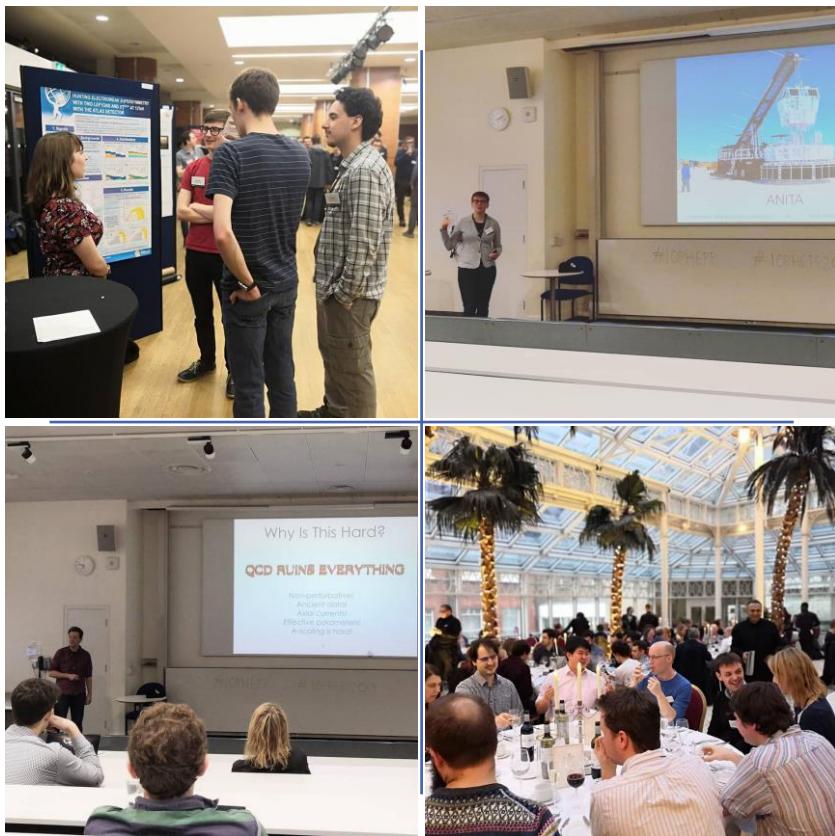


*Happy New Year from the IOP
HEPP committee!*



Follow us!

- Facebook:** [lopHepp, www.facebook.com/IOPHEPP/](https://www.facebook.com/IOPHEPP/)
- Twitter:** [@IOP_HEPP, www.twitter.com/IOP_HEPP](https://www.twitter.com/IOP_HEPP)
- Instagram:** [iop_hepp, www.instagram.com/iop_hepp](https://www.instagram.com/iop_hepp)
- Website:** <http://hepp.iop.org>

Inside this issue

Annual meeting announcement

Report from our chairperson

- Dr. Franz Muheim

IOP prize winners

- Prof. R. Keith Ellis
- Prof. Ian Shipsey
- Prof. Cristina Lazzeroni

IOP HEPP group prize winners

- Dr. Rebecca Chislett
- Will Yeadon

This Year's IOP Half Day Workshops

Early career researchers fund

Student and Junior Researcher Conference Funds

Messages from the committee

Meet the Committee

IOP Institute of Physics

Joint APP, HEPP and NP Conference

6–9 April 2020, University of Edinburgh, UK

The joint meeting of the IOP
**Astroparticle Physics,
High Energy Particle Physics,
and Nuclear Physics groups**

