The Higgs Boson May be Made of Higher Dimensional Matter

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March 9, 2025

The Higgs boson is not only the heaviest particle created by man so far, it may also be the highest dimension particle created by man so far. If calculations are correct, it may be of dimension 20/21, that is, it may be composed of 20-dimensional matter (quarks) circulating in the surface of a 21-sphere. Recent Higgs boson mass measurements of high accuracy, and a mass factoring technique based on n-sphere surface volumes, which was derived from Planck's Energy-Frequency Relation, E=hf, were used to reach that conclusion. A power of two factoring, which is a possible indication of stability, was found within 3 MeV of the ATLAS group's recent 125,220 MeV improved accuracy estimate of the Higgs's mass. The S21h power of two factoring found, (2^{16} - 2^{10}) S21h, translates to a mass of 125,217.08 MeV, which is very close to the ATLAS group's result. Is the Higgs boson made of 20/21 dimensional matter?

Key to the Investigation of Hadron Masses

The key to the investigation of hadron masses with n-sphere surface volumes is the formula (**m=xSnh**), where **m** is the mass of the hadron in units of MeV/c^2, **x** is a number, **Sn** is the value of the surface volume formula of a unit radius n-sphere, and **h** is Planck's constant's coefficient, but with different units. Used here, in the factoring formula m=xSnh, it has units of MeV/c^2, not J-s. (The factoring formula, **m=xSnh**, can be derived from Planck's Energy-Frequency Relation, **E=hf**, and how **h** gets its units changed to MeV/c^2, and its factor of 10^{-34} removed is explained in the derivation of **m=xSnh** on page 5.) When divided into experimental hadron masses (given in units of MeV/c^2) the result will be an integer, or an integer and a fraction, if the hadron's matter is of the same dimension as the factoring unit's dimension. It has been tested on hundreds of experimental hadron masses and has been found to factor many of them convincingly. See page 6 for examples.

Dimensional Analysis of the WxW = H Reaction

One way physicists believe the Higgs boson is created is by a reaction between two W bosons. The reaction can be written as WxW=H. To find the dimension of the product matter (the Higgs boson) in this reaction, the dimensions of the matter in the reactant hadrons (W bosons) must be known. To find the dimension of the matter in a W boson, a convincing factoring of it must be found. The masses of the two W boson candidates most likely to be the W boson, according to experimentalists, are shown below, and both factor convincingly with **S11h**.

Hadron Names	W Boson ExpMass	Diff TM-EM	W Boson ThrMass	HSSV Factoring
W boson candidate #1	**80354**	1.47	**8**0355.47 =	**4096**/7 **S11h**
W boson candidate #2	**80433.5**	0.44	80433.94 =	**4100**/7 **S11h**

The factorings of the W boson candidates with S11 (and **h**) means that the W boson is likely composed of 10 dimensional matter circulating in the surface of an 11-sphere. That's what the factorings tell us. According to conclusions drawn from factoring hundreds of hadrons with n-sphere surface volumes (times **h**), it appears that when two hadrons collide and form a different hadron, *higher dimensional matter is created*. That is, the matter (quarks) in the *product hadron* is of a higher dimension then the matter (quarks) in the *reactant hadrons*, and the amazing thing is, the dimension of the *product hadron's matter* can be calculated if the dimensions of the *reactant hadrons* are known. Just multiply together all the surface volume formulae associated with each of the reactant hadrons (quarks) in the reaction. Examine the resulting formula. Do the powers of 'π' and 'r' in the resulting formula match the powers of 'π' and 'r' in a valid surface volume formula? If so, the resultant hadron is composed of matter (quarks) of the dimension of the matching surface volume formula. To find out what dimension a Higgs boson might be, multiply **S11** by **S11**.

$(\mathbf{S11})(\mathbf{S11}) = (64/945\ \pi^{5} r^{10})\ (64/945\ \pi^{5} r^{10})$

$(\mathbf{S11})(\mathbf{S11}) = 4096/893025\ \pi^{10} r^{20}$

The resulting formula above has the same powers of of 'π' and 'r' as the formula for the surface volume of a 21-sphere, shown below.

