

PHOTON

2019 - International Conference on the Structure and the Interactions of the Photon. Satellite Workshop: Photon Physics and Simulation at Hadron Colliders.



Report of Contributions

Contribution ID: 5

Type: **Talk**

Towards an analytical threshold function of the two lepton pair production in gamma-gamma collisions

Tuesday, 4 June 2019 12:25 (20 minutes)

The analytical asymptotic cross section for arbitrary masses was given a few years ago.
Obtaining an analytical approach of the onset of the asymptotic regime is an interesting challenge.
The current status will be reviewed.

Summary

Primary author: Dr KAPUSTA, Frédéric (LPNHE Paris)

Presenter: Dr KAPUSTA, Frédéric (LPNHE Paris)

Session Classification: Gamma-Gamma Collisions

Track Classification: Gamma-Gamma Collisions

Contribution ID: 9

Type: **Talk**

Prospects for photon-photon measurements with tagged protons in ATLAS

Wednesday, 5 June 2019 14:45 (30 minutes)

In 2017, ATLAS has been equipped with a new, dedicated detector system allowing measurements of forward protons scattered at small angles in diffractive and electromagnetic processes. These ATLAS Forward Proton detectors (AFP) can operate during standard high-luminosity LHC runs and collect large amounts of integrated luminosity. This gives a possibility to study rare interactions, in particular, the two-photon processes. The physics programme includes measurements of photon-photon interactions present in the Standard Model, as well as using searches for new physics. During the talk, the AFP detectors and their performance during 2017 and 2018 operations will be presented. Physics goals and first results will be discussed.

Summary

Presenter: TRZEBINSKI, Maciej (IFJ PAN)

Session Classification: Future Perspectives

Track Classification: Gamma-Gamma Collisions

Contribution ID: 16

Type: **Talk**

Dark Photons

Thursday, 6 June 2019 09:15 (20 minutes)

Dark photons

G.A. Kozlov

Bogolyubov Laboratory of Theoretical Physics Joint Institute for Nuclear Research, Joliot Curie st.,
6, Dubna, Moscow region, 141980 Russia

Abstract

The couplings of the Standard Model sector to the scale invariant degrees of freedom can open the possibility to study dark photons (DP). The model for the DP particle solvable in 4-dimensional space-time is presented at the lowest order of perturbative theory using canonical quantization. The model is gauge and scale invariant and the associated symmetries are spontaneously broken with the following properties: dark photons are massive and can be clarified through their final states. The Dalitz-like decay of the (Higgs-like) scalar boson into a single photon and DP is studied. The interaction between DP and quarks is mediated by the derivative of the scalar field - the dilaton. The mass of the dilaton does not enter the final solutions. The limits are set on the DP mass, the mixing strength between the standard photon and DP. This study can be used to probe the DP sector since the emitted energy of the single photon is encoded with measuring of the missing of the recoil DP.

Summary

Primary author: KOZLOV, Gennady (JINR)**Presenter:** KOZLOV, Gennady (JINR)**Session Classification:** Gamma Final States**Track Classification:** Gamma Final States

Contribution ID: 17

Type: **Talk**

Isolated Photon Production in pp and p–Pb Collisions at the LHC measured with the ALICE experiment

Thursday, 6 June 2019 11:35 (20 minutes)

In high-energy hadron collisions, *direct photons* can be produced at different stages and are of particular interest to study the hot QCD medium since they escape it without being affected.

At high transverse momentum (p_T), their production is dominated by high- p_T parton fragmentation and hard-scattering processes between partons. The latter can be accessed experimentally using an isolation procedure leading to reduce both the fragmentation contribution and the large decay photon background. Their measurement in proton-proton collisions allows to test pQCD calculations and put constraints on parton distribution functions (PDFs). In addition, in proton-ion collisions (e.g., proton-lead) cold nuclear matter effects can be studied and especially nuclear PDFs can be tested. Their knowledge is crucial to understand the global picture of direct photon production in the context of hot nuclear matter where other mechanisms can occur in addition.

In this talk, recent results from the ALICE experiment on the isolated photon production in proton-proton and proton-lead collisions at the LHC will be presented.

Summary

Primary author: MASSON, Erwann (Subatech, IN2P3-CNRS (FR))

Presenter: MASSON, Erwann (Subatech, IN2P3-CNRS (FR))

Session Classification: Gamma Final States

Track Classification: Gamma Final States

Contribution ID: 18

Type: **Talk**

Transition Form Factor Measurements at BESIII

Monday, 3 June 2019 18:00 (20 minutes)

Motivated by the recent developments in data-driven approaches to improve the hadronic light-by-light scattering calculations of the Standard Model prediction of the anomalous magnetic moment of the muon a_μ , the BESIII collaboration has embarked on a dedicated two-photon physics program. The momentum dependence of transition form factors of single pseudoscalar mesons, as well as of multi-meson systems is studied. Based on the high statistics data, collected at the τ -charm factory BESIII operated at the BEPCII accelerator in Beijing, the information can be provided in the relevant momentum region for a_μ . In this presentation we discuss recent results, the current status of ongoing measurements, and the prospects for $\gamma\gamma$ collision studies at BESIII.

Summary

Primary author: REDMER, Christoph Florian (Institute for Nuclear Physics, Johannes Gutenberg - University Mainz)

Presenter: REDMER, Christoph Florian (Institute for Nuclear Physics, Johannes Gutenberg - University Mainz)

Session Classification: Gamma-Gamma Collisions

Track Classification: Gamma-Gamma Collisions

Contribution ID: 19

Type: **Talk**

Particle production in $\gamma\gamma$ interactions at hadronic colliders: Recent results and prospects

Tuesday, 4 June 2019 10:35 (20 minutes)

In this talk we will present a brief review of the recent results for the particle production by $\gamma\gamma$ interactions at $pp/pA/AA$ collisions. In particular, the dilepton production will be discussed, as well the background associated to pomeron induced interactions. Finally, the probe of the X(4350) in $\gamma\gamma$ interactions at the LHC will be discussed.

Summary

Primary author: GONCALVES, Victor (Universidade Federal de Pelotas)

Presenter: GONCALVES, Victor (Universidade Federal de Pelotas)

Session Classification: Gamma-Gamma Collisions

Track Classification: Gamma-Gamma Collisions

Contribution ID: 20

Type: **Talk**

Magnetic monopoles in heavy ion collisions

Tuesday, 4 June 2019 09:55 (20 minutes)

Magnetic monopoles are present in generic classes of models beyond the Standard Model and there are currently searches underway for them at the LHC. The strong magnetic fields present in peripheral heavy ion collisions can produce monopoles by the (dual) Schwinger effect. I will outline recent progress in understanding this process and argue that heavy ion collisions may be the most promising place to carry out searches for monopoles.

Summary

Primary author: GOULD, Oliver (University of Helsinki)

Co-authors: RAJANTIE, Arttu (Imperial College London); HO, David (Imperial College London)

Presenter: GOULD, Oliver (University of Helsinki)

Session Classification: Gamma-Gamma Collisions

Track Classification: Gamma-Gamma Collisions

Contribution ID: 22

Type: **Talk**

Heavy quark spectroscopy

Monday, 3 June 2019 12:00 (30 minutes)

I will review the status of heavy quark spectroscopy, in particular the XYZ and pentaquark candidates.

Summary

Primary author: PILLONI, Alessandro (ROMA1)

Presenter: PILLONI, Alessandro (ROMA1)

Session Classification: Gamma-Hadron Collisions

Track Classification: Gamma-Hadron Collisions

Contribution ID: 23

Type: **Talk**

The PADME experiment at LNF

Thursday, 6 June 2019 09:35 (20 minutes)

Among the theoretical models addressing the dark matter problem, the category based on a secluded sector is attracting increasing interest. The PADME experiment, at the Laboratori Nazionali di Frascati (LNF) of INFN, is designed to be sensitive to the production of a low mass gauge boson A' of a new $U(1)$ symmetry holding for dark particles. This 'dark photon' is weakly coupled to the photon of the Standard Model, and it provides an experimental signature for one of the simplest implementations of the dark sector paradigm. The DAΦNE Beam-Test Facility of LNF provides a high intensity, mono-energetic positron beam impacting on a low Z target. The PADME detectors are designed to measure with high precision the momentum of a photon, produced along with A' boson in e^+e^- annihilation in the target, thus allowing to measure the A' mass as the missing mass in the final state. This technique, particularly useful in case of invisible decays of the A' boson, is adopted for the first time in a fixed target experiment. Simulation studies predict a sensitivity on the interaction strength (ϵ^2 parameter) down to 10^{-6} , in the mass region $1 \text{ MeV} < M_{A'} < 22.5 \text{ MeV}$, for one year of data taking with a 550 MeV beam. In Winter 2018-2019 the first run took place, providing useful data to study the detector performance, along with the beam and background conditions. Intense activity is taking place to deliver preliminary results on the PADME data quality. This talk will review the status of the experiment and the prospects.

Summary

Primary author: TARUGGI, Clara (LNF)**Presenter:** TARUGGI, Clara (LNF)**Session Classification:** Gamma Final States**Track Classification:** Gamma Final States

Contribution ID: 24

Type: **Talk**

SuperKEKB and Belle II status, and prospects on two-photon physics

Wednesday, 5 June 2019 17:05 (20 minutes)

At present experiments with a new Belle II detector at SuperKEKB collider has started at KEK (Japan). These new experiments will continue and widen the studies began at the previous experiments with the Belle detector. The luminosity of the SuperKEKB collider will exceed the previous one by about 40 times, amounting to $8 \times 10^{35} \text{cm}^{-2} \text{s}^{-1}$. The main features of the collider and detector as well as the current status of the SuperKEKB/Belle II project are reported in this talk. Main physics motivations, goals and perspectives of this experiment for two-photon physics are discussed as well.

