STRONG-2020

The *strong Interaction at the frontier of knowledge: fundamenatal research and applications*

Barbara Erazmus (Subatech, CNRS)

Project Review 28 September, 2022

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

Consortium Agreement

- 46 participating institutions (beneficiaries) in
- 16 countries:

Austria, Belgium, Switzerland, Germany, Spain, Finland, France, Croatia, Ireland, Italy, Montenegro, Netherlands, Poland, Portugal, Sweden, United Kingdom

- Location details can be found on online Google map

- 134 other Involved Institutions (not receiving EU funding)

Grant Agreement

Project duration: from 1 June 2019 to 30 November 2023 (54 months)

Total Budget: 10 M €

32 Work Packages (WPs):

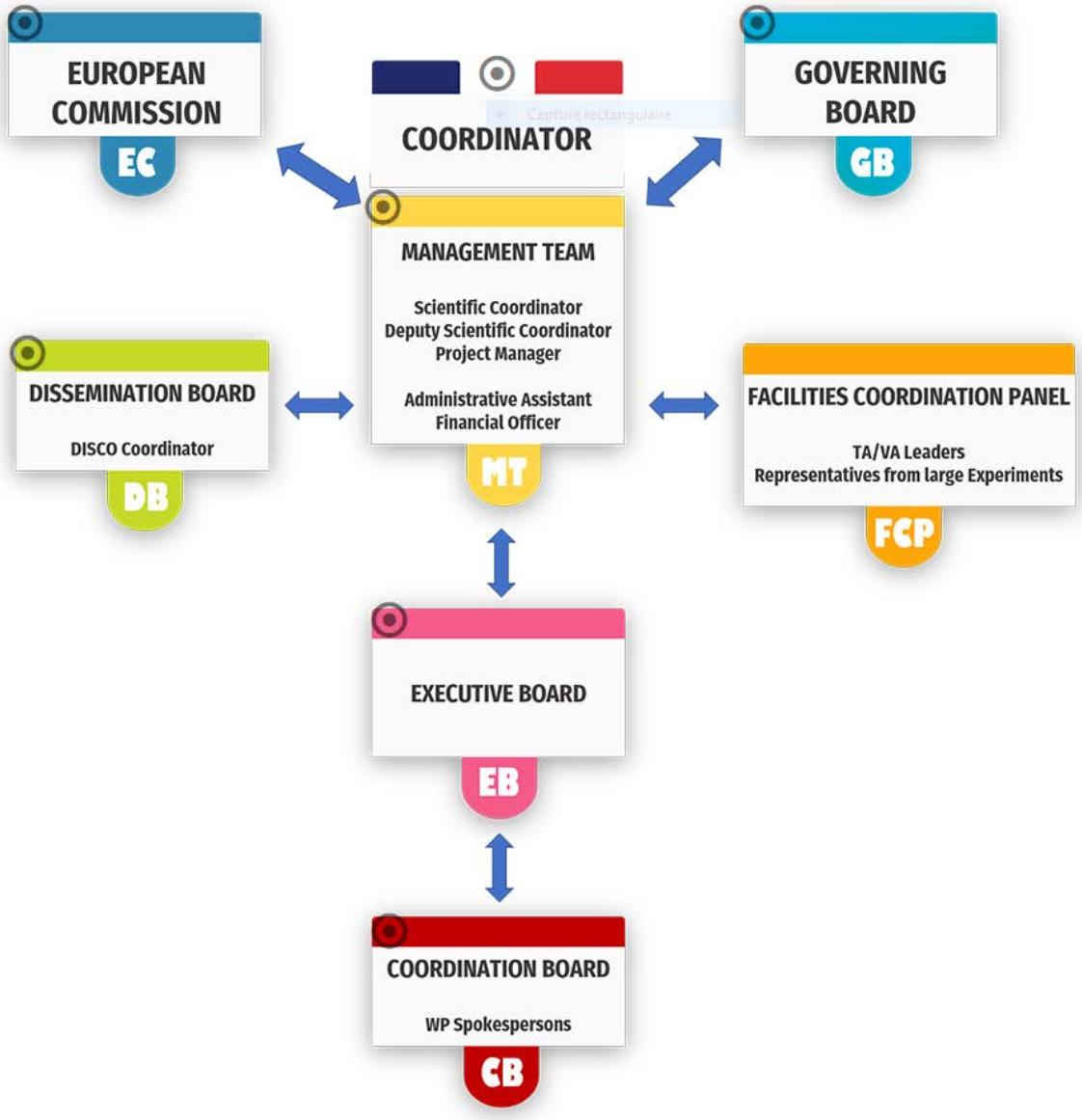
- MAN: Management and Coordination
- DISCO: Dissemination and Communication
- 7 Transnational Access Research Infrastructures (TA)
- 2 Virtual Infrastructures (VA)