University of Edinburgh
6th – 9th April 2020



<http://appheppnp2020.iopconfs.org/home>

Abstract submission deadline

24th January 2020

Early registration deadline

16th February 2020

Registration deadline

26th March 2020

Report from our chairman

Prof. Franz Muheim, University of Edinburgh

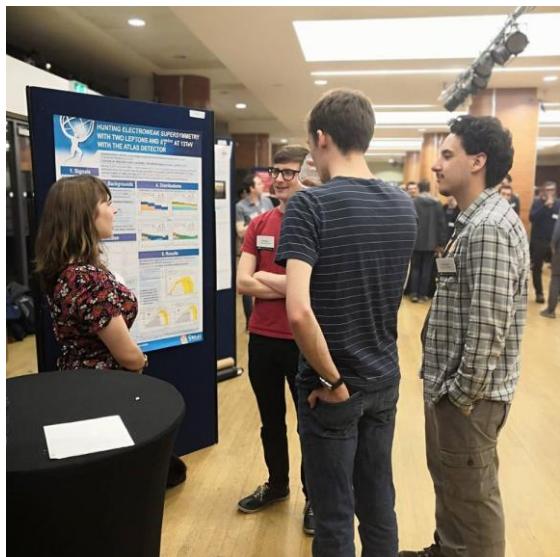
I would like to welcome you to this year's newsletter. A lot has happened in 2019 for the IOP HEPP group. As is usual people are arriving and leaving. During 2019 Sinead Farrington and Agni Bethani both stepped down from the committee: Sinead after many years of service, including being joint secretary and treasurer and Agni, who is leaving the UK, after being very active for the IOP HEPP Social Media pages. They both made significant contributions to the committee and I would like to express my thanks for their excellent work on behalf of the community. Let me add my best wishes to Sinead and Agni on their future. Thankfully I can still rely on Sinead's experience, if required, as her new office is just across from mine.

In the second week of April the annual meeting of the IOP HEPP and Astroparticle Physics (APP) groups took place at Imperial College London. The event was very successful with many excellent plenary and parallel talks, all nicely located in the Huxley building. The conference dinner took place in the Millennium Gloucester hotel. We also held the STFC town meeting on the Tuesday afternoon. I am now looking forward to the second week of April 2020 where there will be a joint meeting of the IOP APP, HEPP and Nuclear Physics (NP) groups which will be held at Edinburgh. This meeting will last four days and I hope to see all of you there.

I would like to congratulate the prize-winners who were presented at the annual HEPP meeting at Imperial College. Rebecca Chislett of University College London was awarded the HEPP group prize for her leadership in data analysis and in muon experiments, and Will Yeadon of the University of Sheffield for winning the IOP HEPP prize for the best poster. At the IOP HEPP meeting, Elena Pian of INAF Bologna was presented with the 2018 Giuseppe Occhialini Award by the IOP and the Italian Physical Society.



A full house at the Joint APP and HEPP conference plenary sessions



PhD students present their work at the Joint APP and HEPP conference poster session

Three members of the HEPP community have been honoured with IOP prizes in 2019. These were celebrated at a ceremony in London on 19th November. Keith Ellis of Durham University was awarded the Paul Dirac Medal and Prize for his seminal work in quantum chromodynamics (QCD) where he performed many of the key calculations that led to the acceptance of QCD as the correct theory of the strong interaction. Ian Shipsey of the University of Oxford was awarded the James Chadwick

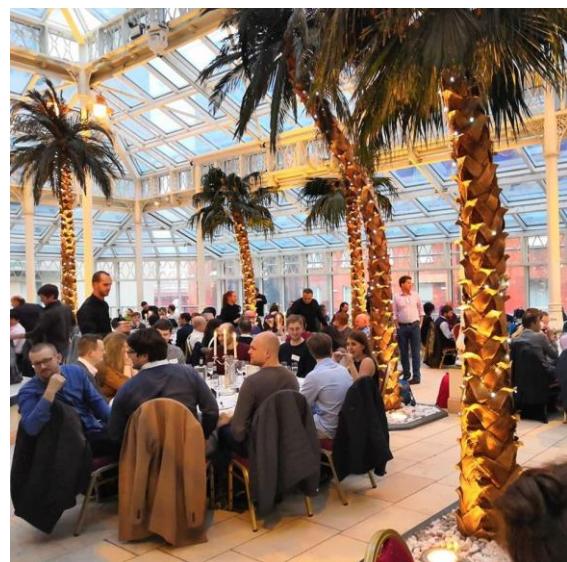
Medal and Prize for his elucidation of the physics of heavy quarks, the development of the enabling instrumentation, and leadership of scientific collaborations. Cristina Lazzeroni of the University of Birmingham was awarded the Lise Meitner Medal and Prize for her exceptional innovation and leadership in making contemporary particle physics accessible to a large and diverse audience. I would like to add my personal congratulations to Keith, Ian and Cristina on their well-deserved prizes. Please also note that calls for nominations for next year's prizes are now open and I encourage you to nominate your colleagues.

