Why the Various Particles Have the Masses They Do

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Abstract

In physics and in Nature, there exits prominent and important particles, such as the Proton, electron, and less stable Pions, Kaons, Muons, and about a dozen others. And even more minor particles with very short lives. This Article mainly addresses the 3 largest mass particles, the Higgs, the W, and the Z boson particles. And I think it largely explains "why they have the particular masses they do." My previous articles did that for the case of lower-mass prominent particles. Links provided below. I do this by our first noting the Mass Ratios of particles, i.e., their masses compared to basic electron, such as the "Proton to electron mass ratio, 1836.15 to 1." And then by noting nearly matching Geometric volume Ratios arising when one or more large spheres are close-packed around, or surround, one or more small spheres – in the most simple, symmetrical pattern arrays. I.e., as sometimes seen in high-school geometry. And I comment on other matters relating to this article.

Introduction, and examples of nearly Matching Ratios

Historically, at least 3 Nobel Laureates bemoaned, 'Not knowing why particles have the mass they do?' We will largely solve that on the pages that follow:

And, as said, this article nicely addresses very large mass particles. But in a sense my previous articles, that address lower-mass particles, are more impressive [1]. That is because, using still greater simplicity, their geometric ratios nearly match so many more particle mass ratios. Here are some links to those earlier articles:

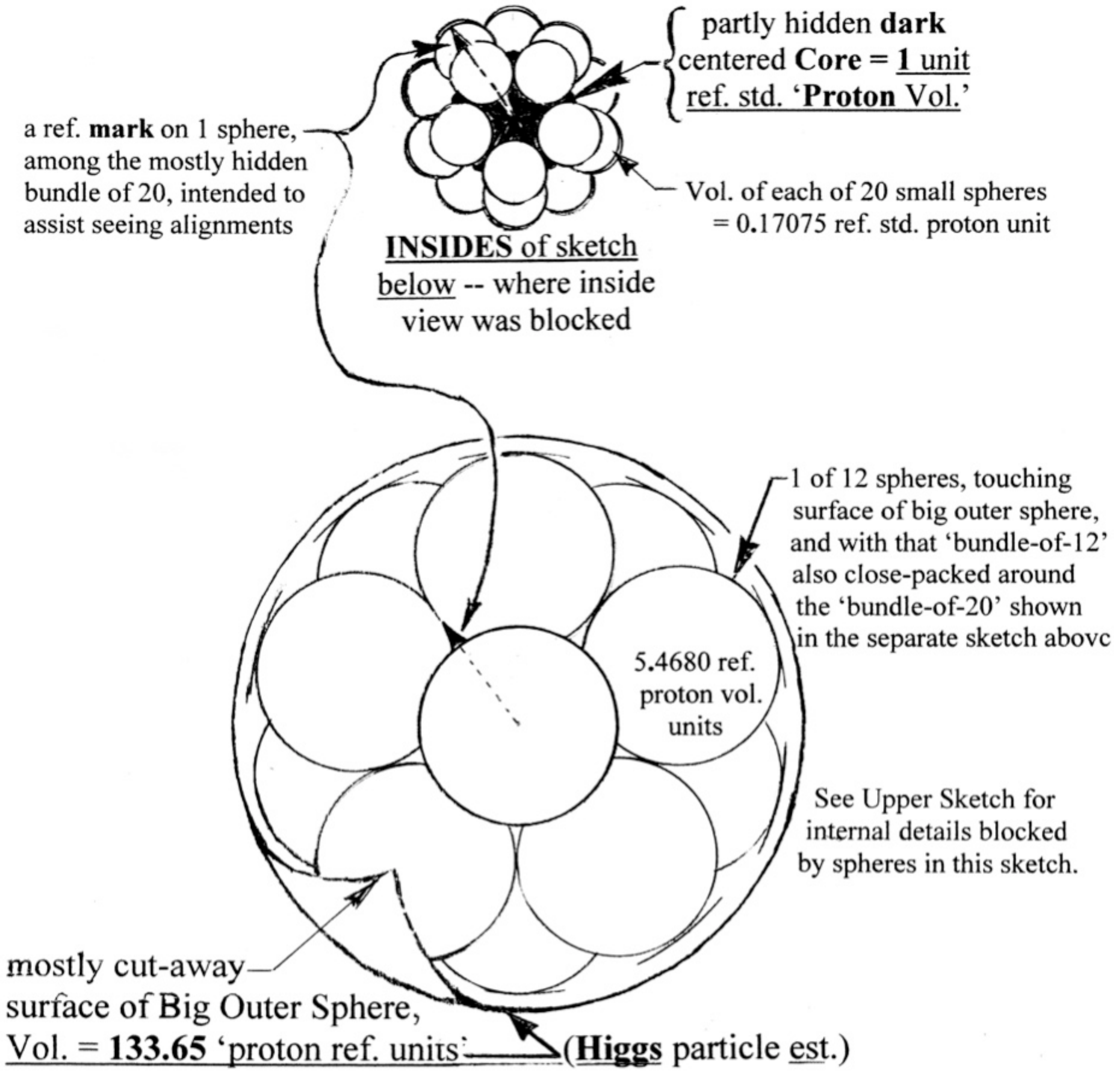
http://viXra.org/abs/1901.0299
http://viXra.org/abs/2106.0052
http://www.causeeffect.org/articles/book.html
http://www.causeeffect.org/video/RatioTalk11-11-16.mp4 (for this link, allow 30 sec. to load)

