

# **International Workshop on $e^+e^-$ collisions from Phi to Psi 2017**

## **Report of Contributions**

Contribution ID : **95**Type : **Poster**

## The OLYMPUS Experiment at DESY

*Tuesday, 27 June 2017 18:30 (0:20)*

### Content

Hard two-photon exchange has been favored theoretically to explain the previously observed discrepancy in measurements of the elastic proton electric-to-magnetic form factor ratio with polarized and unpolarized methods. Several experiments have been carried out to investigate the effects of two-photon exchange. The OLYMPUS experiment at DESY has been one of three dedicated experiments to use comparisons of positron-proton and electron-proton scattering to unequivocally determine the effects of two-photon exchange. Results from the OLYMPUS experiment will be presented. This work has been supported by the U.S. National Science Foundation and Department of Energy.

### Summary

**Primary author(s)** : Prof. KOHL, Michael (Hampton University)

**Presenter(s)** : Prof. KOHL, Michael (Hampton University)

**Session Classification** : Poster Session

Contribution ID : **96**Type : **Poster**

## The MUon Scattering Experiment (MUSE) at PSI

*Tuesday, 27 June 2017 18:30 (0:20)*

### Content

The proton is not an elementary particle but has a substructure governed by the interaction of quarks and gluons. The size of the proton is manifest in the spatial distributions of the electric charge and magnetization, which determine the response to electromagnetic interaction. Recently, contradictory measurements of the proton charge radius between muonic hydrogen and electronic probes have constituted the proton radius puzzle, which has been challenging our basic understanding of the proton. The MUon Scattering Experiment (MUSE) in preparation at the Paul-Scherrer Institute (PSI) has the potential to resolve the puzzle by measuring the proton charge radius with electron and muon scattering simultaneously and with high precision, including any possible difference between the two, and with both beam charges. The status of the MUSE experiment will be reported. This work has been supported by the U.S. National Science Foundation and Department of Energy.

### Summary

**Primary author(s)** : Prof. KOHL, Michael (Hampton University)

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**Presenter(s)** : Prof. KOHL, Michael (Hampton University)

**Session Classification** : Poster Session

Contribution ID : 14

Type : **Poster**

## High-precision measurement of the proton radius with an active hydrogen Time Projection Chamber

*Tuesday, 27 June 2017 18:30 (0:20)*

### Content

One of today's most pressing question in nuclear physics is the understanding of the so-called "proton radius puzzle". The puzzle originates from a striking discrepancy between the electric charge radius of the proton, extracted from the muonic hydrogen Lamb shift, compared to measurements based on electron-proton scattering experiments and atomic transition measurements in electronic hydrogen. Solving this problem requires experiments approaching the problem in new ways. To address this puzzle, we will perform a high-precision measurement of the differential ep-scattering cross section in the region of low momentum transfer at the Mainz Microtron (MAMI). To perform this experiment, a new-generation detector, consisting of a Hydrogen Time Projection Chamber (TPC) and Forward Tracking System will be constructed, and a new electron beam line at MAMI will be built. The experimental setup will allow us to measure the energy and angle of the recoil proton with unprecedented accuracy as well as the angle of the forward scattered electron. This is a completely new approach compared to other experiments, which mainly focus on the electron angle. A test measurement with a TPC prototype will be conducted at MAMI in August 2017, which will serve as basis for the main experiment.

### Summary

**Primary author(s) :** Dr. ADLARSON, Patrik (Johannes Gutenberg Universität-Mainz); Dr. SOKHOYAN, Vahe (Johannes Gutenberg Universität-Mainz)

**Presenter(s) :** Dr. ADLARSON, Patrik (Johannes Gutenberg Universität-Mainz); Dr. SOKHOYAN, Vahe (Johannes Gutenberg Universität-Mainz)

**Session Classification :** Poster Session

Contribution ID : **97**Type : **Poster**

## Beam Dump Experiment (BDX) @ MESA

*Tuesday, 27 June 2017 18:30 (0:20)*

### Content

At the Institute for Nuclear Physics in Mainz the new electron accelerator MESA will go into operation within the next years. In the extracted beam operation (155 MeV, 150 uA) the P2 experiment will measure the weak mixing angle in electron-proton scattering with a very high precision. For the desired accuracy 10,000 hours of operation time are needed and therefore the high-power beam dump of this experiment is ideally suited for a parasitic dark sector experiment.

This poster outlines the physical motivation for a Beam Dump Experiment @ MESA that can significantly contribute to DM searches. At MESA there will be a limited but dedicated floor space available for the BDX. On this basis, first ideas, calculations and drawings for such an experiment are shown.

