

# EuCARD-2 WP5 “XBEAM” Status and Highlights

G. Franchetti, F. Zimmermann  
EuCARD-2 Annual Meeting, Malta  
26 April 2016

thanks to  
K. Aulenbacher,  
M. Biagini, M. Eshraqi





# 7 WP5 XBEAM Workshops since May 2015

- XLINAC mini-workshop "LLRF and Beam Dynamics Mutual Needs in Hadron Linacs," Lund, 1-2 June 2015
- XCOLL "Future electron–hadron colliders at CERN," CERN & Chavannes-de-Bogis, 24-26 June 2015
- XPOL workshop "Search for the Electron EDM in an Electrostatic Storage Ring," JGU Mainz, 10-11 September 2015
- XCOLL "Collimation Tracking Workshop," CERN, 30 October 2015
- XRING/XLINAC workshop "Beam Dynamics meets Diagnostics," Firenze, 4-6 November 2015
- XCOLL co-org. workshop "FCC Week 2016", Rome, 11-15 April 2016
- XPOL workshop "Polarization Issues in Future High Energy Circular Colliders," Rome, 16 April 2016



# milestones and deliverables due up to M32 (31.12.2015)

Report no. (D/M)	Title	Due date	Status
MS33	2nd XCOLL topical workshop	M24 (April 2015)	achieved 28/04/2015 – “Advanced Optics Control (AOC)”, CERN, February 2015
MS34	2nd XRING topical workshop	M24 (April 2015)	achieved 07/01/2015 – “Beam Dynamics meets Magnets 2014,” PSI, Dec. 2014
MS35	2nd XLINAC topical workshop	M24 (April 2015)	achieved 08/07/2015 – “Mutual Needs of LLRF and Beam Dynamics”, Lund, June 2015
MS36	2nd XPOL topical workshop	M24 (April 2015)	achieved 12/11/2015 – “Search for the Electron EDM in an Electrostatic Storage Ring,” JGU Mainz, Sept. 2015

several journal articles and many conference proceedings, e.g.:

G. Franchetti, F. Schmidt, Extending the Nonlinear-Beam-Dynamic Concept of 1D Fixed Points to 2D Fixed Lines, **Phys. Rev. Lett.** **114**, 234801 (2015)

M. Benedikt, D. Schulte, F. Zimmermann, Optimizing Integrated Luminosity of Future Hadron Colliders, **Phys. Rev. ST Accel. Beams** **18**, 101002 (2015)



# milestones and deliverables due up to M36 (30.04.2016)

Report (D/M)	Title	Due date	Status / Plan
MS37	3rd XCOLL topical workshop	M36 (April 16)	achieved 11/03/2016 – “Future electron–hadron colliders at CERN,” CERN and Chavannes-de-Bogis, 24-26 June 2015; “tracking for collimation,” CERN, 30 October 2015
MS38	3rd XRING topical WS	M36	achieved 22/01/2016 – “Beam dynamics meets Diagnostics,” Firenze, 4-6 November 2016
MS39	3rd XLINAC topical WS	M36	
MS40	3rd XPOL topical WS	M36	<i>report on 16 April Rome WS</i>
D5.1	Preliminary strategy for future hadron & lepton colliders	M36	<i>partial draft exists</i>
D5.2	Preliminary strategy for future high performance hadron rings	M36	<i>draft exists</i>
D5.3	Preliminary strategy for future high-power high-current SC linacs	M36	<i>draft exists</i>
D5.4	Preliminary strategy for future polarized beams	M36	<i>to be composed including material from this meeting</i>



# 11 upcoming workshops

Title of event	Date	Location	#part's	Link to event or report
XRING slow extraction workshop	1-3 June	Darmstadt, DE	40-50	<a href="http://indico.gsi.de/conferenceDisplay.py?confId=4496">http://indico.gsi.de/conferenceDisplay.py?confId=4496</a>
XLINAC co-org, HB2016	3-8 July	Malmö, SE	~120	<a href="http://hb2016.esss.se/">hb2016.esss.se/</a>
XCOLL Channeling 2016	25-30 Sept.	Sirmione, IT	~200	<a href="http://www.lnf.infn.it/conference/channeling2016/">http://www.lnf.infn.it/conference/channeling2016/</a>
XCOLL/EuroNNACc "Focus:: Future Frontiers in Accelerator (F3iA)"	Sept. or Oct. 2016	Germany	20-30?	Not yet (R. Assmann, F. Zimmermann)
XPOL new vistas for b.polarimetry	Oct. 2016	Mainz, DE	20-30	Not yet
XCOLL eeFACT'16	24-27 Oct16	Daresbury, UK	100	
EuCAN Universities meet Laboratories 2	3-4 November	Paris, France	50-100	Not yet (organizers A. Faus-Golfe, G. Franchetti, ...)
XLINAC - Upgrading existing high power linacs	8-9 November	Lund, SE	50	Not yet (Trganziere, Ekelof, M. Eshraqi)
XRING – beam dynamics meets vacuum & materials	Dec 2016 or Jan 2017	GSI, DE	60-80	(organizer: M. Tomut)
XBEAM Strategy	13-18Feb17	Valencia, ES	~20	Not yet (A. F.-G., G.F. F.Z)
XCOLL/XRING impedances and instabilities (50 yr imp. 10 yr. F.R.)	March? Or Sept.(ARIES)	Benevento, IT	~80	Not yet (G. Rumolo, S. Petracca)



# XLINAC LLRF and Beam Dynamics Mutual Needs in Hadron Linacs

- key linac challenge: control and confinement of beam losses
- **uncontrolled losses in high power linacs can significantly affect the reliability and availability** (e.g. radiation cooldown needed for hands-on maintenance)
- **topic of great interest for presently operating machines, such as J-PARC and SNS, as well as for future projects, like ESS**
- in high-power linacs, **the ripple and jitter of the RF field amplitude can degrade beam dynamics and, thereby, result in unacceptable losses**
- good mutual understanding of limitations and needs for RF and beam dynamics

**35 participants** from ESS, CEA, CNRS, ESS-Bilbao, GANIL, KEK/J-PARC, Lodz Uni. of Techn., Lund Uni., National Center for Nuclear Research, SNS/ORNL, STFC/RAL, Warsaw Uni. of Techn.

