# Mass Spectrum of the Xi Baryons

D.G. Grossman
March 30, 2022

## Abstract

6.00 S7h = 1314.878 versus 1314.86 PDG FIT for the neutral Xi baryon. All subatomic particle masses can be expressed as multiples of hypersphere surface volumes times ‘h’ – Planck’s constant’s coefficient. In the case of the Xi baryons, the hypersphere surface volume needed is that of a 7-sphere (S7 for short). The purpose of this paper is to show that the masses of all Xi baryons can be expressed as simply defined multiples of S7h, by matching experimental Xi masses with their theoretical values in the mass spectrums generated by S7h that are presented in the paper.

## Contents

# 1. Introduction

Baryons are subatomic particles composed of three quarks. According to Quark Theory, the three quarks inside baryons orbit one another in 3d space under the influence of a central force called the Strong Force. The mathematics for predicting baryon masses using the Quark Model is very complicated and uncertain since two key elements necessary for making accurate predictions are missing, namely the exact masses of the quarks, and an exact mathematical expression for the Strong Force. In this paper, quarks are treated as hypersphere surface volumes of mass of various dimensions, instead of point particles. The highest mathematics involved are the formulae for the hypersphere surface volumes.

It is hoped that the study of hypersphere surface volume factoring of particle masses will *result* in a comprehensive theory of particle structure, including discovering the complex mathematics that is likely associated with physics in higher dimensions.

# 2. Determining the Xi Baryon's Quark Content

The quark content of the Xi baryons is widely quoted as being **uss** or **dss,** depending on charge (neutral or negative). There is good reason to believe that that is incorrect. The correct quark content of the Xi baryons is most likely **ddd**, as the following derivation will show. The derivation below is based on assuming the following quark to hypersphere surface volume *translations* are correct.

| Quark | Hypersphere Surface Volume |
|---|---|
| **u** | $S2 = 2\,\pi\, r$ |
| **d** | $S3 = 4\,\pi\, r^2$ |
| **s** | $S4 = 2\,\pi^2\, r^3$ |

Substituting the correct hypersphere surface volume formulae for **uss**, and **ddd,** and multiplying them together with 'h' - Planck's constant's coefficient, and setting r=1, one gets:

$$\mathbf{ussh} = (2\,\pi\, r\,)(2\,\pi^2\, r^3)(2\,\pi^2\, r^3)h = (8\,\pi^5\, r^7\,)h = \mathbf{16221.663}\ \ \text{MeV/c}^2$$

$$\mathbf{dddh} = (4\,\pi\, r^2)(4\,\pi\, r^2)(4\,\pi\, r^2)h = (64\,\pi^3\, r^6)h = \mathbf{13148.784}\ \ \text{MeV/c}^2$$

PDG's FIT for the neutral Xi baryon is **1314.86** MeV/$c^2$, which is almost exactly **1/10th** the value of **dddh,** shown above. Is this just a coincidence? No. It shows that the quark content of the Xi baryons is **ddd,** not **uss**. It could also be **udd**, since they differ by only a factor of 2r, but **ddd** will be assumed throughout this paper. Many other factorings, as shown in this paper, affirm the conclusion that **ddd** (or udd) is the correct quark content of the Xi baryons. (For most Xi's anyway. Xi(1820) and Xi(1950) seem to have a different quark content.)

# 3. Calculating the Factoring Unit from the Quark Content

To find the factoring unit of a subatomic particle, its quark content must be translated to the corresponding hypersphere surface volume formulae, then multiplied together along with 'h' - Planck's constant's coefficient. In this paper, the quark content of Xi baryons is assumed to be **ddd**, even though they are widely reported as having a quark content of **uss** or **dss**. (see *Determining the Xi Baryon's Quark Content*, above.)

The mass of the '**d**' quark corresponds to 3-sphere surface volume (call it S3). So, to get the *factoring unit* of the **ddd** baryon (in units of $MeV/c^2$) multiply the corresponding quark content surface volume formulae together along with 'h' **-** the coefficient of Planck's constant.

