

42. MONTE CARLO PARTICLE NUMBERING SCHEME

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The Monte Carlo particle numbering scheme presented here is intended to facilitate interfacing between event generators, detector simulators, and analysis packages used in particle physics. The numbering scheme was introduced in 1988 [1] and a revised version [2,3] was adopted in 1998 in order to allow systematic inclusion of quark model states which are as yet undiscovered and hypothetical particles such as SUSY particles. The numbering scheme is used in several event generators, *e.g.* HERWIG, PYTHIA, and SHERPA, and interfaces, *e.g.* /HEPEVT/ and HepMC.

The general form is a 7-digit number:

$$\pm n n_r n_L n_{q_1} n_{q_2} n_{q_3} n_J .$$

This encodes information about the particle's spin, flavor content, and internal quantum numbers. The details are as follows:

1. Particles are given positive numbers, antiparticles negative numbers. The PDG convention for mesons is used, so that K^+ and B^+ are particles.
2. Quarks and leptons are numbered consecutively starting from 1 and 11 respectively; to do this they are first ordered by family and within families by weak isospin.
3. In composite quark systems (diquarks, mesons, and baryons) $n_{q_{1-3}}$ are quark numbers used to specify the quark content, while the rightmost digit $n_J = 2J + 1$ gives the system's spin (except for the K_S^0 and K_L^0). The scheme does not cover particles of spin $J > 4$.
4. Diquarks have 4-digit numbers with $n_{q_1} \geq n_{q_2}$ and $n_{q_3} = 0$.
5. The numbering of mesons is guided by the nonrelativistic (L - S decoupled) quark model, as listed in Tables 15.2 and 15.3.
 - a. The numbers specifying the meson's quark content conform to the convention $n_{q_1} = 0$ and $n_{q_2} \geq n_{q_3}$. The special case K_L^0 is the sole exception to this rule.
 - b. The quark numbers of flavorless, light (u, d, s) mesons are: 11 for the member of the isotriplet (π^0, ρ^0, \dots), 22 for the lighter isosinglet (η, ω, \dots), and 33 for the heavier isosinglet (η', ϕ, \dots). Since isosinglet mesons are often large mixtures of $u\bar{u} + d\bar{d}$ and $s\bar{s}$ states, 22 and 33 are assigned by mass and do not necessarily specify the dominant quark composition.
 - c. The special numbers 310 and 130 are given to the K_S^0 and K_L^0 respectively.
 - d. The fifth digit n_L is reserved to distinguish mesons of the same total (J) but different spin (S) and orbital (L) angular momentum quantum numbers. For $J > 0$ the numbers are: (L, S) = ($J - 1, 1$) $n_L = 0$, ($J, 0$) $n_L = 1$, ($J, 1$) $n_L = 2$ and ($J + 1, 1$) $n_L = 3$. For the exceptional case $J = 0$ the numbers are (0, 0) $n_L = 0$ and (1, 1) $n_L = 1$ (*i.e.* $n_L = L$). See Table 42.1.

Table 42.1: Meson numbering logic. Here qq stands for $n_{q_2} n_{q_3}$.

J	$L = J - 1, S = 1$			$L = J, S = 0$			$L = J, S = 1$			$L = J + 1, S = 1$		
	code	J^{PC}	L	code	J^{PC}	L	code	J^{PC}	L	code	J^{PC}	L
0	—	—	—	00qq1	0 ⁺⁺	0	—	—	—	10qq1	0 ⁺⁺	1
1	00qq3	1 ⁻⁻	0	10qq3	1 ⁺⁻	1	20qq3	1 ⁺⁺	1	30qq3	1 ⁻⁻	2
2	00qq5	2 ⁺⁺	1	10qq5	2 ⁺⁻	2	20qq5	2 ⁻⁻	2	30qq5	2 ⁺⁺	3
3	00qq7	3 ⁻⁻	2	10qq7	3 ⁺⁻	3	20qq7	3 ⁺⁺	3	30qq7	3 ⁻⁻	4
4	00qq9	4 ⁺⁺	3	10qq9	4 ⁺⁻	4	20qq9	4 ⁻⁻	4	30qq9	4 ⁺⁺	5

- e. If a set of physical mesons correspond to a (non-negligible) mixture of basis states, differing in their internal quantum numbers, then the lightest physical state gets the smallest basis state number. For example the $K_1(1270)$ is numbered 10313 ($1^1P_1 K_{1B}$) and the $K_1(1400)$ is numbered 20313 ($1^3P_1 K_{1A}$).
- f. The sixth digit n_r is used to label mesons radially excited above the ground state.