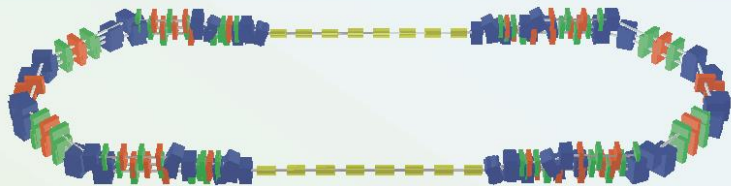
**Highlights: dynamic errors important, especially for long accelerators like ESS & MYRRHA**, as their net effect increases with the square root of number of elements ; halo population is extremely sensitive to RF field nonlinearities; **relaxing the LLRF tolerances on amplitude from 1% to 2%, the density of particles in the tails increases by several orders of magnitude!** ; ...

## Workshop on the LHeC

Electron-proton and electron-ion collisions at the LHC

24 June 2015 CERN

25-26 June 2015 Chavannes-de-Bogis, Switzerland



### International Advisory Committee

Guido Altarelli (Rome)  
Sergio Bertolucci (CERN)  
Nicola Bianchi (INFN)  
Frederick Bordry (CERN)  
Stan Brodsky (SLAC)  
Hesheng Chen (IHEP Beijing)  
Andrew Hutton (Jefferson Lab)  
Young-kee Kim (Chicago and Fermilab)  
Victor A. Matveev (JINR Dubna)  
Shin-Ichi Kurokawa (Tsukuba)  
Leandro Nisati (Rome)  
Leonid Rivkin (EPF Lausanne)  
Herwig Schopper (CERN) - Chair  
Jürgen Schukraft (CERN)  
Achille Stocchi (LAL Orsay)  
John Womersley (STFC)

### Coordination Group

Gianluigi Arduini (CERN)  
Nestor Armesto (Santiago de Compostela)  
Oliver Brüning (CERN)  
Stefano Forte (Milano)  
Andrea Gaddi (CERN)  
Erk Jensen (CERN)  
Max Klein (Liverpool)  
Peter Kostka (Liverpool)  
Bruce Mellado (Wits)  
Paul Newman (Birmingham)  
Voica Radescu (Heidelberg)  
Daniel Schulte (CERN)  
Alessandra Valloni (CERN)  
Frank Zimmermann (CERN)

### Organizing Committee

Sergio Bertolucci (CERN)  
Frederick Bordry (CERN)  
Oliver Brüning (CERN)  
Laurie Hemery (CERN)  
Max Klein (Liverpool)

119 participants (Europe [incl. Turkey]: 86, North America: 21, Asia: 9, Africa: 4)

- "Importance of deep inelastic scattering in the 21st century" (G. Altarelli); "Novel ideas" (Stan Brodsky); precision measurements in the top and Higgs sectors including a **striking Higgs self-coupling sensitivity at the FCC-he**
- ERL-related technology progress:
  - **super-conducting radio frequency (SCRF) cavities,**
  - **high-current electron sources,**
  - recovery of beam power
- **ERL test facility**
  - delivering about 1 GeV energy electrons at high currents of tens of mA
  - first-class potential physics applications
- **technical developments in international collaboration,** three-year R&D programme



# XPOL Search for the Electron EDM in an Electrostatic Storage Ring

- **EDM measurements for charged particles:** exciting new experiment at storage rings
- **spin physics toolbox** allows extraordinary joint approach
- sensitivity of SR-based EDM promising, but systematics to be thoroughly studied
- COSY storage ring at FZ-Jülich: **current JEDI experiments reveal extremely long spin coherence times**, hence fulfilling a necessary condition for an EDM measurement
- a **purely electrostatic ring operating at the frozen spin energy** probably provides best conditions to suppress spurious effects; **this can be achieved at an electron storage ring** since the size of such a machine is significantly lower than of a hadron machine. However, the polarimeter figure of merit is much smaller for electrons. Nevertheless an eEDM ring would be a good test stand to study the many systematic problems and technological challenges related to an EDM experiment. Moreover, a new concept recently proposed by R. Talman may allow changing the mode of polarization detection from an intensity based mode (polarimetry) to a frequency measurement (resonant detection of spin precession frequency). If successfully applied, this method could allow determining the electron EDM at a level of  $10^{-29}$  e\*cm which is three orders of magnitude better than presently available for direct measurements on free elementary particles, e.g. the neutron.
- **EDM searches in storage rings are part of the overall EUCARD effort to expand the potential of accelerator physics in order to enable new methods and results in fundamental research**



# XCOLL Tracking for Collimation

## topics:

- status & prospects of collimation codes; coupling of tools;
- advanced implementations (halo models, hollow electron-lenses, crystals, dynamics simulations);
- status of simulations for heavy ion beams; and
- recent benchmarking of simulations against beam data

