The networking activity HF-QGP within the STRONG-2020 project

Giuseppe E Bruno
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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 824093.

ECT*, on-line - April the 26th 2021

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Outline:

- What is STRONG-2020
- The Network Activity HF-QGP
  - structure
  - objectives
    - tool for data to model comparison

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STRONG-2020

- STRONG-2020 "*The strong interaction at the frontier of knowledge: fundamental research and applications*" has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement Nº 824093
- Coordinator of the project: Barbara Erazmus
- Web site: http://www.strong-2020.eu/

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STRONG-2020

- 45 participating institutions
- 16 countries: Austria, Belgium, Switzerland, Germany, Spain, Finland, France, Croatia, Ireland, Italy, Montenegro, The Netherlands, Poland, Portugal, Sweden and United Kingdom

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Grant Agreement

Project duration: from 1 June 2019 to 31 May 2023 **Total Budget: 10 M €**

32 Work Packages (WPs):

- **MAN:** Management and Coordination
- **DISCO:** Dissemination and Communication
- 7 Transnational Access Research Infrastructures (**TA**)
- 2 Virtual Infrastructures (**VA**)

Experimental /Theoretical /Instrumentation Activities:

- 7 Networking Activities (**NA**)
- 14 Joint Research Activities (**JRA**)

STRONG-2020 kick-off meeting in Nantes, on October 23-25, 2019 https://indico.in2p3.fr/event/19715/

Scientific Frontiers: Research Infrastructures

Transnational Access

- TA1-COSY (Julich)
- TA2-MAMI (Mainz)
- TA3-LNF (INFN, Frascati)
- TA4-FTD/ELSA (Bonn)
- TA5-GSI (GSI, Darmstadt)
- TA6-ECT* (Trento)
- TA7-CERN (CERN, Geneva)

- The selection of infrastructure complement each other and allow for the exploration of specific strong interaction physics questions with different probes, such as electromagnetic probes at the electron machines or hadronic probes at the hadron machines, covering a broad range of energies.

Virtual Access

- VA1-NLOAccess

  Jean-Philippe Landsberg, CNRS, Orsay

- VA2-3DPartons

  Hervé Moutarde CEA, Saclay

- Provide open-access to state-of-the-art computer codes necessary for the high-precision phenomenology of heavy ion reactions and studies of the quark gluon plasma as well as for nucleon and nuclei parton structure research.

The Network Activity HF-QGP

- NA7: Quark-Gluon Plasma characterisation with heavy flavour probes (Hf-QGP)
- Objective: support the joint efforts of experimentalists and theorists in characterizing the properties of the QGP at the LHC energies using Heavy Flavour observables
- Coordinators: Joerg Aichelin and G.B.
- Budget: mostly for meetings/visits plus about 1 year of post-doc in theory and in experiment

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The Network Activity HF-QGP

- Structure of the networking:

  3 sub-groups:

  - Open Heavy Flavour
    - conveners: Andrea Rossi (ALICE), Salvatore Plumari (th.)
  - Quarkonia
    - conveners: Emilien Chapon(CMS) and Enrico Scomparin (ALICE), Alexander Rothkopf (th.)
  - Small System
    - conveners: Zaida Conesa del Valle (ALICE) and Benjamin Audurier (LHCb), Andrea Beraudo (th.)

  Mailing list: STRONG2020-HF_QGP@cern.ch

  - you are welcome to subscribe

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HF-QGP: next actions

- workshop this year at ECT*: «Quark-Gluon Plasma Characterisation with Heavy Flavour Probes»
  - 15 November 2021 — 19 November 2021
  - Hopefully in person
- report with prospects and recommendations for heavy ion periods in run3 and run4 of the LHC
- tool to facilitate the comparison of theory and experimental results in the HF sector
  - We had a dedicated workshop to discuss the case of Rivet two weeks ago

