



REPORT
from
12th IPPOG meeting
CERN, 10-12 November 2016

(by Barbora Bruant Gulejova)

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GUESTS:

Angelos Alexopoulos (CERN), Arturo Sanchez Pineda (INFN), Beatrice Zuaro (INFN), Rita Bertelli (INFN), Sergei Gleyzer (University of Florida), Toru Iijima (Nagoya University/ Belle II), Zdenek Dolezal (Charles University / Belle II)

WEBPAGE

<https://indico.cern.ch/event/573645/>

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1. GENERAL IPPOG ISSUES

1.1. WORD from CERN MANAGEMENT

Presented by Charlotte Warakaulle, Ana Godinho

Charlotte Warakaulle, IR sector director: Warm welcome, follow-up of the discussion in Krakow about [partnership of CERN and IPPOG](#). “IPPOG is an important partner and multiplier of CERN.” All what she said in Krakow is still valid. Last months only reconfirmed that! Four points of synergies mentioned in Krakow are:

- 1) IPPOG represents a key platform for engaging on a global level, building partnerships within the community and across communities, and for supporting the broader scientific objectives of particle physics;
- 2) IPPOG represents a platform for information - sharing and for strategic discussions on how to strengthen support for particle physics and fundamental science more broadly;
- 3) IPPOG can serve as a testing ground for new methods of working, enabling sharing of lessons and good practice;
- 4) IPPOG brings opportunities to engage with countries that would not otherwise be closely involved with CERN.

At the end Charlotte highlighted very good and very well received presentation in June CERN council done by IPPOG chair Hans Peter Beck and thanked to scientific secretary Barbora Gulejova for the great job she is doing for IPPOG.

Ana Godinho, Head of ECO group: ECO group - key interface for IPPOG from CERN. “We will be working together through ECO group, ECO group is at your disposal here at CERN”.

- In ECO there are 2 very different ways of thinking about outreach (but with many similarities): 1) ‘slow, think and prepare’ & 2) ‘react quickly’.
- ECO finds way how to work together. Diversity in people is an asset.
- Ana wants the important information from CERN to be communicated, like teacher programs, new international program weeks in summer, other new projects (student summer camp...).
- Restructuring of CERN E&O websites - to bring resources together also from experiments.
- Close collaboration with experiments, also for the visits (as CERN is not able to accommodate all people wanting to visit)
- EPPCN&IPPOG: many synergies, even if different remits, raising awareness and impact of the outreach.

TO DO/Suggestions: Concrete way of communication between IPPOG and EPPCN would be like that of Interactions with EPPCN, though sharing Press releases...

- **Question:** Are IPPOGers or others interested allowed to go to EPPCN meetings? **Reply:** Not sure, we need to discuss...
- **Suggestion from IPPOG:** IPPOG would like to profit from EPPCN, so that they communicate also IPPOG to the headlines.

Question: Is also EPPCN going to change to IPPCN like EPOG did to IPPOG, or like Interactions which are also more open? **Reply:** EPPCN is formally established by CERN council, but the point is timely and well taken.

1.2. IPPOG NEWS

Presented by Hans Peter Beck

“IPPOG an umbrella for making outreach global”

Chair H-P Beck started by a joke that journal “Nature” might have pre-invented IPPOG, as in its first issue it states as the objective “to place before the general public the grand results of scientific work

and scientific discovery; and to urge the claims of science to move to a more general recognition in education and in daily life...”

Current members of IPPOG: (at the time of the meeting) come from the 22 member states of CERN, Australia, Ireland, Slovenia, South Africa, the USA, and from DESY, CERN and five of the major experiments at the Large Hadron Collider (LHC).

Growing IPPOG membership: New countries, laboratories, experiments engaged in all fields of particle physics are welcome to strengthen IPPOG further.

- New member in 2016: Slovenia was voted in as 27th country in IPPOG, represented by Andrej Gorisek from Jožef Stefan Institute in Ljubljana, providing a framework also including Universities of Ljubljana, Nova Gorica and Maribor.
 - Contacts and interest expressed firmly: Belle II Collaboration - Toru Iijima from Nagoya and Zdenek Dolezal from Prague were both present at the meeting
- TO DO:** Toru engaged to bring good news from Belle II
- Discussions ongoing: Physics Society of Brazil (official invitation letter will be sent after this meeting); few more informal discussions / interests at early stages...

IPPOG activities and news:

- International Masterclasses: The flagship activity of IPPOG - trained over 13'000 students and 1'100 teachers in Spring 2016! 213 institutions in 46 countries participating. Analysis of LHC data has been recently enriched by those from IceCube.
- Competition “Beam line for schools” - IPPOG acts as local contacts to schools in many countries; IPPOG members take responsibilities for multiple countries removing the language barriers
- IPPOG participating at Int. Day of Women and Girls in Science (11 February)- IPPOG Masterclasses for girls only on Feb 11 – female tutors and moderators.
- IPPOG at Conferences: Education & Outreach becoming an integral part in international HEP conferences, here IPPOG is an active player and driver. In 2016 IPPOG participated at more than 4 international conferences, including organising E&O sessions – see more in the [newsletter No 3](#).
- Expanding to Astroparticle physics – discussions and pilot tests: Although, historically, there is a strong bias towards LHC physics, IPPOG is embracing all particle physics activities. [IceCube Masterclass](#); [Auger Masterclass](#); [International Muon Week by Quarknet](#); [International Cosmic Day](#)

IPPOG Collaboration:

- Professionalizing IPPOG: thanks to the help from a dedicated scientific secretary Barbora Gulejova (newsletter twice a year, Memorandum of Understanding, well defined IPPOG structure and tasks, IPPOG Working groups, with action items)
- IPPOG MoU:
 - Massive consultations and discussions with stakeholders in and outside IPPOG past few years
 - After an initial proto-MoU was established, CERN Legal Service took over to give it its final form.
 - This was discussed and agreed at the IPPOG meeting in Krakow
 - MOU circulating between IPPOG members for being signed
 - Proposal and discussion later at this meeting (about contributions and membership fees)
- Effort, Needs & Support:
 - Support** (FTEs, use of infrastructure, in-kind, ad-hoc,...) from CERN, Fermilab, EPS HEPP High-Energy and Particle Physics Division of the European Physical Society, TU Dresden, US National Science Foundation and the US Department of Energy.
 - Manpower:** Masterclasses Coordination: Uta Bilow (Dresden) funded by CERN, before: Helmholtz Alliance: Physics at the Terascale 2008 -2012; Ken Cecire (Notre Dame) funded by Quarknet for US based Masterclasses

IPPOG Coordination: Barbora Gulejova (CERN) IPPOG Scientific Secretary, ½ Fellow

 - **A lot of voluntary effort:** provided by IPPOG members and local teams at universities
 - **As for today nothing is sustained!** (here comes the role of MoU!)

1.3. IPPOG COLLABORATION – MOU

Presented by Hans Peter Beck

Important points from MoU: MoU will entry into force after 10 signatures, the signatories will be members, those who didn't sign, will become candidates (for 2 years). With the MoU entering into force, everything will continue the way how it used to be except of monetary issues. The main goal is to achieve the sustainable funding (in line with the recommendations of the European Strategy 2013). Aim of the official IPPOG Collaboration based on MoU is also to distribute the load over all members.

Budget and contributions:

- Collaboration Board must agree on Budget. Proposed that the Coordination Team would become an executive board for the small daily basis expenditures.
- Different contributions are expected from countries, labs and experiments.
- Voluntary support being heavily received today should go the official **In-Kind contribution** to make it recognised. The procedure should be decided and applied for this recognition.
- However not everything should be In-Kind, otherwise IPPOG will loose flexibility to work.
- Advisory group on Budget and Fees (Hans Peter, Marge, Steve, Barbora, Charles, Jonivar, Pedro, Michael, Thomas, Pete) formed since meeting in Krakow is working on the Budget, Fees and general terms of contribution to IPPOG.

