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LQCD Phase 1 Runs with P4RHMC

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Begin LQCD Phase 1 with p4rhmc

Background

These results represent the first set of runs of 10 β values ranging from 2000–7000 trajectories with the p4rhmc code. This initial run sequence spanned roughly 2-weeks in late January and Early February, 2007.

Scripts

To manage the submission of dependent jobs

- subSet.pl - submits a set of dependent jobs for a single run
- rmSet.pl - removes a set of dependent jobs in reverse order of submission
- statSet.pl - runs pstat command and prints parsed output along with directory contents

The results of running the statSet.pl command are printed below for three different times during the start up the next sequence of runs using the milc code.

Output of statSet.pl on Wednesday, Feb 07, 2007, 11 AM:

```
Jobname # status size_date_lattice on /p/lscratch1/soltz/p4rhmc/
p4b3.46 0   --  100663838 Feb 6 15:00 gauge01190.lat
p4b3.49 0   --  100663837 Feb 6 15:01 gauge01880.lat
p4b3.51 0   --  100663838 Feb 6 15:45 gauge03000.lat
p4b3.54 0   --  100663837 Feb 6 20:15 gauge03140.lat
p4b3.57 0   --  100663837 Feb 6 08:40 gauge02240.lat
p4b3.60 0   --  100663838 Feb 5 17:25 gauge03320.lat
p4b3.63 0   --  100663837 Feb 5 21:03 gauge05780.lat
p4b3.66 0   --  100663838 Feb 6 14:58 gauge04730.1at
p4b3.69 0   --  100663837 Feb 6 16:43 gauge07230.lat
p4b3.76 0   --  100663837 Feb 6 17:54 gauge05620.lat
t0b3.60 3  RUN  402653726 Feb 7 08:50 gauge00120.lat
t0b3.66 3  RUN  402653725 Feb 7 11:07 gauge00140.lat
t0b3.76 3 *WCPU 0
```

```
Jobname # status size_date_lattice on /p/lscratch1/soltz/milc/
mtb6458 2 *WCPU   225644 Feb 6 17:25 o328f21b6458m00820m0820r.01100.00
mtb650  2   RUN   961568 Feb 7 11:13 o328f21b650m00765m0765r.01245.00
mtb655  2   RUN   790121 Feb 7 11:13 o328f21b655m00705m0705r.00840.00
mtb660  2   RUN   628500 Feb 7 11:13 o328f21b660m00650m0650r.01270.00
mtb665  2 *WCPU   961472 Feb 7 00:24 o328f21b665m00599m0599r.00830.00
mtb670  2 *WCPU  1073709 Feb 7 01:04 o328f21b670m00552m0552r.01375.00
mtb676  2 *WCPU  1073462 Feb 6 21:57 o328f21b676m005m05r.01315.00
mtb680  2 *WCPU     3390 Feb 6 17:41 rat.328f21b680m00471m0471r
mtb685  2 *WCPU  1073226 Feb 7 05:40 o328f21b685m00437m0437r.01070.00
mtb690  2 *WCPU 75497568 Feb 6 17:47 l328f21b690m00407m0407r.1010
mtb695  2 *WCPU 75497568 Feb 6 17:56 l328f21b695m0038m038r.990
mtb700  2 *WCPU  1073307 Feb 7 02:55 o328f21b700m00355m0355r.01090.00
mtb708  2 *WCPU  1068889 Feb 7 01:46 o328f21b708m0031m031r.01220.00
```