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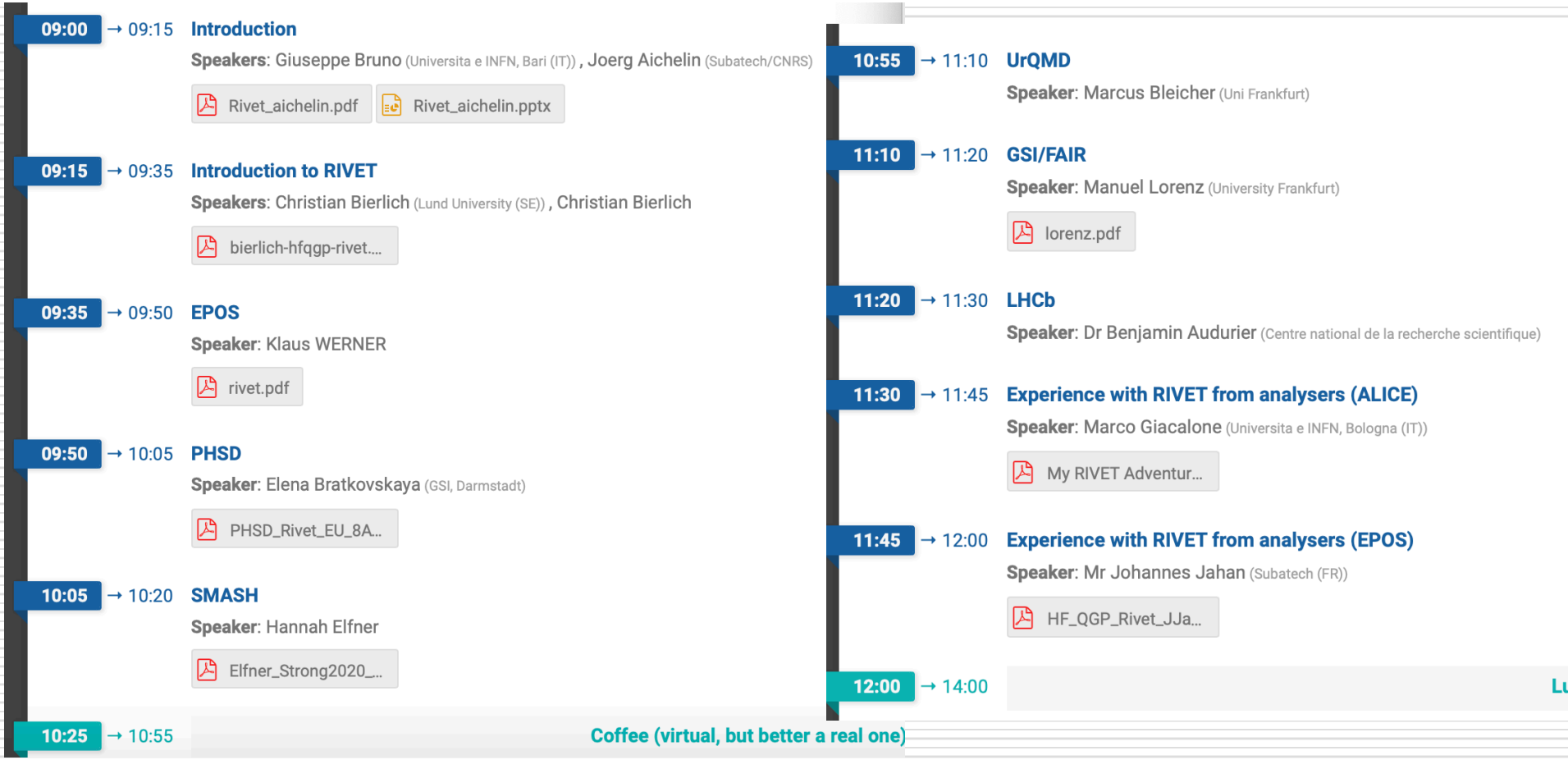
HF-QGP: theory meets experiments for the usage of RIVET

- https://indico.cern.ch/event/1022351/



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HF-QGP: theory meets experiments for the usage of RIVET

