ARIES

EuPRAXIA

Introducing ARIES

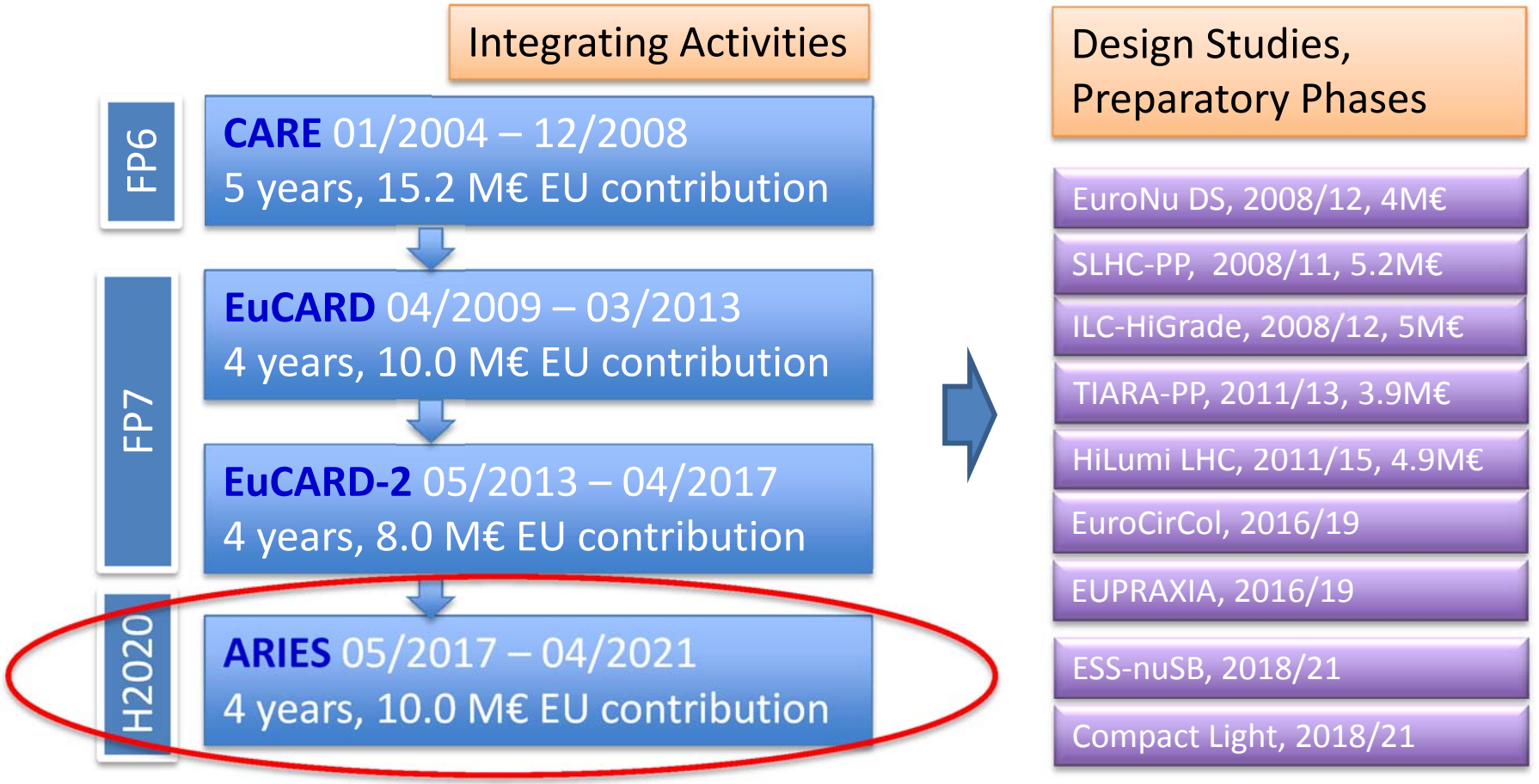
Accelerator Research and innovation for European Science and Society