- g. Numbers have been assigned for complete $n_r = 0$ S - and P -wave multiplets, even where states remain to be identified.
 - h. In some instances assignments within the $q\bar{q}$ meson model are only tentative; here best guess assignments are made.
 - i. Many states appearing in the Meson Listings are not yet assigned within the $q\bar{q}$ model. Here $n_{q_{2-3}}$ and n_J are assigned according to the state's likely flavors and spin; all such unassigned light isoscalar states are given the flavor code 22. Within these groups $n_L = 0, 1, 2, \dots$ is used to distinguish states of increasing mass. These states are flagged using $n = 9$. It is to be expected that these numbers will evolve as the nature of the states are elucidated. Codes are assigned to all mesons which are listed in the one-page table at the end of the Meson Summary Table as long as they have a preferred or established spin. Additional heavy meson states expected from heavy quark spectroscopy are also assigned codes.
6. The numbering of baryons is again guided by the nonrelativistic quark model, see Table 15.6. This numbering scheme is illustrated through a few examples in Table 42.2.
 - a. The numbers specifying a baryon's quark content are such that in general $n_{q_1} \geq n_{q_2} \geq n_{q_3}$.
 - b. Two states exist for $J = 1/2$ baryons containing 3 different types of quarks. In the lighter baryon ($\Lambda, \Xi, \Omega, \dots$) the light quarks are in an antisymmetric ($J = 0$) state while for the heavier baryon ($\Sigma^0, \Xi', \Omega', \dots$) they are in a symmetric ($J = 1$) state. In this situation n_{q_2} and n_{q_3} are reversed for the lighter state, so that the smaller number corresponds to the lighter baryon.
 - c. For excited baryons a scheme is adopted, where the n_r label is used to denote the excitation bands in the harmonic oscillator model, see Sec. 15.4. Using the notation employed there, n_r is given by the N -index of the D_N band identifier.
 - d. Further degeneracies of excited hadron multiplets with the same excitation number n_r and spin J are lifted by labelling such multiplets with the n_L index according to their mass, as given by its N or Δ -equivalent.
 - e. In such excited multiplets extra singlets may occur, the $\Lambda(1520)$ being a prominent example. In such cases the ordering is reversed such that the heaviest quark label is pushed to the last position: $n_{q_3} > n_{q_1} > n_{q_2}$.
 - f. For pentaquark states $n = 9$, $n_r n_L n_{q_1} n_{q_2}$ gives the four quark numbers in order $n_r \geq n_L \geq n_{q_1} \geq n_{q_2}$, n_{q_3} gives the antiquark number, and $n_J = 2J + 1$, with the assumption that $J = 1/2$ for the states currently reported.
 7. The gluon, when considered as a gauge boson, has official number 21. In codes for glueballs, however, 9 is used to allow a notation in close analogy with that of hadrons.
 8. The pomeron and odderon trajectories and a generic reggeon trajectory of states in QCD are assigned codes 990, 9990, and 110 respectively, where the final 0 indicates the indeterminate nature of the spin, and the other digits reflect the expected "valence" flavor content. We do not attempt a complete classification of all reggeon trajectories, since there is currently no need to distinguish a specific such trajectory from its lowest-lying member.
 9. Two-digit numbers in the range 21–30 are provided for the Standard Model gauge bosons and Higgs.
 10. Codes 81–100 are reserved for generator-specific pseudoparticles and concepts.
 11. The search for physics beyond the Standard Model is an active area, so these codes are also standardized as far as possible.
 - a. A standard fourth generation of fermions is included by analogy with the first three.
 - b. The graviton and the boson content of a two-Higgs-doublet scenario and of additional $SU(2) \times U(1)$ groups are found in the range 31–40.
 - c. "One-of-a-kind" exotic particles are assigned numbers in the range 41–80.
 - d. Fundamental supersymmetric particles are identified by adding a nonzero n to the particle number. The superpartner of a boson or a left-handed fermion has $n = 1$ while the superpartner of a right-handed fermion has $n = 2$. When mixing occurs, such as between the winos and charged

Table 42.2: Some examples of octet (top) and decuplet (bottom) members for the numbering scheme for excited baryons. Here qqq stands for $n_{q_1}n_{q_2}n_{q_3}$. See the text for the definition of the notation. The numbers in parenthesis correspond to the mass of the baryons. The states marked as (?) are not experimentally confirmed.

