LEAPS Accelerator Domain

Technology Roadmap

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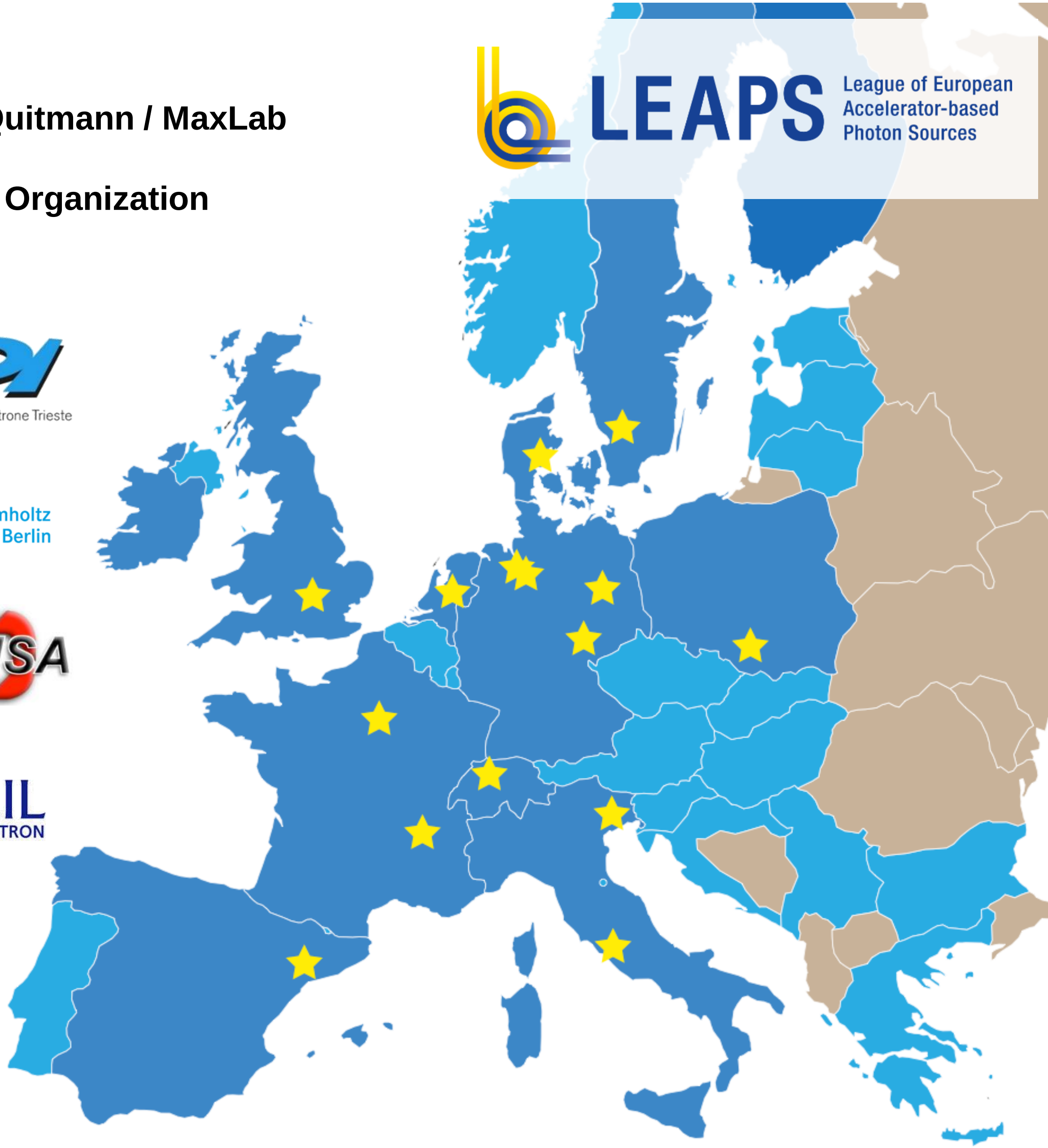
RULε (WP7) Topical Workshop
Injection & Injections Systems
30.08.2017

LEAPS - League of European Accelerator-Based Photon Sources

Launched: 2015
Chair: H. Dosch / DES
Co-chairs A. Harrison / DIAMOND, C. Quitmann / MaxLab
Members: 15 Photon Facilities in EU
European Synchrotron User Organization