## highlights:

- simulations of beam collimation for several machines: **LHC, SPS, FCC, PS, RHIC, and transfer lines;**
- **comparison between LHC beam loss data and simulated collimation cleaning (for proton and ion beams);**
- **validation and results from coupling Sixtrack and FLUKA;**
- **applications to LHC e.g. quench tests w. proton beams**
- alternative codes adapted to perform collimator simulations for large hadron accelerators, such as Merlin and BDSIM;
- dynamics simulations in Sixtrack, crystal collimation simulations for protons, tracking simulations for ion beams



35 participants (Europe: 33, US: 2)

France: IN2P3/LAL 1; Germany: U Frankfurt 1; Italy: La Sapienza 1, Polytecnico Milano 1; Switzerland: CERN 19, EPFL 2; United Kingdom: Huddersfield 1, Imperial College 1, Manchester 2, RHUL 4; United States: BNL 1, SLAC 1



**Beam Dynamics**

meets

**Diagnostics**

Firenze, Italy, 4 – 6 Novembre 2015  
Convitto della Calza

Chair G. Franchetti, GSI

Secretary I. de Caluwe, GSI

**International Committee**

Mei Bai	FZJ	Peter Forck	GSI
Philip Bambade	LAL	Andreas Jansson	ESS
Sara Casalbuoni	KIT	Michiko Minty	BNL
Mohammad Eshraqi	ESS	Toshiyuki Mitsuhashi	KEK
Shinji Machida	AsTEC/RAL	Michael Plum	ORNL/SNS
Catia Milardi	INFN Frascati	Carsten Welsch	U. Liverpool/CI
Kazuhiro Ohmi	KEK	Manfred Wendt	CERN
Markus Steck	GSI	Kay Wittenburg	DESY
Maurizio Vretenar	CERN		
Frank Zimmermann	CERN		



<https://indico.gsi.de/conferenceDisplay.py?oww=True&confid=3509>



65 Participants

- \* Austria: 1 (TU Wien / CIVIDEC)
- \* France: 2 (CEA, SOLEIL)
- \* Germany: 17 (ANKA-KIT, GSI, JFZ, DESY)
- \* Italy: 9 (LNF-INFN, LNL-INFN U Roma, U Sannio, U Bologna)
- \* Japan: 5 (J-PARC/JAEA, KEK)
- \* Slovenia: 1 (Instrumentation Technologies)
- \* Spain: 4 (ALBA-CELLS, ESS-Bilbao)
- \* Sweden: 3 (ESS)
- \* Switzerland: 9 (CERN, PSI)
- \* Turkey: 1 (Middle East Technical U)
- \* UK: 7 (Diamond, ISIS, JAI, STFC);
- \* USA: 6 (BNL, Fermilab, ORNL/SNS);



# “Beam Dynamics Meets Diagnostics” - Firenze



a forum for discussions between beam dynamics specialists and beam instrumentation experts for circular and linear accelerators



joint  
XRING/  
XLINAC  
workshop

## BeDi2015: Beam halo monitoring started with astronomer's dream.....



**eclipse is rare phenomena, and when it occurs only few seconds are available for observation of sun corona, ...**  
**artificial eclipse was the dream of astronomers since ancient times .....**



