages…

WP Structure

WP	Name
WP1	Management (M)
WP2	Physics and Simulation (PS)
WP3	High Gradient Laser Plasma Accelerator Structure (HGLPAS)
WP4	Laser Design and Optimization (LDO)
WP5	Electron Beam Design and Optimization (EBDO)
WP6	FEL Pilot Application (FPA)
WP7	HEP and Other Pilot Applications (HOPA)
WP8	*Outreach and Liaison (OL)*
WP9	*Alternative e-Beam Driven Plasma Structure (AEBDPS)*
WP10	*Use of Other Novel Technologies (UONT)*
WP11	*FEL Application Prototyping (FAP)*
WP12	*Accelerator Prototyping and Exp. at Test Facilities (APETF)*

EU Project WP's

Project WP's

EUPRAXIA - European Plasma for Research Accelerator with eXcellence In Application

In Greek mythology, Eupraxia was the personification of well-being.

- Proposal for an EU Design Study -

Notes (1.6.2014) - PLEASE READ

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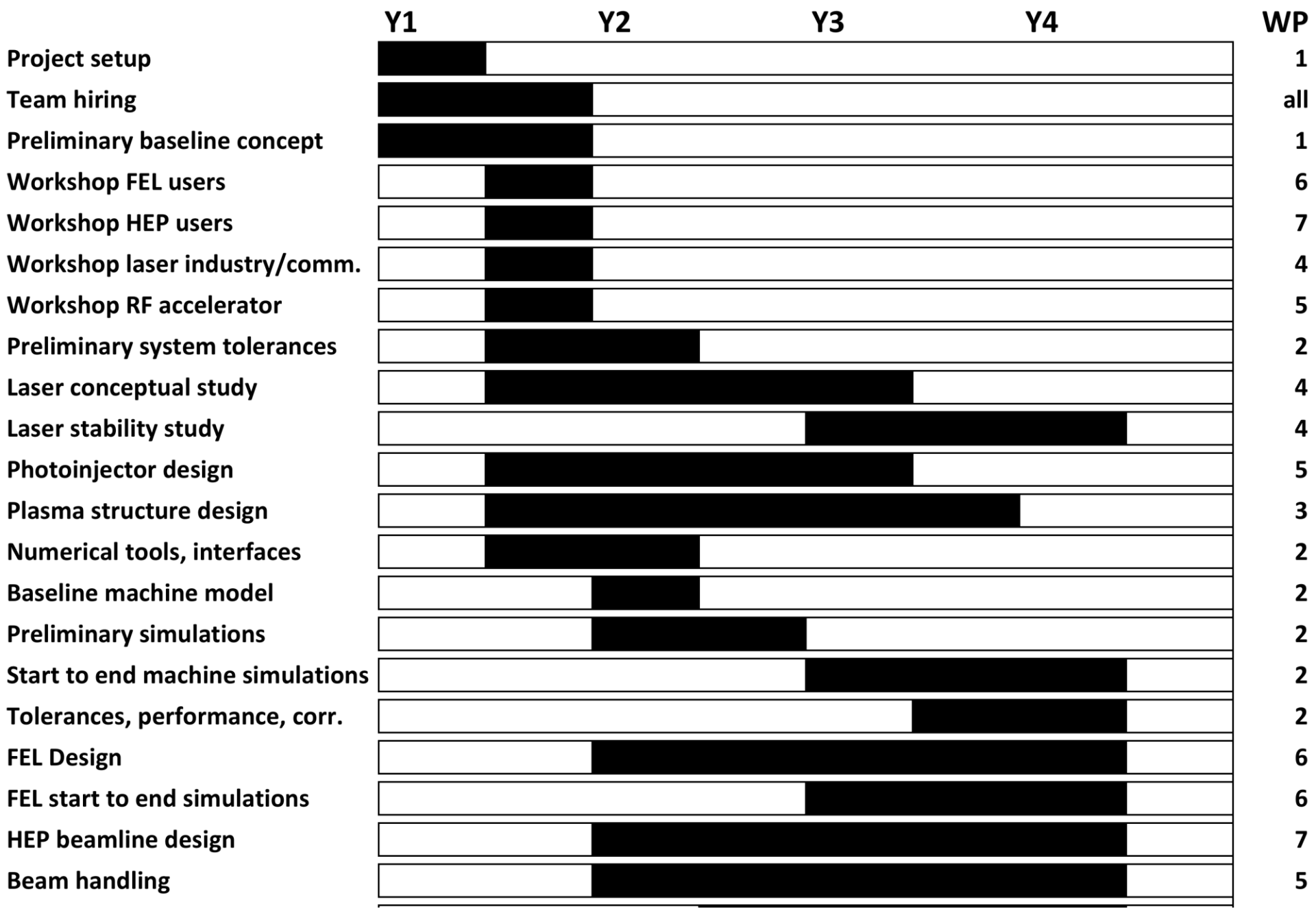
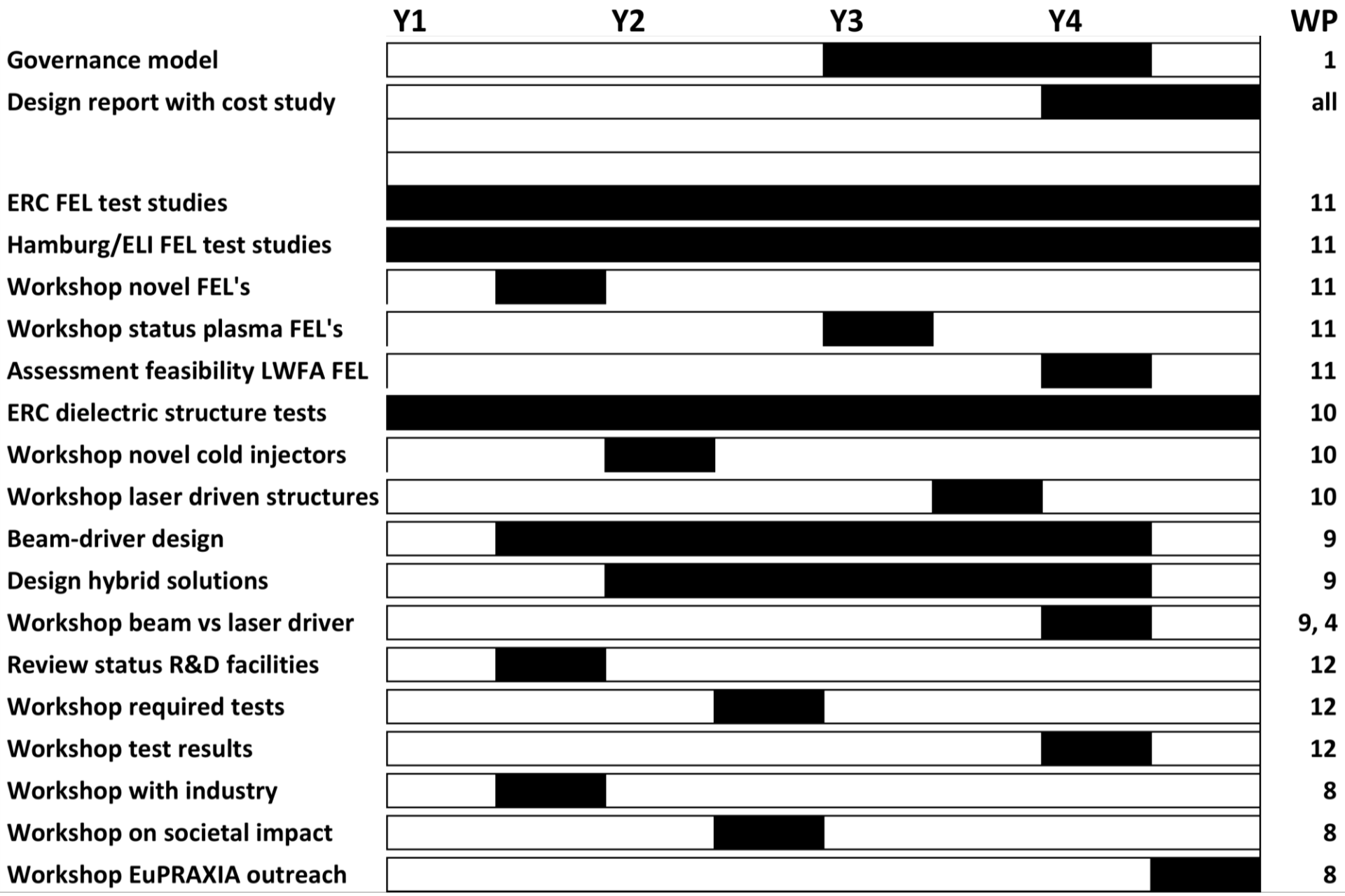
#	WP	Task			WP Leader Principal	Bene-ficiary 1	WP Leader Deputy	Bene-ficiary 2	Officially included
0	**WP1**	**Management (M)**			**Assmann**	**DESY**	**Specka**	**CNRS**	**yes**
1			1.1	Management					
2			1.2	Parameter, Layout and Cost Committee					
3			1.3	Quality Assurance Plan					
4			1.4	Governance Model and Site Study					
5			1.5	Radiological Impact					