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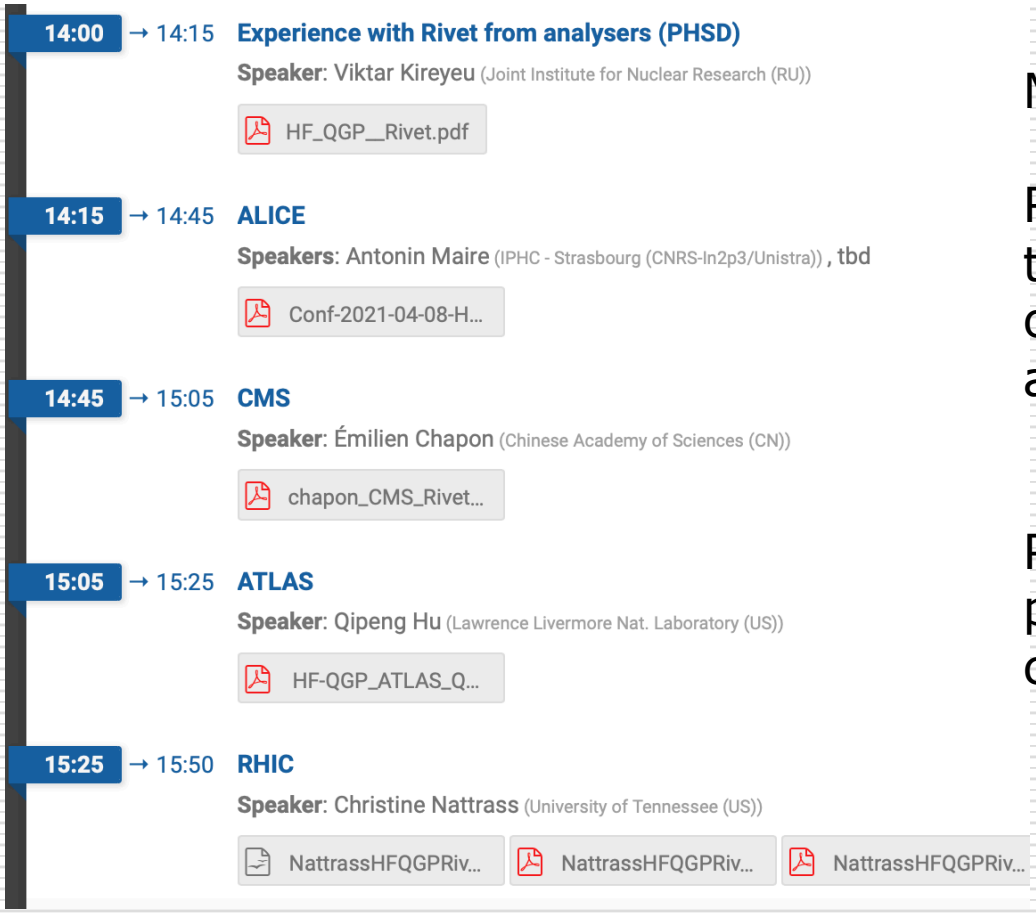

Main outcome:

RIVET is a good starting point for the future comparison of the results of the so-called event generator and the experimental data.

Plan to have a second meeting in person (in Paris) as soon as the conditions would permit

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- Thank you so much for your attention and thanks to the organisers for letting me advertising about the network HF-QGP

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Extra

Low-Energy Frontier

- **JRA3-PrecisionSM** **Mikhail Gorshteyn (UMainz), Andrzej Kupsc (University of Uppsala)**

Precise determination of the muon anomalous magnetic moment (g-2)μ; the CKM matrix element Vud from beta decay, and the weak mixing angle from parity-violating electron scattering. Associated novel constraints (or discovery) of physics beyond the SM.

- **NA4-PREN** **Dominique Marchand (CNRS, Orsay), Randolf Pohl (UMainz)**

Address the "proton-radius puzzle" via combined data-theory analyses of new results in atomic spectroscopy (laser spectroscopy of Hydrogen molecules and molecular ions, muonic atoms, He+ ions, positronium, and muonium) and very-low momentum transfer (Q2) lepton-proton elastic scattering at various energies.

- **NA6-LatticeHadrons** **Michael Peardon (TCD, Dublin)**

Development of combined software, data sharing, and methodologies in lattice QCD theory across Europe along 4 axes: (i) hadron spectroscopy and structure, (ii) hadrons under extreme conditions, (iii) hadrons in the SM and beyond, (iv) novel numerical algorithms and computing for lattice hadron physics.

