Joint Physics Analysis Center
10y review

Adam Szczepaniak, Indiana University/Jefferson Lab

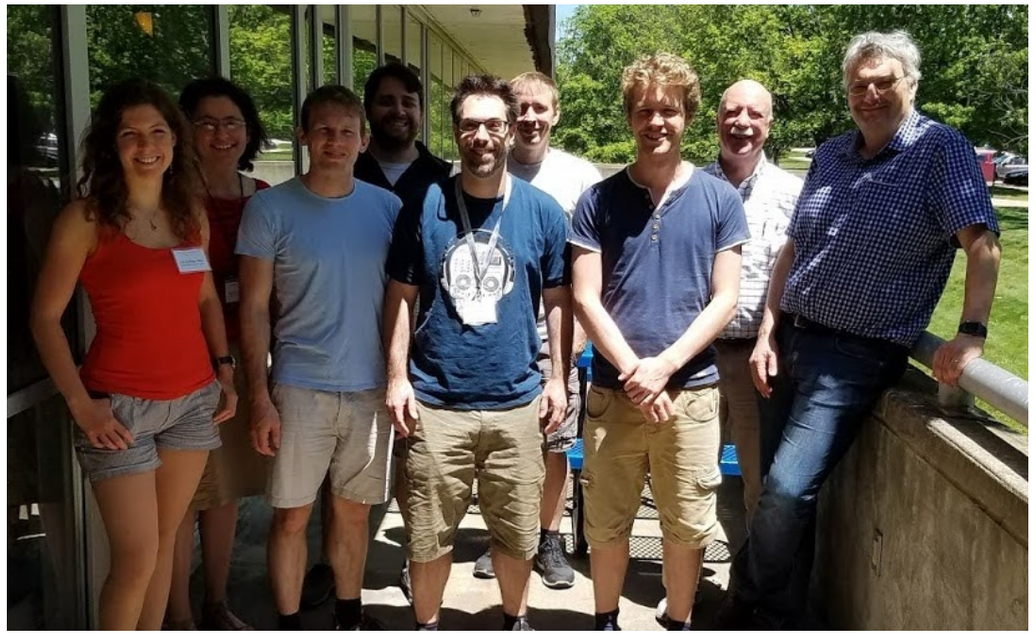
Join Physics Analysis Center

Andrew Jackura

Old Dominion University

INDIANA UNIVERSITY Jefferson Lab

- Established in 2013 to develop theory and phenomenology in support of experimental program at JLab12.
- 10y initially with periodic review: 3y year review, no 6y review (covid).
- Bridge position (Emile Passemar) Director (AS) on joint appointment with JLab.



- 1-2 postdocs, Vincent Mathieu, Igor Danilkin, Cesar Fernandez-Ramirez.

Emilie Passemar

Indiana University

César Fernández Ramírez

UNAM

Igor Danilkin

JGU Mainz

Vincent Mathieu

University of Barcelona

- Over time ~40 researchers have been associated with JPAC.
- (almost) all former postdocs have long-term or permanent positions.
- Tuesday's JPAC meetings have run continuously for the past10 years (record over 8h)

The Collaboration

Full Members

Adam Szczepaniak
Indiana University

Alessandro Pilloni
Università di Messina

Arkaitz Rodas
Jefferson Lab

Astrid Hiller Blin
Tubingen University

César Fernández Ramírez
UNAM

Daniel Winney
South China Normal U.

Emilie Passemar
Indiana University

Gloria Montaña
Jefferson Lab

Łukasz Bibrzycki
Pedagogical University of Kracow

Miguel Albaladejo
IFIC-CSIC Valencia

Mikhail Mikhasenko
LMU Munich

Robert Perry
University of Barcelona

Sergi Gonzàlez-Solís
Los Alamos

Viktor Mokeev
Jefferson Lab

Vincent Mathieu
University of Barcelona

Wyatt Smith

Former Members

- Diane Schott
- Ina Lorenz
- Jannes Nys
- Ling-Yun Dai
- Meng Shi
- Nathan Sherrill
- Peng Guo
- Tim Londergan
- Vladyslav Pauk

Affiliated Members

Andrew Jackura
Old Dominion University

Geoffrey Fox
UVA

Igor Danilkin
JGU Mainz

Jorge A. Silva-Castro
UNAM

Kevin Quirion
Indiana University

Michael Döring
GWU

Nadine Hammoud
INP Krakow

Ron Workman
GWU

Sebastian Dawid
University of Washington

INDIANA UNIVERSITY

Jefferson Lab

- Several fellowship (e.g LANL Director's Fellow, M. Moshinsky award (Mexico), JSA Postdoctoral Fellows, Nathan Isgur Fellow, Helmholtz Young Investigator Award, …)
- 9 PhD students have graduated based on JPAC related work

Arkaitz Rodas
Jefferson Lab

(U.Computense ,2019)

Daniel Winney
South China Normal U.

