FEASIBILITY FOR X-DEPENDENCE OF GPDS FROM EXCLUSIVE PHOTOPRODUCTION AT GLUEX AND BAYESIAN STATISTICS IN J/Ψ PHOTOPRODUCTION

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JUNE 12, 2024

HUGS 2024

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CHARTERED 1693

WHAT DOES THAT ALL MEAN?

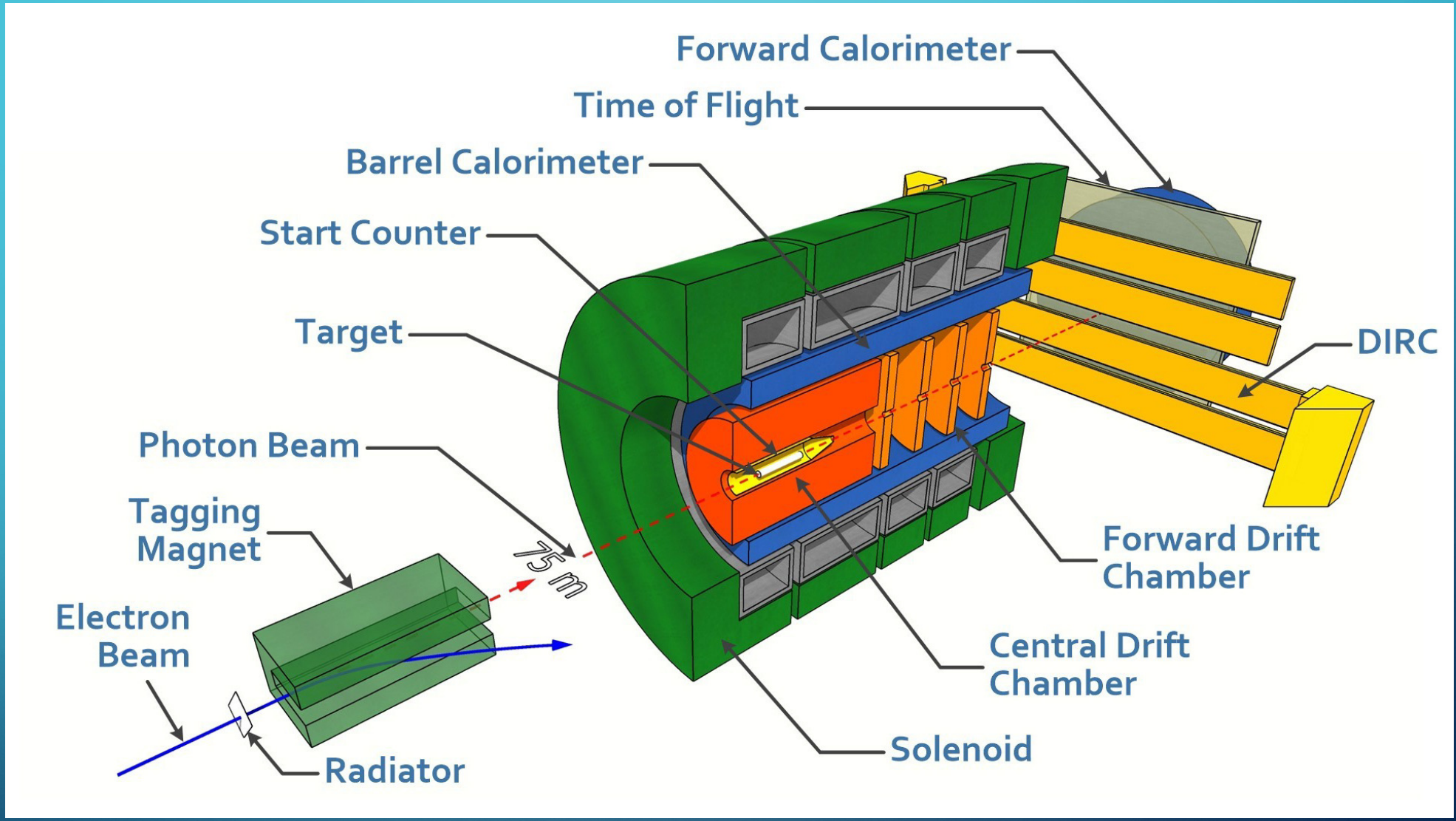
Physics Project

- GPDs
- x-dependence: parton momentum fraction
- Exclusive Photoproduction

Data Science Project

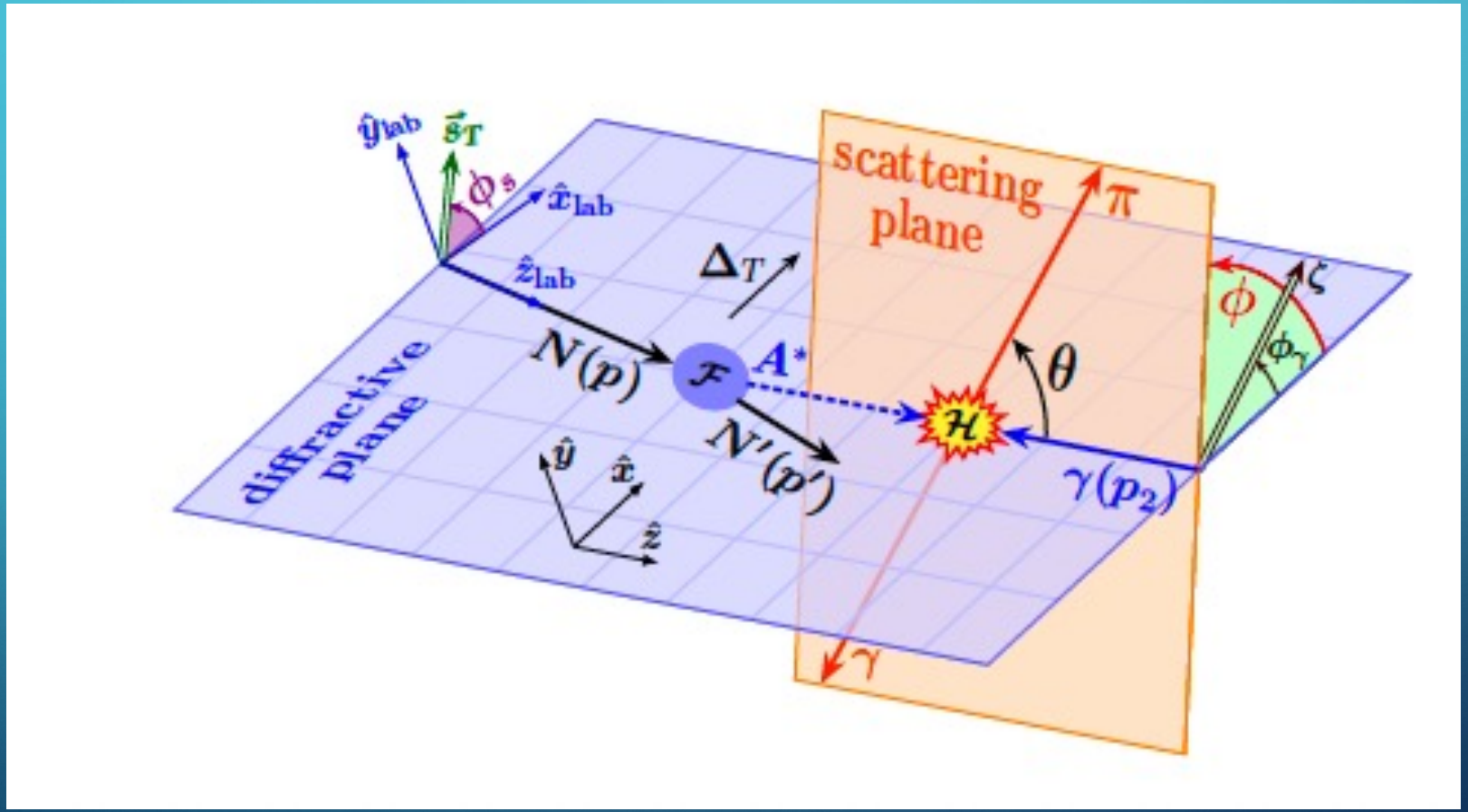
- Frequentist vs Bayesian
- Why should we redo the JPAC model?