A new Integrating Activity for Particle Accelerator R&D

Maurizio Vretenar, CERN – Project Coordinator

ARIES is co-funded by the European Commission Grant Agreement number 730871

EU support to particle accelerator R&D



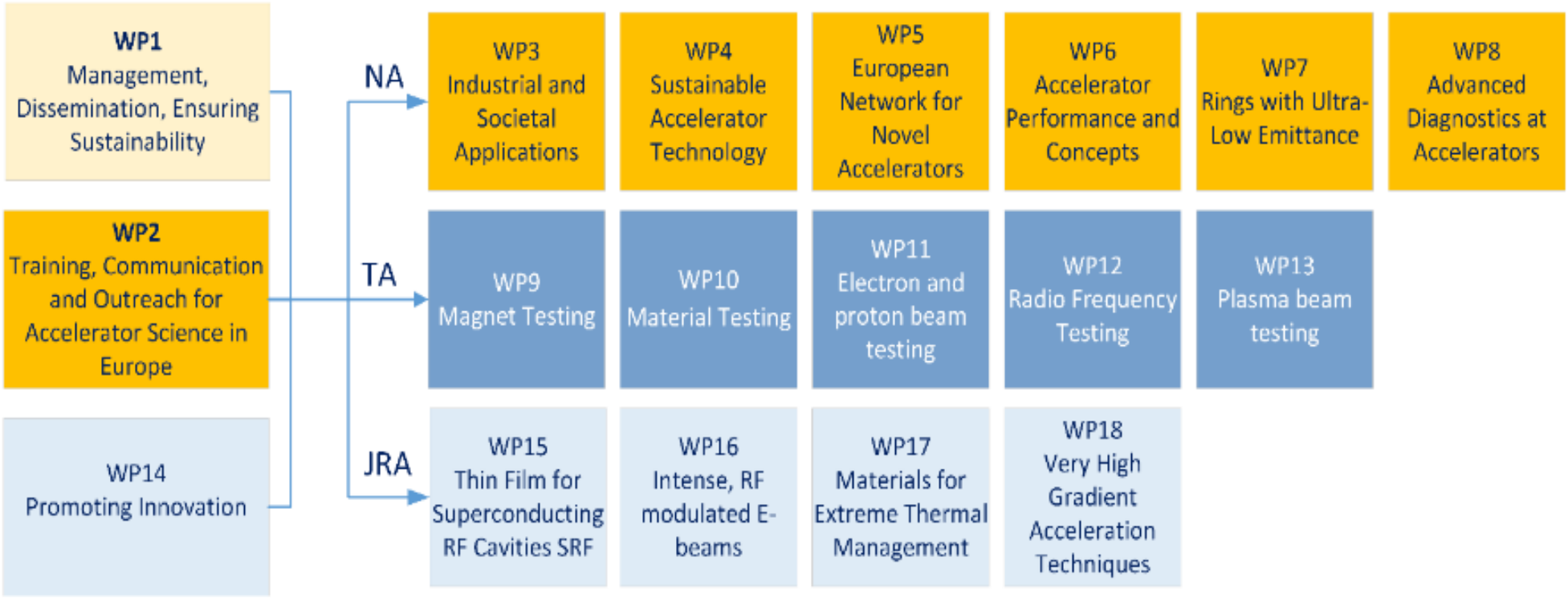
- EC contribution 10 M€, total cost 24.9 M€, funding rate 40%.
- Share of EC contribution: Management 7%, Networks 31%, TA 22%, JRAs 40%.
- 42 beneficiaries from 18 EU countries (+CERN, ESS)

ARIES

Novelty and added value of ARIES

1. **More focus**: The WPs are focused on **advancing well-defined key topics of excellence** that were identified in EuCARD-2.
2. **More access: Transnational Access** strongly increased as a result of the new concept of opening advanced accelerator test infrastructures to the accelerator community and to industry. TA infrastructures from 3 (in EuCARD-2) to 14.
3. **More integration**: Consortium widened to include partners from south and east of Europe. 41 partners, **20 participate for the first time. Co**untries involved from 12 to 18, for the first time Hungary, Latvia, Portugal, Romania, Slovakia, and Slovenia.
4. **More industry: Industrial participation** increased from 2 to 8 beneficiaries, including 3 **SMEs** and one industry association. Role of the industrial partners changes from supporting specific developments to players in co-innovation activities, experts for innovation and market-pull actions, and partners for exploring applications to society.
5. **More innovation**: **focus on innovation** with identification of innovative technologies, co-innovation programmes with industry, and demonstration of novel accelerator technologies for industrial or societal applications via the new Proof-of-Concept fund.
6. **More society**: **benefits to European society** via training of researchers, support for accelerators for medicine, industry and the environment, development of advanced accelerator technologies.

ARIES Structure



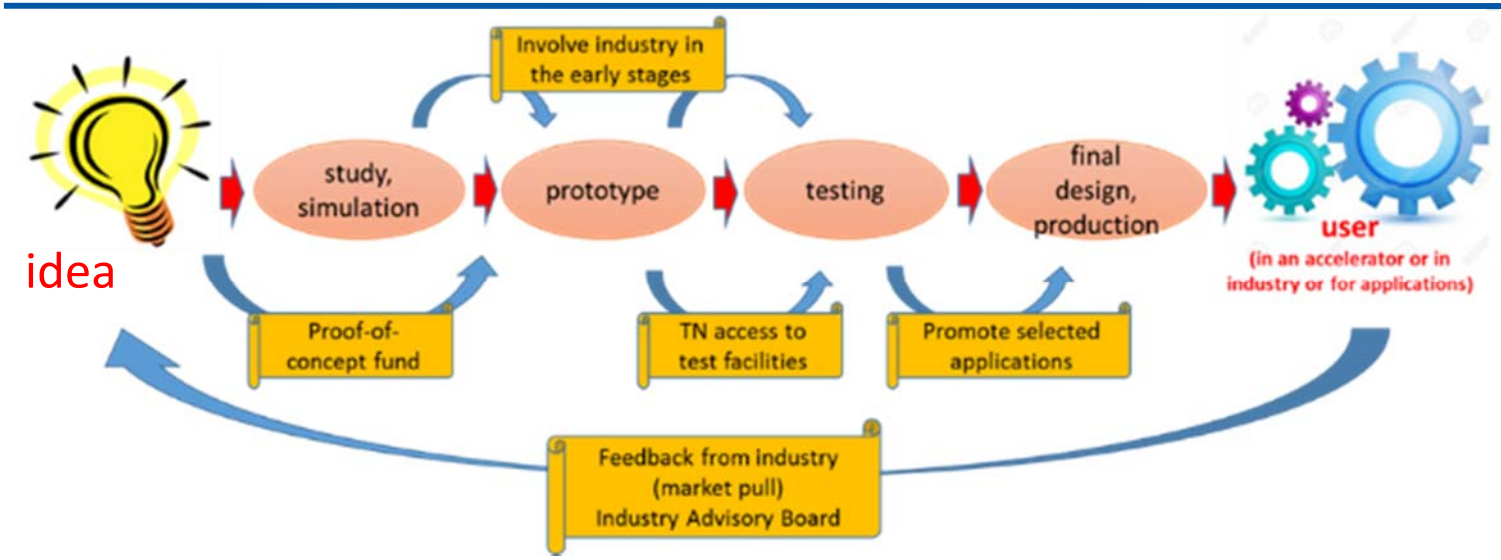
18 Workpackages:

8 **Networks** 5 **Transnational Access**, 5 **Joint Research Activities**.

