

Heavy Ions and New Physics

Virtual ECT*-Trento meeting
May 20/21 2021

<https://indico.cern.ch/e/Heavy-Ions-and-New-Physics>

Marco Drewes, Andrea Giammanco, Jan Hajer (UCLouvain) & David d'Enterria (CERN)

Welcome to the (unfortunately virtual) Workshop!



CP3 – UCLouvain
December 4-5 2018


Organising Committee
Marco Drewes
Andrea Giammanco
Jan Hajer
Fabio Maltoni

Speakers include
Roderik Bruce
Pieter David
David d'Enterria
Glennys Farrar (tbc)
Oliver Gould
Lucian Harland-Lang
Sonia Kabana
Simon Knapen
Georgios Krintiras
Guilherme Milhano
Swagata Mukherjee
Jeremi Niedziela
Jessica Prisciandaro
Valerii Pugach
Federico Redi
Michaela Schaumann

HEAVY IONS AND HIDDEN SECTORS

In the recent past, several proposals have been made to search for new phenomena in heavy ion collisions at the Large Hadron Collider, e.g. axion-like particles, long-lived particles or magnetic monopoles. The objective of this workshop is to connect members of the involved communities to explore these ideas. It provides a unique opportunity for theorists, experimentalists and accelerator physicists who previously had little interaction with each other to discuss new approaches as well as practical and fundamental limitations, and to form collaborations for future research.

Registration: agenda.irmp.ucl.ac.be/event/3186



<https://agenda.irmp.ucl.ac.be/event/3186/>

ECT*
EUROPEAN COMMISSION
FUNDING THE FUTURE

ONLINE Workshop

STRONG*
2020

Heavy Ions and New Physics

May 20-21, 2021 on ZOOM Platform

Abstract | Main Topics

In the recent past, several proposals have been made to exploit heavy ion collisions at the Large Hadron Collider (LHC) to search for new phenomena in particle physics, including axion-like particles, long-lived particles beyond the Standard Model and magnetic monopoles.

The objective of this workshop is to bring together members of the involved communities to exploit the potential of these ideas, either during scheduled LHC runs or in dedicated efforts at the LHC or future colliders. We want to create a unique opportunity for exchange between scientists working in different fields of experimental physics, theoretical physics, accelerator physics and detector physics that otherwise have little connection.

Keynote speakers

Elena BRATKOVSKAYA (GS) – Roderik BRUCE (CERN) – Emilien CHAPON (CERN) – Mateusz DYNDAL (CERN)
Hesham EL FAHAMI (UCLouvain) – Glennys FARRAR (NYU) – Oliver FISCHER (Liverpool University)
Taku GUNJI (Tokyo University) – Lucian HARLAND-LANG (Oxford University)
Yen-jei LEE (Massachusetts Inst. of Technology) – Tanqiu PIKOS (KIT, IAP)
James PINFOLD (Alberta University) – Arttu RAJANTIE (Imperial College)
Suvrat RAO (Hamburg University) – Kristof SCHMIEDEN (CERN) – Ralf ULBRICH (KIT)
Aditya UPRETI (Alabama University) – Susanne WESTHOFF (Heidelberg University)

Program

Organizers

Marco DREWES (UCLouvain); David D'ENTERRIA (CERN);
Andrea GIAMMANCO (UCLouvain); Jan HAJER (Basel University)

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New physics searches with heavy-ion collisions at the CERN Large Hadron Collider

Roderik Bruce¹, David d'Enterria^{*2}, Albert de Roeck², Marco Drewes³,
Glennys R. Farrar⁴, Andrea Giammanco³, Oliver Gould⁵, Jan Hajer³,
Lucian Harland-Lang⁶, Jan Heisig³, John M. Jowett¹, Sonia Kabana^{†7},
Georgios K. Krintiras^{‡3}, Michael Korsmeier^{8,9,10}, Michele Lucente³,
Guilherme Milhano^{11,12}, Swagata Mukherjee¹³, Jeremi Niedziela², Vitalii A. Okorokov¹⁴,
Arttu Rajantie¹⁵, and Michaela Schaumann¹