Low-Energy Frontier

- **JRA7-HaSP** **Marco Battaglieri (INFN, Genova), Juan Nieves (UVEG, Valencia)**

Development of a common data-theory analysis framework to determine exotic hadrons properties by fitting new experimental data (MAMI, TJNAF, BESIII, COMPASS, LHCb and ALICE at CERN) to lattice QCD and effective-field-theory predictions.

- **NA1-FAIRnet** **Fritz-Herbert Heinsius (RUB, Bochum)**

Improved data selection (trigger-detector-less data acquisition, deadtime-free frontend electronics, Field Programmable Array (FPGA) based online selection) plus distributed physics analysis for rare signal events under high background conditions (multi-PByte/month) in anti-p-p, anti-p-A, and A-A collisions for the PANDA and CBM experiments at the future FAIR facility.

- **NA5-THEIA** **Josef Pochodzalla (UMainz)**

Address the "neutron stars hyperon puzzle" (contradiction between the observation of 2-solarmasses neutron stars and microscopical predictions of a softening of the nuclear equation-of-state due to the presence of strange-quark hadrons) through combined theoretical and experimental studies of (anti)hypernuclei and bound strange-meson systems produced in hadronic collisions at various c.m. energies.

High-Energy Frontier

- **JRA5-GPD-ACT** **Silvia Niccolai (CNRS, Orsay), Kresimir Kumericki (UNIZG, Zagreb)**

Extraction of GPDs from new high-precision QCD analyses of novel high-statistics e-p and p-p measurements at fixed-target and collider energies.

- **JRA4-TMD-neXt** **Alessandro Bacchetta (INFN, Pavia)**

Extraction of unpolarized and polarized TMDs and parton fragmentation functions (FFs) from new high-precision QCD analyses of novel high-statistics measurements at e+e-, e-p and p-p at fixed-target and collider energies.

- **JRA6-Next-DIS** **Daria Sokhan (UGlasgow), Francesco Bossu (CEA, Orsay)**

Development of new Monte Carlo tools and studies of benchmark channels, for e-A collisions at future deep-inelastic experiments (Electron-Ion Collider, EIC). Optimisation of associated detector designs for high-resolution tracking, vertexing, photon, and PID.

- **NA2-Small-x** **Néstor Armesto (USC, Santiago de Compostela), Tuomas Lappi (JYU, Jyväskylä)**

Extraction of high-precision nuclear parton distribution functions (nPDF) through global fits including the latest LHC p-A and A-A data. Extension of current gluon-saturation calculations (CGC, BFKL, TMD...) to NLO accuracy with resummation corrections, for observables with three jets and with heavy-quarks.

High-Energy Frontier

- **JRA2-FTE@LHC** **Cynthia Hadjidakis (CNRS, Orsay), Pasquale Di Nezza (INFN, Frascati)**

Development of novel gas-target techniques to be able to carry out the most energetic fixed-target collisions ever performed in the lab, using the LHC beams at ALICE and LHCb. Evaluation of the novel expected constraints on PDFs at high-x in the proton and nucleus, parton spin dynamics, as well as QGP properties via unique quarkonia measurements.

- **NA3-Jet-QGP** **Marco van Leeuwen (Nikhef, Amsterdam), Guilherme Milano (LIP, Lisbon)**

Development of novel experimental and theoretical techniques for jet physics in A-A collisions, providing a reference implementation of jet interactions in a QGP via a full heavy-ion Monte Carlo (MC) event generator. Definition of new observables and development of new tools with increased sensitivity to the physical mechanisms involved in jet- QGP interactions.

- **NA7-Hf-QGP** **Joerg Aichelin (CNRS, Nantes), Giuseppe Bruno (INFN, Bari)**

Extraction of QGP transport coefficients from new high-precision theoretical calculations and experimental measurements of the production of open and closed heavy flavour (HF) quarks (charm and beauty) in A-A collisions at the LHC. Accurate measurements of total c-cbar, b-bbar cross sections in p-p, p-A and A-Acollisions.

- **JRA1-LHC-Combine** **Raphaël Granier de Cassagnac (CNRS, Palaiseau)**

Combination of key LHC (ALICE, ATLAS, CMS, LHCb) measurements in p-p, p-A, and/or A-A collisions to achieve high-precision constraints on nuclear PDFs, QGP properties, SM parameters, and/or searches of physics beyond the SM.