The Elementary Particle Entity Notation (PEN) Scheme

Michel Goossens
CERN, CH-1211 Geneva 23, Switzerland

Abstract
The Elementary Particle Entity Notation (PEN) scheme is presented. It defines markup for all known particles and thus allows for automatic extraction of information about these particles by recognition of their entity names. An implementation with LaTeX is available, which also ensures the typographic correctness of the printed symbols.

Keywords: Text-processing; LaTeX; elementary particles; PEN.

1 Typographical rules for scientific texts

In scientific texts the printed form of a symbol often implies a meaning which is not easily captured by generic markup. Therefore authors using some form of generic coding (like LaTeX or XML) need to know about typographical conventions. The following is a brief summary of the most important rules for composing scientific texts [1, 2].

The most important rule is *consistency*: a symbol should always be the same, whether it appears in a formula or in the text, on the main line or as a superscript or subscript. I.e. in LaTeX, once you have used a symbol inside mathematics mode ('$'), always use it inside mathematics mode. Inside math mode, LaTeX by default prints characters in *italics*.

For scientific work, however, quite a few symbols must be set in *roman* (upright) characters[1]. This is the case for the following families of symbols, which represent the names of:

- units, such as g, cm, s, keV. Note that physical constants are usually in italics, so units involving constants are mixed roman-italics, e.g., GeV/c (where the c is italic because it symbolizes the speed of light, a constant);
- particles, for example p, K, q, H. For elementary particles the PEN (Particle Entity Notation) scheme is proposed (see the next section);
- standard mathematical functions (sin, det, cos, tan, Re, Im, etc.). Use the built-in LaTeX functions for these (`\sin`, `\ln`, etc.);
- chemical elements, for example Ne, O, Cu;
- numbers;
- names of waves or states (p-wave) and covariant couplings (A for axial, V for vector), names of monopoles (E for electric, M for magnetic);
- abbreviations that are initials of bits of words (exp, for experimental; min, for minimum);
- the 'd' in integrands (e.g., $\mathrm{d}p$).

In all cases, following these rules will help the reader understand at first glance what you are talking about. Some instances in which it is important to use the correct symbol, in the correct type, are shown in Table 1.

Let your word processor do as much work as it can. Do not try to change your system's defaults too much; this will decrease the portability and maintainability of your documents. LaTeX implements part of the rules mentioned above by default in math mode.

[1] With LaTeX roman type in maths mode can be achieved by the `\mathrm` command.

Table 1: Importance of using the correct type

roman type		*italic type*	
A	ampere (electric unit)	A	atomic number (variable)
e	electron (particle name)	e	electron charge (constant)
g	gluon (particle name)	g	gravitational constant
l	litre (volume unit)	l	length (variable)
m	metre (length unit)	m	mass (variable)
p	proton (particle name)	p	momentum (variable)
q	quark (particle name)	q	electric charge (variable)
s	second (time unit)	s	c.m. energy squared (variable)
t	tonne (weight unit)	t	time (variable)
V	volt (electric unit)	V	volume (variable)
Z	Z boson (particle name)	Z	atomic charge (variable)

Do not add blanks at random to make formulae look 'nicer', and restrain from using specific page layout commands (like `\newline` or `\newpage` with LaTeX). You will forget that you put them in your text and later wonder why some text is badly adjusted or starts a new line or page.

2 Entity definitions for elementary particles

In texts on high energy physics frequently re-occurring strings are the names of elementary particles. For example, the Z^0 particle can be coded in various different ways with LaTeX: `Z$^0$`, `$\mbox{Z}^0$`, and `$\mathrm{Z^0}$` all achieve the same typographical effect, a roman Z with a superscript 0. In the interest of standardization and typing convenience, we propose below an 'entity' naming scheme, which will not only relieve the user from having to worry about the correctness of what he types, but also will allow an automatic extraction of the particle names from the input file, so that it will be easy to enter data about an article using this convention into a database of abstracts.

The naming scheme uses a notation which takes the following constraints into consideration:

1. The notation should be able to describe all particles in the particle data summary tables from the 'Review of Particle Properties' [3] and any future extension to these.
2. Common particles such as protons and electrons should have short and simple names.
3. Items that are indicated by superscripts are indicated before items that are indicated by subscripts.

The mass or other discriminating characteristic of a particle is not added to the entity name, which means that an entity on its own does in general not unambiguously identify a particle, e.g., Υ(1S) and Υ(10860) are both referred to as `PGU`. This ambiguity is eleminated adding a letter '`R`' (for 'Resonance') to the end of the entity name and specifying the mass or other characteristic of the particle as a mandatory argument parameter. Thus the above two particles are marked up as `\PGUR{1S}`, and `\PGUR{10860}`, respectively. The PEN scheme is independent of any text processing system. A LaTeX impementation is available (`hepnames2.sty`) which allows one to use the PEN names in both mathematics and text mode.

It should be noted that the present scheme differs quite substantially from the original 1994 version in that a more rigorous approach was taken to make it more open-ended. This was achieved by transferring all mass and spectroscopic information into an attribute (argument in the LaTeX implementation). The implementation will be updated regularly to take into account the most recent version of the Review of Particle Properties publication.

2.1 Principles of the Particle Entity Notation (PEN)

Starting at the left, a name is built from the following characters:

Table 2: Codes for Greek characters

Greek	name	code	Greek	name	code	Greek	name	code	Greek	name	code
α	alpha	a	A	Alpha	A	β	beta	b	B	Beta	B
γ	gamma	g	Γ	Gamma	G	δ	delta	d	Δ	Delta	D
ε	epsilon	e	E	Epsilon	E	ζ	zeta	z	Z	Zeta	Z
η	eta	h	H	Eta	H	θ	theta	q	Θ	Theta	Q
ι	iota	i	I	Iota	I	κ	kappa	k	K	Kappa	K
λ	lambda	l	Λ	Lambda	L	μ	mu	m	M	Mu	M
ν	nu	n	N	Nu	N	ξ	xi	x	Ξ	Xi	X
o	omicron	o	O	Omicron	O	π	pi	p	Π	Pi	P
ρ	rho	r	R	Rho	R	σ	sigma	s	Σ	Sigma	S
τ	tau	t	T	Tau	T	υ	upsilon	u	Y	Upsilon	U
ϕ	phi	f	Φ	Phi	F	χ	chi	c	X	Chi	C
ψ	psi	y	Ψ	Psi	Y	ω	omega	w	Ω	Omega	W

1. Start the entity with a recognized string (in the following this was chosen as `uppercase P`). This is necessary to uniquely identify entities as following the PEN convention.
2. The following letters act as an escape to signal a special interpretation of the string. Present escape sequences are:
   - `A` for anti particle (normally visually represented with a bar over the particle's name);
   - `G` for indicating the subsequent letter is Greek. The correspondence between Latin and Greek letters is based on the notation for mathematical Greek characters used by the AAP mathematical formula application [5] and is shown in Table 2.
   - `Q` for quark particle;
   - `S` for supersymmetric particle;
   - `XX` for particle not strictly following naming scheme, e.g., `\PXXA` for *axion*.

   The precedence (from highest to lowest) is `A`, `S`, `Q`, `G` and `XX`.
3. The one-letter name of the particle.
4. Optionally followed by other information, reading from top (superscript(s)) to bottom (subscript(s)), and from left to right.
   - **superscripts:** `z` for *zero*, `m` for *minus*, `p` for *plus*, `pm` for *plus/minus*, `mp` for *minus/plus*, `pr` for *prime*, `st` for *star* (asterisk);
   - **subscripts:** `D` for *digit*, followed by a one-letter code representing the digit, as follows: `z` (zero), `o` (one), `t` (two), `T` (three), `f` (four), `F` (five), `s` (six), `S` (seven), `e` (eight), `n` (nine);
   - **subscripts (*cont.*):** `b` for *bottom*, `c` for *charmed*, `d` for *down*, `s` for *strange*, `t` for *top*, `u` for *up*;
   - **subscripts (*cont.*):** other one-letter codes, such as `J` for *unknown spin* `L` for *left* or *long*, `R` for *right*, `S` for *short*.
5. `P` for *Parenthesis*. In this case an obligatory argument specifies characteristics of the resonance, such as its mass or quantum numbers, which will be typeset between parentheses.