(IU ,2021)

Mikhail Mikhasenko
LMU Munich

(U.Bonn,2019)

Sebastian Dawid
University of Washington

(IU,2022)

Andrew Jackura
Old Dominion University

(IU,2019)

Astrid Hiller Blin
Tubingen University

(U.Valencia 2018)

Pole position of the $a_1(1260)$ from τ-decay

M. Mikhasenko,[1,*] A. Pilloni,[2,3] A. Jackura,[4,5] M. Albaladejo,[2,6] C. Fernández-Ramírez,[7] V. Mathieu,[2] J. Nys,[8] A. Rodas,[9] B. Ketzer,[1] and A. P. Szczepaniak[4,5,2]

(Joint Physics Analysis Center Collaboration)

Nathan Sherrill
U.Sussex

(IU ,2021)

Jannes Nys
U. of Ghent

(U.Ghent ,2018)

Meng Shi
Private industry

(Pekin U ,2015)

PHYSICAL REVIEW D **91,** 034007 (2015)

Double-Regge exchange limit for the $\gamma p \to K^+K^-p$ reaction

M. Shi,[1,2,*] I. V. Danilkin,[2] C. Fernández-Ramírez,[2] V. Mathieu,[3,4] M. R. Pennington,[2] D. Schott,[5] and A. P. Szczepaniak[2,3,4]

[1]*Department of Physics, Peking University, Beijing 100871, China*
[2]*Theory Center, Thomas Jefferson National Accelerator Facility, Newport News, Virginia 23606, USA*
[3]*Center for Exploration of Energy and Matter, Indiana University, Bloomington, Indiana 47403, USA*
[4]*Physics Department, Indiana University, Bloomington, Indiana 47405, USA*
[5]*Department of Physics, The George Washington University, Washington, DC 20052, USA*
(Received 30 November 2014; published 12 February 2015)

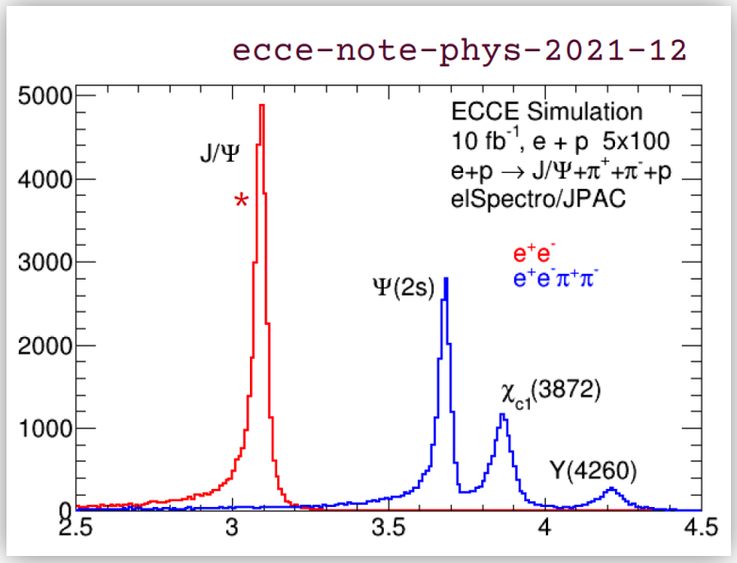
- JPAC members have (co-)organized over 30 international conferences and workshops, including its “own” series: 4 editions of Future Directions in Spectroscopy Analysis (FDSA).

- Two Summer Schools (2015,2017), INT Program (2020), Graduate course on reaction theory (P665), and 2021 JPAC co-organized the virtual National Nuclear Physics Summer School

Hadron Spectroscopy in Photoproduction

Miguel Albaladejo[1], Łukasz Bibrzycki[2], Sean Dobbs[3], César Fernández-Ramírez[4,5], Astrid N. Hiller Blin[6], Vincent Mathieu[7,8], Alessandro Pilloni[9,10], Justin Stevens[11], Adam P. Szczepaniak[12,13,14], and Daniel Winney[13,14,15,16]

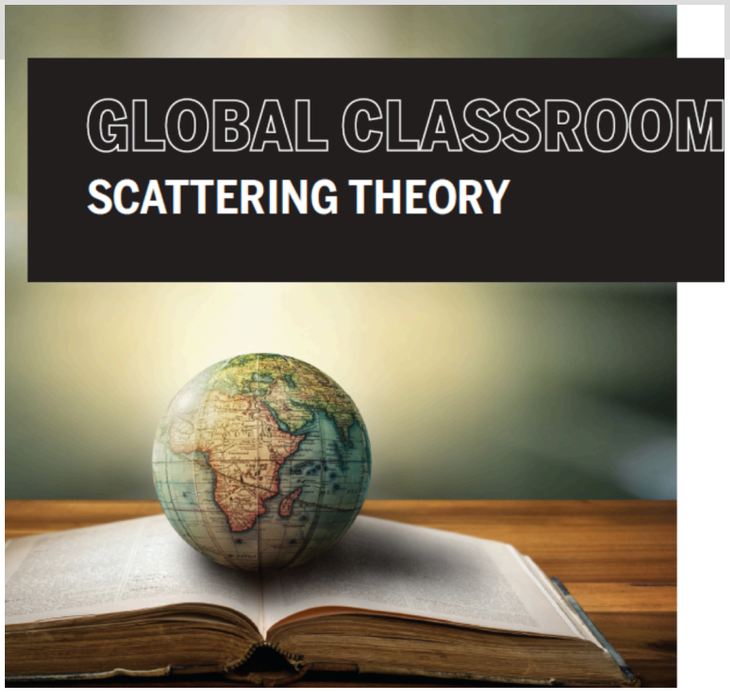
- Over the years JPAC served as a liaison between many theoretical and experimental analysis efforts (BaBar,BESIII,COMPASS,EIC, LHCb,JLab)