Experimental /Theoretical /Instrumentation Activities:

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

Web site: http://www.strong-2020.eu/

Management structure



Management team

- Scientific Coordinator:
- Barbara ERAZMUS

- Deputy Scientific Coordinator:
- Carlo GUARALDO

- Project Manager:
- Emine AMETSHAEVA

Executive Board

- Barbara ERAZMUS
- Carlo GUARALDO
- Boris HIPPOLYTE
- Chiara LA TESSA
- Frank MAAS
- Franck SABATIÉ
- Carlos SALGADO
- Laura TOLOS

Governing Board

- Chairperson:
- Elena GONZALES FERREIRO

- The complete lists of members

Facility Coordination Panel

- Chaired by Scientific Coordinator

- Dieter GRZONKA
- Achim DENIG
- Catalina CURCEANU
- Hartmut SCHMIEDEN
- Yvonne LEIFELS
- Gert AARTS
- David D'ENTERRIA
- Jean-Philippe LANSBERG
- Hervé MOUTARDE

Objectives

The objectives are focused on

hadron, precision, heavy ion physics, partonic structure of hadrons and instrumentation

and organized around the following three pillars:

- low- and high-energy frontier studies
- instrumentation

The Consortium is committed to:

- federate leading experimental and theoretical groups within and outside Europe
- carry out new fundamental and applied research studies

at the frontier of our current knowledge of **the strong interaction**, the force that binds together quarks and gluons and, ultimately, forms the visible baryon matter of our universe

Research infrastructures:

Transnational Access

TA1-COSY Dieter Grzonka (Julich)

TA2-MAMI Achim Denig (Mainz)

TA3-LNF Catalina Curceanu/Carlo Guaraldo (INFN, Frascati)

TA4-FTD/ELSA Hartmut Schmieden (Bonn)

TA5-GSI Yvonne Leifels (GSI, Darmstadt)

TA6-ECT* Gert Aarts (Jochen Wambach) (Trento)

TA7-CERN David d'Enterria (CERN, Geneva)

Virtual Access:

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.

VA1-NLOAccess *Automated perturbative NLO calculations for heavy ions and quarkonia*

Jean-Philippe Lansberg (CNRS, Orsay) : *Extension of the well-known MadGraph automated on-line code for the novel computation of perturbative QCD cross sections in high-energy hadronic collisions at next-to-leading- order (NLO) accuracy, using meson and heavy-ion beams, and for quarkonia final-states.*

Web page: https://nloaccess.in2p3.fr/HO/

VA2-3DPartons *Virtual Access to 3DPartons*

Hervé Moutard (CEA, Saclay) : *Development of a new combined framework to extract generalized (GPDs) and transverse momentum-dependent (TMDs) parton distributions, with higher-order fixed and twist corrections, from fits to experimental e-p and p-p data (handled in a Rivet-like format).*

Web page: http://partons.cea.fr/partons/doc/html/index.html

Hadron Physics:

JRA7-HaSP *Light-and heavy-quark hadron spectroscopy*

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 to lattice QCD and effective-field-theory predictions.*

NA1-FAIRnet *QCD physics at GSI/FAIR*

Fritz-Herbert Heinsius (RUB, Bochum): *Multi-prong 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 *Strange Hadrons and the Equation-of-State of Compact Stars*

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.*

NA6-LatticeHadrons LatticeHadrons

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

Precision Physics:

NA4-PREN *Proton Radius European Network*

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.*

JRA3-PrecisionSM *Precision Tests of the Standard Model*

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.*

Heavy Ions:

JRA1-LHC-Combine *Inter-experiment combination of heavy-ion measurements at the LHC*

Raphaël Granier de Cassagnac (CNRS, Palaiseau) : *Combination of key LHC 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.*

JRA2-FTE@LHC *Fixed Target Experiments at the 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 *Quark-Gluon-Plasma characterisation with jet*

