

**ORGANISATION EUROPÉENNE POUR LA RECHERCHE NUCLÉAIRE**  
**CERN** EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH

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Action to be taken

Voting Procedure

For information	<b>SCIENTIFIC POLICY COMMITTEE</b> 312 <sup>th</sup> Meeting <b>11-12 March 2019</b>	-
For information	<b>RESTRICTED COUNCIL</b> 192 <sup>nd</sup> Session <b>14 March 2019</b>	-

**Update of the European Strategy for Particle Physics**

**Updated Composition of the European Strategy Group**

The Council is invited to take note of the following changes in the composition of the European Strategy Group:

**Major European National Laboratories**

NIKHEF: Professor Sijbrand de Jong

**ESG invitees**

President of the CERN Council: Dr Ursula Bassler

**Organisations with Observer status**

JINR: Professor Boris Sharkov

**Other invitees**

Chair ApPEC: Professor Teresa Montaruli

Chair FALC: Professor Michael Procario

The ESG composition set out in document CERN/SPC/1115-CERN/3389 (annexed) is modified accordingly.



# Annex



**ORGANISATION EUROPÉENNE POUR LA RECHERCHE NUCLÉAIRE**  
**CERN** EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH

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<i>Action to be taken</i>		<i>Voting Procedure</i>
For recommendation	<b>SCIENTIFIC POLICY COMMITTEE</b> 310 <sup>th</sup> Meeting <b>24-25 September 2018</b>	-
For decision	<b>RESTRICTED COUNCIL ON EUROPEAN STRATEGY MATTERS</b> 190 <sup>th</sup> Session <b>28 September 2018</b>	Simple majority of Member States present and voting

**Update of the European Strategy for Particle Physics**

**Composition and establishment of  
the Physics Preparatory Group  
and  
the European Strategy Group**

The Council is invited:

- to appoint the members of the Physics Preparatory Group proposed by the CERN Scientific Policy Committee and the European Committee for Future Accelerators, set out in Sections II and III of this document respectively;
- approve the establishment of the Physics Preparatory Group on the basis of the composition set out in Section VI of this document;
- approve the establishment of the European Strategy Group on the basis of the composition set out in Section VII of this document.



## **Update of the European Strategy for Particle Physics**

### **Composition and establishment of the Physics Preparatory Group and the European Strategy Group**

#### **I. Background**

At its Restricted Session on 15 December 2016, the Council approved the time frame for the next update of the European Strategy for Particle Physics, defining May 2020 as the optimum date for the Council's approval of the updated Strategy, set out in document [CERN/SPC/1080/RA-CERN/3289/RA](#).

At its Restricted Session on 15 March 2018, the Council approved the detailed plan for the Strategy update process and an amendment to the composition of the Physics Preparatory Group (PPG), set out in document [CERN/SPC/1099/Rev.- CERN/3340/Rev](#). According to this plan, the Council should formally launch the Strategy update process through the establishment of the ESG and the PPG at its Session in September 2018.

As a result of this approval, the composition of the Physics Preparatory Group for the update of the European Strategy for Particle Physics scheduled to conclude in May 2020 is as follows:

- the Strategy Secretary (acting as Chair),
- four members appointed by the Council on the recommendation of the SPC,
- four members appointed by the Council on the recommendation of ECFA,
- the SPC Chair,
- the ECFA Chair,
- the Chair of the European Laboratory Directors' meeting,
- one representative appointed by CERN,
- two representatives from Asia appointed by the respective regional representatives in ICFA,
- two representatives from the Americas appointed by the respective regional representatives in ICFA.

According to Council's decision on the revised procedural framework for the European Strategy for Particle Physics ([CERN/3092/RA/Rev3](#)), the composition of the European Strategy Group (ESG) for the update scheduled to conclude in May 2020 is as follows:

#### **Members:**

- the Strategy Secretary (acting as Chair),
- one representative appointed by each CERN Member State,
- one representative appointed by each of the Laboratories participating in the major European Laboratory Directors' meeting, including its Chair,
- the CERN Director-General,
- the SPC Chair,
- the ECFA Chair.

