# Tables of mesoscopic 3D Coulomb balls

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Detailed numerical results for the structural properties of three-dimensional classical Coulomb clusters confined in a spherical parabolic trap are presented. Based on extensive high accuracy computer simulations the shell configurations and energies for particle numbers in the range $2 \leq N \leq 160$ are reported. Further, the mean shell radii and shell widths are calculated.

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*Model:* We consider $N$ classical particles with equal charge $q$ and mass $m$ interacting via the Coulomb force and being confined in a 3D isotropic harmonic trap with frequency $\omega$ with the hamiltonian

$$H_N = \sum_{i=1}^{N} \frac{m}{2}\dot{r}_i^{\,2} + \sum_{i=1}^{N} \frac{m}{2}\omega^2 r_i^2 + \sum_{i>j}^{N} \frac{q^2}{4\pi\varepsilon|\mathbf{r}_i - \mathbf{r}_j|}. \qquad (1)$$

Below we will use dimensionless lengths and energies by introducing the units $r_0 = (q^2/2\pi\varepsilon m\omega^2)^{1/3}$ and $E_0 = (m\omega^2 q^4/32\pi^2\varepsilon^2)^{1/3}$, respectively.

There have been a number of numerical investigations of the system (1). Here we list the references we are aware of and extend/correct their data up to $N = 160$. A subset of this data together with an analysis of metastable states and symmetry properties is discussed in Ref. [1].

Rafac et al. [3], correcting earlier results, identified the first shell closure at $N = 12$ (the 13th particle is the first to occupy a second shell) and presented detailed data, including ground state energies for $N \leq 27$, but they missed the onset of the third shell, as did Hasse et al. [2]. Tsuruta et al. extended the table to $N = 59$ [4]. The most extensive data, for up to a few thousand particles, has been presented by Hasse et al. [2], but they report excited states rather than the ground states for $N = 28 - 31, 44, 54$ and practically for all $N > 63$ (except for $N = 66$). The obvious reason for the computational difficulties is the existence of a large number of excited (metastable) states which are energetically close to the ground state; with increasing $N$ this number grows exponentially whereas the energy difference rapidly vanishes. This means that there exists no straightforward tool to identify the ground state from the large number of (local) minima of the potential energy surface.

We also mention related work on three-dimensional clusters of particles confined to the surface of a sphere [5, 6].

The tables below contain simulation data (details of the molecular dynamics procedure have been given in Ref. [1]) for the shell configuration, total energy per particle, mean shell radius (starting from the outer shell) and standard deviation of radius $r_i$ (denoting the mean width of shell i, not the error of $r_i$).

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TABLE I: Shell configurations, energy per particle for the lowest lying states, mean shell radii $r_{1,2,3,4}$ and widths $\sigma_{1,2,3}$