Output of statSet.pl on Wednesday, Feb 07, 2007, 1 PM:

```
Jobname # status size_date_lattice on /p/lscratch1/soltz/p4rhmc/
p4b3.46 0   --   100663838 Feb 6 15:00 gauge01190.lat
p4b3.49 0   --   100663837 Feb 6 15:01 gauge01880.lat
p4b3:51 0   --   100663838 Feb 6 15:45 gauge03000.lat
p4b3.54 0   --   100663837 Feb 6 20:15 gauge03140.lat
p4b3.57 0   --   100663837 Feb 6 08:40 gauge02240.lat
p4b3.60 0   --   100663838 Feb 5 17:25 gauge03320.lat
p4b3.63 0   --   100663837 Feb 5 21:03 gauge05780.lat
p4b3.66 0   --   100663838 Feb 6 14:58 gauge04730.lat
p4b3.69 0   --   100663837 Feb 6 16:43 gauge07230.lat
p4b3.76 0   --   100663837 Feb 6 17:54 gauge05620.lat
t0b3.60 3   RUN  402653724 Feb 7 11:13 gauge00130.lat
t0b3.66 3   RUN  402653725 Feb 7 11:07 gauge00140.lat
t0b3.76 3 *WCPU 0

Jobname # status size_date_lattice on /p/lscratch1/soltz/milc/
mtb6458 2 *WCPU   225644 Feb 6 17:25 o328f21b6458m00820m0820r.01100.00
mtb650  2   RUN   423876 Feb 7 12:53 o328f21b650m00765m0765r.01275.00
mtb655  2   RUN   158003 Feb 7 12:53 o328f21b655m00705m0705r.00870.00
mtb660  2   RUN   902327 Feb 7 12:53 o328f21b660m00650m0650r.01295.00
mtb665  2   RUN   833047 Feb 7 12:53 o328f21b665m00599m0599r.00855.00
mtb670  2   RUN   499921 Feb 7 12:53 o328f21b670m00552m0552r.01400.00
mtb676  1 *WCPU      237 Feb 7 11:43 o328f21b676m005m05r.01320.19
```

```
mtb680  2   RUN   275120 Feb 7 12:53 o328f21b680m00471m0471r.00960.00
mtb685  2   RUN   418061 Feb 7 12:53 o328f21b685m00437m0437r.01075.00
mtb690  2 *WCPU 75497568 Feb 6 17:47 l328f21b690m00407m0407r.1010
mtb695  2 *WCPU 75497568 Feb 6 17:56 l328f21b695m0038m038r.990
mtb700  2 *WCPU  1073307 Feb 7 02:55 o328f21b700m00355m0355r.01090.00
mtb708  2 *WCPU  1068889 Feb 7 01:46 o328f21b708m0031m031r.01220.00
```

Output of statSet.pl on Thursday, Feb 08, 2007, 8 AM:

```
Jobname # status size_date_lattice on /p/lscratch1/soltz/p4rhmc/
p4b3.46 0   --  100663838 Feb 6 15:00 gauge01190.lat
p4b3.49 0   --  100663837 Feb 6 15:01 gauge01880.lat
p4b3.51 0   --  100663838 Feb 6 15:45 gauge03000.lat
p4b3.54 0   --  100663837 Feb 6 20:15 gauge03140.lat
p4b3.57 0   --  100663837 Feb 6 08:40 gauge02240.lat
p4b3.60 0   --  100663838 Feb 5 17:25 gauge03320.lat
p4b3.63 0   --  100663837 Feb 5 21:03 gauge05780.lat
p4b3.66 0   --  100663838 Feb 6 14:58 gauge04730.lat
p4b3.69 0   --  100663837 Feb 6 16:43 gauge07230.lat
p4b3.76 0   --  100663837 Feb 6 17:54 gauge05620.lat
t0b3.60 2   RUN 402653726 Feb 8 08:34 gauge00200.lat
t0b3.66 2 *WCPU 402653725 Feb 7 15:34 gauge00160.lat
t0b3.76 3   RUN 402653726 Feb 8 08:09 gauge00140.lat

Jobname # status size_date_lattice on /p/lscratch1/soltz/milc/
mtb6458 3 *DELAYED    3389 Feb 8 08:40 rat.328f21b6458m00820m0820r
mtb650  3      RUN  373900 Feb 8 08:41 o328f21b650m00765m0765r.01425.00
mtb655  3      RUN  340111 Feb 8 08:41 o328f21b655m00705m0705r.01020.00
mtb660  3      RUN  297787 Feb 8 08:41 o328f21b660m00650m0650r.01450.00
mtb665  3      RUN  250468 Feb 8 08:41 o328f21b665m00599m0599r.01035.00
mtb670  3      RUN  241501 Feb 8 08:41 o328f21b670m00552m0552r.01580.00
mtb676  3      RUN  257137 Feb 8 08:41 o328f21b676m005m05r.01420.00
mtb680  3      RUN  228156 Feb 8 08:41 o328f21b680m00471m0471r.01145.00
mtb685  3    *WCPU     237 Feb 8 02:20 o328f21b685m00437m0437r.01260.00
mtb690  3    *WCPU 1073346 Feb 8 06:41 o328f21b690m00407m0407r.01210.00
mtb695  3 *DELAYED 1073252 Feb 8 06:07 o328f21b695m0038m038r.01190.00
mtb700  3 *DELAYED 1073142 Feb 8 05:23 o328f21b700m00355m0355r.01285.00
mtb708  3 *DELAYED 1073026 Feb 8 05:08 o328f21b708m0031m031r.01415.00
```

Analysis of β=3.55 delta-H History

Previously, the β=3.55 summary.dat file showed an anomalously large expectation value for $\exp -\Delta H$. Fig. 1 shows this to be due to the values in the very first runs, which were produced when the job was unable to locate the starting thermalized lattice. The data files for these runs were mistakenly copied to the analysis area.