- Over $1.5M in external funding (US and abroad)

Diversity Equity and Inclusion

- JPAC is comprised of people from different backgrounds
- Currently within the collaboration there are four women, one in a permanent position (Emilie), two postdoc associates (Astrid, Gloria) and one PhD student (Nadine)
- Cesar is PI of HUGS International fellowship for graduate students in developing countries, and member of Theory-Research Summer to facilitate summer fellowship for students from Mexico
- Astrid as on the JLab Theory Group DEI committee
- We implement diversity and equity policies in all events we organize (e.g. NNPSS 2021)



SCATTERING THEORY AND APPLICATIONS TO HADRONS

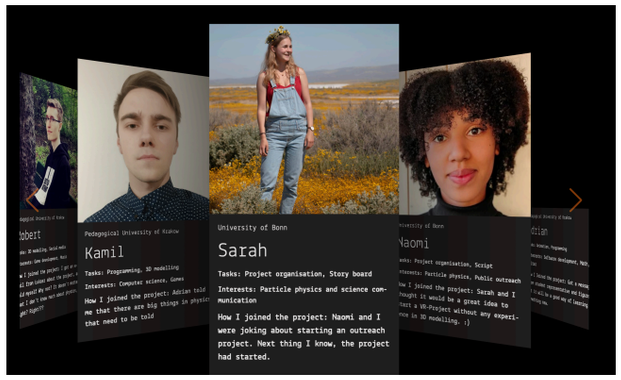
PHYSICAL REVIEW D **105,** L091501 (2022)

Letter

Deep learning exotic hadrons

L. Ng,[1,*] Ł. Bibrzycki,[2,†] J. Nys,[3,‡] C. Fernández-Ramírez,[4,5,§] A. Pilloni,[6,7,8,‖] V. Mathieu,[9,10] A. J. Rasmusson,[11] and A. P. Szczepaniak[11,12,13]

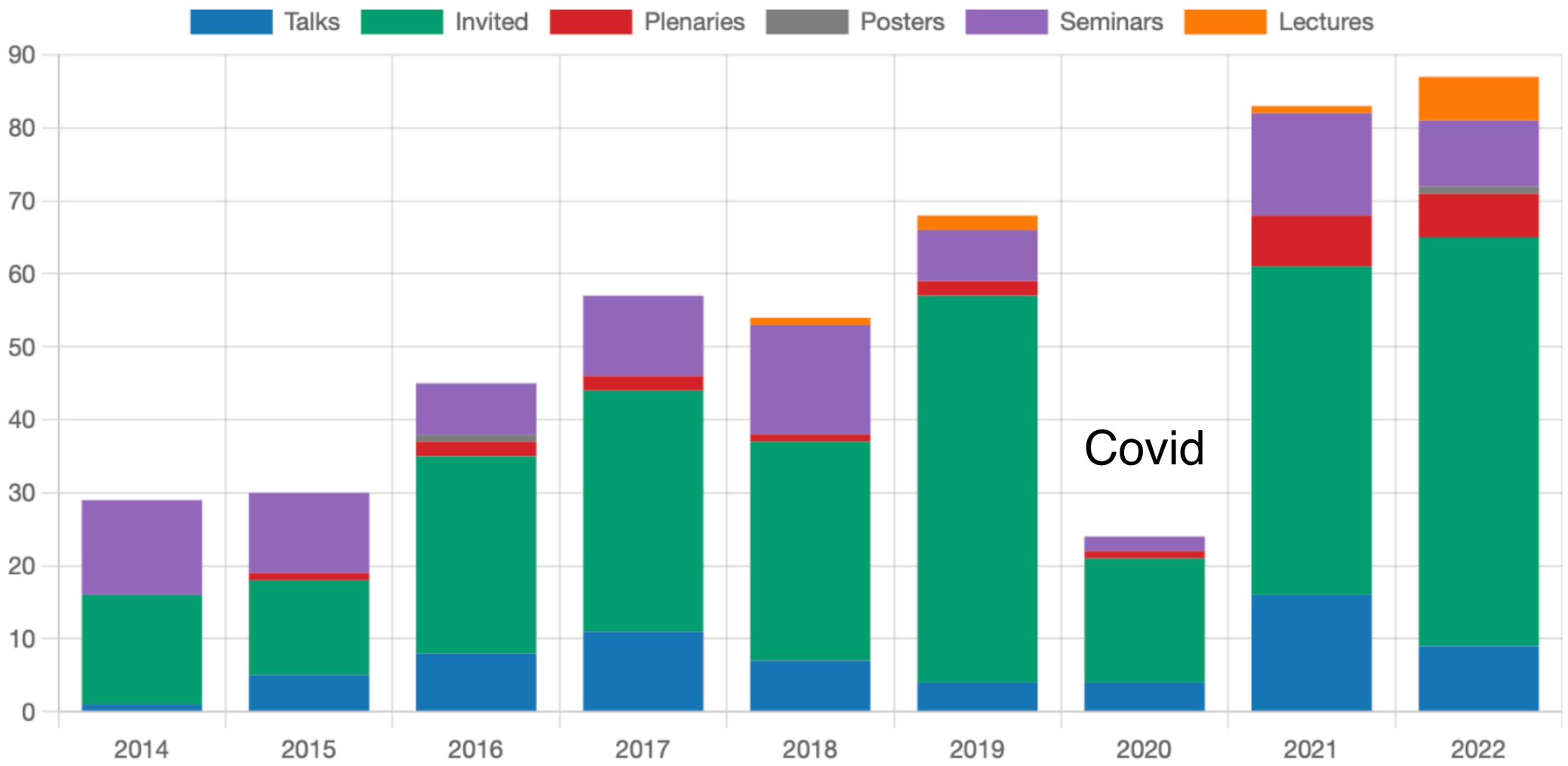
(Joint Physics Analysis Center)



- Projects continue and are projected to result in peer reviewed publications.