LEAPS - League of European Accelerator-Based Photon Sources

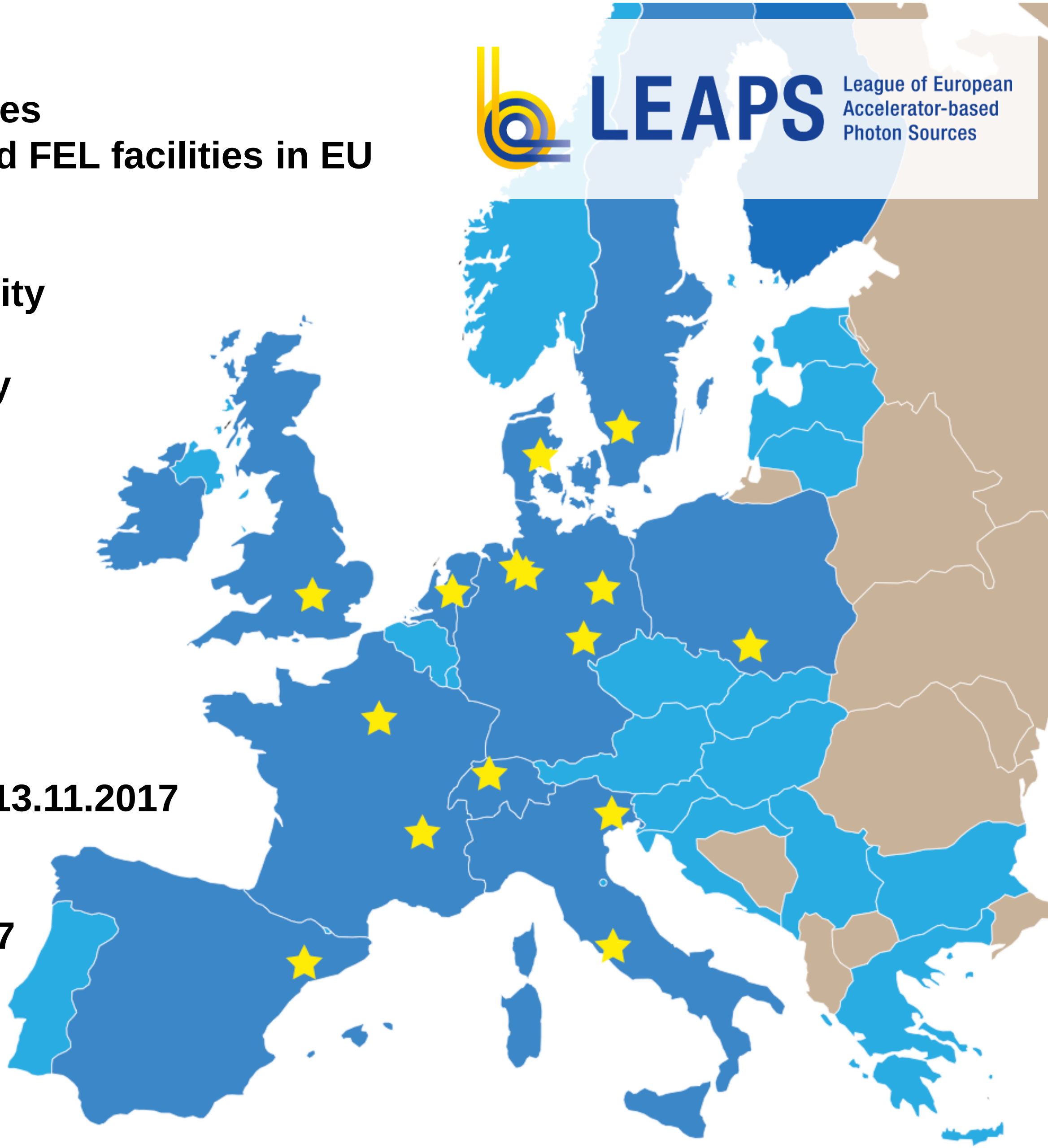
Goals:

- Secure EU leadership for decades
- Coherent Roadmap of all SR and FEL facilities in EU