I am very pleased to tell you that the HEPP group has a very active programme of half-day meetings. Very recently the budgets for 2020 have been announced and it has been increased again from last year. Hence I hope that the community will increase the number of requests for support for half-day meetings. In particular it would be great to have more meetings in the first half of the year to avoid a rush at the end of the year. Please contact Melissa Uchida in the first instance.

Looking forward I am very pleased to tell you that the HEPP group has been awarded a significantly larger amount of funds for 2020 thus recognizing our increasing activity over the last few years. Hence I hope the community will respond by organising half-day meetings and asking for our support. Please contact Melissa in the first instance. In addition we will continue to be able to support international conferences held in the UK. I would also like to remind students and early-career physicists that the IOP offers funding for travel to international conferences. These requests are undersubscribed, thus it is very likely your request will be

successful. For clarification, we cannot fund travel to collaboration meetings. I also hope that by now you have had an opportunity to attend a meeting at the new IOP building at Kings Cross.

I would like to thank my colleagues on the committee for their work, in particular the officers, Trevor Vickey as an efficient secretary and to Melissa Uchida for continuing to coordinate the applications for IOP half-day meeting support as well as being treasurer of the group. The IOP HEPP group also has a social media presence. Thanks to Agni Bethani we are active on facebook <https://www.facebook.com/IOPHEPP/> and you can follow us on twitter: https://twitter.com/IOP_HEPP. Chris Parkinson of the University of Birmingham has edited this newsletter, and I would like to thank him for his excellent work. To continue to be successful the IOP HEPP group is relying on the support of all committee members. Let me give a very warm welcome to the newly elected IOP HEPP committee member Kostas Nikolopoulos of the University of Birmingham. While there is a good mix of committee members from PhD students and early career physicists to junior and senior academics, there will be a call for a theoretical PhD student member as well as an ordinary member to replace Agni. Please contact me if you are interested.



A view of the Joint APP and HEPP conference dinner at the Millennium Gloucester Hotel

IOP prize winners

Prof. R. Keith Ellis (University of Durham, IPPP)

For his seminal work in quantum chromodynamics (QCD) where he performed many of the key calculations that led to the acceptance of QCD as the correct theory of the strong interaction

Prof. Keith Ellis is a leading authority on perturbative Quantum Chromodynamics (QCD) and collider phenomenology. He has made numerous seminal contributions to QCD, which include the development of theoretical techniques that led to the first quantitatively reliable predictions of the Drell-Yan production of lepton pairs. Ellis and

collaborators showed how to regulate divergences associated with soft and collinear parton emission using dimensional regularization, and thus established the method for calculating all higher radiative corrections to hard processes in QCD.

Later, Ellis and collaborators showed that radiative corrections to the Drell-Yan process were large, and thereby provided a good description of contemporary experimental data. When the W and Z bosons were discovered, his calculations were vital to properly describe the total W and Z production cross sections, as well as the transverse momentum and rapidity distributions of the bosons within the QCD improved parton model. His work computing radiative corrections to event shapes in electron-positron annihilation, and to the production of heavy quarks in proton-(anti)proton collisions, were essential for the analysis of the properties of gluons and the discovery of the top quark.