INDIANA UNIVERSITY Jefferson Lab

Talks


Talks
Invited
Plenaries
Posters
Seminars
Lectures
90
80
70
60
50
40
30
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10
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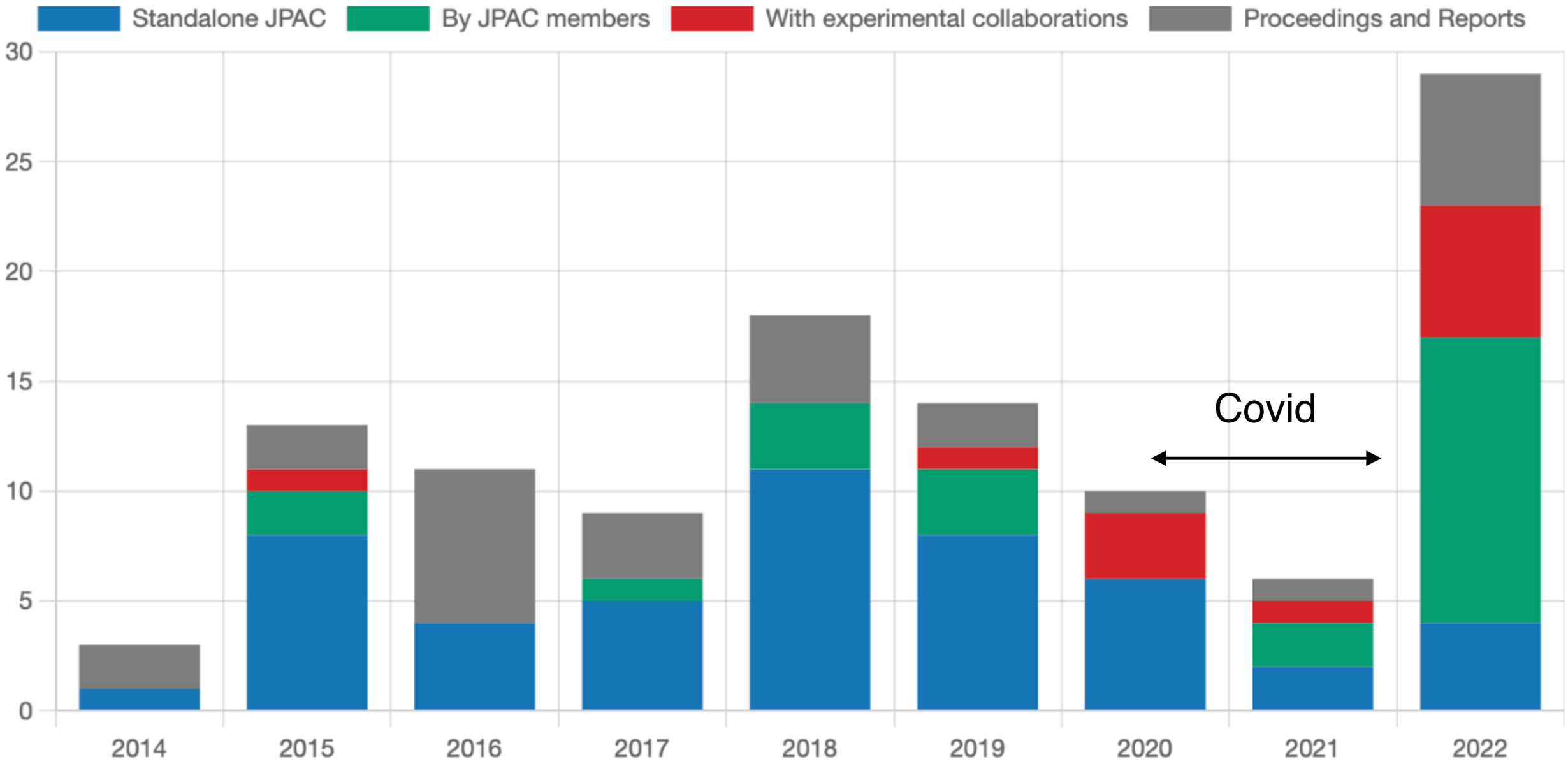
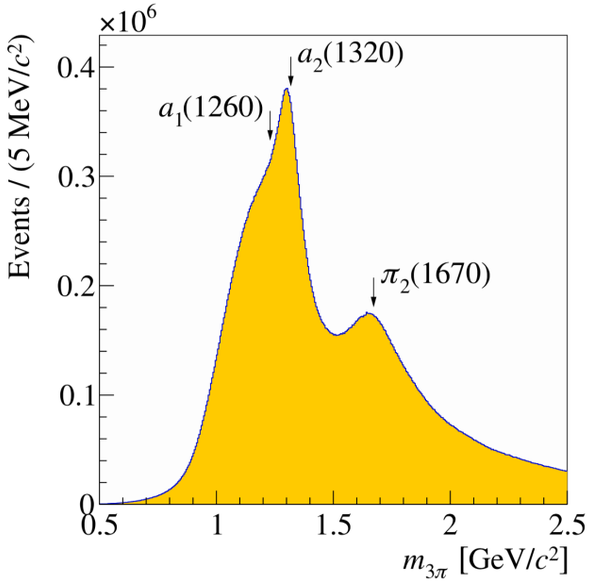
2014
2015
2016
2017
2018
2019
2020
2021
2022
Covid