#	WP	Task			WP Leader Principal	Bene-ficiary 1	WP Leader Deputy	Bene-ficiary 2	Officially included
0	**WP2**	**Physics and Simulation (PS)**			**Mosnier**	**CEA**	**Silva**	**IST**	**yes**
1			2.1	Machine Model					
2			2.2	Start to End Simulations					
3			2.3	Tolerance Budget					
4			2.4	Performance					
0	**WP3**	**High Gradient Laser Plasma Accelerator Structure (HGLPAS)**			**Cros**	**CNRS**	**N.N.**	**JAI**	**yes**
1			3.1	plasma device = target : Laser-Driven Option					
2			3.2	Plasma chamber design issues					
3			3.3	staging					
4			3.4	plasma diagnostics					
5			3.5	module coupling: plasma mirror					
6			3.6	Engineering Issues for Stability					
7			3.7	synchronisation and superposition					
0	**WP4**	**Laser Design and Optimization (LDO)**			**Gizzi**	**CNR Pisa**	**Mathieu**	CILEX(FRANCE)	**yes**
1			4.1	Overview Industrially Available Lasers					
2			4.2	Error and Stability Analysis for Lasers					
3			4.3	Feedbacks and Correction Methods					
4			4.4	Prototype Laser Feedbacks and Tests					
5			4.5	Two plasma-module laser acceleration					
6			4.6	synchronisation and superposition					
0	**WP5**	**Electron Beam Design and Optimization (EBDO)**			**Chiadroni**	**INFN**	**Chance**	**CEA**	**yes**
1			5.1	Beam for Injection (external RF injector)					
2			5.2	Beam extracted from plasma					
3			5.3	Correction and Optimization of Plasma-Accelerated Beam					
4			5.4	e beam diagnostic					
5			5.5	synchronisation and superposition					

#	WP	Task		WP Leader Principal	Bene-ficiary 1	WP Leader Deputy	Bene-ficiary 2	Officially included
0	**WP6**	**FEL Pilot Application (FPA)**		**Couprie**	**SOLEIL**	**Maier**	**U HH**	**yes**
1		6.1	FEL Parameters and Performance					
2		6.2	Undulators					
3		6.3	Experimental Area 1					
4		6.4	Science Reach					
5		6.5	Operational Model (towards 24/7?)					
0	**WP7**	**HEP and Other Pilot Applications (HOPA)**		**Specka**	**CNRS**	**Assmann**	**DESY**	**yes**
1		7.1	applications for particle beams					
2		7.2	Experimental Area 2					
3		7.3	Science Reach					
4		7.4	Operational Model (towards 24/7?)					
0	**WP8**	**Outreach and Liaison (OL)**		**Welsch**	**Cockroft**	**Hidding**	**USTRATH**	**no**
1		8.1	Liaison with FEL and HEP Science					
2		8.2	Dissemination of Information and Industry outreach					
3		8.3	Training of required experts					
0	**WP9**	**Alternative e-Beam Driven Plasma Structure (AEBDPS)**		**Osterhoff**	**DESY**	**N.N.**		**no**
1		9.1	Plasma device = target: e-beam driver option					
2		9.2	Plasma chamber and vacuum issue					
3		9.3	Staging					
4		9.4	Plasma Diagnostics					
5		9.5	Beam Tailoring and Preparation					
6		9.6	Engineering Issues and Stability					
7		9.7	Timing and Synchronization					
0	**WP7**	**Use of Other Novel Technologies**		**Dorda**	**DESY**	**Marchetti**	**DESY**	**no**
1		10.1	Dielectric structures (ERC Synergy AXSIS)					