[Professor R. Keith Ellis](#)

[Prof. Ian Shipsey \(University of Oxford\)](#)

For his elucidation of the physics of heavy quarks, the development of the enabling instrumentation, and leadership of scientific collaborations

Prof. Ian Shipsey is renowned for the elucidation of the physics of beauty and charm quarks. Highlights of his work include the most precise measurements of four of the nine CKM elements, the discovery of B_s production at the Y(5S) resonance, and percent-level tests of Lattice QCD calculations of decay constants and form factors. Prof. Shipsey constructed key CLEO instrumentation including the muon detector, and took a leading role in the design and fabrication of the CLEO-III silicon vertex detector. He was elected as the co-spokesperson of the CLEO/CLEO-c experiment three times.



[Professor Ian Shipsey](#)

As the CMS *quarkonia* convenor he made the first LHC Upsilon cross-section measurement, observed Upsilon suppression in heavy-ion collisions (a smoking-gun signature of quark-gluon plasma), and led one of

two CMS teams that observed the very-rare $B_S \rightarrow \mu^+ \mu^-$ decay. He took a leading role in the production of the Forward-Pixel detector, a key CMS instrument used to discover the Higgs boson. He was co-coordinator of the LHC Physics Center in Fermilab, became CMS Collaboration Board Chair in 2013, and was Chairperson of the APS Division of Particles and Fields in 2011-2014. He joined ATLAS in 2016. With his students and post docs he works in Higgs physics and is a member of the HL-LHC ATLAS tracker (ITk) pixel group.

Outside of collider physics, Prof. Shipsey has been part of the Large Synoptic Survey Telescope camera team since 2008, and twice elected a member of the Board of Directors of the Large Synoptic Survey Telescope Corporation (2009-12 & 2017-2021). He is a member of the Mu3e experiment CMOS HVMAPS tracker team and the PI of the Quantum Sensors for Fundamental Physics Consortium in the UK.

Prof. Cristina Lazzeroni (University of Birmingham)

For her exceptional innovation and leadership in making contemporary particle physics accessible to a large and diverse audience

Professor Cristina Lazzeroni is an enthusiastic and innovative science communicator, bringing the excitement of cutting-edge particle physics to a broad audience. She organises a wide range of events designed to stimulate interactions between researchers and the public, with an emphasis on one-to-one discussion and hands-on activities.

She has been involved in public engagement since 2004, and has contributed to staging six exhibits at the Royal Society Summer Science Exhibition, acting as lead or co-lead five times. She has also participated in the British Science Festival, The Big Bang Fair, the BBC's Bang Goes the Theory Live, Grantham's Gravity Fields Festival, and the science festivals of Brighton, Cheltenham and Manchester. Other activities include teacher masterclasses, research projects for secondary schools and adventure sessions for primary schools. She reaches audiences of around 30,000 each year.

Cristina Lazzeroni's inclusive approach, engaging manner, tireless work and infectious enthusiasm allow her to collaborate successfully with a



Professor Cristina Lazzeroni

range of individuals and organisations. She has undertaken projects involving all nineteen UK groups for experimental particle physics, and has led more than 200 early-career researchers on their first steps in public engagement. In the framework of the international HiSPARC initiative, she involves secondary schools – including ones in disadvantaged inner-city areas in the West Midlands – in a research network investigating cosmic-ray showers.

Aside from her work in public engagement, Cristina Lazzeroni is spokesperson for the CERN experiment NA62, which looks for new physics in ultra-rare kaon decays.