GLUEX


Forward Calorimeter
Time of Flight
Barrel Calorimeter
Start Counter
Target
Photon Beam
Tagging Magnet
Electron Beam
75 m
Radiator
DIRC
Forward Drift Chamber
Central Drift Chamber
Solenoid

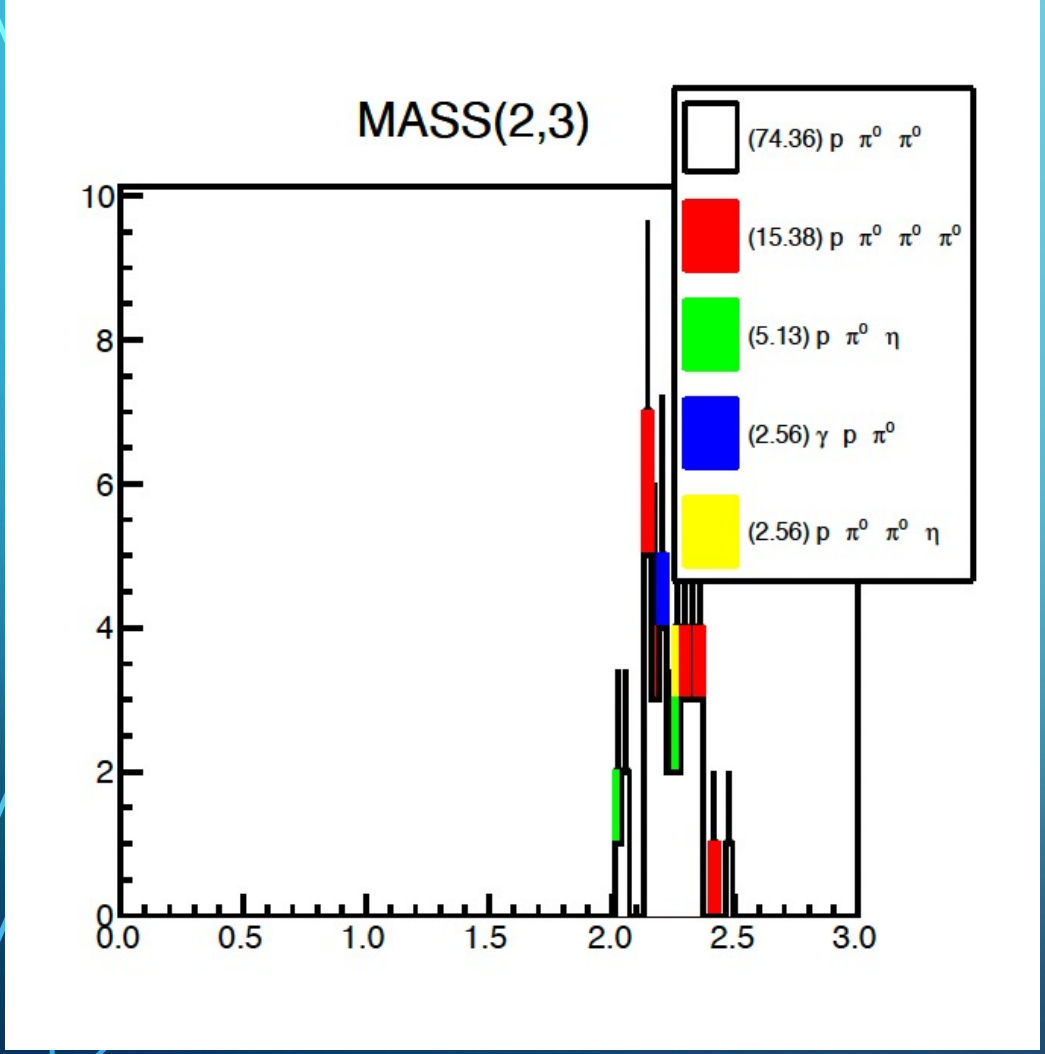
SINGLE DIFFRACTIVE HARD EXCLUSIVE PROCESS:

$\gamma\ P \rightarrow \pi^0\ \gamma\ P \rightarrow \gamma\ \gamma\ \gamma\ P$



Jian-Wei Qiu and Zhite Yu

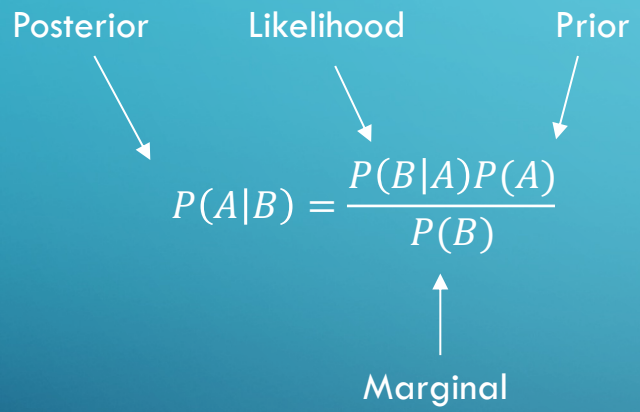
PROBLEM



- $\gamma\ p \rightarrow \pi^0\ \gamma\ p \rightarrow \gamma\ \gamma\ \gamma\ p$
- 3 or 4 photons?
- We can't exclude what we don't know exists
- Transverse Momentum Cut

WHAT'S SO SPECIAL ABOUT BAYESIAN STATISTICS?

Bayesian Statistics allows us to update our beliefs as new information becomes available