Invitees (entitled to attend all open meetings of the ESG and to take the floor):

- the President of the CERN Council,
- one representative from each of the Associate Member States,
- one representative from each Observer State,
- one representative from the European Commission,
- one representative from JINR,
- the Chairs of ApPEC and NuPECC,
- the Chairs of FALC and ESFRI,
- the other members of the Physics Preparatory Group (in addition to the Strategy Secretariat).

## **II. Members of the PPG to be appointed by the Council on the recommendation of the CERN Scientific Policy Committee (SPC)**

At its meeting on 12 March 2018, the SPC decided that it would select members from within its own ranks, and then at its meeting on 7 May 2018, the Committee unanimously agreed to recommend that the Council should appoint the following SPC members as members of the PPG:

- Professor Caterina Biscari – ALBA, Spain; accelerator science,
- Professor Belen Gavela – University of Madrid (AOM), Spain; Beyond the Standard Model theory,
- Professor Beate Heinemann – DESY and Freiburg University, Germany; high-energy collider experiments,
- Professor Krzysztof Redlich – Wroclaw University, Poland; QCD (strong interaction) theory.

## **III. Members of the PPG to be appointed by the Council on the recommendation of the European Committee for Future Accelerators (ECFA)**

The ECFA chair, Professor J. D’Hondt, followed a procedure for the recommendation of ECFA members to the PPG that had been agreed by Restricted ECFA at its meeting in Bucharest on 24 March 2018. A call for nominations was thus issued to all members of Plenary ECFA, including candidates from ECFA non-Member States, and the deadline for replies, to be channelled through the ECFA country representatives, was set at 23 April 2018. Four of the nominees were then selected by the ECFA chair, in consultation with several members of Restricted ECFA and the SPC chair, with the aim of ensuring maximum diversity in terms of expertise, geography, gender and age.

ECFA thus recommends the following PPG members for appointment by the Council:

- Professor Stanislaus Bentvelsen – Nikhef, Netherlands; experimental particle and astroparticle physics,
- Professor Paraskevas Sphicas – University of Athens, Greece, and CERN; high-energy collider experiments,
- Dr Marco Zito – Saclay, France; experimental neutrino physics,
- Professor Antonio Zoccoli – INFN Bologna, Italy; experimental heavy flavour physics.



#### **IV. Members of the PPG from Asia and the Americas, appointed by the regional representatives on ICFA**

On 22 March 2018, the chair of ICFA, Professor G. Taylor was invited by the CERN Council President to appoint two regional representatives from the Americas and two from Asia. On 23 June 2018, after consultation with the members of ICFA, Professor Taylor conveyed to the President of Council the following names:

##### **Representing the Americas:**

- Professor Marcela Carena – University of Chicago and Fermilab, United States; dark matter and Beyond the Standard Model theory, and
- Professor Brigitte Vachon - McGill University; Canada; detector physics.

##### **Representing Asia:**

- Professor Xinchou Lou - Institute of High Energy Physics, China; heavy flavour physics and detectors, and
- Professor Shoji Asai - Tokyo University, Japan; experimental non-accelerator particle physics and high-energy colliders.

#### **V. Member of the PPG appointed by CERN**

On 1 June 2018, the CERN Director-General informed the Council President that, after consultation with her Enlarged Directorate, the member of the PPG appointed by CERN would be Dr Gian Giudice, Head of the CERN Theory department.

#### **VI. Full composition of the Physics Preparatory Group**

Following the nomination processes conducted in the various constituencies, and subject to Council's approval as requested in Section VIII below, the composition of the PPG would be as set out in the table below, in which 15 countries and CERN are represented by six women and eleven men, including twelve experimentalists and five theorists.

