

Interview for Chung-Yao Chao Fellowship 2018

Elena Yatsenko
Shanghai Jiao Tong University, Tsung-Dao Lee Institute

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Education and research experience

February 2018 - Present	SJTU and TDLI, Shanghai - Postdoctoral researcher in ATLAS <ul style="list-style-type: none">- Diboson physics;- Data preparation;- Quark-gluon tagging.
February 2015 - January 2018	LAPP, Annecy - Postdoctoral researcher in ATLAS <ul style="list-style-type: none">- Diboson measurements;- Searches for New Physics;- ATLAS Liquid Argon calorimeter;- Analysis of LAr data quality;- Monte Carlo studies of WZ production.
May 2011 - January 2014	DESY, Hamburg - PhD in ATLAS <p>Thesis: <i>Measurement of the neutral current Drell-Yan production using ATLAS data at $\sqrt{s} = 8$ TeV</i> (Supervisor: Alexander Glazov - Alexander.Glazov@cern.ch)</p> <ul style="list-style-type: none">- Measurements of Drell-Yan production;- Forward-Backward asymmetry in Drell-Yan events;- Monte-Carlo generators studies;- Study of impact of Drell-Yan data on proton PDF fits.
October 2010 - March 2011	University of Hamburg, DAAD grant <ul style="list-style-type: none">- Jet production with multi-Regge kinematics
September 2004 - June 2009	"Specialist degree" (MSc equivalent) in mathematics and system programming, Samara State University, Russia <p>Thesis: <i>Modeling of liquids properties with Monte Carlo methods</i> (Supervisor: Vladimir Saleev)</p> <ul style="list-style-type: none">- Mathematical modelling of physical systems;- Modelling of neutrons penetration through materials with Monte Carlo methods.

Invited seminars:

- *"Diboson physics with the ATLAS detector at the LHC"*, March 2018, Trung-Dao Lee Institute, Shanghai, China
- *"Diboson production in ATLAS and CMS"*, December 2016, Jagiellonian University, Krakow, Poland
- *"Measurements of WZ production with Run-2 ATLAS data"*, December 2016, Henryk Niewodniczanski Institute of Nuclear Physics (IFJ PAN), Krakow, Poland
- *"Impact of electroweak radiative corrections on QCD fits to Drell-Yan differential cross section data"*, December 2012, Joint Institute for Nuclear Research (JINR), Dubna, Russia

International conferences:

- **CHEF 2017**, *"ATLAS LAr Calorimeter Performance in LHC Run-2"*, Lyon, France
- **LHCP 2017**: *"Di- and multiboson measurements in ATLAS"*, Shanghai, China
- **DIS 2016**: *"Measurements of inclusive and differential Drell-Yan cross sections with the ATLAS detector"*, Hamburg, Germany
- **SM@LHC 2015**: *"Measurements used to tune MC generators"*, Florence, Italy
- **DIS 2014**: *"Measurement of the Neutral Current DY process with the ATLAS detector"*, Warsaw, Poland
- **DIS 2013**: *"Measurement of the Z boson transverse momentum: direct and using ϕ^* variable with ATLAS"*, Marseille, France

National conferences and workshops:

- **DPG 2014**, *"Measurement of triple differential Drell-Yan cross section for central-forward electron selection using 20.4 fb⁻¹ of ATLAS 8 TeV data"*, Mainz, Germany
- **ESHEP 2013**, Poster: *"Drell Yan production measurements and constrains on proton structure"*
Parádfürdő, Hungary
- **SLAC Summer Institute**, Poster: *"Tuning Monte Carlo using ATLAS boson transverse momentum measurements"*, 2012, USA
- **Spaatind 2012**, *"Tuning MCs using ATLAS boson transverse momentum measurements"*, Norway

List of publications (i/ii)

Experimental papers:

- ATLAS collaboration, *Measurement of the $W^\pm Z$ boson pair-production cross section in pp collisions at $\sqrt{s} = 13$ TeV with the ATLAS Detector*, Phys. Lett. B 762 (2016) 1.
- ATLAS collaboration, *Measurements of $W^\pm Z$ production cross sections in pp collisions at $\sqrt{s} = 8$ TeV with the ATLAS detector and limits on anomalous gauge boson self-couplings*, Phys. Rev. D 93, 092004 (2016).
- ATLAS collaboration, *Precision measurement and interpretation of inclusive W^+ , W^- and Z/γ^* production cross sections with the ATLAS detector*, Eur. Phys. J. C 77 (2017) 367.
- ATLAS collaboration, *Measurement of the Drell–Yan triple-differential cross section in pp collisions at $\sqrt{s} = 8$ TeV*, [arXiv:1710.05167], submitted to JHEP.
- ATLAS collaboration, *Measurement of the Z/γ^* boson transverse momentum distribution in pp collisions at $\sqrt{s} = 7$ TeV with the ATLAS detector*, JHEP 09 (2014) 145.
- ATLAS collaboration, *Measurement of the low-mass Drell–Yan differential cross section at $\sqrt{s} = 7$ TeV using the ATLAS detector*, JHEP 06 (2014) 112.

Theory and phenomenology papers:

- T. Pierog, Iu. Karpenko, J.M. Katzy, E. Yatsenko, K. Werner, *EPOS LHC : test of collective hadronization with LHC data*, Phys. Rev. C 92, 034906 (2015).
- V.A. Saleev, A.V. Shipilova, E.V. Yatsenko, *Inclusive jet production at the Tevatron collider in the Regge limit of Quantum Chromodynamics*, Phys. Part. Nucl. Lett. 9 (2012) 129.
- B.A. Kniehl, V.A. Saleev, A.V. Shipilova, E. Yatsenko, *Single jet and prompt-photon inclusive production with multi-Regge kinematics: From Tevatron to LHC*, Phys. Rev. D 84 (2011) 074017.

List of publications (ii/ii)

Public notes and proceedings:

- E. Yatsenko, *Di- and multiboson measurements in ATLAS*, ATL-PHYS-PROC-2017-093.
- E. Yatsenko, *Measurement of the Z boson transverse momentum: direct and using ϕ^* variable with ATLAS*, ATL-PHYS-PROC-2013-159.
- ATLAS collaboration, *Multi-Boson Simulation for 13 TeV ATLAS Analyses*, ATL-PHYS-PUB-2017-005.
- ATLAS collaboration, *Measurement of $W^\pm Z$ boson pair-production in pp collisions at $\sqrt{s} = 13$ TeV with the ATLAS Detector and confidence intervals for anomalous triple gauge boson couplings*, ATLAS-CONF-2016-043.
- ATLAS collaboration, *Example ATLAS tunes of Pythia8, Pythia6 and Powheg to an observable sensitive to Z boson transverse momentum*, ATL-PHYS-PUB-2013-017.
- ATLAS collaboration, *Studies of vector boson transverse momentum simulation in Monte Carlo event generators*, ATL-PHYS-PUB-2011-015.

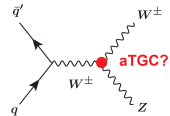
The full list of publications is available from INSPIRE (<http://inspirehep.net/author/E.Yatsenko.1/>)

Work experience: physics measurements

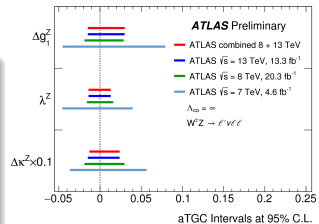
Measurements of $W^\pm Z$ production

Phys. Rev. D 93, 092004 (2016)
Phys. Lett. B 762 (2016) 1
ATLAS-CONF-2016-043

- An important **test of electroweak sector of the Standard Model**.
- s-channel diagram of $W^\pm Z$ production contains vertex with gauge-boson self-interactions
→ highly **sensitive to possible presence of New Physics effects**,
→ modified TGC strength would manifest as the enhancement of events in tails of kinematics distributions.
- $W^\pm Z$ production is measured in fully leptonic decay channel: $W^\pm Z \rightarrow \ell\nu\ell\ell$ ($\ell = e/\mu$).
- Measurements of integrated and differential cross-section.
- New Physics searches in terms of effective Lagrangian and EFT parameters.



- I have worked on three published $W^\pm Z$ measurements:
 1. Analysis of 20.2 fb^{-1} of 8 TeV data;
 2. First 13 TeV ATLAS measurement of $W^\pm Z$ production
 - **contact person for this analysis;**
 - **I have presented the approval talk of this analysis.**
 3. First constraints of anomalous coupling parameters at 13 TeV (13.3^{-1} fb) → previous constraints are improved by up to 18%.
 - **contact person for this analysis;**
 - **I have presented the approval talk of this analysis.**



Dataset	Coupling	Expected [TeV^{-2}]	Observed [TeV^{-2}]
13 TeV	$c_W/\Lambda_{\text{NP}}^2$	[-4.1; 7.6]	[-3.8; 8.6]
	$c_B/\Lambda_{\text{NP}}^2$	[-261; 193]	[-280; 163]
	$c_{WW}/\Lambda_{\text{NP}}^2$	[-3.6; 3.4]	[-3.9; 3.7]

My work in diboson physics was recognised by an invitation to write an overview article for EP Newsletter journal (<http://ep-news.web.cern.ch/>).