Countries: We expect to have around 25000 euros from **monetary membership fees** of first 10 members. Decision about monetary membership fees for countries (1000, 3000 or 5000 euros) is proposed to be made based on GDP and size of the particle physics community of the countries (while the minimum of two results would be applied). Detailed proposal to be seen in [H-P's slide n.12](#). Also the possibility of progressive fees (1000, 2000, 3000, 4000 and 5000) have been proposed. There was also proposal to allow for zero contribution in order to let also poor countries to enter IPPOG, however not on long term and treated as the exceptions. Moreover it should be compensated by In-Kind contribution discussed and agreed by Collaboration Board.

Complicated examples: USA: DPF has budget only 25000 dollars what is huge gap from GDP (Marge) => this is not the right place to look for the money and it must be organised differently; Brasil: Also big GDP, but small PP community, what suggest probably mainly In-Kind contribution...

Laboratories: In-Kind and monetary contribution should be discussed separately and set-out in the Addenda. For example, the discussion with CERN (Rolf Landua) started, we have template for Addenda and proposal of In-Kind contribution from CERN (1/2 FTE for scientific secretary, Website management (Drupal based), Team account administration, Logistics support for meetings at CERN).

Experiments: They are source of expertise, manpower – what provides good In-Kind contribution. However, given that IPPOGers from countries are also part of experiments, there is an issue of possible double counting of the efforts. Example is Farid, who works for ATLAS, but his works is not counted by ATLAS, but University of Oslo. This kind of important efforts should be rewarded – recognition could be mentioned in the Addenda setting out the general contribution of the Experiments.

TO DO: Discussions will continue within Advisory group on Budget and Fees – prepare the Adenda seting out the contributions of IPPOG members, countries, Laboratories and Experiments. These will be shared with CB members, discussed and voted in during the Spring IPPOG meeting.

TO DO: The representatives/delegates from countries who didn't obtain the commitment of signature of IPPOG MOU or didnt identify the signatory yet should continue the discussions.

1.4. IPPOG INTERNAL AFFAIRS

1.4.1. Election of new IPPOG chairperson(s)

Convened by *Dave Barney and Pedro Abreu*

4 candidates presented their views and plans: Hans Peter Beck, Marge Bardeen, Steven Goldfarb and Nicolas Arnaud. IPPOG representatives elected team of co-chairs: **Hans Peter Beck and Steve Goldfarb for the terms of office of the next 3 years**. Congratulations and many thanks to **Marge** for her great work and contribution to IPPOG in the role of co-chair in the past 4 years (3+1)

1.4.2. Spring IPPOG meeting venue

Presented by *Natascha Hoermann and Pedro Abreu*

Two proposed venues: Vienna and Lisbon, different proposed dates.

Decision: Lisbon 20-22 April 2017

1.5. NEWS on IPPOG WEBSITE

Presented by *Barbora Bruant Gulejova*

[IPPOG website today](#) is not bad, BUT we need new and there are 2 distinct issues to work on:

- 1) Webdesign & Structure
- 2) IPPOG resource database

IPPOG RESOURCE DATABASE

Today we have 44 learning topics, 41 item types/categories, 6 filtering/search categories with too many options... Need of curation clearly understood and agreed!

New structure/categories and layout of DB:

- proposed by Barbora, based on discussions of WG on DB in 2014 (Marge, Pete, Ken and Achintya) and WG on IPPOG website in Spring 2015 (Marge, Achintya, Pete, Ivan, Jonas, Marzena, Jacek, Jonivar, Ana and Barbora) and consultation with Rolf Landua and Hans Peter, and agreed in the informal discussion in Nov 2015 (Barbora, Hans Peter, Marge, Pete, Ken):

• **Curated categories:**

Topics from 44 to 17, Item types/categories from 41 to 9, Filtering / search from 6 to 4

Topics:

- 1) **Matter, particles and universe (known physics):** Particles and their interactions, Cosmology, Higgs, Antimatter, Quark-Gluon plasma, Neutrinos
- 2) **Exploring the unknown (Beyond known physics):** SUSY, Dark matter, Dark energy, Extra dimensions
- 3) **Technologies and Experiments:** Accelerators, Detectors
- 4) **Particle physics and society:** Why fundamental research, International Collaboration, Applications and spin-offs, People behind the science

Item types/categories: Photos / Posters / Charts, Videos, Animations / Simulations, Presentations (ppt,pdf), Games, Classroom materials / Tutorials / Lesson plans / Text books, Books, Projects / Competitions, Exhibition items, Souvenirs (could go also to separate item on the website)

Filtering/search by: 1) **Topic** (see above = 17), 2) **Type/Category** (see above =9), 3) **Language** (Arabic, Catalan, Chinese, Czech, Danish, Dutch, English, Finnish, French, German, Greek, Hungarian, Italian, Japanese, Norwegian, Polish, Portuguese, Romanian, Russian, Serbian, Slovak, Slovenian,

Spanish, Swedish, Turkish), 4) **Audience** (Primary school level, Lower secondary school level, Upper secondary school level, Broad public, Educators), 5) **Keyword** (we should think first carefully how to address keywords, if we can manage to be coherent or not...otherwise could be confusing, like CDS)

- **How to search in the BD:** one can search by the filter on the left, but also use the quick search by topics in the middle, while at every moment there is a possibility to refine the search by the filter on the left, which will always appear there. There will be 4 big pictures for 4 main topics in the middle; after click you get to pictures of subtopics and then to concrete items - each item will have info about topic, audience, type and language; including information about all overlapping categories.

Right sidebar: Latest, Featured, Tweets & Facebook, Events calendar...

- **Evaluation:** would be done by visitors of the website and users of the resources

TO DO: Curation of the existing resources!!!! Only to choose which of the resources in the current DB will be transferred to the new IPPOG website and assign them tags (topic, type, audience, language, keyword). Curation group needed, volunteers IPPOGers...?

IPPOG WEBSITE WEBDESIGN & STRUCTURE

Our website must be:

- 1) **Sustainable** – webdesign in DRUPAL (open source web content management system) at CERN with CERN theme (and not a theme from external company, unless for graphic design)
Existing IPPOG website is done in DRUPAL, but impossible to change (as the theme is from external company, where DRUPAL web content management is not much used but a lot is simply programmed).

Why CERN DRUPAL theme?

- The way to have a sustainable webpage with modules etc. continuously updated and supported by ENTICE group at CERN (current website uses many outdated and not supported modules)
- There are brand new good looking CERN themes in pipeline
- Using the CERN theme ensures that it looks good at all devices
- CERN IT Drupal (ENTICE group) support of IPPOG website is an In-Kind contributions from CERN

- 2) **Well - organised** – easy to navigate – STRUCTURE

Main menu bar: Home, Members, Resources, Masterclasses, Cosmic Rays, National resources, Publications, ...

Sidebar: New DB resources, Events calendar (Masterclasses 2017, Beamlines for Schools, Exhibition Arts@CMS, ...), Upcoming conferences, Newsletter, Social media (Twitter, Facebook)

- 3) **Appealing** – GRAPHICS

Panel discussion website design in Fall 2016 (Steve, Marge, Michael, Marzena, Kate) concluded, that there is adequate experience and clear idea how to go forward in IPPOG.

TO DO: Inspiration from other websites: today's trends are appealing pictures and colours! We need especially professional graphical materials to feed the website....Who from IPPOG could help?

TO DO/ Recommended path forward: to create small executive committee to steer development, secure the resources (in IPPOG budget) for the new web/graphic design (work closely with CERN Drupal experts) - Barbora and Steve

TO DO: Shorten existing ippog.web.cern.ch to ippog.org (Barbora + Steve), the only drawback is that while the anonymous users will access the site as ippog.org and transparently continue browsing the website under this domain, CERN authenticated users will always be redirected to ippog.web.cern.ch.

2. IPPOG STORIES / IMPACT

2.1. AN INSIDE VIEW FROM IPPOG

2.1.1. Advantages of DESY's membership in IPPOG

Presented by Thomas Naumann

"IPPOG is a training ground"

IPPOG and DESY mutual benefits:

1) MoU signed by DESY - including 5000 euros contribution for Germany

2) Regular discussion and information exchange

Example: Planetarium show by Michael Barnett, ATLAS

- 4000x4000 full-dome version; German version co-financed by DESY
- German premiere in October at the opening of the exhibition 'Of Galaxies, Quarks and Collisions' Museum of Natural History in Vienna
- proposed to the newly opened Grand Planetarium in Berlin

3) Propose, test and implement outreach ideas + strategies

4) Share lessons learned and best practices between countries, institutions, experiments

Lengthy discussions at IPPOG help to learn and train IPPOGers how to react with general public and ministers.

