

# The `physicx` package

Wenjian Chern (Longaster\*)

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## Abstract

`physicx`

## 1 Implementation

```
1 <*package>
2 <@@=physicx>
3 \cs_generate_variant:Nn \keys_set:nn { nx , on , ox }
4 \cs_generate_variant:Nn \use:n { nnnn { nnno }
5 \cs_generate_variant:Nn \seq_set_split:Nnn { Non, NVV, c, cnV, cVV }
6 \cs_generate_variant:Nn \tl_replace_all:Nnn { Non, Nox }
7 \cs_new:Npn \PHYSICXIGNORE
8 { \exp_stop_f: \exp_not:N \PHYSICXIGNORE }
9 \bool_new:N \g__physicx_mathtools_bool
10 \bool_new:N \g__physicx_physics_bool
11 \bool_new:N \g__physicx_compat_bool
12 \bool_new:N \g__physicx_short_bool
13 \prg_new_conditional:Npnn \physicx_compat: { T, F, TF }
14 {
15   \bool_if:NTF \g__physicx_compat_bool
16   { \prg_return_true: } { \prg_return_false: }
17 }
18 \prg_new_conditional:Npnn \physicx_short: { T, F, TF }
19 {
20   \bool_if:NTF \g__physicx_short_bool
21   { \prg_return_true: } { \prg_return_false: }
22 }
23 \prg_new_conditional:Npnn \physicx_mathtools: { T, F, TF }
24 {
25   \bool_if:NTF \g__physicx_mathtools_bool
26   { \prg_return_true: } { \prg_return_false: }
27 }
28 \prg_new_conditional:Npnn \physicx_option_or:nn #1#2 { T, F, TF }
29 {
30   \bool_lazy_or:nnTF
31   { \cs:w g__physicx_ #1 _bool \cs_end: }
32   { \cs:w g__physicx_ #2 _bool \cs_end: }
33   { \prg_return_true: }
```

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\*Email: [longaster@163.com](mailto:longaster@163.com)

```

34         { \prg_return_false: }
35     }
36
37     \bool_new:N \l__cwamcro_physics_tmpa_bool
38     \int_new:N \l__cwamcro_physics_tmpa_int
39     \int_new:N \l__cwamcro_physics_tmpb_int
40     \msg_new:nnnn { physicx } { unknown-key }
41     { The~key~'#1'~is~unknown~and~is~being~ignored. }
42     {
43         The~module~#2~does~not~have~a~key~called~#1.\\
44         Check~that~you~have~spelled~the~key~name~correctly.
45     }
46     \msg_new:nnn { physicx } { diag-key }
47     { The~value~'#1'~of~diag~key~is~unknown~and~is~being~ignored. }

```

## 1.1 Utils functions

```

\physicx_parse_range:nnnN Parse range, such as -3,6-8,9,10-.
\physicx_parse_range_check:
    \physicx_parse_range_nocheck:
48     \int_new:N \l__physicx_begin_int
49     \int_new:N \l__physicx_end_int
50     \int_new:N \l__physicx_max_int
51     \int_new:N \l__physicx_min_int
52     \bool_new:N \l__physicx_invalid_range_bool
53     \cs_new_protected:Npn \physicx_parse_range_check:
54     {
55         \cs_set_eq:NN \__physicx_parse_range_single:n \__physicx_parse_range_single_check:n
56         \cs_set_eq:NN \__physicx_parse_range_range: \__physicx_parse_range_range_check:
57     }
58     \cs_new_protected:Npn \physicx_parse_range_nocheck:
59     {
60         \cs_set_eq:NN \__physicx_parse_range_single:n \__physicx_parse_range_single_nocheck:n
61         \cs_set_eq:NN \__physicx_parse_range_range: \__physicx_parse_range_range_nocheck:
62     }
63     \cs_new_protected:Npn \physicx_parse_range:nnnN #1#2#3#4
64     {
65         \seq_set_eq:NN #4 \c_empty_seq
66         \int_set:Nn \l__physicx_min_int {#1}
67         \int_set:Nn \l__physicx_max_int {#2}
68         \clist_map_inline:nn {#3}
69         {
70             \__physicx_parse_range_aux:n {##1}
71             \bool_if:NF \l__physicx_invalid_range_bool
72             { \seq_concat:NNN #4 #4 \l__physicx_tmpa_seq }
73         }
74     }
75     \cs_generate_variant:Nn \physicx_parse_range:nnnN { nnvN, nnxN }
76     \cs_new_protected:Npn \physicx_parse_range:nnN
77     { \physicx_parse_range:nnnN { 1 } }
78     \cs_generate_variant:Nn \physicx_parse_range:nnN { nvN, nxN }
79     \cs_new_protected:Npn \__physicx_parse_range_aux:n #1
80     {
81         \bool_set_false:N \l__physicx_invalid_range_bool
82         \seq_clear:N \l__physicx_tmpa_seq
83         \tl_if_in:nnTF {#1} { - }