| $N$ | Config. | $E/N$ | $r_1$ | $r_2$ | $r_3$ | $r_4$ | $\sigma_1$ | $\sigma_2$ | $\sigma_3$ |
|---|---|---|---|---|---|---|---|---|---|
| 2 | (2) | 0.500000(0) | 0.500(0) | - | - | - | 0.000(0) | - | - |
| 3 | (3) | 1.310370(7) | 0.660(9) | - | - | - | 0.000(0) | - | - |
| 4 | (4) | 1.785826(2) | 0.771(5) | - | - | - | 0.000(0) | - | - |
| 5 | (5) | 2.245187(2) | 0.865(1) | - | - | - | 0.010(0) | - | - |
| 6 | (6) | 2.654039(0) | 0.940(6) | - | - | - | 0.000(0) | - | - |
| 7 | (7) | 3.064186(0) | 1.010(6) | - | - | - | 0.013(5) | - | - |
| 8 | (8) | 3.443409(4) | 1.071(4) | - | - | - | 0.000(0) | - | - |
| 9 | (9) | 3.809782(0) | 1.126(9) | - | - | - | 0.006(3) | - | - |
| 10 | (10) | 4.164990(0) | 1.178(3) | - | - | - | 0.005(5) | - | - |
| 11 | (11) | 4.513275(4) | 1.226(5) | - | - | - | 0.010(1) | - | - |
| 12 | (12) | 4.838966(4) | 1.270(0) | - | - | - | 0.000(0) | - | - |
| 13 | (12, 1) | 5.166798(3) | 1.365(9) | 0.000(0) | - | - | 0.000(0) | 0.000(0) | - |
| 14 | (13, 1) | 5.485915(4) | 1.403(3) | 0.007(1) | - | - | 0.005(8) | 0.000(0) | - |
| 15 | (14, 1) | 5.792094(2) | 1.438(3) | 0.000(0) | - | - | 0.005(6) | 0.000(0) | - |
| 16 | (15, 1) | 6.093421(3) | 1.471(9) | 0.000(0) | - | - | 0.005(2) | 0.000(0) | - |
| 17 | (16, 1) | 6.388609(9) | 1.504(2) | 0.000(0) | - | - | 0.006(2) | 0.000(0) | - |
| 18 | (17, 1) | 6.678830(3) | 1.535(3) | 0.000(0) | - | - | 0.000(6) | 0.000(0) | - |
| 19 | (18, 1) | 6.964146(0) | 1.565(4) | 0.000(0) | - | - | 0.004(0) | 0.000(0) | - |
| 20 | (19, 1) | 7.247181(0) | 1.594(6) | 0.000(2) | - | - | 0.006(9) | 0.000(0) | - |
| 21 | (20, 1) | 7.522377(7) | 1.622(6) | 0.000(0) | - | - | 0.003(4) | 0.000(0) | - |
| 22 | (21, 1) | 7.795468(9) | 1.649(9) | 0.000(7) | - | - | 0.006(3) | 0.000(0) | - |
| 23 | (21, 2) | 8.063575(4) | 1.707(7) | 0.530(2) | - | - | 0.030(2) | 0.000(0) | - |
| 24 | (22, 2) | 8.326802(8) | 1.732(6) | 0.526(0) | - | - | 0.029(4) | 0.009(2) | - |
| 25 | (23, 2) | 8.588360(7) | 1.757(0) | 0.526(2) | - | - | 0.026(3) | 0.000(0) | - |
| 26 | (24, 2) | 8.844236(2) | 1.780(5) | 0.524(1) | - | - | 0.026(3) | 0.00(08) | - |
| 27 | (24, 3) | 9.097334(6) | 1.830(5) | 0.689(8) | - | - | 0.036(9) | 0.009(6) | - |
| 28 | (25, 3) | 9.348367(8) | 1.852(5) | 0.688(9) | - | - | 0.036(4) | 0.001(6) | - |
| 29 | (25, 4) | 9.595435(1) | 1.899(2) | 0.798(7) | - | - | 0.037(4) | 0.011(9) | - |
| 30 | (26, 4) | 9.838964(7) | 1.919(7) | 0.796(1) | - | - | 0.034(7) | 0.018(0) | - |
| 31 | (27, 4) | 10.079511(0) | 1.939(9) | 0.792(6) | - | - | 0.038(3) | 0.007(1) | - |