Publications



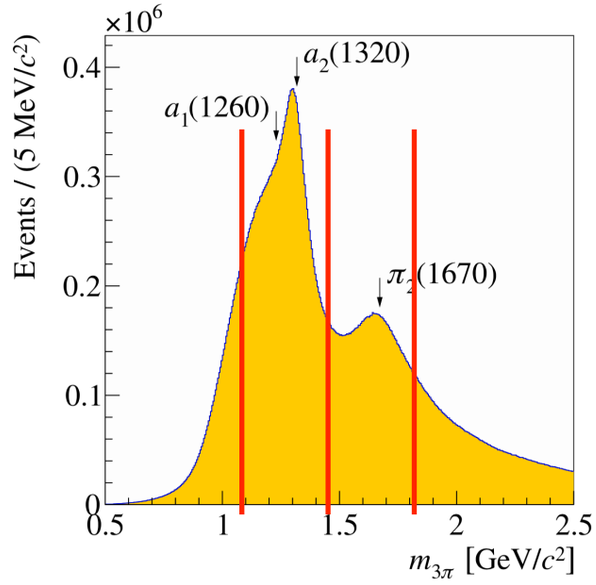
Amplitude analysis

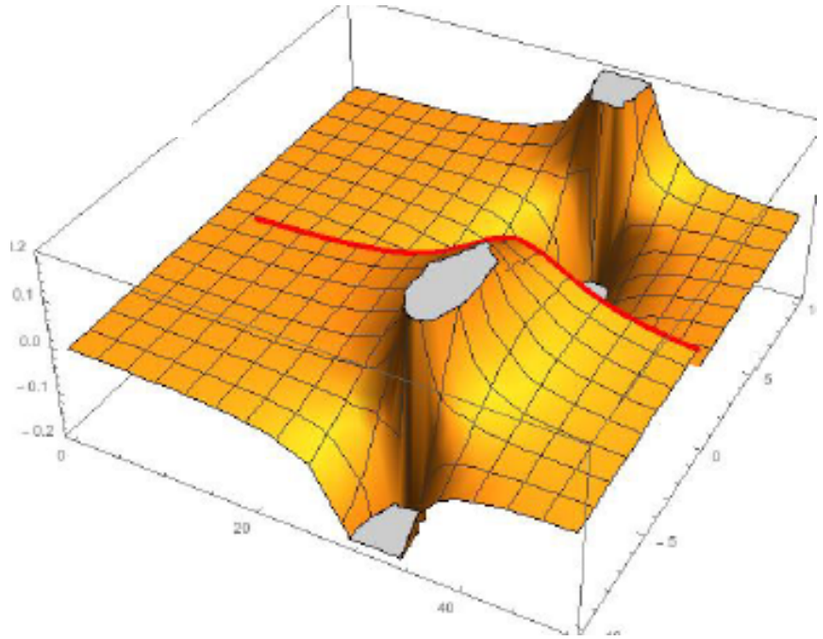
Experiment



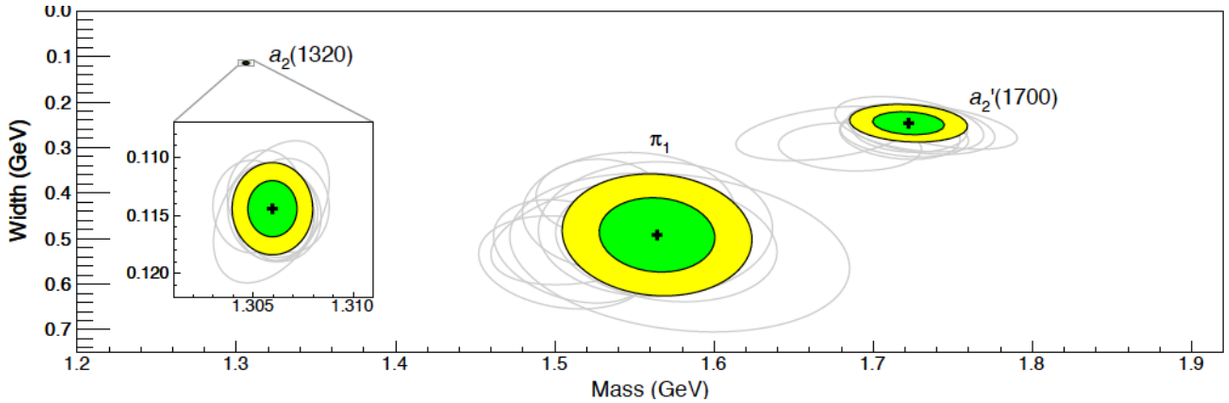
Reaction amplitudes are of main interest : they connect observables with physical phenomena (“unphysical sheet singularities”)

QCD (lattice)





“Our resonances”



$a_2(1700)$

$I^G(J^{PC}) = 1^-(2^{++})$

$a_2(1700)$ MASS

VALUE (MeV)	EVTS	DOCUMENT ID		TECN
1705±40 OUR AVERAGE				
1722±15±67		[1] RODAS	19	JPAC
1698±44		[2] AMSLER	02	CBA
• • • We do not use the following data for averages, fits,				
1681^{+22}_{-35}	46M	[3,4] AGHASYAN	18B	COM
1720±10±60		[5] JACKURA	18	JPAC
1726±12±25		[4] ABLIKIM	17K	BES

$a_1(1260)$

$I^G(J^{PC}) = 1^-(1$

See also our review under the $a_1(1260)$ in PDG 06, Physics **G33** 1 (2006).

