

Baryon spectrum

Vincent Drach
LPSC GRENOBLE
ETM Collaboration



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Outline

- Dynamical twisted mass fermions
- Lattice setup
- Octet of strange Baryon
- Chiral extrapolation
- Isospin breaking effects
- Ω baryon

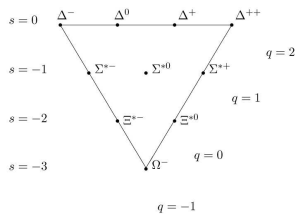
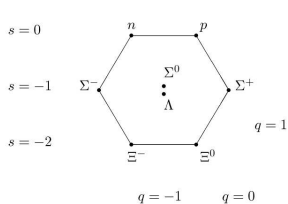
Simulations

- ◆ fermions: $N_f = 2$ maximally twisted mass QCD
 - fermionic action compose of a doublet of fermion.
 - formally equivalent to the QCD in the continuum limit and infinite volume limit
 - $O(a)$ improvement
 - **But**: explicit breaking of parity and isospin in the action

Lattice setup

- ◆ three lattice spacings: 0.07 – 0.10 fm
- ◆ $270 \lesssim m_{\text{PS}} \lesssim 600$ MeV
- ◆ $L > 2$ fm

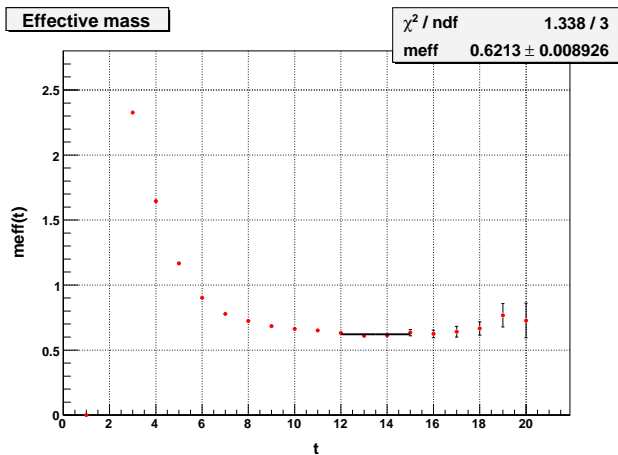
Decuplet and Octet



- Partially quenched study : “doublet” of twisted strange quark.
- Bare quark mass of the strange quark fixed for each value of the lattice spacing in the sector of mesons by V. Lubicz C. Tarrantino and collaborators
- Mass obtain by computing a 2-points function : i.e $\langle J(x)J(0) \rangle$
- Optimization of the interpolating field with smearing : Gaussian + APE