| 32 | (28, 4) | 10.318678(8) | 1.959(6) | 0.793(5) | - | - | 0.033(8) | 0.000(0) | - |
| 33 | (29, 4) | 10.556587(1) | 1.979(1) | 0.791(4) | - | - | 0.034(6) | 0.010(7) | - |
| 34 | (30, 4) | 10.790841(9) | 1.998(0) | 0.790(1) | - | - | 0.035(8) | 0.000(0) | - |
| 35 | (30, 5) | 11.022731(0) | 2.038(1) | 0.885(9) | - | - | 0.041(0) | 0.038(0) | - |
| 36 | (30, 6) | 11.251922(6) | 2.077(5) | 0.958(2) | - | - | 0.035(3) | 0.000(0) | - |
| 37 | (31, 6) | 11.478747(2) | 2.094(7) | 0.958(5) | - | - | 0.035(8) | 0.017(8) | - |
| 38 | (32, 6) | 11.702951(6) | 2.111(9) | 0.954(9) | - | - | 0.039(4) | 0.000(0) | - |
| 39 | (33, 6) | 11.928322(8) | 2.128(9) | 0.954(9) | - | - | 0.035(2) | 0.012(0) | - |
| 40 | (34, 6) | 12.150162(9) | 2.145(3) | 0.954(7) | - | - | 0.038(0) | 0.011(8) | - |
| 41 | (35, 6) | 12.370791(5) | 2.161(8) | 0.953(8) | - | - | 0.035(4) | 0.006(4) | - |
| 42 | (35, 7) | 12.589139(3) | 2.196(1) | 1.026(0) | - | - | 0.040(6) | 0.050(7) | - |
| 43 | (36, 7) | 12.805545(2) | 2.211(9) | 1.025(2) | - | - | 0.037(4) | 0.045(6) | - |
| 44 | (36, 8) | 13.020077(9) | 2.245(4) | 1.084(5) | - | - | 0.038(0) | 0.013(2) | - |
| 45 | (37, 8) | 13.232901(2) | 2.260(3) | 1.084(5) | - | - | 0.038(0) | 0.034(0) | - |
| 46 | (38, 8) | 13.444601(5) | 2.275(1) | 1.084(2) | - | - | 0.036(4) | 0.037(3) | - |
| 47 | (38, 9) | 13.654458(5) | 2.306(6) | 1.139(1) | - | - | 0.034(0) | 0.048(8) | - |
| 48 | (39, 9) | 13.862762(0) | 2.321(0) | 1.137(9) | - | - | 0.033(0) | 0.036(2) | - |
| 49 | (40, 9) | 14.069919(9) | 2.335(1) | 1.137(1) | - | - | 0.034(1) | 0.035(4) | - |
| 50 | (41, 9) | 14.275728(5) | 2.349(0) | 1.137(2) | - | - | 0.036(8) | 0.026(7) | - |
| 51 | (41, 10) | 14.480101(0) | 2.378(8) | 1.187(7) | - | - | 0.035(2) | 0.029(8) | - |
| 52 | (42, 10) | 14.683192(6) | 2.392(2) | 1.187(5) | - | - | 0.034(0) | 0.029(4) | - |
| 53 | (43, 10) | 14.885283(9) | 2.405(5) | 1.187(2) | - | - | 0.037(5) | 0.029(5) | - |
| 54 | (44, 10) | 15.085702(8) | 2.418(6) | 1.187(2) | - | - | 0.035(2) | 0.024(5) | - |
| 55 | (43, 12) | 15.284702(6) | 2.461(8) | 1.277(3) | - | - | 0.031(8) | 0.010(1) | - |
| 56 | (44, 12) | 15.482144(4) | 2.474(3) | 1.278(0) | - | - | 0.036(9) | 0.010(1) | - |
| 57 | (45, 12) | 15.679350(2) | 2.486(9) | 1.276(3) | - | - | 0.036(3) | 0.007(2) | - |
| 58 | (45, 12, 1) | 15.875406(2) | 2.512(6) | 1.376(5) | 0.005(2) | - | 0.046(3) | 0.004(3) | 0.000(0) |
| 59 | (46, 12, 1) | 16.070103(4) | 2.524(7) | 1.376(4) | 0.000(0) | - | 0.048(0) | 0.000(0) | 0.000(0) |
| 60 | (48, 12) | 16.263707(3) | 2.523(6) | 1.275(5) | - | - | 0.036(0) | 0.003(6) | - |

