

2017 International Summer Workshop on Reaction Theory

Introducing ..



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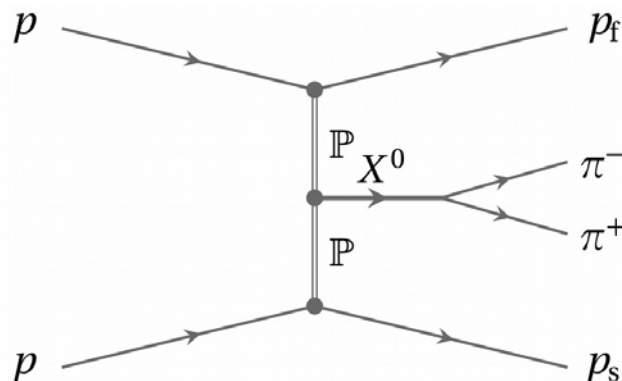
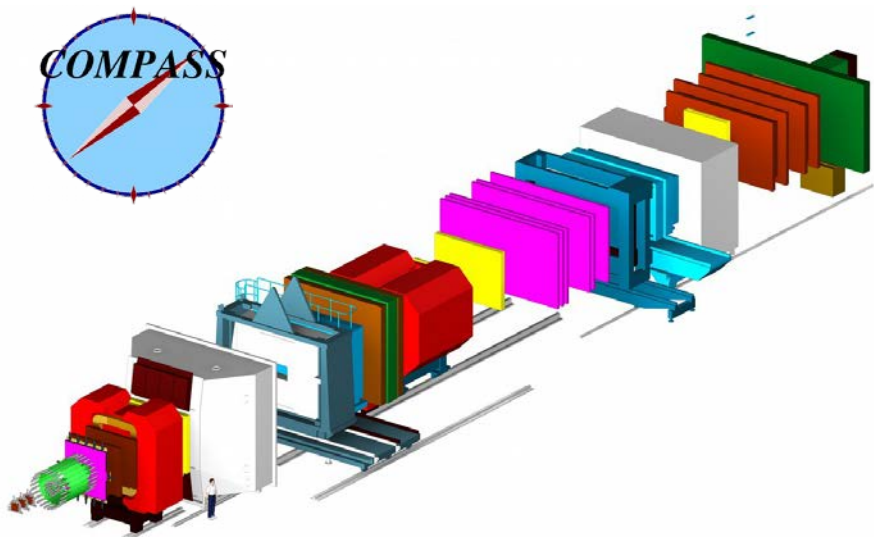


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Alexander Austregesilo

***Jefferson National Laboratory,
USA***

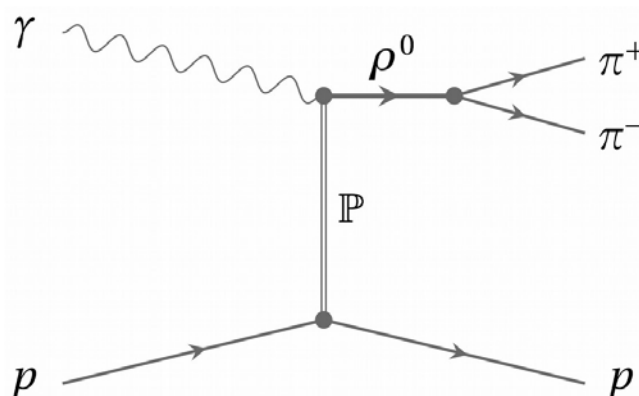
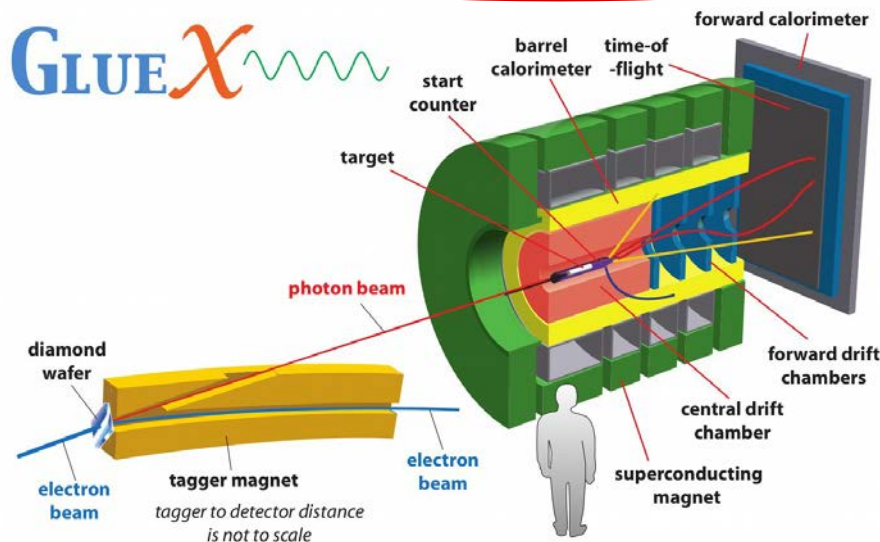
Alexander Austregesilo, PostDoc, JLab



PWA
Moment Analysis
↓
Scalar Mesons f_0
Glueball Search

Light Meson Spectroscopy

System of 2 Pseudoscalar Mesons
($\pi\pi$, KK , $\eta\pi$)



SDME
Moment Analysis (PWA)
↓
Production Mechanism
Polarization Transfer Excited ρ
States



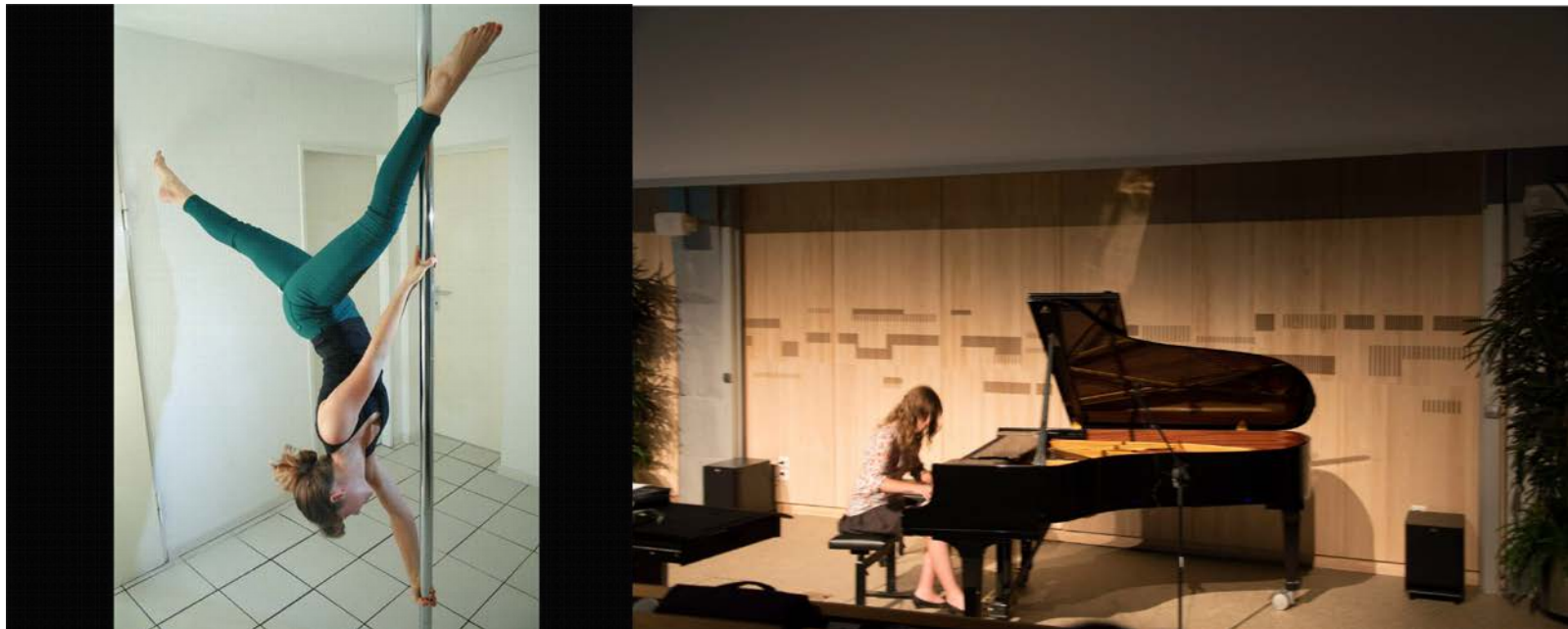
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Astrid Hiller Blin

***University of Valencia,
Spain***



Astrid Nathalie Hiller Blin





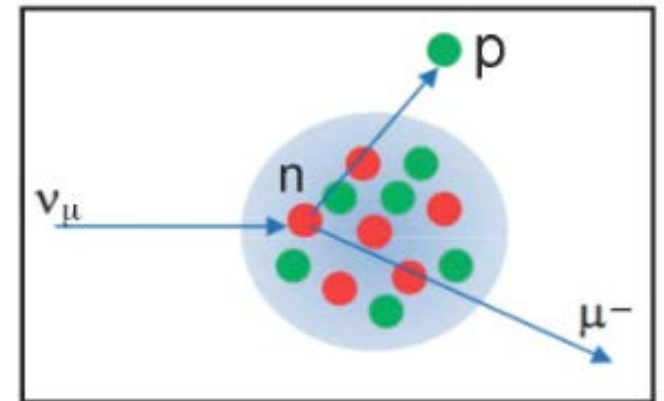
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Cassiano Cattan

***Indiana University,
USA***

Cassiano Cattan

- From Miami, Florida where I did my undergrad at Florida International University
- First year graduate student at IU
- Currently working with Dr. Passemar.
 - Neutrino nucleon scattering
 - Non standard neutrino interactions
- Hobbies include running, playing soccer and hiking.



http://nnpss-tsi.triumf.ca/lectures/Vogel_4.pdf



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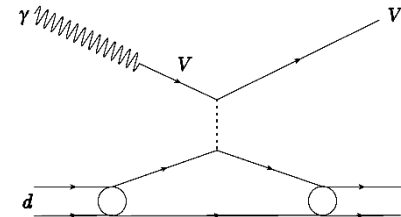
Taya Chetry

***Ohio University,
USA***

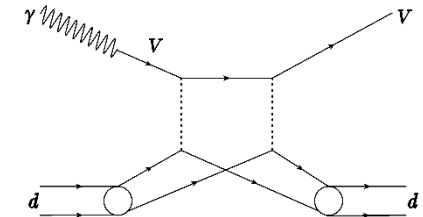
Current Research: (Data from the CLAS collaboration)

Vector Meson Photoproduction off deuteron

- $\gamma d \rightarrow \omega d \rightarrow \pi^+ \pi^- d (\pi^0)$
- $\gamma d \rightarrow \rho d \rightarrow \pi^+ \pi^- d$



Single Scattering



Double Scattering

Dibaryons

- $\gamma d \rightarrow \pi d^* \rightarrow \pi^+ \pi^- d$
- Study of interference with Vector Meson Channels.

Calibration of CLAS12 Pre-Shower Calorimeter at JLab

- Calculation of attenuation coefficients to account for the loss of energy.

Research and Other Interests:

- Resonances, Exotic channels, DIS, Lattice QCD, Regge theory, etc.
- Detector R&D.
- Prediction of Future Events-Creative Thinking.
- Photography along with Music and Food.



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Susana Coito

***Jan Kochanowski University,
Poland***

“2017 International Summer Workshop on Reaction Theory” June 12-22,
2017, Bloomington, Indiana, USA

My name is **Susana Coito** and I was born in **Lisbon, Portugal**.