ARIES Tasks, Budgets, Partners

WP	Type	Name	Acronym	Coordinator	Tasks	# of tasks	Requested EC Contr. (€)	Funding Rate (%)	Total Cost (€)	Beneficiaries
1	NA	Management, dissemination, ensuring sustainability	MADISU	M. Vretenar (CERN)	Management - Internal communication, dissemination, scientific publications and monographs - sustainability of particle accelerator research in Europe	3	739,000	48.9%	1,511,000	CERN, WUT, CEA, DESY
2	NA	Training, Communication and Outreach for Accelerator Science	TCO	P. Burrows (UOXF)	Coordination of communications/outreach activities - Coordination of training activities - E-learning course	4	427,400	66.2%	645,150	UOXF, CERN, ESS, CNRS
3	NA	Industrial and societal applications	ISA	R. Edgecock (HUD)	Low energy e-beam applications, technology - Electron beam new applications - Medium energy electron beams - Radioisotope production	5	490,000	49.1%	997,904	HUD, INCT, FEP, IBA, CIEMAT, CERN, CNRS
4	NA	Efficient energy management	EEM	M. Seidel (PSI)	High Efficiency RF Power Sources - Efficiency of the target station - SRF power conversion - Operation of pulsed magnets	5	510,000	34.6%	1,473,746	CEA, GSI, PSI, ESS, CERN, UU
5	NA	European Network for Novel Accelerators	EuroNNAC	R. Assmann (DESY)	EU Strategy Plasma acc. - EU Strategy Dielectric acc. - EAAC workshop - Young scientist networking and academic standards	5	500,000	55.5%	900,454	DESY, CEA, CERN, CNRS, INFN, UOXF
6	NA	Accelerator Performance and Concepts	APEC	F. Zimmermann (CERN)	Beam Quality Control in Hadron Storage Rings - Reliability and availability - Improved beam stabilisation - Beam quality control in linacs - far future concepts	6	523,750	65.0%	805,626	CERN, GSI, INFN, JGU, HIT
7	NA	Rings with ultra-low emittance	RULE	R. Bartolini (UOXF)	Injection systems - beam dynamics and technology - beam test and commissioning	4	349,129	64.0%	545,817	CERN, INFN, KIT, SOLEIL, UOXF, PSI
8	NA	Advanced Diagnostics at Accelerators	ADA	P. Forck (GSI)	Advanced Instrumentation for hadron LINACs - Hadron Synchrotrons - 3rd Generation Light Sources - FELs	5	254,000	54.6%	465,385	GSI, CERN, ALBA, DESY
9	TA	Magnet testing	Mag	M. Bajko (CERN)	SM18 (CERN) - FREIA (UU)	2	269,810	13.1%	2,063,788	CERN, UU
10	TA	Material testing	Mat	A. Fabich (CERN)	HiRadMat (CERN) - UNILAC, M-Branch (GSI)	2	289,456	24.1%	1,200,112	CERN, GSI
11	TA	Electron and proton beam testing	Ep	J. Schwindling (CEA)	ANKA (KIT), VELA (STFC), IPHI (CEA), SINBAD (DESY), FLUTE (KIT)	5	882,296	40.7%	2,169,699	KIT, STFC, CEA, DESY
12	TA	Radio Frequency testing	Rf	R. Ruber (UU)	FREIA (UU), XBOX (CERN)	2	327,417	26.0%	1,257,165	UU, CERN
13	TA	Plasma beam testing	Pb	B. Cros (CNRS)	Apollon (CNRS), LIDyL (CNRS), LULAL (LUND)	3	468,869	38.9%	1,205,708	CNRS, LUND
14	JRA	Promoting innovation	PI	M. Losasso (CERN)	Proof of Concept innovation fund - Coll. with Industry - Materials for extreme thermal management - HTS conductor process - Timing system for applications	6	1,265,623	40.2%	3,149,419	CERN, STFC, CNI, CEA, WIGNER, UT, UNIGE, BHTS, BREVETTI, RHP, COSYLAB
15	JRA	Thin Film for Superconducting RF Cavities	TF/SRF	O. Malyshev (STFC)	Surface preparation - Deposition and analysis - Superconductivity evaluation	4	550,000	35.6%	1,544,188	CERN, STFC, INFN, SIEGEN, HZB, CEA, IEE/SAS, RTU
16	JRA	Intense RF modulated Electron Beams	IRME	D. Ondreka (GSI)	System integration - Electron gun and modulator - Test stand and diagnostics	4	635,250	38.7%	1,642,625	GSI, CERN, IAP, RTU
17	JRA	Materials for extreme thermal management	PowerMat	A. Rossi (CERN), M. Tomut (GSI)	Materials development and characterization - Dynamic testing and online monitoring - Simulation of irradiation effects and mitigation method -Broader accelerator and societal application	5	645,000	45.0%	1,433,125	CERN, GSI, POLITO, POLIMI, ELI-NP, UM
18	JRA	Very High Gradient Acceleration Techniques	VHGAT	A. Specka (CNRS)	Multistage LWFA - LWFA with exotic laser beams - Laser driven dielectric accelerators - Pushing back the charge frontier	5	873,000	47.1%	1,854,174	CNRS, CEA, IST-ID, DESY, FAU, ULUND
						75	**10,000,000**	**40.2%**	**24,865,085**	