A = Hypothesis

B = Evidence

Priors: a,b,c

Model: y = a+bx +…

Bayesian Framework ← y_{obs}

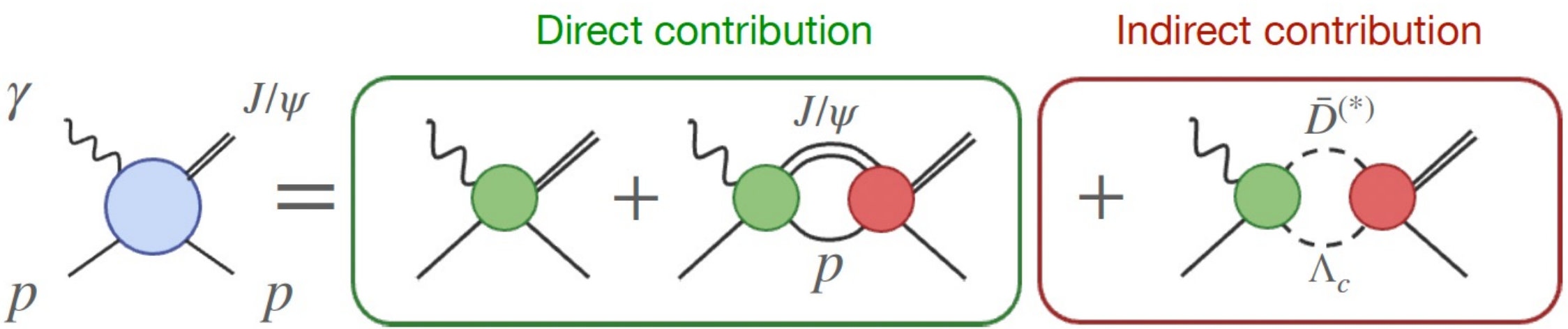
Posterior

CHANNELS

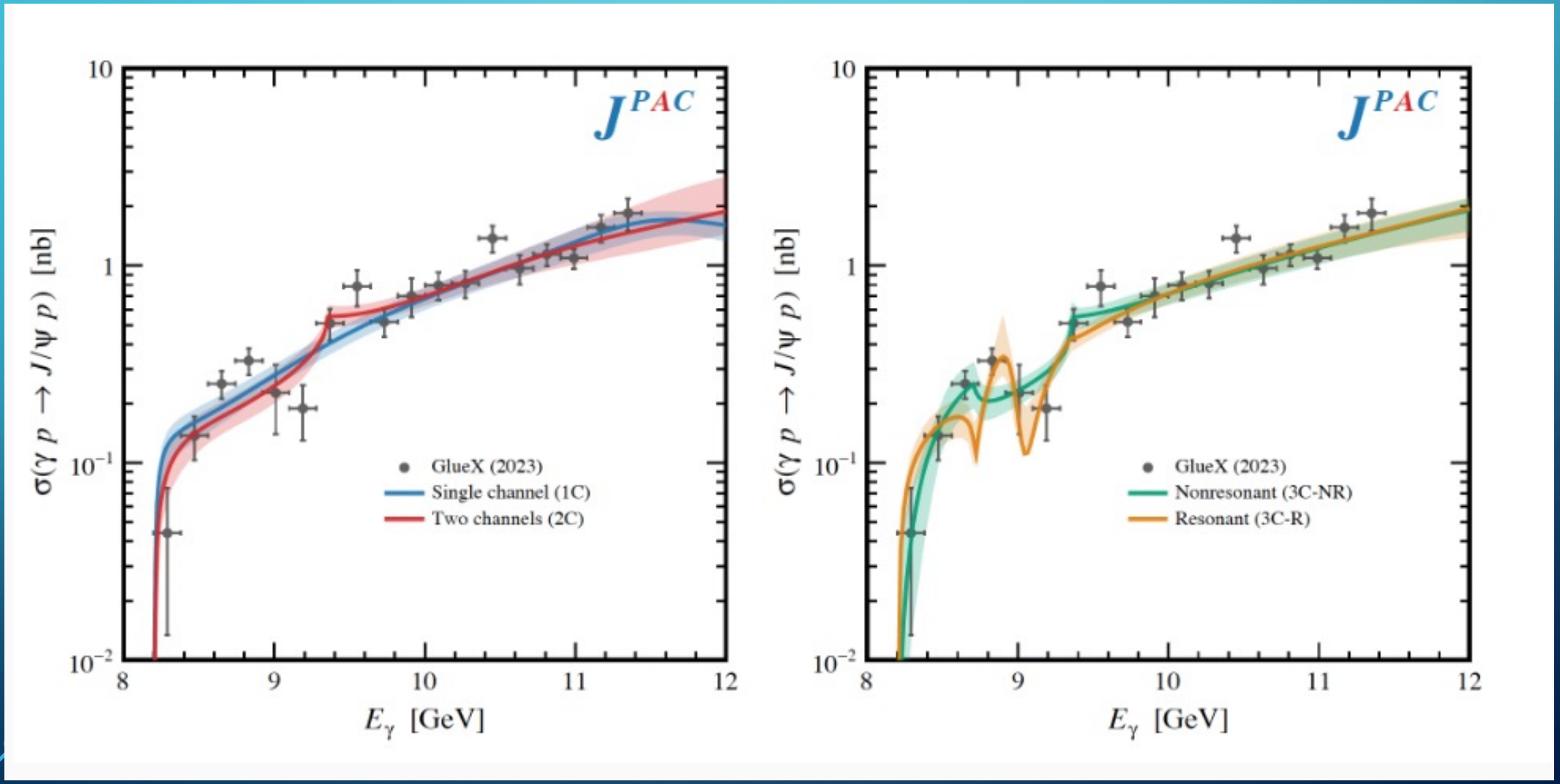
