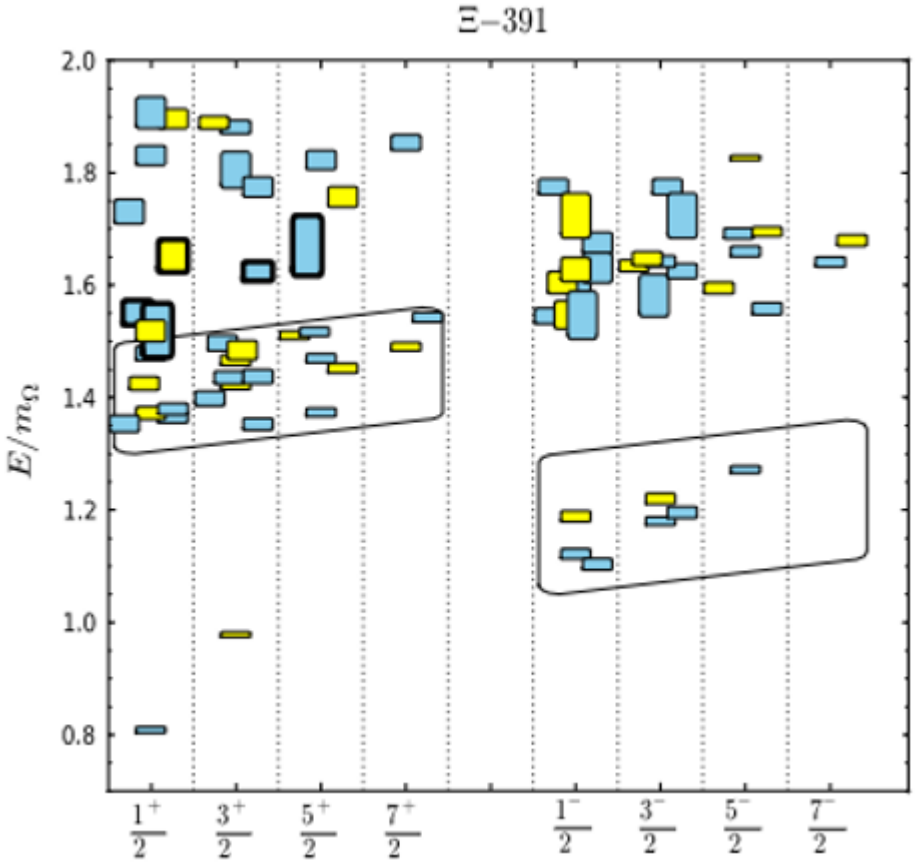
Ξ bump hunt 2026

Alexandre Kellogg and Michael Dugger

LQCD for Ξ states [1]

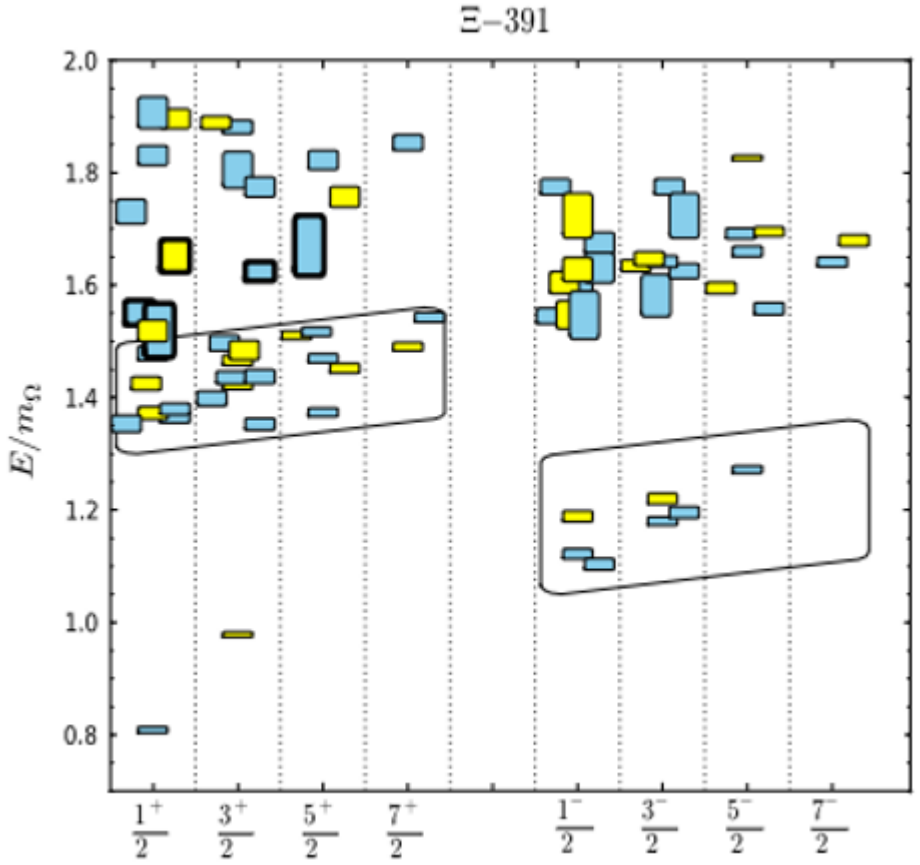
- Pion mass at 391MeV
- Yellow: flavor decuplet
- Blue: flavor octet
- Slanted boxes contain the low lying states that have quantum numbers consistent with quark model calculations



