

EDM executive meeting

20/01/2016

Participants: T. Bowcock, C. Carli, G. Guidoboni, M. Lamont, J. Pretz, Y. Semertzidis, A. Stahl, E. Stephenson, H. Ströher, C. Vallée.

M. Lamont: “Introduction to PBC”.

Physics Beyond Colliders (PBC) aim: new options for CERN’s future to be presented for consideration at the next update of the European Strategy for Particle Physics (ESPP). The update process will take place in 2019.

The physics motivation of EDM is to be considered by the BSM (Beyond Standard Model) working group. In the BSM group there are several projects: SHIP, NA64++, NA62++, KLEVER, IAXO, LSW, EDM under consideration. Keep in mind there is a lot of competition for resources over the coming years – in particular the HL-LHC.

EDM storage ring/experiment: because the machine is integral to the experiment, it is not so obvious to make a separation between the accelerator working group and the physics working group.

Fully developed feasibility study including preliminary costing to be produced by the end 2018.

H. Ströher: “EDM activities at the Forschungszentrum Juelich”.

Proposal of CP violation experiments with charged particles: protons, deuterons, ^3He .

Jülich: JEDI collaboration (spokespersons P. Lenisa and J. Pretz) focused on the deuteron investigation. It works on: R&D, precursor experiments, simulations, technical design report (deuteron ring options).

COSY: 184 m ring circumference, injection with polarized H-/D-, stochastic and electron cooler, four target stations. **This is the only operational test facility for EDM:** polarized beam, polarimeters, RF solenoids.

R&D: Spin coherence time optimization; spin tune measurements and mapping; tests with active feedback system (to stabilize the spin tune phase with respect to precursor RF Wien filter, tested with an rf solenoid). Database measurement for deuteron scattering: study of the analysing power with WASA Forward Detector on carbon and CH_2 , in the energy range from 170 MeV to 380 MeV. Deflector development in Aachen: Fermilab deflector sent to Jülich to gain experience with high electric fields. Test ExB field configuration with a combination of a deflector and big dipole from ANKE (experiment previously installed at COSY).

Precursor experiment: RF Wien filter creates EDM signal accumulation with a pure magnetic ring. Precursor will be located at PAX target station in COSY in April-May 2017 and commissioned in June and September 2017.

Polarimeter development: Based on LYSO crystal (scintillators) as calorimeter. Tests made using extracted beam. First tests began last year.

Simulations of spin tracking. Based on COSY-Infinity program (M. Berz, Michigan State).

Deuteron ring options: Quasi-frozen spin concept for modified COSY ring. EDM sensitivity is currently limited by the knowledge of the ring element alignment (source of systematic error).

Politics: ERC Advanced Grant started in October 2016 keeps COSY running until Sept. 2021. Plan to obtain endorsement in nuclear physics long range plan (NuPECC). **COSY expected not to run beyond 2021 because of the anticipated strategy of FZJ management.**

Foresee an International CPbar-EDM initiative.

Y. Semertzidis: “Storage ring proton EDM collaboration”

Physics objectives at CAPP/IBS & KAIST: axion search, dark matter search, muon g-2 and proton EDM. In particular, the pEDM has great sensitivity on to θ_{QCD} . Sensitivity is broader if combined with the deuteron EDM. Moreover, the existence of an EDM can provide information about the existence of axion physics, the axion mass and it will have an impact on axion dark matter searches. The current limit is set by nEDM.

High statistics is needed with highly polarized beams: possible collaboration of Brookhaven (polarized sources, polarization experience) at CERN.

EDM experiment: For protons (positive anomalous magnetic moment), there is a magic momentum at which the spin vector precession matches the change of momentum vector in the horizontal plane, making possible the frozen spin condition in a purely electrostatic ring. For the deuteron (negative anomalous magnetic moment), frozen spin is achieved with a combination of E and B fields over a range of momenta. The B field provides a large E field in the particle frame (for highly relativistic particles, 1 T corresponds to 300 MV/m), thus increasing sensitivity to the EDM. Combined ExB fields also work for protons and any other ion, and may lead to smaller ring sizes. The ring size is determined by the momentum for optimal polarimeter performance and the achievable E field.