Innovation Strategy



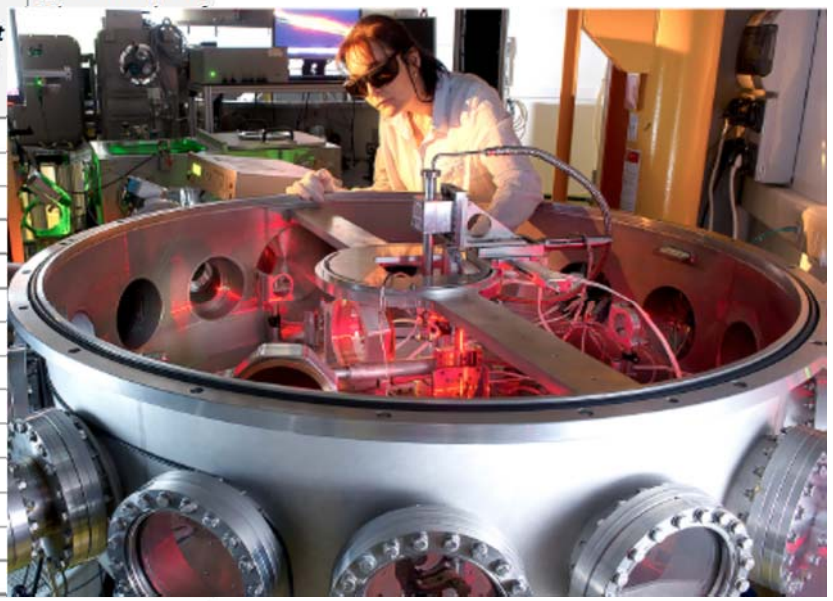
In ARIES Innovation is a Joint Research Activity

Support to all stages of the innovation process:

- **Proof-of-concept innovation fund**: for Business Plan preparation, market assessment, demonstration in connection with industry of the technological viability of new ideas.
- **Industrial Advisory Board**: provide business consultation (eg. business plans) and support market assessments ("market pull").
- **ARIES meets industry events**
- **3 co-innovation programmes with industry:**
  - breakthrough in the cost per kAm of industrial High Temperature Superconductors
  - production of materials for extreme thermal management
  - production of a standardized timing for medical and industrial applications.

Transnational Access

Access provider short name	Short name of infrastructure	Installation		Installation Country code	Type of access	Unit of access	Unit cost (UC) €
		Nr	Short name				
CERN*	MagNet	1	MagNet@CERN	IO	TA-uc	1h	0.00
UU	FREIA	1	Gersemi	SE	TA-ac	1h	-
CERN*	HiRadMat	2	HiRadMat@SPS	IO	TA-uc	1h	0.00
GSI	UNILAC	1	M-branch	DE	TA-uc	1h	274.79
KIT	KIT-ATP	1	KIT-ANKA	DE	TA-uc	1h	416.22
KIT	KIT-ATP	2	KIT-FLUTE	DE	TA-ac	1h	-
CEA	IPHI	1	IPHI	FR	TA-ac	1h	-
DESY*	SINBAD	1	SINBAD	DE	TA-ac	1h	-
STFC	VELA	1	VELA	UK	TA-ac	1h	-
UU	FREIA	2	HNOSS	SE	TA-ac	1h	-
CERN*	XBox	3	XBox@CERN	IO	TA-uc	1h	0.00
CNRS	LULI	1	APOLLON	FR	TA-ac	1h	-
CEA	LIDyL	2	LPA-UHI100	FR	TA-uc	1h	117.00
UL	LULAL	1	LULAL	SE	TA-uc	1h	170.00



- **New concept for the accelerator community**: promote a common usage of the test stands used for the development of new accelerator technologies.
- **14 facilities based in 6 countries**, grouped in 5 thematic WPs
- 664 estimated users for about 18’000 access hours
- Set of **complementary facilities** for testing magnets, materials, components with different beams (protons, high current electrons, variable electron beams, short electron bunches), RF components, plasma acceleration.
- Flagships: IPHI, VELA, ANKA, Apollon.

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After ARIES: New EC programmes

- Accelerators are a successful community: 4 Integrating Activity projects approved in close sequence.
- ARIES will very likely be the last “integrating” project. Support from the EC will continue but on a new keyword: “innovation”.
- The focus will be on **Joint Research Activities** for the development of prototypes and new technologies, involving multiple laboratories and industry.
- An **“Innovation Pilot” programme** addressing 3 advanced communities (synchrotron light sources, accelerators and detectors) is in preparation for the last call of Horizon2020 (2018-20), for a consistent amount of money.
- We must: a) lobby at all levels to support this new scheme that will increase our level of funding, and b) start thinking to what we would like to propose under the new scheme.
- Indicative guidelines: programs with an EC contribution between 100k and 1M, involving at least 2 academic partners and one industry, from different EU countries.