EP Newsletter of the EP department

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Electroweak boson pairs offer new approach to searches for New Physics

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[ATLAS](#) [CMS](#) [New Physics](#)

by [Elena Yatsenko](#)

During the past decades, the Standard Model (SM) of particle physics that explains how the basic building blocks of matter interact is scrutinised by high energy physics experiments. Along with the remarkable success of the SM, there are compelling reasons to consider that at higher energy scales the SM requires an extension into a more fundamental theory. However, the energy scale of New Physics might lie beyond the reach of the LHC and not be directly accessible by the experiments. Thus, probes of processes that can be indirectly affected by the new phenomena become particularly valuable. For such processes, the presence of new interactions, even at higher energy scales, could manifest at the LHC energy reach. One of the most promising channels for searches is the study of the production of electroweak (EW) boson-pairs, namely W and Z bosons and photons, through their self-interactions. New Physics effects, direct or indirect, can modify the

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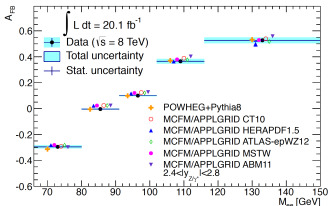
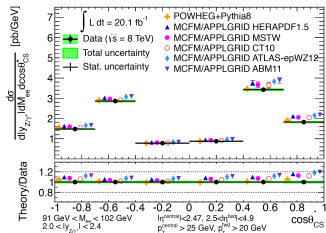
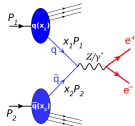
Triple-differential measurement of Z/γ^* production and forward-backward asymmetry

- Differential measurement of Drell-Yan process ($Z/\gamma^* \rightarrow e^+e^-$) as a function of

- $|y_{Z/\gamma^*}|$ - sensitive to initial parton momentum fraction
→ rich source of information about **proton structure**;
- $M_{\ell\ell}$ - probes different scales of the interaction and provides access to both photon and Z boson dominated regions;
- $\cos\theta_{CS}^*$ - gives access to the **weak mixing angle**.

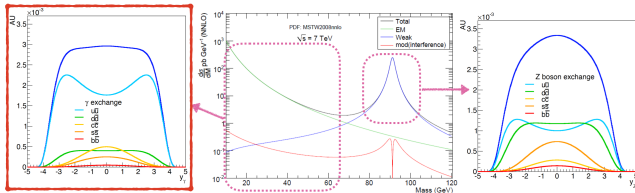
- This is the first triple-differential measurement of Drell-Yan production.
- Central-forward channel** is initiated by processes with large difference between momentum fraction carried by interacting partons
- highly important for **forward-backward asymmetry** measurement, as allows to reduce dilution effects in determining directions of incoming partons.

- Main analyser of central-forward channel**

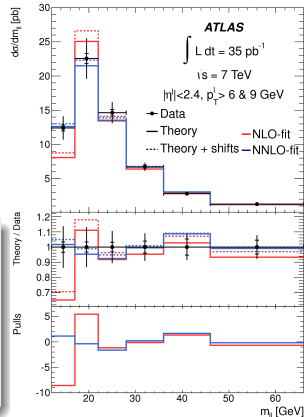


Impact of Drell-Yan Low Mass data on proton PDF fits

- Drell-Yan production in low mass region is **dominated by virtual photon exchange**.
- $u\bar{u}$ annihilation is dominant for photons exchange \rightarrow measurement in this region allows to **improve the knowledge of the \bar{u} distribution**.



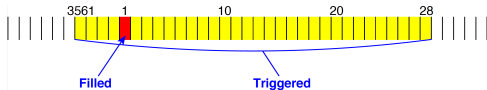
- Theoretical predictions at NLO (MCFM+APPLGRID);
- Include Drell-Yan Low Mass data in QCD fits of deep-inelastic scattering data from HERA experiment;
- Perform fits at NLO and NNLO QCD \rightarrow improved description of the ATLAS data by NNLO-fit.
- I presented these studies on international conference DIS 2014 in Warsaw, Poland.