### Summary

**Primary author(s)** : Mr. CHRISTMANN, Mirco (KPH)

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**Presenter(s)** : Mr. CHRISTMANN, Mirco (KPH); Dr. ACHENBACH, Patrick (Mainz University)

**Session Classification** : Poster Session

Contribution ID : **105**Type : **Poster**

## **Magix: A versatile experiment for low-energy physics**

*Tuesday, 27 June 2017 18:30 (0:20)*

### **Content**

Running in parallel to the existing MAMI electron accelerator, the new workhorse of the Institute of Nuclear Physics of the University of Mainz is an energy recovering electron recirculator capable of delivering 1 mA polarized currents at 105 MeV to a fix target experiment in its path. The Magix experiment is currently being developed to exploit that power to perform high-precision experiments in that energy range. This poster will present part of the ambitious physics program of that experiment including, among others, the search for new particles like the possible new dark mediators in both the visible and invisible decay channels and the precision spectroscopy below the hadronization threshold to improve the constraints on the electronic radius of the proton and to test the prediction of modern effective field theories.

### **Summary**

**Primary author(s)** : Mr. CAIAZZA, Sabato Stefano (KPH Institut, JGU Universitaet Mainz)

**Presenter(s)** : Mr. CAIAZZA, Sabato Stefano (KPH Institut, JGU Universitaet Mainz)

**Session Classification** : Poster Session

Contribution ID : **11**Type : **Poster**

## Recent Results of the Hadronic Cross Sections Measurement of the Processes $e^+e^- \rightarrow K\bar{K}n\pi$ with CMD-3 Detector

*Tuesday, 27 June 2017 18:30 (0:20)*

### Content

After the upgrade of the positron injection facility the electron-positron collider VEPP-2000 started to operate at the end of last year and delivers an excellent luminosity, which is higher than the previous in 2-3 times. The detector CMD-3 has gained a new statistic, which corresponds to integrated luminosity of about  $30 \text{ pb}^{-1}$ . Many processes in the energy region from 1 to 2 GeV go through the production of multihadron events with kaons in the final state. The paper presents preliminary results of measurements of the cross sections for some processes. These new results are badly required to improve the uncertainty of calculation of the hadronic contribution to  $(g-2)/2$  of muon particularly in the light of new experiment in FNAL.

### Summary

**Primary author(s)** : Prof. FEDOTOVICH, Gennady (Budker institute of nuclear physics)

**Presenter(s)** : Prof. FEDOTOVICH, Gennady (Budker institute of nuclear physics)

**Session Classification** : Poster Session

## Study of the process $e^+e^- \rightarrow \pi^+\pi^-\pi^0\eta$ at the SND detector

*Tuesday, 27 June 2017 18:30 (0:20)*

### Content

The reaction  $e^+e^- \rightarrow \pi^+\pi^-\pi^0\eta$  has been studied in the experiment with the SND detector at the VEPP-2000  $e^+e^-$  collider. The reaction proceeds via the four intermediate states:  $\omega\eta$ ,  $\phi\eta$ ,  $a_0\rho$  and structureless  $\pi^+\pi^-\pi^0\eta$  state, which may be, for example,  $\rho(1450)\pi$  with  $\rho(1450) \rightarrow \rho(770)\eta$ . The total  $e^+e^- \rightarrow \pi^+\pi^-\pi^0\eta$  cross section and cross section for the four intermediate states have been measured and fitted in the vector meson dominance model.

### Summary

**Primary author(s)** : Mr. BOTOV, Alexander (Budker Institute of Nuclear Physics)

**Presenter(s)** : Mr. BOTOV, Alexander (Budker Institute of Nuclear Physics)

**Session Classification** : Poster Session



Contribution ID : **104**Type : **Poster**

## Measurement of $e^+e^- \rightarrow K^+K^-$ cross section at $E_{cm} = 2.0 - 3.08$ GeV

*Tuesday, 27 June 2017 18:30 (0:20)*

### Content

The cross section of the  $e^+e^- \rightarrow K^+K^-$  process is measured with data samples collected with Beijing Spectrometer (BESIII) at  $\sqrt{s} = 2.00 - 3.08$  GeV. The results are consistent with those of BaBar and with better precision. A structure near 2.2 GeV is observed with mass  $2229.8 \pm 5.3_{stat} \pm 17.2_{syst}$  MeV and width  $143.7 \pm 12.0_{stat} \pm 7.8_{syst}$  MeV. The kaon form factor is extracted from  $\sigma(e^+e^- \rightarrow K^+K^-)$  and compared with theoretical prediction.