#	WP		Task		WP Leader Principal	Bene-ficiary 1	WP Leader Deputy	Bene-ficiary 2	Officially included
2			10.2	Comb beam --> FET					
3			10.3	Hybrid schemes (Trojan horse)					
4			10.4	Fibre-laser driven --> FET					
0	**WP11**	**FEL Application Prototyping**			**Malka**	**CNRS**	**Maier**	**U HH**	**no**
1			11.1	ERC grant activities France					
2			11.2	LUX and ELI activities Germany					
3			11.3	FEL Parameter Design					
0	**WP12**	**Accelerator Prototyping and Experiments at Test Facilities**			**N.N.**		**N.N.**		**no**
1			12.1	SCAPA (UK)					
2			12.2	STFC (UK)					
3			12.3	LLC (Sweden)					
4			12.4	LAOLA (Germany)					
5			12.5	CILEX (France)					
6			12.6	LOA (France)					
7			12.7	ELBE (Germany)					
8			12.8	CALA (Germany)					
9			12.9	ILPP (Germany)					
0			12.10	ELI (International)					
1			12.11	SPARC (Italy)					
2			12.12	ILIL (Italy)					
3			12.13	AWAKE (CERN)					


Y1
Y2
Y3
Y4
WP
Project setup
1
Team hiring
all
Preliminary baseline concept
1
Workshop FEL users
6
Workshop HEP users
7
Workshop laser industry/comm.
4
Workshop RF accelerator
5
Preliminary system tolerances
2
Laser conceptual study
4
Laser stability study
4
Photoinjector design
5
Plasma structure design
3
Numerical tools, interfaces
2
Baseline machine model
2
Preliminary simulations
2
Start to end machine simulations
2
Tolerances, performance, corr.
2
FEL Design
6
FEL start to end simulations
6
HEP beamline design
7
Beam handling
5


Y1
Y2
Y3
Y4
WP
Governance model
1
Design report with cost study
all
ERC FEL test studies
11
Hamburg/ELI FEL test studies
11
Workshop novel FEL's
11
Workshop status plasma FEL's
11
Assessment feasibility LWFA FEL
11
ERC dielectric structure tests
10
Workshop novel cold injectors
10
Workshop laser driven structures
10
Beam-driver design
9
Design hybrid solutions
9
Workshop beam vs laser driver
9, 4
Review status R&D facilities
12
Workshop required tests
12
Workshop test results
12
Workshop with industry
8
Workshop on societal impact
8
Workshop EuPRAXIA outreach
8

WP	Time	
1	M12	MS: Team in place
1	M12	MS: Report defining baseline concept.
1	M42	DEL: Report site study.
1	M42	DEL: Report govenrance model.
1	M48	DEL: Full design report EUPRAXIA
1	M6	DEL: Project is set up, web site
2	M12	MS: Team in place
2	M18	MS: Report defining tolerance
2	M18	MS: Simulation tools and theory are set up.
2	M18	DEL: Report defining baseline design.
2	M24	MS: Preliminary simulations are set up.
2	M42	MS: Start to end simulations.
2	M42	DEL: Final tolerance analysis.
2	M48	DEL: Full design report EUPRAXIA

WP	Time	
3	M12	MS: Team in place
3	M36	DEL: Design report plasma structure
3	M48	DEL: Full design report EUPRAXIA
4	M12	MS: Team in place
4	M12	MS: Preliminary laser specifications
4	M30	DEL: Report defining Laser parameters
4	M42	DEL: Report defining Laser stabilization
4	M42	Report +/- driver choice based on achievements
4	M48	DEL: Full design report EUPRAXIA
5	M12	MS: Team in place
5	M12	MS: Preliminary RF accelerator specification
5	M30	DEL: Design-report photo-injector
5	M42	DEL: Report on optimal beam handling,
5	M48	DEL: Full design report EUPRAXIA