[1] R. G. Edwards, N. Mathur, D. G. Richards and S. J. Wallace, Flavor structure of the excited baryon spectra from lattice QCD, Phys. Rev. D 87 (2013), p. 054506, URL: https://link.aps.org/doi/10.1103/PhysRevD.87.054506

LQCD compared to PDG

PDG	J, P
Ξ	1/2, +
Ξ(1530)	3/2, +
Ξ(1620)	?, ?
Ξ(1690)	?, ?
Ξ(1820)	3/2, -
Ξ(1950)	?, ?
Ξ(2030)	>= 5/2, ?



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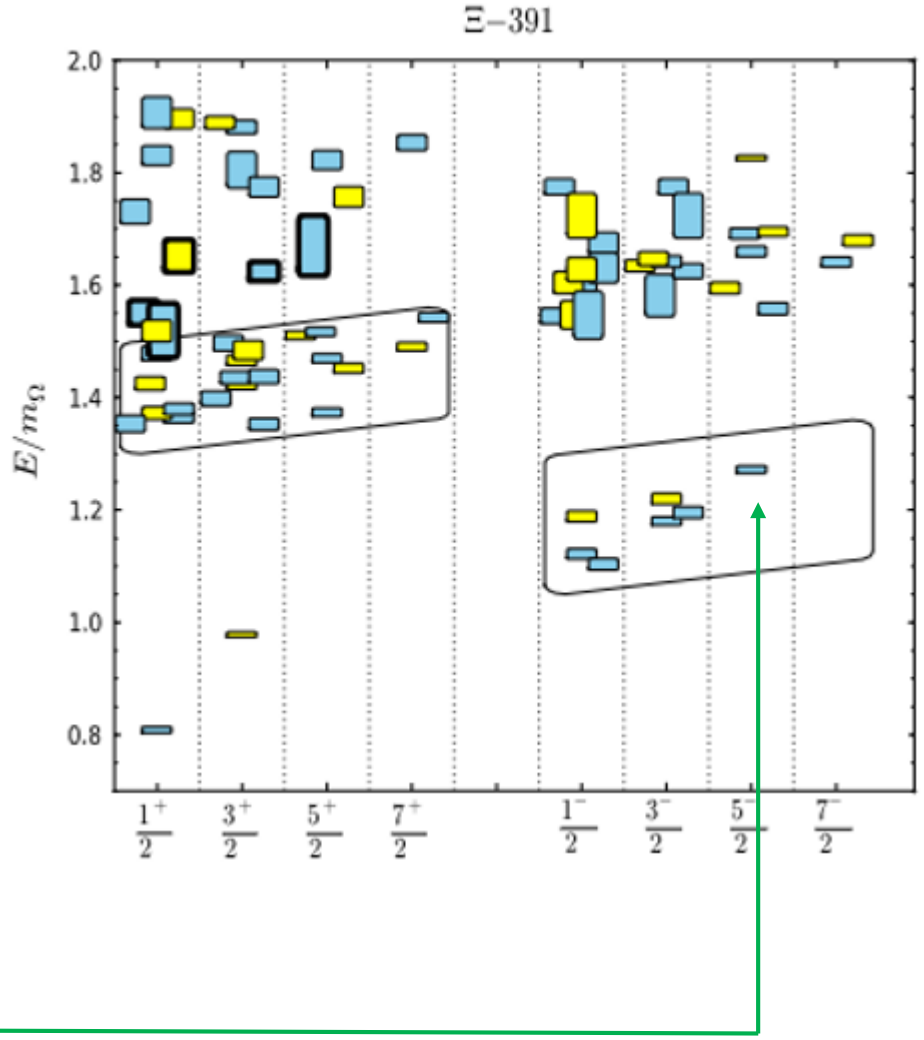