Example: Physics and the Media – Journalist vs Scientist animation (idea of Achintya Rao)

Example: Higgs - What now?

- Higgs discovery is not the end of an era, but beginning of a New Era: We enter a new Scalar World! Are there more Higgses? Why is there Something instead of Nothing? Cosmic connections - the Dark Universe: Primordial Big Bang inflation driven by scalar field; Today's inflation driven by scalar field: Dark Energy, cosmological constant (Nobel 2011); Higgs: scalar field; Dark Matter - is this SUSY?; World(s) born from chaos - of fluctuations of scalar field?
- Many discussions in IPPOG and messages taken by H-P to ICHEP, ICNFP, ...; messages taken by Thomas to DESY, German RECFA evaluation, ...

Example: Precision counts - idea of H-P Beck, reused by IPPOG members

Analogy of precision and limitation of the Standard Model (W, Z, t, Higgs) with Flat Earth model, which is ok for construction of house, but beyond a certain fraction f of the Earth diameter, its surface is more than a fraction f below the horizon – analogy with Higgs coupling precision. The same applies to the physics Beyond Standard Model – SUSY, Extra-dimensions, GUT (Grand Unified Theory)...

5) IPPOG member's cooperation leads to the common publications – papers, conferences

- Article in Science Open Research, "Science and the Media" from Thomas Naumann;
- Article and conference contribution at Int. conference 'Physics, Technology, Ethics', September 2016, Žilina, Slovakia, "Some ethical questions from Particle Physics" by H-P Beck, Ivan Melo, Thomas Naumann.
- Eurovision conference, Berlin, 30.10.2015, session „The Challenges of Covering Science News“ with CERN + ESA, DESY representative Thomas Naumann tells "The Higgs Story - Science and the Media" – based upon discussions in IPPOG, he is ready to stand up at the public event

6) Events organisation and dissemination

- International Cosmic Day - coordinated since 2012 by ~ 1 FTE at DESY (Zeuthen) - possible in-kind contribution of DESY to IPPOG
- International IceCube + Auger Masterclasses – DESY Zeuthen active in these
- Beamline for schools competition – inspiration – German BL4S at DESY under discussion

2.1.2. How Portugal benefits from membership in IPPOG

Presented by Pedro Abreu

Pedro could speak of thousands of benefits that Portugal is getting from membership in IPPOG, but by chance he has chosen this one example: **“How to bring the spark chamber to the library in Alexandria and few other places”**.

- At Autumn EPPOG meeting at CERN in 2004, the Spark Chamber of Nikhef has been presented and agreed to provide all construction drawings and details.
- In 2005-2006 workshop at LIP Coimbra preparing to build their first Spark Chamber, which was commissioned for the public session of the 20th European Cosmic Rays Symposium in Lisbon (Sept. 2006) – very successful, offering custom made Cosmic Rays certificates.
- Reported at the Autumn EPPOG meeting in 2006 as a result of 1 year of tests/rebuilds/more tests/redesigns/etc. + part of a Master Thesis.
- Afterwards the Spark Chamber production was launched. Redesign, change of gas to He (instead of Ne + He mixture) in order to save huge operating costs.
- Spark chamber being displayed and shown in public events and in international meetings, the number of requests/orders started to come on a “regular” basis (Ciência Viva Agency, Auger observatory visitor centre, University of Madrid, etc.).
- In 2014 CERN placed order to deliver Spark Chamber to library in Alexandria, Egypt and other places.
- Now the LIP Spark Chamber is present in (11 working +3 in production) Portugal(3+2), Argentina, Austria(2), Brazil (RJ), Egypt, Italy, Spain, Slovenia (+1), Sweden. Requests are from ESA (NL), São Paulo (Brazil) and Peru.

This is one of the many, many benefits which Portugal gets from IPPOG. Another big one is 2000 students participating yearly from Portugal at MC.

All members share what Thomas Naumann said about benefits of DESY (see presentation above).

2.2. INSPIRING SUCCESS STORIES

2.2.1. CREDO – Citizen’s science project

Presented by *Krzysztof Wieslaw Wozniak*

Cosmic-Ray Extremely Distributed Observatory (CREDO)- real science project open to everyone.

Motivation: Dark matter (DM) is a puzzle. One can search for dark matter indirectly by UHECR (ultra-high energy cosmic rays). According to the 2 component flavour-mixed DM model, there are 2 components of Dark Matter which interact and produce big showers, starting far away, and these of course would cover large areas. Several types of showers are expected. If pre-showers are produced very far ~ 1000 km from Earth (for comparison atmosphere is around 100km), they can change in something what would cover the whole Earth – signals distribution over large areas. Standard method of cosmic rays detection uses clusters of signals, which are close geometrically and in time, thus selecting relatively small and dense showers. However, DM induced pre-showers have low density of particles, signals are spread geometrically and are ordered in time. Detection of events with such signature never tried in cosmic rays experiments!

Aim of project:

- exploring uncharted areas of potential new physics (possibly find a desert or a new land or exclude some models) by collecting information from all possible sources, like smartphones, small cosmic rays detectors, different CR experiments, LHC ...
- involvement of volunteers in data analysis and sharing of data is highly desired.

Partners: There is already an interest and support in several communities: ATLAS, Auger, Hispark, DUBNA, CRAYFIS, DECO, Magic Telescopes, Baikal GVD...

2.2.2. Data-based PP projects and courses

Presented by *Farid Ould-Saada*

Motivation: Even high-school students participating at MC, could work with data, do some plots, use statistical tools... Before MC data were limited, data were missing to do a good statistics, but now we have enough data to do real experiments (open data portal).

Project: starting soon in Norway, similar to MC on Z-path, but go beyond with new concepts added - advanced projects: graviton and SUSY/dark matter. After having studied a set of event displays (example of ATLAS data available for MC), more data were made available by experiments (CERN open data portal). Detailed project description is available to students with their tasks. Using HYPATIA, etc., they download data and start more complicated analysis - like this students really get some plots, which resemble to the result of the real CERN analysis.

3 projects:

- 1) What do 4 - lepton final states tell us about the Standard Model and the Higgs boson?
- 2) Do new fundamental forces or extra dimensions show up at the LHC the way the Z and Higgs bosons did?
- 3) Is the world supersymmetric and/or where is Dark Matter?

Comment: Extremely ambitious, more for even for university students

Recommendation/TO DO: Extend this to develop educational materials

2.2.3. CMS CREATE 2016

Presented by *Barbora Bruant Gulejova*

Barbora participated in one of the competing teams at the 2nd edition of the [CMS Create](#) event in October 2016 at CERN's Ideasquare (dedicated test facility at CERN that hosts detector R&D projects, and facilitates MS student programs).

- 2-day workshop in which teams compete to create a prototype for a public exhibit to explain elements of CMS to the public.
- **Goal:** Design an interactive exhibit for the general public illustrating what CMS does and how it does it. The winning exhibit is inserted on the visit circuit of CMS at Point 5 (underground control room) and should be suited for the general public and children in particular.
- 4 diverse teams of 6 people - 4 CERN members (e.g. CMS physicist, software engineer, hardware engineer, outreach person/guide) and 2 students from IPAC School of Design, Geneva (e.g. graphist, architect). Each team will have 33 hours to complete the challenge with guidance from design professionals and technical experts. Steps: Conceptual design, Prototyping, Presentation.
- **Ambition of the CMS CREATE organisers:** "Maximise team diversity in order to enhance the creative process"

Inspiration for IPPOG: This type of activity could be done wherever also by high school or even younger students. The aspect of multidisciplinary teams is very inclusive – reaching also to students who don't feel comfortable with physics or engineering, but study management, arts, architecture, etc. Reaching to new audiences!

2.2.4. Playing with protons

Presented by *Angelos Alexopoulos*

Rolf Heuer "In these times of crises we need to have teachers interested in science so that they can motivate young people".

Project: Pilot Continuing Professional Development Course for Primary School Teachers from Greece. CMS with CREATIONS and other partners organised this 5-day program for Greek primary school teachers in Ideasquare at CERN – hands-on experiments, special workshops, seminars, visits.