Factoring unit of **ddd** = S3 S3 S3 h

Factoring unit of **ddd** = $(4 \pi r^2)\ (4 \pi r^2)\ (4 \pi r^2)\ h$

Factoring unit of **ddd** = $64 \pi^3 r^6\ h$

The surface volume of a 7-sphere is: **S7** = $(16/15)\ \pi^3 r^6$. The factoring unit of **ddd** is 60 times bigger, but except for that constant of multiplication, they are the same. Throughout this paper **S7h** will be used instead of **S3S3S3h** for factoring Xi baryon masses, because it is more concise (there is less to type) and it is a smaller factoring unit, both of which are advantageous. Factoring results - the theoretical masses found - will be exactly the same regardless of which of the two factoring units is used. Only the expressions found for the results will be different. They will differ by a factor of 60, so, to covert from one to the other just divide or multiply by 60.

To get the value of the factoring unit that is used in this paper, set r=1, then multiply S7 by the coefficient of Planck's constant (h = 6.62607015).

**S7 h** = $\pi^3\ 1^6\ h$
**S7 h** = $219.1464153\ MeV/c^2$

This is the *factoring unit* that was used to construct the mass spectrums in this paper.

# 3. How to Read the Mass Spectrums

Col 1: **n** — The first column of the mass spectrum holds '**n**', the *multiplier* of **S6h**.

Col 2: **nS6h** — The second column shows the *theoretical mass*, which resuls from multiplying '**n**' with **S6h**.

Col 3: **ExpMass** — The third column holds 'ExpMass', the *experimental mass*. It is placed next to the theoretical mass in the mass spectrum that most closely matches it.

Col 4: **Error** — The fourth column holds the *error of the experimental mass*. It is plus or minus.

Col 5: **dm** — This is the difference between the experimental and theoretical masses.

Col 6: **dm /Error** — This is **dm** divided by the **Error,** and the result is shown as a percentage. It shows the difference between theoretical and experimental mass as a percentage of error size.

# Mass Spectrum of $Xi^{o}$ Data

| | n | $6 + \frac{n}{4096}$ S7h | ExpMass | Error | |
|---|---|---|---|---|---|
| | -28 | 1313.380 | **1313.4** | 1.8 | |
| | -27 | 1313.434 | | | |
| | -26 | 1313.487 | | | |
| | -25 | 1313.541 | | | |
| | -24 | 1313.594 | | | |
| | -23 | 1313.648 | | | |
| | -22 | 1313.701 | | | |
| | -21 | 1313.755 | | | |
| | -20 | 1313.808 | | | |
| | -19 | 1313.862 | | | |
| | -18 | 1313.915 | | | |
| | -17 | 1313.969 | | | |
| | -16 | 1314.022 | | | |
| | -15 | 1314.076 | | | |
| | -14 | 1314.129 | | | |
| | -13 | 1314.183 | | | |
| | -12 | 1314.236 | | | |
| | -11 | 1314.290 | | | |
| | -10 | 1314.343 | | | |
| | -9 | 1314.397 | | | |
| | -8 | 1314.450 | | | |
| | -7 | 1314.504 | | | |
| | -6 | 1314.557 | | | |
| | -5 | 1314.611 | | | |
| | -4 | 1314.664 | | | |
| | -3 | 1314.718 | | | |
| | -2 | 1314.771 | | | |
| | -1 | 1314.825 | **1314.82** | 0.06/0.20 | |
| **6.0000 S7h** | **0** | **1314.878** | **1314.86** | 0.20 | PDG's FIT |
| | 1 | 1314.932 | | | |
| | 2 | 1314.985 | | | |
| | 3 | 1315.039 | | | |
| | 4 | 1315.093 | | | |
| | 5 | 1315.146 | | | |
| | 6 | 1315.200 | **1315.2** | 0.92 | |
| | 7 | 1315.253 | | | |
| | 8 | 1315.307 | | | |
| | 9 | 1315.360 | | | |
| | 10 | 1315.414 | | | |
| | 11 | 1315.467 | | | |
| | 12 | 1315.521 | | | |
| | 13 | 1315.574 | | | |
| | 14 | 1315.628 | | | |

**6.0000 S7h** = 1314.878 Theoretical Mass
1314.86 PDG's FIT

Source of ExpMass and Error data: P.A. Zyla et al.(Particle Data Group), Prog. Theor. Exp. Phys. 2020, 083C01 (2020)