### Summary

**Primary author(s)** : Mr. LIU, Dong (USTC)

**Presenter(s)** : Mr. LIU, Dong (USTC)

**Session Classification** : Poster Session

Contribution ID : **103**Type : **Poster**

## Search for the $\chi_{c1}$ charmonium in direct $e^+e^-$ production

*Tuesday, 27 June 2017 18:30 (0:20)*

### Content

With the high luminosity accelerator – BEPCII and the BESIII detector located in Beijing, China, for the first time, we are able to search for a non-vector charmonium – the  $\chi_{c1}$  state in  $e^+e^-$  direct production. In order to investigate the full interference line shape of  $\chi_{c1}$  with continuum background, we propose to take data with  $e^+e^-$  central-of-mass energy 2 MeV below, exactly at, and 2 MeV above the  $\chi_{c1}$  nominal mass. From 14th May to 1st June, and 11th June to 13th June, the BESIII detector successfully accumulated 175  $pb^{-1}$  data at 3508.66 MeV, 175  $pb^{-1}$  data at 3510.66 MeV and 38  $pb^{-1}$  data at 3514.6 MeV. Detailed data analysis is ongoing, and the final results will be released soon.

### Summary

**Primary author(s)** : Dr. LIU, Zhiqing (postdoc)

**Presenter(s)** : Dr. LIU, Zhiqing (postdoc)

**Session Classification** : Poster Session

Contribution ID : **101**Type : **Poster**

## Testing $\chi_c$ properties at BELLE II

*Tuesday, 27 June 2017 18:30 (0:20)*

### Content

The integrated luminosity in the BELLE II experiment (20-50  $\text{ab}^{-1}$ ) will allow to access information never available before. It was found, within the model implemented in the newly updated Monte Carlo generator EKHARA, that at BELLE II it will be possible to study in detail  $\chi_{ci} - \gamma^* - \gamma$  form factors through measurements of the reaction  $e^+e^- \rightarrow e^+e^-\chi_{ci}(\rightarrow \gamma J/\psi(\rightarrow \mu^+\mu^-))$ . The proposed measurements will also serve as tests of the models predicting the  $\chi_{c1}$  and  $\chi_{c2}$  electronic widths.

### Summary

**Primary author(s)** : KISZA, Patrycja (University of Silesia)

**Presenter(s)** : KISZA, Patrycja (University of Silesia)

**Session Classification** : Poster Session

Contribution ID : **107**Type : **Poster**

## Measurement of $J/\psi$ Decay Widths with an Energy Scan Method

*Tuesday, 27 June 2017 18:30 (0:20)*

### Content

We measure the cross sections of  $e^+e^- \rightarrow e^+e^-$  and  $e^+e^- \rightarrow \mu^+\mu^-$  processes using the data set collected with the BESIII detector at fifteen energy points around the  $J/\psi$  resonance. By fitting the theoretical cross section curves of the two processes as functions of energy to the measured cross section data simultaneously, the combinations of  $J/\psi$  decay widths  $\Gamma_{ee}\Gamma_{ee}/\Gamma_{\text{tot}}$  and  $\Gamma_{ee}\Gamma_{\mu\mu}/\Gamma_{\text{tot}}$  are extracted to be  $(0.348 \pm 0.008)$  keV and  $(0.339 \pm 0.005)$  keV with a covariance  $0.000,037$  keV<sup>2</sup>.

With the fitting results,  $\Gamma_{ee}/\Gamma_{\mu\mu}$  is evaluated as  $1.025 \pm 0.014$ , which proves the lepton universality. Assuming the lepton universality and combining the branching ratio of  $J/\psi$  leptonic decay measured by BESIII in 2013, the total width  $\Gamma_{\text{tot}}$  and the leptonic width  $\Gamma_{ll}$  are determined to be  $(94.3 \pm 1.9)$  keV and  $(5.64 \pm 0.10)$  keV, respectively.

### Summary

**Primary author(s)** : ZHOU, Xingyu (IHEP Beijing)

**Presenter(s)** : ZHOU, Xingyu (IHEP Beijing)

**Session Classification** : Poster Session

Contribution ID : 109

Type : Poster

# Accessing the real part of the amplitudes of the forward scatterings of $J/\psi$ and $\phi$ mesons on the protons from photoproduction at threshold

Tuesday, 27 June 2017 18:30 (1:30)

## Content

We provide an updated analysis of the forward  $J/\psi$ -p scattering amplitude, relating its imaginary part to  $\gamma p \rightarrow J/\psi p$  and  $\gamma p \rightarrow c\bar{c}$  cross sections data, and calculating its real part through a once-subtracted dispersion relation.

From a global fit to both differential and total cross section data, we extract a value for the spin-averaged  $J/\psi$ -p s-wave scattering length  $a_{\psi p} = 0.046 \pm 0.005$  fm, which can be translated into a  $J/\psi$  binding energy in nuclear matter  $B_{\psi} = 2.7 \pm 0.3$  MeV.