Aims and expectations: teachers will get familiar with unique culture of cutting-edge science, technology and innovation at CERN, get inspired and motivated to share their newly acquired knowledge and experience with pupils and peers, design learning activities, especially hands-on experiments in the classroom, customized to pupils' needs, develop educational methodologies and resources to enhance the standard curriculum. Goal is also to create sustainable impact by building collaboration and participation among educators and pupils, especially in remote and underprivileged areas; developing a digital platform for sharing ideas, advice and resources; creating a network of science ambassadors who will act as leaders and role models in their local communities – the teachers!
Selection process: Greek ministry of education send out the call to specific state primary schools, 151 applications received, 70% female teachers.

Message to IPPOG: They would like to use the IPPOG network of teachers and IPPOGers are invited to participate in selection process.

2.2.5. Analysis of ATLAS open data with HYPATIA in Athens University

Presented by Christine Kourkoumelis

Project: University students' lab using the HYPATIA tool: 60 students majoring in HEP take the lab each year. Since 2015 introduced the "batch" analysis using ATLAS open data - implementation to the 3rd year physics students labs was done in University of Athens on the winter 2015 semester. There are 2 versions of HYPATIA, 1) Batch online mode, which runs on every browser, 2) IMC HYPATIA. The idea is to use the Batch process using the online version, use the Monte Carlo signal and Monte Carlo background to optimise the cuts.

Different event analysis paths:

- 1) 2 leptons for Z boson study
- 2) 4 leptons for Higgs boson study
- 3) Study different kinematical distributions of real data

Feedback: very successful - students are very enthusiastic and will do it the whole semester. University of Birmingham plan also implement it in winter 2016.

3. WORKING GROUPS

3.1. WG on COSMIC RAYS

Nicolas, Marge, HP, Catarina, Despina, Rasmus, Catia, Julia, Charles Timmermans

Contacts with experiments:

HiSPARC (Bob van Eijk), CZELTA (Karel Smolek), cosmic@web (Carolyn Schwerdt), SkyView (Julian Rautenberg), QuarkNet Cosmic Ray Studies (Mark Adams), ROALTA (Vlad Popa), SEASA (Mark Pearce), EEE (Rosario Nania), Shower of Knowledge (Georgy Shelkov), CROP (Dan Claes), Cosmix (Benoit Lott), CREDO (Piotr Homola), COSMOS à l'Ecole (Claire Bonnoit), CREATE (Prof. L. Thompson), MAZE (Dr Wibig), DUKS (Dr Fynbo)

Next steps planned:

- Organize a meeting between the different experiments (2 days):
 - Workshop on High School Cosmic Ray Experiments, 15th-16th of February 2017, Rome, Centro Fermi
 - You are not alone!
 - Share experiences
 - Experimental fact-sheet
 - Discuss the sharing of information and data (Common data format)
 - Perform a student analysis on the data
 - Funding request

- First step towards common data format/tools
- Masterclasses

TO DO: Follow-up (Charles)

TO DO: Common data format and funding request must be still discussed

TO DO: Set-up a group supporting this projects (Charles, Marge, Barbora, Hans Peter, Steve, Nicolas, Despina, Pete + partners outside IPPOG)

3.2. WG PUBLICATIONS AND SPEAKERS COMMITTEE

Farid Ould-Saada, Pedro Abreu, Marge Bardeen and Despina Hatzifotiadou

The extension of the working group IPPOG@conferences + publications into a committee was discussed and agreed. **IPPOG Speakers and Publications Committee (ISPC)** is in function as of November 11th, 2016 with members (initially) Farid Ould-Saada, Pedro Abreu, Marge Bardeen and Despina Hatzifotiadou. In a period of one year, one of the persons shall be substituted, to allow a yearly rotation of one person and renew the committee.

Mandate of ISPC (stated in the official document): Their focus is to strongly encourage people to contribute and get involved in this work. The duties of the ISPC include:

1. Overview on and collection of relevant events (conferences, workshops, schools, exhibitions)
2. Collection of event and publication material
3. Follow-up of the whole process and quality assurance
 - a. Submission of material: abstracts, conference write-ups, posters, brochures, flyers, publications,...
 - b. Circulation of material within IPPOG
 - c. Organization of talk rehearsal and circulation of draft talk
 - d. Ensure that deadlines are respected
 - e. Assignment of speakers
 - i. Make sure that all partners are well represented
 - ii. Take into account possible lack of funding
 - iii. Encourage and prioritize active people
 - iv. Ensure quality assurance
4. Collection of possible publication journals
5. Together with the IPPOG chairs, define rules for authorship
 - a. Talks are given on behalf of IPPOG
 - b. General publications
 - c. Working group publications
6. Assignment of editorial bodies.

IPPOG Past Conferences – Publications to come?

EPS HEP 2015, Vienna: Panel discussion "IPPOG: Experts in bringing new discoveries to the public" by Michael Kobel

Lepton Photon 2015, Ljubljana: plenary talk "Education & Outreach" by Kate Shaw

EDULEARN16 –Barcelona: Invited talk about e-labs by Marge Bardeen

ICFNP'2016, Kolymbari, Greece: Invited talk by Marge Bardeen

LHCP 2016, Lund: „IPPOG Worldwide Outreach“ by Hans Peter Beck

WCPE 2016, Sao Paulo: „CERN Masterclass courses and the impact on school physics“ by Uta Bilow

ICHEP 2016, Chicago: Talk on behalf of IPPOG not presented!

Physics, Technology, Ethics international conference, Žilina, Slovakia: Invited contribution „On Some Ethical Questions related to Particle Physics“ by Ivan Melo (co-authors Thomas Naumann, H-P Beck)

IPPOG Conferences to come...

ICERI 2016, Sevilla, Spain, 14-16th November 2016

AAAS 2017, Boston, 16-20th February (submit dates passed)
LHCP2017, Shanghai, 15-20th May (abs.deadline: 10/March/2017)
Physics Teaching and Engineering Education, Zilina, Slovakia, 18 -19 May 2017 (abstract invitation sent to Ivan; deadline: 13/Jan/2017)
ICPE-EPEC (GIREF), Dublin, Ireland, 3-7th July 2017 (abs.deadline: 1st March 2017)
EPS-HEP 2017, Venice, Italy, 5-12th July (abs.deadline: 16/Jan/2017)
DPF 2017, Fermilab, 31/July-4/August
LP2017, Guangzhou (China), 7–12 August
ICNFP'2017, Kolybari, Greece, 17-26 August
IESS Nuclear Science Symposium and Medical Imaging Conference (w/ RTSD), 21 - 28th October 2017, Atlanta (abs.deadline: 8/May/2017)
GIREF International Conference, 2-6 July 2018, San Sebastian, Spain

TO DO: Update the list of the upcoming conferences, put their webpages list on the IPPOG website

TO DO: Prepare the list of the Publication opportunities – identify where IPPOGers have a possibility to publish their papers

3.3. WG on MASTERCLASSES in NEW COUNTRIES

Ken Cecire, Uta Bilow, Pedro Abreu, Steven Goldfarb, Natascha Hoermann, Marzena Lapka, Thomas McCauley, Kate Shaw, Gabriel Stoicea, Nick Tracas, Bilow Uta, Beatrice Zuaro

Updates:

- **New South Wales masterclasses:** (Steve+Christine) Working on linking ATLAS masterclass to the Australian curriculum (of which PP is part!); using HYPATIA and helping, ensuring and verifying quality for teachers to be able to do MC well. Work continues: text under review by CERN physicists.
- **SESAME:** Moderators for IMC; Possible to develop own Masterclass.

New countries opportunities:

- Armenia, Ukraine, Cuba, India, Korea, Japan, East Timor, Mozambique (based on the list of collaborators of ATLAS, CMS, ALICE and LHCb)
- In new countries it always needs the first one to be organised to showcase and give basis, so that people know that they can rely on it.