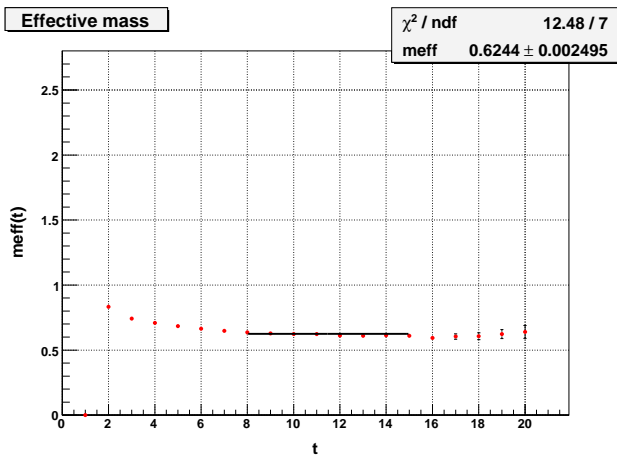
Extraction of masses

Local-Local


 $a \sim 0.0855 \text{ fm}$ $m_{\pi} \sim 440 \text{ MeV}$

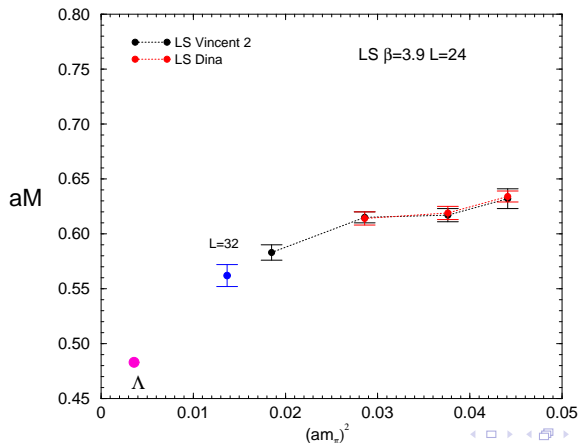
Extraction of masses

Local-Smeared


 $a \sim 0.0855 \text{ fm}$ $m_{\pi} \sim 440 \text{ MeV}$

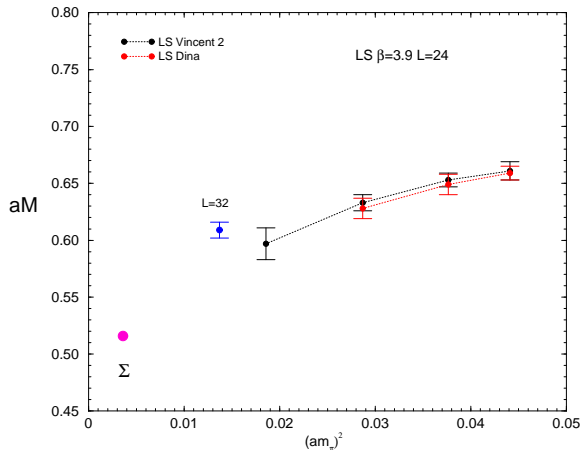
Chiral extrapolation : Λ

- Partially quenched case \rightarrow theoretical frame not clear
- polynomial fits of the form $M = M_0 + am_\pi^2 + bm_\pi^3$