EUROPEAN
PLASMA RESEARCH
ACCELERATOR WITH
EXCELLENCE IN
APPLICATIONS

EuPRAXIA

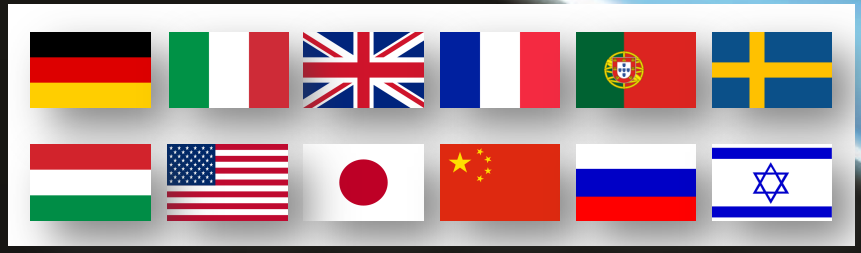
Horizon 2020 EuPRAXIA Design Study

Ralph Aßmann (DESY)

on behalf of the EuPRAXIA collaboration

3rd European Advanced Accelerator Concepts Workshop

September 28th, 2017, Elba



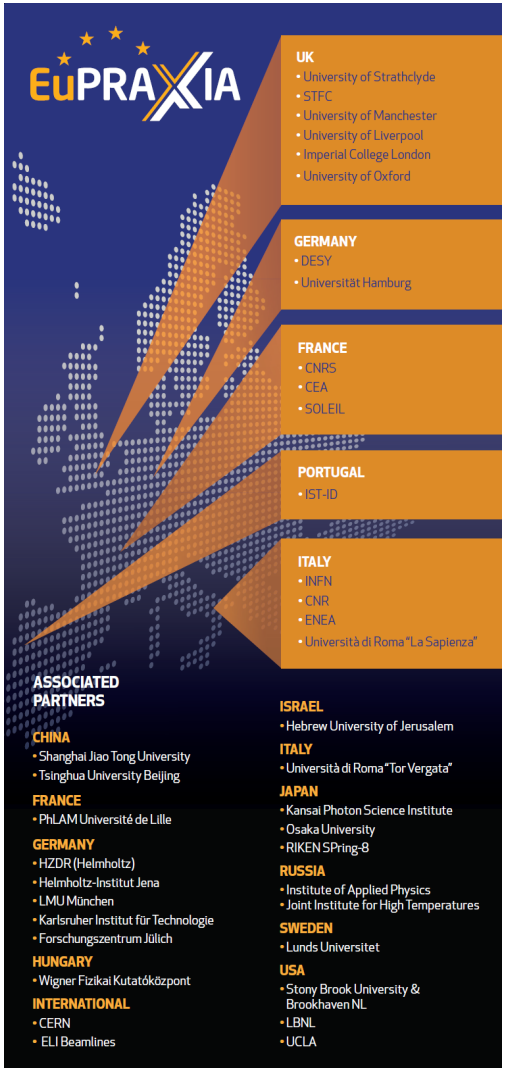
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 653782.

http://eupraxia-project.eu

European Plasma Research Accelerator with eXellence In Applications

Horizon 2020

- EuPRAXIA is a **conceptual design study** for a **5 GeV electron plasma accelerator** as an European research infrastructure
- 125 scientists work in **38 international partners**
  - 16 EU laboratories are beneficiaries
  - 22 associated partners contribute in-kind
  - DESY is coordinator laboratory (R.W. Assmann)
- EuPRAXIA is an **EU Horizon 2020** project
  - Is an accelerator related design study, as EuroCirCol (FCC) from CERN
  - Final CDR will be published in October 2019
- Develop **plasma technology for user readiness**:
  - Incorporate established accelerator technology for optimal quality
  - Combine expertise from accelerator and laser labs, industry, and international partners



A European Strategy for Accelerator Innovation

PRESENT EXPERIMENTS

Demonstrating **100 GV/m** routinely

Demonstrating **GeV** electron beams

Demonstrating basic **quality**

EuPRAXIA INFRASTRUCTURE

Engineering a high quality, compact plasma accelerator

5 GeV electron beam for the 2020's

Demonstrating user readiness

Pilot users from FEL, HEP, medicine, ...

PRODUCTION FACILITIES

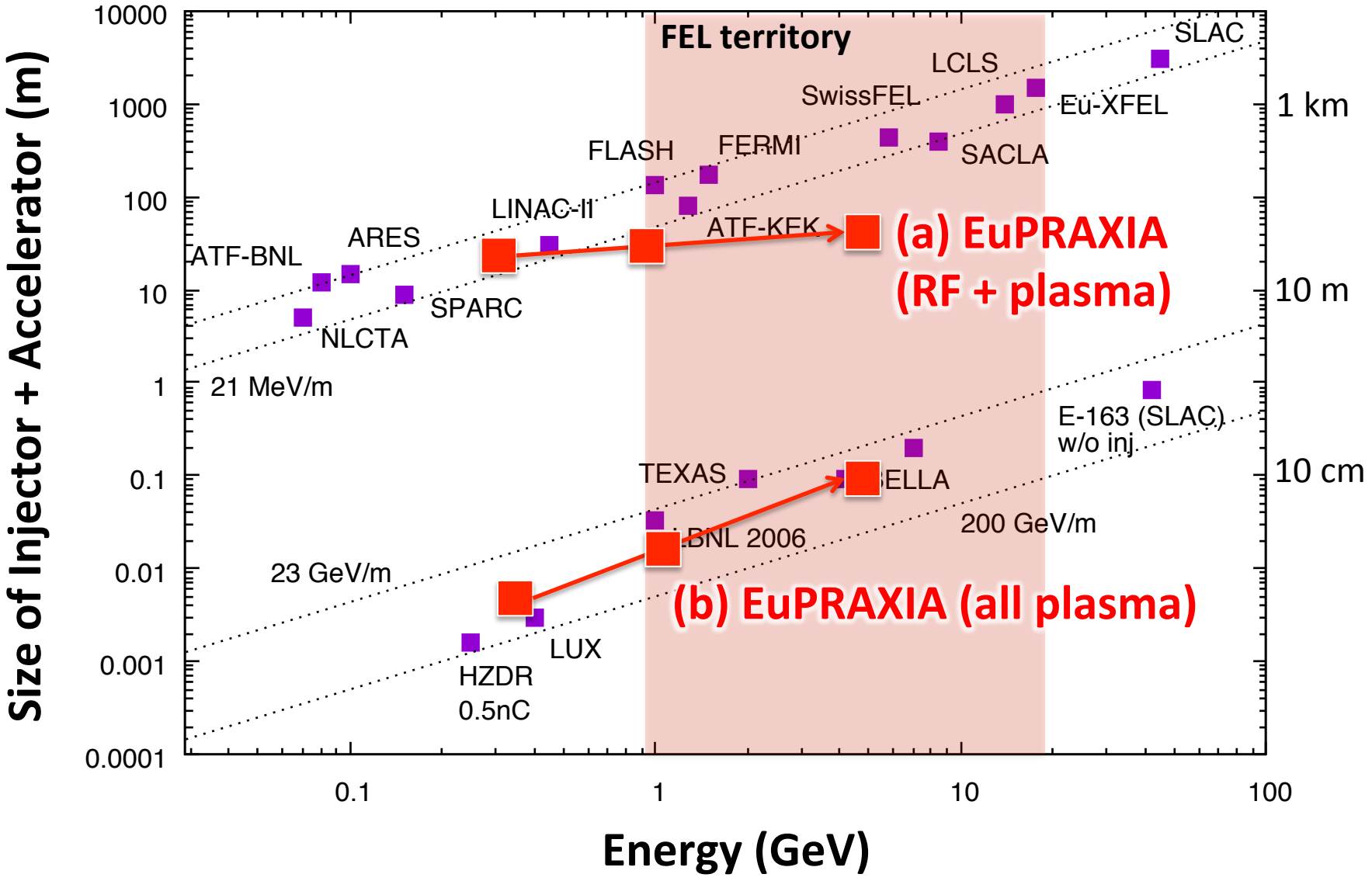
Plasma-based **linear collider** in 2040's