J^P	(D, L_N^P)	$n_r n_L n_{q_1} n_{q_2} n_{q_3} n_J$	N	Λ_8	Σ	Ξ	Λ_1
Octet			211,221	312	311,321,322	331,332	213
$1/2^+$	(56, 0_0^+)	00qqq2	(939)	(1116)	(1193)	(1318)	—
$1/2^+$	(56, 0_2^+)	20qqq2	(1440)	(1600)	(1660)	(1690)	—
$1/2^+$	(70, 0_2^+)	21qqq2	(1710)	(1810)	(1880)	(?)	(?)
$1/2^-$	(70, 1_1^-)	10qqq2	(1535)	(1670)	(1620)	(1750)	(1405)
J^P	(D, L_N^P)	$n_r n_L n_{q_1} n_{q_2} n_{q_3} n_J$	Δ	Σ	Ξ	Ω	
Decuplet			111,211,221,222	311,321,322	331,332	333	
$3/2^+$	(56, 0_0^+)	00qqq4	(1232)	(1385)	(1530)	(1672)	
$3/2^+$	(56, 0_2^+)	20qqq4	(1600)	(1690)	(?)	(?)	
$1/2^-$	(70, 1_1^-)	11qqq2	(1620)	(1750)	(?)	(?)	
$3/2^-$	(70, 1_1^-)	12qqq4	(1700)	(?)	(?)	(?)	

- Higgsinos to give charginos, or between left and right sfermions, the lighter physical state is given the smaller basis state number.
- Technicolor states have $n = 3$, with technifermions treated like ordinary fermions. States which are ordinary color singlets have $n_r = 0$. Color octets have $n_r = 1$. If a state has non-trivial quantum numbers under the topcolor groups $SU(3)_1 \times SU(3)_2$, the quantum numbers are specified by tech, ij , where i and j are 1 or 2. n_L is then $2i + j$. The coloron, V_8 , is a heavy gluon color octet and thus is 3100021.
 - Excited (composite) quarks and leptons are identified by setting $n = 4$ and $n_r = 0$.
 - Within several scenarios of new physics, it is possible to have colored particles sufficiently long-lived for color-singlet hadronic states to form around them. In the context of supersymmetric scenarios, these states are called R -hadrons, since they carry odd R -parity. R -hadron codes, defined here, should be viewed as templates for corresponding codes also in other scenarios, for any long-lived particle that is either an unflavored color octet or a flavored color triplet. The R -hadron code is obtained by combining the SUSY particle code with a code for the light degrees of freedom, with as many intermediate zeros removed from the former as required to make place for the latter at the end. (To exemplify, a sparticle $n0000n_{\tilde{q}}$ combined with quarks q_1 and q_2 obtains code $n00n_{\tilde{q}}n_{q_1}n_{q_2}n_{J.}$) Specifically, the new-particle spin decouples in the limit of large masses, so that the final n_J digit is defined by the spin state of the light-quark system alone. An appropriate number of n_q digits is used to define the ordinary-quark content. As usual, 9 rather than 21 is used to denote a gluon/gluino in composite states. The sign of the hadron agrees with that of the constituent new particle (a color triplet) where there is a distinct new antiparticle, and else is defined as for normal hadrons. Particle names are R with the flavor content as lower index.
 - A black hole in models with extra dimensions has code 5000040. Kaluza-Klein excitations in models with extra dimensions have $n = 5$ or $n = 6$, to distinguish excitations of left- or right-handed fermions or, in case of mixing, the lighter or heavier state (cf. 11d). The nonzero n_r digit gives the radial excitation number, in scenarios where the level spacing allow these to be distinguished. Should the model also contain supersymmetry, excited SUSY states would be denoted by an $n_r > 0$, with $n = 1$ or 2 as usual. Should some colored states be long-lived enough that hadrons would form around them, the coding strategy of 11g applies, with the initial two nm_r digits preserved in the combined code.
 - Magnetic monopoles and dyons are assumed to have one unit of Dirac monopole charge and a variable integer number

$n_{q_1}n_{q_2}n_{q_3}$ units of electric charge. Codes $411n_{q_1}n_{q_2}n_{q_3}0$ are then used when the magnetic and electrical charge sign agree and $412n_{q_1}n_{q_2}n_{q_3}0$ when they disagree, with the overall sign of the particle set by the magnetic charge. For now no spin information is provided.