```

```

84     {
85         \seq_set_split:Nnn \l__physicx_tmpb_seq { - } {#1}
86         \seq_pop_left:NN \l__physicx_tmpb_seq \l__physicx_tmpa_tl
87         \tl_if_empty:NTF \l__physicx_tmpa_tl
88         { \int_set_eq:NN \l__physicx_begin_int \l__physicx_min_int }
89         {
90             \int_set:Nn \l__physicx_begin_int { \l__physicx_tmpa_tl }
91             \int_compare:nNnT \l__physicx_begin_int < \l__physicx_min_int
92             {
93                 \int_set_eq:NN \l__physicx_begin_int \l__physicx_min_int
94             }
95         }
96         \seq_pop_left:NN \l__physicx_tmpb_seq \l__physicx_tmpa_tl
97         \tl_if_empty:NTF \l__physicx_tmpa_tl
98         { \int_set_eq:NN \l__physicx_end_int \l__physicx_max_int }
99         {
100             \int_set:Nn \l__physicx_end_int { \l__physicx_tmpa_tl }
101             \int_compare:nNnT \l__physicx_end_int > \l__physicx_max_int
102             {
103                 \int_set_eq:NN \l__physicx_end_int \l__physicx_max_int
104             }
105         }
106         \__physicx_parse_range_range:
107     }
108     { \__physicx_parse_range_single:n {#1} }
109 }
110 \cs_new:Npn \__physicx_parse_range_single_check:n #1
111 {
112     \bool_lazy_or:nnTF
113     { \int_compare_p:nNn {#1} > \l__physicx_max_int }
114     { \int_compare_p:nNn {#1} < \l__physicx_min_int }
115     { \bool_set_true:N \l__physicx_invalid_range_bool }
116     { \seq_put_right:Nn \l__physicx_tmpa_seq {#1} }
117 }
118 \cs_new:Npn \__physicx_parse_range_single_nocheck:n #1
119 { \seq_put_right:Nn \l__physicx_tmpa_seq {#1} }
120 \cs_new_eq:NN \__physicx_parse_range_single:n \__physicx_parse_range_single_check:n
121 \cs_new:Npn \__physicx_parse_range_range_check:
122 {
123     \bool_lazy_or:nnTF
124     { \int_compare_p:nNn \l__physicx_begin_int > \l__physicx_max_int }
125     { \int_compare_p:nNn \l__physicx_begin_int > \l__physicx_end_int }
126     { \bool_set_true:N \l__physicx_invalid_range_bool }
127     {
128         \int_step_inline:nnn
129         { \l__physicx_begin_int } { \l__physicx_end_int }
130         { \seq_put_right:Nn \l__physicx_tmpa_seq {##1} }
131     }
132 }
133 \cs_new:Npn \__physicx_parse_range_range_nocheck:
134 {
135     \int_compare:nNnTF \l__physicx_begin_int > \l__physicx_end_int
136     { \bool_set_true:N \l__physicx_invalid_range_bool }
137     {

```

```

138         \int_step_inline:nnn
139         { \l__physicx_begin_int } { \l__physicx_end_int }
140         { \seq_put_right:Nn \l__physicx_tmpa_seq {##1} }
141     }
142 }
143 \cs_new_eq:NN \__physicx_parse_range_range: \__physicx_parse_range_range_check:

(End definition for \physicx_parse_range:nnnN, \physicx_parse_range_check:, and \physicx_parse_
range_nocheck:. These functions are documented on page ??.)

144 \cs_new:Npn \__physicx_if_keyval:nTF #1
145 { \tl_if_in:nnTF {#1} { = } }
146 \prg_new_conditional:Npnn \physicx_if_num:n #1 { T, F, TF }
147 {
148     \regex_match:nnTF { \A [[:digit:]]+ \Z } {#1}
149     { \prg_return_true: } { \prg_return_false: }
150 }
151 \prg_new_conditional:Npnn \physicx_if_num_sign:n #1 { T, F, TF }
152 {
153     \regex_match:nnTF { \A [\+|-]* [[:digit:]]+ \Z } {#1}
154     { \prg_return_true: } { \prg_return_false: }
155 }
156 \cs_new:Npn \physicx_search_also:nn #1#2
157 {
158     \clist_map_inline:nn {#1}
159     {
160         \exp_args:Nno \keys_if_exist:nnT {##1} { \l_keys_key_str }
161         {
162             \clist_map_break:n
163             { \keys_set:no {##1} { \l_keys_key_str = #2 } }
164         }
165     }
166 }
167 \prg_new_conditional:Npnn \physicx_search_also:nn #1#2 { T, F, TF }
168 {
169     \bool_set_false:N \l__cwamcro_physics_tmpa_bool
170     \clist_map_inline:nn {#1}
171     {
172         \exp_args:Nno \keys_if_exist:nnT {##1} { \l_keys_key_str }
173         {
174             \clist_map_break:n
175             {
176                 \bool_set_true:N \l__cwamcro_physics_tmpa_bool
177                 \keys_set:no {##1} { \l_keys_key_str = #2 }
178             }
179         }
180     }
181     \bool_if:NTF \l__cwamcro_physics_tmpa_bool
182     { \prg_return_true: } { \prg_return_false: }
183 }
184 \cs_generate_variant:Nn \physicx_search_also:nn { no , oo }
185 \prg_generate_conditional_variant:Nnn \physicx_search_also:nn { no , oo } { T , F , TF }

186 \tl_const:Nn \c_physicx_order_tl { \mathcal{o} }
187 \tl_const:Nn \c_physicx_Order_tl { \mathcal{O} }
188 \cs_new:Npn \physicx_use_amssymb_type:

```

```

189 {
190   \cs_set_eq:NN \physicx_bf: \boldsymbol
191 }
192 \cs_new:Npn \physicx_use_uni_bfit_type:
193 {
194   \cs_set_eq:NN \physicx_bf: \symbfit
195 }
196 \cs_new:Npn \physicx_use_uni_bf_type:
197 {
198   \cs_set_eq:NN \physicx_bf: \symbf
199 }
200 \keys_define:nn { physicx }
201 {
202   compat .bool_set:N = \g__physicx_compat_bool ,
203   compat .default:n = true ,
204   short .bool_set:N = \g__physicx_short_bool ,
205   short .default:n = true ,
206   physics .code:n = \RequirePackage{physics} ,
207   mathtools .code:n = \RequirePackage{mathtools} ,
208   unimath .code:n = \RequirePackage{unicode-math} ,
209 }
210 %
211 \ProcessKeysPackageOptions { physicx }
212 %
213 \@ifpackageloaded{physics}
214 { \bool_set_true:N \g__physicx_compat_bool }
215 { }
216 \@ifpackageloaded{mathtools}
217 { \bool_set_true:N \g__physicx_mathtools_bool }
218 { \bool_set_false:N \g__physicx_mathtools_bool }
219 %
220 \physicx_compat:T
221 {
222   \tl_set_eq:NN \ordersymbol \c_physicx_order_tl
223   \tl_set_eq:NN \Ordersymbol \c_physicx_Order_tl
224 }
225 %
226 \@ifpackageloaded {unicode-math}
227 { \physicx_use_uni_bfit_type: }
228 { \physicx_use_amssymb_type: }

```

`\physicxset` `physicx` setup command.

```

229 \NewDocumentCommand \physicxset { s m }
230 {
231   \IfBooleanTF {#1}
232   { \keys_set:nn { physicx/#2 } }
233   { \keys_set:nn { physicx } {#2} }
234 }

```

(End definition for `\physicxset`. This function is documented on page ??.)

## 1.2 Quantity things

```

\physicx_declare_legacy_quantity:nn\N
\@declarequantitycmd

```

```

235 \tl_new:N \physicx_tmp
236 \tl_new:N \l__physicx_cmd_noauto_body_tl
237 \bool_new:N \l__physicx_cmd_noauto_body_bool
238 \tl_new:N \l__physicx_cmd_auto_body_tl
239 \bool_new:N \l__physicx_cmd_auto_body_bool
240 \tl_new:N \l__physicx_cmd_arg_spec_tl
241 \int_new:N \l__physicx_cmd_arg_int
242 \cs_new:Npn \__physicx_declare_init:nnn #1#2#3
243 {
244   \tl_clear:N \l__physicx_cmd_noauto_body_tl
245   \tl_clear:N \l__physicx_cmd_auto_body_tl
246   \tl_clear:N \l__physicx_cmd_arg_spec_tl
247   \int_set:Nn \l__physicx_cmd_arg_int {#1}
248   \bool_set:Nn \l__physicx_cmd_noauto_body_bool {#2}
249   \bool_set:Nn \l__physicx_cmd_auto_body_bool {#3}
250 }
251 % noauto, auto, cmd, body
252 \cs_new:Npn \physicx_declare_legacy_quantity:nnNn #1#2#3#4
253 {
254   \__physicx_declare_init:nnn { 3 } {#1} {#2}
255   \__physicx_declare_legacy_quantity_aux:nw #4
256   \q_recursion_tail \q_recursion_tail \q_recursion_stop
257   \__physicx_declare_legacy_quantity_aux:NcVVV
258   #3 { \cs_to_str:N #3 ~ body }
259   \l__physicx_cmd_arg_spec_tl
260   \l__physicx_cmd_noauto_body_tl
261   \l__physicx_cmd_auto_body_tl
262 }
263 % arg spec, pre, body to replace(start from #4), post
264 \cs_new:Npn \__physicx_declare_legacy_quantity_aux:nnnn #1#2#3#4
265 {
266   \int_incr:N \l__physicx_cmd_arg_int
267   \if_int_compare:w \l__physicx_cmd_arg_int < 10 \exp_stop_f:
268     \tl_put_right:Nn \l__physicx_cmd_arg_spec_tl {#1}
269     \tl_set:Nx \l__physicx_tmp_tl
270     {
271       {
272         \exp_not:N \tl_if_novalue_p:n
273         {
274           \if_case:w \l__physicx_cmd_arg_int \exp_stop_f:
275           \or: \or: \or:
276           \or: \exp_not:n {##4} \or: \exp_not:n {##5} \or: \exp_not:n {##6}
277           \or: \exp_not:n {##7} \or: \exp_not:n {##8} \or: \exp_not:n {##9}
278           \fi:
279         }
280       }
281     }
282   \if_bool:N \l__physicx_cmd_noauto_body_bool
283     \tl_put_right:No \l__physicx_cmd_noauto_body_tl { \l__physicx_tmp_tl }
284     \tl_put_right:Nn \l__physicx_cmd_noauto_body_tl
285     {
286       {
287         % if is '.', use none
288         \str_if_eq:nnTF {#2} {.} {} {#2}