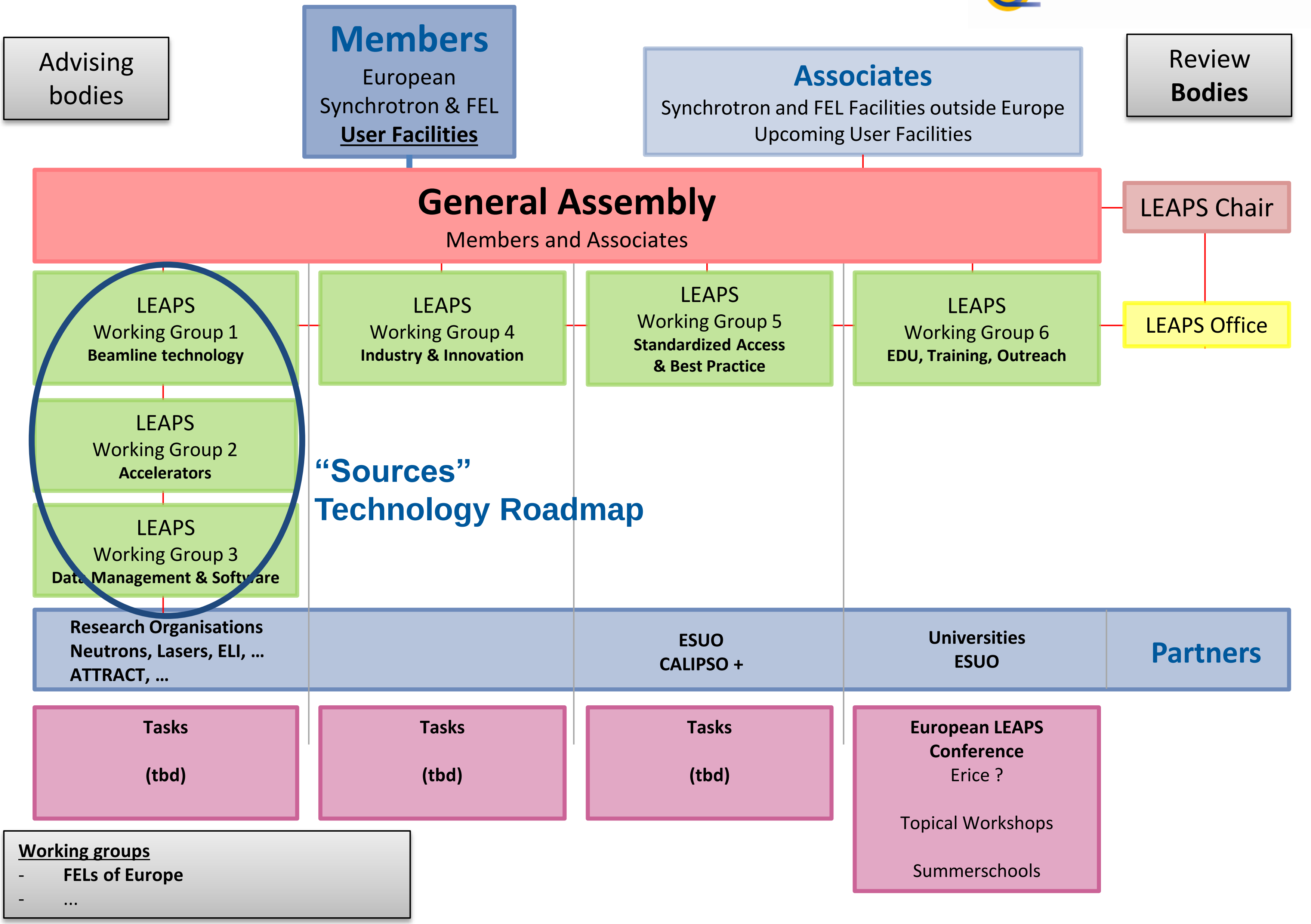
1) Strong & diverse user community
2) Best practice
3) Push & disseminate technology
4) Integration & sustainability
5) Enable excellent science
6) Next generation light sources
7) Open science

LEAPS Charter
LEAPS Strategy Document &
LEAPS Kickoff Event in Brussels, 13.11.2017