Some sketches, below, may exaggerate some main features so they show up better. In some sketches, we use cross-sectional views or indicate partially 'cut-away' regions to hopefully clarify the view.

The first sketch below, as you scroll down, addresses the Higgs Boson particle. It was even shown and discussed in my previous articles (see links above). But it is repeated here, again, because it is 1 of the 3 largest mass particles in physics -- all 3 of which are considered so important to the present 'Standard Model of Particle Physics'.

The 'CERN' European-located group used the super-sized Large Hadron Collider, (LHC) to discover the Higgs Boson. And with the LHC, about 5 years later, in July 2017 discovered the 'Xi double-charm baryon', Ξ_{cc}^{++} . That, I think, is another important particle, although less massive. Thus, near the end of this article, I address it and a few other particles.

Now please, **SCROLL DOWN** to view the sketches, displays, and relationships – key to this article:



Note: Interchanging the '20-spheres' (Dodecahedron) position and the '12-spheres' (Icosahedron) position would **not** change the Vol. of the outer sphere.

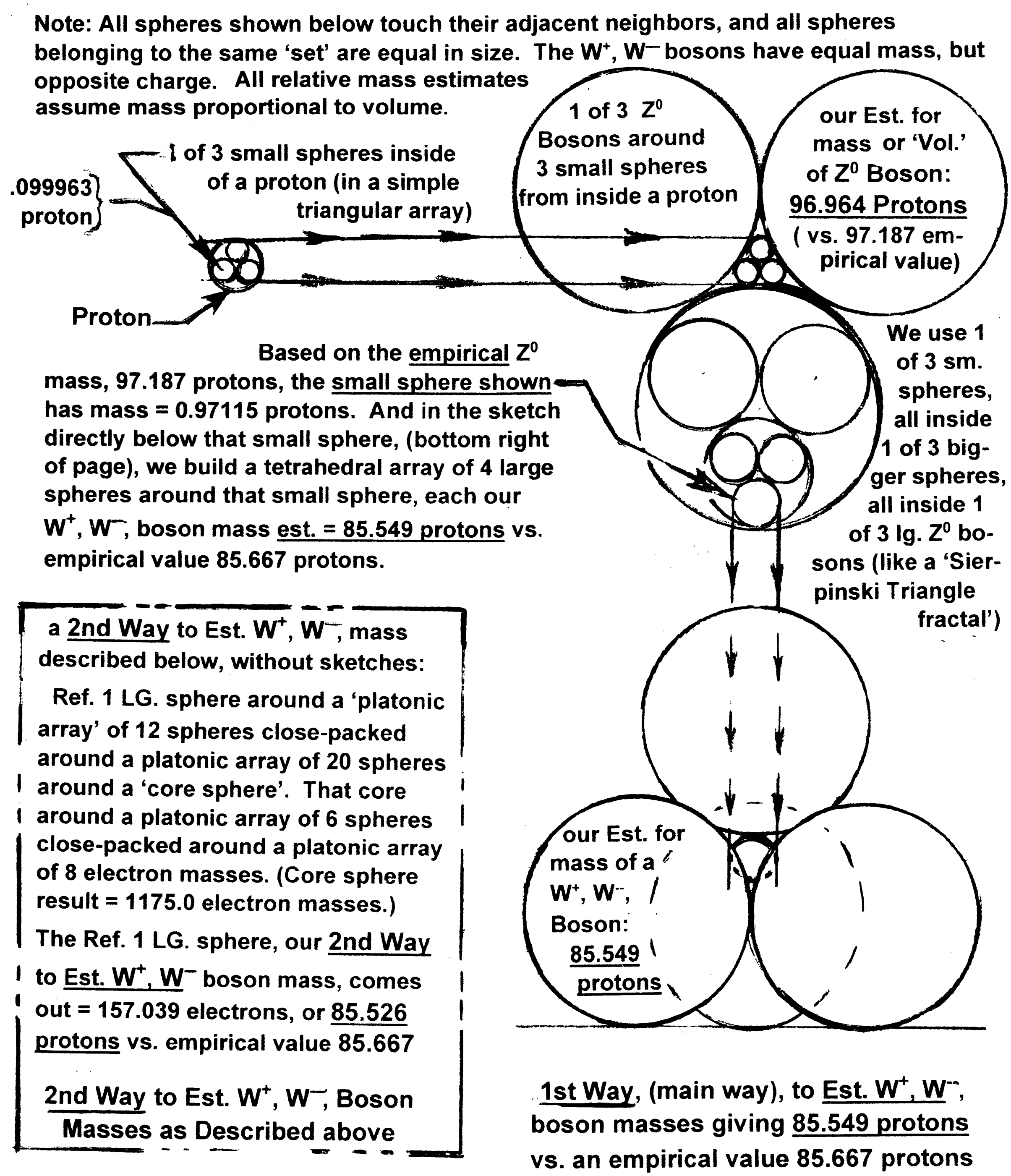
The Higgs Boson with dwg's estimated Mass of 133.65 Protons

. The above sphere patterns, using sphere packing based on 'platonic' arrayed symmetries, give a Volume **Ratio: 133.65/ 1.** I.e., Outer Sphere in lower sketch to dark core sphere in upper sketch).

. That is remarkably near estimates by two independent groups of particle detection experts ranging from **132.90** to **133.72** protons.[2]