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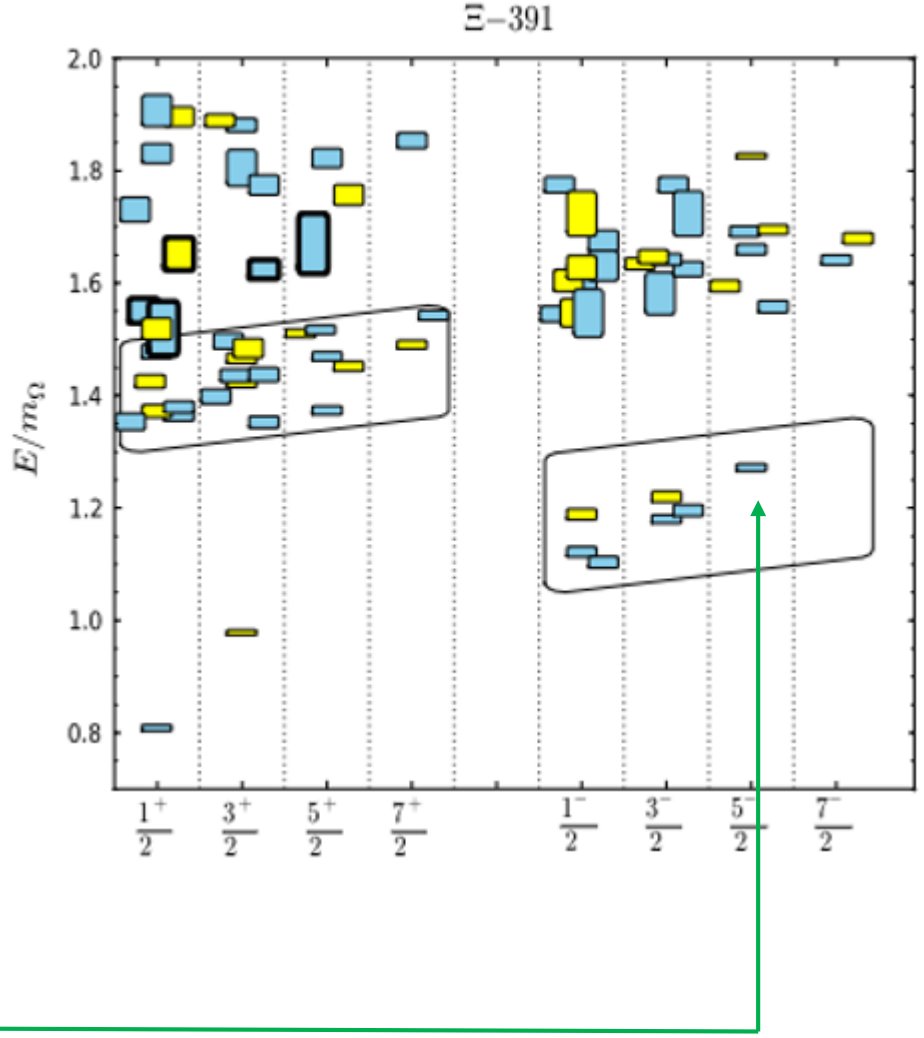
  - Implies there are a total of 8 states expected below the mass of the Ξ(2030)



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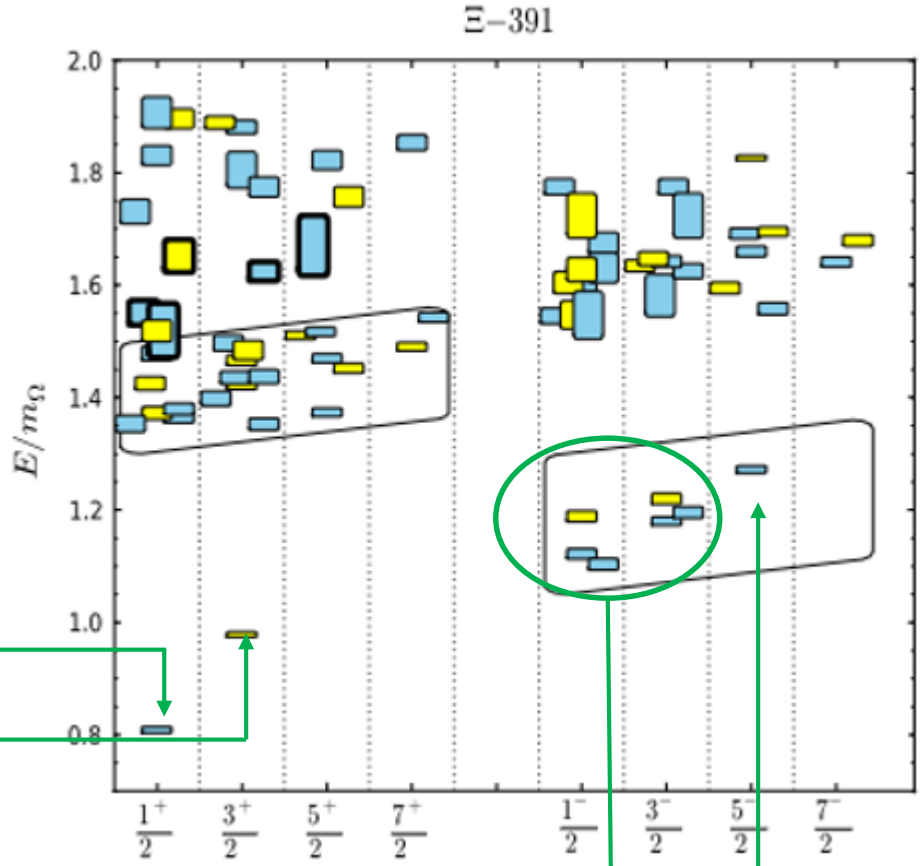