We estimate the forward-backward asymmetry to the  $\gamma p \rightarrow e^-e^+$  process around the  $J/\psi$  resonance, which results from interchanging the leptons in the interference between the  $J/\psi$  production and the Bethe-Heitler mechanisms. To a good approximation this asymmetry depends linearly on  $a_{\psi p}$ , and can reach values around -25 % for forthcoming  $J/\psi$  threshold production experiments at JLab. Its measurement can thus provide a very sensitive observable for a refined extraction of  $a_{\psi p}$ .

We also made a preliminary analysis of the case of  $\phi$ -p forward scattering. A lack of inclusive cross section data, as well as the absence of a consistent dataset for the exclusive total and differential cross section of the  $\phi$  photoproduction off the proton, does not allow us to draw precise constraints on the fit parameters at this point.

By fixing the value of Regge slope, for both elastic and inelastic total  $\phi$ -p scattering cross sections,  $\alpha_{el} = \alpha_{inel} = 1.092$  taken from fits of total photoproduction off the proton, we estimate the value of the subtraction constant of the forward elastic amplitude  $T_{\phi p}(0) \approx 46.3$ , which is approximately two times higher than what we obtained for the  $J/\psi$  case. The estimated forward-backward asymmetry was shown to reach values of about -20% for the beam energies  $E = 2.2, 4.4$  GeV.

The suitable kinematics were investigated for the specific setup of HMS and SHMS detectors of Hall C at JLab. Studies for the other JLab experiments (e.g. GlueX, SOLID) are ongoing.

## Summary

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**Presenter(s) :** Mr. GRZYNIUK, Oleksii (JGU Mainz)

**Session Classification :** Poster Session

Contribution ID : 102

Type : **Poster**

## Theoretical Description of the Invariant Mass Distribution of the decay $Y(4260) \rightarrow J/\psi \pi^+ \pi^-$

*Tuesday, 27 June 2017 18:30 (0:20)*

### Content

In this work, we aim to provide a physical description of the recent BESIII data on the exotic meson decay,  $Y(4260) \rightarrow J/\psi \pi^+ \pi^-$ . In the  $\psi\pi$  invariant mass distribution, one can observe two peaks, which correspond to the exotic meson  $Z_c(3900)$  and its kinematic reflection. Its shape can be parameterized as a S-wave Breit-Wigner and a background, which comes from the final state interactions of two pions. The latter we implement using unitarity and analyticity constraints. In result, a simultaneous description of  $\psi\pi$  and  $\pi\pi$  invariant mass distributions is achieved.

### Summary

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**Presenter(s)** : Mr. MOLNAR, Daniel (JGU Mainz)

**Session Classification** : Poster Session

Contribution ID : **10**Type : **Poster**

## Measurement of $\Gamma_{ee} * B_{hadrons}$ for $J/\psi$ meson with KEDR detector

*Tuesday, 27 June 2017 18:30 (0:20)*

### Content

We report a new precise measurement  $J/\psi$  meson leptonic width performed with the KEDR detector at the VEPP-4M  $e^+e^-$  collider. Cross sections for the processes  $e^+e^- \rightarrow hadrons$  and  $e^+e^- \rightarrow e^+e^-$  were measured at  $J/\psi$  resonance energy range and  $\Gamma_{ee} * B_{hadrons}(J/\psi)$  value was obtained with accuracy about 2%. Leptonic and total widths were calculated, using the table values of the leptonic branching ratios.

### Summary

**Primary author(s)** : Mrs. KHARLAMOVA, Tatyana (BINP)

**Presenter(s)** : Mrs. KHARLAMOVA, Tatyana (BINP)

**Session Classification** : Poster Session

Contribution ID : 92

Type : **Poster**

## Measurement of $\Gamma_{ee} \times \mathcal{B}_{\mu\mu}$ for $\psi(2s)$ meson with KEDR detector

*Tuesday, 27 June 2017 18:30 (0:20)*

### Content

Based on the nine data sets taken with the KEDR detector since 2004 in charmonia region, we report  $\Gamma_{ee} \times \mathcal{B}_{\mu\mu} = 19.4 \pm 0.3 \pm 0.4$  eV for  $\psi(2s)$  meson. The total luminosity accounted for is more than  $6.5 \text{ pb}^{-1}$ , corresponding to about  $4 \times 10^6 \psi(2s)$ .

There were several scans of the resonance allowing us to know the collider energy spread and several runs where the data was taken at the  $\psi(2s)$  peak and slightly below it.