# Mass Spectrum of $Xi^-$ Data

| | n | $6 + \frac{n}{4096}$ S7h | ExpMass | Error | |
|---|---|---|---|---|---|
| | 108 | 1320.656 | | | |
| | 109 | 1320.710 | | | |
| | 110 | 1320.763 | | | |
| | 111 | 1320.817 | | | |
| | 112 | 1320.870 | | | |
| | 113 | 1320.924 | | | |
| | 114 | 1320.977 | | | |
| | 115 | 1321.031 | | | |
| | 116 | 1321.085 | **1321.1** | 0.3 | |
| | 116.666 | 1321.120 | **1321.12** | 0.41 | |
| | 117 | 1321.138 | | | |
| | 118 | 1321.192 | | | |
| | 119 | 1321.245 | | | |
| | 120 | 1321.299 | **1321.3** | 0.4 | |
| | 121 | 1321.352 | | | |
| | 122 | 1321.406 | **1321.4** | 1.1 | |
| | 123 | 1321.459 | **1321.46** | 0.34 | |
| | 124 | 1321.513 | | | |
| | 125 | 1321.566 | | | |
| | 126 | 1321.620 | | | |
| | 127 | 1321.673 | **1321.67** | 0.52 | |
| **6.03125 S7h** | **128** | **1321.727** | **1321.71** | 0.07 | PDG's FIT |
| | 129 | 1321.780 | | | |
| | 130 | 1321.834 | | | |
| | 131 | 1321.887 | **1321.87** | 0.51 | |
| | 132 | 1321.941 | | | |
| | 133 | 1321.994 | | | |
| | 134 | 1322.048 | | | |
| | 135 | 1322.101 | | | |
| | 136 | 1322.155 | | | |
| | 137 | 1322.208 | | | |
| | 138 | 1322.262 | | | |
| | 139 | 1322.315 | | | |
| | 140 | 1322.369 | | | |
| | 141 | 1322.422 | | | |
| | 142 | 1322.476 | | | |
| | 143 | 1322.529 | | | |
| | 144 | 1322.583 | | | |
| | 145 | 1322.636 | | | |
| | 146 | 1322.690 | | | |
| | 147 | 1322.743 | | | |
| | 148 | 1322.797 | | | |

**6.03125 S7h =** 1321.727 Theoretical Mass
1321.71 PDG's FIT

Source of ExpMass and Error data: P.A. Zyla et al.(Particle Data Group), Prog. Theor. Exp. Phys. 2020, 083C01 (2020)