## BeDi2015: Observation in KEK-PF 2005, beam core + halo (superimposed)

Astronomers' coronagraph adapted for accelerators  
(KEK, LHC/HL-LHC,...),

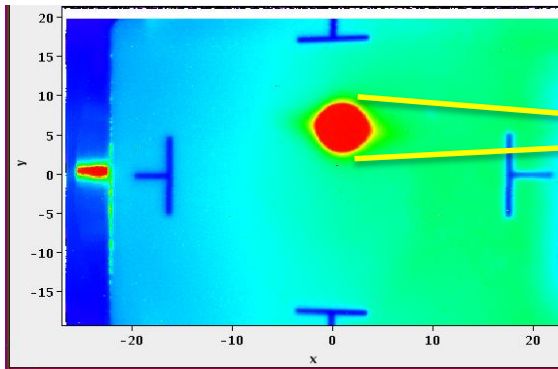


highlight talk by T. Mitsuhashi

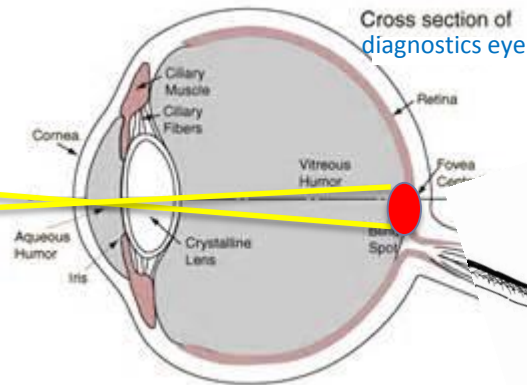
T. Mitsuhashi

# “Beam Dynamics Meets Diagnostics” – conclusion #1

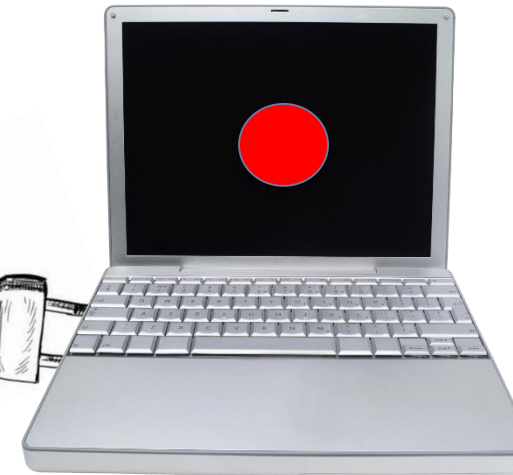
beam



beam  
diagnostics



beam  
dynamics

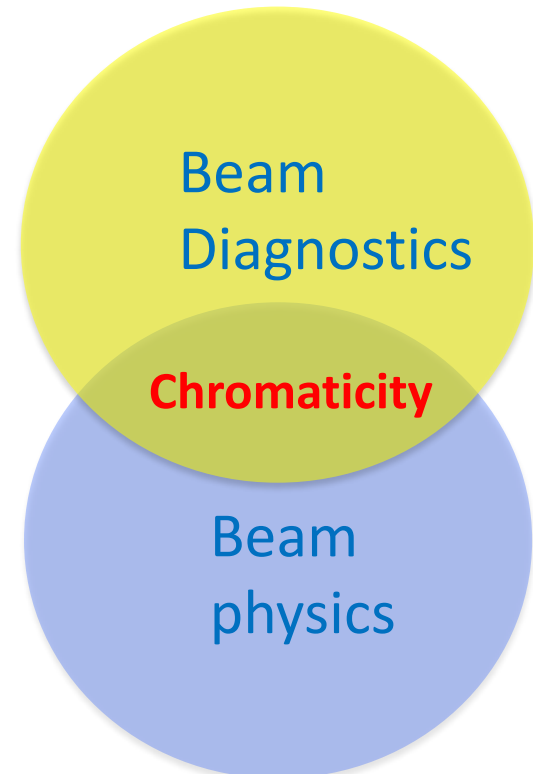
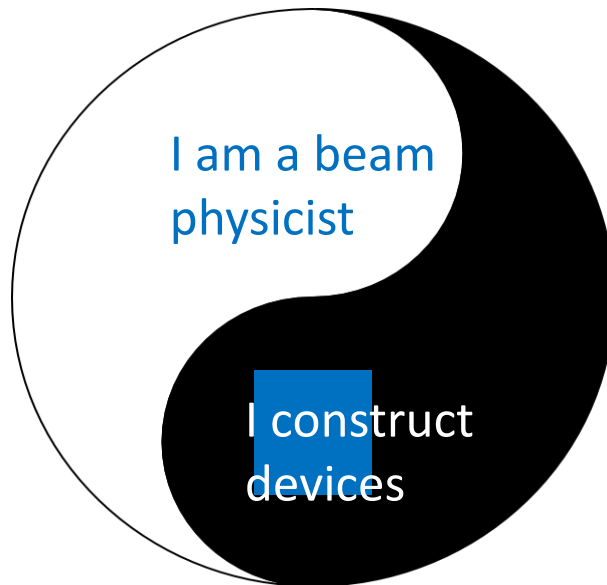


beam diagnostics devices are “**eyes**” for beam dynamics; they are indispensable for operations and for MD studies for improving machine performances, and study / verify simulations studies; examples were shown for FAIR, J-PARC, LHC, RHIC, but also DIAMOND, and SNS

# “Beam Dynamics Meets Diagnostics” – conclusion #4

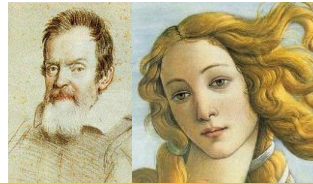
beam diagnostics community seems to be split in those who consider themselves as beam physics, and those who consider themselves as producer of devices; some techniques for measuring chromaticity with high intensity beams require a substantial elaboration of beam physics