$a_1(1260)$ MASS

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	CC
1230 ±40 OUR ESTIMATE					
1299 $^{+12}_{-28}$	46M	[1] AGHASYAN	18B	COMP	19
• • • We do not use the following data for averages, fits, limits, etc.					
1195.05± 1.05± 6.33	894k	AAIJ	18AI	LHCB	D
1209 ± 4 $^{+12}_{-9}$		[2] MIKHASENKO	18	RVUE	τ
1225 ± 9 ±20	7k	[3] DARGENT	17	RVUE	D

$\pi_1(1600)$

$I^G(J^{PC}) = 1^-(1^{-+})$

$\pi_1(1600)$ MASS

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
$\mathbf{1660^{+15}_{-11}}$ **OUR AVERAGE**		Error includes scale factor of 1.2.			
1564± 24±86		[1] RODAS	19	JPAC	191 $\pi^- p \to \eta^{(\prime)} \pi^- p$
1600^{+110}_{-60}	46M	[2] AGHASYAN	18B	COMP	190 $\pi^- p \to \pi^- \pi^+ \pi^- p$

Citation: R.L. Workman *et al.* (Particle Data Group), Prog.Theor.Exp.Phys. **2022**, 083C01 (2022)

$f_0(1500)$

$I^G(J^{PC}) = 0^+(0^{++})$

See the review on "Spectroscopy of Light Meson Resonances."

$f_0(1500)$ MASS

1450 ±10		[4] RODAS	22	RVUE	$J/\psi(1S) \to \gamma (\pi\pi, K\overline{K})$

$f_2(1270)$

$I^G(J^{PC}) = 0^+(2^{++})$

1268 ± 8		[9] RODAS	22	RVUE	$J/\psi(1S) \to \gamma (\pi\pi, K\overline{K})$

$a_2(1320)$

$I^G(J^{PC}) = 1^-(2^{++})$

$a_2(1320)$ MASS

VALUE (MeV)	DOCUMENT ID
1316.9±0.9 OUR AVERAGE	Includes data from the 4 datablocks that follow this one. Error includes scale factor of 1.9. See the ideogram below.

$\eta\pi$ MODE

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	CHG	COMMENT
The data in this block is included in the average printed for a previous datablock.						
1312.2± 2.8 OUR AVERAGE		Error includes scale factor of 2.6. See the ideogram below.				
1306.0± 0.8±1.3		[1] RODAS	19	JPAC		191 $\pi^- p \to \eta^{(\prime)} \pi^- p$
1308 ± 9		BARBERIS	00H			450 $pp \to p_f \eta\pi^0 p_s$

$f_0(2020)$

$f_0(1710)$

$f_0(2330)$

$f_2'(1525)$

$f_2(1950)$

2019 Review of Particle Physics.
M. Tanabashi *et al.* (Particle Data Group), Phys. Rev. D **98**, 030001 (2018) and 2019 update.

OTHER LIGHT QUARK MASS RATIOS

Q MASS RATIO

INSPIRE search

$Q \equiv \sqrt{(m^2_s - \overline{m}^2)/(m^2_d - m^2_u)}$; $\overline{m} \equiv (m_u + m_d)/2$

VALUE		DOCUMENT ID		TECN
• • • We do not use the following data for averages, fits, limits, etc. • • •				
22.1 ±0.7	1	COLANGELO	2018	THEO
22.0 ±0.7	2	COLANGELO	2017	THEO
21.6 ±1.1	3	GUO	2017	THEO
23.4 ±0.4 ±0.5	4	FODOR	2016	LATT
21.4 ±0.4	5	GUO	2015F	THEO
22.8 ±0.4	6	MARTEMYANOV	2005	THEO
22.7 ±0.8	7	ANISOVICH	1996	THEO

JPAC review

17 Nov 2022, 08:15 → 18 Nov 2022, 13:30 US/Eastern

Description

Zoom link for the public session: https://jlab-org.zoomgov.com/j/1607457079?pwd=b0tBVy9CVEVTanpkMmt2OFIranlHZz09

JPAC website: https://www.jpac-physics.org

Summary of the Scientific production by the JPAC collaboration:

1- Publications: https://www.jpac-physics.org/publications

2- Talks/presentations: https://www.jpac-physics.org/talks

3- Organization of events: https://www.jpac-physics.org/events

4- Mentoring and career development: https://www.jpac-physics.org/statistics/mentoring-careers

5- Achievements : https://www.jpac-physics.org/statistics/achievements

6- Old Website: http://jpac.nucleares.unam.mx

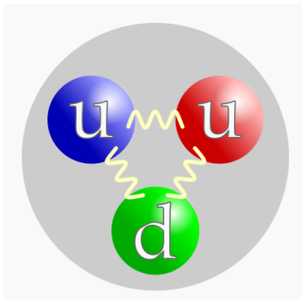
JPAC overview, copy of previous report and response to comments:

JPAC_Overview.pdf JPAC-review-2016.... response-to-jpac-1...