- The nature of Dark Matter (DM) is not known, and therefore a definitive classification is too early. Candidates within specific scenarios are classified therein, such as 1000022 for the lightest neutralino. Generic fundamental states can be given temporary codes in the range 51 - 60, with 51, 52 and 53 reserved for spin 0, 1/2 and 1 ones. Generic mediators of s -channel DM pair creation or annihilation can be given codes 54 and 55 for spin 0 or 1 ones. Separate antiparticles, with negative codes, may or may not exist. More elaborate new scenarios should be constructed with $n = 5$ and $n_r = 9$.
- Hidden Valley particles have $n = 4$ and $n_r = 9$, and trailing numbers in agreement with their nearest-analog standard particles, as far as possible. Thus 4900021 is the gauge boson g_v of a confining gauge field, 490000 n_{q_v} and 490001 n_{ℓ_v} fundamental constituents charged or not under this, 4900022 is the γ_v of a non-confining field, and 4900 $n_{q_v1}n_{q_v2}n_J$ a Hidden Valley meson.
- Occasionally program authors add their own states. To avoid confusion, these should be flagged by setting $nm_r = 99$.
- Concerning the non-99 numbers, it may be noted that only quarks, excited quarks, squarks, and diquarks have $n_{q_3} = 0$; only diquarks, baryons (including pentaquarks), and the odderon have $n_{q_1} \neq 0$; and only mesons, the reggeon, and the pomeron have $n_{q_1} = 0$ and $n_{q_2} \neq 0$. Concerning mesons (not antimesons), if n_{q_1} is odd then it labels a quark and an antiquark if even.
- Nuclear codes are given as 10-digit numbers $\pm 10LZZZAAAI$. For a (hyper)nucleus consisting of n_p protons, n_n neutrons and n_Λ Λ 's, $A = n_p + n_n + n_\Lambda$ gives the total baryon number, $Z = n_p$ the total charge and $L = n_\Lambda$ the total number of strange quarks. I gives the isomer level, with $I = 0$ corresponding to the ground state and $I > 0$ to excitations, see [4], where states denoted m, n, p, q translate to $I = 1 - 4$. As examples, the deuteron is 1000010020 and ^{235}U is 1000922350. To avoid ambiguities, nuclear codes should not be applied to a single hadron, like p , n or Λ^0 , where quark-contents-based codes already exist.

This text and full lists of particle numbers can be found online [5].

References:

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QUARKS

d	1
u	2
s	3
c	4
b	5
t	6
b'	7
t'	8

LEPTONS

e^-	11
ν_e	12
μ^-	13
ν_μ	14
τ^-	15
ν_τ	16
τ'^-	17
$\nu_{\tau'}$	18

GAUGE AND HIGGS BOSONS

g	(9) 21
γ	22
Z^0	23
W^+	24
h^0/H_1^0	25
Z'/Z_2^0	32
Z''/Z_3^0	33
W'/W_2^+	34
H^0/H_2^0	35
A^0/H_3^0	36
H^+	37

SPECIAL PARTICLES

G (graviton)	39
R^0	41
LQ^c	42
DM(S = 0)	51*
DM(S = 1/2)	52*
DM(S = 1)	53*
reggeon	110
pomeron	990
odderon	9990

for MC internal
use 81–100

DIQUARKS

$(dd)_1$	1103
$(ud)_0$	2101
$(ud)_1$	2103
$(uu)_1$	2203
$(sd)_0$	3101
$(sd)_1$	3103
$(su)_0$	3201
$(su)_1$	3203
$(ss)_1$	3303
$(cd)_0$	4101
$(cd)_1$	4103
$(cu)_0$	4201
$(cu)_1$	4203
$(cs)_0$	4301
$(cs)_1$	4303
$(cc)_1$	4403
$(bd)_0$	5101
$(bd)_1$	5103
$(bu)_0$	5201
$(bu)_1$	5203
$(bs)_0$	5301
$(bs)_1$	5303
$(bc)_0$	5401
$(bc)_1$	5403
$(bb)_1$	5503