<b>PPG MEMBERS</b>		<b>Contact e-mails</b>
<b>Strategy Secretariat</b>		
Scientific Secretary (Chair)	Prof. Halina Abramowicz (IL)	<a href="mailto:Halina.Abramowicz@cern.ch">Halina.Abramowicz@cern.ch</a>
SPC Chair	Prof. Keith Ellis (UK)	<a href="mailto:keith.ellis@durham.ac.uk">keith.ellis@durham.ac.uk</a>
ECFA Chair	Prof. Jorgen D'Hondt (BE)	<a href="mailto:jorgen.dhondt@vub.be">jorgen.dhondt@vub.be</a>
Chair EU Lab. Directors' Mtg	Prof. Leonid Rivkin (CH)	<a href="mailto:leonid.rivkin@psi.ch">leonid.rivkin@psi.ch</a>
<b>SPC</b>		
Prof. Caterina Biscari (ES)		<a href="mailto:cbiscari@cells.es">cbiscari@cells.es</a>
Prof. Belen Gavela (ES)		<a href="mailto:belen.gavela@uam.es">belen.gavela@uam.es</a>
Prof. Beate Heinemann (DE)		<a href="mailto:Beate.Heinemann@cern.ch">Beate.Heinemann@cern.ch</a>
Prof. Krzysztof Redlich (PL)		<a href="mailto:redlich@ift.uni.wroc.pl">redlich@ift.uni.wroc.pl</a>
<b>ECFA</b>		
Prof. Stanislaus Bentvelsen (NL)		<a href="mailto:S.Bentvelsen@nikhef.nl">S. Bentvelsen@nikhef.nl</a>
Prof. Paraskevas Sphicas (GR)		<a href="mailto:Paraskevas.Sphicas@cern.ch">Paraskevas.Sphicas@cern.ch</a>
Dr Marco Zito (FR)		<a href="mailto:marco.zito@cea.fr">marco.zito@cea.fr</a>
Prof. Antonio Zoccoli (IT)		<a href="mailto:antonio.zoccoli@bo.infn.it">antonio.zoccoli@bo.infn.it</a>
<b>CERN</b>		
Dr Gian Giudice (CERN)		<a href="mailto:gian.giudice@cern.ch">gian.giudice@cern.ch</a>

<b>ASIA/AMERICAS</b>		
Prof. Marcela Carena (USA)		<a href="mailto:carena@fnal.gov">carena@fnal.gov</a>
Prof. Brigitte Vachon (Canada)		<a href="mailto:brigitte.vachon@mcgill.ca">brigitte.vachon@mcgill.ca</a>
Prof. Xinchou Lou (China)		<a href="mailto:xinchou@ihep.ac.cn">xinchou@ihep.ac.cn</a>
Prof. Shoji Asai (Japan)		<a href="mailto:shoji.asai@cern.ch">shoji.asai@cern.ch</a>

## VII. Composition and establishment of the ESG

Following the Council's approval of document [CERN/SPC/1099/Rev.- CERN/3340/Rev.](#) in March 2018, calls were sent to the CERN Member States, the Associate Member States, the States with special observer status and the Directors of the major European laboratories active in particle physics to appoint their respective members of/invitees to the European Strategy Group by the deadline of 31 August 2018. On the basis of the information received, the composition of the ESG is as shown in the following table.

