Concluding remarks
a.k.a.
impressions and insights

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- **How good is the evidence for "missing states"?**
- **How can we find them?**

- **What is a *missing* resonance?**

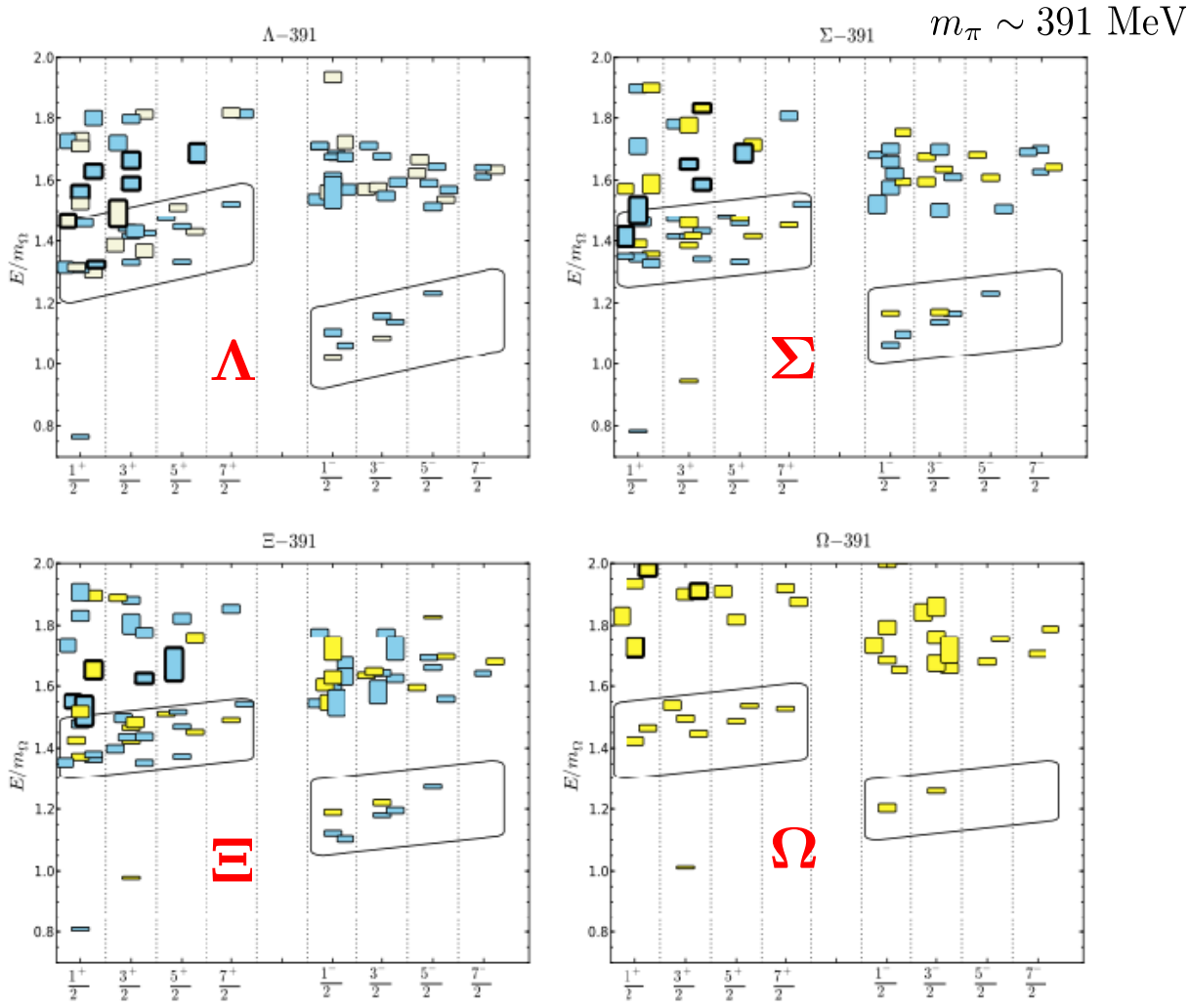
- **What is a *missing* resonance?**
- **A missing person is someone you know exists, but you cannot find. . .**