2.2 Particle encodings according to the PEN Scheme

In Table 3 we show how to encode the particles from the summary tables of particle properties in the 'Review of Particle Properties' [3] using the PEN convention. In the rightmost column we give the computer name of the particle.

The LaTeX implementation is available as a style file `heppennames2.sty`. To obtain the symbol required, prefix the PEN name by a backslash ('\').

References

[1] International Union of pure and applied Physics. *Symbols, Units, Nomenclature and fundamental Constants in Physics*. Physica, 146A:1–67, 1987.

[2] D.E. Lowe. *A Guide to international recommendations on names and symbols for quantities and on units of measurements*. World Health Organization, Geneva, 1975.

[3] L. Alvarez-Gaumé *et al.*: *Particle Data Group*. Physics Letters **B592** 1–1112 (2004). `http://pdg.lbl.gov`

[4] E. van Herwijnen. *Practical SGML*. Wolters-Kluwer Academic Publishers, Boston, 1990.

[5] American National Standards Institute. *American National Standard for Electronic Manuscript Preparation and Markup* ANSI/NISO Z39.59-1988, 1988.

The files `heppennames2.sty`, the definitions for the particle names with LaTeX, and `pennames.pdf`, a printable version of the present document, can be obtained at the URL `http://xml.cern.ch/pennames/pennameswww.xhtml`.

Please send comments or suggestions to `michel.goossens@cern.ch`.

Table 3: PEN names for elementary particles in PDG list

PEN name	Representation	Computer name
	Quarks	
PQq, PAQq	$q, \overline{q}$	q, q-bar
PQd, PAQd	$d, \overline{d}$	d, d-bar
PQqd, PAqQd	$q_d, \overline{q}_d$	q(d), q-bar(d)
PQu, PAQu	$u, \overline{u}$	u, u-bar
PQqu, PAQqu	$q_u, \overline{q}_u$	q(u), q-bar(u)
PQs, PAQs	$s, \overline{s}$	s, s-bar
PQqs, PAQqs	$q_s, \overline{q}_s$	q(s), q-bar(s)
PQc, PAQc	$c, \overline{c}$	c, c-bar
PQqc, PAQqc	$q_c, \overline{q}_c$	q(c), q-bar(c)
PQb, PAQb	$b, \overline{b}$	b, b-bar
PQqb, PAQqb	$q_b, \overline{q}_b$	q(b), q-bar(b)
PQt, PAQt	$t, \overline{t}$	t, t-bar
PQqt, PAQqt	$q_t, \overline{q}_t$	q(t), q-bar(t)
PQbpr, PAQbpr	$b', \overline{b}'$	b', b'-bar
PQqbpr, PAQqbpr	$q_{b'}, \overline{q}_{b'}$	q(b'), q-bar(b')
PQtpr, PAQtpr	$t', \overline{t}'$	t', t'-bar
PQqtpr, PAQqtpr	$q_{t'}, \overline{q}_{t'}$	q(t'), q-bar(t')
	Leptons	
Pl, PAl	$l, \overline{l}$	l, l-bar
Plm, Plp, Plpm	$l^-, l^+, l^\pm$	l-, l+, l+-
PlR, PlmR	l_R, l_R^-	l(R), L(R)-
Pe, Pem, Pep, Pepm	$e, e^-, e^+, e^\pm$	e, e-, e+, e+-
PGb, PGbm, PGbp	β, β^-, β^+	beta, beta-, beta+
PGm, PGmm, PGmp, PGmpm	$\mu, \mu^-, \mu^+, \mu^\pm$	mu, mu-, mu+ , mu+-
PGt, PGtm, PGtp, PGtpm	$\tau, \tau^-, \tau^+, \tau^\pm$	tau, tau-, tau+, tau+-
PGtpr, PGtprm, PGprtp	τ, τ^-, τ^+	tau', tau'-, tau'+
PL, PAL	$L, \overline{L}$	L, L-bar

Table 3: PEN names (*continued*)

PEN name	Representation	Computer name
`PLm, PLp, PLpm`	$\mathrm{L}^-, \mathrm{L}^+, \mathrm{L}^\pm$	`L-, L+, L+-`
`PGn, PAGn`	$\nu, \overline{\nu}$	`nu, nu-bar`
`PGnl, PAGnl`	$\nu_\mathrm{l}, \overline{\nu}_\mathrm{l}$	`nu(l), nu-bar(l)`
`PGne, PAGne`	$\nu_\mathrm{e}, \overline{\nu}_\mathrm{e}$	`nu(e), nu-bar(e)`
`PGnGm, PAGnGm`	$\nu_\mu, \overline{\nu}_\mu$	`nu(mu), nu-bar(mu)`
`PGnGt, PAGnGt`	$\nu_\tau, \overline{\nu}_\tau$	`nu(tau), nu-bar(tau)`
`PGnGtpr, PAGnGtpr`	$\nu_\tau, \overline{\nu}_\tau$	`nu(tau'), nu-bar(tau')`
Gauge and Higgs Bosons (Standard Model)		
`Pg`	g	`g`
`PGg`	γ	`gamma`
`PW`	W	`W`
`PWm, PWp, PWpm`	$\mathrm{W}^-, \mathrm{W}^+, \mathrm{W}^\pm$	`W-, W+, W+-`
`PZ, PZz`	Z, Z^0	`Z, Z0`
`PH, PHz`	H, H^0	`H, H0`
Bosons (outside Standard Model)		
`PWpr, PWDt, PWpDt`	$\mathrm{W}', \mathrm{W}_2, \mathrm{W}_2^+$	`W', W(2), W(2)'`
`PWL, PWR`	$\mathrm{W}_\mathrm{L}, \mathrm{W}_\mathrm{R}$	`W(L), W(R)`
`PZpr, PZprpr, PZst`	$\mathrm{Z}', \mathrm{Z}'', \mathrm{Z}^*$	`Z', Z'', Z*`
`PZzDt, PZzDT`	$\mathrm{Z}_2^0, \mathrm{Z}_3^0$	`Z(2)0, Z(3)0`
`PZL, PZR, PZLR`	$\mathrm{Z}_\mathrm{L}, \mathrm{Z}_\mathrm{R}, \mathrm{Z}_\mathrm{LR}$	`Z(L), Z(R), Z(LR)`
`PZGc, PZGe, PZGy`	$\mathrm{Z}_\chi, \mathrm{Z}_\eta, \mathrm{Z}_\psi$	`Z(chi), Z(eta), Z(psi)`
Light I=1 mesons ($S = C = B = 0$)		
`PGp, PGppm, PGpmp`	$\pi, \pi^\pm, \pi^\mp$	`pi, pi+-, pi-+`
`PGpm, PGpp, PGpz`	π^-, π^+, π^0	`pi-, pi+, pi0`
`PGrP{770}, PGrpP{770}, PGrzP{770}`	$\rho(770), \rho^+(770), \rho^0(770)$	`rho(770)0,+`
`PaDzP{980}, PapDzP{980}, PazDzP{980}`	$\mathrm{a}_0(980), \mathrm{a}_0^+(980), \mathrm{a}_0^0(980)$	`a(0)(980)0,+`
`PbDoP{1235}, PbpDoP{1235}, PbzDoP{1235}`	$\mathrm{b}_1(1235), \mathrm{b}_1^+(1235), \mathrm{b}_1^0(1235)$	`b(1)(1235)0,+`
`PaDoP{1260}, PapDoP{1260}, PazDoP{1260}`	$\mathrm{a}_1(1260), \mathrm{a}_1^+(1260), \mathrm{a}_1^0(1260)$	`a(1)(1260)0,+`
`PGpP{1300}, PGppP{1300}, PGpzP{1300}`	$\pi(1300), \pi^+(1300), \pi^0(1300)$	`pi(1300)0,+`

Table 3: PEN names (*continued*)