TO DO: Toru can bring the message to KEK/Japan, ATLAS collaborates with Nagoya – will be discussed

Masterclasses at schools and conferences:

- Latin American School of HEP, European School of HEP, Asia Europe Pacific School of HEP, ICFA, others...
- Some more similar to African School of Fundamental Physics: Masterclass for students of School to inspire outreach and more; Masterclasses for local students and teachers

IDEAS:

- Participating lecturers might lead masterclasses
- Faculty lists might yield IMC moderators

New idea for further growth: Teacher-run masterclasses where no uni or lab connection is available

- Teacher/physicist manual for Masterclasses with whom to call for help
- Module in CERN teacher programs (national, HST, ...) on IMC - on demand use
- Online course for running a Masterclass
- Draw on what we have done: Virtual Masterclass; Experience with school-based Masterclasses (e.g. International Schools, QuarkNet Virtual centre and fellows, etc.)

Comment: Historically the idea about MC is to have there a Master – PP physicist

TO DO/Proposal: As a good bye message of Virtual visit could be said that students can also join Masterclasses! (Marzena)

3.4. WG on EXPLAINING HOT PP TOPICS to LAY AUDIENCE

Barbora Bruant Gulejova, Panagiotis Charitos, Sue Cheatham, Zdenek Dolezal, Andrej Gorisek, Paul Jackson, Christine Kourkoumelis, Daniel Lellouch, Celso Martinez Rivero, Ivan Melo, Thomas Naumann, Farid Ould-Saada, Jiri Rames, Dirk Ryckbosch, Jonas Strandberg, Peter Watkins

Which ideas and concepts should we explain?

- Already basic concepts in PP have different meaning to us and lay people: particles + fields, (super) symmetries, vacuum, ...
- Higgs - what now? The Scalar Era: Inflation - Dark Energy - Higgs. Vacuum stability
- Higgs at work: HL-LHC: measure couplings,...
- Connections between cosmology and PP: Dark Energy - scalar fields, Dark Matter-WIMPS, neutrinos, axions
- What next: SUSY, Extra Dimensions, Grand Unification. Expect the unexpected! ...
- What if no new discovery, no SUSY? How to explain fine tuning, hierarchy, naturalness? To talk about SUSY, you must explain spin...
- Precision counts: couplings, rare decays (B, $\mu \rightarrow e\gamma$, ...)
- Neutrinos: masses, cosmology, Majorana, ...
- Are we obliged to respond to the concerns of the public even when we know those are not scientifically sound? If so, how much effort is reasonable? How do we make that measurement?
 - CERN response to mini-black holes: clarify scientific + ethic issues
 - German Federal Constitutional Court: “basic research cannot be stopped because individuals do not believe in the established laws of physics”
- How to sell a new European Strategy? How to justify cost of HL-LHC, LC, FCC,...How to explain that there is a lot of work to be done to discover, higher precision needed...
- Return on investment in HEP: time scales slow, but also 100 years for atom, ...(war + Moon landing are worse or less efficient to create spin-offs)

TO DO: We need quantification...collect quantitative info on amount + time scale

Interesting materials on impact of PP mentioned:

- [Cost-Benefit Analysis of the LHC to 2025 and beyond](#): Was it Worth it? (seminar at CERN)
- CERN: Impact on Society
- Some more exist, e.g. on Spin-offs (hadron therapy etc) and PP at work; etc...

Which methods should we use to explain?

1) Analogies, visualization: spin, scalar fields, precision...

We often use analogies to explain the concept and show what the limitations are:

-*Thomas*: Using meteorology to explain to people **scalar field**, scalar field – temperature, vector field – wind

-*Farid*: Physics Masterclasses- Z path- explanation of **spin** there for students who know a little bit, using the image of particle inside of the magnet, which splits with spin

-*Hans Peter*: **Precision counts**, Using the Flat Earth model to explain, that within limitation this model can be used (to build house), but for longer distances one needs to change model - analogy for Standard model (W,Z, t) and need of research to go beyond SM (SUSY, GUT, Extra dimensions...)

-*Thomas*: Example of **Higgs** in the crowd is wrong in 2 ways: 1) Higgs is not a polarisation phenomenon; 2) Person gets stuck and it's not ok. It is not honest, but wrong... Honesty pays off!! It is not worth to tell to politicians what is not completely right – they can find way how to find out, and trust building is also important.

TO DO: We need to explain what's wrong.

2) Simplification, vulgarisation: CERN backgrounders,...

IDEA: Should we translate papers in a summary format that could be read by the public? How many?

TO DO: Yes! ATLAS public summaries, very easy to understand. Steve next meeting?

IPPOG collection of PP explanations / stories for laymen (proposed by Barbora)

- IPPOG is a great source of ideas how to explain the complex subjects of PP to the laypeople, students, etc.
- In form of little stories, images, anecdotes, trick how to explain, ideas how to visualise things, analogies....
- All this great materials are worth being: collected, shared, published, and offered as a tool!
- This would be a nice IPPOG activity which would bring a real product.

TO DO: Collect + publish explanations, coordinated activity (Barbora, Dirk and Farid)

4. PANEL DISCUSSIONS

4.1. BROADENING of PHYSICS SCOPE of MASTERCLASSES

Nicolas Arnaud, Zdenek Dolezal, Andrej Gorisek, Farid Ould-Saada, Dirk Ryckbosch, Pedro Abreu, Kenneth Cecire, Thomas McCauley, Kate Shaw, Gabriel Stoicea, Uta Bilow, Toru Iijima

Motivation: Making IPPOG more inclusive is becoming more relevant with new members bringing more diversity and expertise. Broadening the physics scope of the MC beyond the LHC experiments is compelling and could mean including air shower experiments, neutrino physics, B-physics (Auger, Belle II, DUNE, Icecube, CLIC, Virgo, Ligo, Nova, MicroBooNE), direct searches Dark Matter Experiments, Ice-Top Cosmic rays, SESAME – light sources...

Concrete plans:

- 1) Masterclasses with **Belle II** experiment at Tsukuba, Japan (Zdenek Dolezal, Toru Iijima) – [B-lab](#) – open data analysis programme using Belle II data since 2004. MC planned for 2018, contacts in Asia, Australia, America and Europe...
- 2) QuarkNet and Fermilab moving towards **accelerator based neutrino masterclasses** (Ken Cecire): FNAL experiments, using MicroBooNE, Nova. Activities to be developed for data portfolio, including e-Lab. Students could measure: Cosmic ray muon studies, Purity of liquid argon, Drift velocity of the drifting electron in liquid argon, ID particles based on trajectories and energy depositions
- 3) Masterclass exercise using data from interferometric **gravitational wave detectors** (Nicolas Arnaud): Analysis based on matched filtering, correlating a known waveform with the data; Optimal filtering allows to find «invisible» signals, trying to find signals of known shapes hidden in data; search for candidates coincident in time between 2+ detectors, extract information from the «real» GW candidate
- 4) Masterclass with **IceTop**, an Extended Air Shower array (Dirk Ryckbosch): [IceTop](#) - Cosmic ray Airshower detector @ South Pole, 1 km² array of ice- Cerenkov detectors – using blue circles very nice online experience! Goal of masterclass: determine energy spectrum of CR between 3 and 40 PeV; uses both data and Monte Carlo (for calibration) – already 2 MC last year!
- 5) Masterclasses at **SESAME** (Kate Shaw): light source cyclotron with lots of beamlines. Investigate also with Rutheford Appleton Lab...
- 6) **Dark Matter** extension of Z-path ATLAS Masterclasses (Farid Ould-Saada): Strategic Dark Matter Initiative in Oslo.

Implementation: No need of having new burden, but use the existing brand of MC, expertise, propagation and moderating - include all information about new MC to the existing MC website, learn from each other, get input, global brand, global framework...

TO DO/ Recommendation: [Guidelines](#) – should be discussed further at MC Steering Group, in future put on IPPOG webpages with some instructions of who to contact if one was interested to develop a Masterclass

TO DO: Request to IMC Steering Group to consider extension of the IMC with new Masterclasses

Comment: It is better to distribute all activities over the year, not everything in MC period, so that people can participate in all activities...