$\mathbf{S21} = 2048/654729075\ \pi^{10} r^{20}$

The conclusion to be drawn from this is that the Higgs boson - since it can be created by the collision of two W bosons - likely has a dimension of 20/21, that is, it is likely composed of 20-dimensional matter, circulating in the surface of a 21-sphere.

To confirm that the matter in the Higgs boson is of this dimension, (20/21), divide the Higgs's experimental masses by **S21h** and see if any convincing factorings can be found (such as an integer result, or even better - a power of two result, or a sum of powers of two result.). After checking all available Higgs boson mass measurements, one was found roughly in the middle of the range of measurements, with a highly significant, that is, a convincing factoring. It is **$(2^{16} - 2^{10})$ S21h**, which was found when the experimental mass (a recent estimate of improved accuracy made by the ATLAS group) 125,220 MeV, was divided by **S21h**. See the table below. Masses are in units of MeV/c^2.

Higgs ExpMass	ExpErr	Higgs ThrMass	HSSV Factoring	
125,220	110	125,217.08 =	**$(2^{16} - 2^{10})$ S21h**	**Note:** 64,512 = $(2^{16} - 2^{10})$ S21h

Comments on the $(2^{16} - 2^{10})$S21h Factoring and the Factoring Table

Why was this factoring, $(2^{16} - 2^{10})$S21h, and not (2^{16})S21h, which translates to a mass of 127,204.65 MeV, found for the Higgs boson's mass? Is the mass with the factoring of $(2^{16} - 2^{10})$S21h more stable, or formed more readily, than the mass with the factoring (2^{16})S21h? Which factorings of S21h are most stable and why? Is what we currently known about physics enough to find answers to questions about higher dimensional matter, and specifically, about the structure and dynamics of hadrons?

On the next page is a table of some Higgs boson mass measurements between plus and minus 1000 MeV approximately of **$(2^{16} - 2^{10})$ S21h** matched to their factorings. Notice the factorings are all the result of additions or subtractions of multiples of smaller powers of two to **$(2^{16} - 2^{10})$ S21h**. Most are additions or subtractions of multiples of 64 S21h to **$(2^{16} - 2^{10})$ S21h.**

Just in case **$(2^{16} - 2^{10})$ S21h** was found by the experimentalists by chance, the table on page 4 shows where some other stable Hadrons may possibly be found.

Some Higgs Boson Mass Measurements

Matched with

Hypersphere Surface Volume Factorings of Them

(Mass in units of MeV/c2)

TECN	Higgs ExpMass	+/-	Higgs ThrMass	HSS Volume Factoring	ExpM-ThrM MassDiff	Range
			124,223.29	= $(2^{16}-2^{10}$ **-512**) **S21h**		-1000 MeV
			124,409.63	= $(2^{16}-2^{10}$ **-416)** **S21h**		
			124,471.74	= $(2^{16}-2^{10}$ **-384**) **S21h**		
			124,595.96	= $(2^{16}-2^{10}$ **-320**) **S21h**		
CMS	124,700	310	124,720.19	= $(2^{16}-2^{10}$ **-256**) **S21h**	20.19	
ATLS	124,860	270	124,844.41	= $(2^{16}-2^{10}$ **-192**) **S21h**	15.59	
ATLS	124,970	240	124,968.63	= $(2^{16}-2^{10}$ **-128**) **S21h**	1.37	
LHC	125,090	210	125,092.86	= $(2^{16}-2^{10}$ - **64**) **S21h**	2.86	
LHC	125,150	370	125,154.97	= $(2^{16}-2^{10}$ - **32**) **S21h**	4.97	
ATLS	125,170	110	125,170.50	= $(2^{16}-2^{10}$ - **24**) **S21h**	0.50	
			125,186.02	= $(2^{16}-2^{10}$ - **16**) **S21h**		
PDG	125,200	110	125,201.55	= $(2^{16}-2^{10}$ - **8**) **S21h**	1.55	
ATLS	**125,220**	110	125,217.08	= **$(2^{16}-2^{10})$ S21h**		0 MeV
			125,232.61	= $(2^{16}-2^{10}$ + **8**) **S21h**		
			125,248.14	= $(2^{16}-2^{10}$ + **16**) **S21h**		
			125,263.66	= $(2^{16}-2^{10}$ + **24**) **S21h**		
			125,279.19	= $(2^{16}-2^{10}$ + **32**) **S21h**		
ATLS	125,360	370	125,341.30	= $(2^{16}-2^{10}$ + **64**) **S21h**	18.70	
CMS	125,460	160	125,465.53	= $(2^{16}-2^{10}$ +**128**) **S21h**	5.53	
CMS	125,590	420	125,589.75	= $(2^{16}-2^{10}$ +**192**) **S21h**	0.25	
			125,713.97	= $(2^{16}-2^{10}$ +**256**) **S21h**		
CMS	125,800	400	125,838.20	= $(2^{16}-2^{10}$ +**320**) **S21h**	38.20	
			125,962.42	= $(2^{16}-2^{10}$ +**384**) **S21h**		
ATLS	126,000	400	126,024.53	= $(2^{16}-2^{10}$ +**416**) **S21h**	24.53	
CMS	126,200	600	126,210.87	= $(2^{16}-2^{10}$ +**512**) **S21h**	10.87	+1000 MeV