The Particle Data Group does not mention any direct measurement of this quantity yet. Instead, many  $\psi(2s)$  parameters, including partial widths and branching ratios, are obtained using a complicated simultaneous fit of results of various experiments.

### Summary

**Primary author(s)** : Mr. SUKHAREV, Andrey (BINP)

**Presenter(s)** : Mr. SUKHAREV, Andrey (BINP)

**Session Classification** : Poster Session



Contribution ID : 12

Type : **Poster**

## An Improved Limit for $\Gamma_{ee}$ of **X(3872)** and $\Gamma_{ee}$ Measurement of $\psi(3686)$

*Tuesday, 27 June 2017 18:30 (0:20)*

### Content

Using the data sets taken at center-of-mass energies above 4 GeV by the BESIII detector at the BEPCII storage ring, we search for the reaction  $e^+e^- \rightarrow \gamma_{\text{ISR}} X(3872) \rightarrow \gamma_{\text{ISR}} \pi^+ \pi^- J/\psi$  via the Initial State Radiation technique. The production of a resonance with quantum numbers  $J^{PC} = 1^{++}$  such as the  $X(3872)$  via single photon  $e^+e^-$  annihilation is forbidden, but is allowed by a next-to-leading order box diagram. We do not observe a significant signal of  $X(3872)$ , and therefore give an upper limit for the electronic width times the branching fraction  $\Gamma_{ee}^{X(3872)} \mathcal{B}(X(3872) \rightarrow \pi^+ \pi^- J/\psi) < 0.13$  eV at the 90% confidence level. This measurement improves upon existing limits by a factor of 46. Using the same final state, we also measure the electronic width of the  $\psi(3686)$  to be  $\Gamma_{ee}^{\psi(3686)} = 2213 \pm 18_{\text{stat}} \pm 99_{\text{sys}}$  eV.

### Summary

**Primary author(s)** : Mr. RIPKA, Martin (JGU KPH)

**Presenter(s)** : Mr. RIPKA, Martin (JGU KPH)

**Session Classification** : Poster Session

Contribution ID : **108**Type : **Poster**

## Study of $\tau \rightarrow 3\pi\nu_\tau$ within extended RChT including tensor and scalar resonances

*Tuesday, 27 June 2017 18:30 (0:20)*

### Content

We analyze the contribution from intermediate spin-0 and spin-2 resonances to the  $\tau \rightarrow 3\pi\nu_\tau$  decay by means of a chiral invariant Lagrangian incorporating these mesons. In particular, we study the corresponding axial-vector form-factors. The advantage of this procedure with respect to previous analyses is that it incorporates chiral (and isospin) invariance and, hence, the partial conservation of the axial-vector current. This ensures the recovery of the right low-energy limit, described by chiral perturbation theory, and the transversality of the current in the chiral limit at all energies.

### Summary

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**Co-author(s)** : SANZ CILLERO, Juan Jose (UCM)

**Presenter(s)** : Dr. SHEKHOVTSOVA, Olga (Institute of Nuclear Physics)

**Session Classification** : Poster Session

Contribution ID : 85

Type : **Poster**

# Quark mass dependence in photon pion scattering

*Tuesday, 27 June 2017 18:30 (0:20)*

## Content

Usually the simulation of scattering processes in lattice QCD is carried out at unphysical high values of the quark masses [1]. Hence, a method to extrapolate data obtained in lattice calculations to physical masses is needed to allow for comparison between theory and experiment. To obtain a sound extrapolation, dispersion relations and chiral perturbation theory (ChPT) can be invoked. While a simple combined approach known as the inverse amplitude method (IAM) allows for a successful extrapolation of  $\pi\pi \rightarrow \pi\pi$  data [2], a more complicated framework is needed for inelastic processes such as  $\gamma\pi \rightarrow \pi\pi$ . By extending the dispersive description derived in Ref. [3], the extrapolation can be performed for  $\gamma\pi \rightarrow \pi\pi$ . This particular process is interesting due to both its contribution to the anomalous magnetic moment of the muon and its connection to the axial anomaly.

References:

- 1 Briceno et al.: <https://arxiv.org/abs/1507.06622>
- 2 Bolton, Briceno, Wilson: <https://arxiv.org/abs/1507.07928>
- 3 Hoferichter, Kubis, Sakkas: <https://arxiv.org/abs/1210.6793v2>

## Summary

We investigate the quark mass dependence of the process  $\gamma\pi \rightarrow \pi\pi$  using dispersion relations and chiral perturbation theory.