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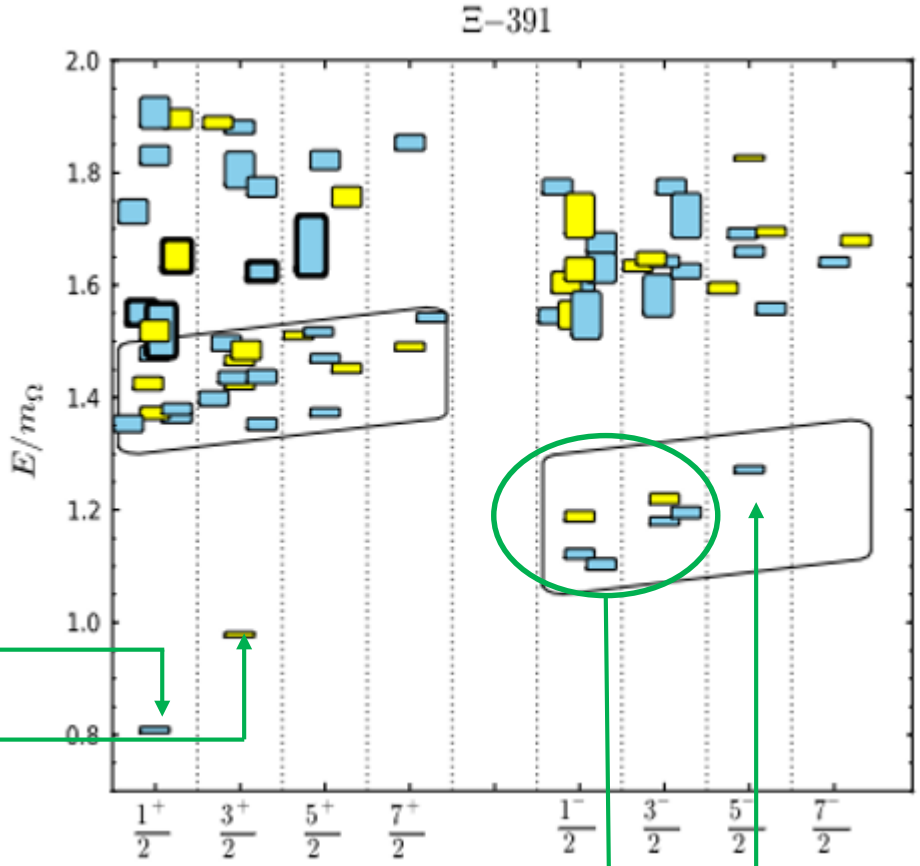
LQCD compared to PDG

- Assuming Ξ(2030) belongs in the boxed region of lowest mass, then $J = 5/2$
  - Implies there are a total of 8 states expected below the mass of the Ξ(2030)
  - Missing 2 PDG states w/mass below Ξ(2030) in order to be compatible with LQCD



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Reaction

$$\gamma\, p \rightarrow K^{+} K^{+} \Xi^{*-},$$

where

$$\Xi^{*-} \rightarrow \Xi^{-} \pi^{0},$$

$$\Xi^{-} \rightarrow \Lambda \pi^{-},$$

and

$$\Lambda \rightarrow p \pi^{-}$$

Some details on data and analysis

Included datasets:

- 2018-01
- 2018-08
- 2019-11

Cuts

- CL cut at 10^{-6}
- Significance of Ξ^- pathlength > 4
- $|t_{fast}| < 3$ GeV^2
- K^* cut (0.85 GeV < mass[$K^+\pi^0$] < 0.95 GeV removed)

Accidental subtraction

- Hybrid method

Bump Hunt 2026

Initially fit to all states listed in the PDG below 2100 MeV

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Bump Hunt 2026

- Voigtians with 2nd degree polynomial background
- σ smear range = 5-15 MeV
- Centers and widths of each Ξ allowed to vary within PDG limits
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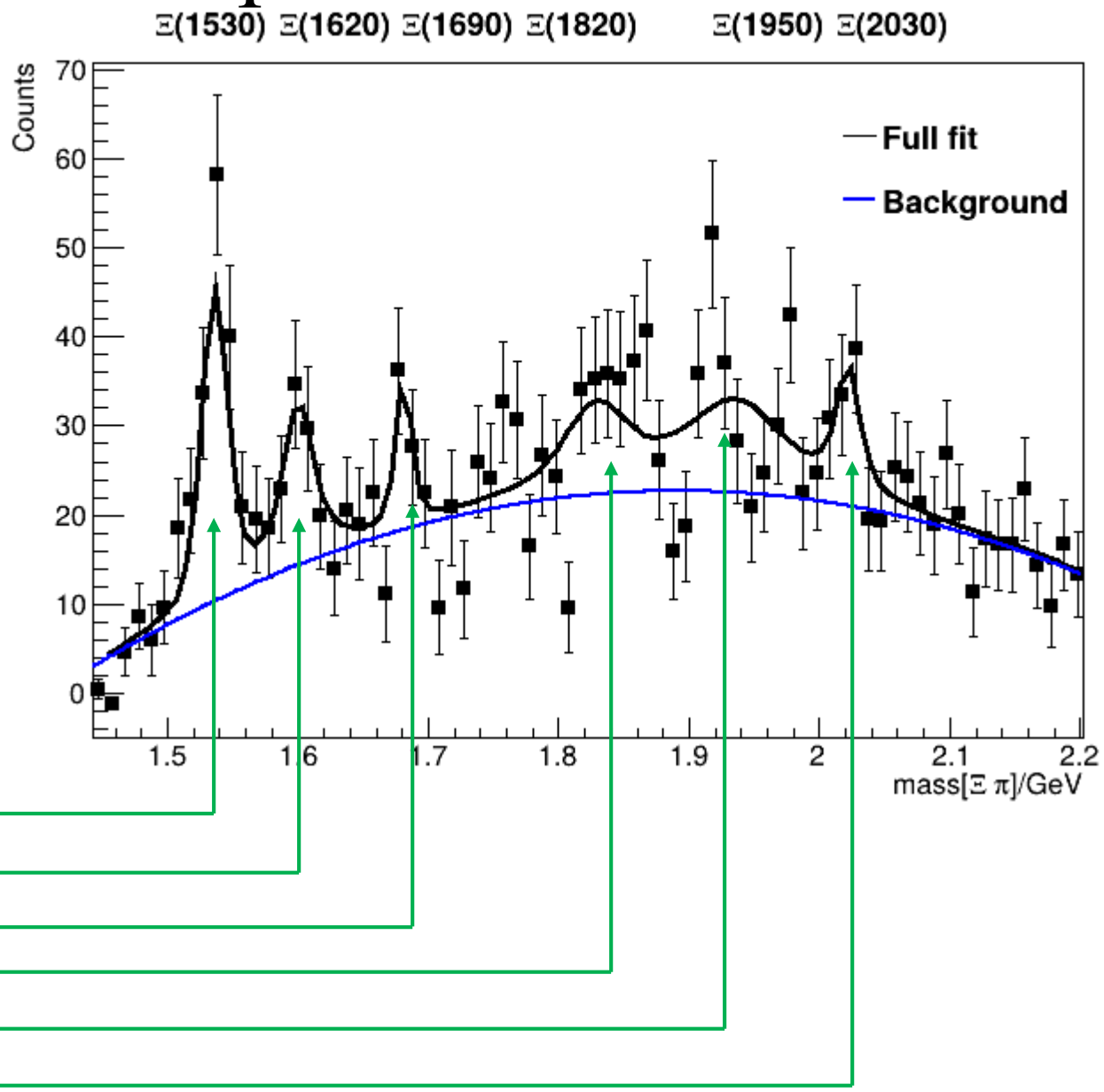