Excited strange (and charm) quark baryons

Light quarks - SU(3) flavor broken

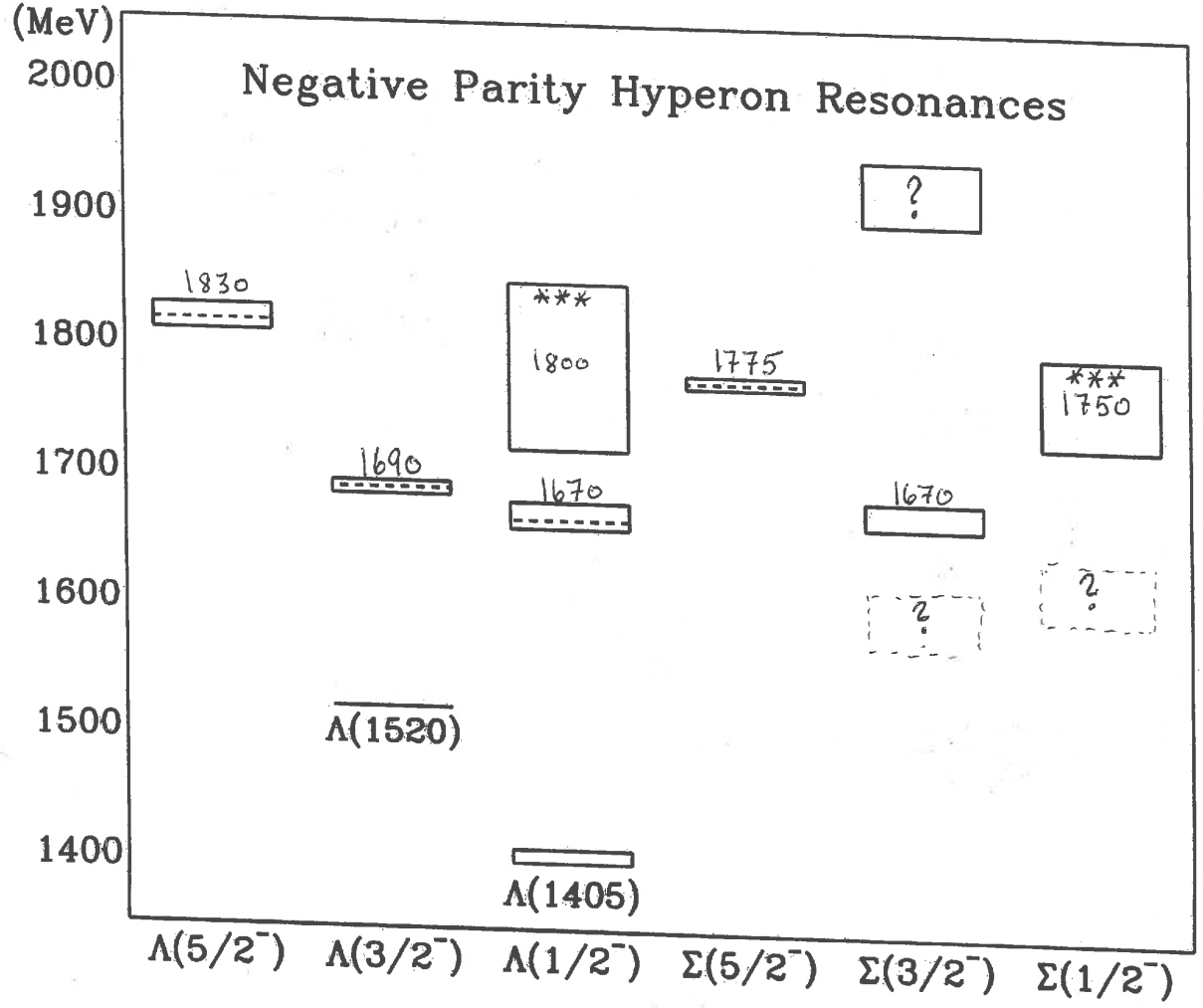
Full non-relativistic quark model counting