Plasma-based **FEL** in 2030's

Medical, industrial applications soon

EuPRAXIA Development Paths

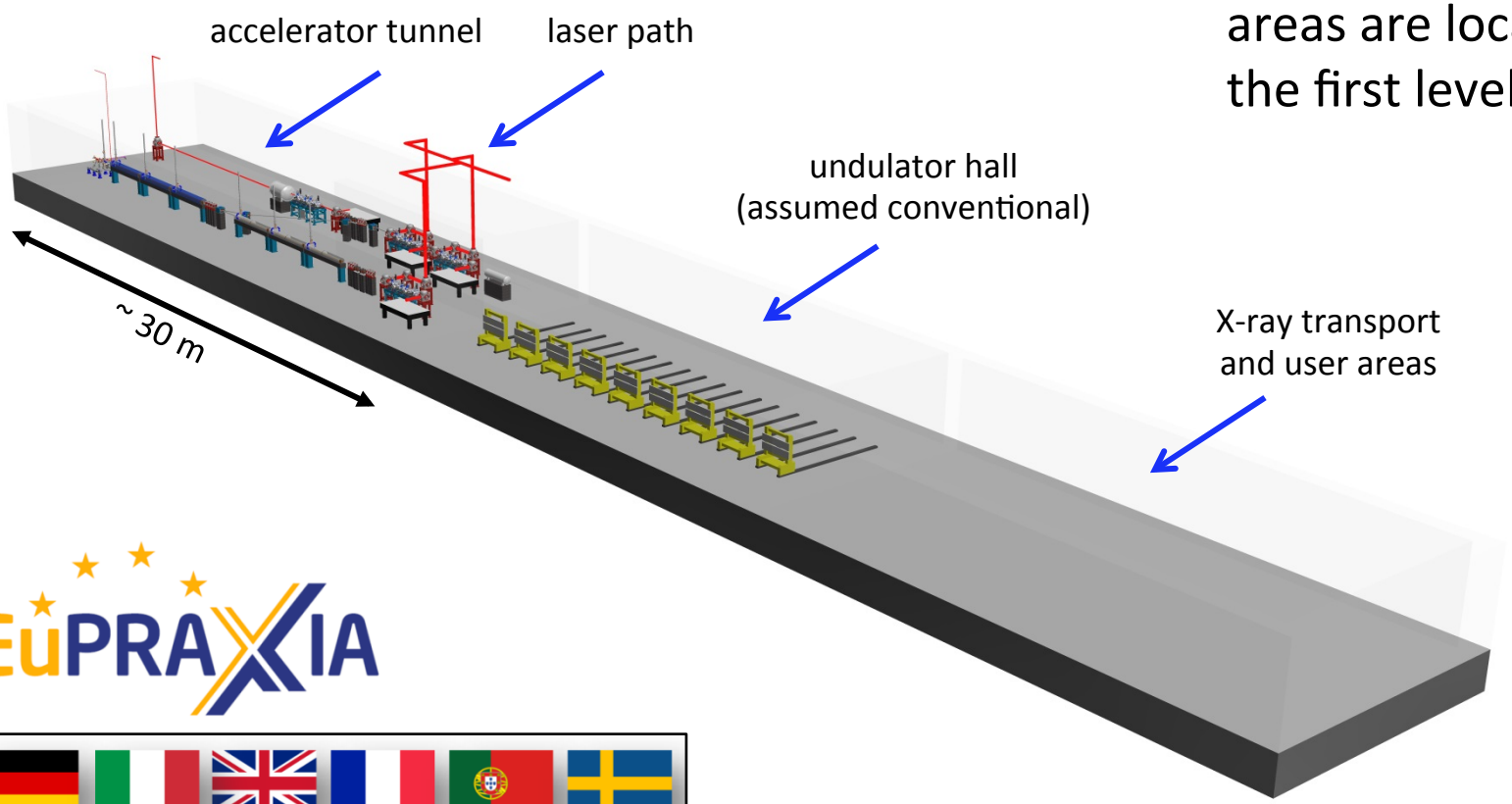
towards high quality electron beams



Overall layout status (ongoing)