Recent CV

Postdocs

Jan Kochanowski University
Kielce, **Poland**
(2016-2019)

Institute of Modern Physics
Lanzhou, **China**
(2014-2016)

PhD

Instituto Superior Técnico
Lisbon, **Portugal**
(2013)

Research Interests

Nonperturbative Meson Spectroscopy

Coupled-channel & Threshold effects

Schrodinger Models & Scattering Theory

Effective Lagrangians & Nonperturbative QFT

Enigmatic XYZ states

Hidden & Open Charm and Beauty

Data Analysis in Particle Physics

Light scalar boson E (38)

Fundamental Interactions

Relativity and Astrophysics

Other interests: Guitar, Singing, Languages



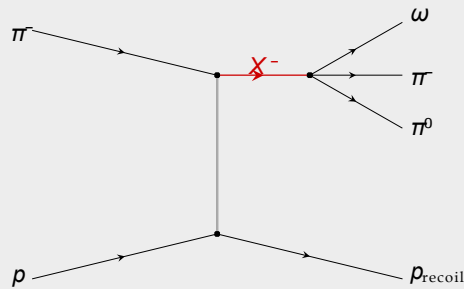
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Christian Dreisbach

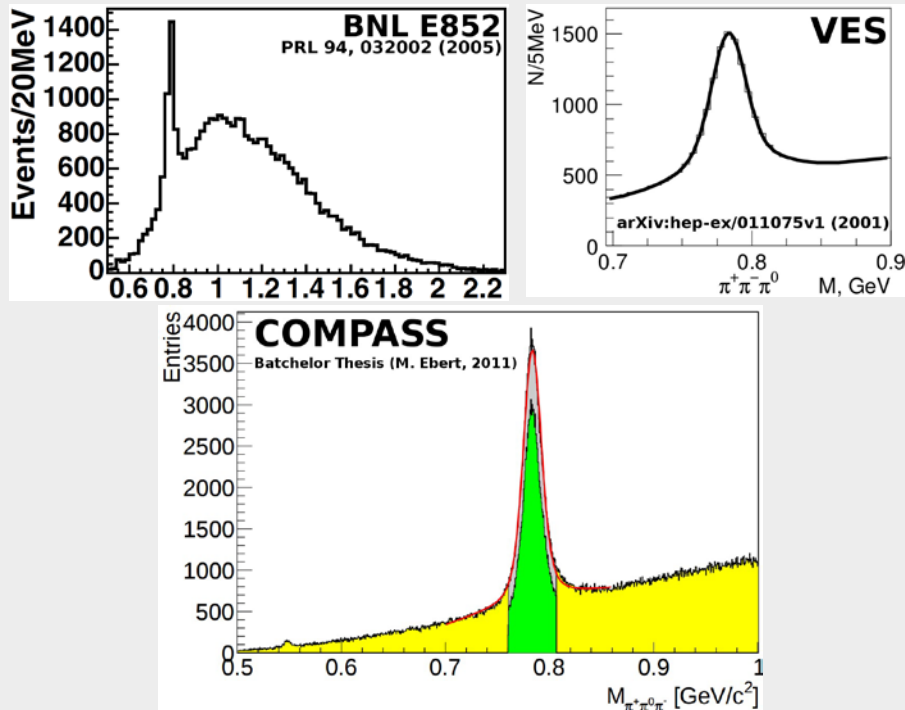
***Technische Universität Muenchen,
Germany***



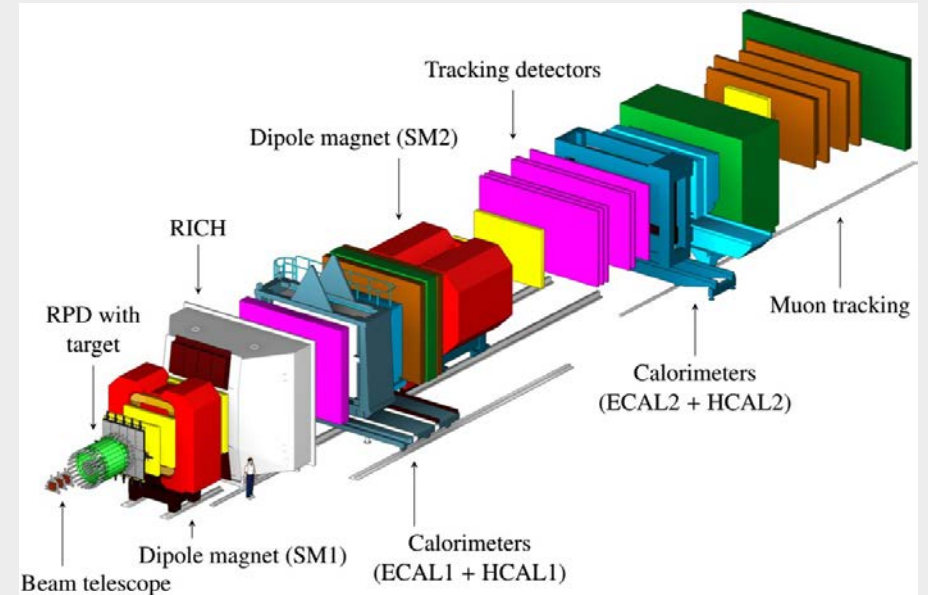
Diffractive production



Invariant mass of $\pi^+\pi^-\pi^0$ subsystem



Experimental setup



Motivation

- Spin-exotic mesons $J^{PC}=1^-+$
 - $\Rightarrow \pi_1(1600)$: BNL and VES
 - $\Rightarrow \pi_1(2000)$: BNL
- COMPASS: $\sim 1000\text{k}$ events
(BNL $\sim 150\text{k}$, VES $\sim 300\text{k}$)



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Pedro Fernandez Soler

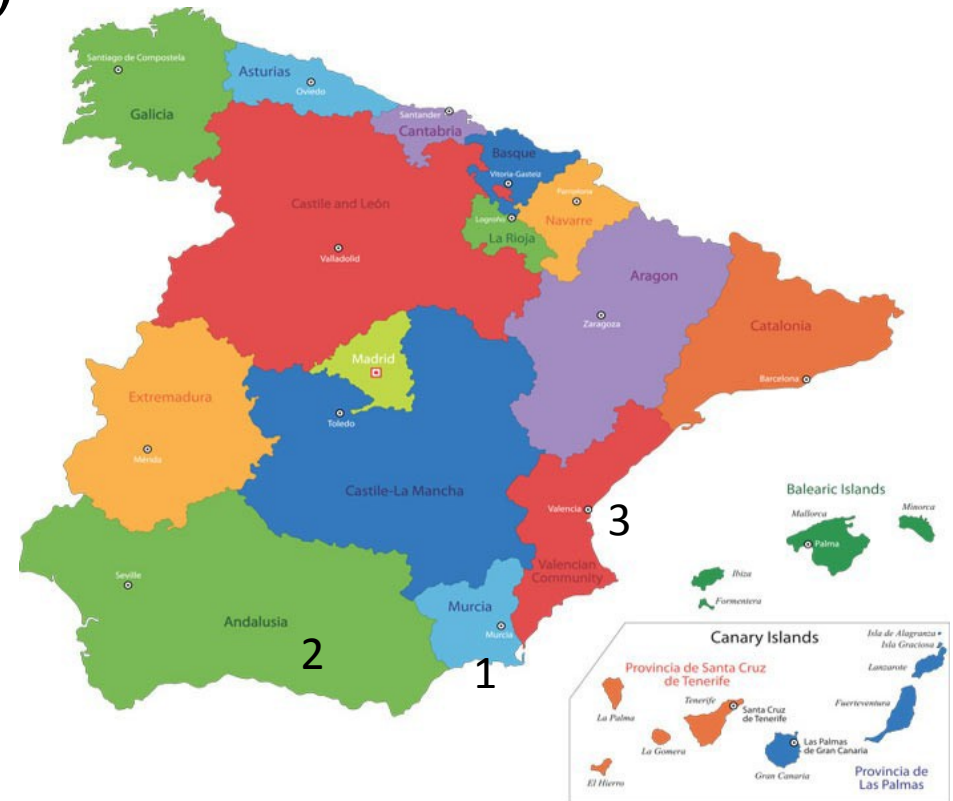
***Instituto de Física Corpuscular,
Spain***

Pedro Fernández Soler (Valencia - Spain)

- 1: Degree in Physics(4 y)
- 2: Master Degree (1 y)
- 3: PhD (2y + 6 m)

□ Topics:

- > Effective theories to study meson spectroscopy in charm and bottom sector:
 $c\bar{q}, b\bar{q}, c\bar{c}, b\bar{b}$
($Z_c(3900), D^*s_0(2317), X(3872), \dots$)
Comparison with LQCD: unitarized interaction of mesons (HQS, χS) in finite volume
- > Dynamically generated resonances (poles)



- [1]Murcia University
- [2]University of Granada
- [3]IFIC University of Valencia

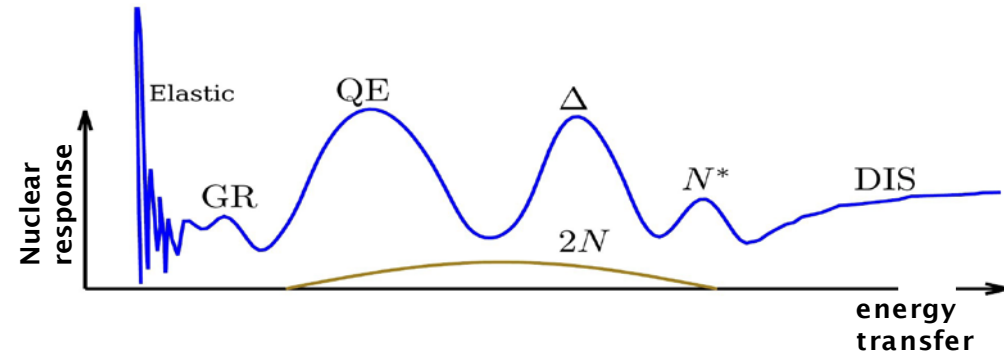
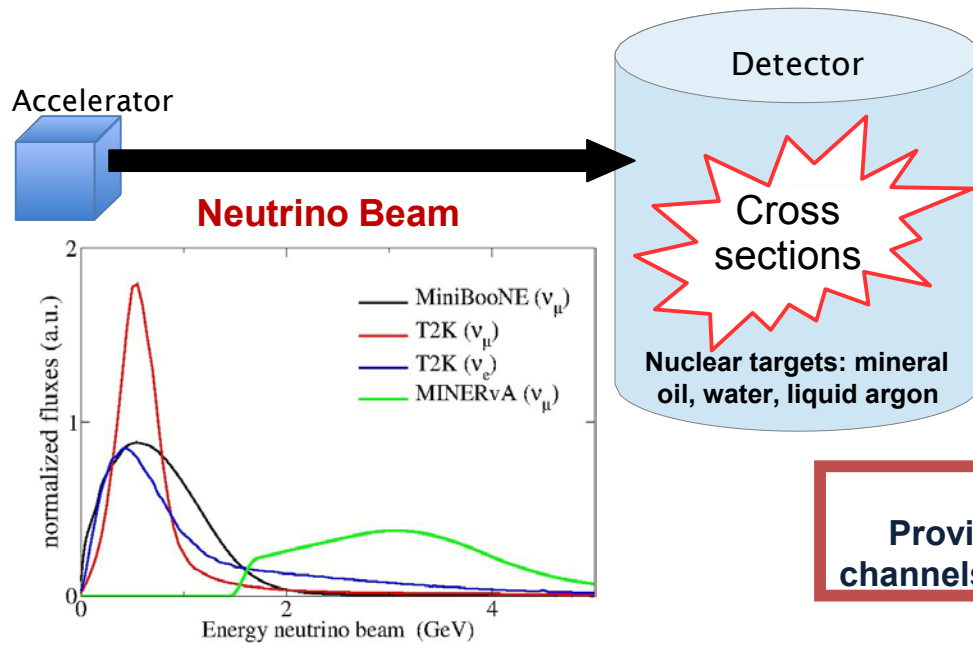


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Raul Gonzalez Jimenez

***Ghent University,
Belgium***

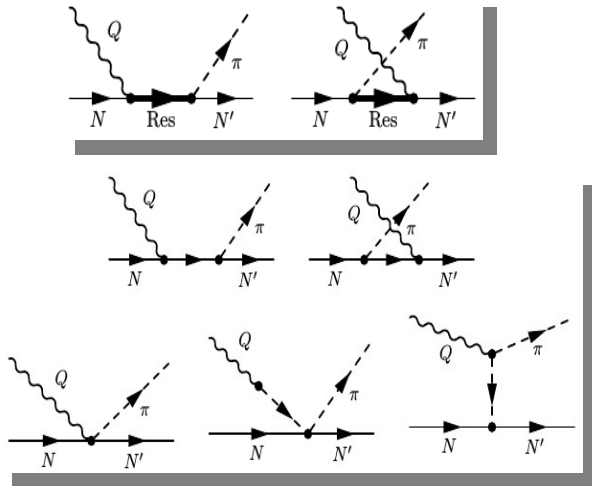
The context: Neutrino-nucleus scattering



Our work:
Provide theoretical models for all possible ν -nucleus reaction channels in the wide energy region covered by the neutrino beams.

My current research line: Electron and neutrino induced single-pion production

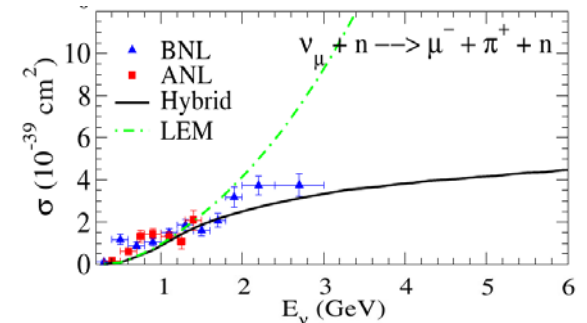
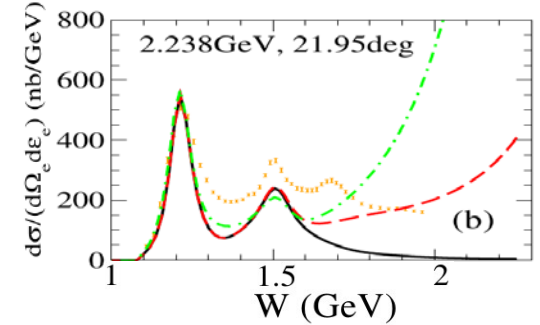
Low-energy model: resonances + background



Low-energy models show a pathological behavior at high invariant masses (W)

Regge phenomenology to extend the model to the high- W region

$$\frac{1}{t - m_\pi^2} \longrightarrow \frac{\pi \alpha'_\pi}{\sin[\pi \alpha_\pi(t)]}$$





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Andrey Grabovsky

***Budker Institute of Nuclear Physics,
Russia***



Grabovsky Andrey



Budker Inst. Of Nuclear Physics and Novosibirsk State University

Worked on

- NLO corrections to BFKL kernel and kernel for evolution of Wilson lines
- Matching of NLO BFKL and BK kernels
- Evolution equation for Baryon Wilson loop operator
- Impact factors for jet and meson photoproduction

Current projects

- Cross section for 2 jet and 3 jet exclusive diffractive photoproduction at HERA and in UPC LHC
- Cross section for diffractive photoproduction of a light vector meson at HERA and in UPC LHC



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Johnathan Gutierrez

***Indiana University,
USA***

Johnathan D. Gutierrez

- Born and raised in San Antonio, TX.
- Dual majored in Math and Physics St. Mary's University (in TX)
- Entering 2nd year at Indiana University
- Have a poor sense of geography.
- I work with Dr. Emilie Passemar
- Currently interested in constraining possible non-standard interactions in Neutrino-Lepton Scattering.
- Enjoy playing pool, binge watching shows, taking random pictures, and hiking.