TABLE II: Continuation of Table I

| $N$ | Config. | $E/N$ | $r_1$ | $r_2$ | $r_3$ | $r_4$ | $\sigma_1$ | $\sigma_2$ | $\sigma_3$ |
|---|---|---|---|---|---|---|---|---|---|
| 61 | (48, 12, 1) | 16.455812(8) | 2.548(8) | 1.375(1) | 0.004(2) | - | 0.045(1) | 0.002(4) | 0.000(0) |
| 62 | (48, 13, 1) | 16.647519(7) | 2.573(8) | 1.413(4) | 0.016(3 | - | 0.044(3) | 0.023(5) | 0.000(0) |
| 63 | (48, 14, 1) | 16.837694(0) | 2.598(8) | 1.447(3) | 0.004(6 | - | 0.039(3) | 0.024(7) | 0.000(0) |
| 64 | (49, 14, 1) | 17.027288(9) | 2.610(1) | 1.447(8) | 0.001(9 | - | 0.037(3) | 0.023(7) | 0.000(0) |
| 65 | (50, 14, 1) | 17.215360(8) | 2.621(2) | 1.447(7) | 0.000(0) | - | 0.049(5) | 0.018(8) | 0.000(0) |
| 66 | (50, 15, 1) | 17.402891(3) | 2.645(3) | 1.480(5) | 0.005(9 | - | 0.043(2) | 0.026(6) | 0.000(0) |
| 67 | (51, 15, 1) | 17.589347(4) | 2.656(3) | 1.480(3) | 0.004(6 | - | 0.043(0) | 0.024(3) | 0.000(0) |
| 68 | (51, 16, 1) | 17.774874(4) | 2.679(7) | 1.512(3) | 0.003(4 | - | 0.034(5) | 0.031(1) | 0.000(0) |
| 69 | (52, 16, 1) | 17.959432(2) | 2.690(3) | 1.512(6) | 0.001(0 | - | 0.039(3) | 0.034(3) | 0.000(0) |
| 70 | (53, 16, 1) | 18.143338(3) | 2.701(0) | 1.511(9) | 0.002(3 | - | 0.041(1) | 0.031(7) | 0.000(0) |
| 71 | (54, 16, 1) | 18.326281(9) | 2.711(6) | 1.511(8) | 0.008(3 | - | 0.041(2) | 0.028(0) | 0.000(0) |
| 72 | (54, 17, 1) | 18.508444(3) | 2.734(2) | 1.542(3) | 0.005(9 | - | 0.035(3) | 0.020(1) | 0.000(0) |
| 73 | (55, 17, 1) | 18.689729(4) | 2.744(5) | 1.542(2) | 0.004(7 | - | 0.037(5) | 0.020(4) | 0.000(0) |
| 74 | (56, 17, 1) | 18.870167(9) | 2.754(6) | 1.542(3) | 0.008(8 | - | 0.042(2) | 0.017(8) | 0.000(0) |
| 75 | (56, 18, 1) | 19.049742(1) | 2.776(5) | 1.571(7) | 0.005(5 | - | 0.037(2) | 0.031(8) | 0.000(0) |
| 76 | (57, 18, 1) | 19.228600(2) | 2.786(5) | 1.571(4) | 0.000(0 | - | 0.037(2) | 0.025(3) | 0.000(0) |
| 77 | (58, 18, 1) | 19.406816(5) | 2.796(4) | 1.571(4) | 0.003(3) | - | 0.038(5) | 0.031(4) | 0.000(0) |
| 78 | (59, 18, 1) | 19.584175(2) | 2.806(3) | 1.571(5) | 0.004(6) | - | 0.039(8) | 0.027(1) | 0.000(0) |
| 79 | (60, 18, 1) | 19.760799(9) | 2.816(1) | 1.570(9) | 0.005(0) | - | 0.040(2) | 0.027(4) | 0.000(0) |
| 80 | (60, 19, 1) | 19.936689(9) | 2.837(0) | 1.600(2) | 0.003(0) | - | 0.038(4) | 0.038(4) | 0.000(0) |
| 81 | (60, 20, 1) | 20.111592(4) | 2.857(7) | 1.627(1) | 0.006(4) | - | 0.031(1) | 0.040(6) | 0.000(0) |
| 82 | (61, 20, 1) | 20.286103(1) | 2.867(1) | 1.627(4) | 0.005(0) | - | 0.031(1) | 0.040(6) | 0.000(0) |
| 83 | (61, 20, 2) | 20.459834(2) | 2.886(6) | 1.688(6) | 0.544(7) | - | 0.039(0) | 0.061(9) | 0.044(5) |
| 84 | (61, 21, 2) | 20.632758(9) | 2.906(4) | 1.714(0) | 0.542(6) | - | 0.034(1) | 0.069(2) | 0.003(3) |
| 85 | (62, 21, 2) | 20.804907(5) | 2.915(6) | 1.713(5) | 0.542(2) | - | 0.038(6) | 0.063(9) | 0.021(7) |
| 86 | (63, 21, 2) | 20.976517(8) | 2.924(7) | 1.713(8) | 0.540(3) | - | 0.041(2) | 0.061(4) | 0.009(6) |
| 88 | (64, 22, 2) | 21.317682(0) | 2.953(2) | 1.737(8) | 0.538(5) | - | 0.033(9) | 0.059(1) | 0.005(7) |
| 89 | (65, 22, 2) | 21.487369(1) | 2.962(1) | 1.737(8) | 0.537(5) | - | 0.034(4) | 0.057(0) | 0.000(0) |
| 90 | (66, 22, 2) | 21.656403(7) | 2.970(9) | 1.737(6) | 0.535(9) | - | 0.037(4) | 0.057(5) | 0.000(0) |