1C: Only J/ψ p interactions included

2C: Includes an intermediate channel

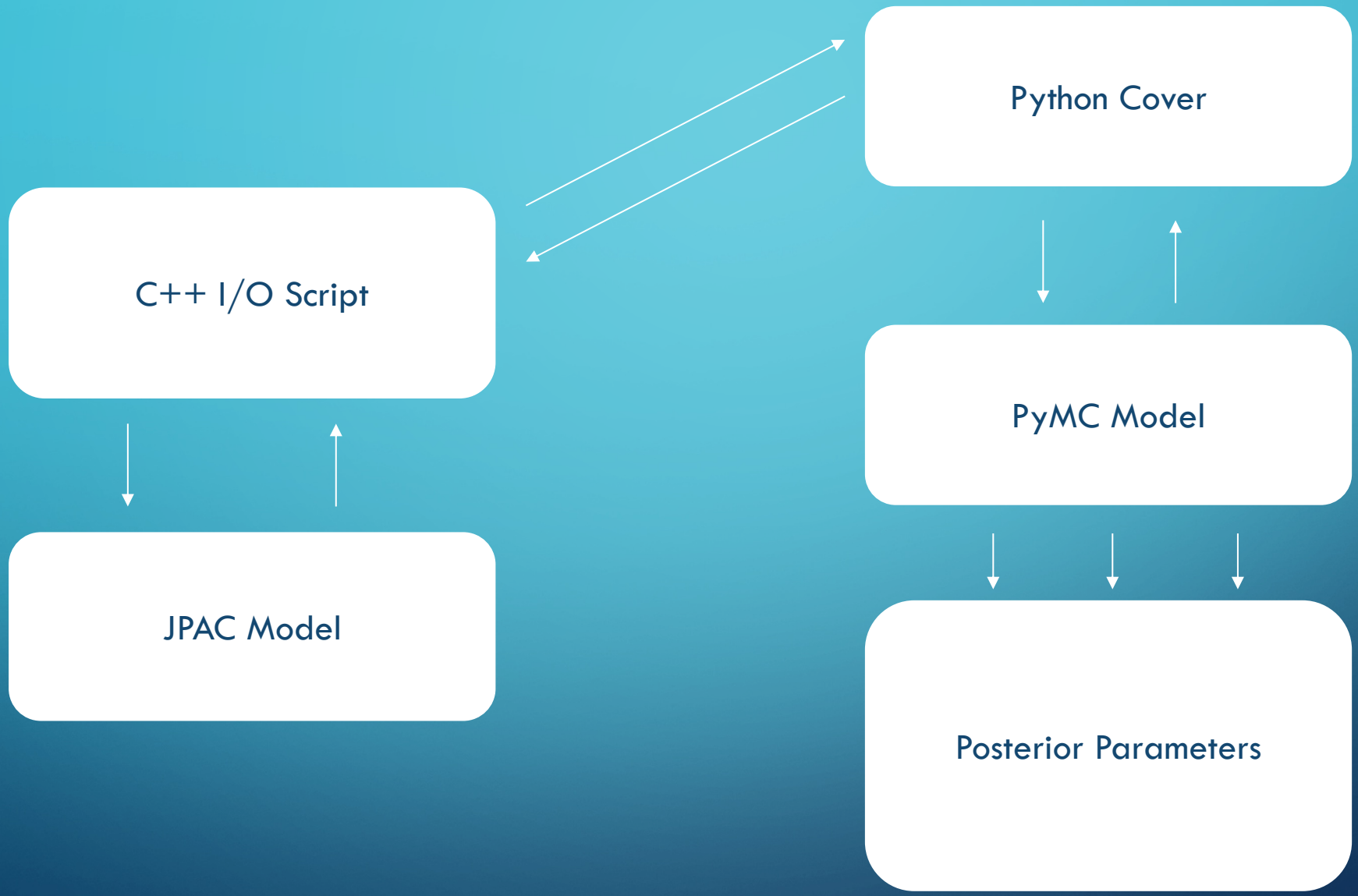
3C: Resonant and Non-Resonant, includes both intermediate channels