PEN name	Representation	Computer name
PaDtP{1320}, PapDtP{1320}, PazDtP{1320}	$a_2(1320), a_2^+(1320), a_2^0(1320)$	a(2)(1320)0,+
PGpDoP{1400}, PGppDoP{1400}, PGpzDoP{1400}	$\pi_1(1400), \pi_1^+(1400), \pi_1^0(1400)$	pi(1)(1400)0,+
PaDzP{1450}, PapDzP{1450}, PazDzP{1450}	$a_0(1450), a_0^+(1450), a_0^0(1450)$	a(0)(1450)0,+
PGrP{1450}, PGrpP{1450}, PGrzP{1450}	$\rho(1450), \rho^+(1450), \rho^0(1450)$	rho(1450)0,+
PGpDoP{1600}, PGppDoP{1600}, PGpzDoP{1600}	$\pi_1(1600), \pi_1^+(1600), \pi_1^0(1600)$	pi(1)(1600)0,+
PaDoP{1640}, PapDoP{1640}, PazDoP{1640}	$a_1(1640), a_1^+(1640), a_1^0(1640)$	a(1)1(1640)0,+
PGpDtP{1670}, PGppDtP{1670}, PGpzDtP{1670}	$\pi_2(1670), \pi_2^+(1670), \pi_2^0(1670)$	pi(2)(1670)0,+
PGrDTP{1690}, PGrpDTP{1690}, PGrzDTP{1690}	$\rho_3(1690), \rho_3^+(1690), \rho_3^0(1690)$	rho(3)(1690)0,+
PGrP{1700}, PGrpP{1700}, PGrzP{1700}	$\rho(1700), \rho^+(1700), \rho^0(1700)$	rho(1700)0,+
PaDtP{1700}, PapDtP{1700}, PazDtP{1700}	$a_2(1700), a_2^+(1700), a_2^0(1700)$	a(2)(1700)0,=
PGpP{1800}, PGppP{1800}, PGpzP{1800}	$\pi(1800), \pi^+(1800), \pi^0(1800)$	pi(1800)0,+
PGrP{1900}, PGrpP{1900}, PGrzP{1900}	$\rho(1900), \rho^+(1900), \rho^0(1900)$	rho(1900)0,+
PGrDTP{1990}, PGrpDTP{1990}, PGrzDTP{1990}	$\rho_3(1990), \rho_3^+(1990), \rho_3^0(1990)$	rho(3)(1990)0,+
PaDfP{2040}, PapDfP{2040}, PazDfP{2040}	$a_4(2040), a_4^+(2040), a_4^0(2040)$	a(4)(2040)0,+
PGpP{2100}, PGppP{2100}, PGpzP{2100}	$\pi(2100), \pi^+(2100), \pi^0(2100)$	pi(2100)0,+
PGrP{2150}, PGrpP{2150}, PGrzP{2150}	$\rho(2150), \rho^+(2150), \rho^0(2150)$	rho(2150)0,+
PGrDTP{2250}, PGrpDTP{2250}, PGrzDTP{2250}	$\rho_3(2250), \rho_3^+(2250), \rho_3^0(2250)$	rho(3)(2250)0,+
PGrDFP{2350}, PGrpDFP{2350}, PGrzDFP{2350}	$\rho_5(2350), \rho_5^+(2350), \rho_5^0(2350)$	rho(5)(2350)0,+
PaDsP{2450}, PapDsP{2450}, PazDsP{2450}	$a_6(2450), a_6^+(2450), a_6^0(2450)$	a(6)(2450)0,+
Light I=0 mesons ($S = C = B = 0$)		
PGh, PGhpr	η, η'	eta, eta'
PfDzP{600}	$f_0(600)$	f0(600)0
PGoP{782}	$\omega(782)$	omega(782)0
PGhprP{958}	$\eta'(958)$	eta'(958)0
PfDzP{980}	$f_0(980)$	f(0)(980)0
PGfP{1020}	$\phi(1020)$	phi(1020)0
PhDoP{1170}	$h_1(1170)$	h(1)(1170)0
PfDtP{1270}	$f_2(1270)$	f(2)(1270)0
PfDoP{1285}	$f_1(1285)$	f(1)(1285)0
PGhP{1295}	$\eta(1295)$	eta(1295)0

Table 3: PEN names (*continued*)

PEN name	Representation	Computer name
PfDzP{1370}	$f_0(1370)$	f(0)(1370)0
PhDoP{1380}	$h_1(1380)$	h(1)(1380)0
PGhP{1405}	$\eta(1405)$	eta(1405)0
PfDoP{1420}	$f_1(1420)$	f(1)(1420)0
PGoP{1420}	$\omega(1420)$	omega(1420)0
PfDtP{1430}	$f_2(1430)$	f(2)(1430)0
PGrP{1450}	$\rho(1450)$	rho(1450)0
PfDzP{1500}	$f_0(1500)$	f(0)(1500)0
PfDoP{1510}	$f_1(1510)$	f(1)(1510)0
PfprDtP{1525}	$f_2'(1525)$	f(2)'(1525)0
PfDtP{1565}	$f_2(1565)$	f(2)(1565)0
PhDoP{1595}	$h_1(1595)$	h(1)(1595)0
PfDtP{1640}	$f_2(1640)$	f(2)(1640)0
PGhDtP{1645}	$\eta_2(1645)$	eta(2)(1645)0
PGoP{1650}	$\omega(1650)$	omega(1650)0
PGoDTP{1670}	$\omega_3(1670)$	omega(3)(1670)0
PGfP{1680}	$\phi(1680)$	phi(1680)0
PfDzP{1710}	$f_0(1710)$	f(0)(1710)0
PGhP{1760}	$\eta(1760)$	eta(1760)0
PfDtP{1810}	$f_2(1810)$	f(2)(1810)0
PGfDTP{1850}	$\phi_3(1850)$	phi(3)(1850)0
PGhDtP{1870}	$\eta_2(1870)$	eta(2)(1870)0
PfDtP{1910}	$f_2(1910)$	f(2)(1910)0
PfDtP{1950}	$f_2(1950)$	f(2)(1950) 0
PfDtP{2010}	$f_2(2010)$	f(2)(2010)0
PfDzP{2020}	$f_0(2020)$	f(0)(2020)0
PfDfP{2050}	$f_4(2050)$	f(4)(2050)0
PfDzP{2100}	$f_0(2100)$	f(0)(2100)0
PfDtP{2150}	$f_2(2150)$	f(2)(2150)0
PfDzP{2200}	$f_0(2200)$	f(0)(2200)0

Table 3: PEN names (*continued*)

PEN name	Representation	Computer name
`PfJP{2220}`	$\mathrm{f_J}(2220)$	`f(J)(2220)0`
`PGhP{2225}`	$\eta(2225)$	`eta(2225)0`
`PfDtP{2300}`	$\mathrm{f_2}(2300)$	`f(2)(2300)0`
`PfDfP{2300}`	$\mathrm{f_4}(2300)$	`f(4)(2300)0`
`PfDtP{2340}`	$\mathrm{f_2}(2340)$	`f(2)(2340)0`
`PfDsP{2510}`	$\mathrm{f_6}(2510)$	`f(6)(2510)0`
Strange mesons ($S = \pm 1, C = B = 0$)		
`PK, PKpm, PKmp, PKm, PKp`	$\mathrm{K}, \mathrm{K}^{\pm}, \mathrm{K}^{\mp}, \mathrm{K}^{-}, \mathrm{K}^{+}$	`K, K+-, K-+, K-, K+`
`PKL, PKS, PKst`	$\mathrm{K_L}, \mathrm{K_S}, \mathrm{K}^*$	`K(L), K(S), K*`
`PAK, PAKst, PAKz`	$\overline{\mathrm{K}}, \overline{\mathrm{K}}^*, \overline{\mathrm{K}}^0$	`K-bar, K(*)-bar, K0-bar`
`PKz, PKzL, PKzS`	$\mathrm{K}^0, \mathrm{K}^0_\mathrm{L}, \mathrm{K}^0_\mathrm{S}$	`K0, K(L)0, K(S)0`
`PKstDzP{800}`	$\mathrm{K}^*_0(800)$	`K*(800)0`
`PKstP{892}`	$\mathrm{K}^*(892)$	`K*(892)0,+`
`PKDoP{1270}`	$\mathrm{K_1}(1270)$	`K(1)(1270)0,+`
`PKDoP{1400}`	$\mathrm{K_1}(1400)$	`K(1)(1400)0,+`
`PKstP{1410}`	$\mathrm{K}^*(1410)$	`K*(1410)0,+`
`PKstDzP{1430}`	$\mathrm{K}^*_0(1430)$	`K(0)*(1430)0,+`
`PKstDtP{1430}`	$\mathrm{K}^*_2(1430)$	`K(2)*(1430)0,+`
`PKP{1460}`	$\mathrm{K}(1460)$	`K(1460)0,+`
`PKDtP{1580}`	$\mathrm{K_2}(1580)$	`K(2)(1580)0,+`
`PKP{1630}`	$\mathrm{K}(1630)$	`K(1630)0,+`
`PKDoP{1650}`	$\mathrm{K_1}(1650)$	`K(1)(1650)0,+`
`PKstP{1680}`	$\mathrm{K}^*(1680)$	`K*(1680)0,+`
`PKDtP{1770}`	$\mathrm{K_2}(1770)$	`K(2)(1770)0,+`
`PKstDTP{1780}`	$\mathrm{K}^*_3(1780)$	`K(3)*(1780)0,+`
`PKDtP{1820}`	$\mathrm{K_2}(1820)$	`K(2)(1820)0,+`
`PKP{1830}`	$\mathrm{K}(1830)$	`K(1830)0,+`
`PKstDzP{1950}`	$\mathrm{K}^*_0(1950)$	`K(0)*(1950)0,+`
`PKstDtP{1980}`	$\mathrm{K}^*_2(1980)$	`K(2)*(1980)0,+`
`PKstDfP{2045}`	$\mathrm{K}^*_4(2045)$	`K(4)*(2045)0,+`

