N* Focus Session
Threshold Resonances

- S_{11} (1535) ~ ηN thresh (1487 MeV)
- P_{11} (1440) ~ ππN thresh (1317 MeV)
- Λ(1405) ~ KN thresh (1433 MeV)
- Each reaction S-wave, ~attractive
- How to decide if qqq or mes-bar molec?
  - EM form factor (e.g. $A_{1/2}(Q^2)$ for S_{11}(1535) flat => small (qqq)
  - Siggi Krewald (Effective Langrangian with coupled channels with microscopic nonres)
    - Can put in qqq or molec
    - Search for pole, better fit with or without res
  - Juan Nieves (chiral coup chan Lagrangian)
    - Can scat. data be fit with no qqq mechanism?
  - David Roberts, Frank Lee (quenched lattice QCD)
    - Can mass be calculated with qqq only?

present

- Effective Lagrangian, K-matrix, CMB *tentatively* identify these states as qqq (same as some quark models)
    - Need better data for $\gamma N \rightarrow \pi N$, $\pi\pi N$; $\pi N \rightarrow \pi\pi N$
    - Coupled channel has excellent flexibility
    - Is EM form factor a signal?

- Chiral Lagrangian fits data with molec.
    - Chiral effects important close to threshold
    - Only S-wave fit to total cross section
    - Use of coupled channels clever

- Lattice unclear
    - State of art has chiral symmetry in quenched calc.
    - Previous calcs had Roper, $\Lambda(1405)$ mass ~400 MeV high, but very recent Kentucky calc (Frank Lee) has sudden change in mass at $m_\pi < 400$ GeV (Baysian!)
    - But is it true mass?
        - Z graphs as with a_0?
        - Coupling to πN, $\pi\pi N$?

future

- Effective Lagrangrian
  - More data is coming
    - $pp \rightarrow pp\pi^+\pi^-$ (WASA, Sweden)
    - $\pi N \rightarrow \pi\pi N$ (BNL)
    - $\gamma N \rightarrow \pi\pi N$ (CLAS, Bonn)
  - Better constraints, use of symmetries
- Chiral Lagrangian
  - Hard to extend
- Lattice QCD
  - Must continue to analyze Ky results
  - $qqqq\bar{q}$ interp. op. "few years away"
  - Full QCD "few years away" (harder)
  - Full scattering simulation "at least 10 years away" Lütcher