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**Session Classification :** Poster Session

Contribution ID : **87**Type : **Poster**

## Dark Photon Search at BESIII with ISR Method

*Tuesday, 27 June 2017 18:30 (0:20)*

### Content

Using a data set of  $2.93 \text{ fb}^{-1}$  taken at a center-of-mass energy of 3.773 GeV with the BESIII detector at the BEPCII collider, a search for an extra U(1) gauge boson, also denoted as a dark photon, has been performed. We examine the initial state radiation reactions  $e^+e^- \rightarrow e^+e^-\gamma_{ISR}$  and  $e^+e^- \rightarrow \mu^+\mu^-\gamma_{ISR}$  for this search, where the dark photon would appear as an enhancement in the invariant mass distribution of the leptonic pairs. We observe no obvious enhancement in the mass range between 1.5 and 3.4 GeV/ $c^2$  and set a 90% confidence level upper limit on the mixing strength of the dark photon and the Standard Model photon. We obtain a competitive limit in the tested mass range.

### Summary

**Primary author(s)** : Dr. GUO, Yuping (KPH, JGU Mainz)

**Presenter(s)** : Dr. GUO, Yuping (KPH, JGU Mainz)

**Session Classification** : Poster Session

Contribution ID : **88**Type : **Poster**

## Composite Baryogenesis

*Tuesday, 27 June 2017 18:30 (0:20)*

### Content

The composite models, which address the existing problems of the Standard Model, generally include the excited leptons. I introduce new scenarios for possible generation of the baryon asymmetry of the universe using these new particles. The scenarios do not contradict to the small neutrino masses and the proton stability, and can be tested at the LHC.

### Summary

**Primary author(s)** : Dr. ZHURIDOV, Dmitry (University of Silesia)

**Presenter(s)** : Dr. ZHURIDOV, Dmitry (University of Silesia)

**Session Classification** : Poster Session

Contribution ID : **94**Type : **Poster**

## Lattice calculation of the pion transition form factor

*Tuesday, 27 June 2017 18:30 (0:20)*

### Content

We report on the lattice QCD calculation of the  $\pi^0 \rightarrow \gamma^* \gamma^*$  form factor with photon virtualities in the range  $Q^2 \in [0 - 1.5] \text{ GeV}^2$ . Different lattice spacings and pion masses are used to extrapolate our result to the physical point. First, we check that our results, once extrapolated to the chiral and continuum limit, are compatible with the chiral anomaly. Then, the shape of the form factor is compared to different phenomenological models proposed in the literature and to experimental data in the single-virtual case when one photon is on-shell. From a phenomenological point of view, this form factor determines the  $\pi^0$  pole contribution to hadronic light-by-light (HLbL) scattering in the muon  $g-2$ , thought to be dominant.

### Summary

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**Presenter(s)** : Dr. GERARDIN, Antoine (Institute for Nuclear Physics, University of Mainz)

**Session Classification** : Poster Session

Contribution ID : **91**Type : **Poster**

# Dispersive reconstruction of the neutral pion transition form factor obeying asymptotic constraints

Tuesday, 27 June 2017 18:30 (0:20)

## Content

The neutral pion transition form factor plays prominent roles both in the hadronic light-by-light scattering corrections to the muon anomaly and in the electromagnetic rare decays of the pion. The singly-virtual transition form factor has been investigated in dispersion relations [1], where the form factor in time-like region was predicted based on the  $e^+e^- \rightarrow 3\pi$  cross section data and the high-precision space-like form factor was obtained at low energy by analytic continuation. In this work, we generalize the dispersive analysis into the doubly-virtual kinematics, incorporating the celebrated upshots obtained from perturbative quantum chromodynamics [2-6]. The resulting form factor provides a possibility to study the  $\pi^0$ -pole contribution to the hadronic light-by-light scattering of the muon  $g - 2$  in a model independent manner with well estimated uncertainty.

[1] M. Hoferichter, B. Kubis, S. Leupold, F. Niecknig and S. P. Schneider, *Dispersive analysis of the pion transition form factor*, Eur. Phys. J. C **74** (2014) 3180, [arXiv:1410.4691 [hep-ph]].

[2] G. P. Lepage and S. J. Brodsky, *Exclusive Processes in Quantum Chromodynamics: Evolution Equations for Hadronic Wave Functions and the Form-Factors of Mesons*, Phys. Lett. B **87** (1979) 359.

[3] G. P. Lepage and S. J. Brodsky, *Exclusive Processes in Perturbative Quantum Chromodynamics*, Phys. Rev. D **22** (1980) 2157.

[4] S. J. Brodsky and G. P. Lepage, *Large Angle Two Photon Exclusive Channels in Quantum Chromodynamics*, Phys. Rev. D **24** (1981) 1808.