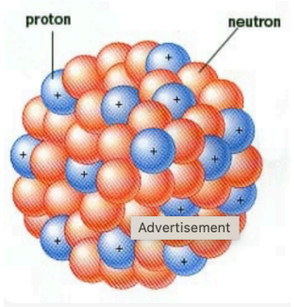
André Petermann *Murray Gell-Mann* *George Zweig*

Petrov, V,A. "Half a Century with Quarks". arXiv:1412.8681

Hadrons



Nuclei



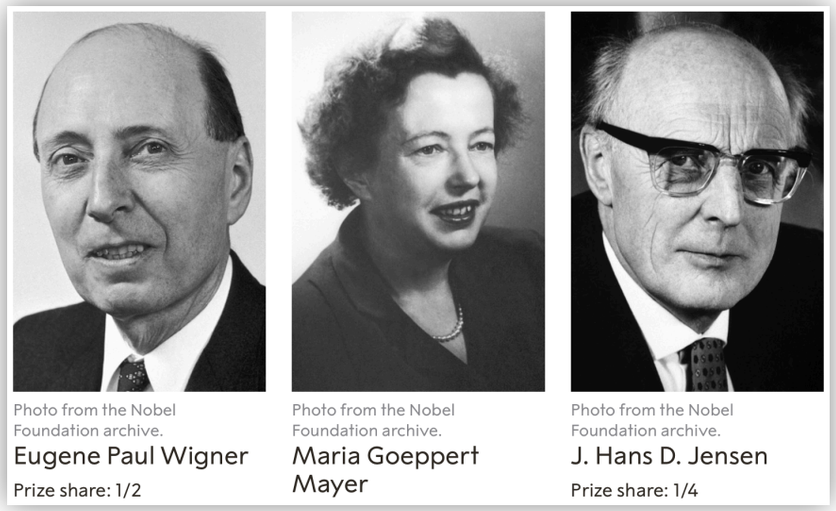
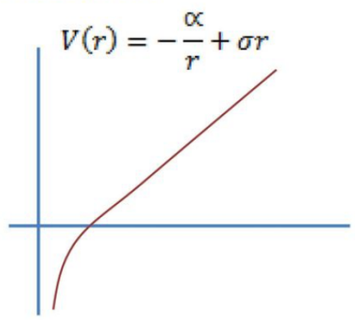


Photo from the Nobel Foundation archive.
Eugene Paul Wigner
Prize share: 1/2

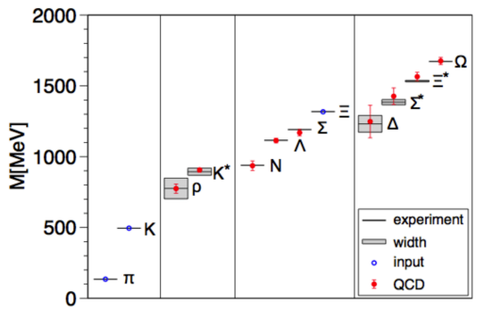
Photo from the Nobel Foundation archive.
Maria Goeppert Mayer

Photo from the Nobel Foundation archive.
J. Hans D. Jensen
Prize share: 1/4

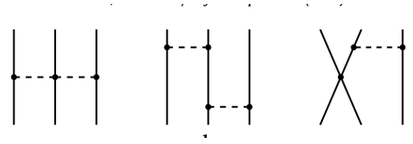
he Nobel Prize in Physics 1963. NobelPrize.org. Nobel Prize Outreach AB 2022. Sat. 17 Sep 2022.



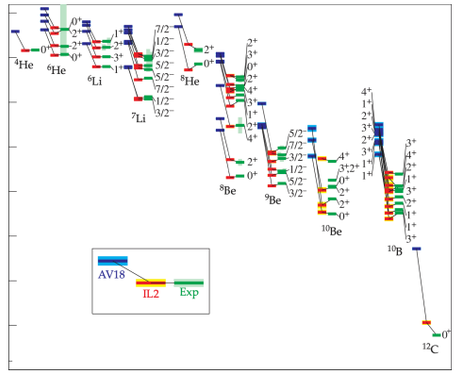
E.Echten et al. Phys. Rev. Lett. 34, 369 (1978)