Table 3: PEN names (*continued*)

PEN name	Representation	Computer name
PKDtP{2250}	$\mathrm{K}_2(2250)$	K(2)(2250)0,+
PKDTP{2320}	$\mathrm{K}_3(2320)$	K(3)(2320)0,+
PKstDFP{2380}	$\mathrm{K}_5^*(2380)$	K(5)*(2380)0,+
PKDfP{2500}	$\mathrm{K}_4(2500)$	K(4)(2500)0,+
PKP{3100}	$\mathrm{K}(3100)$	K(3100)0,+
Charmed mesons ($C = \pm 1$)		
PD, PAD, PDz, PADz	$\mathrm{D}, \overline{\mathrm{D}}, \mathrm{D}^0, \overline{\mathrm{D}}^0$	D, D-bar, D0, D-bar0
PDpm, PDm, PDp	$\mathrm{D}^{\pm}, \mathrm{D}^-, \mathrm{D}^+$	D+-, D-, D+
PDst, PDstpm, PDstm, PDstp	$\mathrm{D}^*, \mathrm{D}^{*\pm}, \mathrm{D}^{*-}, \mathrm{D}^{*+}$	D*, D*+-, D*-, D*+
PDq, PADq, PDzq, PADzq	$\mathrm{D_q}, \overline{\mathrm{D}}_\mathrm{q}, \mathrm{D_q^0}, \overline{\mathrm{D}}_\mathrm{q}^0$	D(q), D(q)-bar, D(q)0, D(q)0-bar
PDstzP{2007}	$\mathrm{D}^*(2007)^0$	D*(2007)0
PDstmP{2010}, PDstpP{2010}	$\mathrm{D}^*(2010)^-, \mathrm{D}^*(2010)^+$	D*(2010)-,+
PDzDoP{2420}	$\mathrm{D}_1(2420)^0$	D(1)(2420)0
PDmDoP{2420}, PDpDoP{2420}	$\mathrm{D}_1(2420)^-, \mathrm{D}_1(2420)^+$	D(1)(2420)-,+
PDstzDtP{2460}	$\mathrm{D}_2^*(2460)^0$	D(2)*(2460)0
PDstmDtP{2460}, PDstpDtP{2460}	$\mathrm{D}_2^*(2460)^-, \mathrm{D}_2^*(2460)^+$	D(2)*(2460)-,+
PDstmP{2640}, PDstpP{2640}	$\mathrm{D}^*(2640)^-, \mathrm{D}^*(2640)^+$	D*(2640)-,+
Charmed, strange mesons ($C = S = \pm 1$)		
PDs, PDpms, PDms, PDps	$\mathrm{D_s}, \mathrm{D_s^{\pm}}, \mathrm{D_s^-}, \mathrm{D_s^+}$	D(s), D(s)+-, D(s)-, D(s)+
PDstpms, PDstms, PDstps	$\mathrm{D_s^{*\pm}}, \mathrm{D_s^{*-}}, \mathrm{D_s^{*+}}$	D(s)*+-, D(s)*-, D(s)*+
PDstmsJP{2317}, PDstpsJP{2317}	$\mathrm{D_{sJ}^*}(2317)^-, \mathrm{D_{sJ}^*}(2317)^+$	D(sJ)*(2317)-,+
PDmsJP{2460}, PDpsJP{2460}	$\mathrm{D_{sJ}}(2460)^-, \mathrm{D_{sJ}}(2460)^+$	D(sJ)(2460)-,+
PDmsDoP{2536}, PDpsDoP{2536}	$\mathrm{D_{s1}}(2536)^-, \mathrm{D_{s1}}(2536)^+$	D(s1)(2536)-,+
PDmsDtP{2573}, PDpsDtP{2573}	$\mathrm{D_{s2}}(2573)^-, \mathrm{D_{s2}}(2573)^+$	D(s2)(2573)-,+
Bottom mesons ($B = \pm 1$)		
PB, PAB, PBz, PABz	$\mathrm{B}, \overline{\mathrm{B}}, \mathrm{B}^0, \overline{\mathrm{B}}^0$	B, B-bar, B0, B-bar0
PBpm, PBm, PBp	$\mathrm{B}^{\pm}, \mathrm{B}^-, \mathrm{B}^+$	B+-, B-, B+
PBq, PABq, PBzq, PABzq	$\mathrm{B_q}, \overline{\mathrm{B}}_\mathrm{q}, \mathrm{B_q^0}, \overline{\mathrm{B}}_\mathrm{q}^0$	B(q), B(q)-bar, B(q)0, B(q)0-bar
PBd, PABd, PBzd, PABzd	$\mathrm{B_d}, \overline{\mathrm{B}}_\mathrm{d}, \mathrm{B_d^0}, \overline{\mathrm{B}}_\mathrm{d}^0$	B(d), B(d)-bar, B(d)0, B(d)0-bar

Table 3: PEN names (*continued*)