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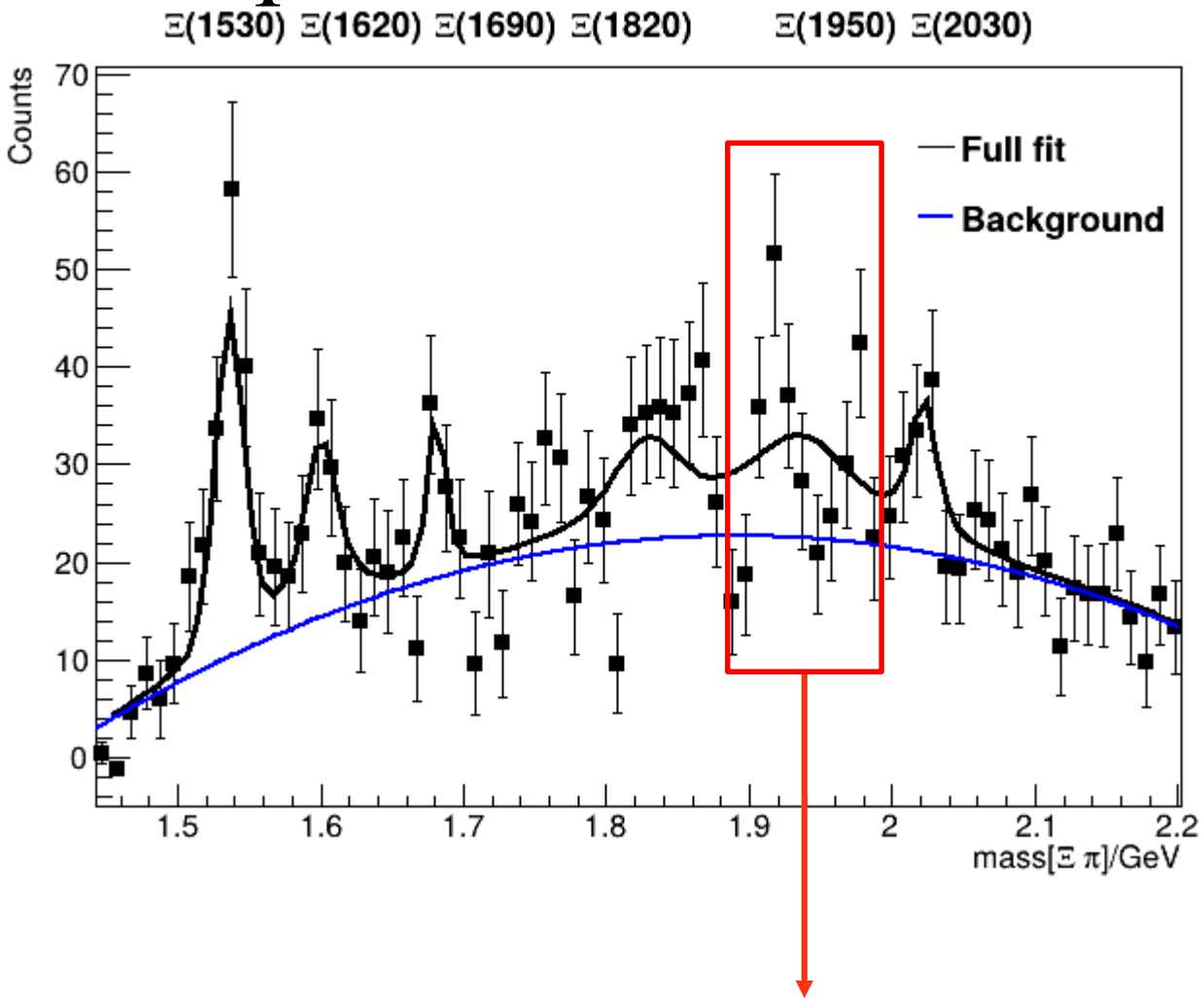