```

```

289         #3
290         \str_if_eq:nnTF {#4} {.} {} {#4}
291     }
292 }
293 \fi:
294 \if_bool:N \l__physicx_cmd_auto_body_bool
295     \tl_put_right:No \l__physicx_cmd_auto_body_tl { \l__physicx_tmp_tl }
296     \tl_put_right:Nn \l__physicx_cmd_auto_body_tl
297     { { ##1 #2 #3 ##2 #4 } }
298 \fi:
299 \fi:
300 }
301 \cs_new:Npn \__physicx_declare_legacy_quantity_aux:nw #1#2
302 {
303     \quark_if_recursion_tail_stop:n {#1}
304     \quark_if_recursion_tail_stop:n {#2}
305     \__physicx_declare_legacy_quantity_aux:nnnn {#1} #2
306     \__physicx_declare_legacy_quantity_aux:nw
307 }
308 \cs_new:Npn \__physicx_declare_legacy_quantity_aux:NNnnn #1#2#3#4#5
309 {
310     \__physicx_nauto_case:nnnn
311     { \use_i:nn } { \use_ii:nn } { \use_i:nn } { \use_i:nn }
312     {
313         \cs_set_protected:Npn #1
314         {
315             \peek_charcode_ignore_spaces:NTF \let
316             { #2 } { #2 [ \left ] \right }
317         }
318         \DeclareDocumentCommand #2 { 0{##2} m s #3 }
319         {
320             \IfBooleanTF { ##3 }
321             { \bool_case_false:n {#4} }
322             { \bool_case_false:n {#5} }
323         }
324     }
325     {
326         \cs_set_protected:Npn #1
327         { #2 \c_empty_tl \c_empty_tl }
328         \DeclareDocumentCommand #2 { m m s #3 }
329         { \bool_case_false:n {#4} }
330     }
331 }
332 \cs_generate_variant:Nn \__physicx_declare_legacy_quantity_aux:NNnnn { NcVVV }
333 \cs_new:Npn \__physicx_nauto_case:nnnn #1#2#3#4
334 {
335     \bool_if:NTF \l__physicx_cmd_noauto_body_bool
336     {
337         \bool_if:NTF \l__physicx_cmd_auto_body_bool
338         {#1} {#2}
339     }
340     {
341         \bool_if:NTF \l__physicx_cmd_auto_body_bool
342         {#3} {#4}

```

```

343     }
344   }
345   \cs_set_protected:Npn \@declarequantitycmd
346   { \physicsx_declare_legacy_quantity:nnNn }

```

(End definition for `\physicsx_declare_legacy_quantity:nnNn` and `\@declarequantitycmd`. These functions are documented on page ??.)

```

\quantity      Redefine some macros in physics package.
\evaluated
\matrixquantity
\smallmatrixquantity
347 \physicsx_declare_legacy_quantity:nnNn
348 \c_true_bool \c_true_bool \quantity
349 {
350   { !g } { { \{ } { #4 } { \} } }
351   { !o } { { [ } { #5 } { ] } }
352   { !d() } { { ( } { #6 } { ) } }
353   { !d|| } { { \vert } { #7 } { \vert } }
354   { !d<> } { { \langle } { #8 } { \rangle } }
355   { !d== } { { \Vert } { #9 } { \Vert } }
356 }
357 \physicsx_declare_legacy_quantity:nnNn
358 \c_true_bool \c_true_bool \evaluated
359 {
360   { !g } { { . } { #4 \nobreak } { \vert } }
361   { !d[| } { { [ } { #5 \nobreak } { \vert } }
362   { !d(| } { { ( } { #6 \nobreak } { \vert } }
363 }
364 \physicsx_declare_legacy_quantity:nnNn
365 \c_true_bool \c_false_bool \matrixquantity
366 {
367   { !g }
368   {
369     { \IfBooleanT{#3}{\left\{ } }
370     { \begin{matrix} #4 \end{matrix} }
371     { \IfBooleanT{#3}{\right\} }
372   }
373   { !o } { { \begin{bmatrix} } { #5 } { \end{bmatrix} } }
374   { !d() }
375   {
376     { \IfBooleanTF{#3}{\left\lgroup}{\left( } }
377     { \begin{matrix} #6 \end{matrix} }
378     { \IfBooleanTF{#3}{\right\rgroup}{\right)} }
379   }
380   { !d|| } { { \begin{vmatrix} } { #7 } { \end{vmatrix} } }
381   { !d<> } { { \left\langle } { \begin{matrix} #8 \end{matrix} } { \right\rangle } }
382   { !d== } { { \begin{Vmatrix} } { #9 } { \end{Vmatrix} } }
383 }
384 \physicsx_declare_legacy_quantity:nnNn
385 \c_true_bool \c_false_bool \smallmatrixquantity
386 {
387   { !g } { { \left\{ } { \begin{smallmatrix} #4 \end{smallmatrix} } { \right\} } }
388   { !o } { { \left[ } { \begin{smallmatrix} #5 \end{smallmatrix} } { \right]} }
389   { !d() }
390   {
391     { \IfBooleanTF{#3}{\left\lgroup}{\left( } }

```



```

392     { \begin{smallmatrix} #6 \end{smallmatrix} }
393     { \IfBooleanTF{#3}{\right\rgroup}{\right}} }
394   }
395   { !d|| } { {\left\vert} { \begin{smallmatrix} #7 \end{smallmatrix} } {\right\vert} }
396   { !d<> } { {\left\langle} { \begin{smallmatrix} #8 \end{smallmatrix} } {\right\rangle} }
397   { !d== } { {\left\Vert} { \begin{smallmatrix} #9 \end{smallmatrix} } {\right\Vert} }
398 }

```

(End definition for `\quantity` and others. These functions are documented on page ??.)

