CPEDM IN ESPP AND PBC WRITE-UPS

INTERNAL PREPARATION MEETING

JUNE 18+19, 2018 I HANS STRÖHER

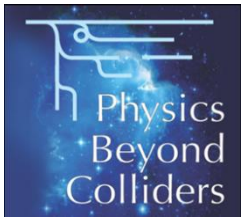
CPEDM IN ESPP AND PBC

What we know (I)

ESPP … **E**uropean **S**trategy for **P**article **P**hysics

Update, initiated by European Strategy Group
Community input due **December 18, 2018**

PBC … **P**hysics **B**eyond **C**olliders



Initiative by CERN
CPEDM input due **November 2018**

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What we know (II)

European Strategy Update

CERN Courier April 2018

News

FUTURE OF THE FIELD

Call for input to European strategy update

- Professor H. Abramowicz (Strategy Secretary and Chair),
- Professor K. Ellis (SPC Chair),
- the incoming ECFA Chair (to be appointed by Plenary ECFA on 16 November) and
- Professor L. Rivkin (Chair of the European Laboratory Directors group).

At its meeting at CERN on 16 November 2017, Plenary ECFA appointed Professor J. D'Hondt

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What we know (III)

European Strategy Update

Community input to the European Strategy process:
Searches for Permanent Electric Dipole Moments

edited by P. Harris and K. Kirch

and endorsed by the
European EDM projects and collaborations:

W. Heil and K. Kirch for the nEDM collaboration, nedm.web.psi.ch

P. Harris for the cryoEDM collaboration, www.cryoedm.org

E.A. Hinds for the eEDM collaboration, www3.imperial.ac.uk/ccm/research/edm/

K. Jungmann and L. Willmann for the Ra-EDM collaboration, www.rug.nl/kvi/research/kvitrimp

A. Serebrov for the PNPI-ILL-PTI neutron EDM collaboration

A. Lehrach, J. Pretz, F. Rathmann for the JEDI (Jülich Electric Dipole moment Investigations) collaboration

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Tasks (I)

European Strategy Update

Coordinated input of the EDM community:

- Meeting last week (SSP2018, Aachen)
- Update of 2012-report

→ CPEDM (i.e. srEDM, charged particles):

- Science: Importance for determination of sources
- Potentially highest sensitivity
- International effort; leading European role
- COSY as R&D and test facility; precursor dEDM
- CERN as possible host of final ring

→ Due December 18, 2018

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What we know (IV)

Mandate of the "Physics Beyond Colliders" Study Group

CERN Management wishes to launch an exploratory study aimed at exploiting the full scientific potential of its accelerator complex and other scientific infrastructure through projects complementary to the LHC and HL-LHC and to possible future colliders (HE-

Scientific goal

The main goal of the Study Group is to explore the opportunities offered by the CERN accelerator complex to address some of today's outstanding questions in particle physics through experiments complementary to high-energy colliders and other initiatives in the world. These experiments would typically: *(i)* enrich and diversify the CERN scientific program, *(ii)* exploit the unique opportunities offered by CERN's accelerator complex and scientific infrastructure, *(iii)* complement the laboratory's collider programme (LHC, HL-LHC and possible future colliders). Examples of physics objectives include searches for rare processes and very-weakly interacting particles, measurements of electric dipole moments, etc.

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What we know (V)

Structure of the Study Group and deliverables

The group will be led by three coordinators representing the scientific communities of accelerator, experimental, and theoretical particle physics: Joerg Jaeckel (Heidelberg), Mike Lamont (CERN), Claude Vallée (CPPM, Marseille).

Following consultation with the relevant communities, they will define the structure and the main activities of the group and appoint conveners of thematic working groups as needed. They will call a kick-off meeting in 2016, organize regular meetings, and monitor the overall scientific activity. The scientific findings will be collected in a report to be delivered by the end of 2018. This document will also serve as input to the next update of the European Strategy for Particle Physics.

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What we know (VI)

J. Jäckel, M. Lamont, C. Vallée — Feb. 7th, 2017

PHYSICS BEYOND COLLIDERS

Structure of Working Groups

Accelerator sub working groups:

- **BDF subgroup:** complete the technical feasibility studies of a Bump Dump Facility as input to the SHiP conceptual design study (CDS).
- **EDM ring subgroup:** fully developed feasibility study including preliminary costing.