SUSY

PARTICLES

\tilde{d}_L	1000001
\tilde{u}_L	1000002
\tilde{s}_L	1000003
\tilde{c}_L	1000004
\tilde{b}_1	1000005 ^a
\tilde{t}_1	1000006 ^a
\tilde{e}_L	1000011
$\tilde{\nu}_{eL}$	1000012
$\tilde{\mu}_L$	1000013
$\tilde{\nu}_{\mu L}$	1000014
$\tilde{\tau}_1$	1000015 ^a
$\tilde{\nu}_{\tau L}$	1000016
\tilde{d}_R	2000001
\tilde{u}_R	2000002
\tilde{s}_R	2000003
\tilde{c}_R	2000004
\tilde{b}_2	2000005 ^a
\tilde{t}_2	2000006 ^a
\tilde{e}_R	2000011
$\tilde{\mu}_R$	2000013
$\tilde{\tau}_2$	2000015 ^a
\tilde{g}	1000021
$\tilde{\chi}_1^0$	1000022 ^b
$\tilde{\chi}_2^0$	1000023 ^b
$\tilde{\chi}_1^+$	1000024 ^b
$\tilde{\chi}_3^0$	1000025 ^b
$\tilde{\chi}_4^0$	1000035 ^b
$\tilde{\chi}_2^+$	1000037 ^b
\tilde{G}	1000039

LIGHT $I = 1$ MESONS

π^0	111
π^+	211
$a_0(980)^0$	9000111
$a_0(980)^+$	9000211
$\pi(1300)^0$	100111
$\pi(1300)^+$	100211
$a_0(1450)^0$	10111
$a_0(1450)^+$	10211
$\pi(1800)^0$	9010111
$\pi(1800)^+$	9010211
$\rho(770)^0$	113
$\rho(770)^+$	213
$b_1(1235)^0$	10113
$b_1(1235)^+$	10213
$a_1(1260)^0$	20113
$a_1(1260)^+$	20213
$\pi_1(1400)^0$	9000113
$\pi_1(1400)^+$	9000213
$\rho(1450)^0$	100113
$\rho(1450)^+$	100213
$\pi_1(1600)^0$	9010113
$\pi_1(1600)^+$	9010213
$a_1(1640)^0$	9020113
$a_1(1640)^+$	9020213
$\rho(1700)^0$	30113
$\rho(1700)^+$	30213
$\rho(1900)^0$	9030113
$\rho(1900)^+$	9030213
$\rho(2150)^0$	9040113
$\rho(2150)^+$	9040213
$a_2(1320)^0$	115
$a_2(1320)^+$	215
$\pi_2(1670)^0$	10115
$\pi_2(1670)^+$	10215
$a_2(1700)^0$	9000115
$a_2(1700)^+$	9000215
$\pi_2(2100)^0$	9010115
$\pi_2(2100)^+$	9010215
$\rho_3(1690)^0$	117
$\rho_3(1690)^+$	217
$\rho_3(1990)^0$	9000117
$\rho_3(1990)^+$	9000217
$\rho_3(2250)^0$	9010117
$\rho_3(2250)^+$	9010217
$a_4(2040)^0$	119
$a_4(2040)^+$	219

LIGHT $I = 0$ MESONS

$(u\bar{u}, d\bar{d}, \text{ and } s\bar{s} \text{ Admixtures})$	
η	221
$\eta'(958)$	331
$f_0(600)$	9000221
$f_0(980)$	9010221
$\eta(1295)$	100221
$f_0(1370)$	10221
$\eta(1405)$	9020221
$\eta(1475)$	100331
$f_0(1500)$	9030221
$f_0(1710)$	10331
$\eta(1760)$	9040221
$f_0(2020)$	9050221
$f_0(2100)$	9060221
$f_0(2200)$	9070221
$\eta(2225)$	9080221
$\omega(782)$	223
$\phi(1020)$	333
$h_1(1170)$	10223
$f_1(1285)$	20223
$h_1(1380)$	10333
$f_1(1420)$	20333
$\omega(1420)$	100223
$f_1(1510)$	9000223
$h_1(1595)$	9010223
$\omega(1650)$	30223
$\phi(1680)$	100333
$f_2(1270)$	225
$f_2(1430)$	9000225
$f_2'(1525)$	335
$f_2(1565)$	9010225
$f_2(1640)$	9020225
$\eta_2(1645)$	10225
$f_2(1810)$	9030225
$\eta_2(1870)$	10335
$f_2(1910)$	9040225
$f_2(1950)$	9050225
$f_2(2010)$	9060225
$f_2(2150)$	9070225
$f_2(2300)$	9080225
$f_2(2340)$	9090225
$\omega_3(1670)$	227
$\phi_3(1850)$	337
$f_4(2050)$	229
$f_J(2220)$	9000229
$f_4(2300)$	9010229