`\physicsx_declare_legacy_paren:NnnnNn`

`\@declareparencmd`

```

399 %% cmd, arg spec, replace(start from #6), pre, left, right, post
400 \cs_new:Npn \physicsx_declare_legacy_paren:NnnnNn #1#2#3#4#5#6#7
401 {
402   \DeclareDocumentCommand #1 { s t\big t\Big t\bigg t\Bigg #2 }
403   {
404     \bool_case_true:nF
405     {
406       { \bool_if_p:n {##2} } { #4 \bigl #5 #3 \bigr #6 #7 }
407       { \bool_if_p:n {##3} } { #4 \Bigl #5 #3 \Bigr #6 #7 }
408       { \bool_if_p:n {##4} } { #4 \biggl #5 #3 \biggr #6 #7 }
409       { \bool_if_p:n {##5} } { #4 \Biggl #5 #3 \Biggr #6 #7 }
410     }
411     {
412       \IfBooleanTF {##1}
413       { #4 #5 #3 #6 #7 }
414       { #4 \!\left #5 #3 \right #6 #7 }
415     }
416   }
417 }
418 \cs_set_protected:Npn \@declareparencmd
419 { \physicsx_declare_legacy_paren:NnnnNn }

```

(End definition for `\physicsx_declare_legacy_paren:NnnnNn` and `\@declareparencmd`. These functions are documented on page ??.)

```

\qty      Redefine some macros in physics package.
\mqty     420 \physicsx_option_or:nnT { compat } { short }
\smqty    421 {
\pqty     422   \cs_set:Npn \qty { \quantity }
\bqty     423   \physicsx_declare_legacy_paren:NnnnNn \pqty { m } {#6} { } { } { }
\vqty     424   \physicsx_declare_legacy_paren:NnnnNn \bqty { m } {#6} { } { } { }
\Bqty     425   \physicsx_declare_legacy_paren:NnnnNn \vqty { m } {#6} { } {\vert \vert { }
\absolutevalue 426   \physicsx_declare_legacy_paren:NnnnNn \Bqty { m } {#6} { } {\{ \} { }
427 }
\eval     428 \physicsx_declare_legacy_paren:NnnnNn \absolutevalue
\abs      429 { m } {#6} { } {\vert \vert { }
\norm     430 \physicsx_option_or:nnT { compat } { short }
\order    431 {
\Order    432   \cs_set:Npn \eval { \evaluated }
\oorder   433   \cs_set:Npn \abs { \absolutevalue }
434 }
\commutator 435 \physicsx_declare_legacy_paren:NnnnNn \norm
\poissonbracket 436 { m } {#6} { } {\lVert \rVert { }
\pb       437 \physicsx_compat:TF
\anticommutator
\acomm

```

```

438 {
439   \physicx_declare_legacy_paren:NnnnNNn \order
440   { m } {#6} { \c_physicx_Order_tl } ( ) { }
441   \physicx_declare_legacy_paren:NnnnNNn \oorder
442   { m } {#6} { \c_physicx_order_tl } ( ) { }
443   \cs_set:Npn \Order { \order }
444   \cs_set:Npn \OOrder { \order }
445 }
446 {
447   \physicx_declare_legacy_paren:NnnnNNn \Order
448   { m } {#6} { \c_physicx_Order_tl } ( ) { }
449   \physicx_declare_legacy_paren:NnnnNNn \order
450   { m } {#6} { \c_physicx_order_tl } ( ) { }
451   \cs_set:Npn \oorder { \order }
452   \cs_set:Npn \OOrder { \Order }
453 }
454 \physicx_declare_legacy_paren:NnnnNNn \commutator
455 { m m } { #6 , #7 } { } [ ] { }
456 \physicx_option_or:nnT { compat } { short }
457 { \cs_set:Npn \comm { \commutator } }
458 \physicx_declare_legacy_paren:NnnnNNn \poissonbracket
459 { m m } { #6 , #7 } { } \{ \} { }
460 \physicx_option_or:nnT { compat } { short }
461 {
462   \cs_set:Npn \pb { \poissonbracket }
463   \cs_set:Npn \anticommutator { \poissonbracket }
464   \cs_set:Npn \acomm { \poissonbracket }
465 }

```

(End definition for \qty and others. These functions are documented on page ??.)

## 1.3 Matrix things

### 1.3.1 Matrix auxillary functions

```

466 \cs_new_nopar:Npn \__physicx_matrix_calc:nn #1#2
467 {
468   \int_set:Nn \l__physicx_matrix_rows_int
469   { \int_max:nn {#1} \l__physicx_matrix_rows_int }
470   \int_set:Nn \l__physicx_matrix_cols_int
471   { \int_max:nn {#2} \l__physicx_matrix_cols_int }
472 }
473 % use matrix element
474 \cs_new_nopar:Npn \physicx_matrix_use_r_c:nn #1#2
475 {
476   \if_cs_exist:w l__physicx_matrix_r@#1_c@#2_tl \cs_end:
477   \exp_not:v { l__physicx_matrix_r@#1_c@#2_tl }
478   \else:
479   \exp_not:o { \physicxempty }
480   \fi:
481 }
482 % set matrix element, check or not
483 \cs_new_nopar:Npn \__physicx_matrix_set_r_c_nock:nnn #1#2
484 { \tl_set:cn { l__physicx_matrix_r@#1_c@#2_tl } }
485 \cs_new_nopar:Npn \__physicx_matrix_set_r_c_ckig:nnn #1#2#3