[5] V. A. Nesterenko and A. V. Radyushkin, *Comparison of the QCD Sum Rule Approach and Perturbative QCD Analysis for  $\gamma^*\gamma^* \rightarrow \pi^0$  Process*, Sov. J. Nucl. Phys. **38** (1983) 284.

[6] V. A. Novikov, M. A. Shifman, A. I. Vainshtein, M. B. Voloshin and V. I. Zakharov, *Use and Misuse of QCD Sum Rules, Factorization and Related Topics*, Nucl. Phys. B **237** (1984) 525.

## Summary

**Primary author(s)** : BAI, Long (Bonn University)

**Co-author(s)** : KUBIS, Bastian (Bonn University); HOFERICHTER, Martin (University of Washington); LEUPOLD, Stefan (Uppsala University)

**Presenter(s)** : BAI, Long (Bonn University)

**Session Classification** : Poster Session

Contribution ID : **100**Type : **Poster**

## Two-photon form factors of the pseudoscalar mesons in Phokhara and Ekhara Monte Carlo generators

*Tuesday, 27 June 2017 18:30 (0:20)*

### Content

Phenomenological model, which describe very well the coupling of the  $\pi^0, \eta, \eta'$  mesons to two photons is presented. The model of the form factors is consistent with the data in the space-like region, as well with the data in the time-like region with exception of the  $\pi^0$  BaBar data and  $\eta$  CMD2 data. The obtained form factors are implemented in Monte Carlo event generator Phokhara and Ekhara and investigation of the impact of radiative corrections for a cross section of  $e^+e^- \rightarrow \gamma\pi^0, (\eta, \eta')$  is studied.

### Summary

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**Session Classification** : Poster Session



Contribution ID : 90

Type : Poster

# Decay of eta' into four pions and its impact on the doubly-virtual eta' transition form factor

Tuesday, 27 June 2017 18:30 (0:20)

## Content

It has been shown that the decay amplitude  $\eta' \rightarrow \pi^+\pi^-\gamma$  has an important impact on the dispersion-theoretical analysis of the singly-virtual  $\eta'$  transition form factor [1]. Consequently, we expect that the *doubly*-virtual transition form factor can be understood in more detail, starting from an analysis of the decay  $\eta' \rightarrow 2(\pi^+\pi^-)$ . It was found that the  $\eta'$  decay into four charged pions is clearly dominated by  $\rho$  resonances [2]. The thus predicted branching ratio has recently been confirmed by a measurement of the BESIII collaboration [3]. The  $a_2$  tensor meson corrects the amplitude of  $\eta' \rightarrow \pi^+\pi^-\gamma$  noticeably [4] and should therefore also be incorporated into the decay at hand. We use a resonance model to describe the tree-level contribution of the  $a_2$  to the decay  $\eta' \rightarrow 2(\pi^+\pi^-)$  and amend the resulting amplitude through a dispersive analysis of the universal  $\pi\pi$  final-state interactions. This leads to non-factorizing contributions to the doubly-virtual  $\eta'$  transition form factor needed for the light-by-light scattering contribution to the anomalous magnetic moment of the muon and will allow to judge the validity of the factorization ansatz currently used therein.

References:

- 1 C. Hanhart *et al.* (2013), arXiv:1307.5654 [hep-ph]
- 2 F. K. Guo, B. Kubis and A. Wirzba (2011), arXiv:1111.5949 [hep-ph]
- 3 M. Ablikim *et al.* [BESIII Collaboration] (2014), arXiv:1404.0096 [hep-ex]
- 4 B. Kubis and J. Plenter (2015), arXiv:1504.02588 [hep-ph]

## Summary

Corrections to the decay amplitude of  $\eta' \rightarrow 2(\pi^+\pi^-)$  due to the  $a_2$  meson, calculated using a resonance model amended by a dispersive analysis, lead to non-factorizing contributions to the doubly-virtual  $\eta'$  transition form factor.

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**Session Classification :** Poster Session

Contribution ID : 6

Type : **Poster**

## Description of tensor meson transition form factors at large $Q^2$ within QCD factorization approach

*Tuesday, 27 June 2017 18:30 (0:20)*

### Content

Due to multiple possible polarizations hard exclusive production of tensor mesons by virtual photons or in heavy meson decays offers interesting possibilities to study the helicity structure of the underlying short-distance process. Motivated by the first measurement of the transition form factor  $\gamma^*\gamma \rightarrow f_2(1270)$  at large momentum transfers by the BELLE collaboration we present an improved QCD analysis of this reaction in the framework of collinear factorization including contributions of twist-three quark-antiquark-gluon operators and an estimate of soft end-point corrections using light-cone sum rules. The results appear to be in a reasonable agreement with the data, in particular the predicted scaling behavior is reproduced in all cases.

