

<https://europeanstrategyupdate.web.cern.ch/>



European Strategy for Particle Physics 2026

Strong Interactions WG

Andrea Dainese (INFN Padova)

European Strategy for Particle Physics 2026 - mandate

- In June 2024, the CERN Council established and approved the **remit of the European Strategy Group**:

”The aim of the Strategy update should be to develop a **visionary and concrete plan** that greatly advances human knowledge in fundamental physics through the **realisation of the next flagship project at CERN**. This plan should attract and value **international collaboration** and should **allow Europe to continue to play a leading role in the field.**”

- The Strategy update should include the **preferred option** for the next collider at CERN and **prioritized alternative options** to be pursued if the chosen preferred plan turns out not to be feasible or competitive.
- The Strategy update should also indicate **areas of priority for exploration complementary to colliders** and for other experiments to be considered **at CERN** and **at other laboratories in Europe**, as well as for participation **in projects outside Europe**.

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The Strategy and the HL-LHC HI programme:

- **“Full exploitation” of HL-LHC, including flavour physics and QGP study, recommended in the 2020 Update**
- **Crucial to show *progress, plans, and broad community support* towards a rich physics programme throughout the full lifetime of the HL-LHC facility**
 - Note: Strategy focuses on facilities and projects, not on running scenarios – which remain with scientific committees

European Strategy for Particle Physics 2026 - timeline



Physics Working Group on Strong Interactions

- **Strong Interactions, one of the nine working groups**
- **Tasks for working groups:**
 - reach out to community to encourage submission of inputs
 - analyse inputs received by 31 March
 - discuss comparison and complementarity of physics programmes
 - prepare parallel session of Symposium (presentations, discussion)
 - prepare contribution to “briefing book”
 - 2019 book: <https://cds.cern.ch/record/2691414/files/1910.11775.pdf>
- Strong Int - conveners: A.D., Cristinel Diaconu (Marseille), Chiara Signorile-Signorile (Munich)
- **Physics areas:**
 - Precision QCD
 - Inner structure of protons and nuclei
 - Hot and dense QCD
 - QCD in hadronic, nuclear and astro(particle)physics

Physics Working Group on Strong Interactions

- Precision QCD

- WG members: D. d'Enterria, S-O. Moch
- Physics: elementary processes, α_S , fragmentation, hadronization, photon-photon
- Machines: HL-LHC, FCC-ee, other lepton collider options

- Inner structure of protons and nuclei

- WG members: N. Armesto, A. Buckley
- Physics: PDFs and nuclear PDFs, gluon saturation, proton spin
- Machines: HL-LHC, EIC, LHeC/FCC-eh

- Hot and dense QCD

- WG members: R. Arnaldi, R. Snellings, U. Wiedemann
- Physics: Heavy ions, Quark-gluon plasma, Collectivity in QCD
- Machines: HL-LHC, SPS, FAIR, FCC-hh / ions

- QCD connections with hadron physics, nuclear physics and astro(particle)physics

- WG members: A. Gérardin, V. Mantovani Sarti, M. Pappagallo
- Physics: hadron spectroscopy and exotica, hadron-hadron strong interaction, QCD in cosmic-ray physics (incl. DM searches), QCD in neutron star cores, QCD in nuclear structure
- Machines; HL-LHC, SPS, FAIR

Physics benchmarks ([more details](#))

Note: this is not an exclusive list of the observables and measurements that the working group will cover. The list of benchmarks will be used to summarise and highlight the complementarity and strengths of the future measurements at existing (e.g. SPS, HL-LHC) and proposed colliders (leptonic, hadronic, electron–hadron).

• Precision QCD

- Strong coupling α_S and its Q^2 dependence.
- Strong interaction effects on top and W masses

• Inner structure of protons and nuclei

- Longitudinal and transverse proton PDF(x, Q^2);
- Longitudinal and transverse nuclear PDF(x, Q^2);

• Hot and dense QCD

- Heavy-flavour hadron production (rare states, kinematic coverage); QGP transport coefficients (heavy quarks, jets);
- QGP thermal radiation / temperature;

• QCD connections with hadronic, nuclear and astro(particle) physics

- Constraints on nature of exotic hadrons from spectroscopy and h-h correlations;
- Precision on anti-nuclei production and absorption relevant for cosmic-ray physics;