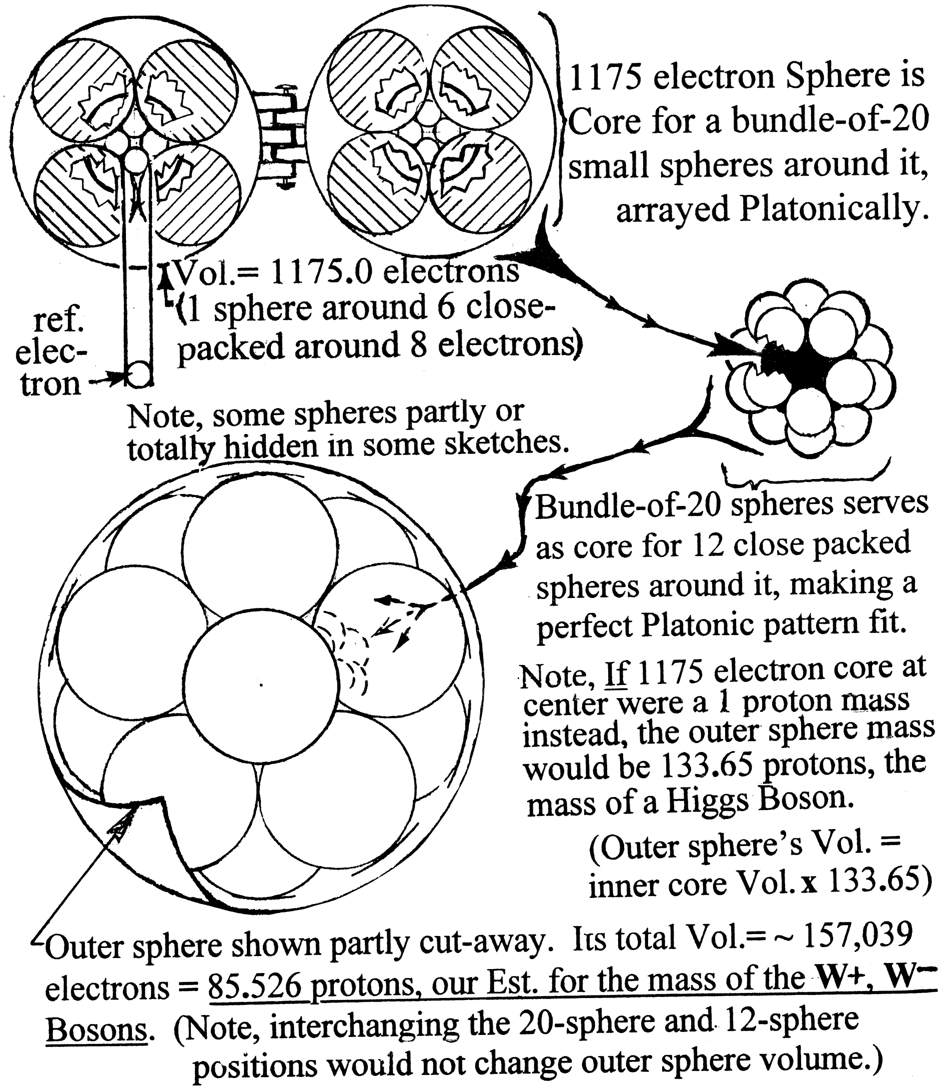
. It is difficult and rare for 'Nature' to create very large particles that last beyond the shortest half-lives, and it is also difficult to measure them. But perhaps we can say, in a sense, **"**The final target of Euclid's 8 books, and the pattern that Plato thought *God* used to make the heavens – also helped us here to nearly match the so-called *God* particle's mass, the Higgs mass, a major target of the current mainstream's Standard Model of Particle Physics!"

Below, we again use 'close-packed spheres' to nearly match masses of other very large mass particles:



Dwg.: Ways to Construct and Est. Masses of Z^0 & W^+, W^{--}, Bosons

Using upper sketches and a proton's substructure, we Est. **the Z^0 boson mass = 96.964 protons**, vs. 97.187 empirical value. At lower right sketch and just above it, we use an empirical Z^0 boson's substructure to Est. the mass of **W^+, W^{--}, bosons = 85.549 protons**, vs. empirical 85.667 value. At lower left, we describe, without sketches, a 2nd Way to Est. W^+, W^{--}, boson masses, giving 85.526 protons, (and on the next page, we show that with a sketch!)



Dwg.: Another Way to Construct & Est. Masses of W^+, W^-, Bosons

Using the platonic arrayed sphere symmetries above, our est. for the W boson's mass is **85.526 protons** vs. empirical 85.667 value. We start with cross-sectional sketch at upper-left, by drawing 6 spheres close-packed around 8 election spheres, and 1 medium-size 'Core' sphere around the 6 spheres. The resulting Core sphere Vol.=1175.0 electrons.

We next draw 20 spheres around that 'dark' Core (sketch at right); and then draw 12 spheres close-packed around the 20 (sketch at lower left). We lastly draw 1 large sphere around the 12, giving for our W^+, W^{--}, boson mass Est. 85.526 protons (or 157,039 electrons).

(Note, the W^+, W^{--}, bosons have opposite charge, but are equal in mass.)

Based on experience, generally, the more different drawings, using sphere patterns, that yet result in the same (or nearly the same) sphere volume ratios – the greater the chance of detecting actual particles with mass ratios nearly matching those geometric ratios. And the greater the particle's prominence and half-life.