## BI Dilemma

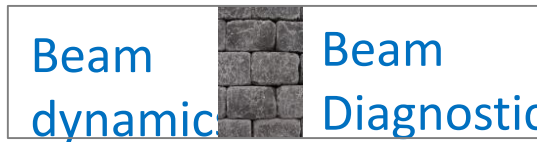


# “Beam Dynamics Meets Diagnostics” - Impact

Arrow of time



Arrow of accelerator time



Beam dynamic

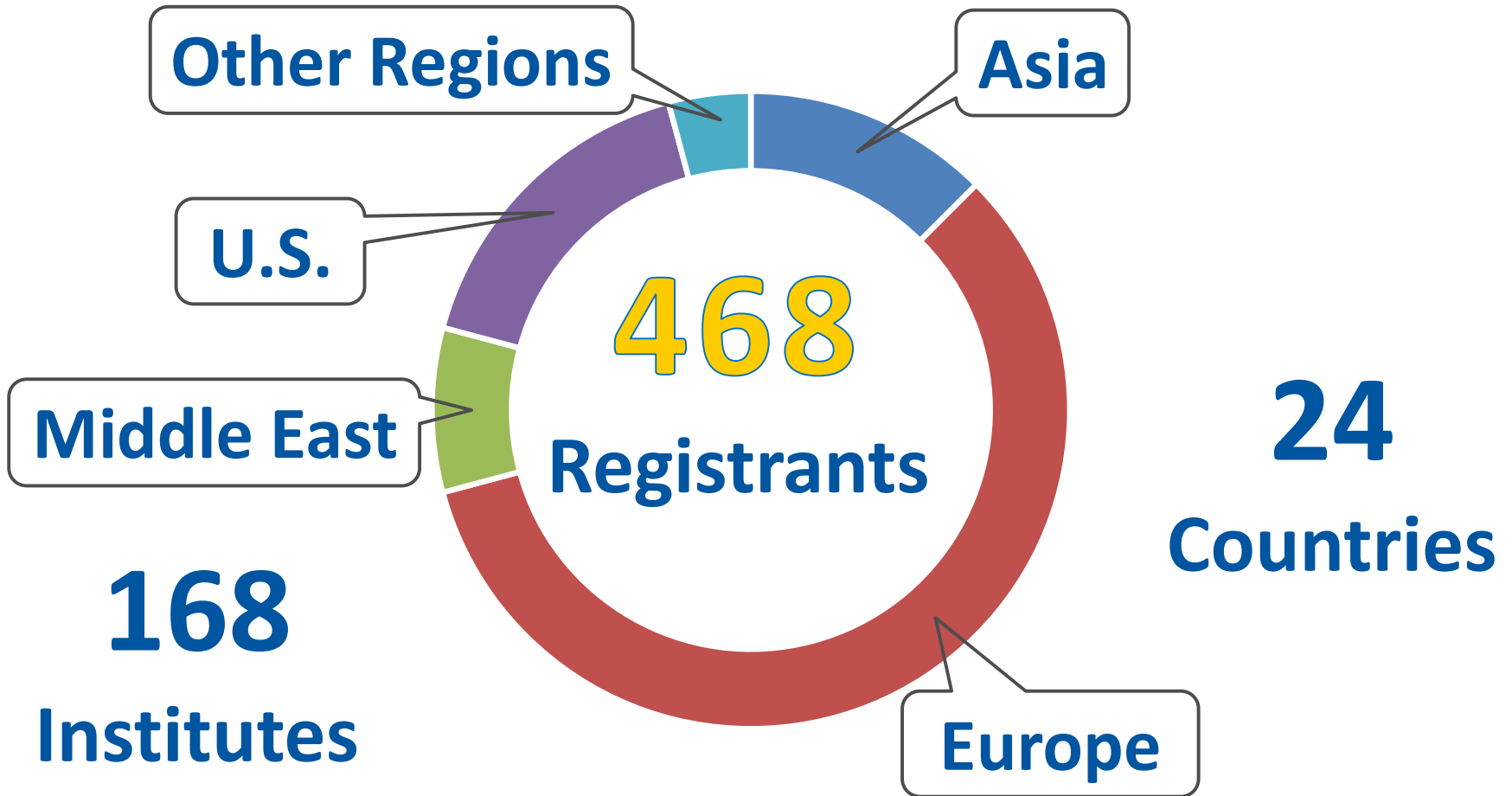
Beam Diagnostics

**Renaissance**  
Beam Dynamics meets Diagnostics



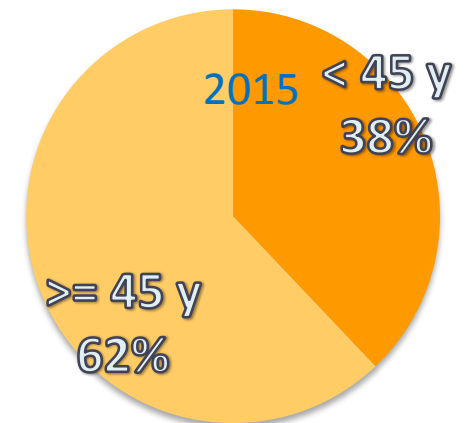
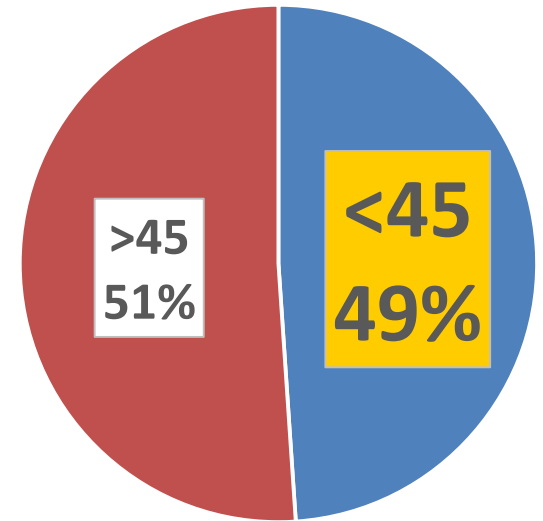
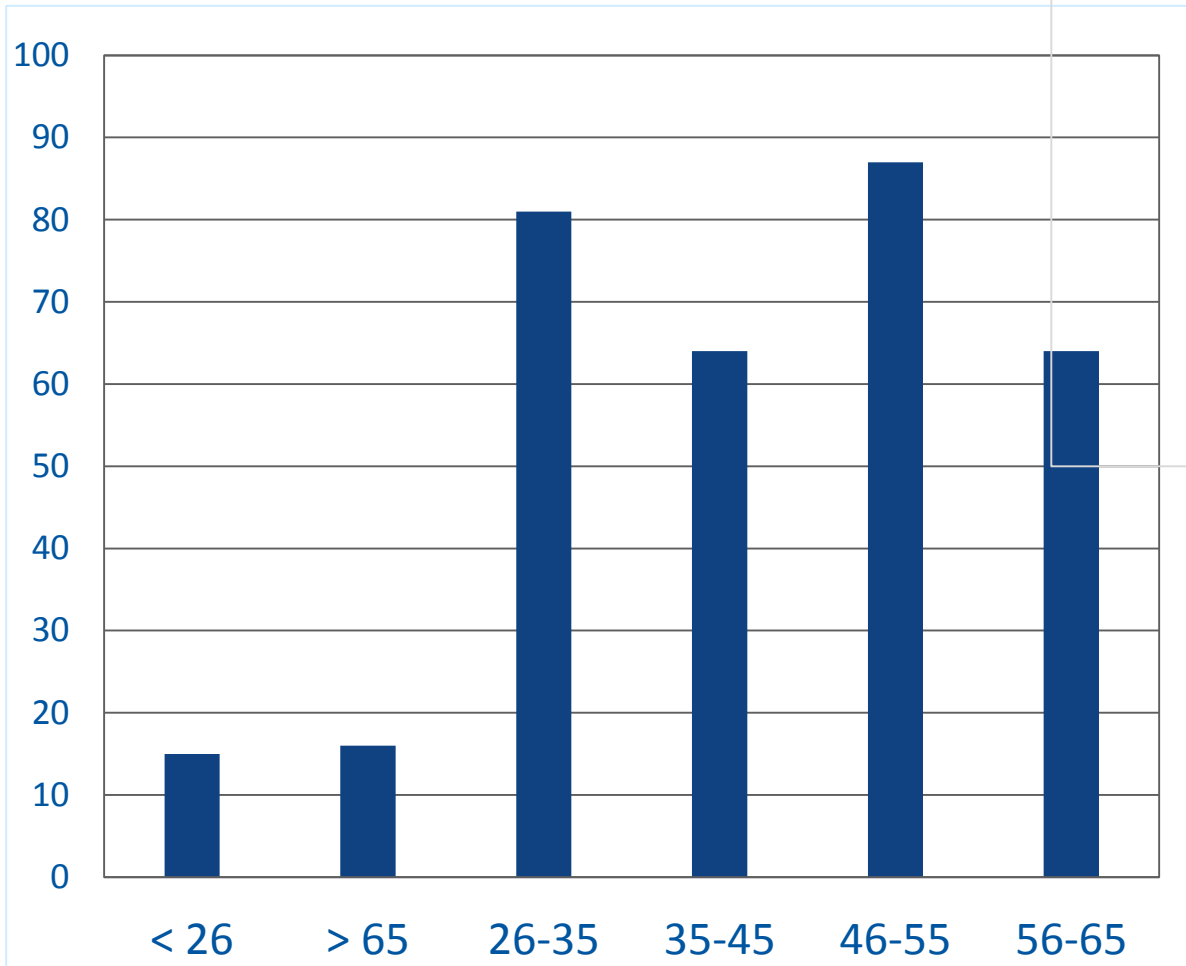
# FCC Week 2016