Input to European Commission
Framework Program FP9 2021-2027



LEAPS - Organisation



LEAPS storage ring facilities


ASTRID / Denmark, 1991


ESRF / France, 1993


ELETTRA / Italy, 1994


BESSY II / Germany, 1998


SLS / Switzerland, 2001


SOLEIL / France, 2006


DIAMOND / UK, 2007


PETRA III / Germany, 2010


ALBA / Spain, 2010


MAX IV / Sweden, 2016

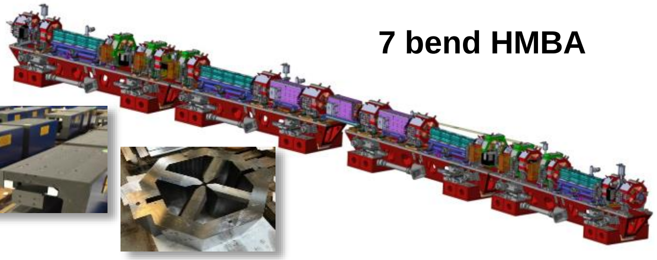

SOLARIS / Poland, 2016

Present situation

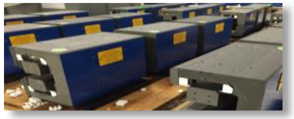
- **MAX IV “First of its kind” DLSR**
  in operation since 2016

7 bend MBA

- **ESRF-EBS (extreme brilliant source) DLSR upgrade**
  implementation phase 2015 – 2020

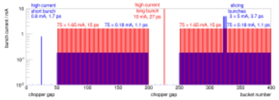


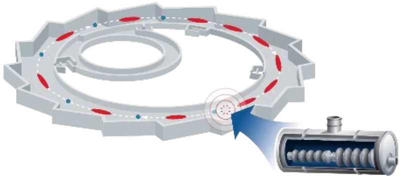
7 bend HMBA



- **BESSY-VSR variable pulse length storage ring upgrade**
  implementation phase 2017 – 2021

cw SRF HOM damped cavities





- **ALBA long-term plans, BESSY III facility, DIAMOND upgrade, Elettra 2.0 upgrade, MAX IV long-term plans, SLS-2 upgrade, SOLEIL upgrade, …**
  pre-project phases, design studies, …

Accelerator technology roadmap process

Need to define technology roadmap, valid for 7 years, starting 2021

→ extrapolate from the present activities (funded upgrades) to a more distant future

→ take into account the needs of upgrades of existing facilities presently under study / preparation / discussion
(most likely some of them will start before outcome of Technology Roadmap is there)

→ take into account the needs of "new facilities"

→ do that as a joint activity, demonstrating that we are able and willing to join forces (together with industry) to advance our field

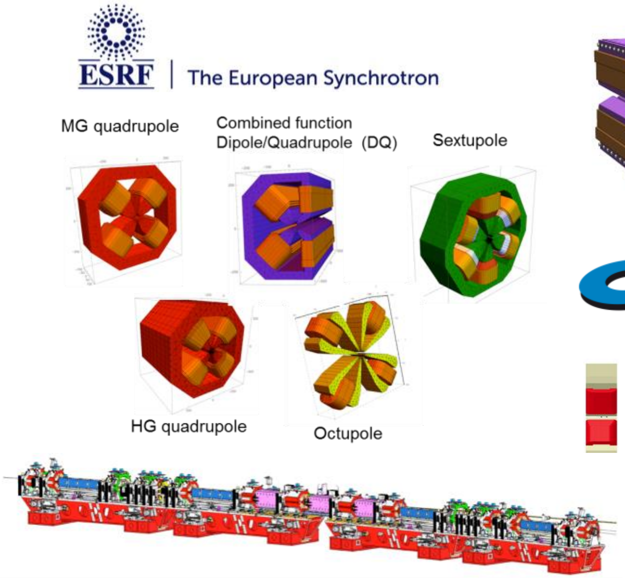
→ identify and define common requirements and standards

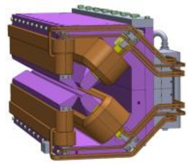
→ concentration (?) on some major "technological developments"