# Mass Spectrum of Xi(1530)$^o$, Xi(1530)$^-$ Data

| | n | $7 + \frac{n}{4096}$ S7h | ExpMass | Error | Baryon |
|---|---|---|---|---|---|
| | -128 | 1527.176 | **1527** | 6 | X(1530)$^0$ |
| | -100 | 1528.674 | **1528.7** | 1.1 | X(1530)$^0$ |
| | **-76** | 1529.959 | **1530** | 1 | X(1530)$^0$ |
| | **-51** | 1531.296 | **1531.3** | 0.6 | X(1530)$^0$ |
| | -50 | 1531.350 | | | |
| | -49 | 1531.403 | **1531.4** | 0.8 | Xi(1530)$^0$ |
| | -48 | 1531.457 | | | |
| | -47 | 1531.510 | | | |
| | -46 | 1531.564 | | | |
| | **-45** | 1531.617 | **1531.6** | 0.4 | X(1530)$^0$ |
| | -44 | 1531.671 | | | |
| | -43 | 1531.724 | | | |
| | -42 | 1531.778 | | | |
| | -41 | 1531.831 | | | |
| | -40 | 1531.885 | | | |
| | -39 | 1531.938 | | | |
| | **-38** | 1531.992 | **1532.0** | **0.4** | X(1530)$^0$ |
| | -37 | 1532.045 | | | |
| | **-36** | 1532.099 | **1532.1** | **0.4** | X(1530)$^0$ |
| | -35 | 1532.152 | | | |
| | **-34** | 1532.206 | **1532.2** | **0.7** | X(1530)$^0$ |
| | -33 | 1532.25 | | | |
| | **-32** | 1532.313 | **1532.3** | **0.7** | X(1530)$^0$ |
| | -31 | 1532.366 | | | |
| | -30 | 1532.420 | | | |
| | -20 | 1532.955 | | | |
| | **-19** | **1533.008** | **1533** | 1 | X(1530)$^0$ |
| | -18 | 1533.062 | | | |
| | -17 | 1533.115 | | | |
| | -16 | 1533.169 | | | |
| | -15 | 1533.222 | | | |
| | -14 | 1533.276 | | | |
| | -13 | 1533.329 | | | |
| | -12 | 1533.383 | | | |
| | -11 | 1533.436 | | | |
| | -10 | 1533.490 | | | |
| | -9 | 1533.543 | | | |
| | **-8** | **1533.597** | **1533.6** | 1.4 | X(1530)$^0$ |
| | -7 | 1533.650 | | | |
| | -6 | 1533.704 | | | |
| | -5 | 1533.757 | | | |
| | -4 | 1533.811 | | | |
| | -3 | 1533.864 | | | |
| | -2 | 1533.918 | | | |
| | -1 | 1533.971 | | | |
| **7.0000 S7h** | **0** | **1534.025** | | | |
| | 1 | 1534.078 | | | |
| | 2 | 1534.132 | | | |
| | 3 | 1534.185 | | | |
| | 4 | 1534.239 | | | |
| | 5 | 1534.292 | | | |
| | 6 | 1534.345 | | | |
| | 7 | 1534.399 | **1534.4** | 1.1 | X(1530)$^-$ |
| | 8 | 1534.452 | | | |
| | 9 | 1534.506 | **1534.5** | 1.2 | X(1530)$^-$ |
| | 10 | 1534.559 | | | |
| | 11 | 1534.613 | | | |
| | 12 | 1534.666 | | | |
| | 13 | 1534.720 | **1534.7** | 1.1 | X(1530)$^-$ |
| | 18 | 1534.987 | **1535** | 4 | X(1530)$^0$ |
| | 24 | 1535.308 | **1535.3** | 2.0 | X(1530)$^-$ |
| | 32 | 1535.736 | **1535.7** | 3.2 | X(1530)$^-$ |
| | 41 | 1536.218 | **1536.2** | 1.6 | X(1530)$^-$ |
| | 112 | 1540.017 | **1540** | 3 | X(1530)$^-$ |

Source of ExpMass and Error data: P.A. Zyla et al.(Particle Data Group), Prog. Theor. Exp. Phys. 2020, 083C01 (2020)

# Commentary on Xi(1530)'s Mass Spectrum

The interesting thing about this mass spectrum is that 12 of the 13 experimental mass data points for the *neutral X(1530)* are less than **7.000 S7h** , while all 7 of the *negative X(1530)* experimental mass data points are greater than **7.000 S7h.**

Both sets of data are very close to 7.000 S7h.

Most *neutral X(1530)* data points are within 0.25% of **7.000 S7h**.
Most *negative X(1530)* data points are within 0.15% of **7.000 S7h**.