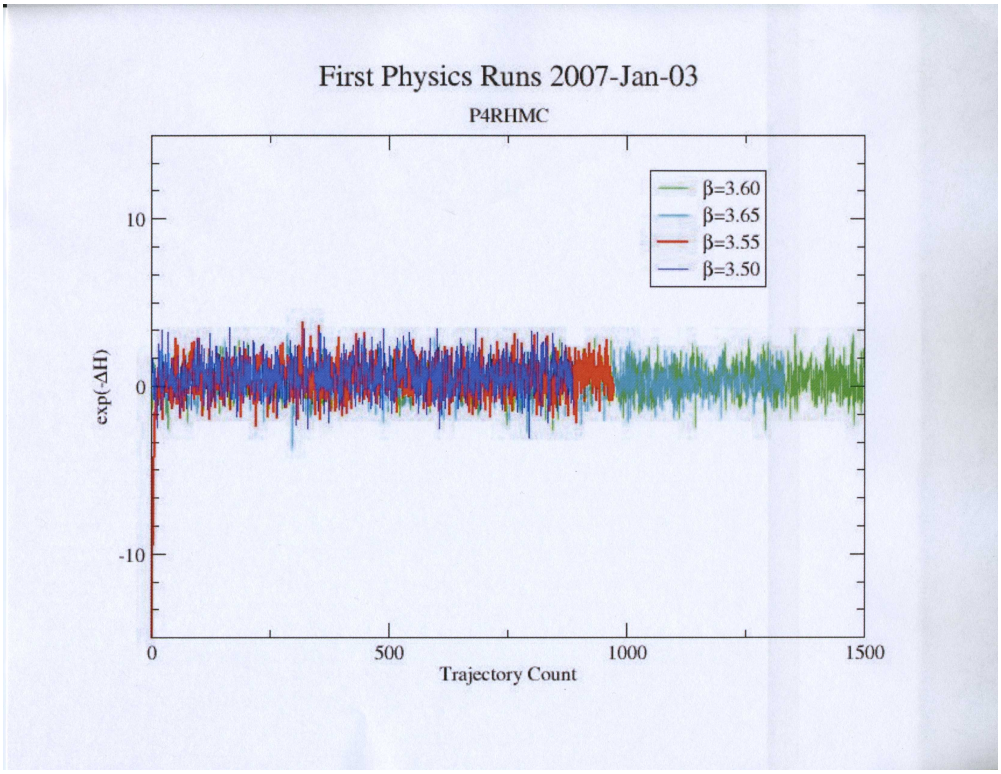

Figure 1: Delta-H history for all β values in the first physics runs with p4rhmc. The initial values for $\beta = 3.55$ are the result of an error in starting the calcluation.

The following summary file is for $\beta = 3.55$ with these initial runs removed.

```
beta=3.55
######################################################
```

```
#Acceptance Accepted=568, Total=932, Rate=0.609442060085837, Expected=0.6127951157188
######################################################
#Chiral Condensate (pbp)
#Total size of pbp.dat = 1860
#pbp block size = 50
#pbp_frequencey = 10
#pbp_hits_per_measurement = 10
#pbp_thermalization = 0
#Mass pbp error 2.3000000000000000e-02 0.0874264686930609 0.000236725430077723
#Mass pbp_sus error 2.3000000000000000e-02 1.24586150339772e-06 3.0310854044965e-07
#Mass pbp error 2.3000000000000000e-03 0.0184323914101817 0.000350130798625224
#Mass pbp_sus error 2.3000000000000000e-03 3.42582948160431e-06 6.4074446973676e-07
######################################################
######################################################
#Plaquette
#Total size of plaq.dat = 932
#block size = 50
#thermalization = 0
#plaq error 0.543412953402311 3.89143740422354e-05
#plaq_sus error 9.49798118429622e-08 1.0731135133982ge-08
######################################################
######################################################
#Rectangle
#Total size of rect.dat = 932
#block size = 50
#thermalization = 0
#rect error 0.307969897563964 5.81613361738268e-05
#rect_sus error 9.49798118429622e-08 1.0731135133982ge-08
######################################################
######################################################
#Wilson line
#Total size of wline.dat = 3728
#block size = 50
#thermalization = 0
#wline error 0.0229803265958633 0.00088397484761194
#wline_sus error
```

Plaquette History Analysis

The plaquette history values are used to estimate thermalization times.