Summary

Primary author: SHWARTZ, Boris (Budker Institute of Nuclear Physics, Novosibirsk State University)

Presenter: SHWARTZ, Boris (Budker Institute of Nuclear Physics, Novosibirsk State University)

Session Classification: Future Perspectives

Track Classification: Gamma-Gamma Collisions

Contribution ID: 25

Type: Talk

Observation of light-by-light scattering and measurements of photon-photon collisions at ATLAS

Tuesday, 4 June 2019 09:15 (20 minutes)

We present the observation of the light-by-light scattering process, $\gamma\gamma \rightarrow \gamma\gamma$, in lead-lead collisions at $\sqrt{s_{NN}} = 5.02$ TeV. The analysis is conducted using 1.73nb⁻¹ of data collected in November 2018 by the ATLAS experiment at the LHC. Light-by-light scattering event candidates are selected in events with two photons produced exclusively, with small diphoton transverse momentum and small acoplanarity. After applying all selection criteria, 59 candidate events are observed for a background expectation of 12 ± 3 events. An excess of events over the expected background is found with an observed significance of 8.2 standard deviations. The fiducial cross section is also measured and compared to the theoretical predictions.

In addition, we present the measurements of $\gamma\gamma \rightarrow W^+W^-$ and $\gamma\gamma \rightarrow \tau^+\tau^-$ in proton-proton collisions at ATLAS. The production of $\gamma\gamma \rightarrow \tau^+\tau^-$ was measured at a centre-of-mass energy of 13 TeV using 3.2 fb⁻¹. Fiducial and differential cross sections are compared to theoretical predictions both with and without corrections for absorptive effects. Exclusive production of W^+W^- consistent with the Standard Model prediction was found with 3 σ significance using 20.2 fb⁻¹ of data at a centre-of-mass energy of 8 TeV. The fiducial cross section was measured and found to be in agreement with Standard Model predictions. Constraints were placed on anomalous quartic gauge boson interactions.

Summary

Presenter: GRABOWSKA-BOLD, Iwona (AGH University of Science and Technology)

Session Classification: Gamma-Gamma Collisions

Track Classification: Gamma-Gamma Collisions

Contribution ID: 26

Type: **Talk**

Project of the Charm-Tau factory in Novosibirsk

Friday, 7 June 2019 09:45 (30 minutes)

The project of the Super C-Tau factory (SCTF) is under development now at BINP in Novosibirsk. This electron-positron collider is intended for experiments in the energy range from 2 to 6 GeV with a luminosity of $10^{35} \text{ cm}^{-2}\text{s}^{-1}$. The high luminosity will provide a wide physical program that includes many fundamental issues like a study of mixing in the D meson system, search for CP-violating effects in decays of charmed particles, and search for “new physics” in rare and Standard Model-forbidden decays of charmed particles and tau lepton. Other important fields including two photon physics is also presented in the researches plans.

Summary

Primary author: SHWARTZ, Boris (Budker Institute of Nuclear Physics)

Presenter: SHWARTZ, Boris (Budker Institute of Nuclear Physics)

Session Classification: Future Perspectives

Track Classification: Future Perspectives

Contribution ID: 27

Type: **Talk**

Gamma-gamma collider based on European XFEL

Friday, 7 June 2019 10:15 (30 minutes)

Using Compton scattering of 0.5 μm laser photons on existing 17.5 GeV (spent) electron beams from European XFEL one can obtain a gamma-gamma collider with $W < 12$ GeV. This energy region is not covered by Super-B collider or LHC (the later due QCD backgrounds). Such a collider will be a nice place for application of modern technologies: powerful lasers, optical cavities, SC linacs and low-emittance electron sources. Physics program: spectroscopy of C^+ resonances in various J^P states ($b\bar{b}$), four quark states, quark molecules and other exotics). Variable circular and linear photon polarization will help to determine quantum numbers. Using a large distance between the interaction and the conversion point, it is possible to obtain quasi-monochromatic collisions and thus to measure the total gamma-gamma section in the region below 12 GeV with a high accuracy. Variable photon polarization allows you to measure separately polarization components of the cross section ($\sigma_{\text{perp}}, \sigma_{\text{paral}}, \sigma_0, \sigma_2$).

Summary

Primary author: TELNOV, Valery (Budker INP)

Presenter: TELNOV, Valery (Budker INP)

Session Classification: Future Perspectives

Track Classification: Future Perspectives

Contribution ID: 28

Type: **Talk**

Electroweak Precision Tests on the SM

Wednesday, 5 June 2019 17:45 (30 minutes)

A global survey of weak mixing angle measurements at low and high energies is presented first. Then I will discuss theoretical uncertainties in precision observables with special emphasis on their correlations. The important role of vacuum polarization in global fits will also be addressed before fit results are presented.

Summary

Primary author: ERLER, Jens (IF-UNAM)

Presenter: ERLER, Jens (IF-UNAM)

Session Classification: Future Perspectives

Track Classification: Gamma-Hadron Collisions

Contribution ID: 29

Type: **Talk**

Search for an invisible vector boson from π^0 decays at NA62

Thursday, 6 June 2019 09:55 (20 minutes)

The high-intensity setup, trigger system flexibility and detector performance make the NA62 experiment at CERN particularly suitable to perform direct searches for long-lived hidden-sector particles, such as dark photons, dark scalars, axion-like particles, and heavy neutral leptons, using kaon and pion decays as well as operating the experiment in dump mode.

Results from NA62 will be presented on a search for π^0 decays to one photon and an invisible massive dark photon. From about 400 million π^0 decays, no signal is observed beyond the expected fluctuation of the background and limits are set in the plane of the dark photon coupling to ordinary photon vs the dark photon mass. The analysis has been also interpreted in terms of the branching ratio BR for the electroweak decay $\pi^0 \rightarrow \gamma \nu \bar{\nu}$: the null result implies a limit on the BR at the level of 2×10^{-7} .

Summary

Primary author: CENCI, Patrizia (PG)

Presenter: PERUZZO, Letizia (JGU Mainz)

Session Classification: Gamma Final States

Track Classification: Gamma Final States

Contribution ID: 30

Type: Talk

Production of W^+W^- and $t\bar{t}$ pairs in photon-photon mechanism in proton-proton scattering

Tuesday, 4 June 2019 11:45 (20 minutes)

Photon-induced processes in proton-proton interactions have become recently very topical. The large energy at the LHC, when combined with relatively large luminosity at run II, allows to start the exploration of such processes.

We discuss production of W^+W^- pairs and $t\bar{t}$ quark-antiquark pairs in proton-proton collisions induced by two-photon fusion including, for a first time, transverse momenta of incoming photons. The unintegrated inelastic fluxes (related to proton dissociation) of photons are calculated based on modern parametrizations of deep inelastic structure functions in a broad range of x and Q^2 .

We focus on processes with single and double proton dissociation. Highly excited remnant systems hadronise producing particles that can be vetoed in the calorimeter. We calculate associated effective gap survival factors. The gap survival factors depend on the process, mass of the remnant system and collision energy. The rapidity gap survival factor due to remnant fragmentation for double

dissociative (DD) collisions is smaller than that for single dissociative (SD) process. We observe approximate factorisation: $S_{R,DD} \approx S_{R,SD}^2$ when imposing rapidity veto. For the W^+W^- final state, the remnant fragmentation leads to a taming of the cross section when the rapidity gap requirement is imposed. Also for $t\bar{t}$ quark-antiquark pairs such a condition reverses the hierarchy observed for the case when such condition is taken into account.

Our results imply that for the production of such heavy objects as t quark and \bar{t} antiquark the virtuality of the photons attached to the dissociative system are very large ($Q^2 < 10^4 \text{ GeV}^2$). A similar effect was observed for the W^+W^- system.

1. M. Luszczak, L. Forthomme, W. Schafer, A. Szczurek, arXiv:1810.12432; JHEP (2019) in print.
2. L. Forthomme, M. Luszczak, W. Schafer, A. Szczurek, Phys.Lett. B789 (2019) 300-307.
3. M. Luszczak, W. Schafer, A. Szczurek, JHEP 1805 (2018) 064.
4. M. Luszczak, W. Schafer and A. Szczurek, Phys. Rev. D93 (2016) 7, 074018.
5. M. Luszczak, A. Szczurek, Ch. Royon, JHEP 1502 (2015) 098.

Summary

Primary authors: SZCZUREK, Antoni (Institute of Nuclear Physics, Krakow and Rzeszow University, Rzeszow); Dr ŁUSZCZAK, Marta (Faculty of Mathematics and Natural Sciences, University of Rzeszow, Poland); Dr LAURENT, Forthomme (Helsinki Institute of Physics); SCHAEFER, Wolfgang (Institute of Nuclear Physics PAN)

Presenters: SZCZUREK, Antoni (Institute of Nuclear Physics, Krakow and Rzeszow University, Rzeszow); Dr ŁUSZCZAK, Marta (Faculty of Mathematics and Natural Sciences, University of Rzeszow, Poland); Dr LAURENT, Forthomme (Helsinki Institute of Physics); SCHAEFER, Wolfgang (Institute of Nuclear Physics PAN)

Session Classification: Gamma-Gamma Collisions

Track Classification: Gamma-Gamma Collisions

Contribution ID: 31

Type: Talk

The $\gamma^*\gamma^* \rightarrow \eta_c(1S, 2S)$ transition form factor

Tuesday, 4 June 2019 12:45 (20 minutes)

We discuss $\gamma^*\gamma^* \rightarrow \eta_c(1S), \eta_c(2S)$ transition form factor for both virtual photons. The general formula is given. We use different models for the $c\bar{c}$ wave function (LFQM or the ones obtained from the solution of the Schrödinger equation for different $c\bar{c}$ potentials: harmonic oscillator, Cornell, logarithmic, power-law and Buchmüller-Tye).