Some of the Higgs boson's experimental mass measurements factor as smaller powers of two added or subtracted from $(2^{16} - 2^{10})$ S21h. As can be seen in the table, some of the matches between experimental and theoretical masses are quite close. 64 S21h is equal to 124 MeV approximately. The source of the Higgs boson experimental mass data in the table comes from Particle Data Group's 2024 report.

Source of Mass Data: S. Navaset al.(Particle Data Group), Phys. Rev. D110, 030001 (2024)

Other Possible Locations
of
Stable Hadron Masses that Factor with S21h

(Mass in units of MeV/c2)

HSS Volume Factoring	ThrMass	
(2^{15}) **S21h** =	63,602.32	
$(2^{16} - 2^{14})$ **S21h** =	95,403.49	
$(2^{16} - 2^{13})$ **S21h** =	111,304.07	
$(2^{16} - 2^{12})$ **S21h** =	119,254.36	
$(2^{16} - 2^{11})$ **S21h** =	123,229.51	
$(2^{16} - 2^{10})$ **S21h** =	125,217.08	Higgs boson
(2^{16}) **S21h** =	127,204.65	
$(2^{16} + 2^{10})$ **S21h** =	129,192.23	
$(2^{16} + 2^{11})$ **S21h** =	131,179.80	
$(2^{16} + 2^{12})$ **S21h** =	135,154.94	
$(2^{16} + 2^{13})$ **S21h** =	143,105.23	
$(2^{16} + 2^{14})$ **S21h** =	159,005.82	
$(2^{16} + 2^{15})$ **S21h** =	190,806.98	
(2^{17}) **S21h** =	244,409.31	

Derivation of the *Hypersphere Surface Volume* Factoring Formula

$$\mathbf{m}_{\text{MeV}} = \mathbf{h}_{\text{MeV}}(\mathbf{xSn})$$

The HSSV factoring formula, **m = h** (**xSn**), which is used to discover hadron dimensions and exact masses, can be derived from Planck's Energy-Frequency Relation: **E = hf.** The key to the derivation is associating a frequency with a unit of hypervolume. A main benefit of the derivation is that it explains how the (10^{-34}) factor was removed from **h**, and its units changed from J-s to MeV/c^2.

If **m = h (xSn**) is correct, (and the factorings of hundreds of hadrons says it is) then a frequency of ($1.602176634 \times 10^{21}$ Hz) is associated with each unit of hypervolume (each unit of **Sn**) of a hadron, no matter the dimension. In the example with **Ds** (See next page), **Ds'**s hypervolume is **10.000 S9**, which equals 1967.053/**h** = 296.8657 hypervolume units. Multiplying 296.8657 by ($1.602176634 \times 10^{21}$ Hz/vol) - the frequency per unit hypervolume constant - will give you a frequency of $4.75631288 \times 10^{23}$ Hz as the frequency associated with the entire particle, which is correct. (Putting that frequency in Planck's energy-frequency law (**E=hf**) will give you the particle's mass in Joules.) So in terms of particle *hypervolume*, Planck's energy-frequency law can be rewritten as:

$$\mathbf{E}_J = \mathbf{h}_{J\text{-}s}\,(\mathbf{xSn})\,(\mathbf{1.602176634 \times 10^{21}}\ \text{Hz/vol}) \qquad (\text{here } \mathbf{h} = 6.62607015 \times 10^{-34}\ \text{J-s})$$