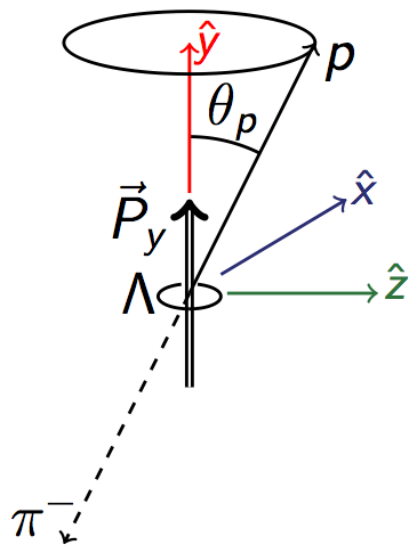
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Walter Ikegami Andersson

***Uppsala University,
Sweden***

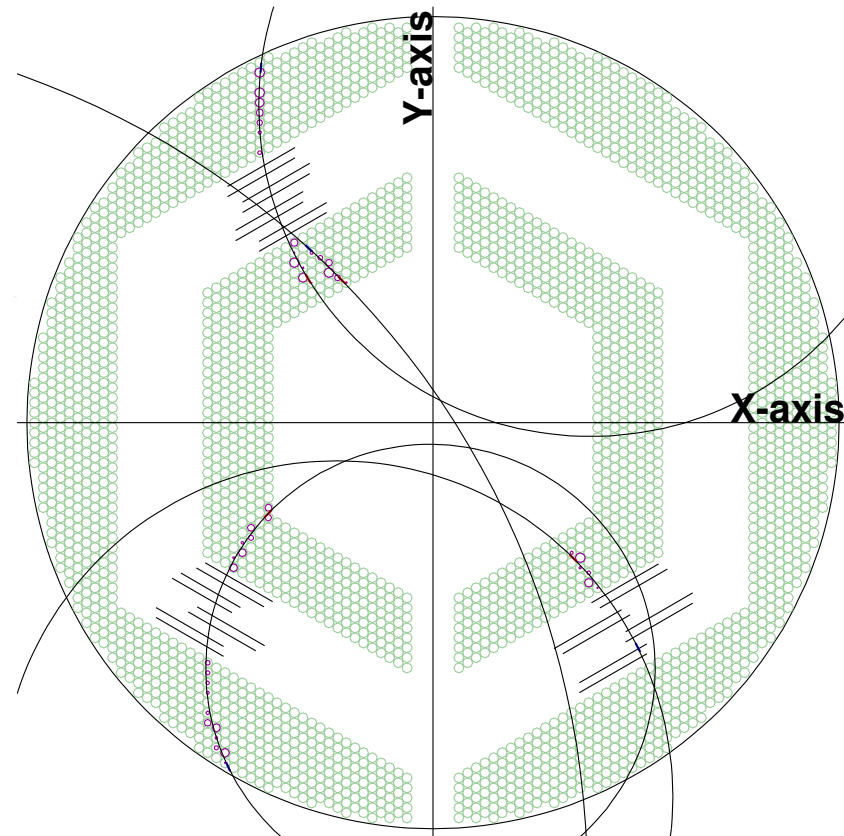
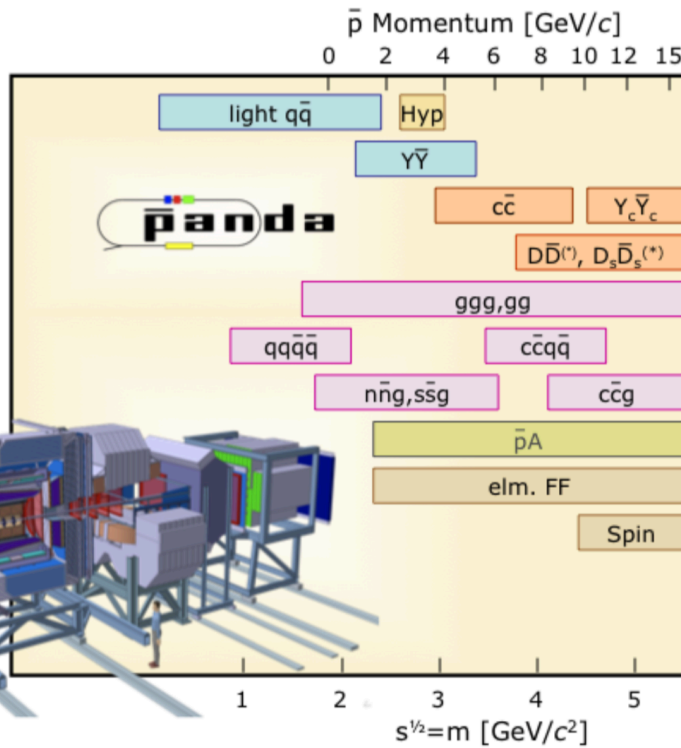


UPPSALA
UNIVERSITET



My research topics:

- Hyperon production dynamics
- Development of pattern recognition algorithms



Walter Ikegami Andersson

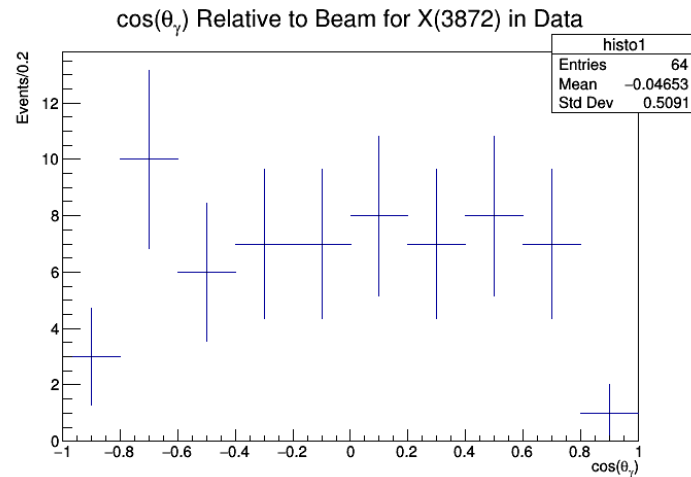
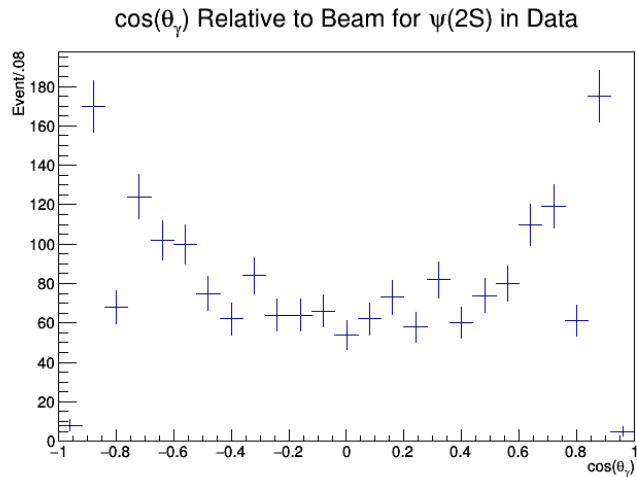
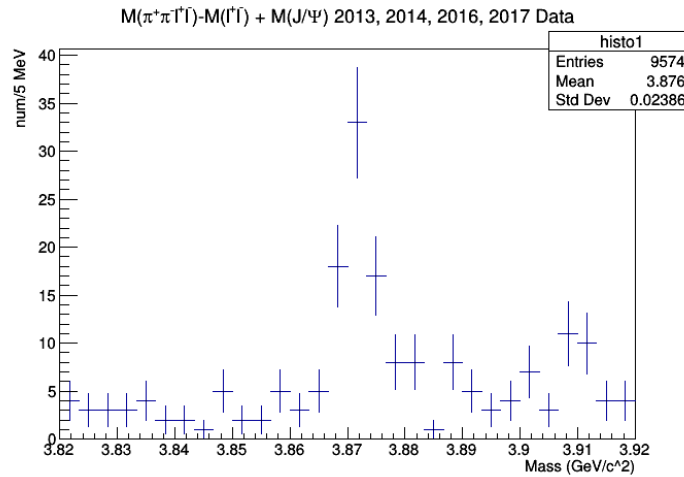
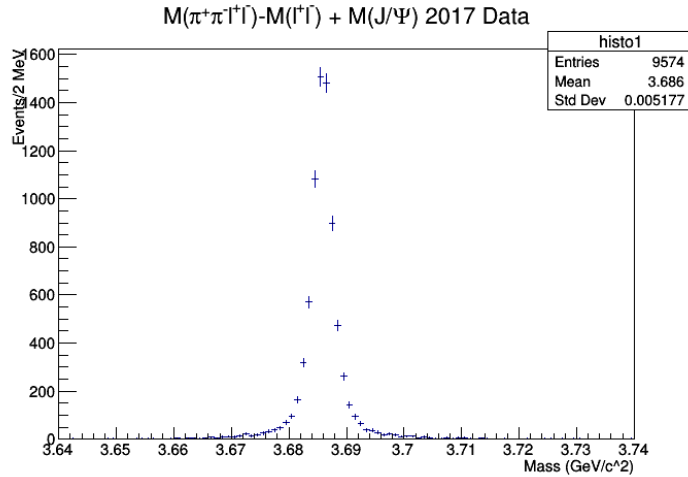


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William Imoehl

***Indiana University,
USA***

Meson Spectroscopy with BESIII



Incoming grad student

Replicating X(3872) results

Working on charmonium decays with J/ψ in final state

Previous work with Belle



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Vyacheslav Ivanov

***Budker Institute of Nuclear Physics,
Russia***

Vyacheslav Ivanov

phd student, Novosibirsk State University, Russia

Budker Institute of Nuclear Physics (CMD-3 detector) & INFN - Laboratori Nazionali di Frascati

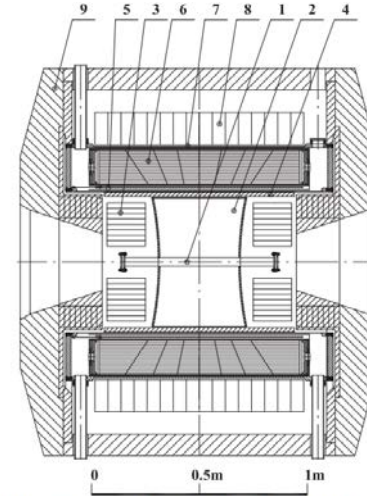
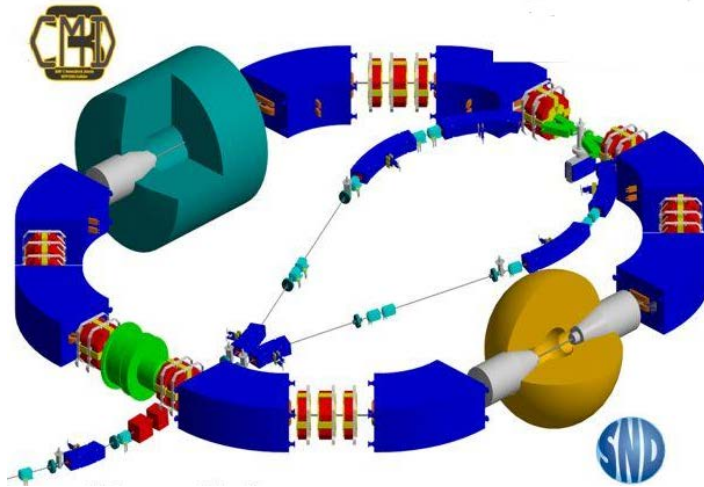


Fig. 1. 1 – beam pipe, 2 – drift chamber, 3 – BGO electromagnetic calorimeter, 4 – Z-chamber, 5 – SC solenoid (0.13T, 13 kG), 6 – LXe electromagnetic calorimeter (the segmentation with “towers” specially shown), 7 – TOF system, 8 – CsI electromagnetic calorimeter, 9 – Yoke.