We compare our results to the BaBar experimental data for $\eta_c(1S)$, for one real and one virtual photon. We discuss approaching of $Q_1^2 F(Q_1^2, 0)$ or $Q_2^2 F(0, Q_2^2)$ to their asymptotic value $\frac{8}{3} f_{\eta_c}$ predicted by Brodsky and Lepage formalism. We discuss applicability of the collinear and/or massless limit and delayed onset of asymptotic behaviour.

We present some examples of two-dimensional distributions for $F_{\gamma^*\gamma^* \rightarrow \eta_c}(Q_1^2, Q_2^2)$.

A factorization breaking measure is proposed and factorization breaking effects are quantified and shown to be almost model independent.

Summary

Primary authors: BABIARZ, Izabela (Institute of Nuclear Physics, Polish Academy of Sciences); Prof. GONCALVES, Victor P. (Instituto de Fisica e Matematica Universidade Federal de Pelotas (UFPel)); Dr PASECHNIK, Roman (Department of Astronomy and Theoretical Physics, Lund University); Dr SCHAFER, Wolfgang (Institute of Nuclear Physics, Polish Academy of Sciences); Prof. SZCZUREK, Antoni (Institute of Nuclear Physics, Krakow and Rzeszow University, Rzeszow)

Presenters: BABIARZ, Izabela (Institute of Nuclear Physics, Polish Academy of Sciences); Prof. GONCALVES, Victor P. (Instituto de Fisica e Matematica Universidade Federal de Pelotas (UFPel)); Dr PASECHNIK, Roman (Department of Astronomy and Theoretical Physics, Lund University); Dr SCHAFER, Wolfgang (Institute of Nuclear Physics, Polish Academy of Sciences); Prof. SZCZUREK, Antoni (Institute of Nuclear Physics, Krakow and Rzeszow University, Rzeszow)

Session Classification: Gamma-Gamma Collisions

Track Classification: Gamma-Gamma Collisions

Contribution ID: 32

Type: **Talk**

Photoproduction of penta-quark states: a theoretical perspective

Tuesday, 4 June 2019 14:45 (30 minutes)

The 2015 LHCb discovery of an exotic structure (denoted by P_c^+) decaying in $J/\psi p$ and conjectured to be a penta-quark state has triggered a renewed interest in the possible existence of multiquark states not predicted by the naive quark model. In this talk we present some considerations on P_c photo-production experiments, aimed at testing its multi-quark interpretation in the framework of a 40-years-old “string-junction” picture that allows a unified description of baryons, tetra-, and penta-quark states.

Summary

The 2015 LHCb discovery of an exotic structure (denoted by P_c^+) decaying in $J/\psi p$ and conjectured to be a penta-quark state has triggered a renewed interest in the possible existence of multiquark states not predicted by the naive quark model. In this talk we present some considerations on P_c photo-production experiments, aimed at testing its multi-quark interpretation in the framework of a 40-years-old “string-junction” picture that allows a unified description of baryons, tetra-, and penta-quark states.

Primary authors: ROSSI, Giancarlo (University of Roma Tor Vergata); VENEZIANO, Gabriele (Collège de France and CERN)

Presenter: ROSSI, Giancarlo (University of Roma Tor Vergata)

Session Classification: Gamma-Hadron Collisions

Track Classification: Gamma-Hadron Collisions

Contribution ID: 33

Type: **Talk**

Rare and radiative B decays at LHCb

Thursday, 6 June 2019 12:55 (20 minutes)

Rare and radiative b-hadron decays are sensitive probes of New Physics through the study of branching fractions, angular observables, CP asymmetries and measurements of the polarisation of the photon emitted in the decay.

The LHCb experiment is ideally suited for the analysis of these decays due to its high trigger efficiency, as well as excellent tracking and particle identification performance.

Recent results from the LHCb experiment are presented and their interpretation is discussed.

Summary

Primary author: LHCB COLLABORATION

Presenter: CALVO GOMEZ, Miriam (La Salle. Universitat Ramon Llull)

Session Classification: Gamma Final States

Track Classification: Gamma Final States

Contribution ID: 34

Type: **Talk**

The Muon g-2 Experiment at Fermilab

Friday, 7 June 2019 09:15 (30 minutes)

The muon anomalous magnetic moment, $a_\mu = \frac{g-2}{2}$, is a low energy observable that can be both measured and computed with high precision. Therefore it provides an important test of the Standard Model (SM) and it is a sensitive probe for new physics. In particular, any deviation from the Standard Model theoretical value can be due to Beyond Standard Model Physics contribution, such as SUSY, Dark Matter, or new unknown contributions.

The a_μ value has been measured to a precision of 0.54 ppm by the E821 experiment at the Brookhaven National Laboratory (BNL). This result shows a $\sim 3.6\sigma$ difference compared to the SM prediction. In an effort to clarify this discrepancy between experimental measurement and theoretical calculation, the Muon g-2 (E989) experiment at Fermilab aims to reduce the experimental error on a_μ by a factor of four.

E989 collected a dataset with the same statistical power of the BNL experiment during the Run 1 data taking (2018). The data are under analysis and the first result will most likely be published next summer. In this talk I will discuss the experimental setup and report on the status of the Run 1 analysis.

Summary

Primary author: SORBARA, Matteo (Università degli Studi di Roma Tor Vergata & INFN Sezione Roma Tor Vergata)

Presenter: SORBARA, Matteo (Università degli Studi di Roma Tor Vergata & INFN Sezione Roma Tor Vergata)

Session Classification: Future Perspectives

Track Classification: Gamma-Hadron Collisions

Contribution ID: 35

Type: **Talk**

Isolated photon and photon+jet production at NNLO QCD accuracy

Thursday, 6 June 2019 12:15 (20 minutes)

Based on [1904.01044], I present recent results of a Next-to-Next-to-leading order (NNLO) calculation of inclusive isolated photon and photon-plus-jet production using the Monte-Carlo event generator NNLOJET. In order to mimic experimental photon isolation criteria we apply a staged isolation procedure. A Frixione-type isolation with small cone size is used to ensure numerical stability, followed by a hard-cone isolation with larger cone size, tailored to the actual experimental setup. We compare the results to recent 13TeV data by ATLAS [1701.06882,1801.00112] and CMS [1807.00782]. We observe substantial corrections in certain kinematical regions, leading to a significant improvement of theory uncertainty and description of the data.

Summary

Primary author: HÖFER, Marius (Universität Zürich)

Co-authors: GEHRMANN, Thomas; GLOVER, Nigel; CHEN, Xuan; HUSS, Alexander

Presenter: HÖFER, Marius (Universität Zürich)

Session Classification: Gamma Final States

Track Classification: Gamma Final States

Contribution ID: 36

Type: **Talk**

Central exclusive production at LHCb

Tuesday, 4 June 2019 15:45 (30 minutes)

The LHCb collaboration has measured central exclusive production of J/ψ , $\psi(2S)$, and Y mesons as well as $J/\psi J/\psi$ and $J/\psi \psi(2S)$ meson pairs in proton-proton collisions. The analyses of Y and charmonium pairs are performed at the centre-of-mass energies of 7 TeV and 8 TeV, and those of J/ψ and $\psi(2S)$ are done at 7 TeV and 13 TeV. The analysis at 13 TeV involves the usage of new shower counters. These allow to reduce background by vetoing events with activity in an extended region in rapidity. The measurements of central exclusive production at LHCb are sensitive to gluon distributions for x -Bjorken values down to 2×10^{-6} (at 13 TeV). An overview of the LHCb results is presented and compared to existing measurements of other experiments.

Summary

Primary author: LHCb**Presenter:** VAN HULSE, Charlotte**Session Classification:** Gamma-Hadron Collisions**Track Classification:** Gamma-Hadron Collisions

Contribution ID: 37

Type: **Talk**

Combination and QCD analysis of charm and beauty production cross-section measurements in deep inelastic ep scattering at HERA

Monday, 3 June 2019 16:00 (30 minutes)

Measurement of open charm and beauty production cross sections in ep deep inelastic scattering (DIS) at HERA from the H1 and ZEUS Collaborations are combined. Reduced cross sections are obtained in a restricted kinematic range. Perturbative QCD calculations are compared to the combined data. Next-to-leading order QCD analysis is performed using these data together with combined inclusive HERA DIS cross sections. The running charm and beauty quark masses are determined.

Summary

Primary author: KARSHON, Uri (Weizmann Institute)

Presenter: KARSHON, Uri (Weizmann Institute)

Session Classification: Gamma-Hadron Collisions

Track Classification: Gamma-Hadron Collisions

Contribution ID: 38

Type: Talk

Diphoton elastic scattering in UPC at smaller $W_{\gamma\gamma}$

Tuesday, 4 June 2019 10:15 (20 minutes)

So far light-by-light scattering ($\gamma\gamma \rightarrow \gamma\gamma$) was not accessible for experiments because the corresponding cross section is rather low. Measurements of diphotons in ultra-peripheral collisions (UPCs) of lead-lead have been reported recently by the ATLAS [1] and CMS Collaborations [2]. Our theoretical results based on equivalent photon approximation in the impact parameter space [3] are in agreement with the current data [1, 2].