Which says a frequency (and therefore energy) is associated with a volume. To convert **h** to units of MeV/c^2 divide the right hand side by $1.602176634 \times 10^{-13}$ Joules/MeV/c^2 (the Joules to MeV/c^2 conversion factor). The result is **h** in units of MeV/c^2 and a factor of (1×10^{34}) times **h(xSn)** on the right . (**E** on the left hand side of the equation then has units of MeV/c^2 by default.) When that factor, (1×10^{34}), is multiplied by Planck's constant, ($6.62607015 \times 10^{-34}$ MeV/c^2), you are left with just Planck's constant's coefficient (6.62607015 MeV/c^2) for **h**. The result is:

$$\mathbf{m}_{\text{MeV}} = \mathbf{h}_{\text{MeV}}\,(\mathbf{xSn}) \qquad (\text{So, here } \mathbf{h} = 6.62607015\ \text{MeV}/c^2, \textbf{ not } 6.62607015 \times 10^{-34}\ \text{J-s.})$$

Where **m** is in units of MeV/c^2, **h** = 6.62607015 MeV/c^2, and **Sn** is the hypervolume calculated from the surface volume formula for an n-sphere using a radius of one (a unit radius). (**Snh** values are given in an appendix for all **n** from dimensions 2 to 21.) That formula seems to work on any dimension of hadron, *which implies that the mass density of the hypervolume of hadrons remains the same over all dimensions*. What is the density of the hypervolume of any hadron? It is 6.62607015 MeV/c^2 per unit hypervolume. That's what the formula says if it is rearranged.

$$\mathbf{h}_{\text{MeV}} = \mathbf{m}_{\text{MeV}} / (\mathbf{xSn})$$

So, if m=h(xSn) is valid, it means that if a correct factoring can be found for a hadron then, a dimension and a precise mass can be assigned to it.

More Evidence That Hadrons Are Made of Higher Dimensional Matter

Examples of Hadron Masses Factorted with Snh

(Masses in units of MeV/c^2)

