

# Christian Bierlich

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## EDUCATION

### PH.D THEORETICAL PHYSICS

Feb. 2017 | Lund University, Sweden  
Theoretical High Energy Physics.  
Thesis: Rope Hadronization, Geometry and Particle Production in pp and pA Collisions, ISBN: 978-91-7753-148-7.  
Supervisor: professor Leif Lönnblad.

### M.Sc PHYSICS

2012 | University of Copenhagen, Denmark  
Experimental High Energy Physics.  
Thesis: Limits on Triple Gauge Boson Couplings, CERN-THESIS-2012-198.  
Supervisor: Assoc. Professor Jørgen Beck Hansen, ATLAS Group

### B.Sc PHYSICS AND MATHEMATICS

2009 | Roskilde University, Denmark

## EMPLOYMENT

### POSTDOC

2018-2020 | University of Copenhagen, Denmark

### POSTDOC

2017 | Lund University, Sweden

## GRANTS, AWARDS

### BOKELUNDS TRAVEL

stipend fund (2018).

### VETENSKAPSRÅDET (SWEDEN)

International Postdoc (2017), amount: 300.000 €.

### STRANGENESS IN QUARK MATTER

Young Scientist award (2017).

## ASSIGNMENTS

### REFEREE

EPJA, EPJC, NUPA, PRC, PRD.

### EXPERT REVIEWER

Polish National Science Center, SONATA funding.

### CONVENORSHIPS

High multiplicities (small system), MPI@LHC 2019.

Heavy Ion convenor, LHCp 2018.

### OTHER

ECFA Young Researchers: Swedish delegate (2019).

## RESEARCH SUMMARY

Researcher focused on phenomenology, at the intersection between dynamics in collisions of protons and collisions of heavy nuclei. My main research venue is the investigation of collective dynamics in proton-proton collisions, on which I have published several papers, and given more than 20 invited talks at international meetings. I collaborate closely with experimental physicists, providing calculations as open source code, and develop new observables.

## SCIENTIFIC PUBLICATIONS

### HADRONIC EFFECTS IN AA COLLISIONS | COUPLING PYTHIA WITH URQMD

da Silva et al: Suppression of the nuclear modification factor with a hybrid model based on perturbative QCD and hadronic rescattering, Submitted to PRC, arXiv:2002.10236.

### THEORY/DATA COMPARISON | RIVET FOR HEAVY ION PHYSICS

CB et al: Confronting Experimental Data with Heavy-Ion Models: Rivet for Heavy Ions, Submitted to PRC, arXiv:2001.10737.

### THEORY/DATA COMPARISON | VERSION 3 OF THE RIVET PROGRAM

CB et al: Robust Independent Validation of Experiment and Theory: Rivet version 3, SciPost Phys. 8 (2020) 026, arXiv:1912.05451.

### NUCLEON SUBSTRUCTURE EVOLUTION | MONTE CARLO

IMPLEMENTATION OF BFKL IN REAL SPACE, AND APPLICATIONS

CB, Rasmussen: Dipole evolution: perspectives for collectivity and  $\gamma^*A$  collisions, JHEP 1910 (2019) 026, arXiv:1907.12871.

### SMALL SYSTEMS JET QUENCHING? | PREDICTIONS FOR SOFT JET MODIFICATIONS IN PP

CB: Soft modifications to jet fragmentation in high energy proton-proton collisions, Phys. Lett. B795 (2019) 194-199, arXiv:1901.07447.

### CERN YELLOW REPORT ON HEAVY ION PHYSICS | THEORY CONTRIBUTOR TO SMALL SYSTEMS SECTION

Citron et al. Emergence of hot and dense QCD matter in small systems in Future physics opportunities for high-density QCD at the LHC with heavy-ion and proton beams, CERN Yellow Rep.Monogr. 7 (2019) 1159-1410, arXiv:1812.06772.