We will discuss how to extend such studies to lower $\gamma\gamma$ energies where photoproduction of pseudoscalar and scalar resonances contribute to the two-photon final state. In addition, we consider the dominant background that arises from $\gamma\gamma$ fusion into pairs of neutral pions [4]. Such π^0 -pairs contribute to the background when only two of the four decay photons are within the experimental acceptance, the other two photons escape undetected. We will discuss in detail how to reduce the unwanted background. We will present differential distributions and total cross section in ultra-peripheral Pb-Pb collisions at $\sqrt{s_{NN}} = 5.05$ and 5.52 TeV [5] and cross section for Ar-Ar collisions at the energy equal to 6.3 TeV [6]. Results for ALICE and LHCb acceptance will be presented.

[1] ATLAS Collaboration, Nature Phys. 13 (2017) 852 & arXiv:1904.03536 [hep-ex]

[2] CMS Collaboration, arXiv:1810.04602

[3] M.Kłusek-Gawenda, P.Lebiedowicz, A.Szczurek, Phys. Rev. **C93** (2016) 044907

[4] M.Kłusek-Gawenda, A.Szczurek, Phys. Rev. **C87** (2013) 054908

[5] M.Kłusek-Gawenda, R.McNulty, R.Schicker, A.Szczurek, 1904.01243 [hep-ph]

[6] Z.Citron et al., arXiv:1812.06772

Summary

Primary authors: KLUSEK-GAWENDA, Mariola (Institute of Nuclear Physics Polish Academy of Sciences); SZCZUREK, Antoni (Institute of Nuclear Physics, Krakow and Rzeszow University, Rzeszow)

Presenter: SZCZUREK, Antoni (Institute of Nuclear Physics, Krakow and Rzeszow University, Rzeszow)

Session Classification: Gamma-Gamma Collisions

Track Classification: Gamma-Gamma Collisions

Contribution ID: 39

Type: **Talk**

Searches for Dark Matter at the LHC in forward proton mode

Tuesday, 4 June 2019 12:05 (20 minutes)

We analyze in detail the LHC prospects for charged electroweakino searches, decaying to leptons, in compressed supersymmetry scenarios, via exclusive photon-initiated pair production. This provides a potentially increased sensitivity in comparison to inclusive channels, where the background is often overwhelming. We pay particular attention to the challenges that such searches would face in the hostile high pile-up environment of the LHC, giving close consideration to the backgrounds that will be present. The signal we focus on is the exclusive production of same-flavour muon and electron pairs, with missing energy in the final state, and with two outgoing intact protons registered by the dedicated forward proton detectors installed in association with ATLAS and CMS. We present results for slepton masses of 120–300 GeV and slepton-neutralino mass splitting of 10–20 GeV, and find that the relevant backgrounds can be controlled to the level of the expected signal yields. The most significant such backgrounds are due to semi-exclusive lepton pair production at lower masses, with a proton produced in the initial proton dissociation system registering in the forward detectors, and from the coincidence of forward protons produced in pile-up events with an inclusive central event that mimics the signal. We also outline a range of potential methods to further suppress these backgrounds as well as to enlarge the signal yields.

Summary

Primary author: HARLAND-LANG, Lucian (University of Oxford)

Presenter: HARLAND-LANG, Lucian (University of Oxford)

Session Classification: Gamma-Gamma Collisions

Track Classification: Gamma-Gamma Collisions

Contribution ID: 40

Type: Talk

Vector meson photoproduction in ultra-peripheral p-Pb and Pb-Pb collisions at the LHC with ALICE

Tuesday, 4 June 2019 15:15 (30 minutes)

Vector mesons are plentifully produced in ultra-peripheral collisions where the impact parameter is larger than the sum of the radii of the two projectiles, implying that electromagnetic induced processes become dominant.

Light vector meson photoproduction cross sections can be used to study Glauber-Gribov shadowing effects at the hadronic level while the photoproduction of heavy vector mesons is expected to be sensitive to the poorly known gluon structure function and gluon shadowing effects at low Bjorken x .

The ALICE Collaboration has published the first measurements of the ρ^0 , J/ψ and $\psi(2S)$ photoproduction cross section in ultra-peripheral Pb-Pb collisions and that for exclusive J/ψ photoproduction off protons in ultra-peripheral proton-lead collisions at the LHC and has obtained a substantially larger data set in 2015-2018 from LHC Run 2, allowing much more detailed studies of the production mechanism to be performed. In particular, the increased energy and more detailed measurements in the forward region in Run 2 give access to lower values of Bjorken- x than in previous studies. In this talk, an overview of the past results from Run 1 and the latest available results from Run 2 will be given. The results are compared to theoretical models.

Summary

Primary author: BROZ, Michal (CTU Prague)

Presenter: BROZ, Michal (CTU Prague)

Session Classification: Gamma-Hadron Collisions

Track Classification: Gamma-Hadron Collisions

Contribution ID: 41

Type: **Talk**

Gravitational form factors & internal forces in hadrons

Monday, 3 June 2019 15:30 (30 minutes)

The gravitational form factors of hadrons can be studied through hard-exclusive reactions, give access to the “last global unknown property” D-term, and promise insights on the internal forces inside hadrons from a unique perspective through their interpretation in terms of energy-momentum tensor densities. The current experimental and theoretical status is reviewed.

Summary

Primary author: SCHWEITZER, Peter (UConn)

Presenter: SCHWEITZER, Peter (UConn)

Session Classification: Gamma-Hadron Collisions

Track Classification: Gamma-Hadron Collisions

Contribution ID: 42

Type: **Talk**

Prospects for photon-photon measurements with CMS/TOTEM

Wednesday, 5 June 2019 15:15 (30 minutes)

Prospects for photon-photon measurements with CMS and TOTEM will be reviewed.

Summary

Presenter: WILLIAMS, Justin (CERN)

Session Classification: Future Perspectives

Track Classification: Gamma-Gamma Collisions

Contribution ID: 43

Type: **Talk**

Measurements with photon-photon collisions in CMS

Tuesday, 4 June 2019 09:35 (20 minutes)

Measurements with photon-photon collisions in CMS are reviewed.

Summary

Presenter: WILLIAMS, Justin (CERN)

Session Classification: Gamma-Gamma Collisions

Track Classification: Gamma-Gamma Collisions

Contribution ID: 44

Type: **Talk**

Photon detection with the CMS ECAL in the present and at the HL-LHC and its impact on Higgs boson measurements

Wednesday, 5 June 2019 15:45 (30 minutes)

The CMS experiment at the LHC features a high-resolution homogeneous electromagnetic calorimeter (ECAL). Its excellent performance in the reconstruction of high-energy photons has played a key role in the discovery of the Higgs boson and the measurement of its properties. The High-Luminosity LHC (HL- LHC) is expected to deliver an integrated luminosity 20 times larger than the LHC, allowing to study rare processes such as Higgs boson pair production and self-coupling. During HL-LHC operations, up to 200 concurrent interactions per-bunch collision are expected. In order to maintain its current performance in the harsher environment of the HL-LHC, an upgrade of the ECAL is planned. This contribution describes the ECAL performance in photon reconstruction and its impact on the measurement of the Higgs boson properties during the LHC Run II. Prospects for Higgs boson measurements at the HL-LHC are presented as well.

Summary

Presenter: CIPRIANI, Marco (ROMA1)

Session Classification: Future Perspectives

Track Classification: Future Perspectives

Contribution ID: 45

Type: **Talk**

Recent results from two-photon processes at Belle

Monday, 3 June 2019 17:00 (20 minutes)

In this talk, I will talk about recent progresses by two-photon processes at Belle. (a) meson transition form factor (TFF), a important input for calculation of hadronic light-by-light scattering contribution, which is one of dominant theory uncertainty source to muon $g-2$. With single tag method, the $\pi^0/f_0(980)/f_2(1270)$ TFF is presented in this talk. (b) The cross section of hadron pair production in no-tag measurements, is a good place to test (p)QCD prediction. The results of $K_s K_s$ via gamma gamma fusion in low- W region is presented, and compared with that of pQCD calculation. (c) Similar to $J/\psi p$, the ϕp is interesting channel for exotic baryons. A search for exotic baryons is presented in gamma gamma $\rightarrow p \bar{p} K^+ K^-$.

Summary

Primary author: YAN, Wenbiao (USTC)**Presenter:** YAN, Wenbiao (USTC)**Session Classification:** Gamma-Gamma Collisions**Track Classification:** Gamma-Gamma Collisions

Contribution ID: 46

Type: **Talk**

Light dark states with electromagnetic form factors

Monday, 3 June 2019 13:00 (30 minutes)

There may exist new sub-GeV particles, χ , which are electrically neutral but couple to the electromagnetic current via higher-dimensional operators. This talk focus on the possible detection of light state coupled to the photon through magnetic- and electric-dipole moments, or carrying an anapole moment or charge radius.

New constraints, as well as future sensitivities, on the existence of such states are derived from a number of high-intensity experiments and other collider observations, since no positive signals have been found. The second half of the talk discusses the possibility that χ is dark matter (or very long-lived) and study ensuing astrophysical and cosmological constraints, and shows that a combination of all considered probes rule out χ particles with dimensional five and six operators as dark matter when assuming a standard freeze-out abundance.