→ **joint effort of FEL, Storage Ring, new compact sources (aka PWA)**

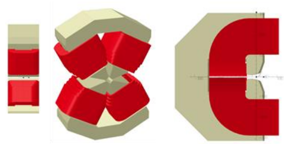
FEL SR Compact

e.g. Magnets





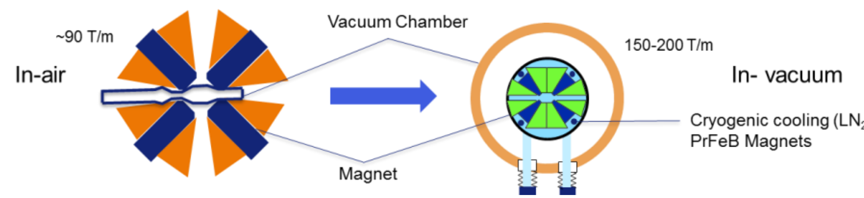
Elettra Sincrotrone Trieste



resistive magnets of many different kinds

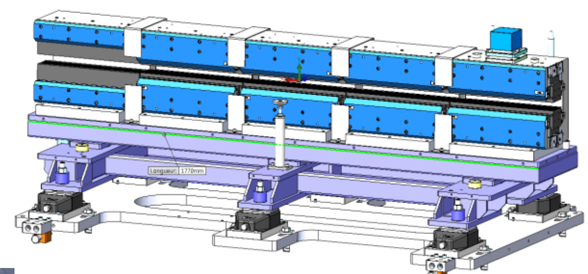
- **high gradient, “combined function”, …**
- **relying on highest manufacturing precision**
- **precise magnetic field measurement for development work and quality control**

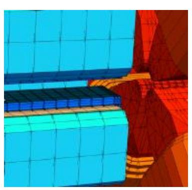
- **are we at the limit? What next?**



permanent magnets

- **large scale installation**
- **stability, field quality**
- **longterm rad. hard.**

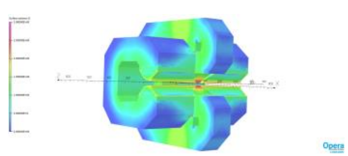




SR

FEL

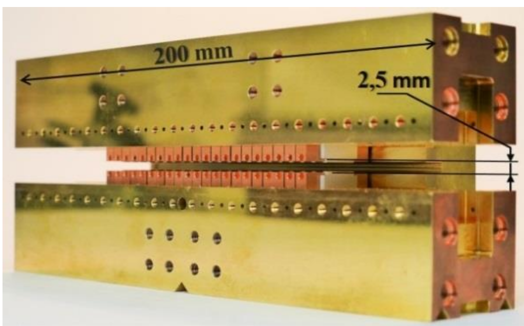
Compact



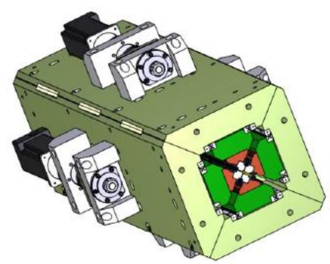
e.g. Insertion devices & radiators

- **advanced in-vacuum CPMU**
  - **- polarized photons (APPLE II/III type)**
  - **- shorter period length**
- **in-vacuum SC Undulators, polarized (?)**
- **special “dipole” / WLS like devices for “*hard* bending radiation” from DLSRs**
  - **- with traceable field quality, e.g. for metrology applications**

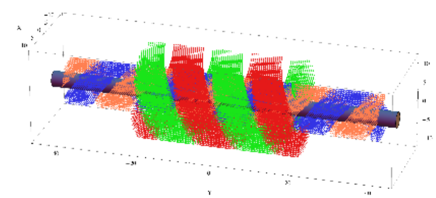
HZB 9mm-Prototyp 2 with hybrid poles (FeCo & PrFeB)