4.2. ETHICS in PARTICLE PHYSICS

Hans Peter Beck, Barbora Bruant Gulejova, Steven Goldfarb, Ivan Melo, Thomas Naumann

Some insights from the International scientific conference ‘Physics, Technology, Ethics’ – on Ethical Aspects of Development and Application of New Technologies in the Context of Globalization Processes - September 2016, Žilina, Slovakia, where Ivan presented an [IPPOG paper\(p 106 in proceedings\)](#):

- **Honesty/frauds:** Ethics includes also honesty. In general there is a lack of honesty, which in turn results in distrust in authorities. Unfortunately, physics/science are not an exception and frauds are not something new, even Newton would introduce fudge factors in order to increase the predictive power of his work; Robert Millikan manipulated his measurements of the charge of electron to make the results more convincing. According to statistics more frauds in countries with lot of career pressure.
- Humans have **narrative identity** (they like stories, life is a story), which is around 3 important categories – Good (Ethics), Beauty (Aesthetics) and Truth (Epistemology). Natural science falls in the Truth, but it would be a mistake to concentrate at only one of these aspects.

Message to PP community: is not to fall into danger of scientism/reductionism (belief that empirical science constitutes the most authoritative world-view to the exclusion of other viewpoint).

Concerns addressed in Article ‘Some ethical questions in particle physics’ (see also [newsletter 3](#)):

1) Cost of Big Science at CERN

Total cost of LHC accelerator (~ 4 billion €) + Experiments at LHC (~ 4 billion €) + LHC's operating costs (~ 1 billion € /year), example of Slovakia's contribution to CERN budget (~ 5 million € /year)

Why not spend this money to cure world hunger or to invest in cancer research instead?

Answer to the cost concerns:

- Cost comparisons: Total cost of LHC ~ cost of bank reform in Slovakia 1999 – 2000; LHC's operating costs 1 billion €/year vs NASA's 17 billion €/year; Slovakia's contribution ~ 1 beer/person/year.
- CERN serves 10,000 researchers, engineers and students from 22 Member countries and 42 additional countries. LHC lifetime is ~ 25 years. We concentrate resources to big common goals in a coordinated effort. Costs are minimized, parallelism occurring in many competing small research teams is avoided. There are many spin-offs/innovations, like www, touch screen, semiconductor chips, cancer treatment etc...

2) Experiments at CERN could be dangerous

In February 2008 a threatening simulation appeared on YouTube in which a black hole created at CERN swallows the Earth. Reasoning of media: microscopic black holes could be created in proton collisions at LHC. Similar to massive macroscopic black holes they could attract matter, swallow our Earth and finally the whole Universe.

Answer to the Black hole concern: CERN developed a clear chain of arguments:

1. The energies of cosmic rays are billion times higher than the LHC energy.
2. Nature performed at least one million LHC experiments with Earth.
3. The Universe in total does a billion LHC experiments per second.
4. Nevertheless stars collapsed to black holes do not dominate the Universe.

5. CERN study clearly concluded: The LHC is safe

3) Science is a toy for a few, too difficult for the rest

There is an objective barrier between complex language of modern science and the public - this requires more and more effort to get through. Nevertheless, communicating our results to the public is our duty. Sharing the beauty of our discoveries with the young generation should be considered an intrinsic part of research work. Example: International Masterclasses...

4) Do we really need a deeper understanding of Universe?

Asking deep questions is part of being human. Science searches for the answers and scientists have to have many virtues to find them. Big science demands also ability to cooperate across cultural differences and to overcome prejudices. Scientists have a lot to offer but have to work hard on communicating their results to the public. If not, growing number of people will look upon our work with suspicion or find it less and less relevant for their lives.

Concerns addressed in panel:

- **Media/ doomsday and other catastrophies... how to react?**

LHC is often blamed in the media for different catastrophes, making it into the negative headlines in news, like Earthquake in Italy, Earthquake in Nepal, Suicide plane in Alps, etc...

Answer: It is strategically wise to be prepared. CERN's approach is not to tackle this directly but to prepare info (fact sheets with e.g. total energy of LHC) which gives people material to make their own conclusions. There are responses on this already made on CERN/ATLAS (about energies, which are energies of collisions, difference between energy and energy density), there are information, hints, factsheets... BUT if one looks for something about these events, one finds ONLY BAD HEADLINES! Backgrounders of CERN, at website of CERN's Press office, but it's really well hidden!

TO DO: IMPORTANT: If the website is to be found on google, it needs to be REGISTERED in google first, it takes time, but it must be done. Therefore one cannot find any of our explanation resources (e.g. CERN Backgrounders and ATLAS summaries) when randomly searching on internet....

- **Communication with public**

Most of our measurements are communicated by physicists to physicists. Although the papers are public, it is not reasonable to think they are read and understood by the public.

TO DO: Should we feel obliged to "translate" all of these papers in a summary format that could be read by the non-PhD public? If not all, how many? Yes! Now there are just ATLAS summaries and CERN backgrounders...some work to be done here...

- **Cultural merit of HEP**

Pursuit of knowledge is for benefit of humanity. In our 'Cathedrals of Science' we are doing a service to society. This activity rests on a belief: There is truth and laws out there that we try to uncover. Both service and belief sound like religion but are non-religious! Scientists strive for the same things unlike other people. In science there is no suffering but only knowledge!

- **Ethics in physics**

Difference between Science and Ethics: Science – what is, Ethics: What should be... However, ethics is inherent part of scientific behaviour in a sense that scientist serve as a model of peaceful collaboration with unique goal. Scientists have inherent ethical behaviour they don't fight, kill... CERN and other big international scientific collaborations show an example of Science for peace, model for efficient international collaboration... Those who interpret good, truth and beauty in different ways, fight and don't behave ethically. We (scientists) describe things, we don't decide or force them to be as we like them to be, we accept what we see / measure.

- **Science and truth**

Truth is described by epistemological conundrum (Platon, Lenin). Truth in physics: As good as we can. We say that physics describes the world with uncertainties. We face all the time: Truth is who is louder! But science is not a question of believe, we just tell you, what we see. In science we aim for absolute truth, unlike in real life or politics. Is there absolute truth behind everything? With error bars...

TO DO: Try to find replies to the questions of panelists:

- Is beauty a valid criterion for scientific truth?
- How well do we understand the concept of "truth?" Is it what we have measured or is it something we are trying to uncover?
- How do we justify our portion of a pie that also includes education, infrastructure, defence, etc.
- How have HEP results in the past affected everyday life?
- What is the timespan from research to daily life impact?
- When could we expect the results of current research to have an impact?
- How do HEP theories influence general culture and the view of the world?
- Are particle physicists obliged to respond to the concerns of the public even when those concerns are not scientifically sound? If so, how much effort is reasonable?

TO DO: Maybe we should clarify the different meaning of truth in the human and scientific realms.

TO DO: We may enlarge the paper – everybody invited to join or to add ideas.

Suggestion: Consider extending the title of the panel, as Ethics by definition is a rule of behaviour based on ideas about what's morally good or bad; philosophy systematising, defending and recommending concepts of right and wrong conduct...

4.3. SPECIAL EVENTS and EXHIBITIONS

Marge Bardeen, Panagiotis Charitos, Catarina Espirito Santo, Despina Hatzifotiadou, Natascha Hoermann, Christine Kourrkoumelis, Catia Peduto, Jiri Rames, Nick Tracas, Peter Watkins, Beatrice Zuaro

- **Pop - Up Physics:** an ICHEP outreach program in partnership with the Chicago Public Libraries (Marge): Fermilab Demos/Presentations: Charge Electricity and Magnetism, Cryogenics Show Light and Color, Forces and Motion, Physics of Sports – 600 children with parents
- **Antimatter matters-** Royal Society Exhibition 2016 - more than 14 000 visitors
- **WOMAD UK** (World of Music, Art and Dance): new in 2016 – Physics Pavilion – where ideas collide! Bridging gap between science and music, Bringing scientific discovery to major music festival
- **CERN exhibitions in Greece / Science fairs in Greece** - Chania, Veroia and Thessaloniki (2016) organized in connection with International Conferences – different hands-on experiments for kids, masterclasses, public lectures and music performance...
- **The new ALICE visitor centre:** in progress, expected to be ready in 2017
- **Accelerating science:** [interactive exhibition](#) in 2016 in Ceske Budejovice, Czech Republic: The experience seeks to inspire a sense of wonder and curiosity about the origins of the universe and particle physics, and to build an appreciation of the value of pure scientific research
- **The beginning of everything – About Galaxies, Quarks and Collisions** – exhibition at Natural history museum Vienna (19th October 2016 – 4th August 2017) – they had Peter Higgs going around like in the Higgs cartoon; Phantom of the Universe – artistic representation of SUSY ([video](#))

Recommendation/TIP: how can you persuade a planetarium-museum to add PP exhibits with (almost) zero money? The exhibit should be cheap or free -> computer screen and use a BIG soft touch screen

4.4. TABLETOP EXPERIMENTS

Rasmus Mackeprang, [Julia Woithe](#), Paul Jackson, Krzysztof Wozniak, [Daniel Lellouch](#), Angelos Alexopoulos

Table top experiments mean very different things, like equipment from “built by students” to “fully bought from a company”; content from experiment vs mock-up; different audiences...