Summary

Primary authors: CHU, Xiaoyong (Institute of High Energy Physics, Vienna); PRADLER, Josef; SEMERLOCK, Lukas

Presenter: CHU, Xiaoyong (Institute of High Energy Physics, Vienna)

Session Classification: Gamma-Hadron Collisions

Track Classification: Gamma-Hadron Collisions

Contribution ID: 47

Type: **Talk**

gamma-gamma physics at KLOE-2

Monday, 3 June 2019 17:40 (20 minutes)

The KLOE-2 experiment completed its data-taking at the e^+e^- DAPHNE collider in Frascati, achieving the integrated luminosity goal of more than 5 fb^{-1} at the ϕ peak. KLOE-2 represents the continuation of KLOE with an upgraded detector and an extended physics program. The new four stations installed to tag electrons and positrons from the reaction $e^+e^- \rightarrow e^+e^- \text{gamma gamma} \rightarrow e^+e^-X$, give the opportunity to investigate gamma-gamma physics at the ϕ resonance. Single pseudoscalar production will improve the determination of the two-photon decay widths of these mesons. An accuracy of $O(1\%)$ for the π^0 is reachable with 5 fb^{-1} , matching the current theory precision. With the same amount of data, the measurement of the $\pi^0 \rightarrow \text{gamma gamma}^* \text{TFF}$ in the space-like region with 5-6% accuracy could be reached in a region not yet exploited of the low momentum transfer. Preliminary results and perspectives on gamma-gamma physics will be presented.

Summary

Primary author: GIOVANNELLA, Simona (LNF)

Presenter: MORICCIANI, Dario (LNF)

Session Classification: Gamma-Gamma Collisions

Track Classification: Gamma-Gamma Collisions

Contribution ID: 48

Type: **Talk**

Fully neutral final states at KLOE/KLOE-2

Thursday, 6 June 2019 10:15 (20 minutes)

In March 2018, the KLOE-2 experiment completed its data-taking at the e^+e^- DAPHNE collider in Frascati, collecting more than 5 fb^{-1} at the ϕ peak, thus extending the KLOE physics program with an upgraded detector. The KLOE detector is well suited for the study of fully neutral final states due to its large radius and a hermetic electromagnetic calorimeter, providing excellent timing and position resolution (50 ps and O(cm), respectively, at 1 GeV). The calorimeter energy resolution ($5\%/\sqrt{E}$) is greatly improved when kinematic constraints are applied. The upgraded KLOE-2 detector extends its acceptance coverage thanks to the new small angle calorimeters placed near the interaction region.

The latest results on prompt neutral final states will be presented, with particular emphasis on five photon final state, which is used to study the $\eta \rightarrow \pi^0 \gamma \gamma \gamma$ decay. This process provides an important test of ChPT because of its sensitivity to the p^6 term on both the branching ratio and the $M(\text{gg})$ spectrum. A preliminary KLOE measurement, based on 450 pb^{-1} , provided a much lower BR value than the most accurate determination from Crystal Ball. A new analysis with a larger data sample is in progress to confirm this result. The same five photon final state is also used to search for the B boson, a postulated leptophobic mediator of dark forces.

Summary

Primary author: GIOVANNELLA, Simona (LNF)

Presenter: BERLOWSKI, Marcin

Session Classification: Gamma Final States

Track Classification: Gamma Final States

Contribution ID: 49

Type: Talk

The multi-messenger approach for current and future transient searches at very high energies

Wednesday, 5 June 2019 11:45 (30 minutes)

The very high energy sky comprises many astrophysical sources originating from explosive or flaring events on different timescales, from fraction of seconds to years. These transient sources are largely observed and monitored in different bands of the electromagnetic spectrum, including very high energy (VHE, $E > 100$ GeV) gamma rays. Furthermore, transient sources are associated with systems of compact objects like black holes and neutron stars. Other non-photonic messengers, like gravitational waves and neutrinos, are expected to be produced in these extreme environments. Therefore the detailed characterization of the sources and environments of transient events should benefit from a multi-messenger approach for such searches.

In this context, Cherenkov telescopes like MAGIC face many challenges in the observation of transient sources at VHE, stemming in particular from their low duty cycle and limited field of view. Nonetheless, the planning of targeted follow-up strategies proved to be successful in the observation of transients. In this contribution, a particular highlight will be given to the synergies between MAGIC and facilities like LIGO/Virgo and IceCube, providing alerts on GW and neutrino events respectively. Such synergies are the key to many outstanding results, as demonstrated by the detection of the flaring blazar TXS 0506+06 in coincidence with a high energy neutrino and the first time detection of a Gamma-Ray Burst at VHE by MAGIC, GRB 190114C.

Finally, the future CTA experiment will open a new window in transient searches, thanks to its improved sensitivity, especially for short timescales.

Summary

Primary author: BERTI, Alessio (TO)

Co-authors: FATTORINI, Alicia (Technische Universität Dortmund); STAMERRA, Antonio (INAF, National Institute for Astrophysics); DORNER, Daniela (Universität Würzburg); MICELI, Davide (UD); MORETTI, Elena (Institut de Física d'Altes Energies (IFAE)); DO SOUTO ESPÍNEIRA, Elia (IFAE); BERNARDINI, Elisa (Padova); LONGO, Francesco (TS); HOANG, John (Instituto de Partículas y Cosmología (IPAR-COS)); CORTINA, Juan (CIEMAT); NODA, Koji (ICRR, University of Tokyo); SATALECKA, Konstanca (DESY); FOFFANO, Luca (PD); RIBÓ, Marc (Universitat de Barcelona, ICC, IEEC-UB); MANGANARO, Marina (University of Rijeka); GARCZARCZYK, Markus (DESY); WILL, Martin (Max-Planck-Institut für Physik); PERESANO, Michele (CEA Paris-Saclay); FUKAMI, Satoshi (ICRR, University of Tokyo); COVINO, Stefano (INAF / Brera Astronomical Observatory); INOUE, Susumu (RIKEN); BHATTACHARYYA, Wrijupan (PhD); SUDA, Yusuke (Max-Planck-Institut für Physik)

Presenter: BERTI, Alessio (TO)

Session Classification: Astrophysical Gamma

Track Classification: Astrophysical Gamma

Contribution ID: 50

Type: **Talk**

Unveiling the unresolved gamma-ray sky through its anisotropies

Wednesday, 5 June 2019 09:45 (30 minutes)

The gamma-ray sky has been revealed in the last decade by the Fermi Large Area Telescope (LAT), offering an outstanding picture of our Universe at the highest energies. The majority of this gamma-ray emission has been attributed to known processes involving cosmic-ray interactions with the interstellar medium within our Galaxy. Another important contribution is represented by the gamma-ray emission of known Galactic and extragalactic astrophysical sources. However, still an important fraction ($\sim 20\%$) of the total gamma-ray emission remains unresolved, and therefore we referred to it as the unresolved gamma-ray background (UGRB). Guaranteed contribution to this component is the cumulative emission of gamma-ray sources that are too faint to be resolved separately and hence lie below the current instrumental sensitivity. On the other hand, even more exotic scenarios involving dark matter particles may contribute as well, making the exact composition of the UGRB one of the main unanswered questions in gamma-ray astrophysics. The unprecedented large sample of high quality gamma-ray photons provided by the Fermi-LAT opened a new window on this study: the measurement and characterization of UGRB spatial anisotropies. In this talk I will give an overview of all the different techniques employed in the effort to give a definitive answer to the question of the UGRB composition.

Summary

The unprecedented large sample of high quality gamma-ray photons provided by the Fermi-LAT opened a new window on the study of the unresolved gamma-ray background (UGRB): the measurement and characterization of its spatial anisotropies. In this talk I will give an overview of all the different techniques employed in the effort to give a definitive answer to the question of the UGRB composition.

Primary author: NEGRO, Michela (TO)**Presenter:** NEGRO, Michela (TO)**Session Classification:** Astrophysical Gamma**Track Classification:** Astrophysical Gamma

Contribution ID: 51

Type: **not specified**

Nucleon structure in lepton-nucleon interactions

Monday, 3 June 2019 12:30 (30 minutes)

Various measurements of photoproduction in lepton-nucleon interactions are presented, along with their theoretical interpretations. These include spin-independent measurements of inclusive charm and beauty production, isolated photons and jets as well as exclusively produced hadrons. Results of hadron photoproduction in data taken with polarised leptons and nucleons are shown also.

Summary

Primary author: VAN HULSE, Charlotte

Presenter: VAN HULSE, Charlotte

Session Classification: Gamma-Hadron Collisions

Track Classification: Gamma-Hadron Collisions

Contribution ID: 52

Type: **Talk**

Status of the anomalous magnetic moment of the muon in spring 2019

Monday, 3 June 2019 15:00 (30 minutes)

In this talk we review the recent progress on the numerical determination of the hadronic contributions to the anomalous magnetic moment of the muon and we discuss the role of experimental data on the accuracy of its determination. Special emphasis on the light-by-light scattering contribution and on its main contribution, the pseudoscalar piece, is made. A state-of-the-art deviation between theory and experiment for the $(g - 2)_\mu$ is discussed and an outlook for the near future made.