Research interests:

Data Analysis:

- Low energy exclusive hadronic cross sections measurements (e.g. $K^+K^-\eta, K^+K^-\omega$)
- Determination of the parameters of resonances (e.g. $\phi(16880)$)
- Monte-Carlo for low-energy hadronic processes, matrix element parametrization etc.
- Unbinned fit of experimental data

Particle Identification:

- Charged particle identification (PID) with the multilayer liquid Xenon (LXe) Calorimeter (CMD-3)
- LXe detector simulation, calibration etc.
- Using Boosted Decision Trees for PID

Theory:

- Radiative corrections, calculation of the multiloop Feynman diagrams via the «integration by parts»
- **Calculation of $\sigma(e^+e^- \rightarrow \mu^+\mu^-(n\gamma))$ with $O(\alpha^4)$ accuracy (necessary for pion form factor measurement \rightarrow g-2 puzzle)**



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Andrew Jackura

***Indiana University,
USA***

Andrew Jackura

Ph.D. Student at Indiana University

Advisor: Adam Szczepaniak

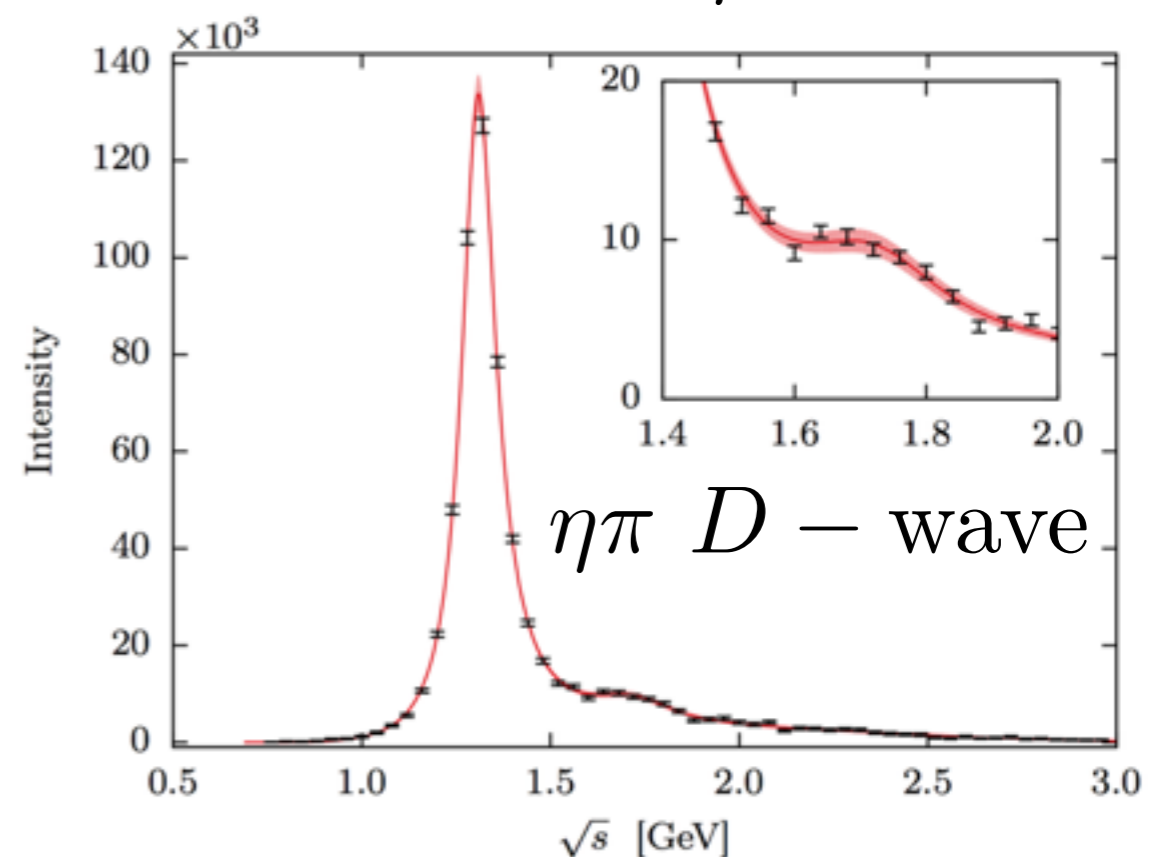
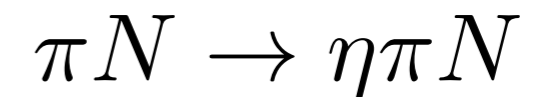
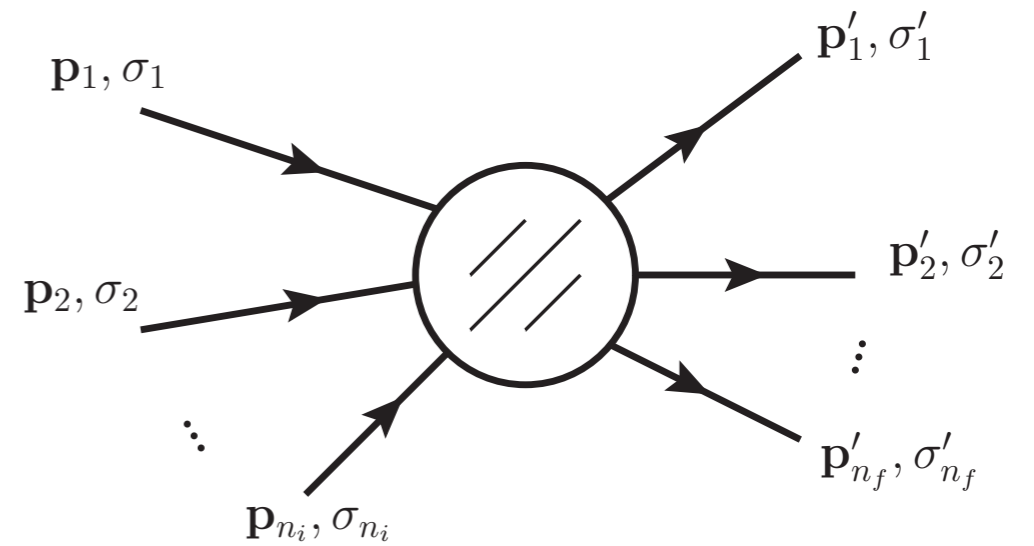
Member of JPAC

Research focus: Relativistic Reaction
Theory for Hadronic Spectroscopy.

Associated with COMPASS experiment

Personal Info: Born in Chicago IL, USA

In my spare time, I play guitar and
draw





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Jack Jenkins

***Indiana University,
USA***

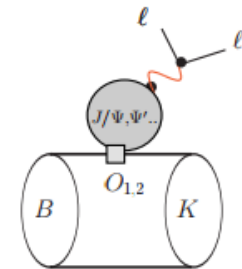
Research Interests

Heavy quark physics

- Fitting cross section of $e^+e^- \rightarrow$ hadrons at charmonium resonances with a semi-empirical model inspired by nuclear physics
- Dispersion relations, non-perturbative effects in $\bar{B} \rightarrow X_s l^+ l^-$ phenomenology with Enrico Lunghi et al

Flavor violating processes

- Studying field theory, renormalization and effective field theory (perturbative summer)



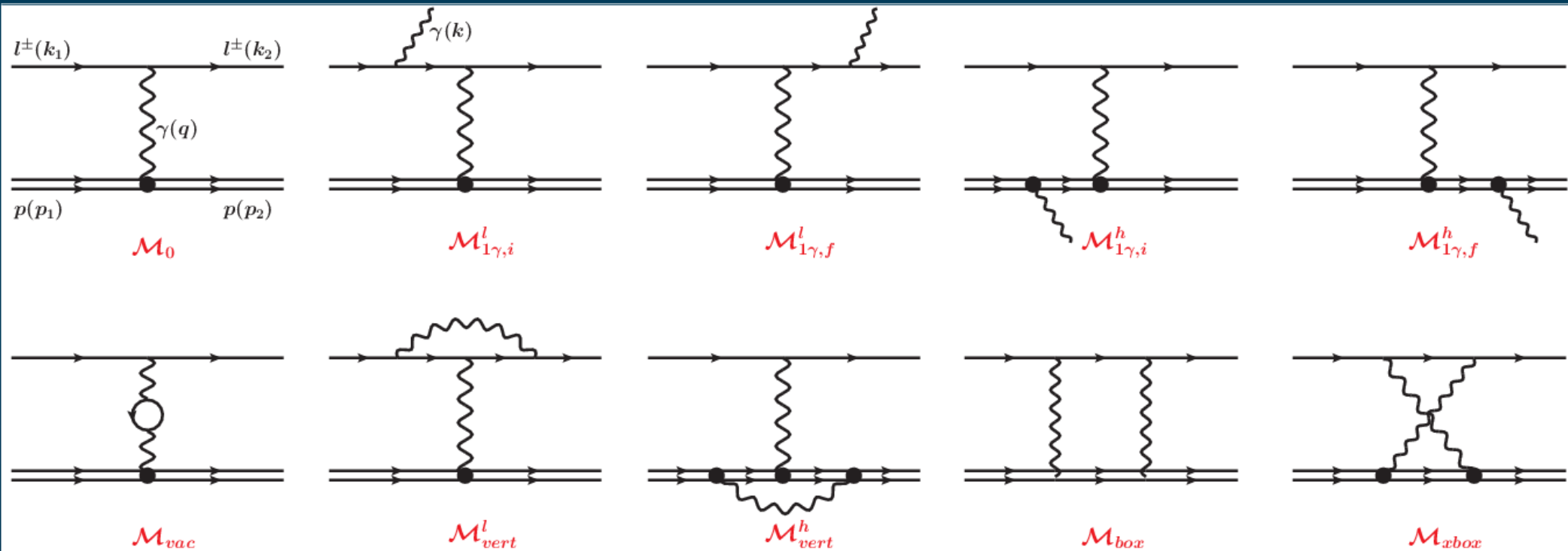


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Oleksandr Koschii

***The George Washington University,
USA***

Effects Beyond the Born Approximation for the Elastic Scattering of Leptons by Nuclei





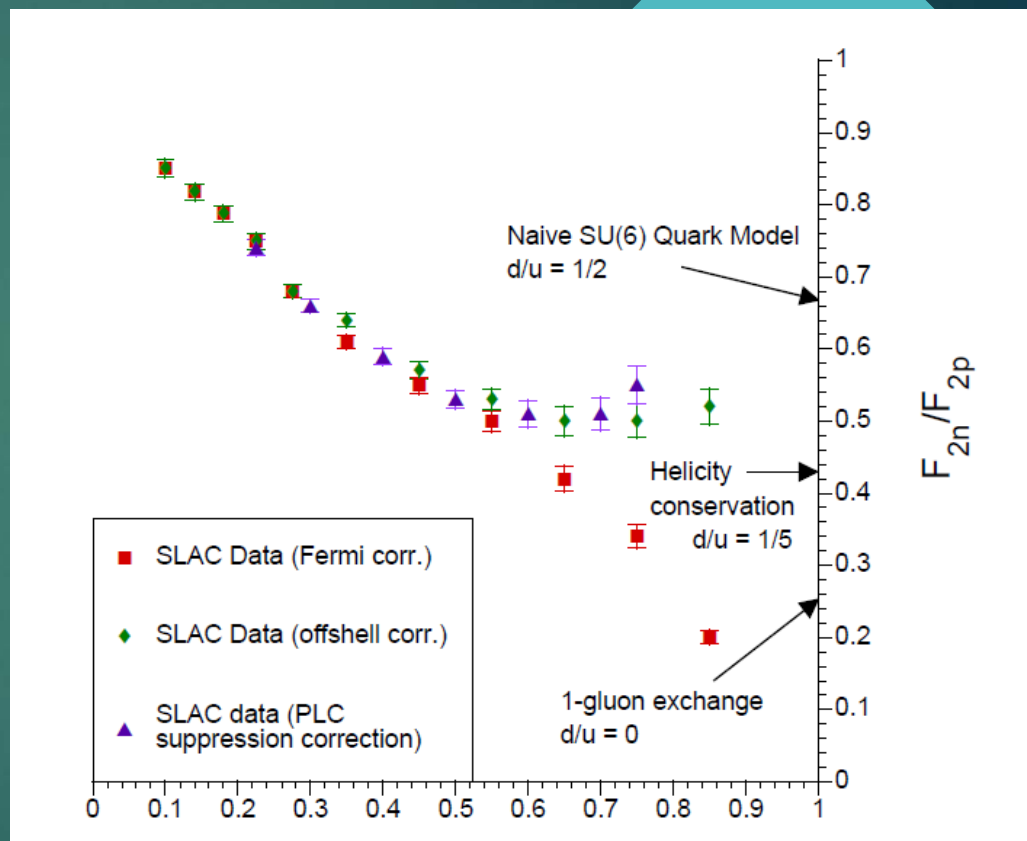
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Christopher Leon

***Florida International University,
USA***

QCD at Large Bjorken x – Chris Leon

- ▶ Large x – quark dominated hadron
- ▶ Region not well-understood
- ▶ Scant data
- ▶ PDF's give no good indication
- ▶ Different models predict very different things
- ▶ Future experiments planned at Jefferson Lab will probe this region
- ▶ Using LCPT and effective Feynman diagrams to obtain W_2 function





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John Martens

***University of Kansas,
USA***

Puzzles: proton-size, muon $g-2$

- 1) Puzzles are sensitive to value of fundamental constants. Global fit to fundamental constants, *including discrepant data*, is necessary.
- 2) Puzzles can be solved by introducing light, weakly-coupling vector/scalar and doing global fit.
- 3) Determinations of r_p from electron scattering data should make use of analytic structure of G_E .