new record: Kick-off 2014 and FCC Week 2015 had about 340 participants each

# EuCARD<sup>2</sup> FCCW2016 – age distribution



# XPOL Polarization Issues in Future High Energy Circular Colliders

Rome, 16 April 2016

Two large colliders ran with polarized e'

Collider	SLC		LEP 2	
	Linear		Circular	
Shut-down	1998		2000	
Max c.m. energy (GeV)	91		104	
Leptons	e <sup>+</sup>	e <sup>-</sup>	e <sup>+</sup>	e <sup>-</sup>
Polarization at source	Yes	No	No	No
Polarization at IP	Yes	No	Yes	Yes
Number of bunches	1	1	4	4
Polarization measured (%)	-85	0	-90	-50

highlight talk by K. Aulenbacher

Participants:  
 Europe (7): U. Geneva (2), CERN (1), JUAS (1),  
 Bonn (1), Mainz (1), INFN Ferrara (1)  
 Asia: 3, KEK (1), BINP (1), IHEP (1)  
 America: 3, BNL (1), FNAL (1), Cornell (1)

Topics: Polarization at LEP, spin-orbit matching for FCC-ee, polarization forecasts for FCC-ee and CEPC, polarimetry From ELSA to FCC-ee, accelerating polarized leptons & hadrons using snakes, prospects for FCC-hh and FCC-he, state of the art in polarized sources, LHC & FCC pol. target



# from Bonn ELSA to FCC-ee & from RHIC to FCC-hh

- extrapolating from ELSA to FCC-ee
- precise Compton polarimetry possible at FCC-ee (bunch by bunch, turn by turn) with a **precision <0.1% at the Z and 0.2% at 175 GeV**
- conventional high power laser

Wolfgang Hillert, U. Bonn

- extrapolating from RHIC: polarization in FCC-hh requires 60 snakes, each 10 m long; minimizing resonance strength with optimized lattice?

Vadim Ptitsyn, BNL



# 2015 EuCARD-2 SAC recommendation #1

*“This Work Package [WP5] is especially active in one of the 5 tasks, Extreme Colliders, so far exclusively meaning FCC. “*

- this statement is not quite correct; XCOLL also covers/covered LHC, LHeC, HL-LHC, channeling, crab cavities, HE-LHC, impedance, collimation, photon and muon colliders, collaboration with ESA/ESTECH, etc.; however, FCC is a direct off-spring of EuCARD/EuCARD-2; historically only EuCARD supported activities related to VHE-LHC & TLEP
- XRING is extremely active (magnets, diagnostics, etc.); → XPOL and XLINAC are also active with annual events (see XPOL highlight talk)
- ARIES APEC task will prepare path for post-FCC colliders



## 2015 EuCARD-2 SAC recommendation #2

*“The successful acceptance of the EuroCirCol design study in H2020 is an offshoot from this activity.”*

→ yes, the entire FCC study is offshoot of EuCARD

*“We recommend giving more visibility to several partners from multiple European laboratories, especially junior participants. “*

→ is this a recommendation for EuroCirCol/FCC or for XBEAM?

