

REPORT ON THE WORKSHOP: HARD MESON AND PHOTON PRODUCTION

TITLE

HARD MESON AND PHOTON PRODUCTION

DATE

11-15 October 2010

ORGANIZERS

N. d'Hose (CEA-Saclay, France)
P. Kroll (U. Wuppertal, Germany)
R. Kaiser (U. Glasgow, United Kingdom)

NUMBER OF PARTICIPANTS

37

MAIN TOPICS

The main topics were

- Generalized Parton Distributions
- Deeply Virtual Compton Scattering
- Deeply Virtual Meson production
- GPD models and GPD fits
- Transverse Spin and Transverse Momentum Dependent Parton Distributions
- Parton Distributions and Form Factors

SPEAKERS:

Mauro Anselmino (<i>Univ. of Torino, Italy</i>)	Morgan Murray (<i>Univ. of Glasgow, UK</i>)
Harut Avakian (<i>JLab, USA</i>)	Hervé Moutarde (<i>CEA Saclay, France</i>)
Jochen Bartels (<i>DESY, Germany</i>)	Dieter Mueller (<i>Univ. of Bochum, Germany</i>)
Vladimir Braun (<i>Univ. of Regensburg, Germany</i>)	Wolf-Dieter Nowak (<i>DESY- Germany</i>)
Jian-Ping Chen (<i>JLab, USA</i>)	Luciano Pappalardo (<i>INFN Ferrara, Italy</i>)
Valeru Druzhinin (<i>BINP Novosibirsk, Russia</i>)	Barbara Pasquini (<i>Univ. of Pavia, Italy</i>)
Horst Fischer (<i>Univ. of Freiburg, Germany</i>)	Franck Sabatié (<i>CEA Saclay, France</i>)
Leonard Gamberg (<i>Penn State Univ., USA</i>)	Andrzej Sandacz (<i>SINS Warsaw, Poland</i>)
Haiyan Gao (<i>Duke Univ., USA</i>)	Marc Schlegel (<i>Univ. of Tuebingen, Germany</i>)
Meinulf Goeckeler (<i>Univ. of Regensburg</i>)	Gunar Schnell (<i>DESY, Germany</i>)
Gary Goldstein (<i>Tufts Univ.</i>)	Laurent Schoeffel (<i>CEA Saclay, France</i>)
Sergei Goloskokov (<i>JINR Dubna</i>)	Kirill Semenov (<i>Ecole Polytechnique Palaiseau, France</i>)
Oleg Kouznetsov (<i>CEA Saclay</i>)	Lech szymanowski (<i>SINS Warsaw, Poland</i>)
Valery Kubarovsky (<i>JLab</i>)	Oleg Teryaev (<i>JINR Dubna, Russia</i>)
Elliot Leader (<i>Imperial College of London</i>)	Sadaharu Uehara (<i>KEK Tsukuba, Japan</i>)
Inti Lehmann (<i>Univ. of Glasgow</i>)	Heiner Wollny (<i>Freiburg Univ. & Germany- CEA Saclay, France</i>)
Simonetta Liuti (<i>Univ. of Virginia</i>)	

SCIENTIFIC REPORT:

During the recent years the framework of generalized parton distributions (GPDs) was developed providing a comprehensive description of the partonic structure of the nucleon and containing a wealth of new information. It embodies both, nucleon form factors as observed in elastic lepton scattering and parton distribution functions (PDFs) measured in deep inelastic lepton scattering (DIS). A GPD can be considered as a momentum dissected form factor providing information on the transverse localization of a parton as a function of the fraction it carries of the nucleon's longitudinal momentum. Thus one obtains a "3-dimensional picture" of the nucleon which is often referred to as "nucleon tomography". GPDs also allow access to such a fundamental property of the nucleon as the orbital angular momentum of quarks.

GPDs can be experimentally accessible in exclusive reactions as hard meson and photon production processes. In the last years an enormous activity could be observed on the theoretical as well as experimental side. Data on many hard exclusive reactions as deeply virtual Compton scattering and hard production of rho, omega, phi, J/psi, upsilon at HERA, HERMES and JLab have been published. In the near future COMPASS will investigate the uncharted kinematic domain between the HERA collider experiments H1 and ZEUS and the fixed-target experiments at HERMES and JLab. This is the domain where role of both quarks and gluons are expected. The 11 GeV extension of the JLab accelerator will provide a very detailed study for the valence quarks domain. Reviews and confrontations of all these experiments have been presented during the workshop.

Many theoretical developments have been presented. Numerical lattice QCD calculations predict moments of GPDs and last improvements have been reviewed. GPD models which reproduced very reasonably well the lattice predictions and the first experiment results have been discussed. Moreover several techniques based on "partial wave expansions" providing fitting procedure to extract GPDs from the experimental data have been discussed and will become fundamental tools for the community.