Summary

Primary author: MASJUAN, Pere (Johannes Gutenberg-Universität Mainz, Institute für Kernphysik)

Presenter: MASJUAN, Pere (Johannes Gutenberg-Universität Mainz, Institute für Kernphysik)

Session Classification: Gamma-Hadron Collisions

Track Classification: Gamma-Hadron Collisions

Contribution ID: 53

Type: Talk

Very-forward photon production in p-p and p-Pb collisions measured by the LHCf experiment

Thursday, 6 June 2019 12:35 (20 minutes)

The main purpose of the LHCf experiment is to test the hadronic interaction models used in ground based cosmic rays experiments to simulate air-showers induced by ultra-high-energy cosmic rays in the Earth atmosphere. Since most of the air-shower energy flow is contained in the very forward region (where soft-QCD processes dominate), Monte Carlo simulations must rely on phenomenological models. The data from accelerator experiments are therefore very important for the tuning of these hadronic interaction models.

The LHCf experiment, situated at the LHC accelerator, is composed of two independent detectors located at 140 metres from the ATLAS interaction point (IP1) on opposite sides along the beam axis: the particular position of the detectors allows LHCf to measure neutral particles up to zero-degree with respect to the beam, with a pseudorapidity coverage of $\eta > 8.4$. Each detector is composed by two sampling and position sensitive calorimeters.

In this contribution the latest photon production measurements from LHCf will be compared with the predictions of DPMJET, EPOS, PYTHIA, QGSJET and SIBYLL Monte Carlo event generators, commonly used in air-shower simulations. The photon production cross section in proton-proton collisions at $\sqrt{s} = 13$ TeV and the preliminary results in proton-lead collisions at $\sqrt{s_{NN}} = 8.16$ TeV will be shown. Furthermore, the LHCf-ATLAS combined results on photon production cross section in p-p collisions at $\sqrt{s} = 13$ TeV will be presented: using ATLAS information on central particles production the type of the interaction (diffractive or non-diffractive) can be discriminated experimentally and it is possible to study in particular the low-mass diffractive interactions.

There is not any hadronic interaction model well reproducing all the experimental data measured by the LHCf experiment. However, these data in the very-forward region will be useful in the tuning of the models and consequently reducing the discrepancy between their predictions.

Summary

Primary author: TIBERIO, Alessio (Università degli Studi di Firenze & INFN)

Co-authors: ADRIANI, Oscar (FI); BERTI, Eugenio (INFN Firenze); BONECHI, Lorenzo (FI); BONGI, Massimo (FI); D'ALESSANDRO, Raffaello (FI); HAGUENAUER, M.; ITOW, Yoshitaka (STEL/KMI Nagoya University); KASAHARA, K.; MASUDA, K.; MENJO, Hiroaki (Nagoya University, Japan); MURAKI, Y.; OHASHI, K.; PAPINI, Paolo (FI); RICCIARINI, Sergio Bruno (FI); SAKO, Takashi (Institute for Cosmic Ray Research, University of Tokyo, Japan); SAKURAI, Nobuyuki (Kobayashi-Maskawa Institute, Nagoya University); SATO, K.; SUZUKI, T.; TAMURA, T.; TORII, S.; TRICOMI, Alessia Rita (CT); TURNER, W. C.; UENO, M.; ZHOU, Qidong (Nagoya university)

Presenter: TIBERIO, Alessio (Università degli Studi di Firenze & INFN)

Session Classification: Gamma Final States

Track Classification: Gamma Final States

Contribution ID: 54

Type: **Talk**

Recent results from VEPP-2000

Since 2010 two detectors, CMD-3 and SND, have been collecting statistics at the electron-positron collider VEPP-2000. The collected integrated luminosity is about 200 pb^{-1} for each detector in the wide c.m. energy range from 0.32 up to 2 GeV. The current status of analysis as well as recent results are reported. Special attention is paid to the studies of $e^+e^- \rightarrow \pi^+\pi^-$, $\pi^0\gamma$, $\eta \rightarrow e^+e^-$, $\eta' \rightarrow e^+e^-$, $f_1 \rightarrow e^+e^-$ processes.

Summary

Primary author: IVANOV, Vyacheslav (Budker Institute of Nuclear Physics)

Presenter: IVANOV, Vyacheslav (Budker Institute of Nuclear Physics)

Session Classification: Gamma-Hadron Collisions

Track Classification: Gamma-Hadron Collisions

Contribution ID: 55

Type: **Talk**

Spectroscopy of light quarks

Monday, 3 June 2019 11:30 (30 minutes)

In this talk we will review some recent progress on light quark spectroscopy coming from η and η' physics.

Summary

Primary author: PASSEMAR, Emilie (Indiana University/JLab)

Presenter: PASSEMAR, Emilie (Indiana University/JLab)

Session Classification: Gamma-Hadron Collisions

Track Classification: Gamma-Hadron Collisions

Contribution ID: 56

Type: **Talk**

Recent results from the Pierre Auger Observatory

Wednesday, 5 June 2019 09:15 (30 minutes)

In this talk some recent results from the Pierre Auger Collaboration will be presented. These include the measurement of the energy spectrum of cosmic rays over a wide range of energies, studies of the cosmic-ray mass composition with the fluorescence and surface detector of the Observatory, studies on the anisotropies in the arrival direction of cosmic rays at different scales and the searches for photons and neutrinos. The astrophysical implications of the spectrum and composition results are also discussed. Finally the progress of the upgrade of the Observatory, AugerPrime is presented.

Summary

Primary author: PETRERA, Sergio (INFN and Gran Sasso Science Institute)

Presenter: PETRERA, Sergio (INFN and Gran Sasso Science Institute)

Session Classification: Astrophysical Gamma

Track Classification: Astrophysical Gamma

Contribution ID: 57

Type: **Talk**

Detection of a gamma-ray halo around Geminga with the Fermi-LAT and implications for the positron flux

Wednesday, 5 June 2019 10:15 (30 minutes)

An excess in the flux of cosmic positrons at Earth above 10 GeV has been measured by Pamela, Fermi-LAT and with unprecedented precision by AMS-02. The observed flux cannot be explained by the production of positrons in the spallation reaction of hadronic cosmic rays (CRs) with the interstellar medium. Various interpretations have been invoked to explain this excess, such as the production in Galactic supernova remnants and pulsar wind nebulae (PWNe) or, intriguingly, in the dark matter halo of the Milky Way. However, a dominant contribution from dark matter is ruled out by the complementary bounds found in other indirect searches. Models where supernova remnants produce secondary CRs struggle to explain the other species of CR fluxes observed by AMS-02. Recently, Milagro and HAWC experiments reported the detection of an extended gamma-ray emission from Geminga and Monogem PWNe at TeV energies. These nearby and powerful PWNe have been widely considered as the main candidates to contribute to the cosmic positrons at Earth. Severe constraints for a significant PWNe contribution to the positron excess can be derived from this gamma-ray emission, which has been interpreted as coming from the electrons and positrons accelerated in the PWNe and undergoing inverse Compton scattering in the interstellar medium.

In this contribution we will report the first detection of a significant extended emission from Geminga at GeV energies in Fermi-LAT data, derived by including the proper motion of its pulsar. We will present a detailed study of the gamma-ray halo around Geminga and Monogem, and show the constraints found for the contribution of these PWNe to the positron excess, combining Milagro and HAWC data with measurements from the Fermi-LAT for the first time. Then we will demonstrate that using gamma-ray data from the LAT is of central importance to provide a precise estimate for the PWN contribution to the cosmic positron flux.

Summary

Primary authors: MANCONI, Silvia (Università degli Studi di Torino); DI MAURO, Mattia (TO); DONATO, Fiorenza

Presenter: MANCONI, Silvia (Università degli Studi di Torino)

Session Classification: Astrophysical Gamma

Track Classification: Astrophysical Gamma

Contribution ID: 58

Type: **Talk**

Evidence for a New Component of Solar Gamma-Ray Emission

Tuesday, 4 June 2019 16:45 (30 minutes)

The Sun is not expected to be a bright gamma-ray source above 1 GeV, due to the moderate strength of solar magnetic fields. However, the Sun may act as a passive gamma-ray source, through the hadronic interaction of galactic cosmic rays with the Solar atmosphere. The Fermi-LAT has detected a bright solar gamma-ray flux, which implies that solar magnetic fields efficiently redirect incoming cosmic rays and produce outgoing gamma-ray emission. Here, I will show new observations, including the first resolved imaging of this gamma-ray signal across the solar surface, that find three surprising results. First, the gamma-ray emission extends to energies exceeding 200 GeV, implying that Solar magnetic fields can redirect TeV protons. Second, the morphology and spectrum of gamma-ray emission varies significantly over the solar cycle. Third, a significant “spectral-dip” appears between energies of 30-50 GeV. These observations are in significant tension with all current models of solar gamma-ray production. I will conclude by focusing on possible theoretical interpretations of these results, and their implications for our understanding of our nearest stellar neighbor.

Summary

Primary author: LINDEN, Tim (The Ohio State University)

Presenter: LINDEN, Tim (The Ohio State University)

Session Classification: Astrophysical Gamma

Track Classification: Astrophysical Gamma

Contribution ID: 59

Type: **Talk**

Gamma-ray and neutrino astrophysics connection

Wednesday, 5 June 2019 12:15 (30 minutes)

The recent discovery of a diffuse neutrino flux of astrophysical origin by IceCube started the search to identify the cosmic sources of this emission. Synergy with other experiments could be a useful mean of investigation and in particular, the combination of neutrino/gamma-ray information is motivated by the fact that both radiations may be produced in the same astrophysical particle-cascades scenario, arriving to us undeflected from the source.

