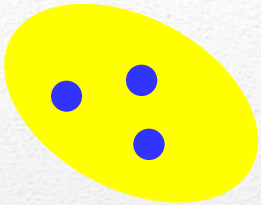
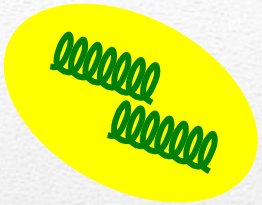
Hadron Spectroscopy

Meson

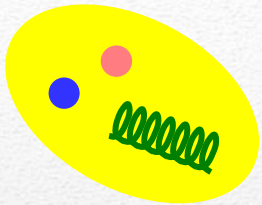
Baryon



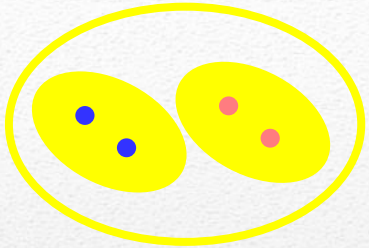
Glueball



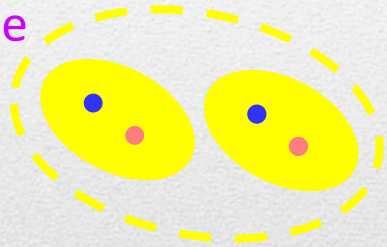
Hybrids

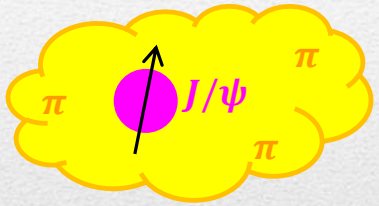


Tetraquark



Molecule

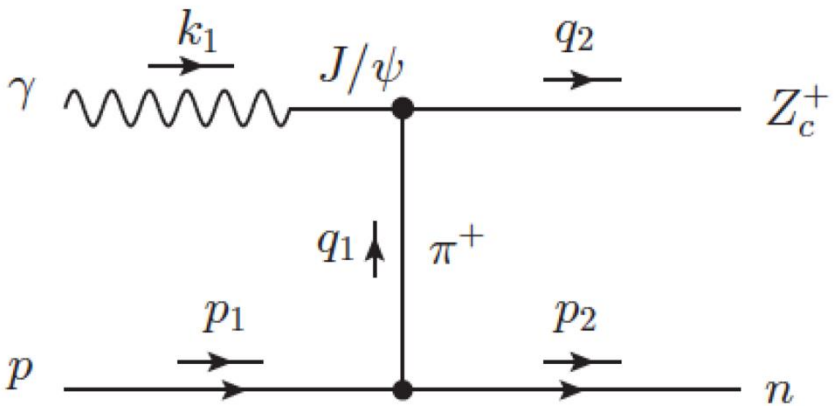




Hadroquarkonium

XYZ states in photoproduction

Justin Stevens, APS 2015



PRD 88 (2013) 114009

$$\mathcal{L}_{V\gamma} = -\frac{eM_V^2}{f_V} V_\mu A^\mu$$

$$\mathcal{L}_{Z\psi\pi} = \frac{g_{Z\psi\pi}}{M_Z}\left(\partial^\mu \psi^\nu \partial_\mu \pi Z_\nu - \partial^\mu \psi^\nu \partial_\nu \pi Z_\mu\right)$$

$$\mathcal{L}_{\pi NN} = -\frac{g_{\pi NN}}{2m_N} \bar{N}\gamma_5\gamma_\mu(\vec{\tau}\cdot\partial^\mu\vec{\pi})N$$

- Several proposals to study XYZ states in photoproduction
  - $\gamma p \to Z_c^+(3900)n, Z_c^+ \to J/\psi\pi^+$ PRD 88 (2013) 114009
  - $\gamma p \to Z_c^+(4430)n, Z_c^+ \to \psi'\pi^+$ PRD 77 (2008) 094005, PRC 83 (2011) 065203
  - $\gamma p \to Z_c^+(4200)n, Z_c^+ \to J/\psi\pi^+$ arXiv:1503:02125 (incl. Regge trajectories in model)
  - $\gamma p \to Y(3940)p, Y(3940) \to J/\psi\omega$ PRD 80 (2009) 114007
- Use an Effective Lagrangian approach with Vector Meson Dominance