| 91 | (66, 22, 3) | 21.824823(2) | 2.989(1) | 1.791(6) | 0.705(0) | - | 0.043(4) | 0.066(7) | 0.004(0) |
| 92 | (67, 22, 3) | 21.992541(8) | 2.997(9) | 1.791(1) | 0.705(2) | - | 0.044(4) | 0.064(9) | 0.015(2) |
| 93 | (66, 24, 3) | 22.159489(7) | 3.026(0) | 1.836(1) | 0.701(9) | - | 0.035(8) | 0.078(1) | 0.013(0) |
| 94 | (67, 24, 3) | 22.325841(4) | 3.034(7) | 1.835(6) | 0.700(1) | - | 0.034(9) | 0.068(3) | 0.019(6) |
| 95 | (67, 24, 4) | 22.491878(2) | 3.052(2) | 1.884(8) | 0.808(9) | - | 0.035(3) | 0.067(7) | 0.021(5) |
| 96 | (68, 24, 4) | 22.657270(6) | 3.060(6) | 1.884(6) | 0.808(3) | - | 0.040(8) | 0.067(5) | 0.033(0) |
| 97 | (69, 24, 4) | 22.822032(2) | 3.068(7) | 1.884(9) | 0.809(5) | - | 0.046(1) | 0.067(8) | 0.029(9) |
| 98 | (69, 25, 4) | 22.986199(1) | 3.086(4) | 1.905(5) | 0.808(1) | - | 0.035(7) | 0.075(0) | 0.028(0) |
| 99 | (70, 25, 4) | 23.149758(0) | 3.094(5) | 1.905(6) | 0.807(1) | - | 0.043(0) | 0.072(2) | 0.027(9) |
| 100 | (70, 26, 4) | 23.312759(3) | 3.111(7) | 1.925(9) | 0.805(5) | - | 0.041(7) | 0.074(0) | 0.022(6) |
| 101 | (70, 27, 4) | 23.475164(4) | 3.129(1) | 1.945(0) | 0.802(8) | - | 0.030(1) | 0.073(1) | 0.005(8) |
| 102 | (72, 26, 4) | 23.637044(1) | 3.128(0) | 1.924(8) | 0.805(2) | - | 0.043(3) | 0.071(0) | 0.018(9) |
| 103 | (72, 27, 4) | 23.798274(3) | 3.145(1) | 1.944(3) | 0.801(7) | - | 0.037(7) | 0.071(2) | 0.008(2) |
| 104 | (72, 28, 4) | 23.959361(3) | 3.161(7) | 1.964(1) | 0.802(1) | - | 0.034(5) | 0.078(1) | 0.001(9) |
| 105 | (73, 28, 4) | 24.120222(9) | 3.169(6) | 1.964(1) | 0.802(0) | - | 0.036(3) | 0.076(8) | 0.010(2) |
| 106 | (74, 28, 4) | 24.280223(2) | 3.177(3) | 1.964(2) | 0.802(3) | - | 0.038(7) | 0.077(2) | 0.009(2) |
| 107 | (75, 28, 4) | 24.439665(7) | 3.185(0) | 1.964(0) | 0.801(0) | - | 0.040(4) | 0.074(4) | 0.006(7) |
| 108 | (76, 28, 4) | 24.598713(7) | 3.192(7) | 1.964(0) | 0.800(7) | - | 0.041(0) | 0.072(3) | 0.005(3) |
| 109 | (77, 28, 4) | 24.757151(3) | 3.200(5) | 1.963(8) | 0.800(6) | - | 0.040(6) | 0.070(5) | 0.003(4) |
| 110 | (77, 28, 5) | 24.915153(9) | 3.216(3) | 2.006(3) | 0.896(1) | - | 0.043(5) | 0.076(3) | 0.041(5) |
| 111 | (77, 29, 5) | 25.072584(2) | 3.232(2) | 2.024(9) | 0.896(9) | - | 0.040(9) | 0.081(7) | 0.030(3) |
| 112 | (76, 30, 6) | 25.229492(1) | 3.255(4) | 2.085(7) | 0.967(0) | - | 0.035(8) | 0.095(0) | 0.041(7) |
| 113 | (77, 30, 6) | 25.385842(0) | 3.263(7) | 2.083(1) | 0.964(0) | - | 0.036(8) | 0.073(2) | 0.016(9) |
| 114 | (78, 30, 6) | 25.541848(2) | 3.271(1) | 2.082(9) | 0.964(0) | - | 0.036(6) | 0.074(5) | 0.009(6) |
| 115 | (77, 32, 6) | 25.697308(2) | 3.294(9) | 2.116(2) | 0.963(0) | - | 0.026(6) | 0.077(4) | 0.004(4) |
| 116 | (78, 32, 6) | 25.852252(8) | 3.302(2) | 2.115(9) | 0.963(3) | - | 0.021(8) | 0.076(0) | 0.004(5) |
| 117 | (79, 32, 6) | 26.007089(4) | 3.309(4) | 2.115(8) | 0.962(2) | - | 0.032(4) | 0.075(3) | 0.005(0) |
| 118 | (80, 32, 6) | 26.161426(8) | 3.316(7) | 2.115(5) | 0.961(3) | - | 0.028(6) | 0.068(5) | 0.007(1) |
| 119 | (81, 32, 6) | 26.315442(5) | 3.323(7) | 2.115(6) | 0.962(4) | - | 0.036(8) | 0.069(8) | 0.003(1) |
| 120 | (82, 32, 6) | 26.468996(0) | 3.330(8) | 2.115(7) | 0.962(0) | - | 0.037(4) | 0.070(2) | 0.004(0) |