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 full heavy-ion MC event generator. Definition of observables and development of tools with increased sensitivity to physical mechanisms involved in jet-QGP interactions.*

NA7-Hf-QGP *Quark-Gluon Plasma characterisation with heavy flavour probes*

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 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.*

GPD/TMD/PDFs:

JRA4-TMD-neXt *3D structure of the nucleon in momentum space*

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.*

JRA5-GPD-ACT *Generalized Parton Distributions*

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.*

JRA6-Next-DIS *Challenges for next generation DIS facilities*

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 *Small-x Physics at the LHC and future DIS experiments*

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 to NLO accuracy with resummation corrections, for observables with three jets and with heavy-quarks.*

Instrumentation activities:

JRA8-ASTRA *Advanced ultra-fast solid STate detectors for high precision RAdiation spectroscopy*

Johann Zmeskal (OeAW, Vienna) : *Development of beyond state-of-art radiation detectors based on semiconductors (Cadmium Telluride, Cadmium Zinc Telluride) able to perform high-precision measurements of X-ray and gamma-ray photons in different environments/conditions.*

JRA9-TIIMM *Tracking and Ions Identifications with Minimal Material budget*

Eleuterio Spiriti (INFN, Frascati) : *Development of new silicon detectors based on Monolithic Active Pixel Sensors (MAPS) for high-precision tracking, and energy loss measurement for advanced particle identification.*

JRA10-CryPTA *Cryogenic Polarized Target Applications*

Hartmut Dutz (UBO, Bonn) : *Production of polarized nucleon targets (at the prototype level) using solid state materials combined with superconducting high-field magnets and the Dynamic Nuclear Polarization method.*

JRA11-CRYOJET *Cryogenically cooled particle streams from nano- to micrometer- size for internal targets at accelerators*

Alfons Khoukaz (WWU, Münster) : *Development of cryogenically-cooled cluster/pellet/microjet sources to be used as targets in a variety of collision setups.*

JRA12-SpinForFAIR *Spin for FAIR*

Paolo Lenisa (INFN, Frascati) : *Optimization of the polarization of protons and antiprotons beams and targets for the GSI/FAIR storage ring.*

JRA13-P3E *Polarized Electrons, Positrons and Polarimetry*

Eric Voutier (CNRS, Orsay) : *Optimization of high-intensity polarized electron and positron beam sources, and full design of the Hydro-Møller polarimeter detector using high-voltage monolithic active pixel sensors (HV-MAPS).*

JRA14-MPGD_HP *Micropattern Gaseous Detectors for Hadron Physics*

Bernhard Ketzer (UBO, Bonn), Fulvio Tessarotto (INFN, Frascati) : *Development (up to the prototype stage) of new gas detectors with improved capabilities in tracking, charged particle identification, photon detection, and timing in the picosecond region, capable of operating under very high beam intensity conditions.*

Annual Meeting 2022, 17 – 19 October

- Workshop on 17 October Recent results and perspectives in hadron physics

  (Institut Pascal, Université Paris-Saclay)

  invited experts and young scientists involved in STRONG-2020

- Plenary sessions on 18 and 19 October (CNRS Paris Michel Ange headquarters)

  presentations of the progress of Work Packages

  Information can be found on the indico page: https://indico.in2p3.fr/event/27767/

Workshop 2023

“Present and future perspectives in Hadron Physics”

- The Workshop will gather a broad Hadron Physics Community
  (including those outside the STRONG-2020 Consortium)
- We will ensure effective outreach of the event
  to attract experienced as well as young scientists in the field

Impact

The research in the field of the strong interaction addresses fundamental questions

- nature of confinement,
- origin of exotic hadronic states and
- properties of hot and dense nuclear matter.

Those studies will have a deep impact on the searches

- beyond the standard model
- in astrophysics and strongly coupled systems
- in particle and condensed matter physics

STRONG-2020 is leading a coherent effort of theoretical and experimental groups complemented with challenging high-technology developments in instrumentation and industrial applications.

On the STRONG-2020 webpage, one can find:

- Detailed description of WPs
- List of past and future events
- STRONG-2020 regular Newsletters
- Live events organized by Dissemination Board
- Link to STRONG-2020 YouTube channel (via News Documents - Dissemination channel)
- Pictures gallery of those who bring the project to life