Looks like a mess ☹

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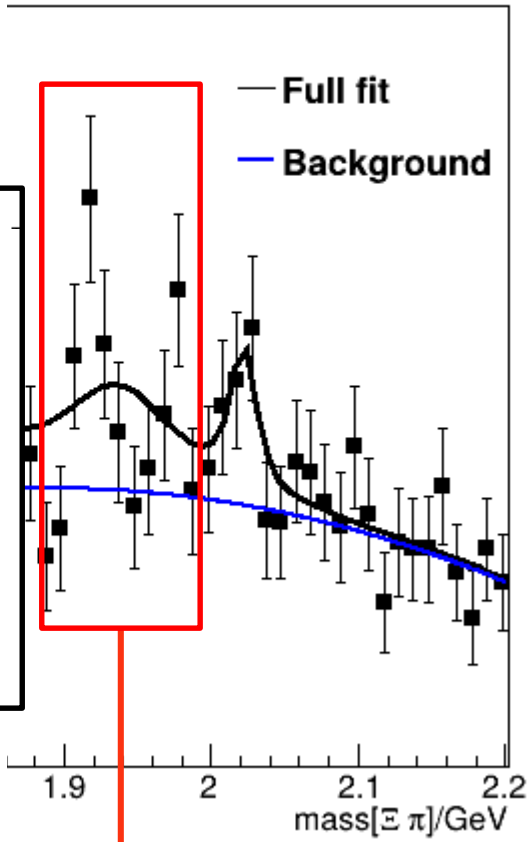
Citation: S. Navas *et al.* (Particle Data Group), Phys. Rev. D **110**, 030001 (2024) and 2025 update

Ξ(1950)

$I(J^P) = \frac{1}{2}(?^?)$ Status: ***

We list here everything reported between 1875 and 2000 MeV. The accumulated evidence for a Ξ near 1950 MeV seems strong enough to include a Ξ(1950) in the main Baryon Table, but not much can be said about its properties. In fact, there may be more than one Ξ near this mass.