ESG MEMBERS	NAME	
<i>Member States</i>		
Austria	Prof. Jochen Schieck	<a href="mailto:jochen.Schieck@cern.ch">jochen.Schieck@cern.ch</a>
Belgium	Prof. Dirk Ryckbosch	<a href="mailto:dirk.ryckbosch@ugent.be">dirk.ryckbosch@ugent.be</a>
Bulgaria	Prof. Leander Litov	<a href="mailto:leandar.litov@cern.ch">leandar.litov@cern.ch</a>
Czech Republic	Prof. Tomas Davidek	<a href="mailto:davidek@ipnp.troja.mff.cuni.cz">davidek@ipnp.troja.mff.cuni.cz</a>
Denmark	Prof. Jens-Jørgen Gaardhøje	<a href="mailto:gardhoje@nbi.dk">gardhoje@nbi.dk</a>
Finland	Prof. Paula Eerola	<a href="mailto:paula.eerola@helsinki.fi">paula.eerola@helsinki.fi</a>
France	Dr Reynald Pain	<a href="mailto:Reynald.Pain@in2p3.fr">Reynald.Pain@in2p3.fr</a>
Germany	Prof. Siegfried Bethke	<a href="mailto:Siggi.Bethke@cern.ch">Siggi.Bethke@cern.ch</a>
Greece	Prof. Costas Fountas	<a href="mailto:costas.fountas@cern.ch">costas.fountas@cern.ch</a>
Hungary	Prof. Peter Levai	<a href="mailto:levai.peter@wigner.mta.hu">levai.peter@wigner.mta.hu</a>
Israel	Prof. Eliezer Rabinovici	<a href="mailto:eliezer@mail.huji.ac.il">eliezer@mail.huji.ac.il</a>
Italy	Prof. Fabio Zwirner	<a href="mailto:fabio.zwirner@pd.infn.it">fabio.zwirner@pd.infn.it</a>
Netherlands	Prof. Eric Laenen	<a href="mailto:t45@nikhef.nl">t45@nikhef.nl</a>
Norway	Prof. Gerald Eigen	<a href="mailto:gerald.eigen@uib.no">gerald.eigen@uib.no</a>
Poland	Prof. Jan Królikowski	<a href="mailto:jan.krolikowski@fuw.edu.pl">jan.krolikowski@fuw.edu.pl</a>
Portugal	Prof. Gaspar Barreira	<a href="mailto:gaspar@lip.pt">gaspar@lip.pt</a>
Romania	Dr Alexandru-Mario Bragadireanu	<a href="mailto:mario.bragadireanu@nipne.ro">mario.bragadireanu@nipne.ro</a>
Slovakia	Prof. Stanislav Tokar	<a href="mailto:Stanislav.Tokar@cern.ch">Stanislav.Tokar@cern.ch</a>
Spain	Prof. Maria José Garcia Borge	<a href="mailto:Maria.Garcia.Borge@cern.ch">Maria.Garcia.Borge@cern.ch</a>
Sweden	Prof. Kerstin Jon-And	<a href="mailto:ker@fysik.su.se">ker@fysik.su.se</a>
Switzerland	Prof. Tatsuya Nakada	<a href="mailto:tatsuya.nakada@cern.ch">tatsuya.nakada@cern.ch</a>
United Kingdom	Prof. Jonathan Butterworth	<a href="mailto:j.butterworth@ucl.ac.uk">j.butterworth@ucl.ac.uk</a>
CERN Director-General	Dr Fabiola Gianotti	<a href="mailto:fabiola.gianotti@cern.ch">fabiola.gianotti@cern.ch</a>
<i>Major European National Labs</i>		
CIEMAT	Dr Nicanor Colino	<a href="mailto:Nicanor.Colino@cern.ch">Nicanor.Colino@cern.ch</a>
DESY	Prof. Joachim Mnich	<a href="mailto:joachim.mnich@desy.de">joachim.mnich@desy.de</a>
IRFU	Prof. Anne-Isabelle Etievre	<a href="mailto:Anne-Isabelle.Etievre@cea.fr">Anne-Isabelle.Etievre@cea.fr</a>
LAL	Prof. Achille Stocchi	<a href="mailto:stocchi@lal.in2p3.fr">stocchi@lal.in2p3.fr</a>
<b>NIKHEF</b>	<b>Prof. Sijbrand de Jong</b>	<a href="mailto:sijbrand@hef.ru.nl">sijbrand@hef.ru.nl</a>
LNF	Dr Pierluigi Campana	<a href="mailto:pierluigi.campana@lnf.infn.it">pierluigi.campana@lnf.infn.it</a>

LNGS	Prof. Stefano Ragazzi	<a href="mailto:stefano.ragazzi@lngs.infn.it">stefano.ragazzi@lngs.infn.it</a>
PSI	Prof. Klaus Kirch	<a href="mailto:klaus.kirch@psi.ch">klaus.kirch@psi.ch</a>
STFC-RAL	Prof. Mark Thomson	<a href="mailto:mark.thomson@stfc.ac.uk">mark.thomson@stfc.ac.uk</a>
<b>Strategy Secretariat Members</b>		
Scientific Secretary (ESG Chair)	Prof. Halina Abramowicz	<a href="mailto:Halina.Abramowicz@cern.ch">Halina.Abramowicz@cern.ch</a>
SPC Chair	Prof. Keith Ellis	<a href="mailto:keith.ellis@durham.ac.uk">keith.ellis@durham.ac.uk</a>
ECFA Chair	Prof. Jorgen D'Hondt	<a href="mailto:jorgen.dhondt@vub.be">jorgen.dhondt@vub.be</a>
Chair EU Lab. Directors' Mtg	Prof. Leonid Rivkin	<a href="mailto:leonid.rivkin@psi.ch">leonid.rivkin@psi.ch</a>