### NEW METHODS FOR JET SUBSTRUCTURE | LARGE COLLABORATIVE EFFORT FOLLOWING A CERN THEORY INSTITUTE

Andrews et al.: Novel tools and observables for jet physics in heavy-ion collisions, arXiv:1808.03689.

### HEAVY ION EVENT GENERATION | COMPUTATIONAL FRAMEWORK FOR GENERATING HEAVY ION UNDERLYING EVENTS

Bellm, CB: PISTA: Posterior Ion STACKing, arXiv:1807.01291.

## ORGANIZED MEETINGS

### QCD WORKSHOP

(2019) QCD ping on challenges in heavy ion physics and QCD.  $\approx$ 50 participants.

### COST WORKSHOP

(2019) Workshop + School at Lund University.  $\approx$ 80 participants.

### RIVET FOR HEAVY IONS

(2018) Workshop at University of Copenhagen. 21 participants.

## ADMINISTRATIVE

### UNIVERSITY BOARD OF RESEARCH EDUCATION

(2017) Member of Lund University board of research education.

### FACULTY BOARD OF RESEARCH EDUCATION

(2014-2017) Member of Lund University, Science faculty board of research education.

### HIRING COMMITTEES

(2013-2017) Member of several hiring committees for Ph.D. students.

### STUDY BOARD

(2008-2009) Member of Roskilde University study board, physics and mathematics.

## PROGRAMMING SKILLS

### ADVANCED:

C++, Python, Matlab.

### INTERMEDIATE:

Java, Mathematica, C, PHP.

### BASIC:

Javascript.

### DESIGN AND LAYOUT:

Webdesign in HTML and CSS, typesetting with  $\LaTeX$ .

### ANGANTYR | THE PYTHIA8 HEAVY ION MODEL

CB, Gustafson, Lönnblad, Shah: The Angantyr model for Heavy-Ion Collisions in PYTHIA8, JHEP 1810 (2018) 134, arXiv:1806.10820.

### SHOVING MODEL | MICROSCOPIC MODEL FOR COLLECTIVITY FROM STRING INTERACTIONS

CB, Gustafson, Lönnblad: Collectivity without plasma in hadronic collisions, Phys. Lett. B (2018) 58-63, arXiv:1710.09725.

### SHOVING MODEL IN DIPSY | THE FIRST VERSION OF THE SHOVING MODEL CITED ABOVE

CB, Gustafson, Lönnblad: A shoving model for collectivity in hadronic collisions, arXiv:1612.05132.

### COLOUR FLUCTUATIONS IN HEAVY ION COLLISIONS |

#### TREATMENT OF THE GLAUBER MODEL WITH FLUCTUATIONS AND EVENT GENERATION IN HEAVY IONS

CB, Gustafson, Lönnblad: Diffractive and non-diffractive wounded nucleons and final states in pA collisions, JHEP 1610 (2016) 139, arXiv:1607.04434.

### HADRON FLAVOUR MODEL PREDICTIONS | PROVIDING PREDICTIONS FOR THE ALICE EXPERIMENT TO DESIGN A MEASUREMENT.

CB, Christiansen: Effects of color reconnection on hadron flavor observables, Phys.Rev. D92 (2015) no.9, 094010, arXiv:1507.02091.

### COLOUR ROPES | MODEL FOR DESCRIBING HADRON FLAVOUR COMPOSITIONS

CB, Gustafson, Lönnblad, Tarasov: Effects of Overlapping Strings in pp Collisions, JHEP 1503 (2015) 148, arXiv:1412.6259.

## CONFERENCE PUBLICATIONS

### INTERNATIONAL SYMPOSIUM ON MULTIPARTICLE DYNAMICS 2019

CB: Sources of multiparticle correlations: a microscopic perspective, arXiv:2002.10746.

### ECFA EARLY-CAREER PANEL 2019

Bethani et al: Report on the ECFA Early-Career Researchers Debate on the 2020 European Strategy Update for Particle Physics, arXiv:2002.02837.

