

# WG3 QCD at short distances : experiment, theory and tools

Emilien Chapon, Laure Massacrier, Melih Ozcelik

September 27-29, 2023  
Assemblée Générale du GDR-QCD, IPHC, Strasbourg,  
France

# Who are we?

- **Émilien Chapon** (CEA/Irfu - Saclay):
  - Experimentalist in the ATLAS collaboration (also former member of CMS)
  - Precision measurements of electroweak observables (also formerly QGP and nuclear PDFs)
- **Laure Massacrier** (IJCLab - Orsay):
  - Experimentalist in the ALICE collaboration (also former member of LHCb)
  - Quarkonium production in all systems (pp, pPb, PbPb, UPC) and QGP physics
  - Fixed-target programme at the LHC: physics performance, implementation
- **Melih Ozcelik** (IJCLab - Orsay):
  - Theoretician
  - precision & phenomenology: higher-order perturbative QCD corrections, non-perturbative linear power corrections, QCD factorisation

# QCD at short distances: evolution of the WG

- In previous **GDR-QCD**, the WG focused on **jets** and **quarkonia**
- Strengthen the focus on **perturbative** QCD
- Aim to widen the scope to include intrinsic aspects of **pQCD techniques and tools** w/o restricting to a specific set of observables:
  - Computations with **multi loop** corrections
  - Inclusion of effect at **all orders (resummation)**
  - **Automation** of such computations
  - Merging and matching techniques to **interface** them to **event generators**
  - Definition of **new experimental observables**
- Build a **community** following the example of the lattice QCD community
- Keep the specificity of a strong implication of the **heavy-ion community**
- **New opportunities** of collaboration between theorists working on pQCD at colliders and LHC & EIC experimentalists

# Main objectives of the WG






- Foster TH-EXP contacts among people working on predictions and measurements where pQCD is particularly relevant
- Forum for theorists working on pQCD (explore areas where there's an overlap):
  - quarkonium  $\longleftrightarrow$  resummation / event generators
  - amplitudes  $\longleftrightarrow$  multiloop computations  $\longleftrightarrow$  pheno predictions
  - boundary pQCD / non-perturbative effects / TMD
  - common numerical/algorithmical challenges
  - HI  $\longleftrightarrow$  TH (e.g. jet substructure, quarkonium flow at high  $p_T$ ...)
- A forum to gather people working on QCD-related topics from different experiments and different communities (discuss tension among results, combination of measurements...)
  - Interface with IRN Terascale (groupement de recherche dedicated to experimental and theoretical search for new physics at the TeV scale)

# Events organised in 2022

- Quarkonium as Tools 2022 (9th-15th January, Aussois):  
<https://indico.cern.ch/e/OniumTools2022>, 40% of the participants are GDR members. 3 online tutorials for tools were opened for registration to GDR members (zoom connexion provided) : FeynOnia , NLOaccess (Helac-Onia + MadGraph), EPOS
- “Heavy Flavour“ programme of 3 weeks at Institut Pascal (Orsay), 3-21 October 2022, with a 1-week workshop: <https://indico.ijclab.in2p3.fr/event/7656/program> => **1 day dedicated to the GDR during the programme/workshop (combined event between WP1 (DPS, MPI) and WP3 (pQCD));** + 2 additional days of satellite meeting with the gluodynamics P2IO labex project
- QCD@LHC conference, 28 Nov.-2 Dec. 2022, IJCLab, Orsay:  
<https://indico.cern.ch/event/1150707/>

# Events already organised in 2023

- 3 days of lectures for students as satellite event of Quarkonium as Tools 2023 (9th-12th January Aussois): <https://indico.cern.ch/event/1213416/overview>
- Joint session at the IRN Terascale meeting (24–26 April 2023, LPSC Grenoble, <https://indico.in2p3.fr/event/28562/>) together with their “Methods and Tools” WG

