

# **2nd Workshop on The Proton Mass; At the Heart of Most Visible Matter**

**Monday, April 3, 2017 - Friday, April 7, 2017**

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## **Scientific Program**

The workshop will support a three-pronged theoretical approach to the subject of the origin of hadron masses with an added value on defining possible measurements that would make whole the investigation of the origin of the proton mass. This theoretical approach combined with experimental measurements should in principle allow for a deeper understanding of this complex subject. Direct lattice QCD direct calculations of hadron masses, mass decompositions, where the role of the constituents are explored, as well as phenomenological and approximated analytical approaches would form the three legs supporting the theory base of this workshop. Experiments aimed at some specific pieces of this puzzle, for example the individual terms in a decomposition of the mass in terms of the constituents, could form a platform for experimental measurements that will be pursued if at all possible.

1- How can lattice QCD help us explore the role of "individual" constituents in making up the hadron masses? For example we want to explore the role of quark masses, in particular strange and heavy quark masses contribute to the proton mass.

2- What can the decomposition in terms of constituents teach us? Can we take advantage of the non-uniqueness of the decomposition to cast it in terms of intuitive physical and independently measurable quantities?

3- In the approximated analytical, phenomenological or model approaches, how well can we control the approximations? Examples are the proton wave function, or the  $\pi N$  sigma term, how to quantify or improve the approximations made and how do different approaches compare with each other ?

4- Identify new measurements that could be pursued at existing or future facilities and which would measure relevant observables closely linked to a given decomposition and could effectively test our assumptions. For example, measurements of the  $J/\psi$  electro- and photo-production at threshold at Jefferson Lab and the measurement of Upsilon electro- and photo-production at threshold at a future Electron Ion Collider