History: Since 2007, COSY has been used as a test facility, providing precision measurements and spin studies. USA: P5 endorsed the pEDM under all funding scenarios and funding will become available when a host laboratory is secured. Korea: studies on SQUID-based BPM, magnetic field shielding and other domains – a toolkit approach.

Muon g-2 collaboration members are potential storage ring EDM collaborators with several of them already expressed desire to join the effort.

C. Carli: “Experience from ELENA on the Development of a smaller Scale Ring at CERN”

ELENA is a magnetic ring. It is situated in the AD ring and decelerates antiprotons to 100 keV before extraction to the experiments.

History: Project approved in 2011. First 100 keV antiprotons foreseen in 2017. ELENA ring and transfer lines from AD to ELENA are under commissioning. Not yet ready for the antiproton experiments, delayed to LS2.

Collaboration: There is no international management board as for HIE-ISOLDE or AWAKE. The project relies on the contributions of many groups. People involved in the ELENA project generally work on other projects at the same time. This seems to be positive experience with about 150 people involved.

Comments following talk:

The end-user is separated from the accelerator team. It will be different for the EDM experiment - the experiment is the ring.

ELENA example: Once the project has been approved, the budget is fixed. Nonetheless with machine changes, it went from 15 to 19 and then to 25 million CHF. Budget renewals are yearly, and the scope of the plan can be reviewed and modified.

There are a lot of external contributions, including from Jülich, but most effort comes from people at CERN. External contributions can be easily handled by CERN.

ROUND TABLE

The EDM community would highly appreciate CERN involvement. The expertise at CERN could be very helpful for the development of the experiment.

It is possible to build an EDM ring at CERN without interfering with other projects if the necessary resources are available.

Physics Beyond Colliders: the deadline to present a document on the EDM project is the end of 2018, before the next European strategy update process (2019-2020).

The proposal should describe the different possibilities for the EDM experiments: proton, deuteron and ^3He (^3He is equivalent to neutron EDM). At this stage, there is no need to take a decision on the strategy – a program should be presented: each particle could be optimized in a different ring, or a combined function ring considered. There are still a lot of open questions about ^3He , since little is known concerning the optimum polarimetry, for example. But the physics case is very good for all the ions, and more cases might be considered.

COSY ring is running until 2021, secured by the ERC Advanced Grant (srEDM). CERN could make a strong case in order to extend the running period beyond 2021. COSY is a great facility to perform EDM R&D and precursor experiments.

Proposal for WORK PACKAGES: **contact people assigned to work packages before the next workshop**

Work packages	Sub-work packages	Coordinator(s)	Contributors
Science case		PBC-BSM (CERN)	KAIST/FZJ/PBC
Ring design	All-Electric ring	Yannis Semertzidis (CAPP/IBS & KAIST)	
	Combined ExB	Mei Bai (FZJ)?	
Beam control, CW/CCW (BPMs, squids, beam instrumentation, ...)		Joerg Pretz (FZJ)	
Beam preparation (spin manipulation, flip, ...)		Anatoli Zelenski (BNL)?	FZJ/CERN
Ring components	Infrastructure (vacuum, RF...)	CERN	
	Shielding, deflectors, ExB elements...	Alexander Nass (FZJ)?	KAIST/CERN/FZJ
Polarimetry		Edward Stephenson (FZJ)	
Systematics		Yannis Semertzidis (CAPP/IBS & KAIST)	
Civil engineering		John Osborne (CERN)?	CERN
Cost estimate		CERN	CERN

Editorial Group: Hans Ströher, Yannis Semertzidis, Mike Lamont, Themis Bowcock

Schedule for documentation release:

- March 13-14, 2017, first workshop
- ~ September 2017 (6 months), first draft
- ~ March 2018 (12 months), revised draft
- ~ September 2018, design report ready to be circulated at CERN