ESG INVITEES	NAME	
President of the CERN Council	<b>Dr Ursula Bassler</b>	<a href="mailto:ursula.bassler@cern.ch">ursula.bassler@cern.ch</a>
<b>Associate Member States in the pre-stage to Membership</b>		
Cyprus	Prof. Panos Razis	<a href="mailto:razis@ucy.ac.cy">razis@ucy.ac.cy</a>
Serbia	Prof. Peter Adžić	<a href="mailto:Peter.Adzic@cern.ch">Peter.Adzic@cern.ch</a>
Slovenia	Prof. Boštjan Golob	<a href="mailto:bostjan.golob@ijs.si">bostjan.golob@ijs.si</a>
<b>Associate Member States</b>		
Lithuania	tbc	
Turkey	Mr Alper Yüksel	<a href="mailto:alper.yuksel@taek.gov.tr">alper.yuksel@taek.gov.tr</a>
Ukraine	Dr Maxim Titov	<a href="mailto:maxim.titov@cea.fr">maxim.titov@cea.fr</a>
<b>States with special Observer status (LHC)</b>		
Japan	Prof. Yasuhiro Okada	<a href="mailto:yasuhiro.okada@kek.jp">yasuhiro.okada@kek.jp</a>
Russian Federation	Prof. Vladimir Kekelidze	<a href="mailto:Vladimir.Kekelidze@cern.ch">Vladimir.Kekelidze@cern.ch</a>
United States of America	Dr Abid Patwa	<a href="mailto:abid.patwa@science.doe.gov">abid.patwa@science.doe.gov</a>
<b>Organisations with Observer status</b>		
European Commission	tbc	
<b>JINR</b>	<b>Prof. Boris Sharkov</b>	<a href="mailto:sharkov@jinr.ru">sharkov@jinr.ru</a>
<b>Other invitees</b>		
<b>Chair ApPEC</b>	<b>Prof. Teresa Montaruli</b>	<a href="mailto:Teresa.Montaruli@unige.ch">Teresa.Montaruli@unige.ch</a>
Chair ESFRI	Prof. Giorgio Rossi	<a href="mailto:giorgio.rossi2@unimi.it">giorgio.rossi2@unimi.it</a>
<b>Chair FALC</b>	<b>Prof. Michael Procario</b>	<a href="mailto:michael.procario@science.doe.gov">michael.procario@science.doe.gov</a>
Chair NuPECC	Prof. Marek Lewitowicz	<a href="mailto:lewitowicz@ganil.fr">lewitowicz@ganil.fr</a>
Other members of the PPG (in addition to the Strategy Secretariat)	(see table, Section VI above)	

**VIII. Proposal**

The Council is invited:

- to appoint the members of the Physics Preparatory Group proposed by the CERN Scientific Policy Committee and the European Committee for Future Accelerators, set out in Sections II and III of this document respectively;
- approve the establishment of the Physics Preparatory Group on the basis of the composition set out in Section VI of this document;
- approve the establishment of the European Strategy Group on the basis of the composition set out in Section VII of this document.

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## ANNEX

### Short CVs of the proposed Physics Preparatory Group members

Caterina Biscari (ALBA/ES) is an experimental physicist recognised for her significant contributions to the design, construction and operation of particle accelerators. She is also an Associate Professor at the *Universidad Autónoma de Barcelona*. Since 2012, she has been Director of ALBA-CELLS, the 3rd-generation synchrotron radiation facility in Barcelona, Spain. She has made key contributions to projects such as the electron-positron collider DAFNE at LNF, the future linear collider test facility CTF3 at CERN, and the hadron-therapy facility CNAO at Pavia.

Belen Gavela Legazpi (Madrid/ES) is a professor of Theoretical Physics at *Universidad Autonoma de Madrid* and a member of the *Instituto de Fisica Teorica, Consejo Superior de Investigaciones Científicas*. Her research interests include axion-like particles, beyond-the-Standard Model Higgs physics, neutrino physics, lepton flavour violation, CP violation, flavour physics and lattice gauge theory.

Beate Heinemann (DESY/DE) is a leading scientist at DESY and a professor for experimental particle physics at the *Albert-Ludwigs-Universität Freiburg*. She was previously a professor at the University of California, Berkeley (US). She has worked on the H1 experiment at DESY and on the CDF experiment at Fermilab (US), and since 2007 has been a member of the ATLAS collaboration at the LHC at CERN. She recently completed two-terms as Deputy Spokesperson of ATLAS.