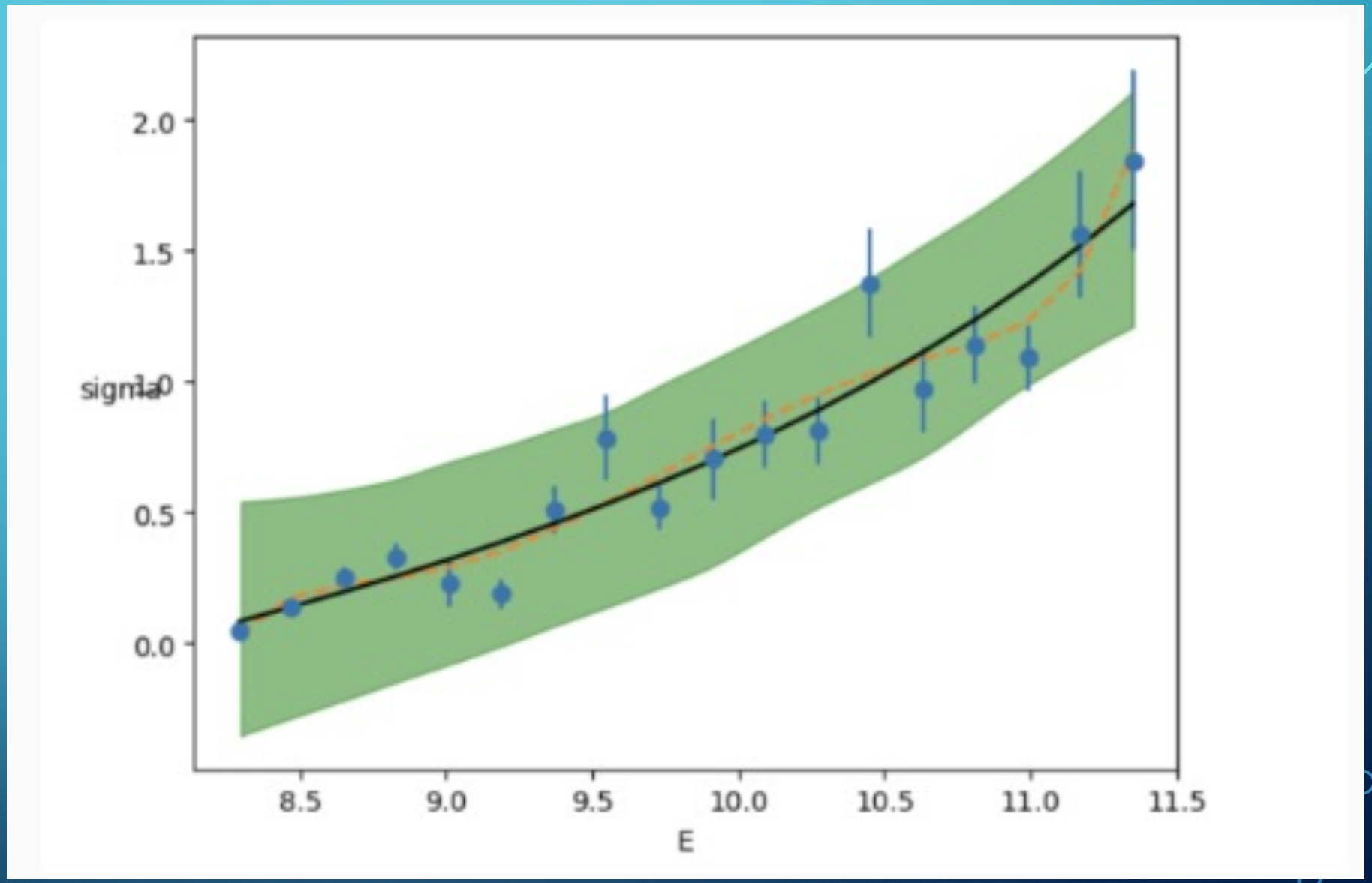
BAYESIAN UNCERTAINTY QUANTIFICATION OF THE JPACPHOTO MODEL OF γ P $\longrightarrow$ J/Ψ P



JPAC Collaboration


Python Cover
C++ I/O Script
PyMC Model
JPAC Model
Posterior Parameters

MODEL: 1C



FUTURE WORK

$\gamma\, p \rightarrow \pi^0\, \gamma\, p$

- Adding new MC simulations, cuts
- Model → elimination/estimation of the contribution of background in the data

$\gamma\, p \rightarrow J/\psi\, p$

- Expand upon model to include Gaussian Process approach to area between data points
- Include uncertainty in model
- Expand model to other channels

REFERENCES

- Jian-Wei Qiu and Zhite Yu. "Extraction of the x-dependence of generalized parton distributions from exclusive photoproduction". September 1, 2023.
- JPAC Collaboration and D. Winney and C. Fernandez-Ramirez and A. Pilloni and A. N. Hiller Blin and M. Albaladejo and L. Bibrzycki and N. Hammoud and J. Liao and V. Mathieu and G. Montana and R. J. Perry and V. Shastry and W. A. Smith and A. P. Szczepaniak. Dynamics in Near-Threshold J/ ψ Photoproduction.