```

```

486 {
487   \tl_if_eq:nnF {#3} { \PHYSICXIGNORE }
488   { \tl_set:cn { l__physicx_matrix_r@#1_c@#2_tl } {#3} }
489 }
490 \cs_new_nopar:Npn \__physicx_matrix_set_r_c_ckepp:nnn #1#2#3
491 {
492   \tl_if_empty:nTF {#3}
493   { \tl_set:co { l__physicx_matrix_r@#1_c@#2_tl } { \physicxempty } }
494   { \tl_set:cn { l__physicx_matrix_r@#1_c@#2_tl } {#3} }
495 }
496 \cs_new_nopar:Npn \__physicx_matrix_set_r_c_ckigep:nnn #1#2#3
497 {
498   \tl_if_eq:nnF {#3} { \PHYSICXIGNORE }
499   {
500     \tl_if_empty:nTF {#3}
501     { \tl_set:co { l__physicx_matrix_r@#1_c@#2_tl } { \physicxempty } }
502     { \tl_set:cn { l__physicx_matrix_r@#1_c@#2_tl } {#3} }
503   }
504 }
505 \cs_set_eq:NN \__physicx_matrix_set_r_c_ckall:nnn
506 \__physicx_matrix_set_r_c_ckigep:nnn
507 \cs_new_eq:NN \physicx_matrix_set_r_c:nnn
508 \__physicx_matrix_set_r_c_nock:nnn
509 % align, cr, sep symbol
510 \str_const:Nn \physicx@align { , }
511 \str_const:Nn \physicx@cr { ; }
512 \str_const:Nn \physicx@sep { , }
513 \bool_new:N \l__physicx_matrix_infinite_bool
514 \bool_new:N \l__physicx_matrix_dotrow_bool
515 \bool_new:N \l__physicx_matrix_dotcol_bool
516 \tl_new:N \l__physicx_matrix_array_tl
517 \tl_new:N \l__physicx_matrix_body_tl
518 \int_new:N \l__physicx_matrix_rows_int
519 \int_new:N \l__physicx_matrix_cols_int
520 \tl_new:N \l__physicx_matrix_main_tl
521 \clist_new:N \l__physicx_matrix_diag_clist
522 \clist_new:N \l__physicx_matrix_item_clist
523 \bool_new:N \l__physicx_matrix_diag_bool
524 \seq_new:N \l__physicx_row_list_seq
525 \seq_new:N \l__physicx_col_list_seq
526 % expand input
527 \cs_new_eq:NN \__physicx_expand:w \exp_not:o
528 %% main, row iterate, col iterate
529 \cs_new_nopar:Npn \physicx@matrilement #1#2#3 { #1 \sb { #2 #3 } }
530 \cs_new_nopar:Npn \__physicx_matrix_row_iterate:n #1 { #1 }
531 \tl_new:N \l__physicx_matrix_last_row_tl
532 \tl_new:N \l__physicx_matrix_last_col_tl
533 \cs_new_nopar:Npn \__physicx_matrix_col_iterate:n #1 { #1 }
534 \cs_new_nopar:Npn \__physicx_matrix_begin:w { }
535 \cs_new_nopar:Npn \__physicx_matrix_end:w { }
536 \cs_new_eq:NN \__physicx_matrix_autocalc:nn \use_none:nn
537 \bool_new:N \l__physicx_matrix_expand_element_bool
538 % when element is empty use \physicxempty
539 \tl_new:N \physicxempty

```

```

540 % save 'element-except' key's value
541 \tl_new:N \physicsexcept
542 \tl_new:N \l__physicx_matrix_args_tl
543 \tl_new:N \l__physicx_matrix_after_begin_tl
544 \tl_new:N \l__physicx_matrix_after_end_tl
545 \bool_new:N \l__physicx_matrix_transpose_bool
546 \bool_new:N \l__physicx_matrix_enhanced_bool
547 \dim_new:N \l__physicx_matrix_sep_dim
548 \cs_new:Npn \__physicx_adi:nnn #1#2#3 { #1#2#3 }
549 \tl_new:N \l__physicx_matrix_beginning_tl
550 \tl_new:N \l__physicx_matrix_ending_tl

```

### 1.3.2 Matrix keys

```

551 \keys_define:nn { physicx }
552 { matrix .code:n = \keys_set:nn { physicx/matrix } {#1} }
553 \keys_define:nn { physicx/matrix }
554 {
555   array .tl_set:N = \l__physicx_matrix_array_tl ,
556   expand .choice: ,
557   expand / none .code:n =
558     \cs_set_eq:NN \__physicx_expand:w \exp_not:o ,
559   expand / text-expand .code:n =
560     \cs_set_eq:NN \__physicx_expand:w \text_expand:n ,
561   expand / f .code:n =
562     \cs_set_eq:NN \__physicx_expand:w \exp_not:f ,
563   expand / romanual .meta:n = { expand = f } ,
564   expand / x .code:n =
565     \cs_set_eq:NN \__physicx_expand:w \use:n ,
566   expand / edef .meta:n = { expand = x } ,
567   rows .int_set:N = \l__physicx_matrix_rows_int ,
568   cols .int_set:N = \l__physicx_matrix_cols_int ,
569   auto-update .choice: ,
570   auto-update / true .code:n =
571     \cs_set_eq:NN \__physicx_matrix_autocalc:nn \__physicx_matrix_calc:nn ,
572   auto-update / false .code:n =
573     \cs_set_eq:NN \__physicx_matrix_autocalc:nn \use_none:nn ,
574   auto-update .default:n = true ,
575   main .tl_set:N = \l__physicx_matrix_main_tl ,
576   row-list .code:n =
577     \seq_set_split:Non \l__physicx_row_list_seq { \physicx@sep } {#1} ,
578   col-list .code:n =
579     \seq_set_split:Non \l__physicx_col_list_seq { \physicx@sep } {#1} ,
580   infinite .bool_set:N = \l__physicx_matrix_infinite_bool ,
581   infinite .default:n = true ,
582   !infinite .code:n =
583     \bool_set_inverse:N \l__physicx_matrix_infinite_bool ,
584   element-code .cs_set:Np = \physicx@matricelement #1#2#3 ,
585   element-code* .choice: ,
586   element-code* / except-empty .code:n =
587     \cs_set_eq:NN \__physicx_matrix_element_aux:nnn
588       \physicx@matricelement
589     \cs_set:Npn \physicx@matricelement ##1##2##3
590       {
591         \tl_if_empty:nTF {##1}