Some mixing of SU(3) flavor irreps



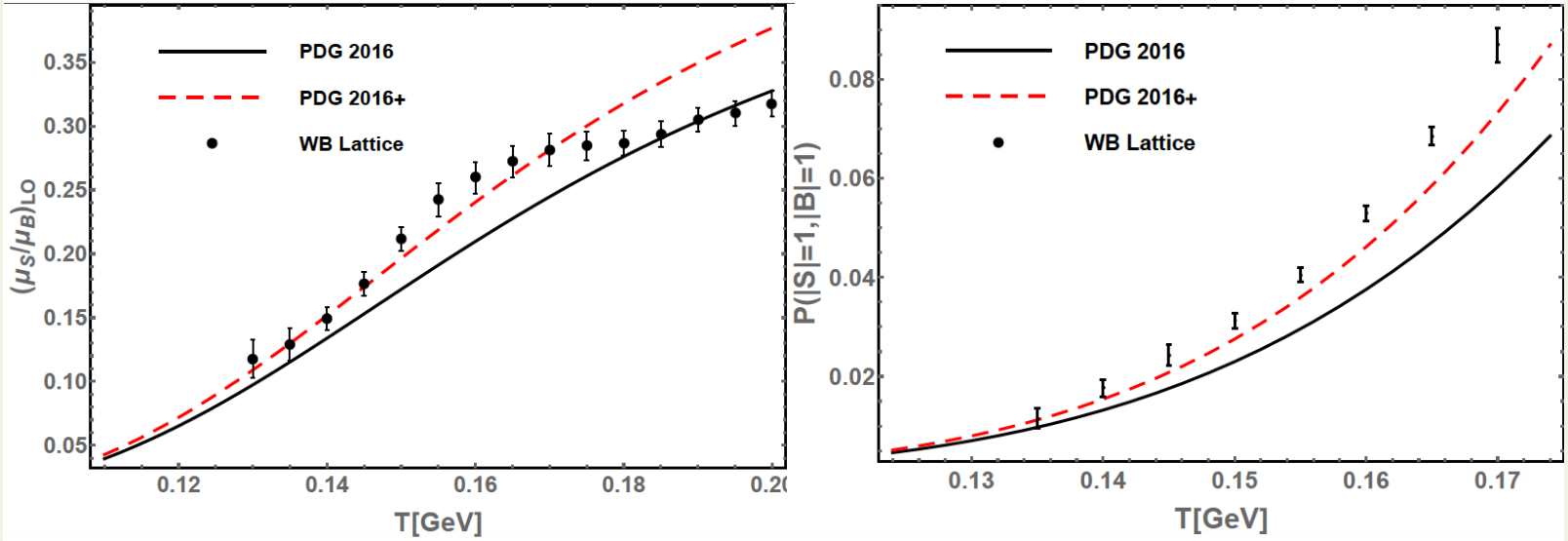
PRD87 054506 (2013)
PRD90 074504 (2014)
PRD91 054502 (2015)

Various quark models:



from Fred Myhrer's talk

Relevance of * states



- Adding states to the spectrum allows to reproduce the lattice data
- We need the * states from the PDG 2016: the spectrum with only **, *** and **** states is not enough

WB collaboration, in preparation

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- **various independent models: there should be more states**
- **so probably there is something there**

- **“You have to distinguish between theory and model”**
- **“We need data to test different models”**

How to find them?

Moskov Amaryan: K^0_L beam at Jlab

What can be learned with a K^0_L beam ?

List of reactions:

Elastic and charge-exchange

$$K^0_L p \to K^0_S p$$
$$K^0_L p \to K^+ n$$

Two-body with S=-1

$$K^0_L p \to \pi^+ \Lambda$$
$$K^0_L p \to \pi^+ \Sigma^0$$

Two-body with S=-2

$$K^0_L p \to K^+ \Xi^0$$
$$K^0_L p \to K^+ \Xi^{0*}$$

Three-body with S=-2

$$K^0_L p \to \pi^+ K^+ \Xi^-$$
$$K^0_L p \to \pi^+ K^+ \Xi^{-*}$$

Three-body with S=-3

$$K^0_L p \to K^+ K^+ \Omega^-$$
$$K^0_L p \to K^+ K^+ \Omega^{-*}$$

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Hall D/GlueX Spectrometer and DAQ