Horizon 2020

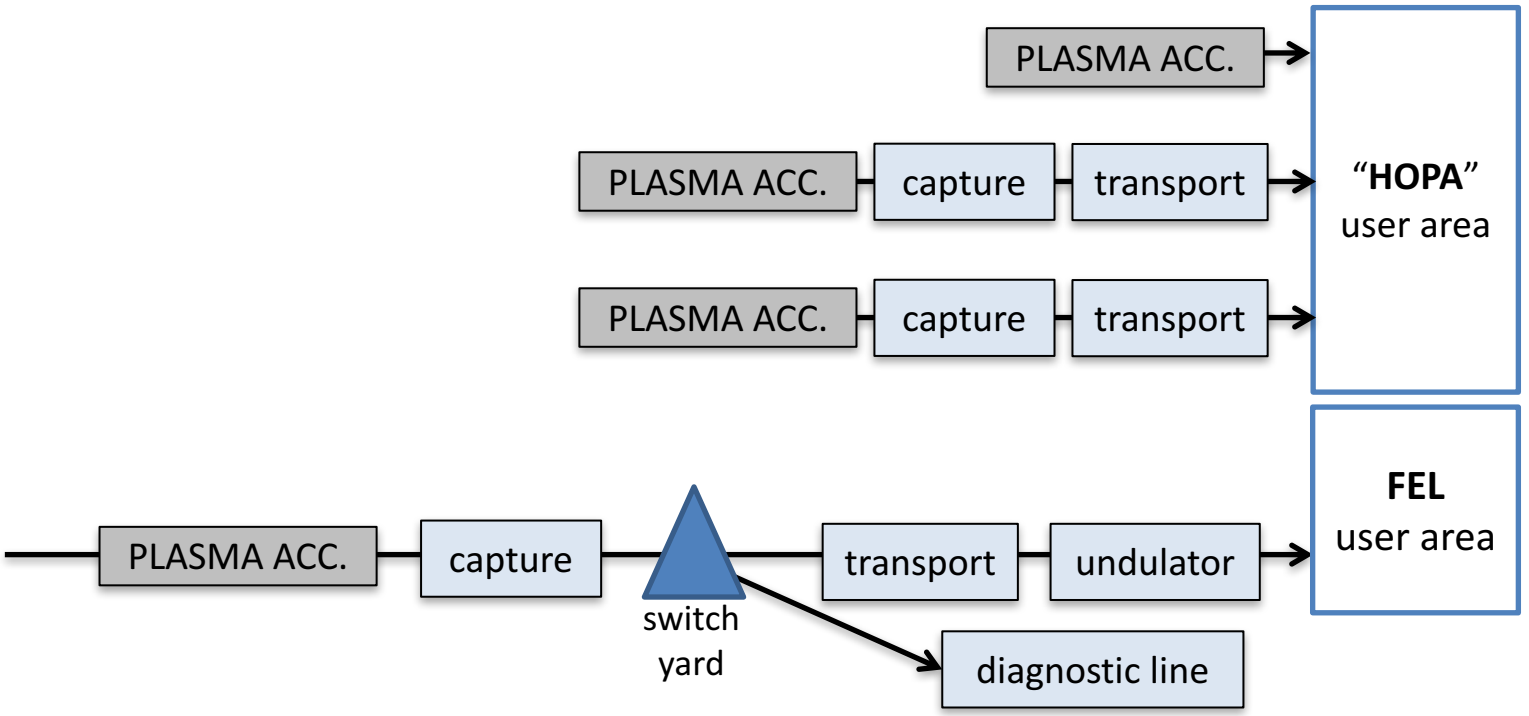
Accelerator research, undulators and user areas are located on the first level



Design by A. Walker (DESY) and Dariusz Kocoń (ELI-Beams)

How to position user areas?

There will be **at least 2 user areas:** FEL and HOPA



Project timeline

09.2014	Proposal submission
07.2015	Approval
11.2015	**Start of EuPRAXIA project**
2016	Organization (collaboration agreements, …). Hiring dedicated personnel. Ten workshops on EuPRAXIA/EuroNNAc matters. Decision parameters for first study versions.
08.2019	Application to **ESFRI roadmap** for 2020 update
10.2019	Final **conceptual design report** and end design study
2020	*Construction decision*
2021 – 2025	*Construction*
2025 – 2035	*Operation*

ESFRI = European Strategy for Future Research Infrastructures

EuPRAXIA is compact solution for (initially) low power accelerator to drive FEL

- Sufficient **beam quality is central goal** of EuPRAXIA
  - Improve energy spread ("beam loading" [1] or "modulated plasma density" [2])
- EuPRAXIA will initially be **low power** and **low wall-plug power efficiency**
  - Baseline (10 Hz): 10s of Watt with ~ 1 mJ/photon pulse energy
  - Dream scenario (1 MHz): kW - MW of power with diode-pumped solid-state laser ("100cube") and/or concepts such as "kHz single cycle laser pulses" [3] or "resonant excitation of plasma waves" by trains of laser pulses [4]
  - Efforts with industry and laser institutes to improve rep. rate & efficiency of currently used laser systems (also incorporate fiber-based lasers with 30 % efficiency)
- EuPRAXIA report will be technical design report and project proposal:
  - Performance, required tolerances, footprint and cost will be assessed
  - We **hope for significant cost benefit** from this new technology