→ XBEAM provides some WS student grants

→ number of young participants growing (e.g. FCCW2016)

→ ARIES APEC will recruit 2-3 students & postdocs



## 2015 EuCARD-2 SAC recommendation #3

*“Collaboration with colleagues working on the CEPC and SppC projects is encouraged, where possible, with the support of management and policy-policy-makers. Two parallel projects of such dimensions should not ignore each other.”*

- we have good personal relations with CEPC/SppC team;  
10 colleagues from CEPC attended FCC Week in Rome
- joint ICFA/XCOLL workshop eeFACT2016 is planned for this fall in the UK
- collaboration between CEPC/SppC is being discussed at directorate level; “collaboration” may have different meanings for CERN and IHEP ...?
- “only linear colliders can be parallel to each other” (M.B.)



# boosting XBEAM impact

- incorporating EuCARD-2 lessons, XBEAM results, and SAC recommendations in the formulation of ARIES APEC
- PRAB special conference editions
  - [BEDI2015 Conference Edition](#)
  - [FCC 2016 Conference Edition](#)
  - [HB2016 Conference Edition](#)
  - ...



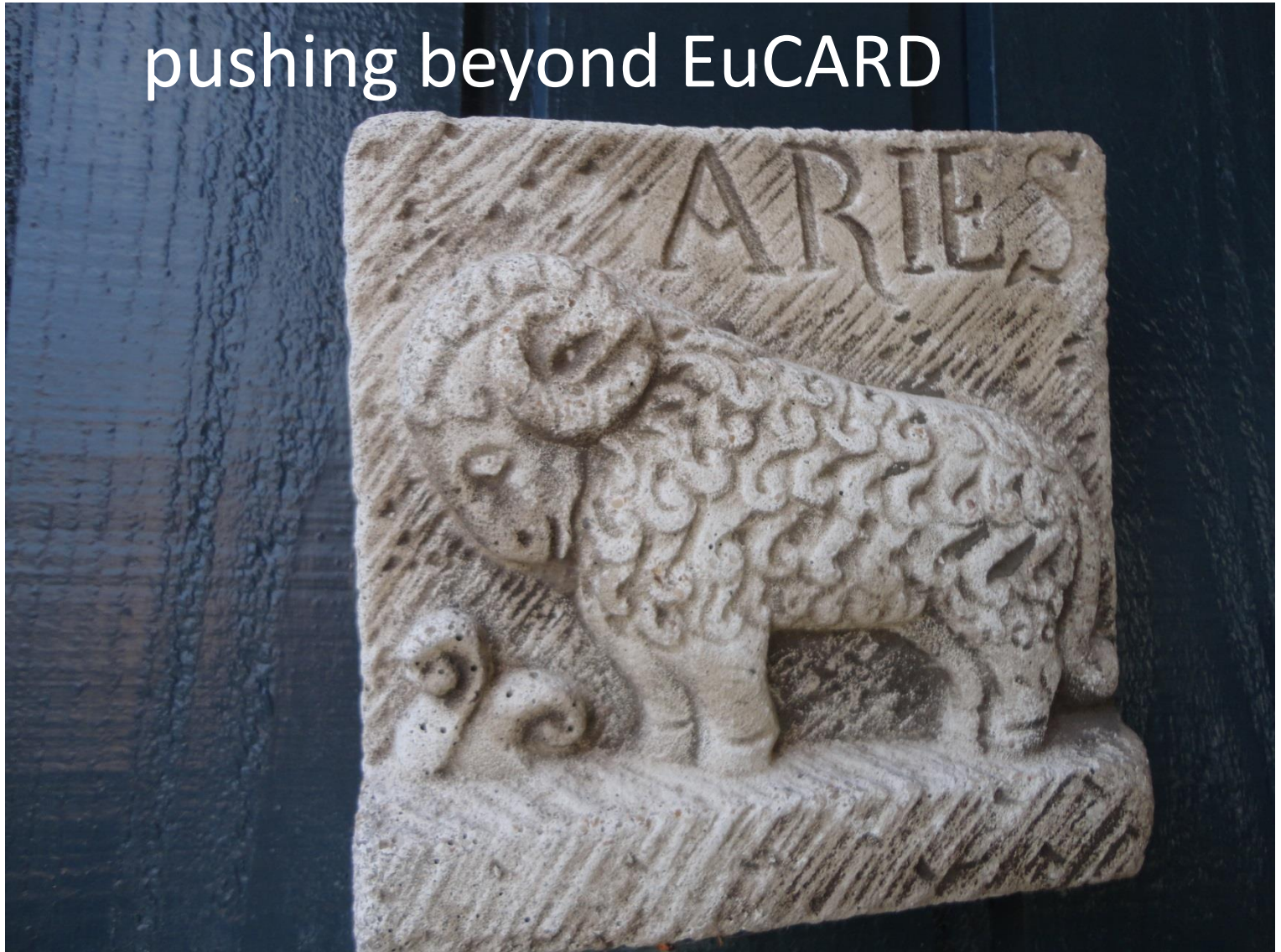
# May'16 - busy period ahead

- preparation of 2016 XBEAM workshops
- finalizing individual task strategies
  - XCOLL - Preliminary strategy for future hadron & lepton colliders (D5.1 M36)
  - XRING - Preliminary strategy for future high performance hadron rings (D5.2 M36)
  - XLINAC - Preliminary strategy for future high-power high-current SC linacs (D5.3 M36)
  - XPOL - Preliminary strategy for future polarized beams (D5.4 M36)



promising outlook

pushing beyond EuCARD





# appendix

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# communication / talks

- Attended events (with EuCARD-2 presentation)