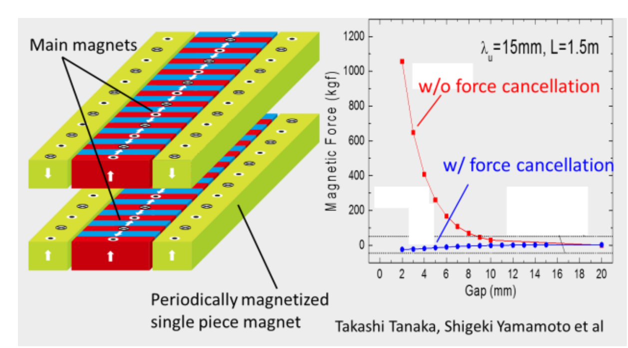
DELTA Undulator



sc Helical



force free P.M. IDs, fixed gap IDs

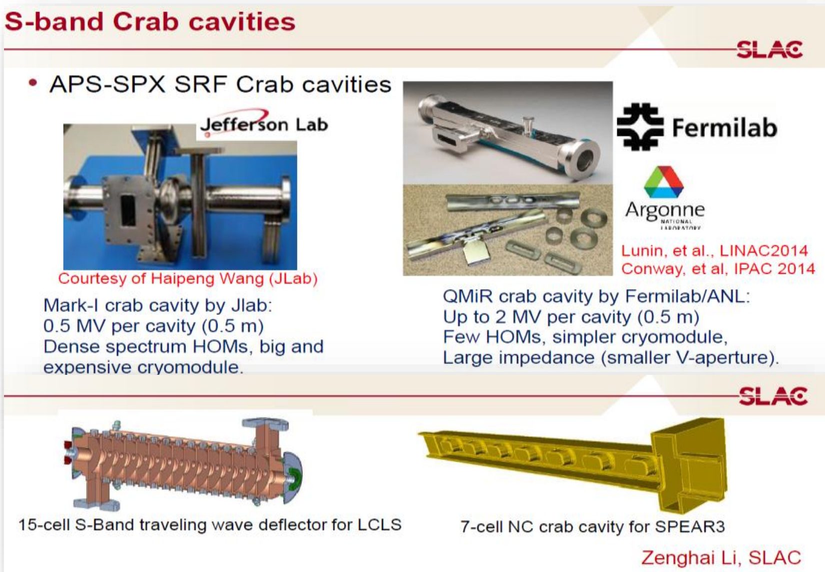


SR

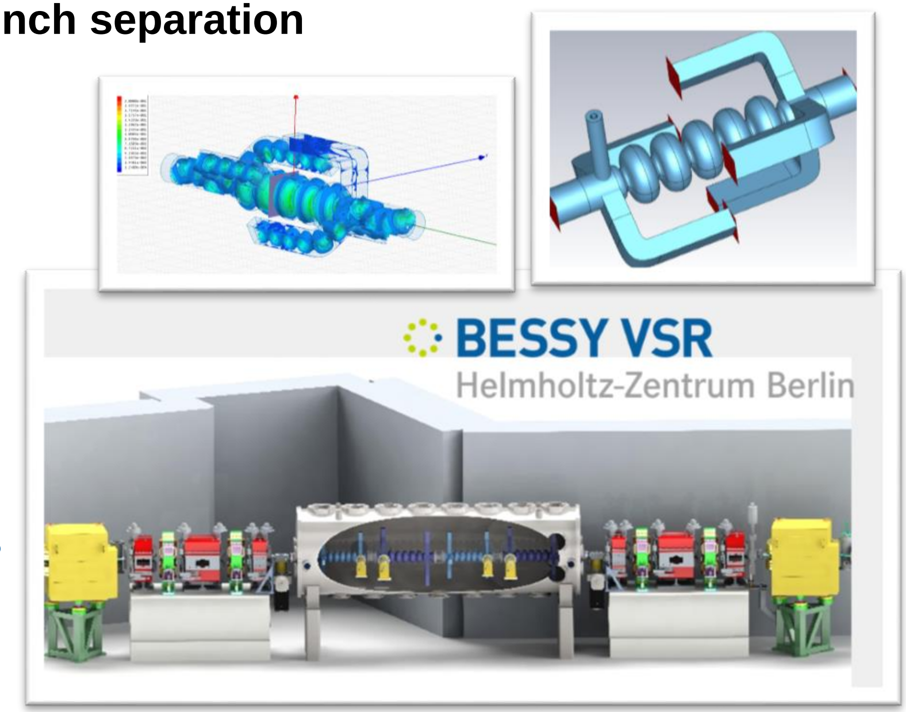
FEL

Compact

e.g. SC/NC Cavities – harmonic cavities and others



sc / nc. crab cavities
- short photon pulses
- bunch separation

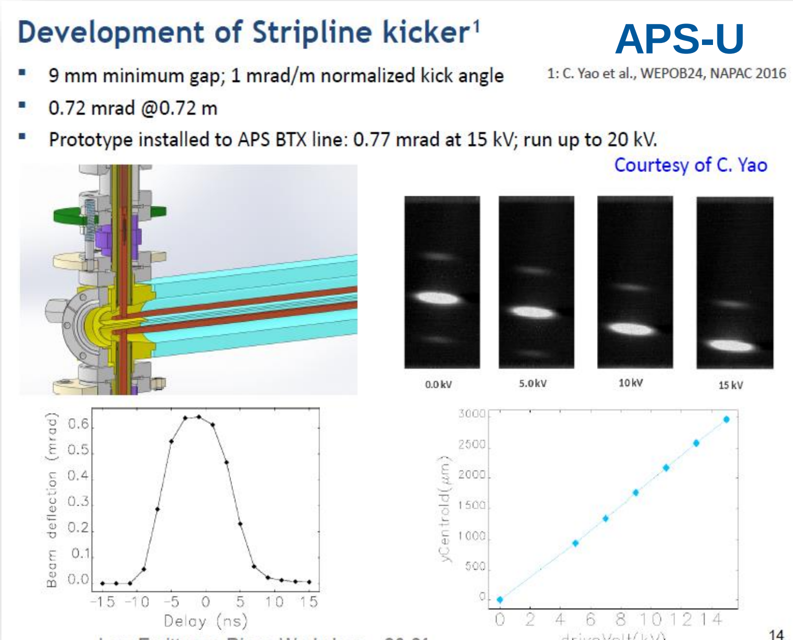


sc cw multi cell, high gradient cavities
- short electron pulses
- beating schemes for variable pulses
- usage in DLSR ?

SR
FEL
Compact

nc/sc cavities with a variety of frequencies from some 10 MHz up to 2 GHz for ultimate control of the longitudinal phase space !

e.g. Injection / kicker technology

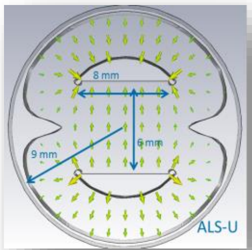


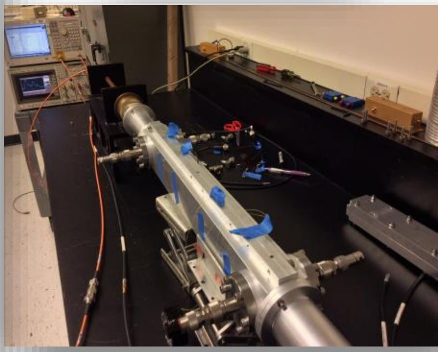
Fast (ns) strip line kickers and pulser for swap-out injection, spreader, diagnostic, beam separation