This document summarises proposed searches for new physics accessible in the heavy-ion mode at the CERN Large Hadron Collider (LHC), both through hadronic and ultraperipheral $\gamma\gamma$ interactions, and that have a competitive or, even, unique discovery potential compared to standard proton-proton collision studies. Illustrative examples include searches for new particles — such as axion-like pseudoscalars, radions, magnetic monopoles, new long-lived particles, dark photons, and sexaquarks as dark matter candidates — as well as new interactions, such as non-linear or non-commutative QED extensions. We argue that such interesting possibilities constitute a well-justified scientific motivation, complementing standard quark-gluon-plasma physics studies, to continue running with ions at the LHC after the Run-4, i.e., beyond 2030, including light and intermediate-mass ion species, accumulating nucleon-nucleon integrated luminosities in the accessible fb^{-1} range per month.


Science Goals






- What new physics signatures can be searched for with heavy ions?
- What new particles can be found (that are less accessible than in pp collisions)?
- Which new exotic phenomena in the Standard Model can be probed?
- Which ion species should be used?
- How can the integrated luminosity in heavy ion runs be optimised?
- How can the experimental triggers be optimised?
- How can one exploit the absence of pile-up in heavy ion collisions?
- Are there well-motivated hardware modifications?
- What are the implications for future colliders?

Community Goals

- Provide a unique opportunity for members of different communities (theorists, experimentalists, and accelerator physicists) who otherwise have no or little exchange with each other to discuss the possibility to search for New Physics in heavy ion collisions
- Discuss a potential dedicated **contributed white paper to Snowmass**, and how it can be organised. Do we have enough new material? Worthful? Interest? If so, deadline: March 2022
LOI: https://www.snowmass21.org/docs/files/summaries/EF/SNOWMASS21-EF7_EF8-207.pdf
- https://snowmass21.org/submissions/start#contributed_papers

Meeting agenda: 22 talks (~50/50% TH/EX), 130+ participants

<	Thu 20/05	Fri 21/05	All days	>
    				
14:00	Welcome to ECT*			<i>Gert Aarts</i>
	Workshop Introduction			<i>Andrea Giammanco et al.</i>
	Future of heavy ion collisions at the LHC			<i>Dr Roderik Bruce</i>
	LHC as a Gravitational Wave detector			<i>Suvrat Rao</i>
15:00	Exotic phenomena in CMS			<i>Émillien Chapon</i>
	ALP searches in heavy ion collisions			<i>Kristof Schmieden</i>
	ALP searches prospects with heavy ions at LHCb			<i>Murilo Santana Rangel</i>
16:00	Measurements of g-2 in HI collisions			<i>Mateusz Dyndal et al.</i>
	Coffee break			
17:00	Magnetic monopoles in heavy ion collisions			<i>Prof. Arttu Rajantie</i>
	Latest Results from the MoEDAL with p-p and Pb-Pb Collisions at the LHC			<i>Aditya Upreti</i>
	The MoEDAL-MAPP Experiment at LHC's Run-3 and Beyond			<i>James Pinfold</i>
18:00	Latest developments of the SuperChic Monte Carlo event generator for photon-induced collisions			<i>Lucian Harland-Lang et al.</i>

<	Thu 20/05	Fri 21/05	All days	>
    				
14:00	New physics searches in heavy ion collisions in CMS			<i>Yen-Jie Lee et al.</i>
	Light dark photons searches with heavy ions			<i>Elena Bratkovskaya</i>
	New physics searches in heavy ion collisions in ALICE			<i>Taku Gunji</i>
15:00	New physics scenarios with soft decay products at the LHC			<i>Susanne Westhoff et al.</i>
	Exotic searches with exotic data sets			<i>Hesham El Faham</i>
16:00	New physics searches with the CMS CASTOR very forward detector			<i>Ralf Ulrich</i>
	New physics searches in cosmic ray air showers			<i>Oliver Fischer et al.</i>
17:00	Is there room for new physics to explain the muon anomaly in ultrahigh-energy cosmic rays showers?			<i>Dr Tanguy Pierog</i>
	Sexaquark production and detection in heavy ion collisions			<i>Glennys Farrar</i>
	Contribution X			
18:00	Discussion of possible Snowmass'22 white paper contribution on "New physics with Heavy Ions"(all contributors)			