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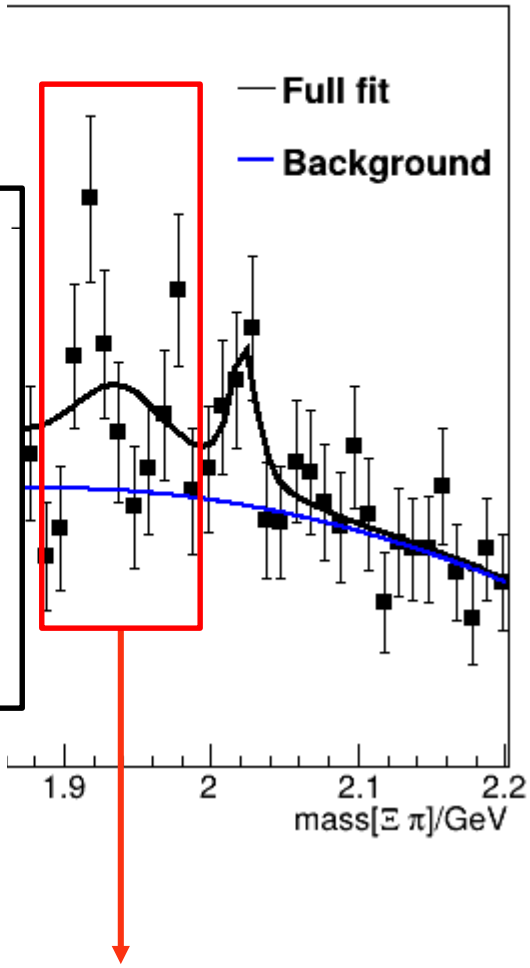
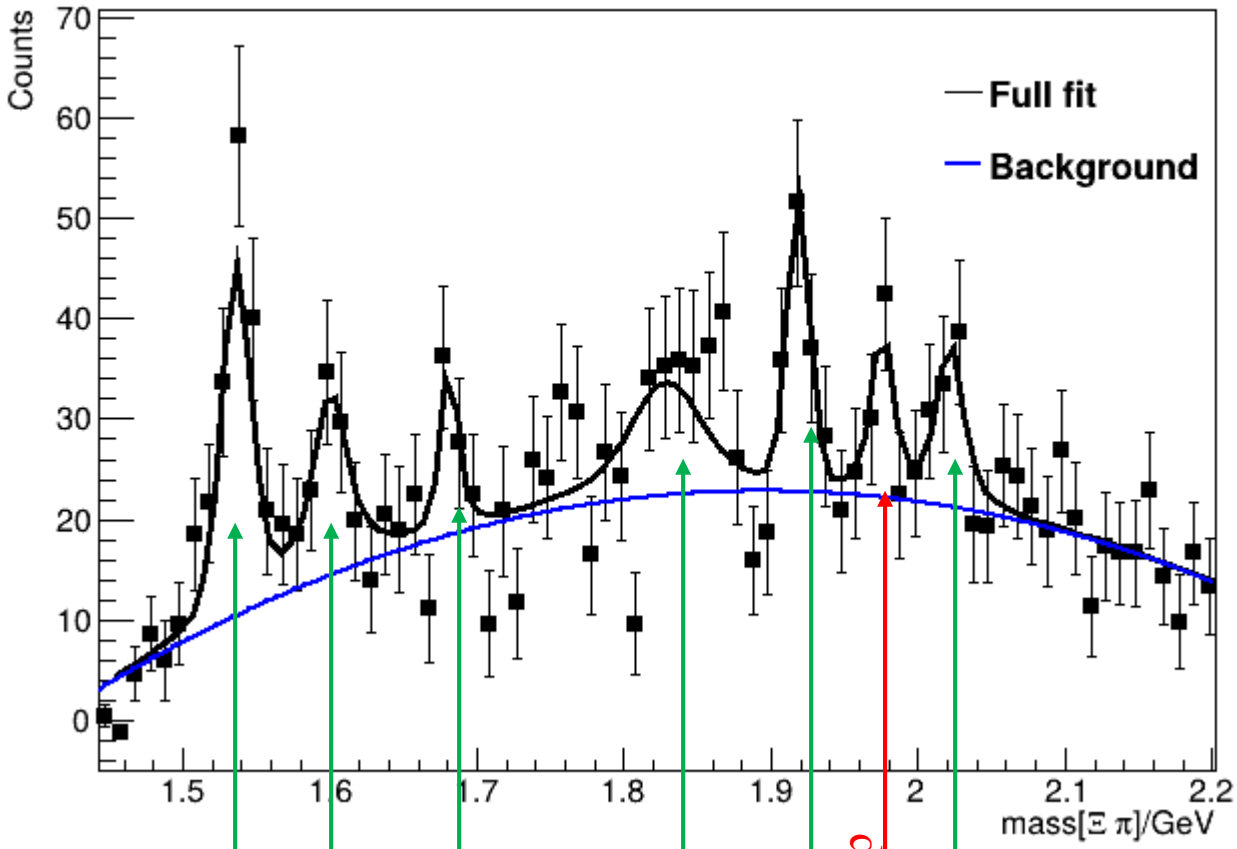


Lets try putting an extra bump in and letting fit parameters for original peak loose

Looks like a mess ☹

Bump Hunt 2026

- Ξ(1950) split into two peaks. One of the peaks called "Bump".



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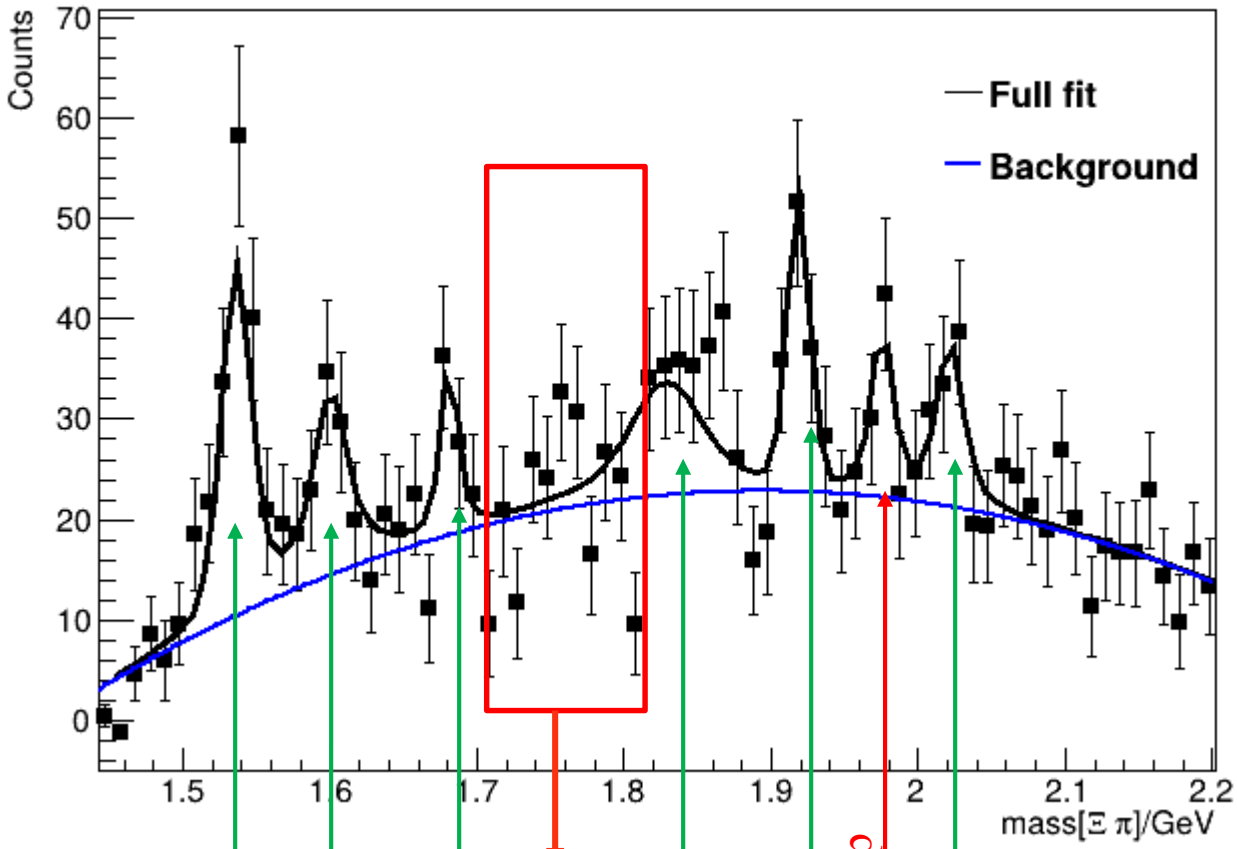
- Additional bump near 1750?