HSS Volume Factoring		Hadron's ThrMass	TM-EM	Hadron's ExpMass	ExpErr	Hadron's Name	
4.4444	**S5h** =	775.071	0.051	**775.02**	.35	**ρ(775)**	
6.0000	**S6h =**	1232.698	0.202	**1232.9**	1.2	**Δ(1232)**	
2.5000	**S7h** =	547.866	0.001	**547.865**	0.031	**η**	
25/7	**S7h =**	782.665	0.015	**782.65**	0.12	**ω**	
6.00000	**S7h** =	1314.878	0.018	**1314.86**	0.20	**Xi°**	
6.03125	**S7h =**	1321.726	0.016	**1321.71**	0.07	**Xi$^-$**	
26.6666	**S8h** =	5737.239	0.039	**5737.2**	0.7	**B1(5747)**	
10.0000	**S9h** =	1967.053	0.053	**1967.0**	1.0	**Ds**	
15.0000	**S10h** =	2534.634	0.034	**2534.6**	0.3	**Ds1(2536)**	
16.0000	**S11h =**	2197.219	0.181	**2197.4**	4.4	**Xc0(1P)**	
29.0000	**S11h =**	3982.461	0.039	**3982.5**	1.8	**Zcs(3982)**	
4096/7	**S11h =**	80355.47	1.473	**80354**	23	**W Boson**	[2]
4100/7	**S11h =**	80433.94	0.445	**80433.5**	9.4	**W boson**	[2]
26.0000	**S12h** =	2760.433	0.333	**2760.1**	1.1	**D3*(2750)**	
27.0000	**S12h** =	2866.605	0.005	**2866.6**	AVG	**Ds3(2860)$^+$**	
28.0000	**S12h =**	2972.775	0.975	**2971.8**	8.7	**D(3000)^0**	
50.0000	**S13h** =	3922.028	0.013	**3922.15**	1.2	**X(3930)**	
61.4400	**S14h =**	3415.496	0.004	**3415.5**	0.4	**Xc0(1P)**	
64.0000	**S14h =**	3557.808	0.008	**3557.8**	1.2	**Xc2(1P)**	
93.0000	**S15h =**	3525.820	0.020	**3525.8**	0.2	**h1(1P)**	
2^{17} /900	**S16h =**	3633.472	0.128	**3633.6**	1.7	**nc(2s)**	
2^{17}+128 /900	**S16h** =	3637.020	0.020	**3637.0**	5.7	**nc(2s)**	
2^{17}+256 /900	**S16h =**	3640.569	0.069	**3640.5**	3.2	**nc(2s)**	
17160/70	**S17h =**	3893.006	0.006	**3893.0**	2.3	**Zc(3900)**	
18304/70	**S17h =**	4152.540	0.040	**4152.5**	1.7	**Xc1(4140)**	
20736/70	**S17h =**	4704.049		**4704**	10	**Xc0(4700)**	
222.0000	**S17h =**	3525.484	0.084	**3525.40**	0.13	**hc(1P)**	
384.0000	**S17h =**	6098.135	0.135	**6098.0**	1.7	**Σb(6097)**	
100.5000	**S18h =**	984.646	0.054	**984.7**	0.4	**fo(980)**	
280.0000	**S20h** =	957.590	0.090	**957.5**	0.2	**η'(958)**	
(2^{16}-2^{10})	**S21h =**	125217.08	2.920	**125220**	110	**Higgs Boson**	[2]

Note: **17160** = 16384 + 512 + 256 + 8
18304 = 16384 + 1024 + 512 + 256 + 128
20736 = 16384 + 4096 + 2048 + 256

Source of Mass Data: P.A. Zylaet al.(Particle Data Group), Prog. Theor. Exp. Phys.2020, 083C01 (2020) and 2021 update

APPENDIX A

All 34 of Particle Data Group's Reported 2024 Higgs Boson Mass Measurements

(From smallest to largest)
(MeV/c^2)

#	Higgs TECN	Higgs ExpMass	+/-	Diff From 125,220 MeV
1	CMS	122,000	7000	
2	ATLS	124,300	600	-1000 MeV
3	ATLS	124,510	520	
4	ATLS	124,510	520	
5	CMS	124,700	310	-500 MeV
6	ATLS	124,790	370	
7	ATLS	124,860	270	
8	ATLS	124,930	400	
9	ATLS	124,940	170	
10	ATLS	124,970	240	-250 MeV
11	ATLS	124,990	180	
12	CMS	125,020	260	
13	LHC	125,070	250	
14	LHC	125,090	210	
15	ATLS	125,100	110	
16	ATLS	125,110	110	
17	LHC	125,150	370	
18	ATLS	125,170	110	
19	ATLS	125,220	110	0 MeV
20	CMS	125,260	200	
21	CMS	125,300	400	
22	ATLS	125,360	370	
23	CMS	125,380	140	
24	CMS	125,460	160	+250 MeV
25	ATLS	125,500	200	
26	CMS	125,590	420	
27	CMS	125,600	400	
28	CMS	125,780	260	+500 MeV
29	CMS	125,800	400	
30	ATLS	125,980	420	
31	ATLS	126,000	400	
32	ATLS	126,020	430	
33	CMS	126,200	600	+1000 MeV
34	ATLS	126,800	200	

Source: S. Navaset al.(Particle Data Group), Phys. Rev. D110, 030001 (2024)