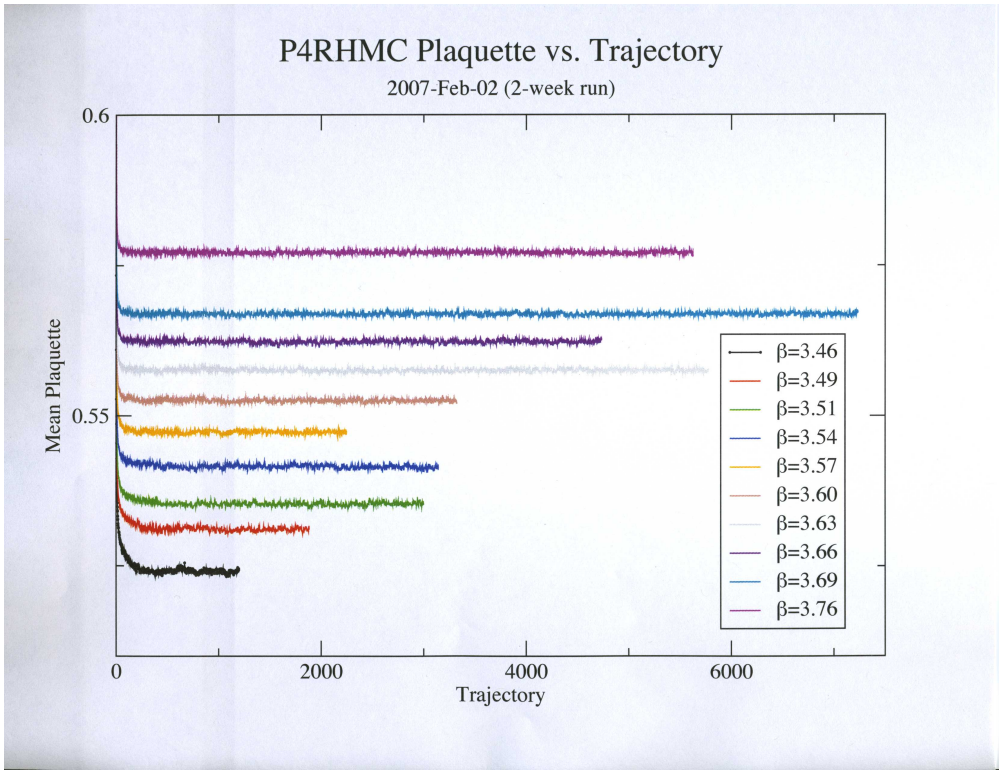

Figure 2: Plaquette histories for 10 β values for the initial set of 32^3x8 runs with p4rhmc.