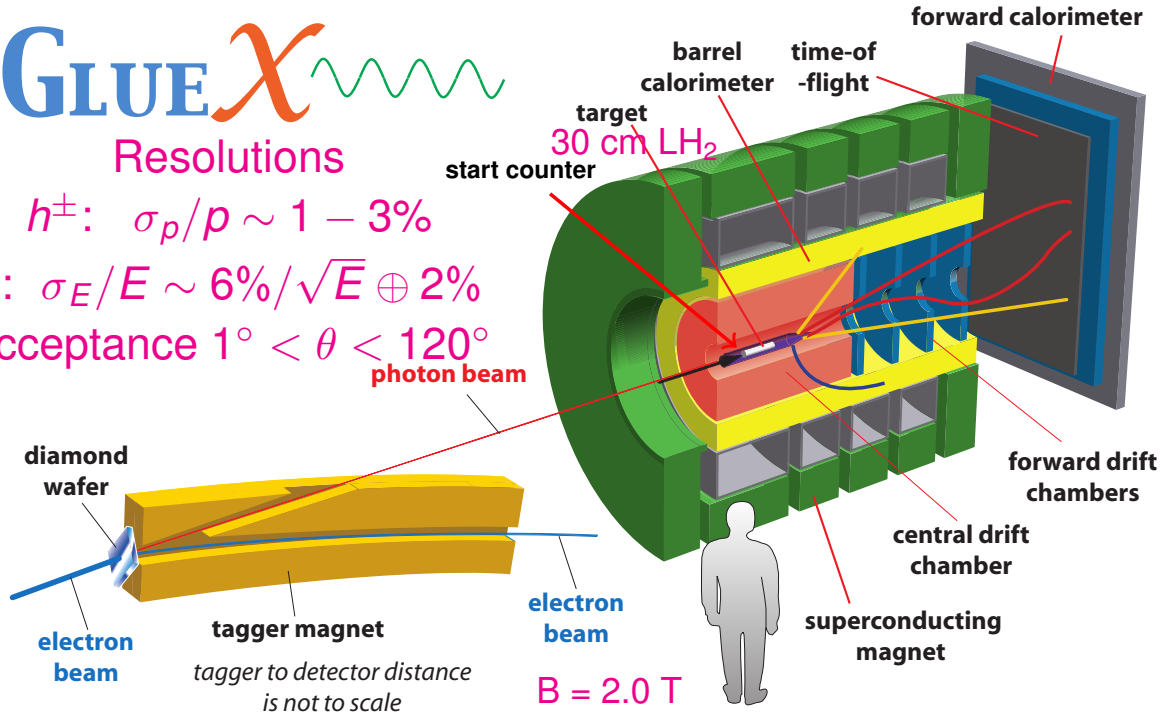
GLUEX

Resolutions

$h^{\pm}$: $\sigma_p/p \sim 1-3\%$

γ: $\sigma_E/E \sim 6\%/\sqrt{E} \oplus 2\%$

Acceptance $1^\circ < \theta < 120^\circ$



Detectors

- CDC, FDC
- BCAL, FCAL
- TOF, ST

Plans to add

- 2017 L3
- 2018 DIRC

Photoproduction γp 1.5 kHz for a 10 MHz beam; Trigger $\sum E_{CAL} > X$

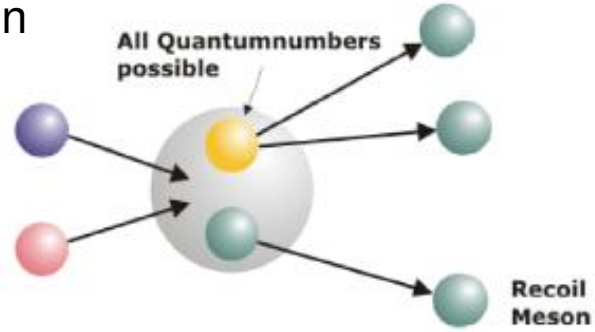
GlueX-I 10 MHz/peak: trigger 20 kHz $\Rightarrow$ DAQ $\Rightarrow$ tape 30 kHz spring 2016

GlueX-II 50 MHz/peak: trigger 100 kHz $\Rightarrow$ DAQ $\Rightarrow$ L3 farm $\sim$ 20 kHz $\Rightarrow$ tape

Antiproton Annihilations: Gluon Rich Environment

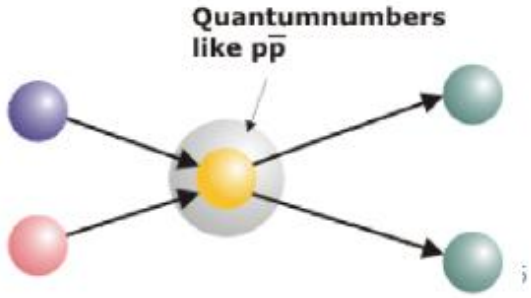
Production: all states with exotic and non-exotic quantum numbers accessible via associated production

- high discovery potential



Formation: all states with non-exotic quantum numbers accessible

- not only limited to 1^{--} as e^+e^- colliders
- precision physics of known states
- resonant, high statistics, extremely good precision in mass and width



antiproton probe unique: large coupling to $\bar{B}B$

Jim Ritman

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Detailed discussion about the discovery potential of $K^0_L p$ only Mark Manley:

Discussion

- Pure hyperon states in the $N = 2$ $(\mathbf{20},1^+)$ multiplet cannot couple to $\overline{K}N$ via a single-quark transition operator. They will not be considered further.
- Pure hyperon states in the $N = 3$ $(\mathbf{20},1^-)$, $(\mathbf{70},2^-)$, and $(\mathbf{20},3^-)$ multiplets cannot couple to $\overline{K}N$ via a single-quark transition operator. They will not be considered further.
- The next several slides compare experimental observations with predictions for low-lying states in the other multiplets (not including $N = 3$)

Jacquelyn Noronha-Hostler:
Bulk/thermal properties using quark model spectrum— How?

Interface between Spectroscopy and Heavy-Ions

If there are missing resonances, it would systematically affect most theory to experiment comparisons in heavy-ion collisions

- Most models in heavy-ions have a standardized hadron cocktail that they read in (includes particle ID, mass, degeneracy, quantum numbers, decay width, and branching ratios)
- These lists can be easily used to make direct comparison between the Hadron Resonance Gas and Lattice QCD
- Needed for dynamical models and thermal fits
- Can a database be created for easy comparisons with the most up-to-date PDG list vs. Quark Models?

- **When are we ready admit a predicted state does not exist?**

Looking forward to new data