```

```

592         {##1}
593         { \_physicx_matrix_element_aux:nnn {##1} {##2} {##3} }
594     } ,
595 element-code* / except-dots .code:n =
596     \cs_set_eq:NN \_physicx_matrix_element_aux:nnn
597     \physicx@matrxiement
598     \cs_set:Npn \physicx@matrxiement ##1##2##3
599     {
600         \tl_if_in:nnTF { \cdots\vdots\ldots\ddots } {##1}
601         {##1}
602         { \_physicx_matrix_element_aux:nnn {##1} {##2} {##3} }
603     } ,
604 element-code* / except-tl .code:n =
605     \cs_set_eq:NN \_physicx_matrix_element_aux:nnn
606     \physicx@matrxiement
607     \cs_set:Npn \physicx@matrxiement ##1##2##3
608     {
609         \tl_if_in:onTF { \physicxexcept } {##1}
610         {##1}
611         { \_physicx_matrix_element_aux:nnn {##1} {##2} {##3} }
612     } ,
613 element-code* / except-regex .code:n =
614     \cs_set_eq:NN \_physicx_matrix_element_aux:nnn
615     \physicx@matrxiement
616     \cs_set:Npn \physicx@matrxiement ##1##2##3
617     {
618         \exp_args:No \regex_match:nnTF { \physicxexcept } {##1}
619         {##1}
620         { \_physicx_matrix_element_aux:nnn {##1} {##2} {##3} }
621     } ,
622 element-code* / only-regex .code:n =
623     \cs_set_eq:NN \_physicx_matrix_element_aux:nnn
624     \physicx@matrxiement
625     \cs_set:Npn \physicx@matrxiement ##1##2##3
626     {
627         \exp_args:No \regex_match:nnTF { \physicxexcept } {##1}
628         { \_physicx_matrix_element_aux:nnn {##1} {##2} {##3} }
629         {##1}
630     } ,
631 element-code* / unknown .code:n =
632     \cs_set:Npx \physicx@matrxiement { \exp_not:c {#1} },
633 element-except .tl_set:N = \physicxexcept ,
634 element-except+ .code:n =
635     \tl_put_right:Nn \physicxexcept {#1} ,
636 expand-element .bool_set:N = \l__physicx_matrix_expand_element_bool ,
637 expand-element .default:n = true ,
638 empty .tl_set:N = \physicxempty ,
639 check .choice: ,
640 check / none .code:n =
641     \cs_set_eq:NN \physicx_matrix_set_r_c:nnn
642     \_physicx_matrix_set_r_c_nock:nnn ,
643 check / empty .code:n =
644     \cs_set_eq:NN \physicx_matrix_set_r_c:nnn
645     \_physicx_matrix_set_r_c_ckepp:nnn ,

```

```

646 check / ignore .code:n =
647     \cs_set_eq:NN \physicx_matrix_set_r_c:nnn
648     \__physicx_matrix_set_r_c_ckig:nnn ,
649 check / igep .code:n =
650     \cs_set_eq:NN \physicx_matrix_set_r_c:nnn
651     \__physicx_matrix_set_r_c_ckigep:nnn ,
652 check / all .code:n =
653     \cs_set_eq:NN \physicx_matrix_set_r_c:nnn
654     \__physicx_matrix_set_r_c_ckall:nnn ,
655 check .default:n = all ,
656 row-iterate .cs_set:Np = \__physicx_matrix_row_iterate:n #1 ,
657 col-iterate .cs_set:Np = \__physicx_matrix_col_iterate:n #1 ,
658 last-row .tl_set:N = \l__physicx_matrix_last_row_tl ,
659 last-col .tl_set:N = \l__physicx_matrix_last_col_tl ,
660 diag .clist_set:N = \l__physicx_matrix_diag_clist ,
661 diag+ .code:n =
662     \clist_put_right:Nn \l__physicx_matrix_diag_clist {#1} ,
663 diag-now .code:n = \physicx_matrix_diag_parse:n {#1} ,
664 diag-data .code:n = \__physicx_matrix_set_data:nn { diag } {#1} ,
665 diag-data+ .code:n = \__physicx_matrix_add_data:nn { diag } {#1} ,
666 item .clist_set:N = \l__physicx_matrix_item_clist ,
667 item+ .code:n =
668     \clist_put_right:Nn \l__physicx_matrix_item_clist {#1} ,
669 item-now .code:n = \physicx_matrix_item_parse:n {#1} ,
670 item-data .code:n = \__physicx_matrix_set_data:nn { item } {#1} ,
671 item-data+ .code:n = \__physicx_matrix_add_data:nn { item } {#1} ,
672 check-range .choice: ,
673 check-range / true .code:n = \physicx_parse_range_check: ,
674 check-range / false .code:n = \physicx_parse_range_nocheck: ,
675 check-range .default:n = true ,
676 begin .tl_set:N = \__physicx_matrix_begin:w ,
677 end .tl_set:N = \__physicx_matrix_end: ,
678 args .code:n =
679     \tl_set:Nn \l__physicx_matrix_args_tl { [#1] } ,
680 args* .tl_set:N = \l__physicx_matrix_args_tl ,
681 after-begin .tl_set:N = \l__physicx_matrix_after_begin_tl ,
682 after-begin+ .code:n =
683     { \tl_put_right:Nn \l__physicx_matrix_after_begin_tl {#1} } ,
684 after-end .tl_set:N = \l__physicx_matrix_after_end_tl ,
685 after-end+ .code:n =
686     { \tl_put_right:Nn \l__physicx_matrix_after_end_tl {#1} } ,
687 sepdim .dim_set:N = \l__physicx_matrix_sep_dim ,
688 type .multichoice: ,
689 saveto .tl_set:N = \l__physicx_matrix_save_tl ,
690 saveto* .code:n =
691     \tl_set:Nn \l__physicx_matrix_save_tl { \cs:w #1 \cs_end: } ,
692 transpose .bool_set:N = \l__physicx_matrix_transpose_bool ,
693 transpose .default:n = true ,
694 ' .meta:n = { transpose = true } ,
695 T .meta:n = { transpose = true } ,
696 MaxMatrixCols .int_set:N = \c@MaxMatrixCols ,
697 enhanced .bool_set:N = \l__physicx_matrix_enhanced_bool ,
698 enhanced .default:n = true ,
699 !enhanced .code:n =