Summary data files

The following are the summary data files for all β values with thermalization cutoff nominally set to 400.

```
beta=3.46
######################################################
#Acceptance Accepted=431, Total=798 , Rate=0.540100250626566, Expected=0.532439347744
######################################################
```

```
#Chiral Condensate (pbp)
#Total size of pbp.dat = 2380
#pbp block size = 50
#pbp_frequencey = 10
#pbp_hits_per_measurement = 10
#pbp_thermalization = 800
#Mass pbp error 3.1300000000000001e-02 0.154877031091864 0.000275228820332701
#Mass pbp_sus error 3.1300000000000001e-02 1.42450842360907e-06 4.1095364265243e-07
#Mass pbp error 3.1300000000000000e-03 0.0727243505702389 0.000386196267458777
#Mass pbp_sus error 3.1300000000000000e-03 2.58788550736396e-06 7.98699749678043e-07
########################################################
########################################################
#Plaquette
#Total size of plaq.dat = 1198
#block size = 50
#thermalization = 400
#plaq error 0.524110866662354 5.01970670680408e-05
#plaq_sus error 9.56557539982805e-08 1.94099883841571e-08
########################################################
########################################################
#Rectangle
#Total size of rect.dat = 1198
#block size = 50
#thermalization = 400
#rect error 0.284062092600724 7.21122750955974e-05
#rect_sus error 9.56557539982805e-08 1.94099883841571e-08
########################################################
########################################################
#Wi 1 son li ne
#Total size of wline.dat = 4792
#block size = 50

beta=3.49
########################################################
#Acceptance Accepted=927, Total=1487, Rate=0.623402824478816, Expected=0. 62230414470
########################################################
#Chiral Condensate (pbp)
#Total size of pbp.dat = 3760
#pbp block size = 50
#pbp_frequencey = 10
```

```
#pbp_hits_per_measurement = 10
#pbp_thermalization = 800
#Mass pbp error 2.9000000000000001e-02 0.130956505315019 0.000184891445153408
#Mass pbp_sus error 2.9000000000000001e-02 1.3174271666797ge-06 2.77781116434423e-07
#Mass pbp error 2.8999999999999998e-03 0.0516703304411535 0.000296220836236635
#Mass pbp_sus error 2.8999999999999998e-03 3.31957120860736e-06 8.7499809432382e-07
######################################################
######################################################
#Plaquette
#Total size of plaq.dat = 1887
#block size = 50
#thermalization = 400
#plaq error 0.531113454542434 2.85064602711884e-05
#plaq_sus error 8.35881959574773e-08 5.20397814654133e-09
######################################################
######################################################
#Rectangle
#Total size of rect.dat = 1887
#block size = 50
#thermalization = 400
#rect error 0.292713110562705 3.93451608703016e-05
#rect_sus error 8.35881959574773e-08 5.20397814654133e-09
######################################################
######################################################
#Wilson line
#Total size of wline.dat = 7548
#block size = 50

beta=3.51
######################################################
#Acceptance Accepted=1502, Total=2601, Rate=0.577470203767782, Expected=0.57534905366
######################################################
#Chiral Condensate (pbp)
#Total size of pbp.dat = 6000
#pbp block size = 50
#pbp_frequencey = 10
#pbp_hits_per_measurement = 10
#pbp_thermalization = 800
#Mass pbp error 2.589999999999999ge-02 0.113036213063255 0.000114474804318076
#Mass pbp_sus error 2.589999999999999ge-02 9.76940109936067e-07 1.13086902878248e-07
```

```
#Mass pbp error 2.589999999999999ge-03 0.0399420921280152 0.000214938433969671
#Mass pbp_sus error 2.589999999999999ge-03 3.47465478284097e-06 4.05760484671382e-07
######################################################
######################################################
#Plaquette
#Total size of plaq.dat = 3001
#block size = 50
#thermalization = 400
#plaq error 0.535339796828222 1.75045465365658e-05
#plaq_sus error 7.69606817362651e-08 4.8574415767367e-09
######################################################
######################################################
#Rectangle
#Total size of rect.dat = 3001
#block size = 50
#thermalization = 400
#rect error 0.2979289888363 2.5201369754703e-05
#rect_sus error 7.69606817362651e-08 4.8574415767367e-09
######################################################
######################################################
#Wi 1 son li ne
#Total size of wline.dat = 12004
#block size = 50

b=3.54
######################################################
#Acceptance Accepted=1686, Total=Z746, Rate=0.613983976693372, Expected=0. 6172890304
######################################################
#Chiral Condensate (pbp)
#Total size of pbp.dat = 6280
#pbp block size = 50
#pbp_frequencey = 10
#pbp_hits_per_measurement = 10
#pbp_thermalization = 800