Krzysztof Redlich (Wroclaw/PL), now a professor of theoretical physics at the University of Wroclaw, has previously held positions at Bielefeld, GSI Darmstadt and CERN. His interests include heavy-ion collisions and phenomenology, lattice gauge theory, effective field theory and thermal field theory.

Stanislaus Bentvelsen – (Nikhef/NL) is a professor at the Institute of Physics at the University of Amsterdam and presently director of Nikhef. He participated in the ZEUS experiment (PhD), in OPAL (as a CERN fellow/staff scientist), and led the Nikhef group in the ATLAS collaboration. He is a member of several astroparticle physics committees and has a wide physics overview, with a particular affinity for education and outreach.

Paraskevas Sphicas – (Athens/GR and CERN) is a CERN staff physicist and professor at the University of Athens. He was previously professor at MIT (US). He participated in the UA1 and CDF experiments and is today a member of the CMS collaboration, where he has served as physics coordinator, publication committee chair, deputy spokesperson among other leadership responsibilities, in particular in detector-related activities. He has a broad overview of physics and instrumentation and has recently focussed more especially on searches for supersymmetry.

Marco Zito – (Saclay/FR) is a staff physicist at IRFU-CEA. He was previously involved in the BaBar experiment and is presently working on neutrino physics through participation in the T2K, HyperK, DUNE, WA105 (Long Baseline demo for double-phase Liquid Argon TPC and MIND detectors) experiments. He gave a plenary talk on neutrino physics at the Open Symposium prior to the 2013 update of the European Strategy for Particle Physics.

Antonio Zoccoli – (INFN Bologna/IT) is professor at the University of Bologna, the Vice-President of INFN and a member of the Board of Directors of the Gran Sasso Science Institute. He participated in the LEAR physics programme and in the HERA-B experiment and is presently a member of the ATLAS collaboration (leader of the Bologna team). He has experience with non-mainstream experiments at CERN and elsewhere and, as Vice-President of INFN, a broad overview of the field.

Gian Giudice – (CERN) is a CERN staff scientist and Head of the CERN Theory department. He has previously held positions at INFN, the University of Texas, Austin, and at Fermilab (US). His area of interest is the formulation of new theories beyond the Standard Model, a field in which he has contributed seminal ideas.

Marcela Carena – (Chicago and Fermilab/US) is professor at the University of Chicago and Distinguished Scientist at Fermilab, where she is the Head of the Theoretical Physics division. She is a Humboldt Research Award recipient and a fellow of the APS and the AAAS. She is currently Past-Chair of the APS division of Particles and Fields. An expert in Higgs physics and co-author of the Higgs boson review of the particle data group, she has done seminal work on model extensions of the Standard Model.

Brigitte Vachon – (McGill/CA) is an associate professor at the McGill University. She is a member of the IUPAP C11 Commission and chairs the Canadian funding agency review committee for subatomic physics. She was a member of the Scientific Council of the Institute of Particle Physics of Canada and of the US Department of Energy (DOE) Comparative Reviews for High-Energy Physics. Her expertise lies in complex trigger systems, detectors and readout electronics. She has contributed to three generations of particle collider experiments, OPAL, D0, and ATLAS.

Xinchou Lou – (IHEP/CN) is the Director of the Experimental Physics Division of the Institute of High-Energy Physics in Beijing, responsible for the ATLAS, CMS and CEPC programmes. He is a Distinguished Research Fellow of the Chinese Academy of Science, project director of the CEPC Study Group and deputy chair of the BESIII Institutional Board. He was professor at University of Texas (Austin) before moving to Beijing. He was a member of the CLEO, MKII, OPAL, BES and BaBar experiments. His expertise lies in heavy flavour physics, Higgs and beyond-the-Standard Model searches as well as in detectors and computing.

Shoji Asai – (Tokyo/JP) is professor at Tokyo University and Director of the International Centre for Particle Physics (ICEPP). He chairs the committee on the Scientific case for the ILC as a Higgs Factory, is a member of the FCC steering committee and was a member of the European Strategy Group in the previous update process. His area of expertise is non-accelerator physics (laser, positronium, XFEL). He was also a member of the OPAL experiment and is presently involved in the ATLAS experiment, in SUSY and Higgs physics and computing.