TABLE III: Continuation of Table II

| $N$ | Config. | $E/N$ | $r_1$ | $r_2$ | $r_3$ | $r_4$ | $\sigma_1$ | $\sigma_2$ | $\sigma_3$ |
|---|---|---|---|---|---|---|---|---|---|
| 121 | (83, 32, 6) | 26.622118(4) | 3.337(9) | 2.115(4) | 0.961(4) | - | 0.038(1) | 0.067(6) | 0.002(8) |
| 122 | (84, 32, 6) | 26.774879(2) | 3.344(9) | 2.115(5) | 0.962(0) | - | 0.039(8) | 0.068(5) | 0.003(7) |
| 123 | (83, 34, 6) | 26.927194(9) | 3.367(2) | 2.149(3) | 0.962(5) | - | 0.036(7) | 0.085(6) | 0.004(3) |
| 124 | (84, 34, 6) | 27.079019(5) | 3.374(1) | 2.149(1) | 0.962(7) | - | 0.034(4) | 0.086(7) | 0.009(6) |
| 125 | (84, 34, 7) | 27.230457(6) | 3.388(4) | 2.185(0) | 1.034(0) | - | 0.035(9) | 0.085(2) | 0.062(7) |
| 126 | (84, 35, 7) | 27.381438(1) | 3.402(7) | 2.200(9) | 1.034(1) | - | 0.036(9) | 0.089(2) | 0.067(6) |
| 127 | (85, 35, 7) | 27.532034(0) | 3.409(4) | 2.201(4) | 1.034(0) | - | 0.040(1) | 0.091(0) | 0.042(8) |
| 128 | (85, 35, 8) | 27.682123(2) | 3.423(5) | 2.235(8) | 1.092(2) | - | 0.040(7) | 0.083(2) | 0.036(8) |
| 129 | (85, 36, 8) | 27.831888(6) | 3.437(9) | 2.250(2) | 1.091(9) | - | 0.032(8) | 0.081(5) | 0.034(1) |
| 130 | (86, 36, 8) | 27.981234(3) | 3.444(5) | 2.250(1) | 1.091(7) | - | 0.035(2) | 0.083(2) | 0.048(8) |
| 131 | (87, 36, 8) | 28.130244(0) | 3.451(3) | 2.249(8) | 1.090(9) | - | 0.034(2) | 0.078(5) | 0.030(5) |
| 132 | (87, 37, 8) | 28.278862(5) | 3.465(1) | 2.264(9) | 1.090(5) | - | 0.034(4) | 0.081(8) | 0.014(0) |
| 133 | (88, 37, 8) | 28.427061(5) | 3.471(8) | 2.264(2) | 1.091(2) | - | 0.035(5) | 0.085(7) | 0.013(4) |
| 134 | (88, 37, 9) | 28.574953(4) | 3.485(5) | 2.297(0) | 1.144(0) | - | 0.031(2) | 0.071(5) | 0.054(1) |
| 135 | (88, 38, 9) | 28.722421(1) | 3.499(2) | 2.311(0) | 1.143(6) | - | 0.030(2) | 0.073(9) | 0.048(8) |
| 136 | (89, 38, 9) | 28.869526(8) | 3.505(4) | 2.311(2) | 1.144(0) | - | 0.031(5) | 0.078(7) | 0.043(7) |
| 137 | (90, 38, 9) | 29.016328(0) | 3.511(9) | 2.311(0) | 1.144(0) | - | 0.033(4) | 0.078(9) | 0.040(2) |
| 138 | (90, 39, 9) | 29.162701(3) | 3.525(4) | 2.325(1) | 1.143(3) | - | 0.029(9) | 0.080(5) | 0.037(0) |
| 139 | (91, 39, 9) | 29.308773(6) | 3.531(6) | 2.325(1) | 1.143(0) | - | 0.034(2) | 0.085(7) | 0.034(9) |