### Summary

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**Session Classification** : Poster Session

Contribution ID : **98**Type : **Poster**

## Development of large scale focal plane detectors for MAGIX

*Tuesday, 27 June 2017 18:30 (0:20)*

### Content

**MAGIX** is a planned experiment that will be implemented at the upcoming accelerator MESA in Mainz. Due to its location in the energy-recovering lane of the accelerator beam-currents up to **1 mA** with a maximum energy of **105 MeV** will be provided for precision experiments. MAGIX itself consists of a jet-target and two magnet-spectrometers. Inside the spectrometers **GEM**-based detectors will be used in the focal plane. The design goals for the detector modules are a spatial resolution of **50  $\mu\text{m}$** , a size of **1,20 x 0,30 m<sup>2</sup>** and a minimal material budget. To accomplish these goals we started developing several GEM-prototypes to study different behaviors and techniques for the final detector. The GEMs used are provided by CERN and are trained, stretched and framed in our laboratory. In this contribution the requirements, ongoing development and achieved measurements are presented.

### Summary

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**Session Classification** : Poster Session

Contribution ID : **106**Type : **Poster**

## Development of the internal Gas-Jet-Target for MAGIX

*Tuesday, 27 June 2017 18:30 (0:20)*

### Content

MAGIX is a planned experiment that will be implemented at the upcoming accelerator MESA in Mainz. Due to its location in the energy-recovering lane of the accelerator beam currents up to 1 mA with a maximum energy of 105 MeV will be provided for precision experiments.

MAGIX itself consists of a Jet Target and two magnet-spectrometers. The Jet-Target consists of a Laval-Nozzle and a catcher which is mounted in a high performance pumping system. This contribution is about the hydrodynamics and the technical implementation of the target system.

### Summary

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**Session Classification :** Poster Session

Contribution ID : 93

Type : Poster

# The Design and Performance of the Münster Gas-Jet Target for MAGIX at MESA

*Tuesday, 27 June 2017 18:30 (0:20)*

## Content

The experiments at the future electron accelerator MESA (Mainz Energy-recovering Superconducting Accelerator) at the University of Mainz focus on the validity of the Standard Model of particle physics. Thereby, the main interest is the search for dark photons as candidates for dark matter, and precision measurements of fundamental constants, such as the proton radius or the electroweak mixing angle. The MAGIX experiment (MESA Gas Internal target eXperiment) will be located in the energy-recovering sector of this future electron accelerator with energies up to 105 MeV, a beam current of 1 mA, and a high luminosity of  $10^{35} \frac{1}{\text{cm}^2 \text{s}}$ . MAGIX will consist of a multi-purpose spectrometer and a gas-jet target which was designed, built up, and set into operation at the University of Münster. The gas-jet beam is produced by the expansion of gas within Laval nozzles and provides constant thickness in time and space (e.g.  $10^{19} \frac{\text{atoms}}{\text{cm}^2}$  directly behind the nozzle). By cooling and changing the pressure of the gas at the nozzle, the gas-jet target can also be operated in a cluster-jet mode. This offers the possibility to achieve a directed, less divergent beam even at large distances from the nozzle. Thereby, the highest thicknesses with a lower gas flow to improve the vacuum conditions can be achieved. Currently, measurements to characterize the target beam depending on different properties, e.g. different nozzle designs, different stagnation conditions of the gas in front of the nozzle, are performed. For this purpose, a Mach-Zehnder interferometer is used to determine the thickness distribution and the shape of the gas-jet. The design of the Münster gas-jet target and the beam properties will be presented and discussed.

## Summary

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**Session Classification :** Poster Session

Contribution ID : **89**Type : **Poster**

## The crystal Zero Degree Detectors at BESIII

*Tuesday, 27 June 2017 18:30 (0:20)*

### Content

The BESIII experiment based at the BEPCII  $e^+e^-$  collider (Beijing, China) is investigating physics in the charm- $\tau$  region. Processes in which the particles emission peaks towards small polar angles, such as Initial State Radiations (ISR) from  $e^+e^-$  annihilations, are currently detected with limited efficiency.

In order to improve their detections, we propose two small taggers placed at the very forward/backward angles. Each detector is composed of two arrays of 4x3 rectangular-shaped scintillating LYSO crystals, separated by a gap. The scintillation light will be collected by silicon photomultipliers (SiPMs) and the signals will be digitized using sampling Analog-to-Digital Converters (sADC).

In this contribution, we present the results from the tests of a single LYSO crystal and the read-out electronics using radioactive sources. Studies of the final setup, using Geant4 based simulation of BESIII and the cZDDs, are also shown.

This work is supported by the DFG under contract No. CRC 1044.

### Summary

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**Session Classification** : Poster Session