With these assumptions, we can place limit on the known astrophysical source classes contribution to the diffuse neutrino flux.

Another ground of discovery in this field is the search for transient and variable neutrino/electromagnetic sources, in which case the atmospheric neutrino and muon backgrounds can be reduced by taking time- and space-coincidence. Recent results with Fermi will be presented.

Summary

Primary authors: GASPARRINI, Dario (ROMA2); Prof. BUSON, Sara (Würzburg Universität)

Presenter: GASPARRINI, Dario (ROMA2)

Session Classification: Astrophysical Gamma

Track Classification: Astrophysical Gamma

Contribution ID: 60

Type: Talk

Light neutral meson production at the LHC measured by ALICE

Thursday, 6 June 2019 11:55 (20 minutes)

We review production of light neutral mesons, neutral pions and eta mesons, measured in pp, pA and AA collisions at LHC energies. Neutral meson production provides exploration of various physics topics: In pp collisions one can test pQCD predictions, study structure function in proton and fragmentation functions, and build a reference for pA and AA collisions; In pA collisions, it enables to study cold nuclear matter effects; In AA collisions, high transverse momentum neutral mesons give insights of the parton energy loss in hot quark-gluon plasma. Furthermore, these two mesons are the dominant source of decay photons which need to be precisely determined in order to measure direct photons.

In ALICE, neutral mesons are reconstructed in the two-photon decay channel. Photons can be reconstructed via several methods, using electromagnetic calorimeters and utilizing dielectrons from photon conversion in a detector material. This allows to provide spectra in a very wide transverse momenta range and cross check of results among them. In this talk, experimental results on the light neutral meson production in pp, p-Pb and Pb-Pb collisions at LHC energies will be presented.

Summary

Primary author: SEKIHATA, Daiki (Center for Nuclear Study, the University of Tokyo)

Presenter: SEKIHATA, Daiki (Center for Nuclear Study, the University of Tokyo)

Session Classification: Gamma Final States

Track Classification: Gamma Final States

Contribution ID: 61

Type: **Talk**

Standard Model measurements with photons

Monday, 3 June 2019 10:00 (30 minutes)

In this talk I will discuss photon measurements i) as tests of pQCD and used to tune PDFs ii) providing important information for BSM searches, and iii) related with the Higgs Boson. I will go over LHC and non-LHC results and give prospects for HL-LHC and beyond.

Summary

Primary author: SAOULIDOU, Niki (University of Athens, Greece)

Presenter: SAOULIDOU, Niki (University of Athens, Greece)

Session Classification: General Talks

Track Classification: General Talks

Contribution ID: 62

Type: **Talk**

Photon-induced processes at high energy hadron colliders

Friday, 7 June 2019 11:45 (30 minutes)

I discuss the possibilities for using the LHC as a photon colliding machine. The photon parton density is quite precisely known and I consider the implications for the LHC phenomenology. In addition, the colour singlet nature of the photon means that it can readily lead to exclusive or semi-exclusive events, with limited or no extra particle production in the final state. I will show how such exclusive processes, in particular in combination with proton tagging measurements, provide a well understood environment in which to test the Standard Model and search for the BSM physics. I shall focus on a few topical examples.

Summary

Primary author: KHOZE, Valeri (IPPP, University of Durham)

Presenter: KHOZE, Valeri (IPPP, University of Durham)

Session Classification: General Talks

Track Classification: General Talks

Contribution ID: 63

Type: **Talk**

The EuPRAXIA@SPARC_LAB project

Friday, 7 June 2019 11:15 (30 minutes)

On the wake of the results obtained so far at the SPARC_LAB test-facility at LNF, we are currently investigating the possibility to design and build a new multi-disciplinary user-facility, equipped with a soft X-ray Free Electron Laser (FEL) driven by a ~1 GeV high brightness linac based on plasma accelerator modules. EuPRAXIA@SPARC_LAB is conceived as an innovative and evolutionary tool for multi-disciplinary investigations in a wide field of scientific, technological and industrial applications. It could be progressively extended to be a high brightness “particle beams factory” able to produce electrons, photons (from THz to γ -rays), neutrons, protons and positrons, that will be available for a wide national and international scientific community interested to take profit of advanced particle and radiation sources. This fundamental goals will be integrated in the LNF facility by using a high gradient X-band RF linac and the high power laser FLAME to drive Plasma Oscillations in the accelerator module. This activity is performed in synergy and in the framework of the H2020 Design Studies EuPRAXIA and CompactLight. In this talk we report about the recent progresses in the on going design study and about opportunities and perspectives for the high brightness beam physics scientific community.

Summary

Primary author: FERRARIO, Massimo (INFN-LNF)**Presenter:** FERRARIO, Massimo (INFN-LNF)**Session Classification:** General Talks**Track Classification:** General Talks

Contribution ID: 64

Type: **Talk**

Perspectives of photon physics at future colliders

Friday, 7 June 2019 12:45 (30 minutes)

We discuss recent highlights in SM photon physics at the LHC, new opportunities at its forthcoming high-luminosity runs, and perspectives for its possible high-energy upgrade and a future electron-ion collider (EIC). Particular emphasis is put on the role of photoproduction processes in understanding the nuclear structure and interactions at high energies and on searches for photon-like particles in extensions of the SM motivated e.g. by dark matter.

Summary

Primary author: KLASSEN, Michael**Presenter:** KLASSEN, Michael**Session Classification:** General Talks**Track Classification:** General Talks

Contribution ID: 65

Type: Talk

Higgs boson production in photon-photon interactions with proton, light-ion, and heavy-ion beams at current and future colliders

Wednesday, 5 June 2019 16:45 (20 minutes)

The production of the Higgs boson in photon-photon interactions with proton and nucleus beams at three colliders planned or proposed at CERN — the high-luminosity Large Hadron Collider (HL-LHC), the high-energy LHC (HE-LHC), and the Future Circular Collider (FCC) — is studied. The cross sections for the process $A \gamma\gamma A \rightarrow (A) H(A)$, with the ions A surviving the interaction and the Higgs scalar exclusively produced, are computed with Madgraph 5 modified to include the corresponding elastic γ fluxes, for Pb-Pb, Xe-Xe, Kr-Kr, Ar-Ar, O-O, p-Pb, and p-p over the nucleon-nucleon collision energy range $\sqrt{s_{NN}} \approx 3\text{--}100$ TeV. Simulations of the $\gamma\gamma \rightarrow H \rightarrow b\bar{b}$ decay mode — including realistic (mis)tagging and reconstruction efficiencies for the final-state b-jets, as well as appropriate kinematical selection criteria to reduce the similarly computed $\gamma\gamma \rightarrow b\bar{b}, c\bar{c}, q\bar{q}$ continuum backgrounds — have been carried out. Taking into account the expected luminosities for all systems, the yields and significances for observing the Higgs boson in ultraperipheral collisions (UPCs) are estimated. At HL-LHC and HE-LHC, the colliding systems with larger Higgs significance are Ar-Ar(6.3 TeV) and Kr-Kr(12.5 TeV) respectively, but 3σ evidence for two-photon Higgs production would require 200 and 30 times larger integrated luminosities than those planned today at both machines. Factors of ten can be gained by running for a year, rather than the typical 1-month heavy-ion operation at the LHC, but the process will likely remain unobserved until a higher energy hadron collider, such as the FCC, is built. In the latter machine, the 5σ observation of Higgs production in UPCs is feasible in just the first nominal run of Pb-Pb and p-Pb collisions at $\sqrt{s_{NN}} = 39$ and 63 TeV respectively.

Summary

Primary author: ERNANI MARTINS NETO, Daniel (UFRJ)

Co-authors: REBELLO TELES, Patricia (Brazilian Center for Physics Research); D'ENTERRIA, David (CERN)

Presenter: D'ENTERRIA, David (CERN)

Session Classification: Future Perspectives

Track Classification: Future Perspectives

Contribution ID: 66

Type: Talk

Axion-like particles and high energy astrophysics

Tuesday, 4 June 2019 17:45 (30 minutes)

Axion-like particles (ALPs) are light, neutral, (pseudo-)scalar bosons predicted by several extensions of the Standard Model of particle physics such as the String Theory and are supposed to interact primarily only with two photons. In the presence of an external magnetic field photon-ALP oscillations may occur and produce sizable astrophysical effects in the very-high energy (VHE) band. Photon-ALP oscillations increase the transparency of the Universe to VHE photons partially preventing the gamma-gamma absorption due to the Extragalactic Background Light (EBL). Furthermore, they have important implications for active galactic nuclei (AGNs) by modifying their observed spectra both for flat spectrum radio quasars (FSRQs) and BL Lacs. Many attempts have been made in order to constrain the ALP parameter space (two-photon coupling, ALP mass) by studying irregularities in spectra due to photon-ALP conversion in galaxy clusters, consequences of ALP emission by main sequence stars and by supernovae but the debate is still open. Future observational data in an extended energy band (like with the Cherenkov Telescope Array) might give an answer.