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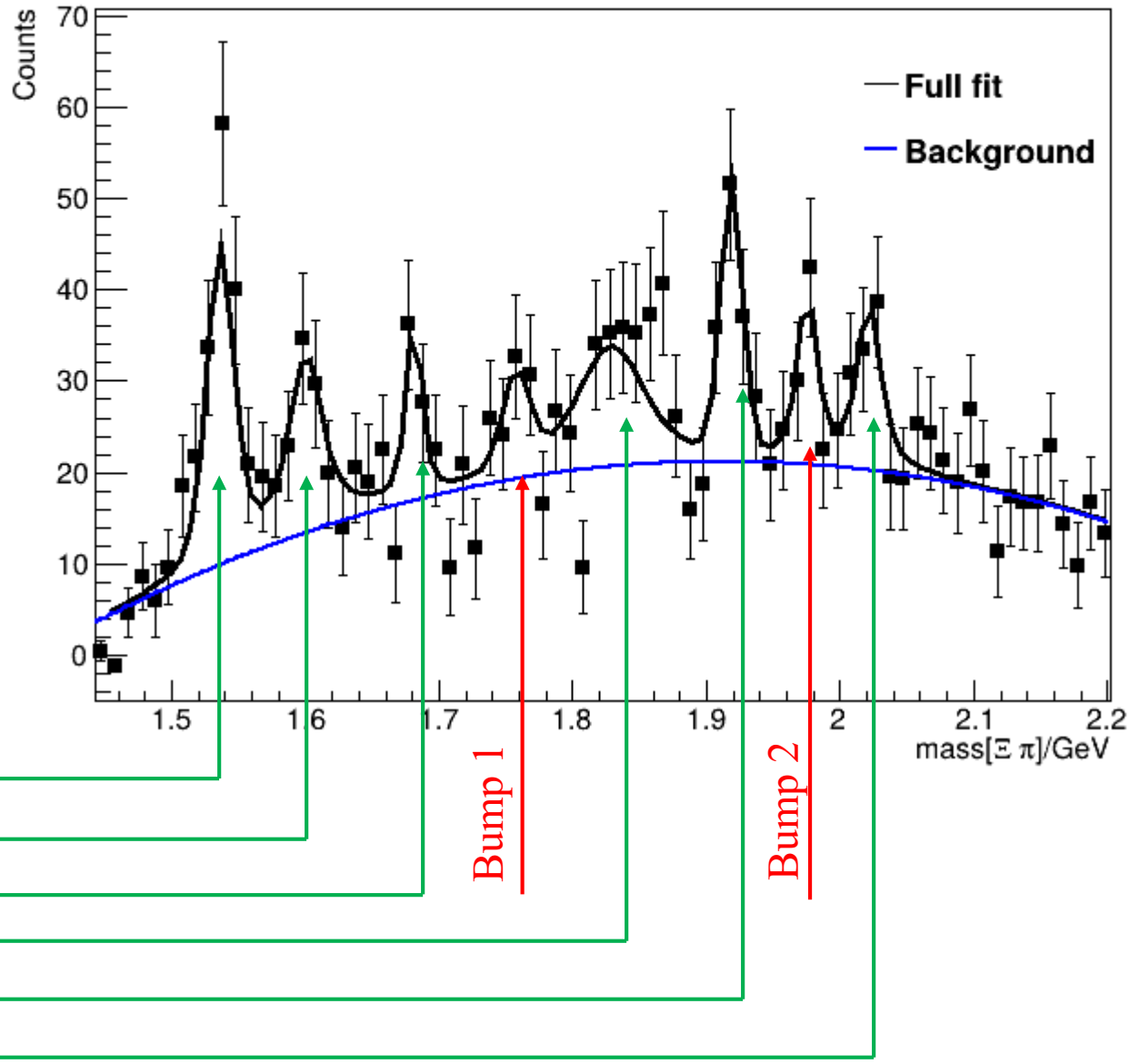
Bump Hunt 2026

- Not enough statistics to promote bumps, but they could, conceivably, complete lowest box in the LQCD predictions ☺
- Interesting possibility!



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