STRANGE MESONS		CHARMED MESONS		$c\bar{c}$ MESONS		LIGHT BARYONS		BOTTOM BARYONS			
K_L^0	130	D^+	411	$\eta_c(1S)$	441	p	2212	Λ_b^0	5122		
K_S^0	310	D^0	421	$\chi_{c0}(1P)$	10441	n	2112	Σ_b^-	5112		
K^0	311	$D_0^*(2400)^+$	10411	$\eta_c(2S)$	100441	Δ^{++}	2224	Σ_b^0	5212		
K^+	321	$D_0^*(2400)^0$	10421	$J/\psi(1S)$	443	Δ^+	2214	Σ_b^+	5222		
$K_0^*(800)^0$	9000311	$D^*(2010)^+$	413	$h_c(1P)$	10443	Δ^0	2114	Σ_b^{*-}	5114		
$K_0^*(800)^+$	9000321	$D^*(2007)^0$	423	$\chi_{c1}(1P)$	20443	Δ^-	1114	Σ_b^{*0}	5214		
$K_0^*(1430)^0$	10311	$D_1(2420)^+$	10413	$\psi(2S)$	100443	STRANGE BARYONS					
$K_0^*(1430)^+$	10321	$D_1(2420)^0$	10423	$\psi(3770)$	30443	Λ	3122	Σ_b^{*+}	5224		
$K(1460)^0$	100311	$D_1(H)^+$	20413	$\psi(4040)$	9000443	Σ^+	3222	Ξ_b^-	5132		
$K(1460)^+$	100321	$D_1(2430)^0$	20423	$\psi(4160)$	9010443	Σ^0	3212	Ξ_b^0	5232		
$K(1830)^0$	9010311	$D_2^*(2460)^+$	415	$\psi(4415)$	9020443	Σ^-	3112	Ξ_b^{*-}	5312		
$K(1830)^+$	9010321	$D_2^*(2460)^0$	425	$\chi_{c2}(1P)$	445	Σ^{*+}	3224 ^c	Ξ_b^0	5322		
$K_0^*(1950)^0$	9020311	D_s^+	431	$\chi_{c2}(2P)$	100445	Σ^{*0}	3214 ^c	Ξ_b^-	5314		
$K_0^*(1950)^+$	9020321	$D_{s0}^*(2317)^+$	10431	$b\bar{b}$ MESONS				Σ^{*-}	3114 ^c	Ξ_b^{*0}	5324
$K^*(892)^0$	313	D_s^{*+}	433	$\eta_b(1S)$	551	Ξ^0	3322	Ξ_b^-	5332		
$K^*(892)^+$	323	$D_{s1}(2536)^+$	10433	$\chi_{b0}(1P)$	10551	Ξ^-	3312	Ω_b^-	5334		
$K_1(1270)^0$	10313	$D_{s1}(2460)^+$	20433	$\eta_b(2S)$	100551	Ξ^{*0}	3324 ^c	Ω_b^{*-}	5334		
$K_1(1270)^+$	10323	$D_{s2}^*(2573)^+$	435	$\chi_{b0}(2P)$	110551	Ξ^{*-}	3314 ^c	Ξ_{bc}^0	5142		
$K_1(1400)^0$	20313	BOTTOM MESONS				$\eta_b(3S)$	200551	Ξ_{bc}^+	5242		
$K_1(1400)^+$	20323	B^0	511	$\chi_{b0}(3P)$	210551	Λ_c^+	4122	Ξ_{bc}^0	5412		
$K^*(1410)^0$	100313	B^+	521	$\Upsilon(1S)$	553	Σ_c^{++}	4222	Ξ_{bc}^+	5422		
$K^*(1410)^+$	100323	B_0^0	10511	$h_b(1P)$	10553	Σ_c^+	4212	Ξ_{bc}^{*0}	5414		
$K_1(1650)^0$	9000313	B_0^{*+}	10521	$\chi_{b1}(1P)$	20553	Σ_c^0	4112	Ξ_{bc}^{*+}	5424		
$K_1(1650)^+$	9000323	B^{*0}	513	$\Upsilon_1(1D)$	30553	Σ_c^{*+}	4224	Ω_{bc}^0	5342		
$K^*(1680)^0$	30313	B^{*+}	523	$\Upsilon(2S)$	100553	Σ_c^{*0}	4114	$\Omega_{bc}^{\prime 0}$	5432		