Hot and dense QCD: national and community inputs

- **Submission of inputs: <https://indico.cern.ch/event/1439855/>**
- **Important to have several inputs related to QCD and to heavy ions**
- **National inputs coordinated by FAs** should have QCD/HI at CERN as a prominent item
- **National inputs prepared by the heavy-ion communities** important as well (theory, multiple experiments)
- **Inputs on specific aspects of the programme**, especially with impact outside HI/QGP, enrich the physics standing of the future HI programme



Venice Open Symposium 23-27 June

<https://agenda.infn.it/event/44943/>

2026 UPDATE
OPEN SYMPOSIUM
European Strategy
for Particle Physics



23-27 JUNE 2025



Additional information

Physics Preparatory Group

PPG MEMBERS	
Strategy Secretariat	
Scientific Secretary (Chair)	Prof. Karl Jakobs (DE)
SPC Chair	Dr Hugh Montgomery (USA)
ECFA Chair	Prof. Pareskevas Sphicas (GR)
LDG Chair	Prof. Dave Newbold (UK)
SPC	
Prof. Pilar Hernandez (ES)	
Prof. Gino Isidori (CH)	
Prof. Fabio Maltoni (BE/IT)	
Prof. Jocelyn Monroe (UK)	
ECFA	
Dr Tommaso Boccali (IT)	
Dr Thomas Bergauer (AT)	
Dr Cristinel Diaconu (FR)	
Prof. Monica Dunford (DE)	
CERN	
Dr Gianluigi Arduini (CERN)	
ASIA/AMERICAS	
Dr Anadi Canepa (USA)	
Prof. Xinchou Lou (China)	
Prof. Rogerio Rosenfeld (Brazil)	
Prof. Yuji Yamazaki	

Working Group		
	Co-convener (PPG member)	Co-convener
Electroweak physics	Monica Dunford (DE, exp)	Jorge de Blas (ES, theory)
Strong interaction	Cristinel Diaconu (FR, exp)	Andrea Dainese (IT, exp, HI)
Flavour physics	Gino Isidori (CH, theory)	Marie-Hélène Schune (FR, exp)
BSM physics	Fabio Maltoni (BE/IT, theory)	Rebeca Gonzalez Suarez (SE, exp)
Neutrino physics and cosmic messengers	Pilar Hernandez (ES, theory)	Sara Bolognesi (FR, exp)
Dark matter and dark sector	Jocelyn Monroe (UK, exp)	Matthew McCullough (CERN, theory)
Accelerator science and technology	Gianluigi Arduini (CERN, acc)	Phil Burrows (UK, exp, acc)
Detector instrumentation	Thomas Bergauer (AT, exp)	Ulrich Husemann (DE, exp)
Computing	Tommaso Boccali (IT, exp, comp)	Borut Kersevan (SL, exp, comp)

2019 inputs on Strong Interaction

Category: Facilities and experiments with strong interactions as key topic

- (Id13) NA61++ (SPS)
- (Id42) PBC@CERN, COMPASS++, MUSE@PSI, MUonE, DIRAC++, NA61++
- (Id46) Heavy flavour in HI
- (Id47 and Id67 and Id110) LHC-FT: ALICE and LHCb (LHCSpin)
- (Id90) NA60+ (SPS)
- (Id110) ALICE upgrade for HL-LHC
- (Id135) QCD/HI at FCC-hh and FCC-eh
- (Id143) COMPASS++/AMBER (SPS)
- (Id152) QCD/HI at HL-LHC
- (Id159) LHeC/PERLE
- (Id160) QCD/HI at HE-LHC

Category: Synergies on a global scale

- (Id76) J-PARC
- (Id93) NICA
- (Id99) US-based EIC

Category: Facilities & experiments with strong interactions as a topic

- (Id13 and Id50) AWAKE
- (Id49) Super Charm-Tau Factory

Category: QCD results in support for other programs

- (Id117) Auger experiment
- (Id131) LBNF/DUNE
- (Id151) New physics with HI collisions

Category: QCD theory in support

- (Id100 and Id101) Precise calculations @ colliders
- (Id114) MC generators
- (Id163) QCD theory

Category: QCD and nuclear physics

- (Id39) ISOLDE/EPIC

Category: National roadmaps

- (Id21) INFN Hadron
- (Id37) Germany ALICE
- (Id56) INFN HI
- (Id115) Germany Hadron

Category: Individual and community thoughts

- (Id48) Town meeting on Heavy Ions
- (Id103) DIS
- (Id140) personal input
- (Id148) NuPECC