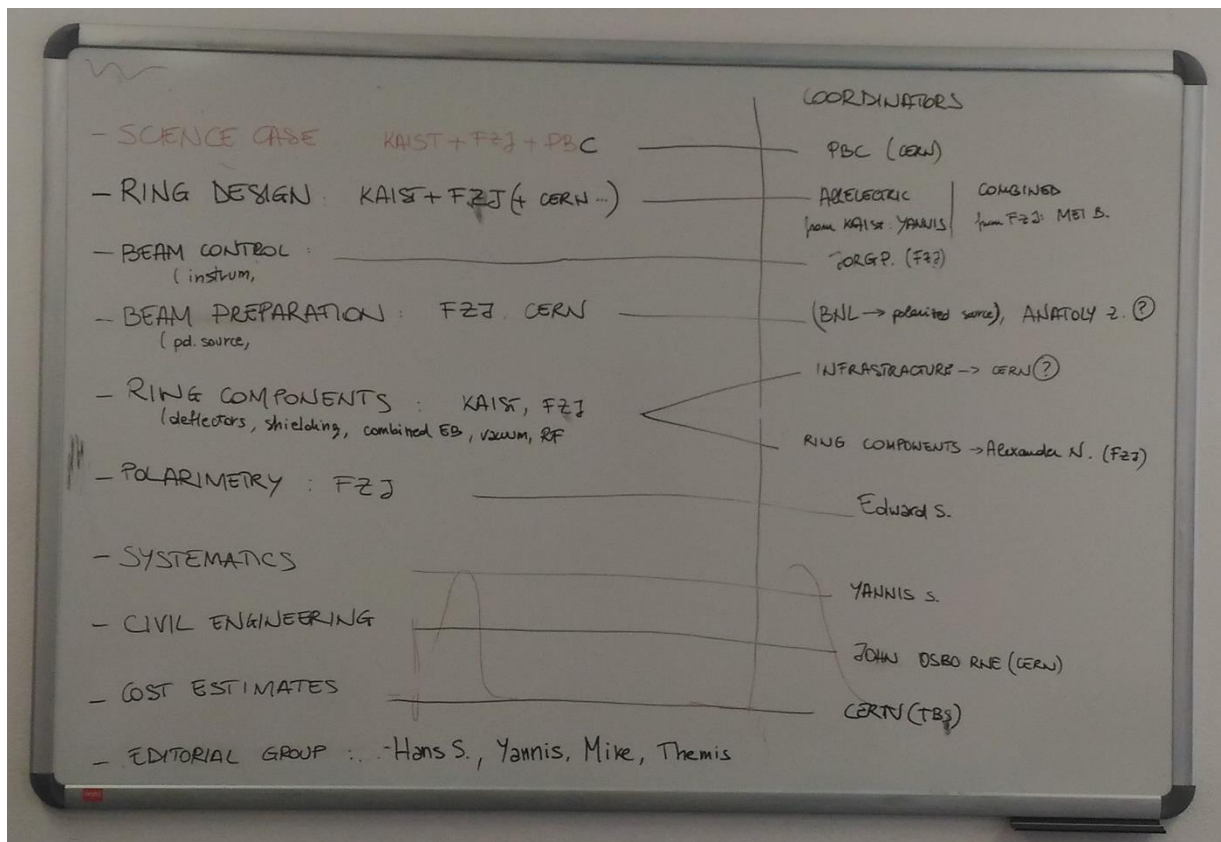
Open actions:

- Proposal: add a work package "R&D at COSY" with Frank Rathmann (FZJ) as coordinator.
- Confirm the proposed coordinators (all – as appropriate).
- Confirm chair of editorial committee.

Kick off meeting for the EDM experiment: March, 13-14 2017 at CERN

Website for registration: <http://indico.cern.ch/event/609422/>

- Day 1 morning, PBC intro/overall time-line; introduction to collaboration – aims, timeline, work package breakdown, goals, deliverables
- Day 1 afternoon, people grouped together by working packages
- Day 2 presentations + round tables + editorial meeting
- Rough number of participants: 20 FZJ, 5 KAIST, CERN. **TOTAL: ~50**
- The g-2 people will not be able to join due to a conflict with FNAL g-2 meeting.
- **Help for hotel reservation – Connie Potter**



Reported by G. Guidoboni