Comparison: EIC vs. others

Too late (?) for charm physics ✘

Flexibility in the production mechanism ✓
Flexibility in energy (no Λ_b) ✓
Less clean environment ✘

Same luminosity ✓
Lower cross sections ✘
Better efficiencies for neutrals (?) ✓

Polarized electron & ion beams ✓

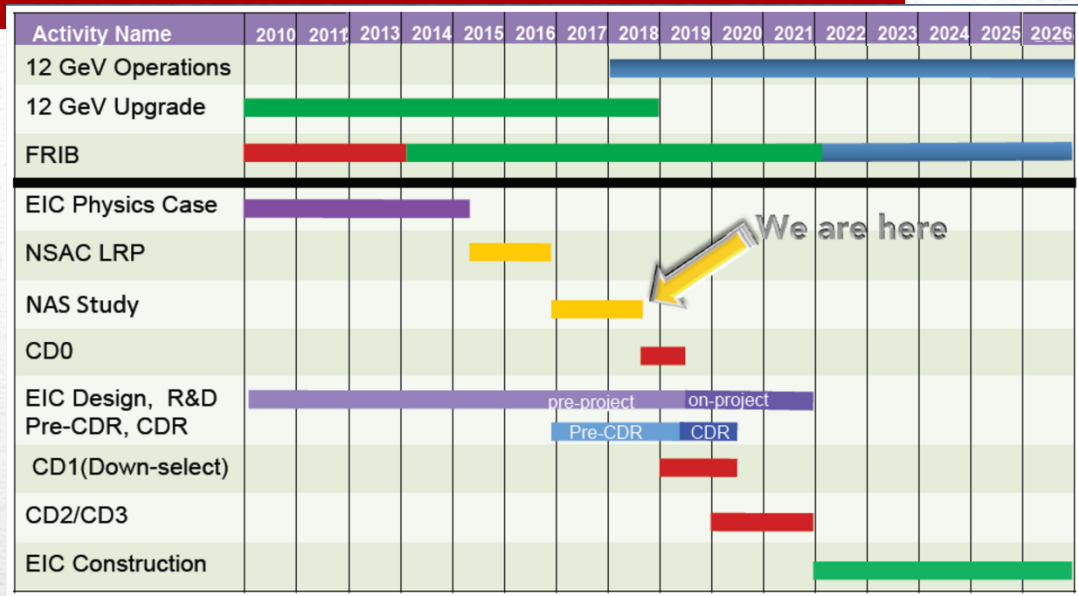
What for?

- High energy in the COM, possibility to study heavy flavors
  - Meson(-like) spectroscopy: X_b, Z_b, $(?)_b$
  - Baryon(-like) spectroscopy: P_b, $(?)_b$
  - Doubly heavy: Ξ_{cc}, Ξ_{bc}; T_{bb}
  - Gluon-rich (small-x): heavy hybrids production?
- Diffractive production (photon-pomeron fusion, Primakoff)
- .....

Need for cross section estimates
(NRQCD? Regge models?)

Timeline

- **July 2018:**
  presentation of the project at the EIC User group
- **December 2018:**
  Workshop in Trento
- **Spring 2019:**
  White book



CD0 = DOE "Mission Need" statement; CD1 = design choice and site selection (VA/NY)
CD2/CD3 = establish project baseline cost and schedule

Working group

- **Theorists:**
  F.K. Guo (CAS), T. Mehen (Duke), A. Pilloni (JLab), A. Szcepaniak (IU/JLab)

- **Experimentalists:**
  M. Battaglieri (INFN-GE), Y. Furletova (JLab), J. Stevens (W&M)