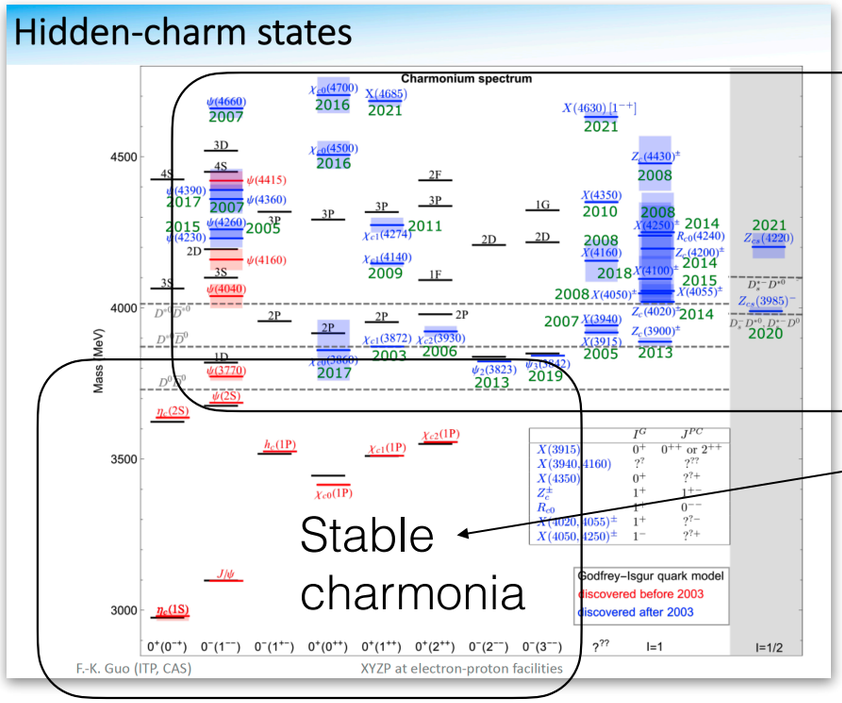
S. Durr et al., Science 322, 1224 (2008)



R. Machleidt,D.R. Entem, PhysRep, 503,1 (2011)



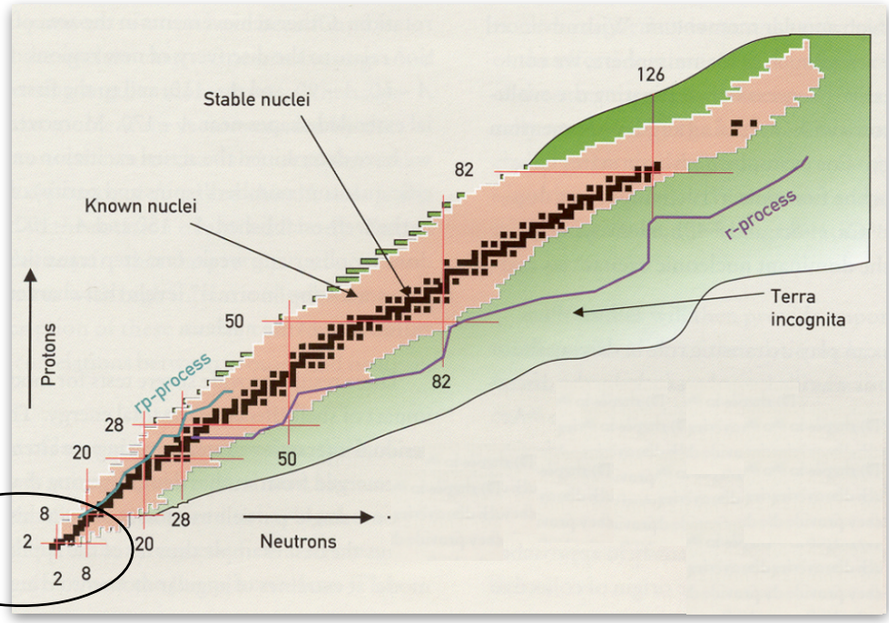
D.Dean, Physics Today 60, 11, 48 (2007)



F-K.Guo

Terra incognita

- Are these analogs of compact, halo, Borromean, etc.



JPAC's vision for the next decade

- Complete development of the tools and techniques necessary to extract physics results from the GlueX and CLAS experiments. Work with the experimental collaborations on implementation of these tools in data analyses.

- Develop a broad program of XYZP studies relevant to the current measurements at accelerators and the future electron-hadron facilities, including the EIC and the upgraded Jefferson Lab.

- Explore AI/ML tools, and make use of their properties as universal interpolators, model selectors and efficient spanners of parameter space, with the ultimate goal of extracting amplitudes from data.

- Support the growth of the QCD spectroscopy community by investing in the education of next generations. Lead the development of distributed, project-based learning platforms for students.

08:30 → 09:00	**Executive session: Welcome - Review Charges**	
09:00 → 09:05	**Welcome** **Speaker**: David Dean (Deputy Director for Science, Jefferson Lab)	5m
09:05 → 09:15	**Review Charges** **Speaker**: Jianwei Qiu (Jefferson Lab)	10m
09:15 → 09:45	**JPAC overview (20+10)** **Speaker**: Adam Szczepaniak (JLab / Indiana University)	30m
09:45 → 10:15	**JPAC role: Lattice Perspective (20+10)** **Speaker**: Jozef Dudek (JLab / College of William & mary)	30m
10:15 → 10:45	**Amplitude analysis for GlueX and CLAS (20+10)** **Speaker**: Vincent Mathieu (University of Barcelona)	30m
10:45 → 11:00	**Break**	15m
11:00 → 11:20	**Pentaquarks (15+5)** **Speaker**: Astrid Hiller Blin (University of Regensburg)	20m
11:20 → 11:40	**AI/ML (15+5)** **Speaker**: Cesar Fernandez-Ramirez (UNED/ICN-UNAM)	20m
11:40 → 12:10	**XYZ and future (20+10)** **Speaker**: Alessandro Pilloni (Messina U. and INFN Catania)	30m
12:10 → 13:00	**Executive session: Preparing for homework questions**	

Friday, 18 November

09:30 → 11:00	**All: JPAC Answers to Homework questions + Q&A**
11:00 → 12:30	**Executive session: Committee Discussion and Preparation of Closeout**
12:30 → 13:00	**Closeout**