#Mass pbp error 2.4000000000000000e-02 0.0931435433453949 0.000170638920465567
#Mass pbp_sus error 2.4000000000000000e-02 1.78681593188871e-06 2.45285152166955e-07
#Mass pbp error 2.3999999999999998e-03 0.0211951596377821 0.00030749278380982
#Mass pbp_sus error 2.3999999999999998e-03 6.39794440875484e-06 8.38204282524751e-07
######################################################
######################################################
```

```
#Plaquette
#Total size of plaq.dat = 3146
#block size = 50
#thermalization = 400
#plaq error 0.541524707942608 2.1721843305707ge-05
#plaq_sus error 8.4264431021718ge-08 5.1886505520377ge-09
#######################################################
#######################################################
#Rectangle
#Total size of rect.dat = 3146
#block size = 50
#thermalization = 400
#rect error 0.305632640202785 3.21030480589444e-05
#rect_sus error 8.4264431021718ge-08 5.1886505520377ge-09
#######################################################
#######################################################
#Wilson line
#Total size of wline.dat = 12584
#block size = 50

beta=3.57
#######################################################
#Acceptance Accepted=1282, Total=1850, Rate=0.692972972972973, Expected=0.68558738874
#######################################################
#Chiral Condensate (pbp)
#Total size of pbp.dat = 4484
#pbp block size = 50
#pbp_frequencey = 10
#pbp_hits_per_measurement = 10
#pbp_thermalization = 800
#Mass pbp error 2.1200000000000000e-02 0.0742965999554433 0.000176342253044472
#Mass pbp_sus error 2.1200000000000000e-02 1.96508995214786e-05 1.83666297313492e-05
#Mass pbp error 2.119999999999999ge-03 0.0110362077548924 0.000167919053042762
#Mass pbp_sus error 2.119999999999999ge-03 1.87022940219494e-06 3.95993587383762e-07
#######################################################
#######################################################
#Plaquette
#Total size of plaq.dat = 2250
#block size = 50
#thermalization = 400
```

```
#plaq error 0.547284695146346 2.0174484632954ge-05
#plaq_sus error 7.3057560630269ge-08 4.13491791468014e-09
#####################################################
#####################################################
#Rectangle
#Total size of rect.dat = 2250
#block size = 50
#thermalization = 400
#rect error 0.312820149174691 2.9179378325158ge-05
#rect_sus error 7.3057560630269ge-08 4.13491791468014e-09
#####################################################
#####################################################
#Wilson line
#Total size of wline.dat = 9000
#block size = 50

beta=3.60
#####################################################
#Acceptance Accepted=2083, Total=2929, Rate=0.711164219870263, Expected=0.71707628018
#####################################################
#Chiral Condensate (pbp)
#Total size of pbp.dat = 6640
#pbp block size = 50
#pbp_frequencey = 10
#pbp_hits_per_measurement = 10
#pbp_thermalization = 800
#Mass pbp error 1.9199999999999998e-02 0.0615532435279621 8.31588564428407e-05
#Mass pbp_sus error 1.9199999999999998e-02 4.93863696607813e-07 6.7410510066550ge-08
#Mass pbp error . 1.9200000000000000e-03 0.00722918550221107 4.97967917983531e-05
#Mass pbp_sus error 1.9200000000000000e-03 2.56466108612504e-07 4.02756758232038e-08
#####################################################
#####################################################
#Plaquette
#Total size of plaq.dat = 3329
#block size = 50
#thermalization = 400
#plaq error 0.552527344109708 1.46093164423691e-05
#plaq_sus error 6.779032376784e-08 3.3077006785081e-09
#####################################################
#####################################################
```

```
#Rectangle
#Total size of rect.dat = 3329
#block size = 50
#thermalization = 400
#rect error 0.319326644128558 1.9815482648348e-05
#rect_sus error 6.779032376784e-08 3.3077006785081e-09
#####################################################
#####################################################
#Wilson line
#Total size of wline.dat = 13316
#block size = 50

beta=3.63
#####################################################
#Acceptance Accepted=3771, Total=5380, Rate=0.70092936802974, Expected=0.702848152514
#####################################################
#Chiral Condensate (pbp)
#Total size of pbp.dat = 11560
#pbp block size = 50
#pbp_frequencey = 10
#pbp_hits_per_measurement = 10
#pbp_thermalization = 800
#Mass pbp error 1.7000000000000001e-02 0.0503511163632884 5.59007810504951e-05
#Mass pbp_sus error 1.7000000000000001e-02 4.03009409671626e-07 4.34361505601024e-08
#Mass pbp error 1.699999999999999ge-03 0.00539286968527937 2.16572554207505e-05
#Mass pbp_sus error 1.699999999999999ge-03 8.43586704849051e-08 1.50634321299667e-08
#####################################################
#####################################################
#Plaquette
#Total size of plaq.dat = 5780
#block size = 50
#thermalization = 400