IOP HEPP group prize winners

Dr. Rebecca Chislett (University College London) winner of the HEPP group prize

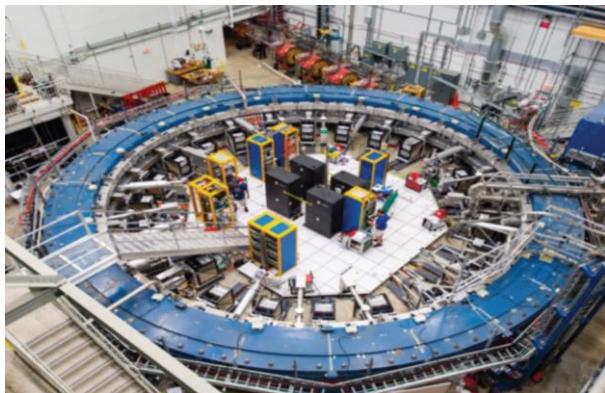
Muon experiments in particle physics search for the new physics required to explain the known weaknesses in the Standard Model by making high precision measurements using high intensity, as an alternative to the LHC experiments which push on the energy frontier. These are made possible due to the availability of intense muons beams, for example at the new muon complex at Fermilab where the muon g-2 experiment and Mu2e experiments are based.

The muon g-2 experiment aims to measure the anomalous magnetic moment to a precision of 140 parts per billion (ppb). Dirac predicted the value to be exactly equal to zero, however higher order loop corrections result in it being non-zero. New physics models can also enter these loops meaning that it is also sensitive to as yet unknown particles, as demonstrated in the rich history of such measurements. It is a quantity of interest because it can be theoretically predicted to a high precision and as such the measurement is a stringent test of the Standard Model. The result is highly anticipated in the field because the previous measurement made at Brookhaven at a precision of 540ppb lies 3.7σ away from the theoretical prediction, a discrepancy which has existed for close to two decades. Providing the same central value is measured, the new



Rebecca Chislett, winner of the HEPP group prize 2019

measurement is sufficient to establish the presence of physics beyond the Standard Model at 7σ .

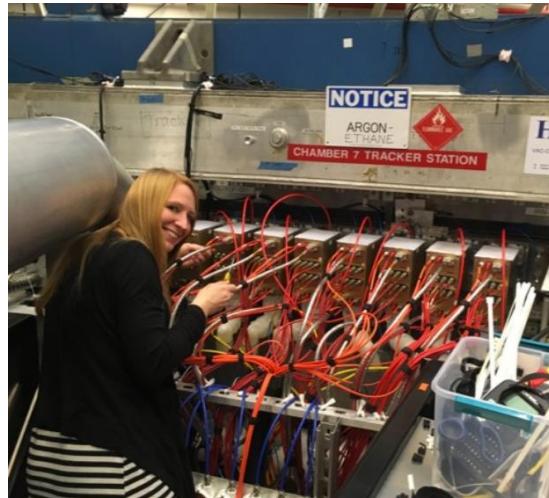


The g-2 experiment at Fermilab. Muons enter through the red quadrupoles at the top, and are held in the blue storage ring until they decay into positrons, which are detected by the 24 calorimeters around the centre of the ring.

using the calorimeters in the centre of the ring. By counting the number of high energy positron hitting the calorimeter faces as a function of time the spin precession frequency can be determined. When this is combined with a highly precise measurement of the magnetic field that the muons experienced in the storage ring the anomalous magnetic moment can be calculated.

The experiment can also be used to look for a potential muon Electric Dipole Moment (EDM), analogous to the magnetic dipole moment, but predicted to be effectively zero in the Standard Model. Any observation of an EDM would therefore be evidence for new physics. The EDM is also a CP violating quantity so would provide an extra source of CP-violation which is something that is required to help explain the abundance of matter over anti-matter in the observable universe. An EDM would

The measurement is made by injecting a beam of polarised muons into a storage ring. The anomalous part of the magnetic moment causes the spin vector to precess around the momentum vector. The kinematics of the muon decay mean that the highest energy positrons are released preferentially in the direction of the muon spin. These positrons curl inwards and are measured



Dr. Chislett installing tracking detectors, which were built at Liverpool, into the ring. The trackers are used to measure the beam distribution to help understand key systematics, as well as to look for a potential muon EDM.

introduce an additional oscillation of the spin vector, but in the vertical rather than horizontal plane. The new tracking detectors that were provided for the experiment by the UK allow for the measurement of the

oscillation in the vertical decay angle of positrons, enabling the limit on a muon EDM to be reduced by 2 orders of magnitude.