<b>MadGraph and NLO Access</b> <i>Grand Amphi, LPSC Grenoble</i>	<i>Dr Carlo FLORE</i> 	13:45 - 14:05
<b>QCD corrections for precision measurements of W/Z at the LHC using POWHEG</b> <i>Grand Amphi, LPSC Grenoble</i>	<i>Emanuele Re</i> 	14:10 - 14:30
<b>Combined EW+PDF fits</b> <i>Grand Amphi, LPSC Grenoble</i>	<i>Juan Salvador TAFOYA VARGAS</i> 	14:35 - 14:55
<b>TMD/PDF extraction for precision W/Z measurements at the LHC</b> <i>Grand Amphi, LPSC Grenoble</i>	<i>Valerio Bertone</i> 	15:00 - 15:20
<b>Round table -cont-</b> <i>Grand Amphi, LPSC Grenoble</i>		15:25 - 15:50
<b>Farewell (famous last words...)</b> <i>Grand Amphi, LPSC Grenoble</i>	<i>Ana M. Teixeira, Marie-Helene Gen</i> 	15:50 - 16:00

Discussion with IRN conveners to produce a database with available theoretical tools, github to share codes among communities

- QCD evolution workshop 2023 (22–26 May 2023, IJCLab, <https://indico.cern.ch/event/1239374/>)

# Events planned for the rest of 2023 and 2024

- GDR QCD workshop on coherence/incoherence in hadronic & diffractive collisions at DIS and at hadron colliders - IJCLab - 11-12 Oct 2023:  
<https://indico.in2p3.fr/event/30433/>
- NLOAccess annual meeting (20 - 24 Nov 2023):  
<https://indico.cern.ch/event/1269836/>
- Quarkonia as tools 2024 (07 Jan 2024 - 13 Jan 2024):  
<https://indico.cern.ch/event/1324160/> + Satellite meeting (14 - 17 Jan 2024) on resummation/factorization after Quarkonia as Tools:  
<https://indico.cern.ch/event/1290502/>
- Synergies between LHC and EIC for quarkonium physics (15 - 19 Jul 2024, ECT Trento)
- Discussion on possibility for an IRN terascale joint meeting in 2024
- Joint seminar theory + experiment:
  - Quarkonia in Run 3 LHC + wishlist for theorists?
  - $W_{\text{mass}}$  + QCD corrections ?

**Thank you for your attention!**

**...and do not hesitate to contact us!**

**Contacts: [laure.massacrier\\_at\\_ijclab.in2p3.fr](mailto:laure.massacrier_at_ijclab.in2p3.fr), [melih.ozcelik\\_at\\_ijclab.in2p3.fr](mailto:melih.ozcelik_at_ijclab.in2p3.fr), [Emilien.Chapon\\_at\\_cern.ch](mailto:Emilien.Chapon_at_cern.ch)**



Back up

# Events organized in 2021

- Workshop quarkonia as tools 2021, 22-26 Mar. 2021 (Online):  
<https://indico.cern.ch/event/983750/>
- Aussois Quarkonium & QCD meeting, 20-26 Jun. 2021 (Aussois):  
<https://indico.cern.ch/event/1041993/>
- Official Kick-off meeting of the Working Group during a joint STRONG 2020 WP/ GDR workshop: 31May - 4th Jun. 2021 (Orsay/Online):  
<https://indico.ijclab.in2p3.fr/event/7201/>
  - review of the state of the art, identify main common interests in French Community
  - Hands-on sessions on computing tools and platforms: POWHEG, HELAC-onia, MadGraph, NLOACCESS, PARTONS....
- Joint seminar of the GDR QCD, IJCLab QCD transverse group and labex P2IO gluodynamics project, 12th Oct. 2021 (Orsay/Online):  
<https://indico.ijclab.in2p3.fr/event/7602/>
  - $\eta_c$  prompt hadroproduction (theory + experiment)