

# “Extractions and interpretations of hadron resonances and multi-meson production reactions with 12 GeV upgrade”

**David Richards**

**Interim Director, Theory Center**

# Excited Baryon Analysis Center

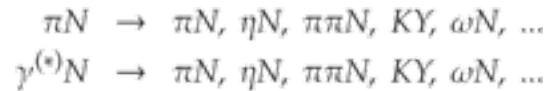
- Analyse wealth of experimental data on baryon resonance production at Jlab and elsewhere
- Motivation: ensure the **2003** OMB Milestones in Hadronic Physics are satisfied:
  - **HP2009**: *Complete the combined analysis of available data on single  $\pi$ ,  $\eta$ , and  $K$  photo-production of nucleon resonances and incorporate the analysis of two-pion final states into the coupled-channel analysis of resonances.*
  - **HP2012**: *Measure the electromagnetic excitations of low-lying baryon states ( $<2$  GeV) and their transition form factors over the range  $Q^2 = 0.1 - 7$  GeV<sup>2</sup> and measure the electro- and photo-production of final states with one and two pseudoscalar mesons.*
- Established in **Spring 2006**
- Led by **Harry Lee**
  - **Hiroyuki Kamano**
  - **Satoshi Nakamura**
  - **Kazuo Tsushima**

**+ wealth of collaborators**

# Excited Baryon Analysis Center

**EBAC: extract and Interpret N\***

**Reaction Data**



May 24-26

**Dynamical Coupled-Channels Analysis**

**N\* params**

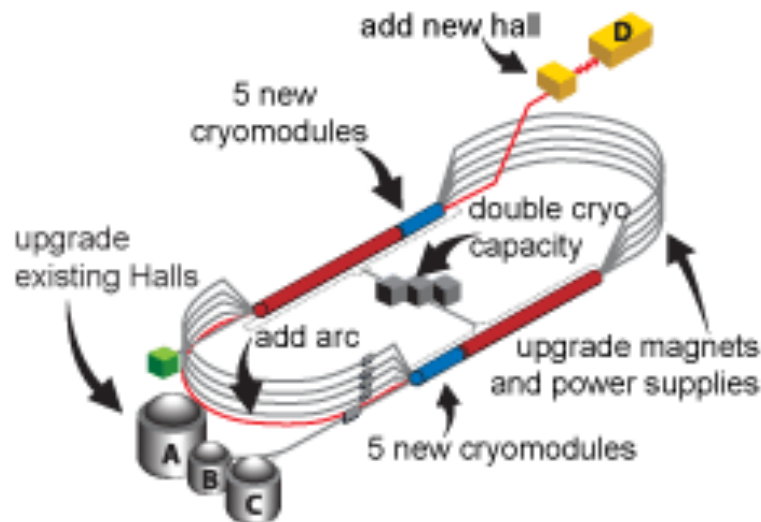
Hadron Models

Lattice QCD

**QCD**

# 12 GeV Upgrade

- \$310M Project
- Construction approved Sept 2008
- Ground Breaking April 2009
- **Completion 2015**



**Workshops and collaborations vital in refining physics case**

# Approved experiment E12-09-003: Nucleon Resonance Studies with CLAS12

## ”Electromagnetic N-N\* Transition Form Factors Workshop”

October 13-15, 2008

arXiv:0907.1901v3 [nucl-th] 25 Sep 2009

## Theory Support for the Excited Baryon Program at the JLab 12 GeV Upgrade\*

I. Aznauryan,<sup>1,2</sup> V. Braun,<sup>3</sup> V. Burkert,<sup>1</sup> S. Capstick,<sup>4</sup> R. Edwards,<sup>1</sup>  
I.C.Cloet,<sup>5</sup> M. Giannini,<sup>6</sup> T.-S. H. Lee,<sup>1,7</sup> H.-W. Lin,<sup>1</sup> V. Mokeev,<sup>1,8</sup>  
C.D. Roberts,<sup>7</sup> E. Santopinto,<sup>9</sup> P. Stoler,<sup>10</sup> Q. Zhao,<sup>11</sup> and B.S. Zou<sup>11</sup>

<sup>1</sup> Thomas Jefferson National Accelerator Facility, Newport News, VA 23606, USA

<sup>2</sup> Yerevan Physics Institute, 375036 Yerevan, Armenia

<sup>3</sup> Institute for Theoretical Physics, University of Regensburg, 93040, Regensburg, Germany

<sup>4</sup> Department of Physics, Florida State University, USA

<sup>5</sup> Department of Physics, University of Washington, Seattle, WA 98195, USA

<sup>6</sup> University of Genova and National Institute of  
Nuclear Physics. Genova, Via Dodecaneso, 33, Italy

<sup>7</sup> Physics Division, Argonne National Laboratory, Argonne, IL 60439, USA

<sup>8</sup> Skobeltsyn Nuclear Physics Institute at Moscow State University,  
Moscow 119899, Leninskie gory, OEPVAYa, Russia

<sup>9</sup> National Institute of Nuclear Physics. Genova, Via Dodecaneso, 33, Italy

<sup>10</sup> Physics Department, Rensselaer Polytechnic Institute, Troy, NY 12180, USA

<sup>11</sup> Institute of High Energy Physics, Chinese Academy of Sciences, Beijing 100049, P.R. China