### STRANGENESS IN QUARK MATTER 2019

da Silva et al: Studying the effect of the hadronic phase in nuclear collisions with PYTHIA and UrQMD, arXiv:1911.12824.

### QUARK MATTER 2018

CB: Microscopic collectivity: The ridge and strangeness enhancement from string-string interactions, Nucl. Phys. A982 (2019), arXiv:1907.05271.

### STRANGENESS IN QUARK MATTER 2017

CB: Rope Hadronization and Strange Particle Production, EPJ Web Conf. 171 (2018), arXiv:1710.04464.

## COLLABORATIONS

### **PYTHIA**

Member of the PYTHIA MC Collaboration.

### **RIVET**

Co-author of the RIVET package.

### **DIPSY**

Co-developer of the DIPSY MC.

### **EIC**

Member of the EIC Software working group as Monte Carlo expert.

### **MCNET**

Member of the MC-ITN MCNet for European MC developers.

### **ALICE GUEST**

Currently guest of the ALICE collaboration.

## **PARTON RADIATION AND FRAGMENTATION FROM LHC TO FCC-EE**

CB: Colour reconnections in pp collisions, arXiv:1702.01329.

## **HARD PROBES 2016**

CB: Multiparton interactions: From pp to pA, Nucl. Part. Phys. Proc. 289-290 (2017) 377-380, arXiv:1610.09955.

## **DIS 2016**

CB: Hadronisation models and colour reconnection, PoS DIS2016 051, arXiv:1606.09456.

## **MPI@LHC 2014**

CB: Finite  $N_c$  effects in pp and AA Monte Carlo event generation with DIPSY, arXiv:1506.05829.

## POPULAR SCIENCE ARTICLES

Translated to five languages and published in Science Illustrated world wide.

### **THE MIRROR IMAGE OF THE UNIVERSE**

CB: Orig. Universets spejlbillede, Illustreret Videnskab (2020) nr. 1

### **ULTRA-PRECISE ATOMIC CLOCK TO MEASURE EARTH'S WEIGHT**

CB: Orig. Ultrapræcist atomur skal måle Jordens vægt, Illustreret Videnskab (2019) nr. 11

### **NOW WE CAN TELEPORT DATA TO SPACE**

CB: Orig. Nu kan vi teleportere data ud i rummet, Illustreret Videnskab (2018) nr. 5

### **THE MINIATURES OF THE SOLAR SYSTEM**

CB: Orig. Solsystemets miniputter, Illustreret Videnskab (2017) nr. 9

### **WHERE ARE THEY?**

CB, Bindslev: Orig. Hvor bliver de af?, Illustreret Videnskab (2017) nr. 8

### **RESEARCHERS CATCHES ECHO FROM BLACK HOLES**

CB: Orig. Forskere fanger ekko fra sorte huller, Illustreret Videnskab (2016) nr. 10

### **THE HUNT FOR THE NINTH PLANET**

CB: Orig. Jagten på den niende planet, Illustreret Videnskab (2016) nr. 12

## SELECTED PRESENTATIONS

Please inquire for a full list also including presentations at local seminars and internal meetings.

**INVITED TALK 2019** | RIVET FOR HEAVY IONS  
MCEG for future  $ep$  and  $eA$  facilities, Vienna, Austria.

**INVITED SEMINAR 2019** | A MICROSCOPIC PERSPECTIVE ON HEAVY ION PHYSICS: NEWS FROM PYTHIA AND ANGANTYR  
GSI Theory seminar, GSI, Darmstadt, Germany.

**INVITED TALK 2019** | SOURCES OF MULTIPARTICLE CORRELATIONS: A MICROSCOPIC PERSPECTIVE  
49th International Symposium on Multiparticle Dynamics (ISMD), Santa Fe, USA.