PEN name	Representation	Computer name
`PBu, PABu, PBzu, PABzu`	$\mathrm{B_u}, \overline{\mathrm{B}}_\mathrm{u}, \mathrm{B_u^0}, \overline{\mathrm{B}}_\mathrm{u}^0$	`B(u), B(u)-bar, B(u)0, B(u)0-bar`
`PBst, PBstp, PBstz`	$\mathrm{B}^*, \mathrm{B}^{*+}, \mathrm{B}^{*0}$	`B*, B*+, B*0`
`PBstDz, PBstpDz, PBstzDz`	$\mathrm{B_0^*}, \mathrm{B_0^{*+}}, \mathrm{B_0^{*0}}$	`B(0)*, B(0)*+, B(0)*0`
`PBstDo, PBstpDo, PBstzDo`	$\mathrm{B_1^*}, \mathrm{B_1^{*+}}, \mathrm{B_1^{*0}}$	`B(1)*, B(1)*+, B(1)*0`
`PBDoP{L}, PBpDoP{L}, PBzDoP{L}`	$\mathrm{B_1(L)}, \mathrm{B_1(L)^+}, \mathrm{B_1(L)^0}$	`B(1)(L), B(1)(L)+, B(1)(L)0`
`PBDoP{H}, PBpDoP{H}, PBzDoP{H}`	$\mathrm{B_1(H)}, \mathrm{B_1(H)^+}, \mathrm{B_1(H)^0}$	`B(1)(H), B(1)(H)+, B(1)(H)0`
`PBstDt, PBstpDt, PBstzDt`	$\mathrm{B_2^*}, \mathrm{B_2^{*+}}, \mathrm{B_2^{*0}}$	`B(2)*, B(2)*+, B(2)*0`
`PBstJP{5732}, PBstpJP{5732}, PBstzJP{5732}`	$\mathrm{B_J^*(5732)}, \mathrm{B_J^*(5732)^+}, \mathrm{B_J^*(5732)^0}$	`B(J)*(5732), B(J)*(5732)+,0`
Bottom, strange mesons $(B = \pm 1, S = \pm 1)$		
`PBs, PABs, PBzs, PABzs`	$\mathrm{B_s}, \overline{\mathrm{B}}_\mathrm{s}, \mathrm{B_s^0}, \overline{\mathrm{B}}_\mathrm{s}^0$	`B(s), B(s)-bar, B(s)0, B(s)0-bar`
`PBsts, PBstzs`	$\mathrm{B_s^*}, \mathrm{B_s^{*0}}$	`B(s)*, B(s)*0`
`PBstsDz, PBstzsDz`	$\mathrm{B_{s0}^*}, \mathrm{B_{s0}^{*0}}$	`B(s0)*, B(s0)*0`
`PBstsDo, PBstzsDo`	$\mathrm{B_{s1}^*}, \mathrm{B_{s1}^{*0}}$	`B(s1)*, B(s1)*0`
`PBsDoP{L}, PBzsDoP{L}`	$\mathrm{B_{s1}(L)}, \mathrm{B_{s1}(L)^0}$	`B(s1)(L), B(s1)(L)0`
`PBsDoP{H}, PBzsDoP{H}`	$\mathrm{B_{s1}(H)}, \mathrm{B_{s1}(H)^0}$	`B(s1)(H), B(s1)(H)0`
`PBstsDt, PBstzsDt`	$\mathrm{B_{s2}^*}, \mathrm{B_{s2}^{*0}}$	`B(s2)*, B(s2)*0`
`PBstsJP{5850}, PBstssJP{5850}`	$\mathrm{B_{sJ}^*(5850)}, \mathrm{B_{sJ}^*(5850)^0}$	`B(s)*(5850), B(s)*(5850)0`
Bottom, charmed mesons $(B = \pm 1, C = \pm 1)$		
`PBc, PBmc, , PBmpc, PBpc`	$\mathrm{B_c}, \mathrm{B_c^-}, \mathrm{B_c^+}$	`B(c), B(c)-, B(c)+`
`PBstc, PBstpc`	$\mathrm{B_c^*}, \mathrm{B_c^{*+}}$	`B(c)*, B(c)*+`
`PBstcDz, PBstpcDz`	$\mathrm{B_{c0}^*}, \mathrm{B_{c0}^{*+}}$	`B(c0)*, B(c0)*+`
`PBstcDo, PBstpcDo`	$\mathrm{B_{c1}^*}, \mathrm{B_{c1}^{*+}}$	`B(c1)*, B(c1)*+`
`PBcDoP{L}, PBpcDoP{L}`	$\mathrm{B_{c1}(L)}, \mathrm{B_{c1}(L)^+}$	`B(c1)(L), B(c1)(L)+`
`PBcDoP{H}, PBpcDoP{H}`	$\mathrm{B_{c1}(H)}, \mathrm{B_{c1}(H)^+}$	`B(c1)(H), B(c1)(H)+`
`PBstcDt, PBstpcDt`	$\mathrm{B_{c2}^*}, \mathrm{B_{c2}^{*+}}$	`B(c2)*, B(c2)*+`
c/$\overline{\mathrm{c}}$ *mesons*		
`PGhc, PGhcP{1S}`	$\eta_\mathrm{c}, \eta_\mathrm{c}(1\mathrm{S})$	`eta(c), eta(c)(1S)`
`PJGy, PJGyP{1S}`	J/ψ, J/$\psi(1\mathrm{S})$	`J/psi, J/psi(1S)`
`PGc, PGcc, PGccDzP{1P}`	$\chi, \chi_\mathrm{c}, \chi_{\mathrm{c0}}(1\mathrm{P})$	`chi, chi(c), chi(c0)(1P)`

Table 3: PEN names (*continued*)

PEN name	Representation	Computer name
`PGccDoP{1P}`	$\chi_{c1}(1P)$	`chi(c1)(1P)`
`Phc, PhcP{1P}`	$h_c, h_c(1P)$	`h(c), h(c)(1P)`
`PGccDtP{1P}`	$\chi_{c2}(1P)$	`chi(c2)(1P)`
`PGhcP{2S}`	$\eta_c(2S)$	`eta(c)(2S)`
`PGy, PGyP{2S}`	$\psi, \psi(2S)$	`psi, psi(2S)`
`PGyP{3770}`	$\psi(3770)$	`psi(3770)`
`PX, PXP{3872}`	$X, X(3872)$	`X mesons, X(3872)`
`PGyP{4040}`	$\psi(4040)$	`psi(4040)`
`PGyP{4160}`	$\psi(4160)$	`psi(4160)`
`PGyP{4415}`	$\psi(4415)$	`psi(4415)`
	$b/\overline{b}$ *mesons*	
`PGhb, PGhbP{1S}`	$\eta_c, \eta_c(1S)$	`eta(b), eta(b)(1S)`
`PGU, PGUP{1S}`	$Y, Y(1S)$	`Upsilon, Upsilon(1S)`
`PGcbDzP{1P}`	$\chi_{b0}(1P)$	`chi(b0)(1P)`
`PGcbDoP{1P}`	$\chi_{b1}(1P)$	`chi(b1)(1P)`
`PGcbDtP{1P}`	$\chi_{b2}(1P)$	`chi(b2)(1P)`
`PGUP{2S}`	$Y(2S)$	`Upsilon(2S)`
`PGcbDzP{2P}`	$\chi_{b0}(2P)$	`chi(b0)(2P)`
`PGcbDoP{2P}`	$\chi_{b1}(2P)$	`chi(b1)(2P)`
`PGcbDtP{2P}`	$\chi_{b2}(2P)$	`chi(b2)(2P)`
`PGUP{3S}`	$Y(3S)$	`Upsilon(3S)`
`PGUP{4S}`	$Y(4S)$	`Upsilon(4S)`
`PGUP{10860}`	$Y(10860)$	`Upsilon(10860)`
`PGUP{11020}`	$Y(11020)$	`Upsilon(11020)`
	Light baryons	
`Pn, Pp, PAn, PAp`	$n, p, \overline{n}, \overline{p}$	`n, p, n-bar, p-bar`
`PGa`	α	`alpha` (He^{++} nucleus)
	N *baryons*	
`PN, PNp, PNz`	N, N^+, N^0	`N` resonances

Table 3: PEN names (*continued*)

PEN name	Representation	Computer name
PNP{1440}	$\mathrm{N}(1440)$	N(1440)0,+
PNP{1520}	$\mathrm{N}(1520)$	N(1520)0,+
PNP{1535}	$\mathrm{N}(1535)$	N(1535)0,+
PNP{1650}	$\mathrm{N}(1650)$	N(1650)0,+
PNP{1675}	$\mathrm{N}(1675)$	N(1675)0,+
PNP{1680}	$\mathrm{N}(1680)$	N(1680)0,+
PNP{1700}	$\mathrm{N}(1700)$	N(1700)0,+
PNP{1710}	$\mathrm{N}(1710)$	N(1710)0,+
PNP{1720}	$\mathrm{N}(1720)$	N(1720)0,+
PNP{1900}	$\mathrm{N}(1900)$	N(1900)0,+
PNP{1990}	$\mathrm{N}(1990)$	N(1990)0,+
PNP{2000}	$\mathrm{N}(2000)$	N(2000)0,+
PNP{2080}	$\mathrm{N}(2080)$	N(2080)0,+
PNP{2090}	$\mathrm{N}(2090)$	N(2090)0,+
PNP{2100}	$\mathrm{N}(2100)$	N(2100)0,+
PNP{2190}	$\mathrm{N}(2190)$	N(2190)0,+
PNP{2200}	$\mathrm{N}(2200)$	N(2200)0,+
PNP{2220}	$\mathrm{N}(2220)$	N(2220)0,+
PNP{2250}	$\mathrm{N}(2250)$	N(2250)0,+
PNP{2600}	$\mathrm{N}(2600)$	N(2600)0,+
PNP{2700}	$\mathrm{N}(2700)$	N(2700)0,+
	Δ *baryons*	
PGD, PGDpp, PGDp, PGDz, PGDm	$\Delta, \Delta, \Delta, \Delta, \Delta$	Delta resonances
PGD{1232}	$\Delta 1232$	Delta(1232)-,0,+,++
PGD{1600}	$\Delta 1600$	Delta(1600)-,0,+,++
PGD{1620}	$\Delta 1620$	Delta(1620)-,0,+,++
PGD{1700}	$\Delta 1700$	Delta(1700)-,0,+,++
PGD{1750}	$\Delta 1750$	Delta(1750)-,0,+,++
PGD{1900}	$\Delta 1900$	Delta(1900)-,0,+,++
PGD{1905}	$\Delta 1905$	Delta(1905)-,0,+,++

