The three-quark potential of various quark configurations

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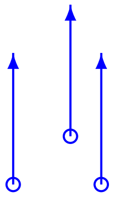
We study the static three-quark potential in SU(3) lattice gauge theory at zero temperature with the Polyakov loop correlation function (PLCF). By employing the multilevel algorithm we overcome the smallness of the signal to noise ratio and obtain remarkably clean signals. We investigate the 224 sets of three-quark configurations with various sizes and geometries.

1. Three-quark potential

- The static three-quark source



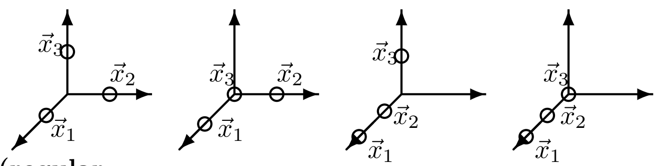
⇒ Polyakov loop correlation function (PLCF)

⇒ NO junction in source

- The multilevel algorithm is useful to compute the correlation functions of extremely small expectation values, which arrows us to obtain potentials even from 1 gauge configuration. [Koma[2], Lat2014]

2. Simulation setting

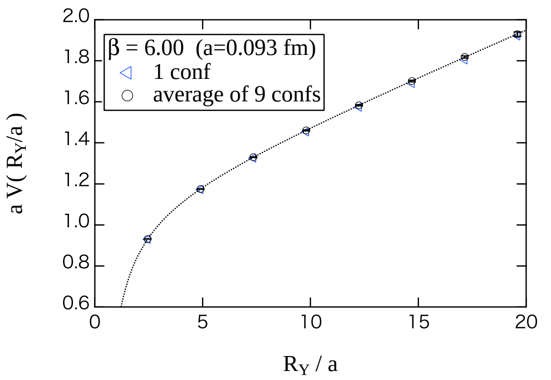
- Three quarks are placed at the vertices of regular, isoceles, right and obtuse triangls, and in line.



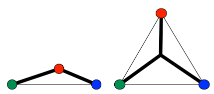
(regular, isosceles) (right) (obtuse) (line)

- The Wilson gauge action, 24^4 lattice, $\beta = 6.00$, $a = 0.093$ fm, 1 gauge configuration, 6 sublattices, 500000 internal updates

(ex) regular triangle

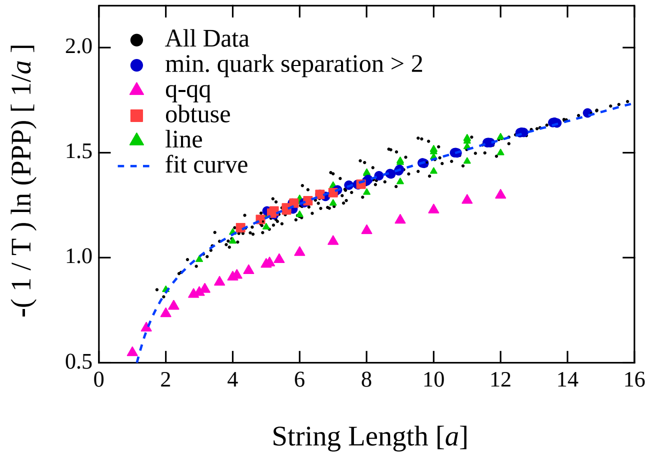


- String length
  = Λ distance (obtuse and line)
  = Y distance (otherwise)

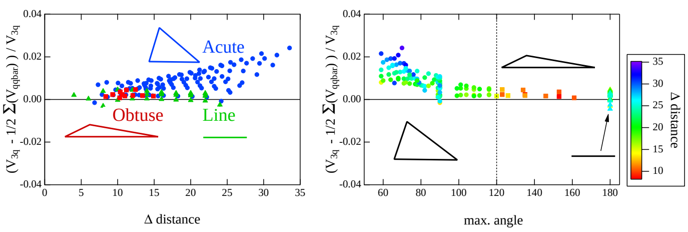


3. Numerical results

- The static potential for the 224 sets of three-quark configurations



- The three-body effect



$$V_{q\bar{q}} = -\frac{0.296}{r} + 0.0463r + 0.795$$

[Koma[2], Lat2014]

4. Summary

- We compute the static potential for the 224 sets of three-quark configurations with the PLCF at zero temperature.
- The potentials fall into one curve when the minimum distance among the three quarks is greater than $2a$.
- The three-body effect becomes clear for larger sizes of the triangles.

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