#plaq error 0.557550328524785 1.22582114785498e-05
#plaq_sus error 7.24325953891751e-08 3.03846777542875e-09
#####################################################
#####################################################
#Rectangle
#Total size of rect.dat = 5780
#block size = 50
#thermalization = 400
```

```
#rect error 0.325575698136081 1.83221765545025e-05
#rect_sus error 7.24325953891751e-08 3.03846777542875e-09
#####################################################
#####################################################
#Wilson line
#Total size of wline.dat = 23120
#block size = 50

beta=3.66 ################################################### #Acceptance Accepted=3
#####################################################
#Chiral Condensate (pbp)
#Total size of pbp.dat ='9460
#pbp block size = 50
#pbp_frequencey = 10
#pbp_hits_per_measurement = 10
#pbp_thermalization = 800
#Mass pbp error 1.7000000000000001e-02 0.0473572815980015 4.16953030851332e-05
#Mass pbp_sus error 1.7000000000000001e-02 1.94683859063523e-07 2.2867744349619ge-08
#Mass pbp error 1.699999999999999ge-03 0.00492804801424322 1.21218679042718e-05
#Mass pbp_sus error 1.699999999999999ge-03 2.5454107177948e-08 3.70235743543383e-09
#####################################################
#####################################################
#Plaquette
#Total size of plaq.dat = 4738
#block size = 50
#thermalization = 400
#plaq error 0.562294700043319 1.49120721039911e-05
#plaq_sus error 7.34516872739691e-08 4.20515843838846e-09
#####################################################
#####################################################
#Rectangle
#Total size of rect.dat = 4738
#block size = 50
#thermalization = 400
#rect error 0.331472849875438 2.17961463891355e-05
#rect_sus error 7.34516872739691e-08 4.20515843838846e-09
#####################################################
#####################################################
#Wilson line
#Total size of wline.dat = 18952
```

```
#block size = 50

beta=3.69
######################################################
#Acceptance Accepted=4694, Total=6838, Rate=0.686458028663352, Expected=0.69092044658
######################################################
#Chiral Condensate (pbp)
#Total size of pbp.dat = 14460
#pbp block size = 50
#pbp_frequencey = 10
#pbp_hits_per_measurement = 10
#pbp_thermalization = 800
#Mass pbp error 1.499999999999999ge-02 0.0397419877398399 2.22933007422785e-05
#Mass pbp_sus error 1.499999999999999ge-02 9.87104436320635e-08 9.25518369596677e-09
#Mass pbp error 1.5000000000000000e-03 0.00405388223573915 5.51300481310112e-06
#Mass pbp_sus error 1.5000000000000000e-03 8.90033977918697e-09 2.15019288186467e-09
######################################################
######################################################
#Plaquette
#Total size of plaq.dat = 7238
#block size = 50
#thermalization = 400
#plaq error 0.5669156397283 8.45801590902053e-06
#plaq_sus error 6.20752329879092e-08 2.06678874007656e-09
######################################################
######################################################
#Rectangle
#Total size of rect.dat = 7238
#block size = 50
#thermalization = 400
#rect error 0.337254229945257 1.27506814428676e-05
#rect_sus error 6.20752329879092e-08 2.06678874007656e-09
######################################################
######################################################
#Wilson line
#Total size of wline.dat = 28952
#block size = 50

beta=3.76
######################################################
```

```
#Acceptance Accepted=3810, Total=5228, Rate=0.728768171384851, Expected=0.72631909910
######################################################
#Chiral Condensate (pbp)
#Total size of pbp.dat = 11240
#pbp block size = 50
#pbp_frequencey = 10
#pbp_hits_per_measurement = 10
#pbp_thermalization = 800
#Mass pbp error 1.389999999999999ge-02 0.0335766135368291 1.4256989990626ge-05
#Mass pbp_sus error 1.389999999999999ge-02 3.14134095922711e-08 2.94899422955881e-09
#Mass pbp error 1.3900000000000000e-03 0.00338151103578613 2.42092222275282e-06
#Mass pbp_sus error 1.3900000000000000e-03 1.16249212966214e-09 2.02953647497193e-10
######################################################
######################################################
#Plaquette
#Total size of plaq.dat = 5628
#block size = 50
#thermalization = 400
#plaq error 0.577119521728935 8.71538581025594e-06
#plaq_sus error 5.97249422674642e-08 1.9856607642316ge-09
######################################################
######################################################
#Rectangle
#Total size of rect.dat = 5628
#block size = 50
#thermalization = 400
#rect error 0.350091021298252 1.36371415695941e-05
#rect_sus error 5.97249422674642e-08 1.9856607642316ge-09
######################################################
######################################################
#Wilson line
#Total size of wline.dat = 22512
#block size = 50
```