Quantum tomography

Density matrix formalism provides model-independent way to reconstruct polarization of unknown intermediate state from 4-momenta of inclusive reaction products. Ex: lepton pair production.

Principal component analysis of space physics data

- 1) $> 90\%$ of inner magnetosphere ion dynamics is determined by two figures of merit, which are linear combinations of ~ 200 textbook variables.
- 2) Figures of merit can be used to estimate textbook storm-severity indices to within $\sim 20\%$.



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Vincent Mathieu

***Indiana University,
USA***

Joint Physics Analysis Center

HOME PROJECTS PUBLICATIONS LINKS



JPAC acknowledges support from DOE and NSF



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Interactive webpage: <http://www.indiana.edu/~jpac/>



Photoproduction:

1. High energy model for η' beam asymmetry photoproduction: $\gamma p \rightarrow \eta^{(\prime)} p$ page
2. High energy model for η photoproduction: $\gamma p \rightarrow \eta p$ page
3. High energy model for π^0 photoproduction: $\gamma p \rightarrow \pi^0 p$ page
4. High energy model for J/ψ photoproduction: $\gamma p \rightarrow J/\psi p$ page

Hadroproduction:

1. Pion-nucleon scattering:
 - Amplitudes $\pi N \rightarrow \pi N$ amplitude page
 - Finite energy sum rules $\pi N \rightarrow \pi N$ FESR page
2. Kaon-nucleon scattering: $\bar{K} N \rightarrow \bar{K} N$ page

Light meson Decay:

1. η meson into three pions: $\eta \rightarrow 3\pi$ page
2. vector meson into three pions: $\omega, \phi \rightarrow 3\pi$ page



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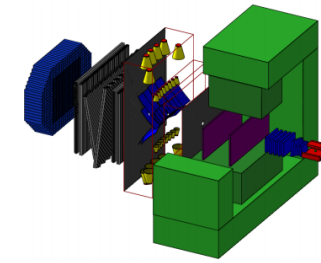
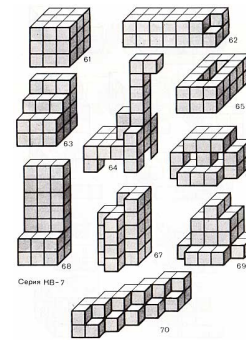
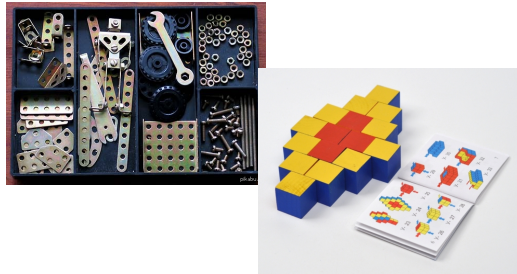
Mikhail Mikhasenko

***Bonn University,
Germany***

Misha Mikhasenko

Vertex Spectrometer

Born in Ural, Russia



BSc at MIPT, Moscow, Germany

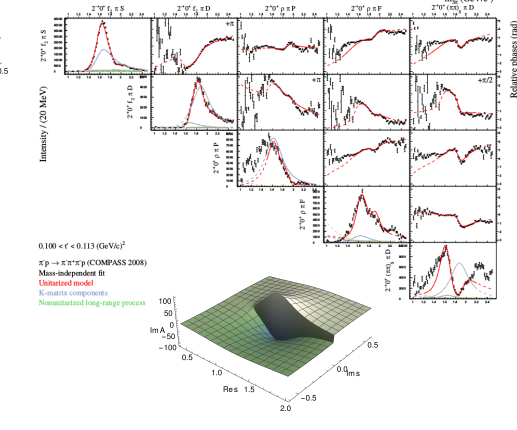
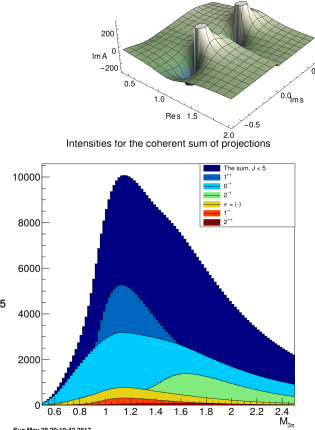
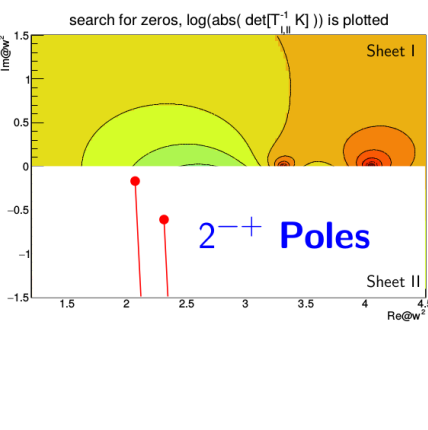
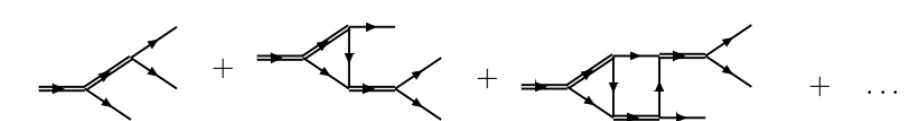
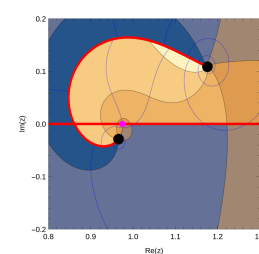
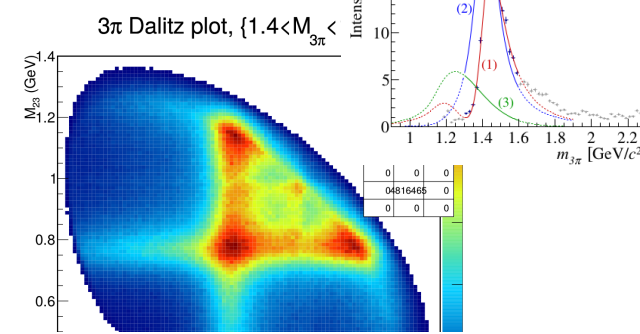
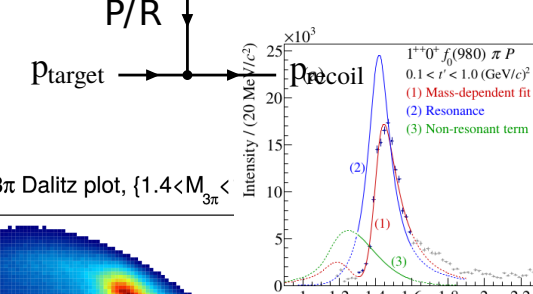
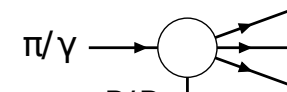
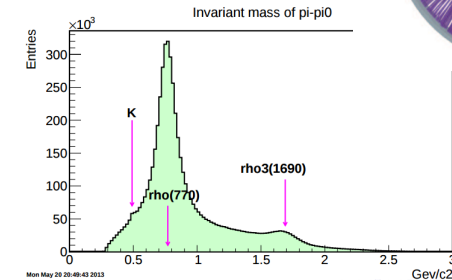
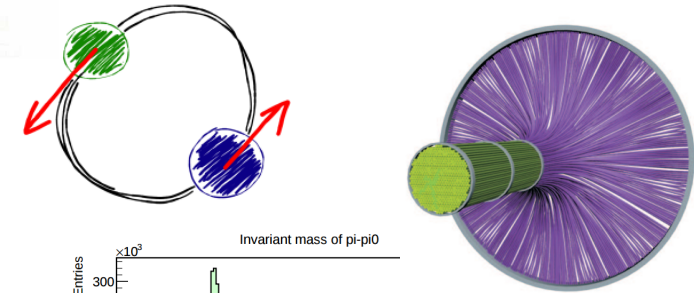
Active target detector simulations with Dr. Y. Khokhlov
Pionic atom with Prof. A. Likhoded

MSc at IHEP, Protvino, Germany

Studies of SIPMs with Dr. Y. Khokhlov
Intrinsic charm with Prof. A. Likhoded
Partial Wave Analysis of pi-pi0 system with Prof. A. Zaytzev

PhD (ongoing) HISKP, Bonn, Germany

Studies of pion induced final states at COMPASS with Prof. B. Ketzner
JPAC studies





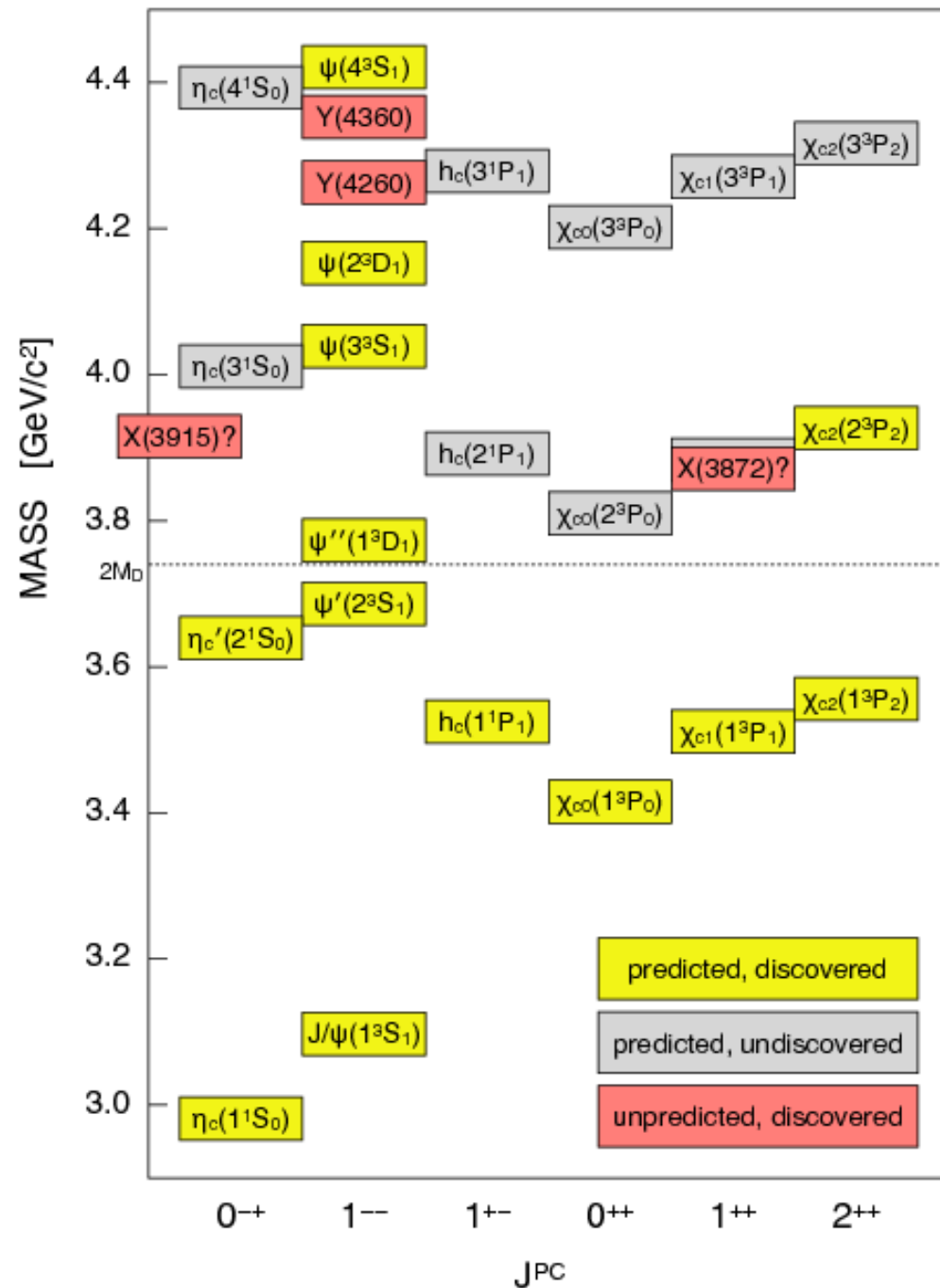
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Joseph Mirabelli

***Indiana University,
USA***

Meson Spectroscopy with BESIII

- Recent plethora of XYZ states in charmonium sector searches
- Current work: recording cross sections on all $X+J/\psi$ final states in BESIII data



Calorimetry Timing Systematics with GlueX

- GlueX FCAL constructed by IU engineers and physicists
- 2800 lead glass modules make up detector array
- Current work: use LED data to improve timing resolution