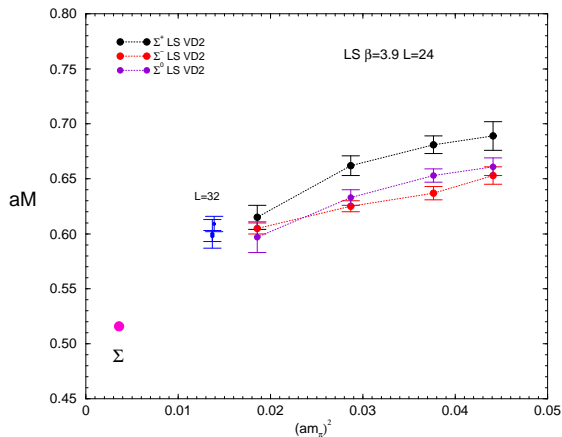
Chiral extrapolation : Σ^0

- Fit not very stable and it seems that we overestimate the strange quark mass



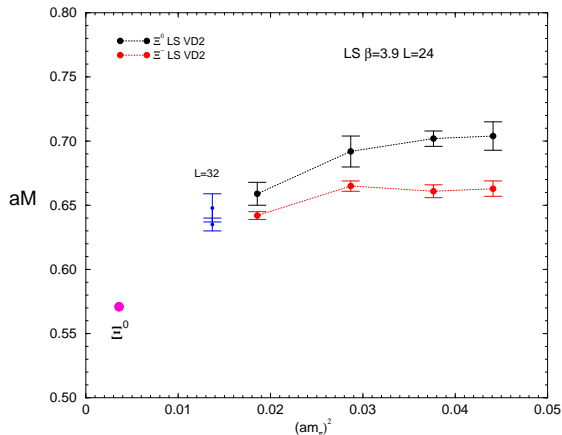
Isospin Breaking

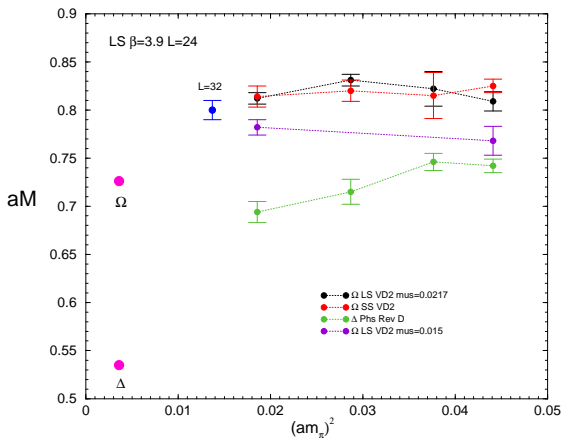
- Test of isospin breaking in the Σ and Ξ sector
- For small pion mass and small lattice spacing all the Σ have to be degenerate



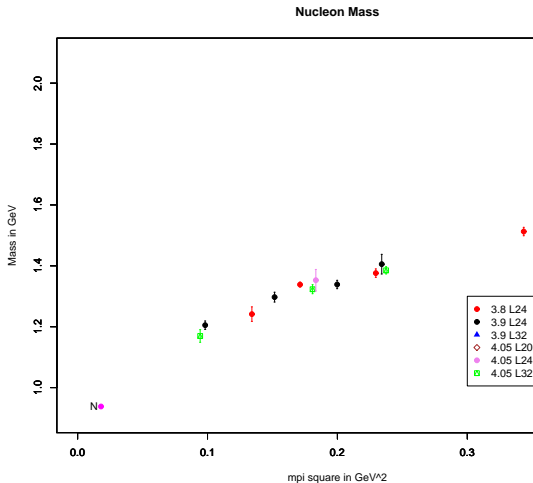
Isospin Breaking

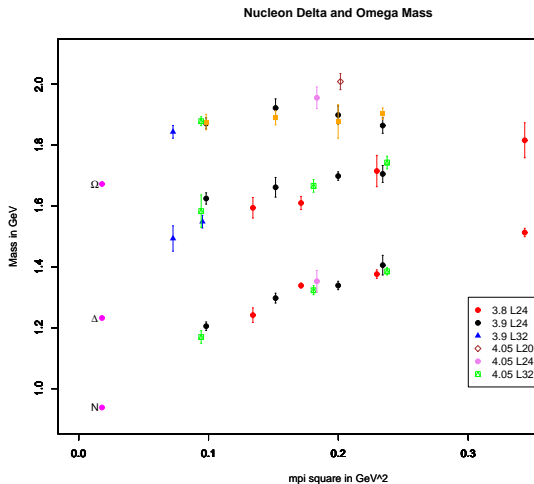
- Idem for the Ξ



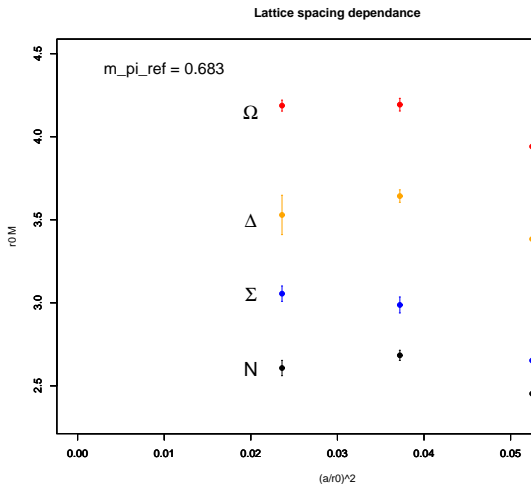
Ω baryon

Nucleon



Nucleon, Δ and Ω 

Lattice spacing dependence



Summary

- Right hierarchy of mass for the octet
- Question of the chiral extrapolation very difficult to manage...
- Isospin breaking seems to decrease for low pion mass
- Lattice artefacts has to be investigate more carefully