# Mass Spectrum of Xi(1620), Xi(1690)$^-$ Data

Res = (32/7$^4$) **S7h** = 2.920735231 MeV/c$^2$

| n | | $\frac{n}{7^4}$ S7h | ExpMass | Error | Baryon |
|---|---|---|---|---|---|
| | 544(32) | 1588.880 | | | |
| | 545(32) | 1591.801 | | | |
| | 546(32) | 1594.721 | | | |
| | 547(32) | 1597.642 | | | |
| **137(128)** = | 548(32) | 1600.563 | | | |
| | 549(32) | 1603.484 | | | |
| | 550(32) | 1606.404 | **1606** | 6 | **Ξ(1620)** |
| | 551(32) | 1609.325 | | | |
| **138(128)** = | 552(32) | 1612.246 | | | |
| | 553(32) | 1615.167 | | | |
| | 554(32) | 1618.087 | | | |
| | 555(32) | 1621.008 | | | |
| **139(128)** = | 556(32) | 1623.929 | **1624** | 3 | **Ξ(1620)** |
| | 557(32) | 1626.850 | | | |
| | 558(32) | 1629.770 | | | |
| | 559(32) | 1632.691 | **1633** | 12 | **Ξ(1620)** |
| **140(128)** = | 560(32) | 1635.612 | | | |
| | 561(32) | 1638.532 | | | |
| | 562(32) | 1641.453 | | | |
| | 563(32) | 1644.374 | | | |
| **141(128)** = | 564(32) | 1647.295 | | | |
| | 565(32) | 1650.215 | | | |
| | 566(32) | 1653.136 | | | |
| | 567(32) | 1656.057 | | | |
| **142(128)** = | 568(32) | 1658.978 | | | |
| | 569(32) | 1661.898 | | | |
| | 570(32) | 1664.819 | | | |
| | 571(32) | 1667.740 | | | |
| **143(128)** = | 572(32) | 1670.661 | | | |
| | 573(32) | 1673.581 | | | |
| | 574(32) | 1676.502 | | | |
| | 575(32) | 1679.423 | | | |
| **9(2048)** = | 576(32) | 1682.343 | | | |
| | 577(32) | 1685.264 | | | |
| | 578(32) | 1688.185 | | | |
| | 579(32) | 1691.106 | **1691.1** | 1.9/2.0 | **Ξ(1690)$^-$** |
| **145(128)** = | 580(32) | 1694.026 | **1694** | 6 | **Ξ(1690)$^-$** |
| | 581(32) | 1696.947 | | | |
| | 582(32) | 1699.867 | **1700** | 10 | **Ξ(1690)$^-$** |
| | 583(32) | 1702.788 | | | |
| | 584(32) | 1705.709 | | | |

Source of ExpMass and Error data: P.A. Zyla et al.(Particle Data Group), Prog. Theor. Exp. Phys. 2020, 083C01 (2020)

## Mass Spectrum of Ξ(1820) Data

| n | $\frac{n}{77}$ | S13h | ExpMass | Error | dm | dm/Error |
| --- | --- | --- | --- | --- | --- | --- |

This baryon will be treated in another paper, because it appears not to factor with **S7h** or **S6h**, therefore does not have **ddd** or **udd** quark content, and therefore it is not a Xi baryon as defined in this paper. It appears to have possibly **sss** or **ccc** quark content.

## Mass Spectrum of Ξ(1950) Data

| n | $\frac{n}{81}$ | S13h | ExpMass | Error | dm | dm/Error |
| --- | --- | --- | --- | --- | --- | --- |

This baryon will be treated in another paper, because it appears not to factor with **S7h** or **S6h**, therefore does not have **ddd** or **udd** quark content, and therefore it is not a Xi baryon as defined in this paper. It appears to have possibly **sss** or **ccc** quark content.

# Mass Spectrum of Xi(2030) Data ( $7^3$ divisor)

Res = (1/343) **S7h** = 0.638910832 MeV/$c^2$

| | n | $\frac{n}{7^3}$ S7h | ExpMass | Error | dm | dm/Error |
|---|---|---|---|---|---|---|
| | 3156 | 2016.403 | | | | |
| | 3157 | 2017.041 | | | | |
| | 3158 | 2017.680 | | | | |
| | 3159 | 2018.319 | | | | |
| 395(8) = | 3160 | 2018.958 | **2019** | 7 | 0.042 | 0.6% |
| | 3161 | 2019.597 | | | | |
| | 3162 | 2020.236 | | | | |
| | 3163 | 2020.875 | | | | |
| | 3164 | 2021.514 | | | | |
| | 3165 | 2022.153 | **2022** | 7 | 0.153 | 2.2% |
| | 3166 | 2022.792 | | | | |
| | 3167 | 2023.431 | | | | |
| **99(32)** = | 3168 | 2024.070 | **2024** | 2 | 0.070 | 3.5% |
| | 3169 | 2024.708 | | | | |
| | 3170 | 2025.347 | | | | |
| | 3171 | 2025.986 | | | | |
| | 3172 | 2026.625 | | | | |
| | 3173 | 2027.264 | | | | |
| | 3174 | 2027.903 | | | | |
| | 3175 | 2028.542 | | | | |
| 397(8) = | 3176 | 2029.181 | | | | |
| | 3177 | 2029.820 | | | | |
| | 3178 | 2030.459 | | | | |
| | 3179 | 2031.098 | | | | |
| | 3180 | 2031.736 | | | | |
| | 3181 | 2032.375 | | | | |
| | 3182 | 2033.014 | | | | |
| | 3183 | 2033.653 | | | | |
| 398(8) = | 3184 | 2034.292 | | | | |
| | 3185 | 2034.931 | | | | |
| | 3186 | 2035.570 | | | | |
| | 3187 | 2036.209 | | | | |
| | 3188 | 2036.848 | | | | |
| | 3189 | 2037.487 | | | | |
| | 3190 | 2038.126 | | | | |
| | 3191 | 2038.764 | | | | |
| 399(8) = | 3192 | 2039.403 | | | | |
| | 3193 | 2040.042 | | | | |
| | 3194 | 2040.681 | | | | |
| | 3195 | 2041.320 | | | | |
| | 3196 | 2041.959 | | | | |
| | 3197 | 2042.598 | | | | |
| | 3198 | 2043.237 | | | | |
| | 3199 | 2043.876 | | | | |
| **100(32)** = | 3200 | 2044.515 | **2044** | 8 | 0.515 | 6.4% |
| | 3201 | 2045.154 | | | | |
| | 3202 | 2045.792 | | | | |
| | 3203 | 2046.431 | | | | |
| | 3204 | 2047.070 | | | | |