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What we know (VII)

J. Jäckel, M. Lamont, C. Vallée — April 17th, 2018

PHYSICS BEYOND COLLIDERS

Working Groups membership

EDM subgroup:

- Core members: Mike Lamont (CERN), Gianluigi Arduini (CERN), Christian Carli (CERN), Mei Bai (Jülich/GSI), Klaus Jungmann (Gröningen), Yannis Semertzidis (electrostatic ring proponent), Jörg Pretz, Achim Stahl, Ed. Stephenson, Hans Ströher and Paolo Lenisa (JEDI proponents).

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What we know (VIII)

PBC DELIVERABLES

Due end 2018 as input to the next European Particle Physics strategy update

Guidelines for structure and content distributed to all participants end 2017

			[facility, construction schedule and costing].
EDM	EDM WG	EDM Collab.	Fully developed feasibility study of the proton/deuteron EDM storage ring: *ring layout options; experimental aspects of the EDM measurement (e.g. systematics); initial civil engineering studies for a possible siting at CERN; timeline and cost estimate; collaboration structure.*

Working group	10 pager for ESPP for 18th December - WG dependent	Possible proponents/clients submitting 10 pager to ESPP	PBC deliverable for 18th December * (referenced by 10 pager)	Foreseen no pages
EDM	Y		3 appendices: COSY; prototype; full ring (feasibility study).	50,50,200

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What we know (IX)

Structure of the PBC BSM document for the ESPP

PBC - BSM Subgroup

The Authors

Contents

1 Physics motivation

2 Experimental worldwide context

3 Experiments proposed in the BSM PBC context

4 Overall summary

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Tasks (II)

PBC deliverables:

- Executive Summary (10 pages)
- 0.5-1 page per project (i.e. CPEDM)
  - Underlying physics
  - Experimental feasibility/maturity
  - Collaboration strength
  - Cost, time scale, roadmap

For CPEDM:

- Full Report
- Appendices
  - Achievements
  - Prototype
  - Final Ring

→ Due November 2018 (Summary), I/2019 (Full Report)

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Strategy (I)

Summary of the CPEDM Meeting

During the CPEDM Meeting on March 8 and 9, 2018 in Jülich, the following items were discussed and agreed upon:

(1) The **ultimate goal** of the CPEDM collaboration is to design, build and operate an all-electric storage ring for protons at frozen-spin momentum (0.7 GeV/c) and with clock-wise and counter clock-wise beams to search for an Electric Dipole Moment with a sensitivity of the order of 10^{-29} e.cm. The siting of the ring remains open for the moment; it could, e.g., be built at CERN. Items for investigation are:

i. Design of a realistic lattice
ii. Spin tracking
iii. Systematic error budget
iv. Technical realization

The immediate objective is to prepare the required documents in the form of a feasibility study for PBC (Physics Beyond Colliders) and the ESPP (European Strategy for Particle Physics) – deadline December 2018. The longer-term goals are a CDR (Conceptual Design Report) followed by a TDR (technical Design Report), the delivery dates for which are to be established this year.

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Strategy (II)

(2) As an **inevitable intermediate step** the CPEDM collaboration plans to design, build and operate a prototype all-electric storage ring for protons at low energy (around 30 MeV) to demonstrate the fundamental operation principles and scrutinize/mitigate the risks:

- Storage of a proton beam of sufficient intensity (10^{10} particles) for sufficient times (> 1000 s)
- Clock-wise and counter clock-wise operation (separately, simultaneously)
- Orbit control: high precision beam pick-ups, beam-based alignment
- Mechanical tolerances
- Cryogenic operation as a possible requirement for the ultimate ring
- Systematic errors: quantitative investigation

It should be foreseen that the ring can in addition be equipped with magnetic deflectors to operate it in a frozen-spin mode at low energy (approx. 45 MeV) in order to perform an EDM measurement with lower sensitivity. The possibility of performing an axion search should also be considered. However, both of those provisions should not impose an undue burden to the funding and the timeline of the prototype to serve as such, addressing its primary goals.

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Discussion (I)