[1] S. Van der Meer, CLIC Note No. 3, CERN; PS, '85-65
[2] R. Brinkmann et al., PRL **118**, 214801 (2017)
[3] D. Guenot *et al.*, Nat. Photonics 11(5), 293-296 (2017)
[4] J. Cowley *et al.*, Phys. Rev. Lett. **119**, 044802 (2017)

Political Landscape: European Initiatives

e-EPS
Facts and info from the European Physical Society

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LEAPS: devising a new era of accelerator-based photon science in Europe

By Carolin Hahn. Published on 22 May 2017 in:
May 2017, News, Europe, League of European Accelerator-based Light Sources, LEAPS, Light source, Particle Accelerator

The Directors of the European Synchrotron and FEL user facilities have decided to establish a strategic partnership – the League of European Accelerator based-Photon Sources (LEAPS)– which aims for an unprecedented level of cooperation and development and outreach to academic and industrial users as well as to the general public.

So far, 16 facilities have joined this initiative which is strongly encouraged by policy makers such as Robert-Jan Smits, the Director-General for Research and Innovation of the European Commission, who met with LEAPS representatives in Brussels on April 26, 2017.

LEAPS at Diamond Light Source in November 2016

The primary goal of LEAPS is to ensure the quality and impact of fundamental, applied and industrial research carried out at their facilities. The Partnership deploys its substantial collective knowledge, experience and expertise in Synchrotron and FEL science and technology, Research Infrastructure management, and service to scientific users to the greater benefit of European science and society. It also aims to play an integrating role for countries with less developed communities and infrastructure for research and innovation, in Europe and beyond.

Partners (PTB just joined and is still missing here)

The Partnership is currently preparing a roadmap document outlining the future of accelerator-based photon science in Europe, which will be handed over to DG research and innovation at the big international LEAPS roll-out meeting in November 2017.

LEAPS is aiming to get substantial funding from the EU in the 9th framework program based on its track record of more than three decades of accelerator based light sources and a community exceeding 30,000 users across Europe.

LEAPS is supported by ALBA, DESY, Diamond Light Source, Elettra, ESRF, European XFEL, FELIX, HZB, HZDR, INFN, ISA, MAX IV, PSI,SOLARIS, SOLEIL, and most recently PTB, and is collaborating with the European Synchrotron User Organization ESUO.

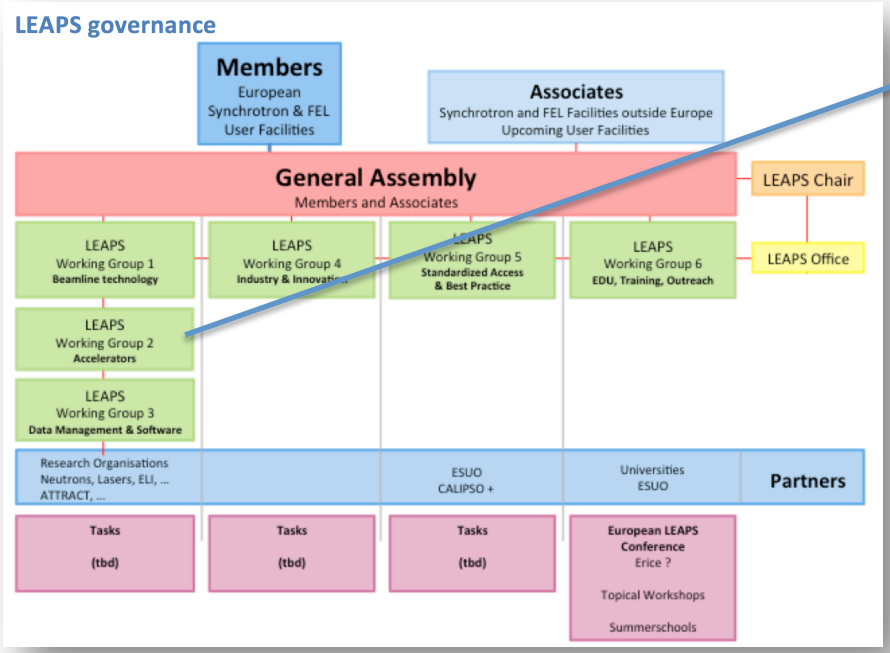
Find more information at www.leaps-initiative.eu

http://www.epsnews.eu/2017/05/leaps-devising-a-new-era-of-accelerator-based-photon-science-in-europe/

LEAPS: devising a new era of accelerator-based photon science in Europe

The Directors of the European Synchrotron and FEL user facilities have decided to establish a strategic partnership – the **League of European Accelerator based-Photon Sources** (LEAPS)– which aims for an unprecedented level of cooperation and development and outreach to academic and industrial users as well as to the general public.

Political Landscape: European Initiatives



Brussels event: Nov 13, 2017

The accelerator WG2 is coordinated by **Hans Braun** (PSI).

Three topics have been defined with topic leaders:

1. **FEL developments**
   Thomas Tschentscher and Simone Di Mitri
2. **Storage rings**
   Andreas Jankowiak
3. **Future compact sources**
   Ralph Assmann

We hope for significant funding for accelerator R&D from the EU for LEAPS as the representative body of photon science in Europe.

En résumé

- ARIES et Eupraxia contribuent à soutenir la R&D accélérateurs, forte participation FR
- Réseaux et accès contribuent à l'intégration de la communauté
- Emergence des techniques avancées: design accélérateur « plasma »
- Stratégie des nouvelles techniques d'accélération en discussion
- Futurs outils de financement au niveau EU en discussion