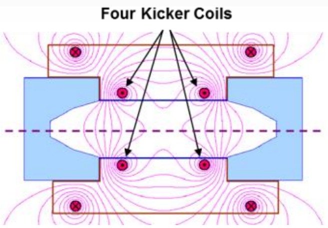
- stability, reliability, …

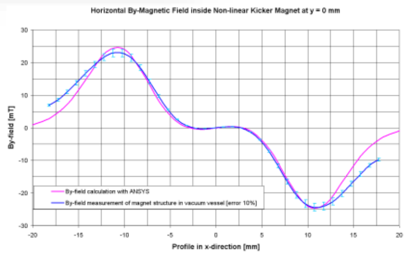
- beam tests started/ongoing

ALS-U







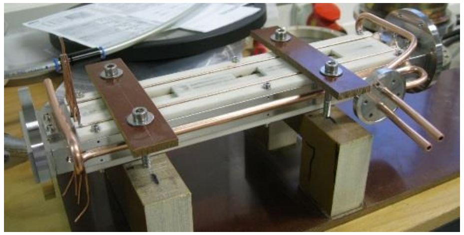


SR

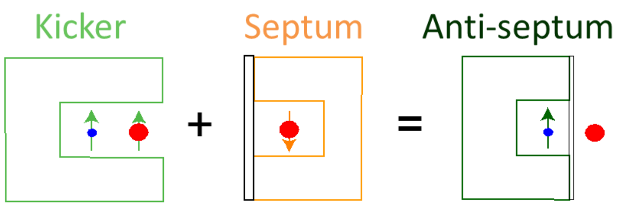
FEL

Compact

Non-linear injection kicker



injection with anti-septum



Accelerator technology roadmap – Work Packages I

Proposal	Submitting Authors	Labs interested in R&D	Total cost estimate Mio€	Topic S=synchroton F=FEL C=compact source
Short period insertion devices	M.E. Couprie (SOLEIL) T. Schmidt (PSI)	SOLEIL, PSI, DESY, ELETTRA, ESRF, HZB, Diamond, Maxlab, ALBA, ANKA		
High Gradient/Field magnets with very small aperture	P. Tavares (MAXLAB)	ALBA, ASTRID, HZB, Elettra, DESY, ESRF, MAX IV, PSI, SOLEIL		
Seed laser systems	M. Danailov (ELETTRA)	DESY, ELETTRA, EU-XFEL,HZDR, LNF, PSI		
Electron bunch control (advanced bunch compressor, Laser heater, collimation)	S. Di Mitri (ELETTRA)	DESY, ELETTRA, EU-XFEL, MAXLAB, PSI		
Advanced schemes for tailoring FEL pulses	S. Werin (MAXLAB) E. Allaria (ELETTRA)	ELETTRA, PSI, DESY, SOLEIL, MAXLAB, Eu-XFEL, DESY		
Low emittance Photo-injectors (cw/sc and pulsed/nc)	T. Kamps (HZB)	HZB, DESY, HZDR, PSI, ELETTRA, LNF, MAXLAB		
LEAPS accelerating techniques cwRF	H. Weise (DESY)	DESY, EUuXFEL, NCNR (Poland)		
FEL tests stand (either stand-alone or attached to existing FEL)	M.E. Couprie (SOLEIL), B. Faatz (DESY)	SOLEIL, DESY, ELETTRA, PSI		
Tunable high power THz source for Eu-XFEL	Frank Stephan (DESY Zeuthen)	DESY, EU-XFEL (+ large number of potentially collaborating universities)		
Very small aperture vacuum chamber	T. Schmidt (PSI) C. Herbeoux (SOLEIL)	ALBA, DESY, PSI, ANKA, SOLEIL, DIAMOND, MAXLAB		

Accelerator technology roadmap – Work Packages II

Proposal	Submitting Authors	Labs interested in R&D	Cost estimate Mio€	Topic S=synchroton F=FEL C=compact source
Injection systems for low dynamic aperture rings (kicker and pulser)	R. Bartolini (DIAMOND)	ALBA, Elettra, DESY, HZB, ESRF, MAXLAB, PSI, SOLEIL		
sc / nc cavities for bunch length control + RF systems	Jens Knobloch, Andreas Jankowiak (HZB)	ALBA, DESY, HZB, MAX IV, SOLEIL		
Diagnostics and Feedback for advanced photon beam stability	G. Rehm (DIAMOND) R. De Monte (ELETTRA)	DIAMOND, Elettra, HZB, MAX IV, ESRF, PSI, SOLEIL		
Sub femtosecond timing and synchronization	S. Hunziker (PSI)	PSI, DESY, ELETTRA		
Joint R&D on compact plasma accelerator for photon science (context EU design study EuPRAXIA)	R. Assmann (DESY), M. Ferrario (INFN), U. Schramm (HZDR)	DESY, INFN, HZDR, ..., EuPRAXIA (EU) Consortium (38 institutes)		

It is expected, that own contributions in the order of 20 to 50% are necessary

LEAPS Technology Roadmaps - Overview

LEAPS Technology Roadmaps
Chairs: Edgar Weckert (DESY), Jean Daillant (SOLEIL)

Sources

1) Beamline Technology – Edgar Weckert / Jean Daillant
(Optic components, mirrors, gratings, detectors, sample preparation / environment, …)

2) Accelerator Technology – Hans Braun (PSI)

FEL – Thomas Tschentscher (XFEL)
Storage Rings – Andreas Jankowiak (HZB)
Compact Accelerators (aka PWA) – Ralph Assmann (DESY)

3) Data Management and Software – Mark Heron (Diamond Light Source)

Next steps:
- Prepare “high level” Accelerator Technology Roadmap document, as part of a “Sources” Technology Roadmap for the LEAPS document, handed out to the EU commission during the “kick off” event in Brussel (11/2017)
- prepare “more detailed” documents for the identified work packages
- define on proposals for pilot projects (Undulators, FEL Test Facility)