Source of ExpMass and Error data: P.A. Zyla et al.(Particle Data Group), Prog. Theor. Exp. Phys. 2020, 083C01 (2020)

# Mass Spectrum of Xi(2030) Data ( $7^4$ divisor)

Res = (32/2401) **S7h** = 2.920735231 MeV/$c^2$

| | **n** | $\frac{n}{7^4}$ **S7h** | **ExpMass** | **Error** | **dm** | **dm/Error** |
|---|---|---|---|---|---|---|
| | 684(32) | 1997.783 | | | | |
| | 685(32) | 2000.704 | | | | |
| | 686(32) | 2003.624 | | | | |
| | 687(32) | 2006.545 | | | | |
| | 688(32) | 2009.466 | | | | |
| | 689(32) | 2012.387 | | | | |
| | 690(32) | 2015.307 | | | | |
| | 691(32) | 2018.228 | | | | |
| | 692(32) | 2021.149 | | | | |
| | 693(32) | 2024.070 | **2024** | 2 | 0.070 | 3.5% |
| | 694(32) | 2026.990 | | | | |
| | 695(32) | 2029.911 | **2030** | 10 | 0.089 | 0.9% |
| | 696(32) | 2032.832 | | | | |
| | 697(32) | 2035.752 | | | | |
| | 698(32) | 2038.673 | | | | |
| | 699(32) | 2041.594 | | | | |
| | 700(32) | 2044.515 | **2044** | 8 | 0.515 | 6.4% |
| | 701(32) | 2047.435 | | | | |
| | 702(32) | 2050.356 | | | | |
| | 703(32) | 2053.277 | | | | |
| **11(2048)** = | 704(32) | 2056.198 | **2058** | 17 | 1.802 | 3.5% |
| | 705(32) | 2059.118 | | | | |
| | 706(32) | 2062.039 | | | | |
| | 707(32) | 2064.960 | | | | |
| | 708(32) | 2067.881 | | | | |
| | 709(32) | 2070.801 | | | | |
| | 710(32) | 2073.722 | | | | |
| | 711(32) | 2076.643 | | | | |
| | 712(32) | 2079.563 | | | | |
| | 713(32) | 2082.484 | | | | |
| | 714(32) | 2085.405 | | | | |
| | 715(32) | 2088.326 | | | | |
| | 716(32) | 2091.246 | | | | |
| | 717(32) | 2094.167 | | | | |
| | 718(32) | 2097.088 | | | | |
| | 719(32) | 2100.009 | | | | |
| | 720(32) | 2102.929 | | | | |
| | 721(32) | 2105.850 | | | | |
| | 722(32) | 2108.771 | | | | |
| | 723(32) | 2111.692 | | | | |
| | 724(32) | 2114.612 | | | | |

Source of ExpMass and Error data: P.A. Zyla et al.(Particle Data Group), Prog. Theor. Exp. Phys. 2020, 083C01 (2020)