Some Other Miscellaneous Particles, including the 'Xi double-charm baryon', Ξ_{cc}^{++} .

In my previous articles, links given above, we have often noted that many particle masses are almost exactly equal the mass of the average mass of two different particles or super-symmetrical sphere vol. ratios. That is also the case for some examples given below, and we show that without drawings, to save space:

The empirical mass of the Neutral D Meson, D^0, is 3649.37 electrons. That is almost exactly the average of the mass of the Xi double charm baryon, Ξcc^{++}, 7,086.1 electrons and a 212.85 electron mass or relative vol., that '212.85' resulting when one medium-size sphere surrounds a platonic array of 8 smaller spheres close-packed around an array of 6 electron spheres. The average of those 2 masses, (7,086.1 and 212.85 electrons), is our Est. for the D^0, 3649.48 electrons. (Until the Ξcc^{++} was discovered, I could not achieve near that good of match.)

The 'roughly known' empirical mass of the Charm Omega baryon', ($\Omega^0{}_c$), is about 5278.86 electrons**.** That is very near the average mass of the Xi double charm baryon, Ξcc++, 7086.1 electrons and the Tauon, (τ), 3477.19 electrons. The average of those 2 masses, (7086.1 and 3477.19 electrons), is our Est. for the $\Omega^0{}_c$, 5281.6 electrons**.** (Until the mass of the Ξcc^{++} was determined, I could not fully appreciate that near match.)

The empirical mass of the Charm-Lambda Baryon ($\Lambda^+{}_c$) is 4474.5 electrons. That is somewhat close to the average mass of the Xi double charm baryon, Ξcc^{++}, 7086.1 electrons and the Eta Prime meson, η′, 1874.1 electrons. The average of those 2 masses, (7086.1 and 1874.1 electrons), is our Est. for ($\Lambda^+{}_c$), 4480.1 electrons. This est. is meaningful -- near enough to have an effect, but is about 5.6 electrons too high. Thus, we ask if some other appealing 2-particle or construction-averaging would counter-balance it by being about 5.6 electrons too low. And, indeed, such counter-balancing ave. is given on pg.11 of the 3rd 'http' link, above, but details skipped here to save space.

The empirical mass of the Xi double charm baryon, Ξcc^{++}, is 7086.1 electrons, and we used it, with a 'co-partner', to helpfully estimate the masses of 3 other particles, above. And one very good, simple way to est. the (Ξcc^{++}) mass, itself, is to consider the construct of "one large sphere around 12 smaller platonically arrayed spheres, and those 12 around a medium-sized Core sphere. And that Core sphere, equal to the 'familiar' 212.85 electron mass – that 212.85 sphere having (internally) 8 spheres close-packed around 6 electrons, platonically arrayed." That results in a very good mass Est. for Ξcc^{++}, 7086.6 electrons.

The 'roughly known' empirical mass of the Bottom Omega baryon', ($\Omega^-{}_b$), is 11,848.14 electrons. That is very near the ave. of 2 particle masses or structures, the mass of the Tauon, (τ), 3477.19 electrons, and the mass (or relative vol.) existing when one big outer sphere surrounds 4 protons, each equaling 1836.15 electrons, and tetrahedrally arrayed. That resulting big outer sphere mass = 20,217.8 electrons. So, the ave. of those masses, (3477.19 and 20,217.8 electrons), is our Est. for ($\Omega^-{}_b$), 11,847.5 electrons, a great est.

There are too many other important big-mass particles to cover here, but they are addressed in my 3rd 'http' link above, including the various B mesons. But one of those meson masses, the Charm B meson, (B_c^+) is 12,283.8 electrons. That is near the ave. of 2 structures, the 1st being the previous big sphere around 4 protons, 20,217.8 electrons. And the 2nd resulting when a big sphere surrounds 8 platonically arrayed spheres, and each of those 8 spheres has (internally) the 'previously discussed' 212.85 electrons (that 212.85 arising for each sphere having 8 internal small spheres close-packed around 6 electrons). That 2nd big resulting sphere thus equals 4340.4 electrons. The ave. of the 1st and 2nd big spheres, (20,217.8 and 4340.4 electrons), is our Est. for (B_c^+), 12,279.1 electrons.