Work experience: Data calibration and preparation

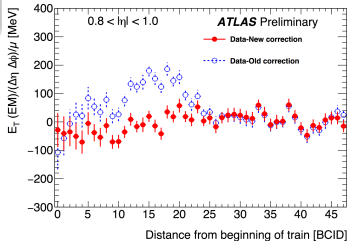
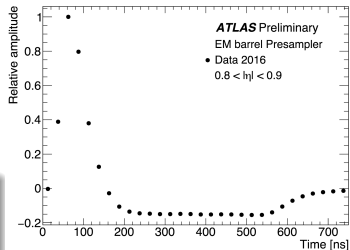
Measurement of ionisation pulse shapes, LAr data quality, Run control shifts

- Precise knowledge of the shape of **ionisation signal in the LAr calorimeter** is crucial to determine pileup correction. This correction accounts for the **energy shift** caused by not complete cancellation of positive energy from in-time pileup contribution by out-of-time pileup in the beginning of the train.
- I have analysed raw ATLAS data collected during special proton runs with isolated bunches.
- Measurement is performed with very high granularity as a function of $|\eta|$.



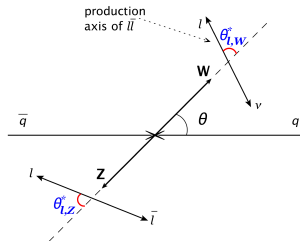
- The measured pulse shapes allowed to **improve significantly** the accuracy of the pileup correction.

<https://twiki.cern.ch/twiki/bin/view/AtlasPublic/LArCaloPublicResults2015>



Working plan

- 1 Currently I am working on two measurements:
 - Analysis of angular properties of WZ events, I am **contact person** for this measurement.
 - $WZjj$ studies.
 - **two papers will be published during 2018.**
- 2 I have taken **responsibilities** of Standard Model derivation framework **contact** starting from February 2018.
- 3 Extend involvement into **searches of VBS production and polarisation studies** using full Run-2 dataset:
 - stringent test for EWSB;
 - sensitive channel for searches of New Physics via processes
 - gauge-violating aTGC may manifest in modifications of longitudinal/transverse polarisation fractions: explore angular variables for searches of anomalous couplings. with quartic gauge boson self interactions.
- 4 Development of **quark/gluon tagger** using Run-2 data:
 - differentiation between quark-initiated and gluon-initiated jets is important for New Physics searches, and for searches of rare Standard Model processes (VBS production).



Summary

- Active participation in **physics measurements** using ATLAS data at 7, 8 and 13 TeV: focus on Drell-Yan and diboson production.
- **Interpretation** of measured data:
 - in terms of EFT higher-dimension operators
 - study impact of Drell-Yan data on proton PDFs.
- Wide range of **Monte-Carlo generator studies**.
- Work on **ATLAS LAr detector**.

- Use my expertise in diboson studies to explore new aspects of diboson production.
- Extend research area to VBS searches.
- Performance studies (quark-gluon tagger).

Work experience: Monte-Carlo activities

Validation of EPOS generator for ATLAS

- Validation of EPOS generator implementation for LHC using ATLAS minimum bias data
- This work was necessary to start using EPOS at the LHC.

Implementation of ATLAS measurements in Rivet framework

- Rivet framework is developed for comparison to and development of theory models with experimental data.
- I have implemented 7 ATLAS measurements in Rivet:
 $Z p_T$ at 7 and 8 TeV, $W p_T$ at 7 TeV, $Z \phi^*$ at 7 TeV,
Drell-Yan Low Mass at 7 TeV, WZ at 8 and 13 TeV.

Tuning of PYTHIA6 and POWHEG+PYTHIA6 Monte-Carlo generators

- Include ATLAS $Z p_T$ and $Z \phi^*$ data into PYTHIA6 parton shower tunes using RIVET and PROFESSOR frameworks.
- Significant improvement of data description by the tuned Monte-Carlo generator.

Phys. Rev. C 92, 034906 (2015)
ATLAS.2011.J925932
ATLAS.2011.S9131140
ATLAS.2012.J1204784
ATLAS.2014.J1288706
ATLAS.2014.J1300647
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ATL-PHYS-PUB-2011-015
ATL-PHYS-PUB-2017-005