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Daniel Molnar

***Johannes Gutenberg Universitat
Mainz,
Germany***



B.Sc. Physics

- Production and Characterization of the Superconductors Ru-1221 and Ru-1222
- Prof. Dr. Renato Jardim, University of Sao Paulo, Brazil

M.Sc. Physics

- Effective Field Theory for the X(3872) Radiative Decay
- Prof. Dr. Renato Higa, University of Sao Paulo, Brazil

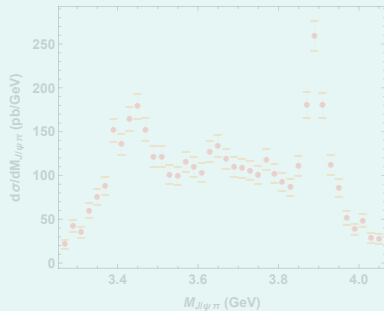
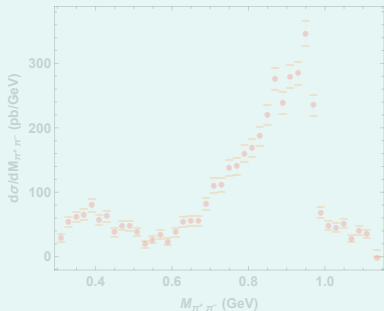
Ph.D. Physics (in progress)

- Theoretical Studies of Exotics in the Charmonium Spectrum
- Prof. Dr. Marc Vanderhaeghen, University of Mainz, Germany



$Y(4260) \rightarrow J/\psi \pi^+ \pi^-$

- Experimental data BES III 2017

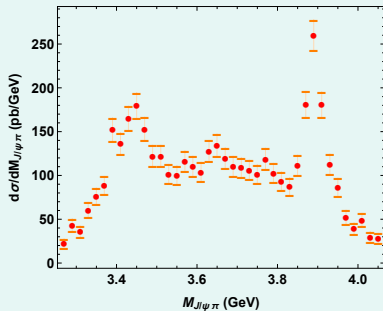
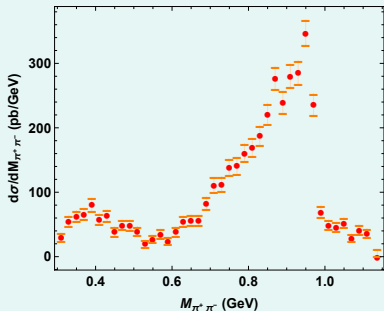


- $Y(4260) \rightarrow Z_C^\pm \pi^\mp \rightarrow J/\psi \pi^+ \pi^-$



$Y(4260) \rightarrow J/\psi \pi^+ \pi^-$

- Experimental data BES III 2017

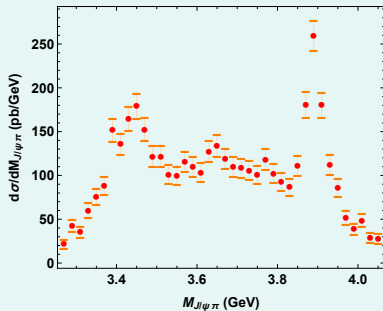
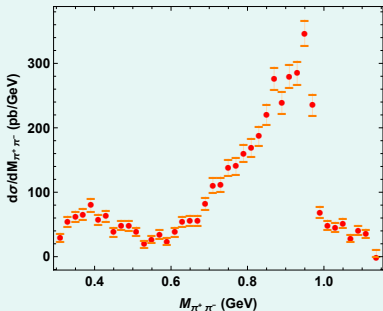


- $Y(4260) \rightarrow Z_C^\pm \pi^\mp \rightarrow J/\psi \pi^+ \pi^-$

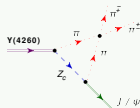


$Y(4260) \rightarrow J/\psi \pi^+ \pi^-$

- Experimental data BES III 2017



- $Y(4260) \rightarrow Z_C^\pm \pi^\mp \rightarrow J/\psi \pi^+ \pi^-$





INDIANA UNIVERSITY

Christopher Mullen

***University of Glasgow,
UK***

Nucleon Polarisation Measurements in Photoproduction

- Photoproduction to study baryon resonances Crystal Ball
- experiment at MAMI
- $\gamma\text{D} \rightarrow \text{p(n)} + \pi_0 + n_{\text{spec}}(p_{\text{spec}})$ charged pion channels

Differential Cross Section for Pion Photoproduction

$$\rho_f \frac{d\sigma}{d\Omega} = \frac{d\sigma}{d\Omega_0} [1 - P_\gamma^L \Sigma \cos 2\phi_m + \sigma_{x'} (P_\gamma^C C_{x'} + P_\gamma^L O_{x'} \sin 2\phi_m) + \sigma_{y'} (P - P_\gamma^L T \cos 2\phi_m) + \sigma_{z'} (P_\gamma^C C_{z'} + P_\gamma^L O_{z'} \sin 2\phi_m)]$$

- Analyse final state nucleon in graphite polarimeter (PID, Analysing material, MWPCs)
- Scattering of polarised nucleons gives up/down
- asymmetry Asymmetry is proportional to polarisation
- Also: dibaryon hunting via deuterium photo-disintegration



INDIANA UNIVERSITY

Edwin Munevar

***Universidad Distrital Francisco
Jose de Caldas,
Colombia***

Photon Beam Asymmetry Measurement from the $\gamma D \rightarrow K^+ \Sigma^-(p)$ and $\gamma D \rightarrow K^+ \Sigma^- p$ Reactions



g13 CLAS Run Period

Goal: to produce strangeness data on the neutron using polarized photons with very high statistics

- Deuteron target
- Polarized photon beam (both circular and linear polarization): 0.8 – 2.5 GeV
- CLAS detector
- High-quality data and good kinematic coverage
- Many experimental observables available for each reaction channel



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Kirill Nikonov

***Johannes Gutenberg Universität
Mainz,
Germany***

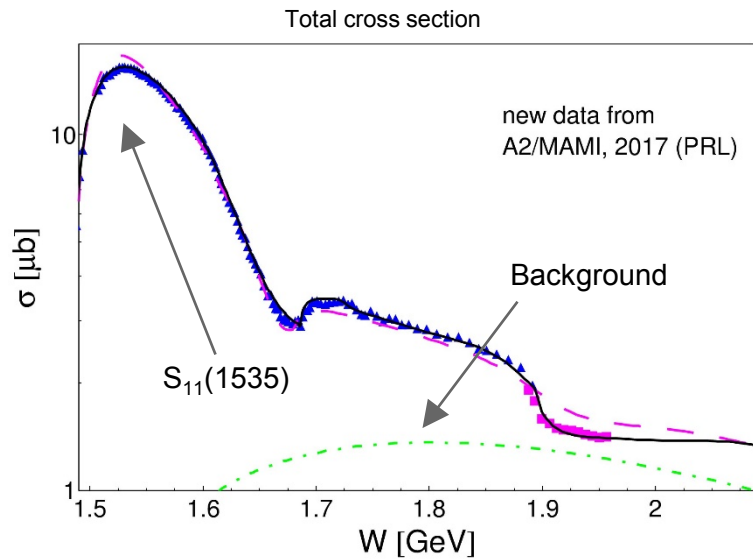
JOHANNES GUTENBERG
UNIVERSITÄT MAINZ



Partial Wave Analysis of Pseudoscalar Meson Photoproduction Using Fixed-t Dispersion Relations

Nikonov Kirill, PhD student.

$\gamma p \rightarrow \eta p$



New data from JLab, ELSA, MAMI.

- New η MAID isobar model (resonances+background).
- η MAID does not fulfill analyticity.
- Fixed- t dispersion relations applied for η MAID

Goals:

- Fit the new data.
- Obtain resonance parameters in an improved and less model dependent way, e.g. pole positions, residues.



INDIANA UNIVERSITY

Jannes Nys

***Ghent University,
Belgium***

JANNES NYS

- ✓ PhD student (Jan Ryckebusch)
- ✓ Theorist
- ✓ JPAC member

- ✓ Photo- and electroproduction
- ✓ Regge theory
- ✓ Amplitude analysis
- ✓ Statistical analysis

- ✓ Finishing PhD, looking for post-doc

Current research

- ✓ Global Regge analysis
- ✓ Writing PhD thesis



INDIANA UNIVERSITY

Joint Physics Analysis Center



Amplitude extraction in pseudoscalar-meson photoproduction: towards a situation of complete information

J Nys, T Vrancx, J Ryckebusch
Journal of Physics G: Nuclear and Particle Physics 42 (3), 034016

Model discrimination in pseudoscalar-meson photoproduction

J Nys, J Ryckebusch, DG Ireland, DI Glazier
Physics Letters B 759, 260-265

Finite-energy sum rules in eta photoproduction off a nucleon

J Nys, V Mathieu, C Fernandez-Ramirez, ANH Blin, A Jackura, ...
Physical Review D 95 (3), 034014

$K^+ \Lambda$ electroproduction above the resonance region

T Vrancx, J Ryckebusch, J Nys
Physical Review C 89 (6), 065202

Amplitude analysis and the nature of the $Z_c(3900)$

A Pilloni, C Fernandez-Ramirez, A Jackura, V Mathieu, M Mikhasenko, ...
arXiv preprint arXiv:1612.06490

On the η and η' Photoproduction Beam Asymmetry at High Energies

V Mathieu, J Nys, C Fernández-Ramírez, A Jackura, M Mikhasenko, ...
arXiv preprint arXiv:1704.07684

Measurement of the beam asymmetry Σ for π^0 and η photoproduction on the proton at $E_\gamma = 9$ GeV

H Al Ghouli, EG Anagnostis, A Austregesilo, F Barbosa, A Barnes, ...
Physical Review C 95 (4), 042201

Electroweak single-pion production off the nucleon: from threshold to high invariant masses

R González-Jiménez, N Jachowicz, J Nys, V Pandey, T Van Cuyck, ...
arXiv preprint arXiv:1612.05511

Thursday, June 22

Astrid Blin and Jannes Nys:
"Application of Regge Theory"

Astrid Blin and Jannes Nys:
"Application of Regge Theory (cont.)"



INDIANA UNIVERSITY

Elisabetta Perotti

***Uppsala University,
Sweden***



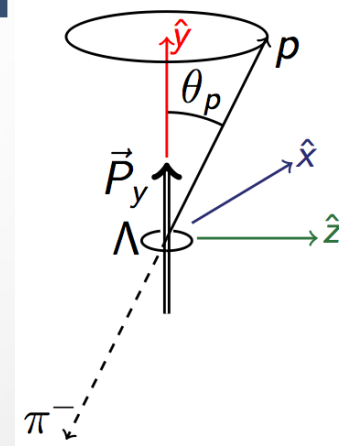
EXPLORE BARYON STRUCTURE



STRANGENESS

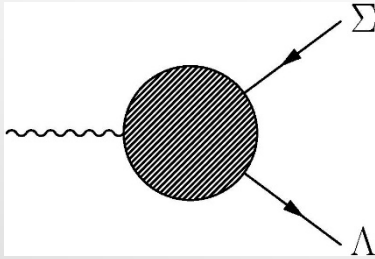
HYPERON PHYSICS

Spin physics



- Spin-density matrix
- Polarization parameters

Electromagnetic Transition Form Factor



- Baryon Chiral Perturbation Theory
- Dispersion Theory



INDIANA UNIVERSITY

Alessandro Pilloni

***Jefferson National Lab,
USA***

Alessandro Pilloni

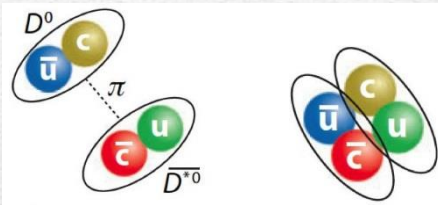
1983: Born in Rome (Italy)

2012-2015: Ph.D. student at «Sapienza» Università di Roma



advisor Prof. A.D. Polosa

Main research topic: Exotic Charmonium Spectroscopy



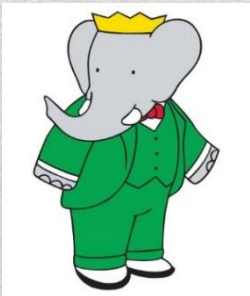
2015-: Postdoc at Jefferson Lab
in the JPAC collaboration

Main research topic: Amplitude analysis,
focused on exotic signatures



2013-: Member of the *BABAR* collaboration
analysis of *CP* violations in *SCS* Charm Decays

