

The GlueX Experiment in Hall-D

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The Long Road to Now

•	Jul. 1997 – Workshop at Indiana University	1
•	Dec. 1999 – External Project Review	
•	Apr. 2004 – Critical Decision 0	
•	Oct. 2004 – External Detector Review	
•	Oct. 2008 – Critical Decision 3	
•	Apr. 2009 – Hall-D Complex Ground Breaking	
•	Jan. 2012 – Beneficial Occupancy of Hall D	18 Years
•	May 2014 – 10.5 GeV electron beam to tagger dump.	
•	Oct. 2014 – Photon beam to GlueX.	
•	Apr. 2015 – Engineering/Physics Running with GlueX.	
•	Sep. 2015 – Physics Running with GlueX!	

Quantum Chromo Dynamics



The rules that govern how the quarks froze out into hadrons are given by QCD.



Atoms are electrically neutral: a charge and an anti-charge (+-).



Quarks have color charge: red, blue and green. Antiquarks have anticolors: cyan, yellow and magenta.



Hadrons are color neutral (white), red-cyan, blue-yellow, green-magenta or red-blue-green, cyan-yellow-magenta.

Quantum Chromo Dynamics





Color Field: Because of self interaction, confining flux tubes form between static color charges



Confinement arises from flux tubes and their excitation leads to a new spectrum of mesons

The QCD Potential

flux-tube

m=0







The QCD Potential







Gluonic Excitations provide an experimental measurement of the excited QCD potential.

Observations of the nonets on the excited potentials are the best experimental signal of gluonic excitations.

Quantum Chromo Dynamics





QCD describes the interactions of quarks and gluons and should predict the spectrum of bound-state baryons (qqq) and mesons ($q\overline{q}$).

There should also be mesons in which the gluonic field contributes directly to the J^{PC} quantum numbers of the states --- hybrid mesons. Some are expected to have ``exotic'' quantum numbers.



QCD Exotics



Experimental evidence exists for π_1 states.

2 nonets of 2⁺⁻ exotic mesons

The GlueX Experiment





Coherent Bremsstrahlung







Summary



- We are excited to have the GlueX/Hall-D photoproduction programs starting very soon.
- We anticipate an exciting meson program over the next decade.
- When we are done, we hope that we have the answer to: ``Where are the QCD states with static glue?"

Expected Decay Modes

 $\pi_1 \rightarrow \pi\rho, \pi b_1, \pi f_1, \pi \eta', \eta a_1$ $\eta_1 \rightarrow \eta f_2, \alpha_2 \pi, \eta f_1, \eta \eta', \pi (1300)\pi, \alpha_1 \pi,$ $\eta_1' \rightarrow \mathbf{K}^* \mathbf{K}, \, \mathbf{K}_1(1270) \mathbf{K}, \, \mathbf{K}_1(1270) \mathbf{K}, \, \mathbf{\eta} \mathbf{\eta}'$

 $b_2 \rightarrow \omega \pi, a_2 \pi, \rho \eta, f_1 \rho, a_1 \pi, h_1 \pi, b_1 \eta$ $h_2 \rightarrow \rho \pi, b_1 \pi, \omega \eta, f_1 \omega$ $h'_{2} \rightarrow K_{1}(1270)K, K_{1}(1270)K, K_{2}^{*}K, \phi\eta, f_{1}\phi$

$$b_0 \rightarrow \pi$$
(1300)π , $h_1 \pi$, $f_1 \rho$, $b_1 \eta$
 $h_0 \rightarrow b_1 \pi$, $h_1 \eta$
 $h'_0 \rightarrow K_1$ (1270)K, K(1460)K, $h_1 \eta$

Early Reach With Statistics Hard

Kaons do not have exotic QN's

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 $p\pi$

 $p2\pi$

GlueX Physics Analysis



GlueX ready to do physics, analyses being worked out in advance using the full suite of GlueX/Hall-D software and data from large-scale data challenges.

Physics reactions of interest:

Understand the detector $\gamma p ightarrow \pi^0 p$ $\gamma p ightarrow \eta p$	Initial exotic hybrid searches $\gamma p \rightarrow \eta \pi(n, p)$ $\gamma p \rightarrow \eta' \pi(n, p)$ $\gamma p \rightarrow \rho \pi(n, p)$	Strange Baryons $\gamma p \rightarrow K^+ \Lambda$ $\gamma p \rightarrow K\Sigma$ $\gamma p \rightarrow KK\Xi$	Activity in the physics working group has shifted to physics analysis.
$\gamma p o ho p$ $\gamma p o \omega p$ $\gamma p o \eta' p$ $\gamma p o \phi p$	$\gamma p \to \omega \pi(n, p)$ $\gamma p \to \omega \pi \pi(n, p)$ $\gamma p \to \eta \pi \pi(n, p)$	Other Physics Interests η Decays η Primakov J/ψ Production 	