TO DO/Consensus: Need to organise all these experiments at one place - centralized repository of experiment recipes. All efforts should be centralised and stored in a systematic way.

Examples of experiments or activities, which offer insight and excitement to students - “playing” and experiencing particle physics:

- 1) Opportunities to talk about particle physics: Playing with Protons (primary school), [Mystery boxes](#) (see the scientific methodology), [Liquid Nitrogen show](#), levitating superconductors...
- 2) Demonstration experiments / mechanical analogies: [Quadrupole Ion Traps](#) (2 spoons to make a quadrupole field, voltage, trapping particle, antimatter research), [Salad bowl accelerator](#), [Weltmaschine exhibits](#), [Rutherford scattering with marbles](#) (form factors, cross-section,...), [Elektromagneten der Teilchenphysik hands-on–das ATLAS Magnetsystem](#).

Recommendation: Don't forget to discuss the limits of these models, avoid misconceptions!!!

- 3) „Real“ particle physics measurements: [DIY Cloud Chambers](#) (beer glass, sponge and frying pan – good heat conductivity, using radioactive balloon as a source: rub balloon with cat fur and leave it somewhere for a while, it will attract Radons, then cut balloon carefully to obtain a nice Radon source!), [Muon Hunter](#), DIY Ionisation chambers, [CosMO](#) and other cosmic particle detectors, [RCLs](#) (Remotely Controlled Laboratories)
- 4) More expensive equipment: MX-10 Pixel detector, [IpadPix](#) prototype - pixel detector for education

TO DO: Put it all to the IPPOG database in the category “Do it yourself”, plan: new S’CoolLAB PhD student will have a look what exists and what teachers want (Julia)

5. VARIOUS REPORTS

5.1. MASTERCLASSES 2016

Presented by [Ken Cecire](#), [Uta Bilow](#)

ALICE: largely didn't change, new material for the strangeness exercise: 4 short introductory videos ([theory + tutorials](#)), [e-learning modules](#), possible to download [virtual box](#)

CMS WZH: lot of news - more data (10K events); finding primary particle mass (choose leptons with pick tool, calculate mass in iSpy, Transfer to CIMA); piloted concept summer 2016 - expected in IMC 2017; using 2011 CMS Open Data (better able to select just what we need for IMC)

ATLAS W-path: nothing new this year

ATLAS Z-path: new physics added:the “adiabatique” introduction of Graviton excitation in the di-leptons and di-photons, gravito

n successfully detected by many students, nice way of introducing new properties of particles, such as Spin; Z-path web pages updated with more concepts; Supersymmetry and Dark Matter introduced into more advanced projects

LHCb: new arrangement of hour connection with CERN, adding China and Russia, connection directly from the pitch underground - very successful!

TO DO/ to be improved: Refresh exercise and vidyo in control room

MASTERCLASSES in general:

- Registration to MC open till 18th Nov 2016, but if free slots found, it is possible to join even later, videoconferences with CERN (always 4-5pm) and Fermilab (variable times).
- **New institutes/countries:**
Confirmed: Italy (Trento), Finland (Jyväskylä), Turkey (Konya Bilim Center, METU Ankara), U.K (Plymouth, Derby), Russia (Moscow), St. Petersburg (Bangladesh, Dhaka), China (Beijing)
Interest expressed: Oxford (U.K.), Georgia, Rwanda
- **Improving the communication on IMC:**
 - circulars on fixed day - every Friday
 - social media:

Facebook: www.facebook.com/pages/International-Particle-Physics-Masterclasses/114950505201581

Twitter: <https://twitter.com/physicsimcCommunication>; @physicsIMC

TO DO: Many Twitter account do not follow and should follow us: Help us to get these on board!

@_nikhef; @ALICEexperiment; @CERN; @CERN_FR; @CMSexperiment; @Desy; @desynews; @EPFL; @EPFL_en; @KEK_en; @KEK_JP; @LHCbExperiment; @QMUL [Queen Mary University London]; @STFC; @teilchenwelt; @uw_icecube; @uslhic; @AAPTHQ; @helmholtz_de; @helmholtz_en; @LHCnews; @particlenuews [interactions.org]; @symmetrymag; @argonne; @berkeleyLab; @BrookhavenLab; @CEA_Recherche; @CEA_Saclay; @doescience; @Livermore_Lab; @J_PARC; @MIT_Physics

- **Videoconference WG** (Katharine Leney, Michael Hauschild, Kate Shaw, Marzena Lapka + Uta)
Improved concept of VC part of IMC, which is very important part of the day:
 - Skip boring report part, include more questioning and interaction parts
 - After icebreaker introduce more questioning by moderators and by students
 - Q&A – keep as before – very good
 - Quiz will be redesigned – with new questions and answers and more attractive design
 - LHCb: Connect from the pitch

Comment: It is not possible to do the whole MC from the pitch underground, because people work there. The connection is only about 5 minutes.

Worldwide Data Day (W2D2)

LHC World Wide Data Day is a 24-hour span, midnight-to-midnight UTC, in which students from around the world can analyze data from the LHC (ATLAS and CMS version) and share results via an ongoing, 24 hour videoconference with physicist moderators taking shifts in four locations around the world: Co-EPP in Australia, CERN in Switzerland, Fermilab in the United States, and TRIUMF in Canada.

Date: Frida 2 December 2016; so far (in nov.2016) 22 institutes signed up, still space available

African School for fundamental physics

- Kigali, Rwanda, August 2016, 3 weeks, 76 graduate students from Africa and beyond (ATLAS W)
- 20 high school teachers and others (CMS WZH)
- Mini-masterclasses for students at 3 Kigali high schools (ATLAS and CMS)
- (additional) High school students in Addis Ababa, Ethiopia (CMS WZH)

Feedback: It worked well and it helped to move along the MCs

TO DO: New posters for IMC available at MC library – put to IPPOG DB (Ken)

5.2. PHYSICS FOR EVERYONE – HIGGS PARTICLE – Pragmatic and demystifying approach

Presented by *Nick Tracas*

Physics creates models to describe nature. These models should not have “internal errors”. Up to now, the only type of models which have the ability to describe nature with no internal errors are called Gauge Theories. These theories, distinguish matter particles (electron, quarks etc) and particle-carriers (photon, Z-particle, W-particle etc) of the (fundamental) forces (electromagnetism, weak force etc). Although experiments confirm that some of the carriers (Z-particle, W-particle) do have mass, the rules of Gauge Theories forbids the appearance of mass for such particles. In scientific language this means that terms which correspond to mass for these particles should not appear in the mathematical expression which describes the model (the so called Lagrange function). The introduction of a new particle (the Englert-Brout-Higgs (EBH)- particle), introduces new interactions with the rest of the particles. Clever choice of the potential energy of the new particle (but fully acceptable by the rules of the Gauge Theories), leads to a non standard lower-energy-state (the so called vacuum). The requirement that we consider this new state as the new lower-energy-state, creates the “forbidden” mass terms while obeying all the rules that the Gauge Theories dictate. The question, before the experimental verification of the EBH particle, was whether this mechanism, which produces the desired terms, is really used by a nature (which means that the EBH particle does exist) or was just a mathematical trick to overcome the stringent Gauge Theory rules. In July 2012, the LHC experiments ATLAS and CMS confirmed that nature “votes” for the existence of EBH particle!

Recommendations: La Grangian and Gauge theory are too complicated for 15 years old... one must start with something what students know (calculation of pendulum (Farid)). It is necessary to find an intermediate level for explaining, for example [article on Higgs from H-P Beck in German](#).