Table 3: PEN names (*continued*)

PEN name	Representation	Computer name
PGD{1910}	$\Delta 1910$	Delta(1910)-,0,+,++
PGD{1920}	$\Delta 1920$	Delta(1920)-,0,+,++
PGD{1930}	$\Delta 1930$	Delta(1930)-,0,+,++
PGD{1940}	$\Delta 1940$	Delta(1940)-,0,+,++
PGD{1950}	$\Delta 1950$	Delta(1950)-,0,+,++
PGD{2000}	$\Delta 2000$	Delta(2000)-,0,+,++
PGD{2150}	$\Delta 2150$	Delta(2150)-,0,+,++
PGD{2200}	$\Delta 2200$	Delta(2200)-,0,+,++
PGD{2300}	$\Delta 2300$	Delta(2300)-,0,+,++
PGD{2350}	$\Delta 2350$	Delta(2350)-,0,+,++
PGD{2390}	$\Delta 2390$	Delta(2390)-,0,+,++
PGD{2400}	$\Delta 2400$	Delta(2400)-,0,+,++
PGD{2420}	$\Delta 2420$	Delta(2420)-,0,+,++
PGD{2750}	$\Delta 2750$	Delta(2750)-,0,+,++
PGD{2950}	$\Delta 2950$	Delta(2950)-,0,+,++
	Λ *strange baryons*	
PGL, PAGL	$\Lambda, \overline{\Lambda}$	Lambda, Lambda-bar
PGLP{1405}	$\Lambda(1405)$	Lambda(1405)0
PGLP{1520}	$\Lambda(1520)$	Lambda(1520)0
PGLP{1600}	$\Lambda(1600)$	Lambda(1600)0
PGLP{1670}	$\Lambda(1670)$	Lambda(1670)0
PGLP{1690}	$\Lambda(1690)$	Lambda(1690)0
PGLP{1800}	$\Lambda(1800)$	Lambda(1800)0
PGLP{1810}	$\Lambda(1810)$	Lambda(1810)0
PGLP{1820}	$\Lambda(1820)$	Lambda(1820)0
PGLP{1830}	$\Lambda(1830)$	Lambda(1830)0
PGLP{1890}	$\Lambda(1890)$	Lambda(1890)0
PGLP{2000}	$\Lambda(2000)$	Lambda(2000)0
PGLP{2020}	$\Lambda(2020)$	Lambda(2020)0
PGLP{2100}	$\Lambda(2100)$	Lambda(2100)0

Table 3: PEN names (*continued*)

PEN name	Representation	Computer name
PGLP{2110}	$\Lambda(2110)$	Lambda(2110)0
PGLP{2325}	$\Lambda(2325)$	Lambda(2325)0
PGLP{2350}	$\Lambda(2350)$	Lambda(2350)0
PGLP{2585}	$\Lambda(2585)$	Lambda(2585)0
	Σ *strange baryons*	
PGS, PAGS	$\Sigma, \overline{\Sigma}$	Sigma, Sigma-bar
PGSm, PGSp, PGSz, PGSpm	$\Sigma^-, \Sigma^+, \Sigma^0, \Sigma^\pm$	Sigma-,+,0,+-
PGSstm, PGSstp, PGSstz	$\Sigma^{*-}, \Sigma^{*+}, \Sigma^{*0}$	Sigma*-,+, z
$\Sigma(\{)$ ...}	$\Sigma(\ldots)$	Sigma resonances
PGSmP{...}, PGSpP{...}, PGSzP{...}	$\Sigma(\ldots)^-, \Sigma(\ldots)^+, \Sigma(\ldots)^0$	Sigma(...)-,0,+
PGSP{1385}	$\Sigma(1385)$	Sigma(1385)-,0,+
PGSP{1480}	$\Sigma(1480)$	Sigma(1480)-,0,+
PGSP{1560}	$\Sigma(1560)$	Sigma(1560)-,0,+
PGSP{1580}	$\Sigma(1580)$	Sigma(1580)-,0,+
PGSP{1620}	$\Sigma(1620)$	Sigma(1620)-,0,+
PGSP{1660}	$\Sigma(1660)$	Sigma(1660)-,0,+
PGSP{1670}	$\Sigma(1670)$	Sigma(1670)-,0,+
PGSP{1690}	$\Sigma(1690)$	Sigma(1690)-,0,+
PGSP{1750}	$\Sigma(1750)$	Sigma(1750)-,0,+
PGSP{1770}	$\Sigma(1770)$	Sigma(1770)-,0,+
PGSP{1775}	$\Sigma(1775)$	Sigma(1775)-,0,+
PGSP{1840}	$\Sigma(1840)$	Sigma(1840)-,0,+
PGSP{1880}	$\Sigma(1880)$	Sigma(1880)-,0,+
PGSP{1915}	$\Sigma(1915)$	Sigma(1915)-,0,+
PGSP{1940}	$\Sigma(1940)$	Sigma(1940)-,0,+
PGSP{2000}	$\Sigma(2000)$	Sigma(2000)-,0,+
PGSP{2030}	$\Sigma(2030)$	Sigma(2030)-,0,+
PGSP{2070}	$\Sigma(2070)$	Sigma(2070)-,0,+
PGSP{2080}	$\Sigma(2080)$	Sigma(2080)-,0,+
PGSP{2100}	$\Sigma(2100)$	Sigma(2100)-,0,+

Table 3: PEN names (*continued*)

PEN name	Representation	Computer name
PGSP{2250}	$\Sigma(2250)$	Sigma(2250)-,0,+
PGSP{2455}	$\Sigma(2455)$	Sigma(2455)-,0,+
PGSP{2620}	$\Sigma(2620)$	Sigma(2620)-,0,+
PGSP{3000}	$\Sigma(3000)$	Sigma(3000)-,0,+
PGSP{3170}	$\Sigma(3170)$	Sigma(3170)-,0,+
	Ξ strange baryons	
PGX, PAGX	$\Xi, \overline{\Xi}$	Xi, Xi-bar
PGXm, PGXz, PGXstm, PGXstz	$\Xi^-, \Xi^0, \Xi^{*-}, \Xi^{*0}$	Xi-, Xi0, Xi*-, Xi*0
PGXP{1530}, PGXmP{1530}, PGXzP{1530}	$\Xi(1530), \Xi(1530)^-, \Xi(1530)^0$	Xi(1530),-,0
PGXP{1620}	$\Xi(1620)$	Xi(1620)-,0
PGXP{1690}	$\Xi(1690)$	Xi(1690)-,0
PGXP{1820}	$\Xi(1820)$	Xi(1820)-,0
PGXP{1950}	$\Xi(1950)$	Xi(1950)-,0
PGXP{2030}	$\Xi(2030)$	Xi(2030)-,0
PGXP{2120}	$\Xi(2120)$	Xi(2120)-,0
PGXP{2250}	$\Xi(2250)$	Xi(2250)-,0
PGXP{2370}	$\Xi(2370)$	Xi(2370)-,0
PGXP{2500}	$\Xi(2500)$	Xi(2500)-,0
	Ω strange baryons	
PGO, PAGO, PGOm	$\Omega, \overline{\Omega}, \Omega^-$	Omega, Omega-bar, Omega-
PGOP{2250}, PGOmP{2250}	$\Omega(2250), \Omega(2250)^-$	Omega(2250), Omega(2250)-
PGOP{2380}	$\Omega(2380)$	Omega(2380)-
PGOP{2470}	$\Omega(2470)$	Omega(2470)-
	Λ_c charmed baryons	
PGLc, PGLpc	Λ_c, Λ_c^+	Lambda(c), Lambda(c)+
PGLpcP{2593}	$\Lambda_c(2593)^+$	Lambda(c)(2593)+
PGLpcP{2625}	$\Lambda_c(2625)^+$	Lambda(c)(2625)+
PGLpcP{2765}	$\Lambda_c(2765)^+$	Lambda(c)(2765)+
PGLpcP{2880}	$\Lambda_c(2880)^+$	Lambda(c)(2880)+