Title of event	Date	Location	No. participants	Link to event or report
IPAC15	3-8 May	Richmond, USA	~1300	<a href="https://www.jlab.org/conferences/ipac2015/index.php">https://www.jlab.org/conferences/ipac2015/index.php</a>
Future Research Infrastructures: Challenges and Opportunities	9-11 July	Varenna, Italy	74	<a href="https://agenda.infn.it/conferenceDisplay.py?confId=9137">https://agenda.infn.it/conferenceDisplay.py?confId=9137</a>
EPS-HEP	22-29 July 2015	Vienna, Austria	~1000	<a href="http://xbeam.web.cern.ch/XBEAM/literature/2015/EPS2015_Shiltsev_v4.pdf">http://xbeam.web.cern.ch/XBEAM/literature/2015/EPS2015_Shiltsev_v4.pdf</a> ; <a href="http://eps-hep2015.eu/">http://eps-hep2015.eu/</a>
ICABU 2015	4-6 November	Gyeongju, Korea	234	<a href="http://pal.postech.ac.kr/icabu2015/">http://pal.postech.ac.kr/icabu2015/</a>
AccApp'15	9-13 November	Washington, DC, USA	~200	<a href="http://accapp15.org/">http://accapp15.org/</a>

- Scientific papers submitted relevant to the project

Author	Title	Link
G. Franchetti et al.	<b>The Extreme Beams Initiative in EuCARD-2</b>	<b>IPAC15 Richmond</b> <a href="http://accelconf.web.cern.ch/AccelConf/IPAC2015/papers/mopje073.pdf">http://accelconf.web.cern.ch/AccelConf/IPAC2015/papers/mopje073.pdf</a>
M. Benedikt et al.	FCC-hh Hadron Collider – Parameter Scenarios and Staging Options	<b>IPAC15 Richmond</b> <a href="http://accelconf.web.cern.ch/AccelConf/IPAC2015/papers/tupty062.pdf">http://accelconf.web.cern.ch/AccelConf/IPAC2015/papers/tupty062.pdf</a>
M. Benedikt et al.	Combined Operation and Staging Scenarios for the FCC-ee Lepton Collider	<b>IPAC15 Richmond</b> <a href="http://accelconf.web.cern.ch/AccelConf/IPAC2015/papers/tupty061.pdf">http://accelconf.web.cern.ch/AccelConf/IPAC2015/papers/tupty061.pdf</a>
F. Zimmermann et al.	Scenarios for Circular Gamma-Gamma Higgs Factories	<b>IPAC15 Richmond</b> <a href="http://accelconf.web.cern.ch/AccelConf/IPAC2015/papers/tupty057.pdf">http://accelconf.web.cern.ch/AccelConf/IPAC2015/papers/tupty057.pdf</a>

- Scientific papers submitted relevant to the project

Author	Title	Link
G. Franchetti, F. Schmidt	Extending the Nonlinear-Beam-Dynamics Concept of 1D Fixed Points to 2D Fixed Lines	<b>Phys. Rev. Lett. 114, 234801</b> <a href="http://journals.aps.org/prl/abstract/10.1103/PhysRevLett.114.234801">http://journals.aps.org/prl/abstract/10.1103/PhysRevLett.114.234801</a>
F. Zimmermann et al.	Status and Challenges for FCC-ee	CERN-ACC-2015-111 <a href="http://cds.cern.ch/record/2057706?ln=en">http://cds.cern.ch/record/2057706?ln=en</a>
M. Benedikt, F. Zimmermann	Outline and Status of the FCC-ee Design Study	<b>ICFA Newsletter No. 67</b> CERN-ACC-2015-112 <a href="http://cds.cern.ch/record/2057708?ln=en">http://cds.cern.ch/record/2057708?ln=en</a>
F. Zimmermann et al.	Beam Dynamics Challenges for FCC-ee	<b>ICFA Newsletter No. 67</b> CERN-ACC-2015-113 <a href="http://cds.cern.ch/record/2057711?ln=en">http://cds.cern.ch/record/2057711?ln=en</a>

- Scientific papers submitted relevant to the project

Author	Title	Link
M. Benedikt, F. Zimmermann	Future Circular Colliders	<b>Proc. Varenna 2015</b> CERN-ACC-2015-164 <a href="http://cds.cern.ch/record/2110736?ln=en">http://cds.cern.ch/record/2110736?ln=en</a>
M. Benedikt, D. Schulte, F. Zimmermann	Optimizing integrated luminosity of future hadron colliders	<b>Phys. Rev. ST Accel. Beams 18, 101002</b> (2015) <a href="http://journals.aps.org/prstab/abstract/10.1103/PhysRevSTAB.18.101002">http://journals.aps.org/prstab/abstract/10.1103/PhysRevSTAB.18.101002</a> CERN-ACC-2015-166 <a href="http://cds.cern.ch/record/2112115?ln=en">http://cds.cern.ch/record/2112115?ln=en</a>
M. Benedikt, F. Zimmermann	Future Circular Colliders	<b>Proc. Lepton-Photon 2015</b> CERN-ACC-2015-165 <a href="http://cds.cern.ch/record/2110739?ln=en">http://cds.cern.ch/record/2110739?ln=en</a>
M. Benedikt, F. Zimmermann	Status and Challenges of the Future Circular Collider Study	<b>Proc. AccApp'15 Washington DC</b> CERN-ACC-2016-0005

- articles and talks to be included/flagged in CDS
- need to advance with preparation of upcoming workshops