Optional -- Other Misc. Comments – speculative, perhaps for more 'specialized' readers

The links to my other articles (as provided earlier, above) contain other discussions and relevant information that should likely address most of the questions that readers of my present article may still have. But there may still be at least one important question, which I will now mention and try to address here, as follows:

In the above, I've often said that 'this or that' particle or boson is 'this or that' times more massive than a more basic 'key' particle, like the stable proton. But why does that key basic particle, (say the prominent Proton) – have its own particular mass, 'to start with?'

I will try to be as brief as possible, giving more of an 'outline' than total justification, and omitting many details available in specialized textbooks, etc. All basic 'small' particles, like the proton, electron, and even so-called 'photons', have vastly different energies and masses. But have either the same 'spin angular momentum', for example, '1/2', or a simple multiplier of that 1/2, (like 2 x ½ = 1 unit). That unit is called 'the reduced Planck constant', or 'the Planck Bar constant', or the like. And more importantly the descriptive units or 'dimensions' of that Planck entity Can Be Expressed as 'Spin Angular Momentum'!

Even long before Max Planck's great work and his Planck Constant, many Scientists and Physicists considered even seemingly empty space to be pretty full of various Vortices, spinning 'this way and that', with 'Spin Angular Momentums', regardless of whether they were called 'aether', 'fields', 'spinners' or whatever. So, importantly, here, we will assume that all, or nearly all, of space (even rather small regions) -- have 'spinning' entities in them. And that there is an AVERAGE amount of 'spin angular momentum' over a short time period, around any randomly chosen small point in space. And if that region, or a nearby region, of space is occupied by a major particle 'candidate' globular amorphous mass, like a potential Proton, then the small region of space will try to impose upon that globular potential particle -- that average 'quantum' amount of spin angular momentum.

Now, suppose, as inferred from "Niels Bohr's 'Liquid Drop Model of the Nucleus' – that there is a super-high maximum density that mass material, in this universe, can have, like liquid water, i.e., beyond which – no more increase in pressure can squeeze or reduce significantly such masses' volume. (Democritus also had a rather similar concept and model.) Then, assume that 'space' is 'pressurized' to some high, rather constant 'average' pressure, as seems expected because of the 'spinning entities' in space. Then that pressure, together with that (Bohr's) glob of rather uniform high-density matter -- will result in a particular (characteristic) maximum wave velocity through that globular mass. I.e., sort of like the velocity that a compressive sound wave has through water -- when the water is in a shallow tank, under atmospheric pressure.

Now, suppose that a small sphere, within that high-density glob, begins to spin, such that its material obtains that highest maximum (characteristic) spinning speed that it can have, (like the 'speed of light'). And suppose that its spin angular momentum or 'spin' is also limited by that 'Planck constant' related average amount of spin that such small entity can have -- as outlined previously, above.

Then those 'side conditions' would determine a maximum amount of mass that a special particle candidate would have, as it is forming from that spinning glob of mass. And, therefore, a special advantage for that 'quantum' mass particle, with regard to stability, compared with other particle candidates. And likely 'reinforced' somewhat, by feedback, as likely other nearby regions of space tend to emulate or 'get in step' with that 'quantum' amount of angular momentum and energy. And thus, perhaps, the major factor determining a 'favored'(supported) particular mass value for the 'proton candidate'.

References

[1] As of this paper's date, its author, Carl Littmann, still has his website showing examples, and more: See www.causeeffect.org, Home page, and article under it, "Booklet of large & small Spheres in Patterns, and large & small Mass Particles".
[2] Wikipedia, the free online encyclopedia, topic "*Higgs Boson*", as noted 3-22-2022 under sub-topic, History, '3.2, Experimental search', in the last sentence in the 2nd paragraph under subheading, 'Findings since 2013'.
[3] Added to paper, Jan. 2023, by description, without Dwgs., of some "Ω, Λ, B, D, , Ξ" particles.