APPENDIX B

Quark Assignments
to
n-Sphere Surface Volume Formulae

Sphere Dimension	Quark Names Old	Quark Names New		Corresponding n-Sphere Surface Formula
2	**u**	q1	=	$2\ \pi^1 r^1$
3	**d**	q2	=	$4\ \pi^1 r^2$
4	**s**	q3	=	$2\ \pi^2 r^3$
5	**c**	q4	=	$8/3\ \pi^2 r^4$
6	**b**	q5	=	$\pi^3 r^5$
7	**t**	q6	=	$16/15\ \pi^3 r^6$
8	------	q7	=	$1/3\ \pi^4 r^7$
9	------	q8	=	$32/105\ \pi^4 r^8$
10	------	q9	=	$1/12\ \pi^5 r^9$
11	------	q10	=	$64 / 945\ \pi^5 r^{10}$
12	------	q11	=	$1 / 60\ \pi^6 r^{11}$
13	------	q12	=	$128 / 10395\ \pi^6 r^{12}$
14	------	q13	=	$1 / 360\ \pi^7 r^{13}$
15	------	q14	=	$256 / 135135\ \pi^7 r^{14}$
16	------	q15	=	$1 / 2520\ \pi^8 r^{15}$
17	------	q16	=	$512 / 2027025\ \pi^8 r^{16}$
18	------	q17	=	$1 / 20160\ \pi^9 r^{17}$
19	------	q18	=	$1024 / 34459425\ \pi^9 r^{18}$
20	------	q19	=	$1 / 181440\ \pi^{10} r^{19}$
21	------	q20	=	$2048 / 654729075\ \pi^{10} r^{20}$

APPENDIX C

n-Sphere Surface Volume Formulae

(Dimension 2 - Dimension 21)

Sphere Dimension	Sn		Surface Volume Formula	(π, r) Powers
2	**S2**	=	$2 \ \pi^1 r^1$	(1, 1)
3	**S3**	=	$4 \ \pi^1 r^2$	(1, 2)
4	**S4**	=	$2 \ \pi^2 r^3$	(2, 3)
5	**S5**	=	$8/3 \ \pi^2 r^4$	(2, 4)
6	**S6**	=	$\pi^3 r^5$	(3, 5)
7	**S7**	=	$16/15 \ \pi^3 r^6$	(3, 6)
8	**S8**	=	$1/3 \ \pi^4 r^7$	(4, 7)
9	**S9**	=	$32/105 \ \pi^4 r^8$	(4, 8)
10	**S10**	=	$1/12 \ \pi^5 r^9$	(5, 9)
11	**S11**	=	$64 / 945 \ \pi^5 r^{10}$	(5, 10)
12	**S12**	=	$1 / 60 \ \pi^6 r^{11}$	(6, 11)
13	**S13**	=	$128 / 10395 \ \pi^6 r^{12}$	(6, 12)
14	**S14**	=	$1 / 360 \ \pi^7 r^{13}$	(7, 13)
15	**S15**	=	$256 / 135135 \ \pi^7 r^{14}$	(7, 14)
16	**S16**	=	$1 / 2520 \ \pi^8 r^{15}$	(8, 15)
17	**S17**	=	$512 / 2027025 \ \pi^8 r^{16}$	(8, 16)
18	**S18**	=	$1 / 20160 \ \pi^9 r^{17}$	(9, 17)
19	**S19**	=	$1024 / 34459425 \ \pi^9 r^{18}$	(9, 18)
20	**S20**	=	$1 / 181440 \ \pi^{10} r^{19}$	(10, 19)
21	**S21**	=	$2048 / 654729075 \ \pi^{10} r^{20}$	(10, 20)

APPENDIX D

Values of n-Sphere Surface Volume
Units of Factorization

(Below **h** = 6.62607015 MeV/c^2, not 6.62607015 x 10^{-34} J-s)

(Dimension 2 - Dimension 21)