5.3. BEAMLINER FOR SCHOOLS 2016/2017

Presented by *Markus Joos*

Beamline for schools (BL4S) competition started in 2014 as part of CERN 60, BL4S is a worldwide competition for teams of high school students, aged at least 16 years and guided by a teacher (or other adult), to use a fully equipped beam line at CERN’s Proton Synchrotron. Teams have to design an experiment which uses a particle beam. They have to submit a written proposal and a one-minute video. Teams can get support and advice from CERN’s BL4S team or from volunteer physicists from all over the world, mainly via the IPPOG. Equipment provided by CERN can be used for the proposed experiments. Winning team spend 1 week at CERN.

New in 2016: - Additional prizes for shortlisted and noteworthy teams
- Improved documentation and [Web site](#)
- Short descriptions of BL4S in [20 languages](#)
- New type of detector: MRPC

New in 2017: better publicity, announced much earlier.

Impact of BL4S: In total ~ 5500 students have participated since 2014 (2/3 boys, 1/3 girls), two winning teams have written scientific papers about their experiment; Celebrities visiting CERN help us to promote BL4S among the target group

Cost of the project: Beam time and time invested by staff: offered by CERN; Direct cost: 140 - 170 kCHF, financed by CERN and Society foundation

TO DO / Challenges (where IPPOG can help):

- not enough teachers – they must spend a lot of time with teams
- publicity is main challenge every year

-
- regional contacts in some countries missing (Australia, Bulgaria, Denmark, Ireland and Romania, as well as some non-IPPOG nations such as India, China, Japan, Russia)

5.4. IMPACT and USAGE of WORLDWIDE OPEN DATA

Presented by Arturos Sanchez Pineda

Data is not information. Data requires interpretation/analysis to become information. Different types of data (with different impact: scientific, financial, meteorological,). Different data formats – in general we cannot expect that all experiments will save their data in the same format.

It is difficult to control how data are used, we can't impose that they are used only for science, also could be used for arts, etc... Also it is difficult to evaluate the impact of the current Education & Outreach activities on the audience. First it is needed to understand who is there to use the data.

CERN has an **Open Data web platform** that is in constant development. It includes data from 4 biggest LHC's experiments aiming to extend the data and resources from the others hosted at CERN. These have their own repositories of datasets (ATLAS, CMS) who go to the OD platform using for example ROOT as an analysis tool.

ATLAS Open Data platform: hub for the official ATLAS OpenData resources which are constantly being produced. Data (100 trillion proton collisions, world's first open release of 8 TeV data) and Monte Carlo of 2012 for education released together with a set of tools that allow to run analysis-kind software and getting a set of histograms and plots (for students, researchers and curious public).

Recent project: part of this web-based hub for all the ATLAS members or teams using public ATLAS samples and/or tools and creating great [projects in/for their external institutions](#) or even larger projects (like the masterclasses!) – e.g. Canada, Germany, Norway, Venezuela, Colombia, Italy...

Conclusions: There is very large PP community waiting to share their data and experiences! Only CERN has 20 experiments. Many experiments have the repositories of their data. It is not obvious to coordinate all these web-based efforts. See more details [here](#).

TO DO/Recommendation: We can take advantage of the experiences in IPPOG, CERN and ATLAS/CMS, etc... to create common frameworks and protocols that make easy the collaboration with smaller-yet-huge experiments out there. Documentation and design of friendly + powerful User Interfaces (UI) should be our top priority in order to get more people to really use and enjoy the data and tools.

TO DO/Recommendation for practical actions:

Practical Actions as recommendations & ideas ongoing and under test

- Online catalogue of all possible/existing open datasets (and/or resources) at CERN and CERN-related experiments (can be archived using a map) with the instructions to get an inspiration on what to do with data
- Online Catalogue (mapping) of the HEP and general large theory and experimental collaborations on physics worldwide

5.5. ORGANISING E&O SESSIONS for LHCP and ICHEP

Presented by Kate Shaw

Outreach Parallel Session at 4th LHC Physics conference in Lund, June 2016

- Conveners: Kate Shaw (INFN / ICTP), Angelos Alexopoulos (University of Ioannina, Greece)
- 2 hours slot: 6 x (12+3 minute) talks (1.5 hours) + 30 minutes Panel Session for discussion, very busy session! (~30 people!)
- Aims: have interesting, forward looking talks; represent LHC parties appropriately; engage physicists, encourage them to do more outreach; build networks

Observations:

- Suggestion to review slides in advance (some were too detailed)
- Never enough time for discussion & questions!!

Outreach Session at 38th International Conference of High Energy Physics ICHE in Chicago, Aug.2016

- 46 submitted abstracts – all wanted talks! Some merging was necessary + posters
- 19 + 3 talks (4h 45 mins); panel session at the end (1h 15 minutes)
- invited poster presenters and other outreach guests (4 in total) - each spoke for 3 minutes about a topic of choice for discussion, 11 Posters

Observations:

- Dedicated topics for panel sessions are good; it is good to get proceedings
- Education, Outreach, Diversity, Communication, ALL very interesting topics for physicists, and A LOT of work is going on
- Always need more time for discussion & questions!!

Recommendation from IPPOG: Do the sandwich lunch to continue discussion, or dedicated day for outreach when it would not compete with other physics sessions in parallel

- Kate got a list of names at the end, many people doing and interested in outreach who wanted to know how to join a network or email list!

TO DO: How can we (IPPOG) facilitate the wider outreach community? We can use this list and create a category IPPOG friends...(to be discussed)

5.6. COUNTRY HIGHLIGHTS

5.6.1. GREECE

Presented by *Nicholas Tracas, Yiota Foka*

Greek Outreach Activities Nov. '15 – Nov '16:

- IMC in 4 different places in Greece, 320 students + Local Masterclasses at many places in Greece
- Giving seminars for students at their schools or at universities including ALICE, CMS virtual visits (huge number of students and teachers, reaching even to kindergarten level); different lectures (Greek Physical Society); Democritus Summer schools
- Different events: Open Doors of NTUA, Athens Science festival, Researcher's night
- HYPATHIA awarded by Global online laboratory consortium the GOLC 2016 PRIZE for best visualized experiment
- XII Quark Confinement and the Hadron Spectrum conference, summer 2016 in Thessaloniki (366 participants, 316 talks, plenary on outreach) - preceded by student lectures and 2 days public events: CERN for all ages - public events in Veroia public library and Thessaloniki, many different stations and activities, tabletop experiments, gadgets, leaflets..., demo Masterclass projected in big screen, projections of films and events; Welcome drink at City Hall, Aristotelis School and lecture...
- ICNFP organised every year at Crete- fantastic settings, large variety of activities including Science Fair, plenaries, parallel talks, Masterclass demo, little experiments, puzzles, books, card games, viewmaster etc.; evening public lecture (in Greek) + music performance, public lecture in English; Several IPPOGers participating; a lot of attention from press

5.6.2. SPAIN

Presented by *Alberto Ruiz Jimeno*

Spain highlights 2016:

- European Researchers' night 2016
- Scientific coffee in Santander
- Masterclasses 2016 – in different places
- Science week 2015 – CERN exposition on largest instrument ever build – for HS students
- Physics in our lives – event in different cities in 2014/2015
- [Gamma Hunters](#) in IFAE (Barcelona) using MAGIC telescope data - web application for high energy astrophysics, addressed to secondary school students which combines physics and computing

5.6.3. UK

Presented by *Peter Watkins*

UK outreach activities / programmes:

- STFC, Swindon Office Public Engagement: 2 new PP related projects launched by [Institute for Research in Schools](#) - [CERN@school](#) (a new charity that aims to engage school students and their teachers with fundamental research):
 - **MoEDAL**: enables school students to join particle hunters at the LHC, CERN, looking for a brand new exotic particle, the magnetic monopole (students use the Timepix detector through the CERN@school project)
 - **Higgs Hunters**: students can become part of the team searching for an unusual particle called a “Baby Higgs”, which leave a particular signature in the data captured in the ATLAS experiment at the LHC. Higgs Hunters gives students access to this data and teaches them how to make classifications.
- Many UK schools and teachers **visiting CERN**
- [Masterclasses in UK](#) in 18 institutions, 1000 students
- [STFC Public Engagement Funding Schemes](#) – funding awards to different PP projects