2016-: Associated theorist to the LHCb collaboration



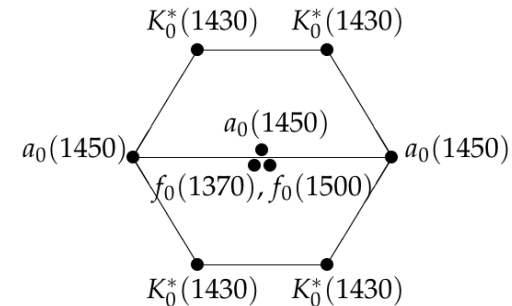
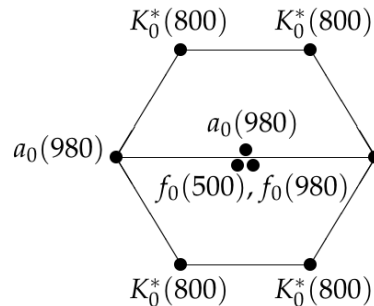
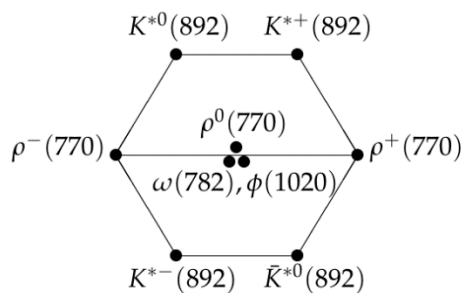
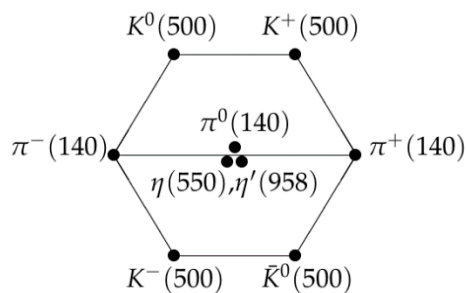
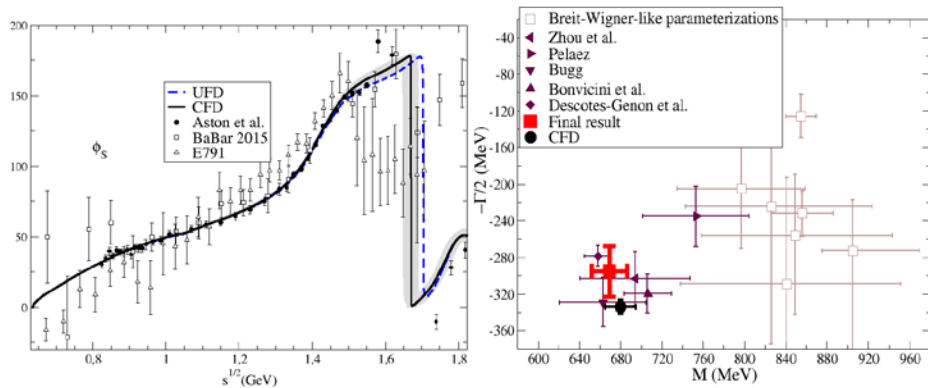
...



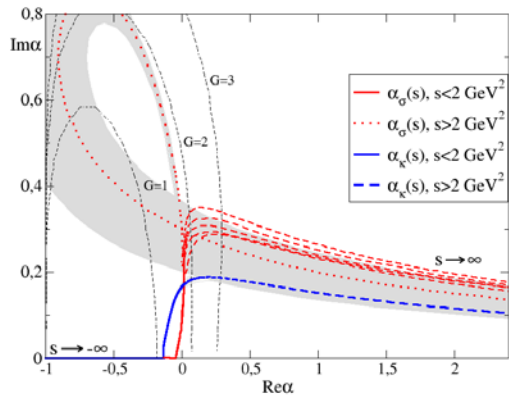
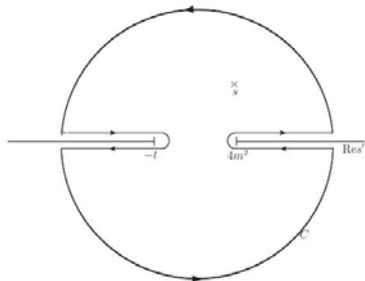
INDIANA UNIVERSITY

Arkaitz Rodas

***Universidad Complutense de Madrid,
Spain***



$$T(s, t, u) = \frac{1}{2\pi i} \oint ds' \frac{T(s', t, u)}{s' - s}$$





INDIANA UNIVERSITY

Daniel Sadasivan

***The George Washington University,
USA***

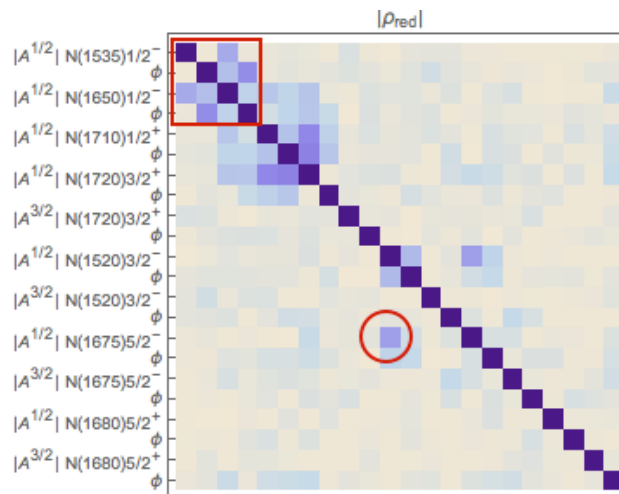
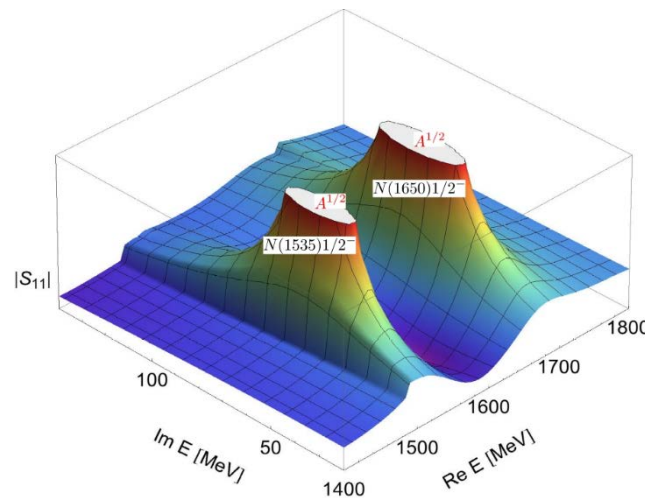
Daniel Sadasivan

George Washington University

Advisor: Michael Doring

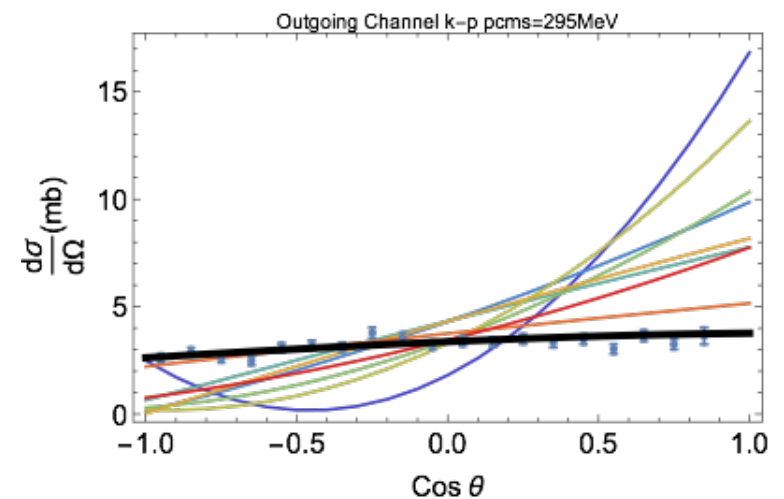
Project 1:

We calculated the correlations between helicity couplings, (fundamental electromagnetic resonances defined as shown in the upper left picture), for Eta-Photoproduction. We can plot them as shown in the lower left plot. We use these plots and statistical methods to analyze the impact of polarization observables.



Project 2:

The free parameters of the Meissner-Mai model have been fitted to data for total cross section but not for differential cross section. We fit these parameters for the data for differential cross sections and perform analysis on the locations of the poles.





INDIANA UNIVERSITY

Stefano Sconfiatti

***Universita' degli Studi di Pavia -
INFN (Pavia),
Italy***

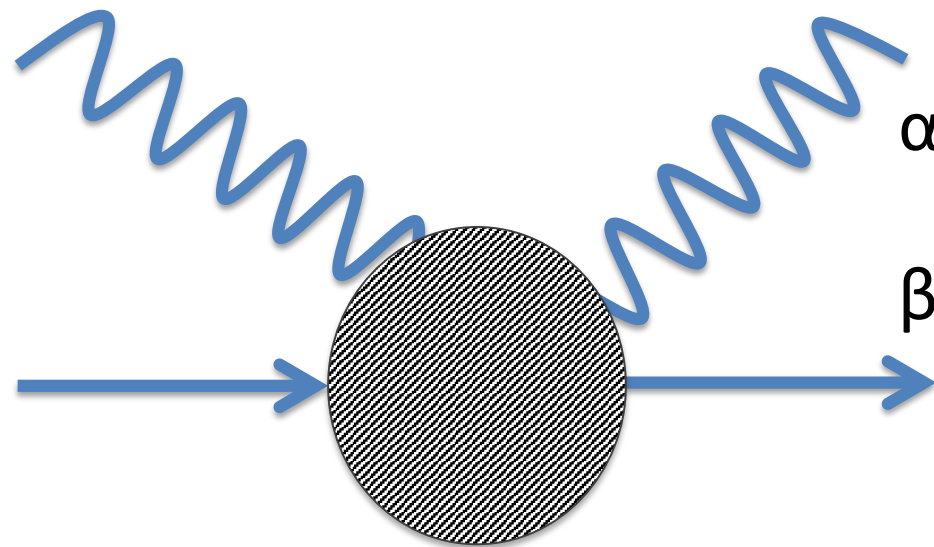


UNIVERSITÀ
DI PAVIA

Stefano Sconfiatti



Nucleon Compton Scattering: DIPOLE DYNAMICAL POLARIZABILITIES



$$\alpha(\omega) = \alpha_{E10} + \text{energy dependent terms}$$

$$\beta(\omega) = \beta_{M10} + \text{energy dependent terms}$$

**FIRST EXTRACTION from
EXPERIMENTAL DATA!**

Università degli Studi di Pavia – INFN (Pavia)



INDIANA UNIVERSITY

Nathan Sherrill

***Indiana University,
USA***

- Born/grew up in North Carolina
- Graduate student at IU working primarily under Adam Szczepaniak and with JPAC
- Research projects I am involved in:
 - $\pi\pi$ scattering in the Khuri-Treiman approximation – A.S. and Emilie Passemar
 - Amplitude analysis of the $\Lambda(1405)$ CDD pole structure – A.S. & Lingyun Dai (Jülich)
 - Sensitivity studies at future EIC in search of CPT/Lorentz violation using deep inelastic scattering – V. A. Kostelecky & E. Lunghi
- I look forward to meeting all of you!



INDIANA UNIVERSITY

Jorge Silva Castro

***Universidad Nacional
Autonoma de Mexico,
Mexico***



Jorge Silva Castro



- I am 24 years old and born in Mexico City.
- First year student msc. physics at UNAM-Mexico.
- I am developing my master thesis under the supervision of Cesar Fernandez at ICN-UNAM.
- My current research is on hadron physics, employing dispersive approaches and Regge theory.





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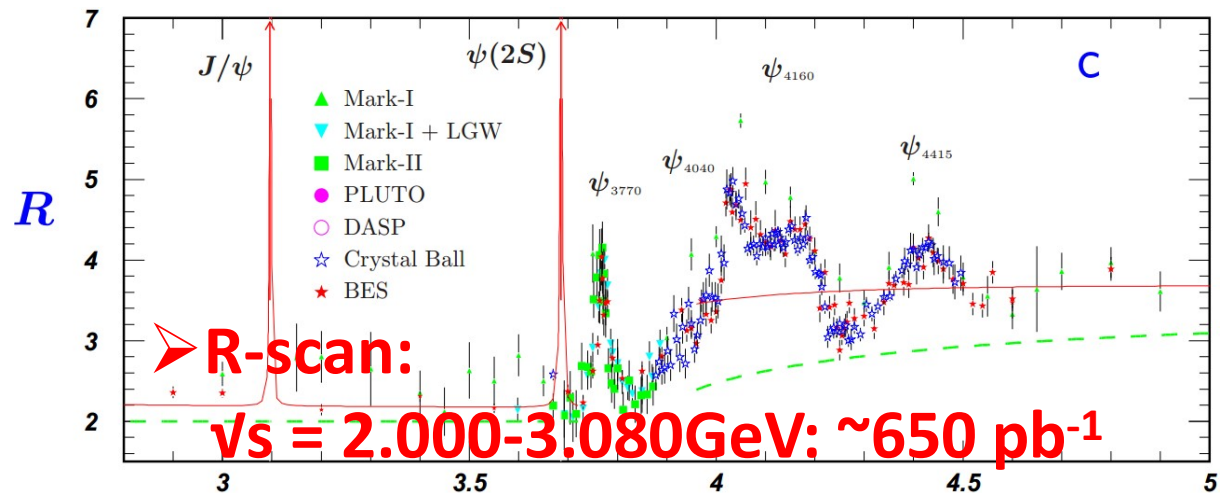
Yankun Sun

***University of Science and
Technology of China (USTC),
State Key Laboratory of Particle
Detection and Electronics,
China***

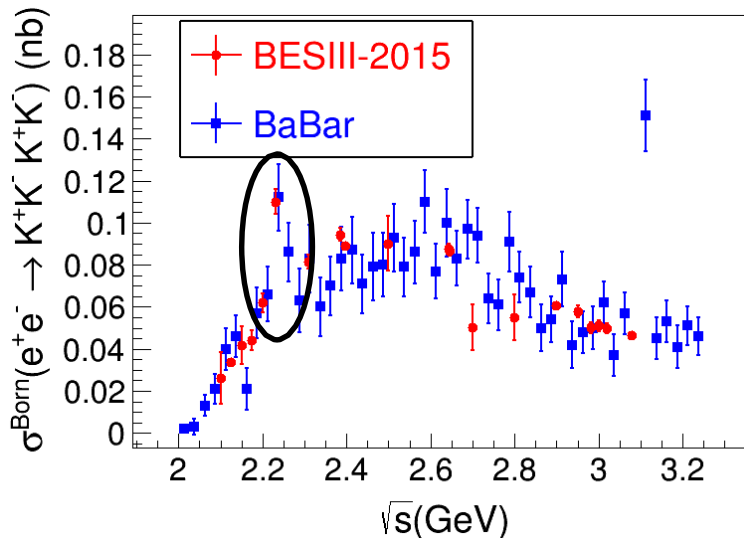
Measurement of cross sections (R-Scan Data: $\sqrt{s}=2.0\text{GeV}\sim 3.08\text{GeV}$)

◆ R-QCD:

- ✓ R measurement;
- ✓ τ -physics;
- ✓ Form factor of hadrons.
- ✓ Light hadron spectroscopy
- ✓ Need further study in low energy region.