In order to calculate hard meson production the meson distribution or light-cone wave functions are required. Our understanding of these functions, in particular those for the pion, has been challenged by a recent BABAR measurement of the pion-photon transition form factor at very large photon virtualities, Q^2 . The BABAR data exhibit an unexpectedly strong increase of the form factor, scaled by Q^2 with the photon virtuality. This measurement has immediately provoked a number of theoretical papers in which explanations of this measurement are attempted. However, a convincing explanation which is not in conflict with other results, is still lacking. It was very interesting to watch the disputed developments of this field.

Another interesting topic is the connection between GPDs and transverse momentum dependent distributions (TMDs). In a more general way Wigner distributions encode all the possible correlations between quark transverse position and momentum and the recently introduced generalized transverse-momentum dependent distributions (GTMDs) provide connection with the Wigner distributions, the GPDs and the TMDs. The intrinsic transverse parton momentum effects become visible in hadronic Drell-Yan and semi-inclusive (SIDIS) processes which give access to the TMDs. Many results have also been presented and connections between these two activities (GPDs – TMDs) have been developed.

RESULT AND HIGHLIGHTS

The presentations at the workshop covered experimental results from all experiments in the field of hard meson and photon production and a broad range of theory presentations, from progress in fundamental questions to GPD model building.

The discussions at the end of each talk were lively and were continued over the lunch and coffee breaks. The central topic of the workshop turned out to be the interface between experimentalists and their data and theorists and their models. A new collaboration between experimentalists and theorists started during the workshop in order to use the most elaborated GPD model not only for meson production but also for photo production where the Bethe Heitler interference has to be taken into account.

It is clear that GPD models and fits to the experimental data will be one of the key points over the next years. A Collaboration to perform global analysis in order to extract the GPD from all the hard meson and photon production data as the one dedicated to Parton Distribution Functions from DIS and SIDIS data has still to emerge.

Talks on the web:

The talks of the workshop can be accessed via the workshop website at:

<http://gpd.gla.ac.uk/gpd2010/>

	Monday 11	Tuesday 12	Wednesday 13	Thursday 14	Friday 15
09:00		O. Teryaev Transversity and TMD friends	V. Druzhinin Measurements of the photon-meson transition form factors at BABAR	A. Sandacz Review on Exclusive Meson Production (I)	M. Goeckeler Lattice Results on GPDs and TMDs
09:40	A. Richter Presentation of the ECT	G. Schnell Experimental Review on Transversity and TMDs	V. Braun The gamma*-gamma -> pi0 form factor in QCD: a theory appraisal	V. Kubarovsky Deeply Virtual Exclusive Reactions with CLAS (JLab)	B. Pasquini Wigner Distributions in Light Cone Quark Models
10:20	D. Mueller DPDs and TMDs in terms of effective LCWFs	J-P Chen Transversity Experiments at JLab Hall A	O. Teryaev Comment on axial anomaly and transition form factors	G. Goldstein The Use of Dispersion Relation in Hard Exclusive Processes	L. Szymanowski Exclusive rhoT Process beyond leading twist
11:00	Coffee break @ ECT* garden				
11:30	F. Sabatié Review on Deeply Virtual Compton Scattering experiments	M. Anselmino The Sivers and Collins functions	J. Bartels AdS/CFT Correspondence : the high energy limit	W-D Nowak Exclusive Meson Production at HERMES	I. Lehmann The Olympus Experiment at DESY
12:10	H. Fischer DVCS Program at COMPASS	M. Schlegel Transverse Momentum Dependent Parton Distributions	S. Uehara Meson Pair Production on Two-Photon Collisions at BELLE	H. Wollny Studies of TMDs at COMPASS	L. Schoeffel Last results from meson and photon production at HERA
12:50	Lunch @ ECT* Canteen				
14:00	H. Moutarde Extraction of the Compton Form Factor H from DVCS measurements in the quark sector	L. Gamberg Gluonic Poles in "G"-GPM and universality	Excursion	A. Sandacz Review on Exclusive Meson Production (II)	
14:40	K. Kumericky Extraction of GPDs from DVCS off unpolarized target	E. Leader Polarized PDFs and Higher Twist from NLO Analysis of DIS and SIDIS		O. Kouznetsov Exclusive pi0 signal in COMPASS	
15:20	K. Semenov-Tian-Shansky Recent Status of the Dual Parametrization for GPDs	E-M Kabuss Experimental overview on Polarized Quark Distributions		S. Liuti Parametrisation of GPD	
16:00	Coffee break @ ECT* garden				
16:30	H. Avakian Transversity Program at CLAS (JLab)	H. Gao Review on Nucleon Form Factors		Discussion on GPD Models Peter Kroll	
17:10	M. Murray DVCS at HERMES	L. Pappalardo TMD studies at HERMES			
20:00	Dinner @ ECT*	Dinner @ La Baracca	Dinner @ Patelli	Soc. dinner @ Orso Grigio	Pizza @ Alla Mostra