| 140 | (91, 40, 9) | 29.454518(1) | 3.544(9) | 2.339(1) | 1.142(9) | - | 0.029(5) | 0.084(2) | 0.042(4) |
| 141 | (92, 40, 9) | 29.599899(6) | 3.551(4) | 2.338(7) | 1.141(7) | - | 0.033(5) | 0.075(1) | 0.038(4) |
| 142 | (92, 40, 10) | 29.744962(8) | 3.564(4) | 2.368(9) | 1.193(0) | - | 0.034(1) | 0.070(0) | 0.045(4) |
| 143 | (93, 40, 10) | 29.889733(5) | 3.570(7) | 2.368(9) | 1.193(2) | - | 0.031(4) | 0.071(4) | 0.032(2) |
| 144 | (94, 40, 10) | 30.034090(4) | 3.576(9) | 2.368(8) | 1.193(1) | - | 0.033(1) | 0.070(7) | 0.055(2) |
| 145 | (94, 41, 10) | 30.178106(2) | 3.589(8) | 2.382(5) | 1.192(0) | - | 0.035(8) | 0.071(2) | 0.034(8) |
| 147 | (95, 42, 10) | 30.465219(1) | 3.608(7) | 2.395(7) | 1.192(3) | - | 0.029(9) | 0.079(4) | 0.039(4) |
| 148 | (96, 42, 10) | 30.608238(9) | 3.614(8) | 2.395(5) | 1.192(3) | - | 0.030(6) | 0.078(8) | 0.036(7) |
| 149 | (96, 43, 10) | 30.750998(2) | 3.627(3) | 2.409(0) | 1.192(6) | - | 0.032(3) | 0.085(3) | 0.037(6) |
| 150 | (96, 42, 12) | 30.893383(1) | 3.639(5) | 2.454(1) | 1.281(6) | - | 0.034(8) | 0.079(5) | 0.010(3) |
| 151 | (96, 43, 12) | 31.035390(0) | 3.652(4) | 2.465(9) | 1.281(4) | - | 0.027(1) | 0.068(5) | 0.014(6) |
| 152 | (96, 44, 12) | 31.177075(2) | 3.664(9) | 2.478(3) | 1.281(1) | - | 0.031(1) | 0.067(4) | 0.016(5) |
| 153 | (97, 44, 12) | 31.318527(6) | 3.670(8) | 2.478(1) | 1.281(1) | - | 0.028(2) | 0.067(3) | 0.012(9) |
| 154 | (98, 44, 12) | 31.459632(1) | 3.676(9) | 2.477(7) | 1.281(0) | - | 0.026(3) | 0.062(5) | 0.014(4) |
| 155 | (98, 44, 12, 1) | 31.600488(0) | 3.688(7) | 2.504(2) | 1.384(6) | 0.002(2) | 0.030(1) | 0.079(9) | 0.009(0) |
| 156 | (98, 45, 12, 1) | 31.741100(1) | 3.700(6) | 2.516(9) | 1.383(8) | 0.012(7) | 0.033(3) | 0.087(1) | 0.006(2) |
| 157 | (100, 44, 12, 1) | 31.881320(7) | 3.700(4) | 2.503(8) | 1.383(9) | 0.004(3) | 0.034(0) | 0.076(2) | 0.006(5) |
| 158 | (100, 45, 12, 1) | 32.021293(6) | 3.712(2) | 2.516(6) | 1.383(4) | 0.004(3) | 0.032(7) | 0.085(2) | 0.006(3) |
| 159 | (101, 45, 12, 1) | 32.161014(1) | 3.718(0) | 2.516(4) | 1.383(7) | 0.005(3) | 0.031(0) | 0.088(1) | 0.005(9) |
| 160 | (102, 45, 12, 1) | 32.300404(8) | 3.723(8) | 2.516(1) | 1.383(3) | 0.007(3) | 0.034(1) | 0.082(2) | 0.005(2) |