# Mass Spectrum of Xi(2250) Data

Res = (32/2401) **S7h** = 2.920735231 MeV/$c^2$

| | n | $\frac{n}{7^4}$ S7h | ExpMass | Error | dm | dm/Error |
|---|---|---|---|---|---|---|
| | 748(32) | 2184.710 | | | | |
| | 749(32) | 2187.631 | | | | |
| | 749.5(32) | 2189.091 | **2189** | **7** | 0.091 | 1.3% |
| | 750(32) | 2190.551 | | | | |
| | 751(32) | 2193.472 | | | | |
| | 752(32) | 2196.393 | | | | |
| | 753(32) | 2199.314 | | | | |
| | 754(32) | 2202.234 | | | | |
| | 755(32) | 2205.155 | | | | |
| | 756(32) | 2208.076 | | | | |
| | 757(32) | 2210.997 | | | | |
| | 758(32) | 2213.917 | **2214** | **5** | 0.083 | 1.7% |
| | 759(32) | 2216.838 | | | | |
| | 760(32) | 2219.759 | | | | |
| | 761(32) | 2222.680 | | | | |
| | 762(32) | 2225.600 | | | | |
| | 763(32) | 2228.521 | | | | |
| | 764(32) | 2231.442 | | | | |
| | 765(32) | 2234.362 | | | | |
| | 766(32) | 2237.283 | | | | |
| | 767(32) | 2240.204 | | | | |
| **12(2048)** = | 768(32) | 2243.125 | **2244** | **52** | 0.875 | 1.7% |
| | 769(32) | 2246.045 | | | | |
| | 770(32) | 2248.966 | | | | |
| | 771(32) | 2251.887 | | | | |
| | 772(32) | 2254.808 | | | | |
| | 773(32) | 2257.728 | | | | |
| | 774(32) | 2260.649 | | | | |
| | 775(32) | 2263.570 | | | | |
| | 776(32) | 2266.491 | | | | |
| | 777(32) | 2269.411 | | | | |
| | 778(32) | 2272.332 | | | | |
| | 779(32) | 2275.253 | | | | |
| | 780(32) | 2278.173 | | | | |
| | 781(32) | 2281.094 | | | | |
| | 782(32) | 2284.015 | | | | |
| | 783(32) | 2286.936 | | | | |
| | 784(32) | 2289.856 | | | | |
| | 785(32) | 2292.777 | | | | |
| | 786(32) | 2295.698 | **2295** | **15** | 0.698 | 4.6% |
| | 787(32) | 2298.619 | | | | |
| | 788(32) | 2301.539 | | | | |
| | 789(32) | 2304.460 | | | | |
| | 790(32) | 2307.381 | | | | |

Source of ExpMass and Error data: P.A. Zyla et al.(Particle Data Group), Prog. Theor. Exp. Phys. 2020, 083C01 (2020)