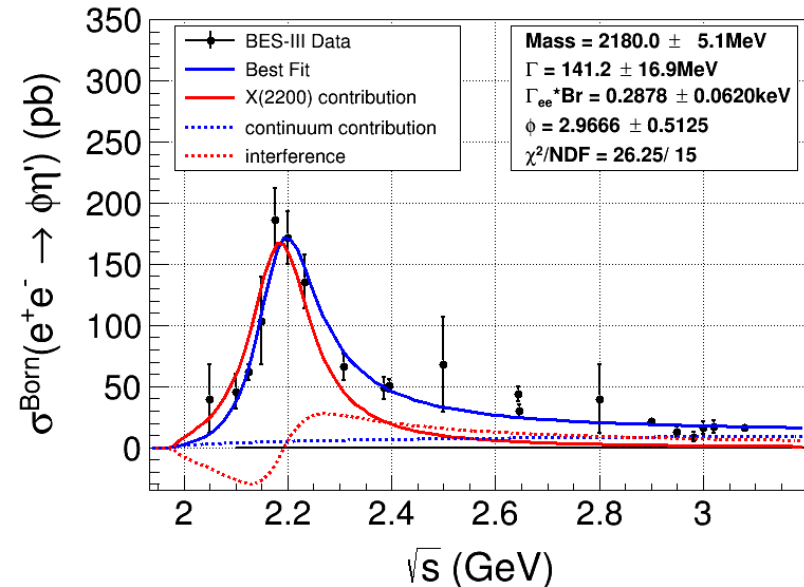


◆ Cross sections of $e^+e^- \rightarrow \phi K^+K^-$ and $K^+K^- K^+K^-$.



◆ Cross sections of $e^+e^- \rightarrow \phi \eta'$

- Possible structure around 2.2 GeV (first time).





INDIANA UNIVERSITY

Arkadiusz Trawinski

***Independent researcher,
Poland***

Hadrons in the Hamiltonian picture

Arkadiusz (Arek) Trawiński

Any hadron can be described in terms of constituents of any size, e.g.

$$|\pi\rangle = \psi_{q\bar{q}}(\lambda) |q\bar{q}; \lambda\rangle + \psi_{q\bar{q}g}(\lambda) |q\bar{q}g; \lambda\rangle + \psi_{q\bar{q}gg}(\lambda) |q\bar{q}gg; \lambda\rangle + \dots$$

When one assumes that $|\pi\rangle \approx \psi_{q\bar{q}/\pi}(\lambda_c) |q\bar{q}; \lambda_c\rangle$, then we can obtain the pion state for a general value of λ using the \mathcal{W} -transformation.

The eigenvalue equation inspired by the LF-holography gives

$$\psi_{u\bar{d}/\pi}(x, k^\perp; \lambda_c) = \mathcal{N} \bar{u}(\not{p}_\pi + M) \gamma_5 v \exp \left[-\frac{m_c^2 + (k^\perp)^2}{2x(1-x)\kappa^2} \right],$$

$$\psi_{uud/p}(p_i; \lambda_c) = \sum_k \mathcal{N}_k I_k(123) \exp \left[-\sum_{i=1}^3 \frac{(p_i^\perp)^2 + m_c^2}{6\kappa^2} \frac{P^+}{p_i^+} \right] \epsilon^{abc}.$$

A.P. Trawiński, PhD. thesis (2016)

S. Głazek, Acta Phys.Polon. B42 (2011) 1933-2010

G. de Téramond, S. Brodsky, Phys.Rev.Lett. 94 (2005) 201601

G. de Téramond, S. Brodsky, Phys.Rev.Lett. 102 (2009) 081601



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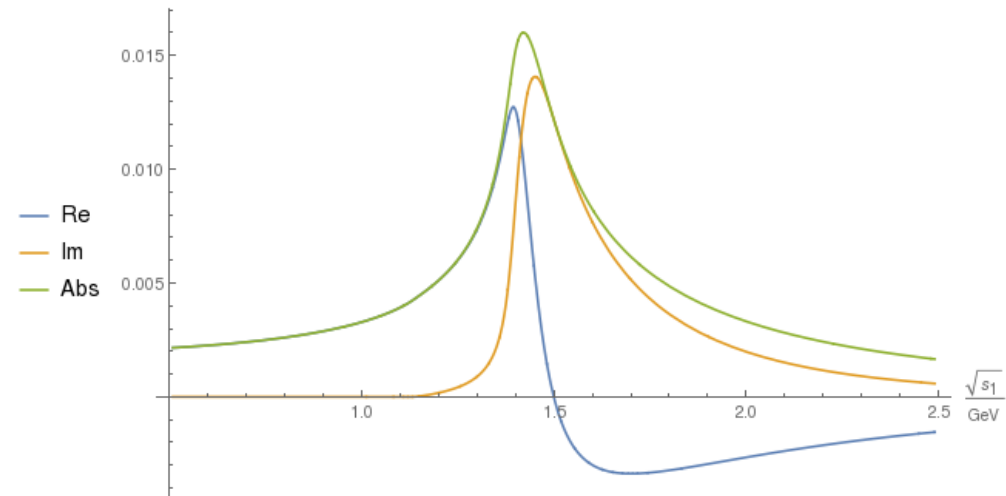
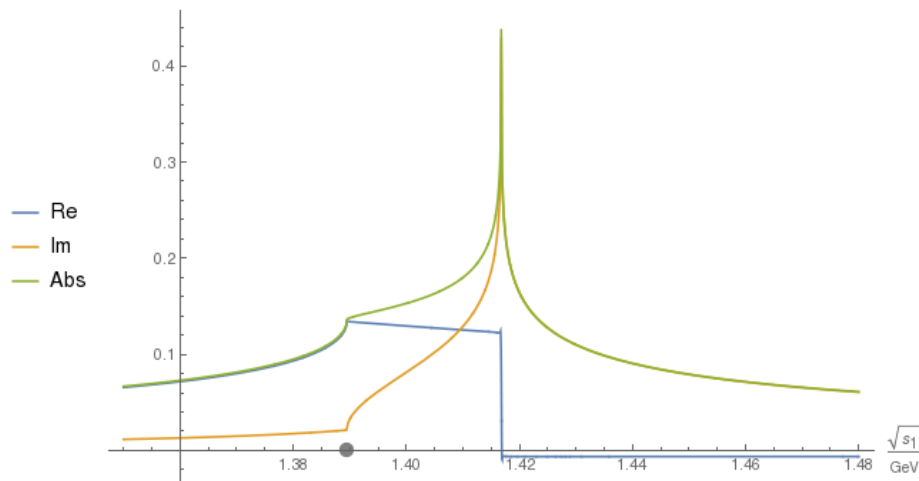
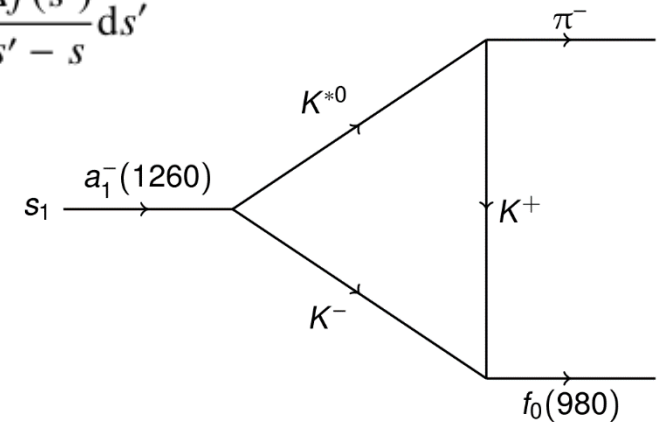
Mathias Wagner

***Bonn University,
Germany***

Mathias Wagner

- Dispersive approach to triangle diagram
-
- Fit model to COMPASS data
-
- Try to explain recently found $a_1(1420)$ resonance-like signal without introducing a new particle

$$f(s) = \frac{1}{2\pi i} \int_{s_{th}}^{\infty} \frac{\Delta f(s')}{s' - s} ds'$$





INDIANA UNIVERSITY

Daniel Winney

***Indiana University,
USA***



INDIANA UNIVERSITY

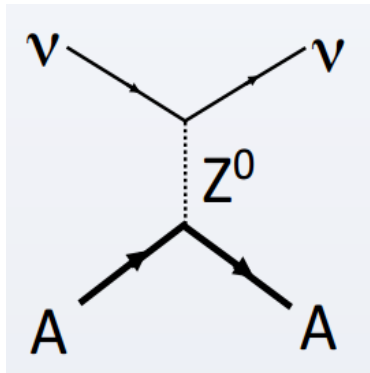
Daniel Winney

Previously at CSUSB (Undergrad) / Murrillo Family Observatory



Presently at Indiana University

- *Neutrino – Nucleon Interactions (CEvNS and NSI)*





INDIANA UNIVERSITY

Jonathan Zarling

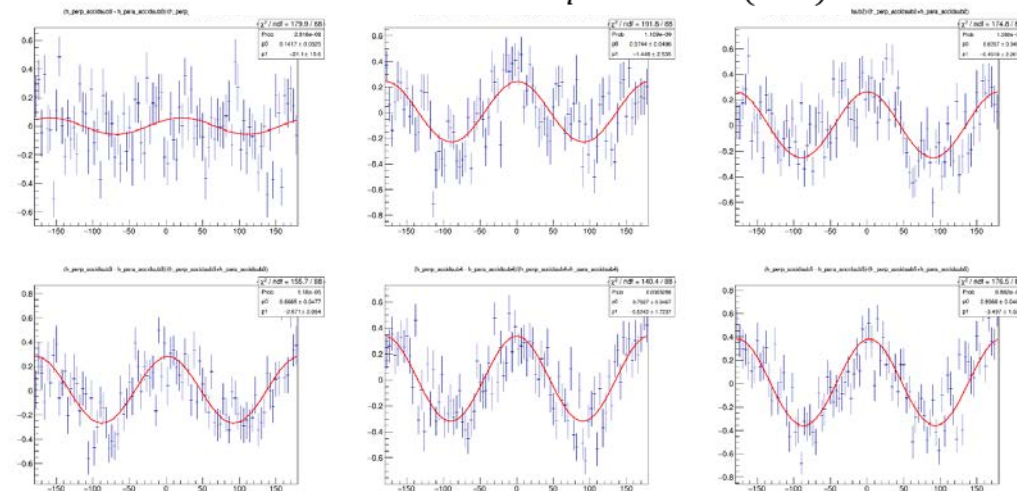
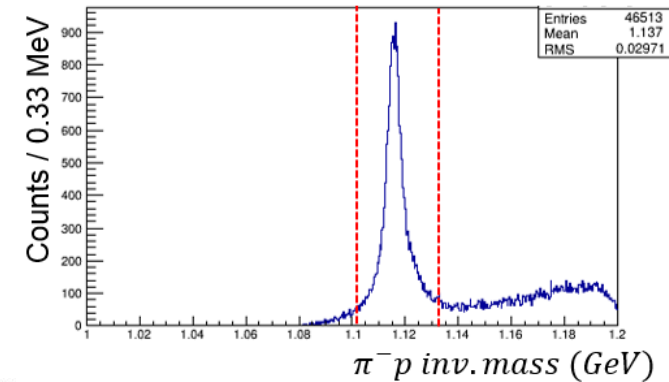
***Indiana University,
USA***



Jon Zarling

FCAL Hardware and Commissioning

Photoproduction asymmetries
w/ π^\pm or K^+ , e.g. $\gamma p \rightarrow K^+ \Lambda$



Increasing $|t| \rightarrow$