Summary

Primary author: GALANTI, Giorgio (INAF, Osservatorio Astronomico di Brera)

Presenter: GALANTI, Giorgio (INAF, Osservatorio Astronomico di Brera)

Session Classification: Astrophysical Gamma

Track Classification: Astrophysical Gamma

Contribution ID: 67

Type: **Talk**

Observation of high-energy cosmic photons with new-generation space telescopes

Wednesday, 5 June 2019 12:45 (30 minutes)

While the Fermi gamma-ray telescope lives its 11th year in orbit, new particle and gamma-ray space detectors are in operation as DAMPE (DARk Matter Particle Explorer), or are in the development stage as HERD (High Energy Cosmic Radiation Detector) and e-Astrogam. DAMPE was launched in 2015 by a collaboration of Chinese, Italian and Swiss scientific institutions and performs high-quality observations of cosmic electrons, protons, nuclei and also gamma rays up to 10 TeV with good angular and energy resolution. HERD will be installed on board the Chinese Space Station to be launched in 2022 and will perform accurate measurements of energy and direction of cosmic rays and photons. An overview on these and other future experiments and a summary of the main gamma-ray results and expectations will be presented.

Summary

Primary author: FUSCO, Piergiorgio (BA)**Presenter:** FUSCO, Piergiorgio (BA)**Session Classification:** Astrophysical Gamma**Track Classification:** Astrophysical Gamma

Contribution ID: 68

Type: **Talk**

Indirect searches for dark matter from radio to gamma rays

Tuesday, 4 June 2019 17:15 (30 minutes)

The particle nature of dark matter remains one of the most mysterious and urgent research questions of modern particle physics and cosmology. Despite decades of research, the mass of possible dark matter particles is only constrained to within 80 orders of magnitude or so. Astronomical observations spanning the full electromagnetic spectrum allow to search for dark matter particles across the mass scales. I will briefly review the most popular models for dark matter, including axions, sterile neutrinos, WIMPs and primordial black holes, discuss the current status of astrophysical searches, and highlight opportunities for the upcoming years.

Summary

Primary author: WENIGER, Christoph (GRAPPA, University of Amsterdam)

Presenter: WENIGER, Christoph (GRAPPA, University of Amsterdam)

Session Classification: Astrophysical Gamma

Contribution ID: 69

Type: **Talk**

The electron-ion collider –A collider to unravel the mysteries of hadron structure

Friday, 7 June 2019 12:15 (30 minutes)

Understanding the properties of nuclear matter and its emergence through the underlying partonic structure and dynamics of quarks and gluons requires a new experimental facility in hadronic physics known as the Electron-Ion Collider (EIC). The EIC will address some of the most profound questions concerning the emergence of nuclear properties by precisely imaging gluons and quarks inside protons and nuclei such as the distribution of gluons and quarks in space and momentum, their role in building the nucleon spin and the properties of gluons in nuclei at high energies. Two facility concepts have been presented to address these conditions, at Brookhaven National Laboratory and Jefferson Laboratory taking advantage of existing accelerator infrastructure and accelerator expertise. This presentation will highlight the capabilities of an EIC and discuss its status.

Summary

Primary author: ASCHENAUER, Elke-Caroline (BNL)

Presenter: ASCHENAUER, Elke-Caroline (BNL)

Session Classification: General Talks

Track Classification: General Talks

Contribution ID: 70

Type: **Talk**

Multi-messenger astronomy of gravitational-wave transients in the "Automatic Public Alert" Era

Wednesday, 5 June 2019 11:15 (30 minutes)

The search for electromagnetic counterparts or neutrino emissions from gravitational-wave sources engages a wide scientific community. Here, we outline the pathway that led to the birth of multi-messenger astronomy with the first direct observations of the gravitational-wave signals measured to date, focusing on the new challenges of LIGO and Virgo Observing Run 3 (O3) and the beginning of the public gravitational-wave alert era.

Summary

Primary author: GRECO, Giuseppe (Urbino University/INFN-Firenze)

Presenter: GRECO, Giuseppe (Urbino University/INFN-Firenze)

Session Classification: Astrophysical Gamma

Track Classification: Astrophysical Gamma

Contribution ID: 71

Type: **Talk**

A Light Dark Matter Portal: the axion-like particle

Thursday, 6 June 2019 11:15 (20 minutes)

The nature of the dark matter is still an unsolved mystery and its identification represent a big challenge for model builders and experimentalists. For many years the WIMP miracle has been considered the most promising solution among the Dark Matter candidates. Recently lower energy scales have attracted increasing interest. I will present the axion-like particle (ALP) as a possible candidate for a Portal to a Light Dark Sector, with particular attention to the phenomenology at low energy electron positron colliders.

Summary

Primary author: GIACCHINO, Federica (LNF)**Presenter:** GIACCHINO, Federica (LNF)**Session Classification:** Gamma Final States**Track Classification:** Gamma Final States

Contribution ID: 72

Type: **Talk**

"Coherent photoproduction of J/ψ in nucleus-nucleus collisions and future perspectives for electron-ion collider "

Wednesday, 5 June 2019 17:25 (20 minutes)

We investigate the exclusive photoproduction of J/ψ mesons in ultraperipheral heavy-ion collisions in the color dipole approach.

We use the color dipole formulation of Glauber-Gribov theory to calculate the diffractive amplitude on the

nuclear target. We compare our results to recent published data on exclusive J/ψ production in ultraperipheral

lead-lead collisions at $\sqrt{s_{NN}}=2.76$ and $\sqrt{s_{NN}}=5.02$ TeV. We describe these data well, however at high- γA

energies there is room for additional shadowing corrections, corresponding to triple-Pomeron terms or shadowing from large mass diffraction.

It is very interesting to investigate this issue at future measurements at electron-ion collider (EIC)

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It will be crucial for a deeper understanding of the nuclear glue.

Based on Phys.Rev. C99 (2019) no.4, 04490

Summary

Primary author: LUSZCZAK, Agnieszka (Cracow University of Technology)

Presenter: LUSZCZAK, Agnieszka (Cracow University of Technology)

Session Classification: Future Perspectives

Track Classification: Future Perspectives

Contribution ID: 73

Type: **Talk**

Study of QED in strong field regime at LUXE experiment

Tuesday, 4 June 2019 11:25 (20 minutes)

The talk presents the LUXE experiment which plans on using the European XFEL electron beam at DESY with an energy of 17.5 GeV and a high intensity optical laser to study non-perturbative QED phenomena. The main focus of the experiment will be the measurement of the rate of laser assisted electron-positron pair production in collisions of high energy photons with an intensive laser beam and high intensity Compton scattering in electron-laser interaction. The design of the experimental setup, detector systems requirements and simulation results will be presented and discussed.

Summary

Primary author: BORYSOV, Oleksandr (Deutsches Elektronen-Synchrotron DESY)

Presenter: BORYSOV, Oleksandr (Deutsches Elektronen-Synchrotron DESY)

Session Classification: Gamma-Gamma Collisions

Track Classification: Gamma-Gamma Collisions

Contribution ID: 74

Type: **Talk**

The Synchrotron: father of the Frascati particle accelerators

Monday, 3 June 2019 09:30 (30 minutes)

On 9 February 1959 it was announced that the 1 GeV energy was reached by the Frascati synchrotron. This great achievement, considering the Italy of the post-war period, started the Frascati history on particle physics experiments and on development of particle accelerators and detectors. The synchrotron team then developed the accelerator concept by building the first electron and positrons collider in the world, ADA: subsequently the ADONE colliders and the first Phi-Factory DAPHNE have been realized in Frascati.

Summary

Primary author: GHIGO, Andrea (LNF)

Presenter: GHIGO, Andrea (LNF)

Session Classification: General Talks

Track Classification: General Talks

Contribution ID: 75

Type: **Talk**

Recent results on two-photons processes at BaBar

Monday, 3 June 2019 17:20 (20 minutes)

We study process $e^+e^- \rightarrow e^+e^-\eta'$ in the double-tag mode and measure for the first time the $\gamma\gamma \rightarrow \eta'$ formfactor $F(Q^2_1, Q^2_2)$ in the momentum-range $2 < Q^2_1, Q^2_2 < 60 \text{ GeV}^2$. The analysis is based on data with an integrated luminosity 469 fb^{-1} collected at the PEP-II e^+e^- collider with the BABAR detector at center-of-mass energies near 10.6 GeV. The results for the formfactor are compared with the predictions based on pQCD and VMD.

Summary

Primary author: LUKIN, Peter (Budker Institute of Nuclear Physics and Novosibirsk State University)

Presenter: LUKIN, Peter (Budker Institute of Nuclear Physics and Novosibirsk State University)

Session Classification: Gamma-Gamma Collisions

Track Classification: Gamma-Gamma Collisions

Contribution ID: 76

Type: **Talk**

Parton distribution functions and EW corrections

Monday, 3 June 2019 10:30 (30 minutes)

Precision phenomenology at the LHC requires accounting for both higher-order QCD and electroweak corrections as well as for photon-initiated subprocesses. In this talk I summarise the development history concerning: the inclusion of electroweak effects in parton distribution functions, the evolution of PDF algorithms for the determination of the photon PDF during the past decade, and the impact of photon-initiated contributions to several processes.

Summary

Primary author: CARRAZZA, Stefano (MI)**Presenter:** CARRAZZA, Stefano (MI)**Session Classification:** General Talks**Track Classification:** General Talks

Contribution ID: 77

Type: **not specified**

Tools

Session Classification: Workshop on Photon Physics and Simulation at Hadron Colliders

Contribution ID: 78

Type: **Talk**

Welcome Speech

Monday, 3 June 2019 09:15 (15 minutes)

Summary

Presenters: CAMPANA, Pierluigi (LNF); PANCHERI, Giulia (LNF)

Contribution ID: 79

Type: **Talk**

Final Remarks

Friday, 7 June 2019 13:15 (5 minutes)

Presenter: DI NEZZA, Pasquale (LNF)

Session Classification: General Talks