The muon g-2 experiment at Fermilab has currently just started its third year of data taking and is expected to take at least one more year of data following this one. The first result, based on the data taken in the first run, is expected to be published early next year with an uncertainty similar to that of the Brookhaven experiment. Subsequent results will improve upon this to reach the final goal of a four-fold improvement on the current world's best measurement. This is sufficient to resolve whether the long-standing discrepancy with the Standard Model really is a sign of new physics.

-- *R. Chislett*

Will Yeadon (University of Sheffield) winner of the HEPP group poster prize

The ATLAS inner tracking detector at CERN is nearing the end of its service life, accumulated radiation damage and component wear necessitates elements undergo replacement. Technological advancements have allowed this replacement to serve as an upgrade – facilitating investigations into higher centre of mass energy levels probing for new physics. Working at the core of the proposed upgraded ATLAS detector is the inner tracker (ITk), the replacement for the Semi-Conductor Tracking Detector (SCT). The ITk will be an all-silicon semiconductor tracking system comprising a barrel part and two end-caps, each of which will comprise a pixel detector close to the beam-line and a strip detector further out.

To remove the heat load from the detector electronics, the ITk strip detector stave design has an embedded titanium cooling circuit within its carbon fibre structure. The cooling circuit, constructed from 2.275mm outer-diameter ultra-thin walled titanium tubes, uses the CO₂ cooling system from the main ATLAS cooling plant. Titanium was chosen due to the requirements of low mass, high strength, low



Will Yeadon presents his award-winning poster at the Joint APP and HEPP conference 2019

radiation length and high reliability in a service life of 20+ years with limited maintenance access. Using this specification of titanium presented challenges for the welding required in the production of the cooling circuits for the ITk strip barrel and forward pixel end-caps.

This year at the Joint HEPP and APP conference in London, I presented the current progress in research and development into cooling circuit welding and joint production. My poster detailed the welding process and the process optimization methodology used to ensure high-quality joints. The IOP conference provided me with a great opportunity to attend talks from a variety of areas in HEPP and APP research. This was particularly interesting for me as my research is heavily hardware focused and I have relatively limited exposure to large parts of HEPP and APP research.

-- W. Yeadon

This year's IOP Half-Day Workshops

The IOP HEPP committee has funding available for half-day meetings on any topic of interest to the HEP community in the UK. We have had many interesting and fruitful meetings on topics including Higgs Physics, LHC extensions, Neutrinoless Double Beta Decay: Status and Prospects, The future of Long Baseline Neutrino Oscillation Experiments, Dark Matter, Neutrino Interaction Physics, Gravitational Waves, Exotic hadrons spectroscopy, Exotic phenomena in neutrino physics and many more.

You can apply for up to £500 to fund speakers travel, coffee and lunch if funding allows (attendees travel could also be funded from this but the maximum award is £500 total). To apply simply email the organiser Melissa Uchida at mauchida@hep.phy.cam.ac.uk and write in your email: title, venue, organisers, date (can be tentative) and give a short abstract explaining the topic, remit and benefit of the meeting.

(Re)interpreting the results of new physics searches at the LHC (Imperial College London)

N. Wardle, G. Watt, and others

The 4th workshop of the LHC Re-interpretation workshop was held at Imperial College London on the 2nd - 4th of April. The workshop consisted of presentations by a number of invited speakers covering topics from data preservation challenges and developments from the LHC experiments, to the latest interpretations of LHC data placing constraints on potential physics beyond the Standard Model. There was plenty of lively discussion between the experimental and theoretical physicists and

a collaborative report on best practices and the current status of re-interpretations is being produced as a result. Over 50 participants, from the UK, Europe and the US, took part in the workshop, including several who were connected remotely via video conferencing.