WP	Time	
6	M12	MS: Team in place
6	M12	MS: Preliiminary FEL user requirements
6	M42	DEL: FEL design report at FLASH2.
6	M42	MS: FEL simulations
6	M48	DEL: Full design report EUPRAXIA
7	M12	MS: Team in place
7	M12	MS: Preliiminary HEP user requirements
7	M42	DEL: Provide report on HEP beamline design.
7	M48	DEL: Full design report EUPRAXIA

WP	Time	
8	M12	Report on needs and interests from industry
8	M24	Report on potential for maximum societal impact
8	M48	Presentations, publicity for EuPRAXIA final proposal
9	M42	Design report beam driver
9	M42	Report hyprid (laser/beam) solutions and potential
9	M42	Report +/- driver choice based on achievements
10	M18	Report potential of novel injectors
10	M36	Report potential of dielectric structures
11	M12	Report novel FEL concepts, ideas and approaches.
11	M32	Report novel FEL status.
11	M42	Report summarizing lessons leanrt on feasibility.
12	M12	Web site with talks on status'
12	M24	Program of tests and prototyping for EuPRAXIA support
12	M42	Report on feasibility and open R&D points

To Do Ahead

- 10.6. Freeze WP's and institutes/scientists involved.
- 13.6. Final input material to all involved
  - WP list
  - Preliminary parameters
  - Draft milestones and deliverables
- 30.6. Deadline version 1
- 4.7. Distribute version 1
- 10.7. Deadline comments
- 15.7. Version 2 to all and ESGARD

In parallel: Formal documents for EU being prepared with all partners.

Thanks for your attention

Timeline EU DS

- 20.03.2014 – Decision in EuroNNAc member's board
- 24.03.2014 – Presentation to ESGARD, feedback…
- 01.04.2014 – Call for additional beneficiaries, industry, …
- 20.04.2014 – Layout EU DS application, Authors fixed
- 29.05.2014 – 1st Draft to Mrs. Mundt (DESY) → EU office DESY (U. Krell)
- 06.06.2014 – Meeting Daresbury UK. Final decisions.
- 30.06.2014 – 2nd Draft
- 15.07.2014 – Final Draft
- 24.07.2014 – Final Draft for last, urgent comments
- 30.08.2014 – Submission

Beneficiaries and Members 2 - mod

#	Country	Institute	#Ben	Name	Official duty	Topic interest	Travel money	EU Post-Doc
13	Italy	CNR Pisa	6	L. Gizzi	EU WP Leader	Laser	€24'000.00	1
14			6	L. New Labate	Technical	Laser	€12'000.00	0
15		INFN Frascati	7	E. Chiadroni	EU WP Leader	Beams	€24'000.00	1
16	Portugal	IST	8	L. Silva	EU Deputy	Physics and Simulations	€24'000.00	1
17			8	J. Vieira	Technical	Physics and Simulations	€12'000.00	0
18	France	CEA	9	A. Mosnier	EU WP Leader	Physics and Simulations	€24'000.00	0.5
19			9	Chance	EU Deputy	Beams	€24'000.00	0.5
20		CNRS	10	A. Specka	EU WP Leader	LWFA, Staging, HEP	€24'000.00	1
21			10	B. Cros	EU WP Leader	LWFA, Staging	€24'000.00	0.5
22			10	V. Malka	WP Leader	LWFA, start-to-end-simulations, FEL's	€24'000.00	0.5
23			10	F. Mathieu	EU WP L/D	Laser	€24'000.00	0.5
24		Soleil	11	M.E. Couprie	EU WP Leader	undulators, novel FEL's, LWFA	€24'000.00	1
1	*CERN*						*€12'000.00*	*0*
2	*ELI*						*€12'000.00*	*0*
3	*Hungary*						*€12'000.00*	*0*
4	*US*						*€12'000.00*	*0*
5	*Japan*						*€12'000.00*	*0*
	Total						€516'000.00	13.5
	Value							#####
	Total allocated						€2'946'000.00	
	Available						€54'000.00	

Associated Partners