$K^*(1680)^+$	30323	$B_1(L)^0$	10513	$h_b(2P)$	110553	Σ_c^{*0}	4114	$\Omega_{bc}^{\prime 0}$	5434		
$K_2^*(1430)^0$	315	$B_1(L)^+$	10523	$\chi_{b1}(2P)$	120553	Ξ_c^+	4232	Ω_{bcc}^+	5442		
$K_2^*(1430)^+$	325	$B_1(H)^0$	20513	$\Upsilon_1(2D)$	130553	Ξ_c^0	4132	Ω_{bcc}^{*+}	5444		
$K_2(1580)^0$	9000315	$B_1(H)^+$	20523	$\Upsilon(3S)$	200553	Ξ_c^+	4322	Ξ_{bb}^-	5512		
$K_2(1580)^+$	9000325	B_2^0	515	$h_b(3P)$	210553	Ξ_c^0	4312	Ξ_{bb}^0	5522		
$K_2(1770)^0$	10315	B_2^{*+}	525	$\chi_{b1}(3P)$	220553	Ξ_c^{*+}	4324	Ξ_{bb}^{*-}	5514		
$K_2(1770)^+$	10325	B_s^0	531	$\Upsilon(4S)$	300553	Ξ_c^{*0}	4314	Ξ_{bb}^{*0}	5524		
$K_2(1820)^0$	20315	B_{s0}^0	10531	$\Upsilon(10860)$	9000553	Ω_c^0	4332	Ω_{bb}^-	5532		
$K_2(1820)^+$	20325	B_s^{*0}	533	$\Upsilon(11020)$	9010553	Ω_c^{*0}	4334	Ω_{bb}^{*-}	5534		
$K_2^*(1980)^0$	9010315	$B_{s1}(L)^0$	10533	$\chi_{b2}(1P)$	555	Ξ_{cc}^+	4412	Ω_{bbc}^0	5542		
$K_2^*(1980)^+$	9010325	$B_{s1}(H)^0$	20533	$\eta_{b2}(1D)$	10555	Ξ_{cc}^{++}	4422	Ω_{bbc}^{*0}	5544		
$K_2(2250)^0$	9020315	B_{s2}^{*0}	535	$\Upsilon_2(1D)$	20555	Ξ_{cc}^{*+}	4414	Ω_{bbb}^-	5554		
$K_2(2250)^+$	9020325	B_c^+	541	$\chi_{b2}(2P)$	100555	Ξ_{cc}^{*+}	4424				
$K_3^*(1780)^0$	317	B_{c0}^{*+}	10541	$\eta_{b2}(2D)$	110555	Ω_{cc}^+	4432				
$K_3^*(1780)^+$	327	B_c^{*+}	543	$\Upsilon_2(2D)$	120555	Ω_{cc}^{*+}	4434				
$K_3(2320)^0$	9010317	$B_{c1}(L)^+$	10543	$\chi_{b2}(3P)$	200555	Ω_{ccc}^{*+}	4444				
$K_3(2320)^+$	9010327	$B_{c1}(H)^+$	20543	$\Upsilon_3(1D)$	557						
$K_4^*(2045)^0$	319	B_{c2}^{*+}	545	$\Upsilon_3(2D)$	100557						
$K_4^*(2045)^+$	329										
$K_4(2500)^0$	9000319										
$K_4(2500)^+$	9000329										

Footnotes to the Tables:

- *) Numbers or names in bold face are new or have changed since the 2014 *Review*.
- a) Particularity in the third generation, the left and right sfermion states may mix, as shown. The lighter mixed state is given the smaller number.
- b) The physical $\tilde{\chi}$ states are admixtures of the pure $\tilde{\gamma}$, \tilde{Z}^0 , \tilde{W}^+ , \tilde{H}_1^0 , \tilde{H}_2^0 , and \tilde{H}^+ states.
- c) Σ^* and Ξ^* are alternate names for $\Sigma(1385)$ and $\Xi(1530)$.