Table 3: PEN names (*continued*)

PEN name	Representation	Computer name
	Σ_c *charmed baryons*	
PGSc, PGSstc	Σ_c, Σ_c^*	Sigma(c), Sigma*(c)
PGSppc, PGSpc, PGSzc	$\Sigma_c^{++}, \Sigma_c^{+}, \Sigma_c^{0}$	Sigma(c)++,+,0
PGScP{ }, PGSppcP{ }, PGSpcP{ }, PGSzcP{ }	$\Sigma_c(\,), \Sigma_c(\,)^{++}, \Sigma_c(\,)^{+}, \Sigma_c(\,)^{0}$	Sigma(c) resonances
PGScP{2455}	$\Sigma_c(2455)$	Sigma(c)(2455)++,+,0
PGScP{2520}	$\Sigma_c(2520)$	Sigma(c)(2520)++,+,0
PGSstppc, PGSstpc, PGSstzc	${\Sigma_c}^{*++}, {\Sigma_c}^{*+}, {\Sigma_c}^{*0}$	Sigma(c)*++,+,0
PGSstcP{ }, PGSstppcP{ }, PGSstpcP{ }, PGSstzcP{ }	${\Sigma_c}^*(\,), {\Sigma_c}^*(\,)^{++}, {\Sigma_c}^*(\,)^{+}, {\Sigma_c}^*(\,)^{0}$	Sigma(c)* resonances
	Ξ_c *charmed baryons*	
PGXc, PGXpc, PGXzc	$\Xi_c, \Xi_c^{+}, \Xi_c^{0}$	Xi(c), Xi(c)+, Xi(c)0
PGXcP{ } PGSpcP{ }, PGSzcP{ }	$\Sigma_c(\,), \Sigma_c(\,)^{+}, \Sigma_c(\,)^{0}$	Xi(c) resonances
PGXcP{2645}	$\Xi_c(2645)$	Xi(c)(2645)+,0
PGXcP{2790}	$\Xi_c(2790)$	Xi(c)(2790)+,0
PGXcP{2815}	$\Xi_c(2815)$	Xi(c)(2815)+,0
PGXprc, PGXprpc, PGXprzc	$\Xi_c', \Xi_c'^{+}, \Xi_c'^{0}$	Xi(c)', Xi(c)'+, Xi(c)'0
PGXstc, PGXstpc, PGXstzc	$\Xi_c^*, \Xi_c^{*+}, \Xi_c^{*0}$	Xi(c)*, Xi(c)*+, Xi(c)*0
	Ω_c *charmed baryons*	
PGOc, PGOzc	Ω_c,Ω_c^{0}	Omega(c), Omega(c)0
PGOstc, PGOstzc	Ω_c^*,Ω_c^{*0}	Omega(c)*, Omega(c)*0
	Ξ_{cc} *double charm baryons*	
PGXcc, PGXpcc, PGXppcc	$\Xi_{cc}, \Xi_{cc}^{+}, \Xi_{cc}^{++}$	Xi(cc), Xi(cc)+, Xi(cc)++
PGXstcc, PGXstpcc, PGXstppcc	$\Xi_{cc}^{*+}, \Xi_{cc}^{*+}, \Xi_{cc}^{*++}$	Xi(cc)*, Xi(cc)*+, Xi(cc)*++
	Ω_{cc} *double charm baryons*	
PGOcc, PGOpcc	Ω_{cc},Ω_{cc}^{+}	Omega(cc), Omega(cc)+
PGOstcc, PGOstpcc	Ω_{cc}^*,Ω_{cc}^{*+}	Omega(cc), Omega(cc)*+
	Ω_{ccc} *triple charm baryons*	
PGOccc, PGOppccc	Ω_{ccc},Ω_{ccc}^{++}	Omega(ccc), Omega(ccc)++
	Λ_b *bottom baryons*	
PGLb, PGLzb	Λ_b, Λ_b^{0}	Lambda(b), Lambda(b)0

Table 3: PEN names (*continued*)

PEN name	Representation	Computer name
	Σ_b *charmed baryons*	
PGSb, PGSstb	Σ_b, Σ_b^*	Sigma(b), Sigma*(b)
PGSpb, PGSzb, PGSmb	Σ_b^+, Σ_b^0, Σ_b^-	Sigma(b)+,0,-
PGSstpb, PGSstzb, PGSstmb	Σ_b^{*+}, Σ_b^{*0}, Σ_b^{*-}	Sigma(b)*+,0,-
	Ξ_b *botom baryons*	
PGXb, PGXmb, PGXzb	Ξ_b, Ξ_b^-, Ξ_b^0	Xi(b), Xi(b)-, Xi(b)0
PGXprb, PGXprmb, PGXprzb	Ξ_b', $\Xi_b'^-$, $\Xi_b'^0$	Xi(b)', Xi(b)'-, Xi(b)'0
PGXstb, PGXstmb, PGXstzb	Ξ_b^*, Ξ_b^{*-}, Ξ_b^{*0}	Xi(b)*, Xi(b)*-, Xi(b)*0
	Ω_b *bottom baryons*	
PGOb, PGOmb	Ω_b,Ω_b^-	Omega(b), Omega(b)-
PGOstb, PGOstmb	Ω_b^*,Ω_b^{*-}	Omega(b)*, Omega(b)*-
	Ξ_{bc} *bottom–charm charm baryons*	
PGXbc, PGXpbc, PGXzbc	Ξ_{bc}, Ξ_{bc}^+, Ξ_{bc}^0	Xi(bc), Xi(bc)+, Xi(bc)0
PGXprbc, PGXprpbc, PGXprzbc	Ξ_{bc}', $\Xi_{bc}'^+$, $\Xi_{bc}'^0$	Xi(bc)', Xi(bc)'+, Xi(bc)'0
PGXstbc, PGXstpbc, PGXstzbc	Ξ_{bc}^*, Ξ_{bc}^{*+}, Ξ_{bc}^{*0}	Xi(bc)*, Xi(bc)*+, Xi(bc)*0
	Ω_{bc} *bottom–charm charm baryons*	
PGObc, PGOzbc	Ω_{bc},Ω_{bc}^0	Omega(bc), Omega(bc)0
PGOprbc, PGOprzbc	Ω_{bc}',$\Omega_{bc}'^0$	Omega(bc)', Omega(bc)'0
PGOstbc, PGOstzbc	Ω_{bc}^*,Ω_{bc}^{*0}	Omega(bc)*, Omega(bc)*0
	Ω_{bcc} *bottom–double charm baryons*	
PGObcc, PGOpbcc	Ω_{bcc},Ω_{bcc}^+	Omega(bcc), Omega(bcc)+
PGOstbcc, PGOstpbcc	Ω_{bcc}^*,Ω_{bcc}^{*+}	Omega(bcc), Omega(bcc)*+
	Ξ_{bb} *double bottom baryons*	
PGXbb, PGXmbb, PGXzbb	Ξ_{bb}, Ξ_{bb}^-, Ξ_{bb}^0	Xi(bb), Xi(bb)-, Xi(bb)0
PGXstbb, PGXstmbb, PGXstzbb	Ξ_{bb}^*, Ξ_{bb}^{*-}, Ξ_{bb}^{*0}	Xi(bb)*, Xi(bb)*-, Xi(bb)*0
	Ω_{bb} *double bottom baryons*	
PGObb, PGOmbb	Ω_{bb},Ω_{bb}^-	Omega(bb), Omega(bb)-
PGOstbb, PGOstmbb	Ω_{bb}^*,Ω_{bb}^{*-}	Omega(bb)*, Omega(bb)*-
	Ω_{bbc} *double bottom–charm baryons*	

Table 3: PEN names (*continued*)