# Mass Spectrum of Xi(2500) Data

Res = (32/2401) **S7h** = 2.920735231 MeV/$c^2$

| | n | $\frac{n}{7^4}$ S7h | ExpMass | Error | dm | dm/Error |
|---|---|---|---|---|---|---|
| | 814(32) | 2377.478 | | | | |
| | 815(32) | 2380.399 | | | | |
| | 816(32) | 2383.320 | | | | |
| | 817(32) | 2386.241 | | | | |
| | 818(32) | 2389.161 | | | | |
| | 819(32) | 2392.082 | | | | |
| | 820(32) | 2395.003 | | | | |
| | 821(32) | 2397.924 | | | | |
| | 822(32) | 2400.844 | | | | |
| | 823(32) | 2403.765 | | | | |
| | 824(32) | 2406.686 | | | | |
| | 825(32) | 2409.607 | | | | |
| | 826(32) | 2412.527 | | | | |
| | 827(32) | 2415.448 | | | | |
| | 828(32) | 2418.369 | | | | |
| | 829(32) | 2421.290 | | | | |
| | 830(32) | 2424.210 | | | | |
| | 831(32) | 2427.131 | | | | |
| **13(2048)** = | 832(32) | 2430.052 | **2430** | **20** | 0.052 | 0.3% |
| | 833(32) | 2432.972 | | | | |
| | 834(32) | 2435.893 | | | | |
| | 835(32) | 2438.814 | | | | |
| | 836(32) | 2441.735 | | | | |
| | 837(32) | 2444.655 | | | | |
| | 838(32) | 2447.576 | | | | |
| | 839(32) | 2450.497 | | | | |
| | 840(32) | 2453.418 | | | | |
| | 841(32) | 2456.338 | | | | |
| | 842(32) | 2459.259 | | | | |
| | 843(32) | 2462.180 | | | | |
| | 844(32) | 2465.101 | | | | |
| | 845(32) | 2468.021 | | | | |
| | 846(32) | 2470.942 | | | | |
| | 847(32) | 2473.863 | | | | |
| | 848(32) | 2476.783 | | | | |
| | 849(32) | 2479.704 | | | | |
| | 850(32) | 2482.625 | | | | |
| | 851(32) | 2485.546 | | | | |
| | 852(32) | 2488.466 | | | | |
| | 853(32) | 2491.387 | | | | |
| | 854(32) | 2494.308 | | | | |
| | 855(32) | 2497.228 | | | | |
| | 856(32) | 2500.149 | **2500** | **10** | 0.149 | 1.5% |
| | 857(32) | 2503.070 | | | | |
| | 858(32) | 2505.990 | **2505** | **10** | 0.990 | 9.9% |
| | 859(32) | 2508.911 | | | | |
| | 860(32) | 2511.832 | | | | |

Source of ExpMass and Error data: P.A. Zyla et al.(Particle Data Group), Prog. Theor. Exp. Phys. 2020, 083C01 (2020)

## 6. Large Block Mass Spectrum of the Xi Baryons

Res = (2048 / $7^4$ ) S7h = 186.9270548 MeV/$c^2$

| Large Block | | n | $\frac{n}{7^4}$ S7h | ExpMass | Error | Baryon |
|---|---|---|---|---|---|---|
| | | 143(128) | 1670.660 | | | |
| **9(2048)** | = | 144(128) | 1682.343 | | | |
| | | 145(128) | 1694.026 | **1694** | 6 | **Ξ(1690)** |
| | | 159(128) | 1857.588 | | | |
| **10(2048)** | = | 160(128) | 1869.271 | **1870** | 9 | **Ξ(1820)** |
| | | 161(128) | 1880.953 | | | |
| | | 175(128) | 2044.515 | **2044** | 8 | **Ξ(2030)** |
| **11(2048)** | = | 176(128) | 2056.198 | **2058** | 17 | **Ξ(2030)** |
| | | 177(128) | 2067.881 | | | |
| | | 191(128) | 2231.442 | | | |
| **12(2048)** | = | 192(128) | 2243.125 | **2244** | 52 | **Ξ(2250)** |
| | | 193(128) | 2254.808 | | | |
| | | 207(128) | 2418.369 | | | |
| **13(2048)** | = | 208(128) | 2430.052 | **2430** | 20 | **Ξ(2500)** |
| | | 209(128) | 2441.735 | | | |

## Commentary

Four Xi baryons have experimental masses that fall exactly on large factor blocks. One Xi baryon has mass data that falls *very close* to a large factor block - the Xi(1690).

Source of ExpMass and Error data: P.A. Zyla et al.(Particle Data Group), Prog. Theor. Exp. Phys. 2020, 083C01 (2020)

## 7. Summary

The first four Xi baryons - $Xi^o$, $Xi^-$, $Xi(1530)^o$, and $Xi(1530)^-$ - all seem to factor with power of two denominator fractions. They might have quark content **udd** instead of **ddd**, because all the N and Δ baryons, which have quark content **udd**, factor that way also. The rest of the Xi baryons seem to factor with power of seven denominator fractions times S7h, so they probably have quark content **ddd**.

The Xi(1820) and Xi(1950) don't seem to factor with S7h or S6h. They seem to factor with S13h. If that's the case, that would mean they have a quark content of **sss** or **ccc**, so they are not treated in this paper.

Two other Xi baryons - the Xi(2120) and Xi(2370) - are also not treated. More experimental mass data of good accuracy is needed to reach a firm conclusion about how they factor.

## 8. References

**[1]** P.A. Zyla et al. (Particle Data Group), Prog. Theor. Exp. Phys. 2020, 083C01 (2020)