**CONTRIBUTED TALK 2019** | STUDYING THE EFFECT OF THE HADRONIC PHASE IN NUCLEAR COLLISIONS WITH PYTHIA AND URQMD  
18th International Conference on Strangeness in Quark Matter (SQM), Bari, Italy.

**INVITED TALK 2019** | PYTHIA, ANGANTYR AND DIPSY  
ALICE mini workshop on minimum bias, Underlying event and Monte Carlo, CERN, Switzerland.

**INVITED TALK 2019** | SOFT MODIFICATIONS TO PP FRAGMENTATION: THE SHOVING MODEL  
COST workshop on interplay of hard and soft QCD probes, Lund, Sweden.

**INVITED TALK 2018** | RIVET FOR HEAVY IONS: LATEST DEVELOPMENTS  
10th International Workshop on Multiple Partonic Interactions at the LHC (MPI@LHC), Perugia, Italy.

**INVITED TALK 2018** | SOFT QCD FROM  $e^+e^-$  TO  $AA$   
10th International Workshop on Multiple Partonic Interactions at the LHC (MPI@LHC), Perugia, Italy.

**CONTRIBUTED TALK 2018** | MICROSCOPIC COLLECTIVITY: THE RIDGE AND STRANGENESS ENHANCEMENT FROM STRING-STRING INTERACTIONS IN PYTHIA8  
27th International Conference on Ultrarelativistic Nucleus–Nucleus Collisions (Quark Matter), Venice, Italy.  
Proceedings: arXiv:1807.05271.

**INVITED TALK 2018** | PRODUCTION MECHANISMS IN MONTE CARLO GENERATORS  
LightUP 2018 Light Flavour workshop, CERN, Switzerland.

**INVITED TALK 2018** | POSSIBILITY OF  $eD$  COLLISIONS IN PYTHIA8/ANGANTYR  
EIC Simulation meeting, JLAB, USA (remote presentation).

**INVITED TALK 2018** | DIPSY AND ANGANTYR: TOWARDS  $eA$  EXCLUSIVE FINAL STATES  
Monte Carlo Event Generators for  $eA$ , Regensburg, Germany.

**INVITED TALK 2018** | MICROSCOPIC COLLECTIVITY FROM STRING INTERACTIONS IN PP  
1st JETSCAPE Workshop, LBNL Berkeley, USA

**INVITED TALK AND PANELIST 2017** | COLLECTIVITY IN SMALL SYSTEMS: A MICROSCOPIC PERSPECTIVE  
INFN meeting on heavy ion physics at LHC, Turin, Italy

**INVITED TALK 2017** | COLLECTIVITY IN THE LUND MONTE CARLO  
4th International Conference on the Initial Stages in High Energy Nuclear Collisions, Cracow, Poland

**INVITED TALK 2017** | SMALL SYSTEMS: THEORY OVERVIEW  
Workshop on the physics on HL-LHC and perspectives at HE-LHC, CERN, Switzerland

**CONTRIBUTED TALK 2017** | ROPE HADRONIZATION IN THE DIPSY EVENT GENERATOR  
17th International Conference on Strangeness in Quark Matter, Utrecht, Netherlands.  
Proceedings: EPJ Web Conf. 171 (2018) 14003. Won the young scientist award for best presentation.

**INVITED TALK 2017** | PARTICLE PRODUCTION AND QGP EFFECTS IN PP AND  $pA$  WITH THE DIPSY GENERATOR  
QCD Challenges in  $pp$ ,  $pA$  and  $AA$  collisions at high energies, ECT\* Trento, Italy

**INVITED TALK 2017** | COLLECTIVITY IN SMALL SYSTEMS WITH THE DIPSY AND FRITIOFP8 MC EVENT GENERATORS

Workshop on collectivity in small systems, Copenhagen, Denmark

**INVITED TALK 2016** | COLOUR RECONNECTION AT FCC-EE – LESSONS FROM PP

Workshop on parton radiation and fragmentation, CERN, Switzerland, proceedings: arXiv:1702.01329

**INVITED TALK 2016** | MULTI-PARTON AND MULTI-NUCLEON CORRELATIONS: THEORETICAL OVERVIEW

3rd International Conference on the Initial Stages in High-Energy Nuclear Collisions, Lisbon, Portugal.