PEN name	Representation	Computer name
PGObbc, PGOzbbc	Ω_{bbc}, Ω^0_{bbc}	Omega(bbc), Omega(bbc)0
PGOstbbc, PGOstzbbc	Ω^*_{bbc}, Ω^{*0}_{bbc}	Omega(bbc)*, Omega(bbc)*0
	Ω_{bbb} triple bottom baryons	
PGObbb, PGOmbbb	Ω_{bbb}, Ω^-_{bbb}	Omega(bbb), Omega(bbb)-
	Supersymmetric particles	
	Squarks	
PSQ, PASQ	$\widetilde{q}$, $\overline{\widetilde{q}}$	~q, ~q-bar
PSQL, PASQL, PSQR, PASQR	$\widetilde{q}_L$, $\overline{\widetilde{q}}_L$, $\widetilde{q}_R$, $\overline{\widetilde{q}}_R$	~q(L), ~q-bar(L), ~q(R), ~q-bar(R)
PSQd, PASQd	$\widetilde{d}$, $\overline{\widetilde{d}}$	~d, ~d-bar
PSQdL, PASQdL PSQdR, PASQdR	$\widetilde{d}_L$, $\overline{\widetilde{d}}_L$, $\widetilde{d}_R$, $\overline{\widetilde{d}}_R$	~d(L), ~d-bar(L), ~d(R), ~d-bar(R)
PSQu, PASQu	$\widetilde{u}$, $\overline{\widetilde{u}}$	~u, ~u-bar
PSQuL, PASQuL PSQuR, PASQuR	$\widetilde{u}_L$, $\overline{\widetilde{u}}_L$, $\widetilde{u}_R$, $\overline{\widetilde{u}}_R$	~u(L), ~u-bar(L), ~u(R), ~u-bar(R)
PSQs, PASQs	$\widetilde{s}$, $\overline{\widetilde{s}}$	~s, ~s-bar
PSQsL, PASQsL PSQsR, PASQsR	$\widetilde{s}_L$, $\overline{\widetilde{s}}_L$, $\widetilde{s}_R$, $\overline{\widetilde{s}}_R$	~s(L), ~s-bar(L), ~s(R), ~s-bar(R)
PSQc, PASQc	$\widetilde{c}$, $\overline{\widetilde{c}}$	~c, ~c-bar
PSQcL, PASQcL PSQcR, PASQcR	$\widetilde{c}_L$, $\overline{\widetilde{c}}_L$, $\widetilde{c}_R$, $\overline{\widetilde{c}}_R$	~c(L), ~c-bar(L), ~c(R), ~c-bar(R)
PSQb, PASQb	$\widetilde{b}$, $\overline{\widetilde{b}}$	~b, ~b-bar
PSQbL, PASQbL PSQbR, PASQbR	$\widetilde{b}_L$, $\overline{\widetilde{b}}_L$, $\widetilde{b}_R$, $\overline{\widetilde{b}}_R$	~b(L), ~b-bar(L), ~b(R), ~b-bar(R)
PSQbDo, PASQbDo	$\widetilde{b}_1$, $\overline{\widetilde{b}}_1$	~b1, ~b1-bar
PSQbDt, PASQbDt	$\widetilde{b}_2$, $\overline{\widetilde{b}}_2$	~b2, ~b2-bar
PSQt, PASQt	$\widetilde{t}$, $\overline{\widetilde{t}}$	~t, ~t-bar
PSQtL, PASQtL PSQtR, PASQtR	$\widetilde{t}_L$, $\overline{\widetilde{t}}_L$, $\widetilde{t}_R$, $\overline{\widetilde{t}}_R$	~t(L), ~t-bar(L), ~t(R), ~t-bar(R)
PSQtDo, PASQtDo	$\widetilde{t}_1$, $\overline{\widetilde{t}}_1$	~t1, ~t1-bar
PSQtDt, PASQtDt	$\widetilde{t}_2$, $\overline{\widetilde{t}}_2$	~t2, ~t2-bar
	Higgses	
PSHm, PSHp, PSHpm	H^-, H^+, $H^\pm$	H-, H+, H+-
PSHpmpm	$H^\pm$	H++,-
PSHzDo, PSHzDt, PSHzDT	H^0_1, H^0_2, H^0_3	H(1)0, H(2)0, H(3)0
PSh, PShz	h, h^0	h, h0

Table 3: PEN names (*continued*)

PEN name	Representation	Computer name
`PSA, PSAz`	A, A^0	`A, A0`
	Gauge bosons	
`PSg, PSGg`	$\widetilde{\gamma}, \widetilde{\gamma}$	`~g, ~gamma`
`PSW, PSWp, PSWm, PSWpm`	$\widetilde{\mathrm{W}}, \widetilde{\mathrm{W}}^+, \widetilde{\mathrm{W}}^-, \widetilde{\mathrm{W}}^\pm$	`~W, ~W+, ~W-, ~W+-`
`PSZ, PSZz`	$\widetilde{\mathrm{Z}}, \widetilde{\mathrm{Z}}^0$	`~Z, ~Z0`
`PSGc, PSGcz`	$\widetilde{\chi}, \widetilde{\chi}^0$	`chi, chi0`
`PSGczDo, PSGczDt, PSGczDT, PSGczDf`	$\widetilde{\chi}_1^0, \widetilde{\chi}_2^0, \widetilde{\chi}_3^0, \widetilde{\chi}_4^0$	`~chi(0,1), .., ~chi(0,4)`
`PSGcm, PSGcp, PSGcpm`	$\widetilde{\chi}^-, \widetilde{\chi}^+, \widetilde{\chi}^\pm$	`~chi-, chi+, chi+-`
`PSGcmDo, PSGcpDo, PSGcpmDo`	$\widetilde{\chi}_1^-, \widetilde{\chi}_1^+, \widetilde{\chi}_1^\pm$	`~chi(+,1)+`
`PSGcmDt, PSGcpDt, PSGcpmDt`	$\widetilde{\chi}_2^-, \widetilde{\chi}_2^+, \widetilde{\chi}_2^\pm$	`~chi(+,2)+`
	Sleptons	
`PSl , PASl`	$\widetilde{\mathrm{l}}, \bar{\widetilde{\mathrm{l}}}$	`~l, ~l-bar`
`PSe, PSemL, PSemR`	$\widetilde{\mathrm{e}}, \widetilde{\mathrm{e}}_\mathrm{L}, \widetilde{\mathrm{e}}_\mathrm{R}$	`~e, ~e(L)-, ~e(R)-`
`PSGm, PSGmmL, PSGmmR`	$\widetilde{\mu}, \widetilde{\mu}_\mathrm{L}^-, \widetilde{\mu}_\mathrm{R}^-$	`~mu, ~mu(L)-, ~mu(R)-`
`PSGt, PSGtmDo, PSGtmDt`	$\widetilde{\tau}, \widetilde{\tau}_1^-, \widetilde{\tau}_2^-$	`~tau, ~tau(1)-, ~tau(2)-`
`PSGn, PASGn`	$\widetilde{\nu}, \bar{\widetilde{\nu}}$	`~nu, ~nu-bar`
`PSGne, PSGneL, PSGneR`	$\widetilde{\nu}_\mathrm{e}, \widetilde{\nu}_\mathrm{eL}, \widetilde{\nu}_\mathrm{eR}$	`~nu(e), ~nu(e,L), ~nu(e,R)`
`PSGnGm, PSGnGmL, PSGnGmR`	$\widetilde{\nu}_\mu, \widetilde{\nu}_\mathrm{\mu L}, \widetilde{\nu}_\mathrm{\mu R}$	`~nu(mu), ~nu(mu,L), ~nu(mu,R)`
`PSGnGt, PSGnGtDo, PSGnGtDt`	$\widetilde{\nu}_\tau, \widetilde{\nu}_{\tau 1}, \widetilde{\nu}_{\tau 2}$	`~nu(tau), ~nu(tau,1), ~nu(tau,2)`
	Special particles	
`PXXA, PXXAz`	A, A^0	`A, A0` (Axion)
`PXXG, PXXSG`	$\mathrm{G}, \widetilde{\mathrm{G}}$	`G, ~G` (graviton, gravitino)
`PgA`	g_A^0	`g(A)` (axigluon)
`PGT, PGTp`	Θ, Θ^+	`Theta, Theta+` (pentaquark)
`PGF, PGFmm`	Φ, Φ^{--}	`Phi, Phi-` (pentaquark)