Sphere Dimension	Unit of Factorization		Formula		Value (MeV/c^2)
2	**S2h**	=	2 $\pi^1 r^1 h$	=	41.63282661
3	**S3h**	=	4 $\pi^1 r^2 h$	=	83.26565322
4	**S4h**	=	2 $\pi^2 r^3 h$	=	130.7933822
5	**S5h**	=	8/3 $\pi^2 r^4 h$	=	174.3911763
6	**S6h**	=	$\pi^3 r^5 h$	=	205.4497644
7	**S7h**	=	16/15 $\pi^3 r^6 h$	=	219.1464153
8	**S8h**	=	1/3 $\pi^4 r^7 h$	=	215.1464901
9	**S9h**	=	32/105 $\pi^4 r^8 h$	=	196.7053624
10	**S10h**	=	1/12 $\pi^5 r^9 h$	=	168.9756582
11	**S11h**	=	64 / 945 $\pi^5 r^{10} h$	=	137.3262492
12	**S12h**	=	1 / 60 $\pi^6 r^{11} h$	=	106.1705373
13	**S13h**	=	128 / 10395 $\pi^6 r^{12} h$	=	78.44057013
14	**S14h**	=	1 / 360 $\pi^7 r^{13} h$	=	55.59076334
15	**S15h**	=	256 / 135135 $\pi^7 r^{14} h$	=	37.91204905
16	**S16h**	=	1 / 2520 $\pi^8 r^{15} h$	=	24.94907624
17	**S17h**	=	512 / 2027025 $\pi^8 r^{16} h$	=	15.88056197
18	**S18h**	=	1 / 20160 $\pi^9 r^{17} h$	=	9.797479330
19	**S19h**	=	1024 / 34459425 $\pi^9 r^{18} h$	=	5.869441980
20	**S20h**	=	1 / 181440 $\pi^{10} r^{19} h$	=	3.419965454
21	**S21h**	=	2048 / 654729075 $\pi^{10} r^{20} h$	=	1.940989032

APPENDIX E

Smallest Formation Quarks per n-Sphere

(Dimension 2 - Dimension 21)

Sphere Dimension	Sn		Surface Volume Formula	(π, r) Powers	Formation Quarks
2	**S2**	=	$2\ \pi^1 r^1$	(1, 1)	u
3	**S3**	=	$4\ \pi^1 r^2$	(1, 2)	d
4	**S4**	=	$2\ \pi^2 r^3$	(2, 3)	du = $8\ \pi^2 r^3$ = 4 **S4**
5	**S5**	=	$8/3\ \pi^2 r^4$	(2, 4)	dd = $64\ \pi^2 r^4$ = 24 **S5**
6	**S6**	=	$\pi^3 r^5$	(3, 5)	ddu = $32\ \pi^3 r^5$ = 32 **S6**
7	**S7**	=	$16/15\ \pi^3 r^6$	(3, 6)	ddd = $256\ \pi^3 r^6$ = 273..**S7**
8	**S8**	=	$1/3\ \pi^4 r^7$	(4, 7)	dddu = $128\ \pi^4 r^7$ = 384 **S8**
9	**S9**	=	$32/105\ \pi^4 r^8$	(4, 8)	dddd = $1024\ \pi^4 r^8$ = 312..**S9**
10	**S10**	=	$1/12\ \pi^5 r^9$	(5, 9)	ddddu
11	**S11**	=	$64 / 945\ \pi^5 r^{10}$	(5, 10)	ddddd
12	**S12**	=	$1 / 60\ \pi^6 r^{11}$	(6, 11)	dddddu
13	**S13**	=	$128 / 10395\ \pi^6 r^{12}$	(6, 12)	dddddd
14	**S14**	=	$1 / 360\ \pi^7 r^{13}$	(7, 13)	ddddddu
15	**S15**	=	$256 / 135135\ \pi^7 r^{14}$	(7, 14)	ddddddd
16	**S16**	=	$1 / 2520\ \pi^8 r^{15}$	(8, 15)	dddddddu
17	**S17**	=	$512 / 2027025\ \pi^8 r^{16}$	(8, 16)	dddddddd
18	**S18**	=	$1 / 20160\ \pi^9 r^{17}$	(9, 17)	ddddddddu
19	**S19**	=	$1024 / 34459425\ \pi^9 r^{18}$	(9, 18)	ddddddddd
20	**S20**	=	$1 / 181440\ \pi^{10} r^{19}$	(10, 19)	dddddddddu
21	**S21**	=	$2048 / 654729075\ \pi^{10} r^{20}$	(10, 20)	dddddddddd

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