**CONTRIBUTED TALK 2016** | HEAVY ION COLLISIONS WITH GENERAL PURPOSE EVENT GENERATORS

8th International Conference on Hard and Electromagnetic Probes of High-Energy Nuclear Collisions, Wuhan, China, proceedings: arXiv:1610.09955.

**CONTRIBUTED TALK 2016** | HEAVY IONS: A NEW TERRITORY FOR GENERAL PURPOSE EVENT GENERATORS

Danish Physical Society yearly meeting, Middelfart, Denmark

**INVITED TALK 2016** | HADRONISATION MODELS AND COLOUR RECONNECTION

24th International Workshop on Deep-Inelastic Scattering and Related Subjects, DESY, Hamburg, Germany

**INVITED TALK AND PANELIST 2016** | ROPE HADRONIZATION IN THE DIPSY EVENT GENERATOR

QCD Challenges at the LHC: from pp to AA, Taxco, Mexico

**INVITED TALK 2015** | SOFT QCD AND COLOURS IN PYTHIA AND DIPSY - TESTS AND PREDICTIONS

ALICE workshop on strangeness, CERN, Switzerland

**CONTRIBUTED TALK 2015** | ROPE HADRONIZATION IN THE DIPSY EVENT GENERATOR

Partikeldagarna, Swedish Physical Society, Uppsala, Sweden

**CONTRIBUTED TALK 2014** | FINITE  $N_c$  EFFECTS IN PP AND AA MONTE CARLO EVENT GENERATION WITH DIPSY

6th International Workshop on Multiple Partonic Interactions at the LHC, Cracow, Poland, proceedings: arXiv:1506.05829.

**CONTRIBUTED TALK 2014** | ROPE HADRONIZATION

54th Cracow School of Theoretical Physics, Zakopane, Poland

**CONTRIBUTED TALK 2013** | THE FUSED STRING MODEL FOR HADRONIZATION

5th International Workshop on Multiple Partonic Interactions at the LHC, Antwerp, Netherlands

## POSTER PRESENTATIONS

**THE DIPSY EVENT GENERATOR (2015)** 7th International Conference on Hard and Electromagnetic Probes of High-Energy Nuclear Collisions, Montreal, Canada

**MONTE CARLO EVENT GENERATORS (2014)** COMPUTE Summer Retreat, Ystad, Sweden

**ROPE HADRONIZATION (2014)** MCnet Summer School, Ambleside, UK

**LIMITS ON TRIPLE GAUGE BOSON COUPLINGS (2012)** Danish Physical Society national meeting, Nyborg, Denmark

## TEACHING EXPERIENCE

### PH.D LEVEL

- (2020) Local supervisor for exchange student.
- (2014-2018) Developing and teaching in Monte Carlo tutorial sessions at European summer schools.
- (2018) Lecture: Monte Carlo implementation of QCD processes, JETSCAPE Winter School, LBNL US.

### UNDERGRADUATE LEVEL

- (2020) Lund University Supervising Bachelors project.
- (2019) University of Copenhagen Supervising first year physics projects, including oral examinations.
- (2018) University of Copenhagen, co-supervisor for a Masters project and student projects.

- (2012-2017) Lund University, teaching assistant, development of teaching material and oral examinations: Linear Algebra II, Introduction to Theoretical Physics, Introduction to Java.
- (2011) University of Copenhagen, teaching assistant: Classical Mechanics, Electromagnetism.

#### **OTHER LEVELS**

- (2010-2011) High school physics and mathematics, Frederiksborg Gymnasium og HF. Taught two A-level classes, arranged oral examinations.
- (2006-2010) Community center, Albertslund Ungdomsskole. Physics and chemistry.