The presentations are available at the web page for the meeting:

<https://indico.cern.ch/event/795041/>

UK-QFT VIII (King's College London)

J. Alexandre, P. Millington, and D. Seynaeve

On the 28th November 2019, the eighth UK-QFT meeting was held at King's College London. These meetings provide a unique opportunity to bring together researchers from the UK communities (and overseas), who are working at the forefronts of quantum field theory and quantum gravity research across high-energy physics, cosmology and astroparticle physics. We welcomed over 30 participants from 10 institutions, including postgraduate students, early career researchers and senior members of the community. The contributed talks covered a broad range of exciting topics, including perturbative quantum gravity, field-space covariance and geometry, constraints on the inflationary field content, real-time path-integral methods, integrable models, spontaneous breaking of scale invariance, quantum fields as sensors for fundamental physics, (2+1)-dimensional quantum field theories and magnetic monopoles. With the IOP HEPP Group's generous support, we were able to provide refreshments and lunch, helping to provide a friendly and interactive environment for all of the attendees.

The presentations are available at the web page for the meeting:

<https://indico.cern.ch/event/850806/>

Research student conference fund

The Institute of Physics provides financial support to research students to attend international meetings and major national meetings.

Eligibility: Research Student Conference Fund (RSCF) bursaries are available to PhD students who are a member of the Institute and of an appropriate Institute group. For example, if an applicant is a member of the Women in Physics Group only then they could only seek support to attend a conference related to women in physics and not to low temperature physics. To be eligible for that meeting, the applicant would also need to be a member of the Low Temperature Group.

More details can be found at:

http://www.iop.org/about/grants/research_student/page_38808.html

Early-career researchers fund for HEPP group members

The Institute of Physics provides financial support to early career researchers to attend international meetings and visit international facilities.

Eligibility: For the purpose of this fund, an early career researcher is defined as an individual within three years of beginning their first paid contract of employment in industry or academia, either full-time or part-time, where research and/or the application of physics is the primary function of their role. This excludes any career breaks.

Early career researchers may apply for up to £300.

More details can be found at:

http://www.iop.org/about/grants/early-career/page_67022.html

Messages from the committee

This year the HEPP group committee has welcomed Professor Kostas Nikolopoulos as a new member, while we are sad to see Agni Bethani and Sinead Farrington leaving. On leaving, Agni sent us the following message.

Agni Bethani (leaving)

Over the last 3 years I had the pleasure to be part of the IOP HEPP committee. As an “academic nomad”, I will continue my physics journey in Belgium. I will miss the sense of community. But my favourite thing was how little by little we improve, evolve and adapt to the ever-changing needs of HEPP. It has been an incredible experience working with the wonderful team of the IOP committee. I would like to thank you all for that. Keep up the good work, I hope we will get to work together again in the future.

Meet your committee



Franz Muheim (Edinburgh): Chairperson



Trevor Vickey (Sheffield):
Honorary secretary



Sinead Farrington (Edinburgh)



Mrinal Dasgupta (Manchester)



Agni Bethani (Manchester)



Jarek Nowak (Lancaster)



Chris Parkinson (Birmingham)



Andy Buckley (Glasgow)



Melissa Uchida (Cambridge): Treasurer,
Half days & PAB group cross-member



Baptiste Ravina (Sheffield):
experimental student representative



Christoph Englert (Glasgow)



Teppei Katori (King's College London):
APP cross member



Kostas Nikolopoulos (Birmingham)

We also have ex-officio/cross members to link with other IOP and STFC groups:

Claire Shepherd-Themistocleous (STFC,
co-opted as chair of PPAP)

Elizabeth Cunningham
(STFC, co-opted as head of particle physics
outreach)

Disclaimer: views expressed herein are not necessarily those of the Institute of Physics, nor are they indicative of any current or future policy of the Institute.