J. Chem. Inf. Comput. Sci. **1995**, *35*, 579–580



# Particle Mass Ratios and Similar Volumetric Ratios in Geometry

Carl R. Littmann

56 Crestwood Drive, St. Louis Missouri 63105

Received January 18, 1995[⊗]

Whether by coincidence or not, certain particle mass ratios are nearly equal to certain geometric volume ratios in patterns, and aspects of these patterns are somewhat analogous to "close packing" of spheres. This article correlates some of these particle mass ratios with volumetric ratios in patterns.

## DESCRIPTION

In some simple geometric patterns, such as when three large touching spheres surround one or three small touching spheres, certain volumetric ratios arise.

When comparing the masses of certain important particles (pions, kaons, and protons, with electrons) certain mass ratios also arise.

In some cases (shown in Table 1), the geometric ratios and average mass ratios are nearly equal.

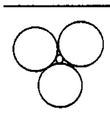
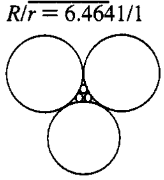
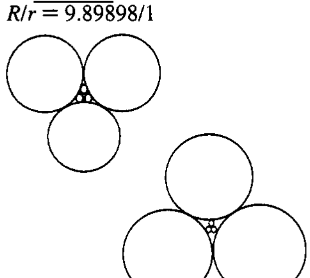
In all the following cases discussed, the centers of *all spheres are coplanar.*

The first two patterns, case A and case B, involve three large spheres in a triangular pattern surrounding one and three small spheres, respectively. The volumetric ratios (large sphere to small sphere) are compared to the mass ratios of "semistable" mesons to electrons. Case A compares pions to electrons, and case B compares kaons to electrons.

In the last pair of patterns to be considered, case B and C, there are six equal small spheres, three intermediate size spheres (as in case B), and three large spheres (case C). The packing in case C is less efficient than case B, as each large sphere is touching only one small sphere instead of two. The average volumetric ratio is three large spheres and three intermediate size spheres to six small spheres. This volumetric ratio is compared to a mass ratio, as determined from the average mass of a proton, antiproton, neutron, and antineutron to the mass of an electron. If the neutron (antineutron) were ignored, the ratio comparison would be in better agreement. (The proton is a stable particle, but the mean life of a neutron outside a nucleus is about 12 min.)

From data in some books,[1-3] or perhaps more recent sources, one may calculate or "check out" the approximate ratios found in Table 1. ($R$ and $r$ denote the radii of large and small spheres, respectively; the volumetric ratio (large sphere to small sphere) varies as the cube of the ratio of their radii, $(R/r)^3$.)

**Table 1.** Geometric Patterns, Volume Ratios, and Mass Ratios

| geometric pattern (ctrs of all spheres coplanar) | (see pattern) volumetric ratio | ("important" particles) ratio of masses | "av" ratio of masses |
|---|---|---|---|
|  case "A" $R/r = 6.4641/1$ | 1 lg sphere to 1 sm sphere (ctred in pattern) 270.10/1 | pion$^+$ or pion$^-$ to electron 273.13/1<br>pion$^0$ to electron 264.14/1 | 270.13/1 |
|  case "B" $R/r = 9.89898/1$ | 3 lg spheres to 3 sm spheres (all 3 smaller spheres also same size) 970.00/1 | KAON$^0_s$ or KAON$^0_L$ to electron 973.92/1<br>KAON$^+$ or KAON$^-$ to electron 966.04/1 | 969.98/1 |
|  case "B" and case "C" $R_1/r = 9.89898/1$, $R_2/r = 13.9282/1$ | 6 equal small spheres with radius $r$, 3 intermediate spheres with radius $R_1$ as in case B, and 3 large spheres with radius $R_2$ (case C) $(3R_1^3 + 3R_2^3)/6r^3 = 1836.00/1$ | neutron or antineutron to electron 1838.68/1<br>proton or antiproton to electron 1836.15/1 | 1837.42/1 |

0095-2338/95/1635-0579$09.00/0 

## REFERENCES AND NOTES

(1) Dalitz, R. H.; Goebel, C. In *McGraw-Hill Encyclopedia of Science & Technology*, 7th ed.; McGraw-Hill, Inc.: New York and other cities, 1992; Vol. 10, "Meson", p 662.

(2) *Handbook of Chemistry and Physics*, 73rd ed.; CRC Press: Boca Raton, FL, 1992; Section 1−2, Table 2, "The 1986 Recommended Values of the Fundamental Physical Constants".

(3) Semat, H. *Introduction to Atomic and Nuclear Physics*, 4th ed.; Holt, Rinehart & Winston: New York, 1962; Chapter 15, p 526.


CI950007D

⊗ Abstract published in *Advance ACS Abstracts*, April 15, 1995.