```

```

700     \bool_set_inverse:N \l__physicx_matrix_enhanced_bool ,
701     cr .tl_set:N = \physicx@cr ,
702     align .tl_set:N = \physicx@align ,
703     sep .tl_set:N = \physicx@sep ,
704     adi-order .choice: ,
705     adi-order / adi .code:n = \cs_set:Nn \__physicx_adi:nnn {##1##2##3} ,
706     adi-order / dia .code:n = \cs_set:Nn \__physicx_adi:nnn {##2##3##1} ,
707     adi-order / iad .code:n = \cs_set:Nn \__physicx_adi:nnn {##3##1##2} ,
708     adi-order / aid .code:n = \cs_set:Nn \__physicx_adi:nnn {##1##3##2} ,
709     adi-order / ida .code:n = \cs_set:Nn \__physicx_adi:nnn {##3##2##1} ,
710     adi-order / dai .code:n = \cs_set:Nn \__physicx_adi:nnn {##2##1##3} ,
711     beginning .tl_set:N = \l__physicx_matrix_beginning_tl ,
712     beginning+ .code:n =
713       \tl_put_right:Nn \l__physicx_matrix_beginning_tl {#1} ,
714     ending .tl_set:N = \l__physicx_matrix_ending_tl ,
715     ending+ .code:n =
716       \tl_put_right:Nn \l__physicx_matrix_ending_tl {#1} ,
717
718     unknown .code:n =
719       \physicx_search_also:nnF
720       {
721         physicx/matrix/type ,
722         physicx/matrix/expand ,
723         physicx/matrix/element-code* ,
724       }
725       {#1}
726       {
727         \exp_args:No \physicx_if_num:nTF { \l_keys_key_str }
728         {
729           \keys_set:nx { physicx/matrix }
730           { MaxMatrixCols = \l_keys_key_str }
731         }
732         {
733           \msg_error:nnxx { physicx } { unknown-key }
734           \l_keys_path_str { physicx }
735         }
736       } ,
737   }

```

```

\physicx_matrix_new_type:nnn
\physicx_matrix_new_type:nn
  \setmatrixtype

```

```

738 \cs_new:Npn \physicx_matrix_new_type:nnn #1#2#3
739 {
740   \keys_define:nn { physicx/matrix }
741     { type / #1 .meta:n = { begin={#2} , end={#3} } }
742 }
743 \cs_new:Npn \physicx_matrix_new_type:nn #1#2
744 {
745   \keys_define:nn { physicx/matrix }
746     { type / #1 .meta:n = {#2} }
747 }
748 \NewDocumentCommand \setmatrixtype { s >{ \TrimSpaces } m }
749 {
750   \IfBooleanTF {#1}
751     { \physicx_matrix_new_type:nn {#2} }

```

```

752     { \physicx_matrix_new_type:nnn {#2} }
753 }

```

(End definition for `\physicx_matrix_new_type:nnn`, `\physicx_matrix_new_type:nn`, and `\setmatrixtype`. These functions are documented on page ??.)

A few types.

```

754 \setmatrixtype {m} {\begin{matrix}} {\end{matrix}}
755 \setmatrixtype {p} {\begin{pmatrix}} {\end{pmatrix}}
756 \setmatrixtype {b} {\begin{bmatrix}} {\end{bmatrix}}
757 \setmatrixtype {B} {\begin{Bmatrix}} {\end{Bmatrix}}
758 \setmatrixtype {v} {\begin{vmatrix}} {\end{vmatrix}}
759 \setmatrixtype {V} {\begin{Vmatrix}} {\end{Vmatrix}}
760 \setmatrixtype {sm} {\begin{smallmatrix}} {\end{smallmatrix}}
761 \physicx_mathtools:T
762 {
763   \setmatrixtype {m*} {\begin{matrix*}} {\end{matrix*}}
764   \setmatrixtype {p*} {\begin{pmatrix*}} {\end{pmatrix*}}
765   \setmatrixtype {b*} {\begin{bmatrix*}} {\end{bmatrix*}}
766   \setmatrixtype {B*} {\begin{Bmatrix*}} {\end{Bmatrix*}}
767   \setmatrixtype {v*} {\begin{vmatrix*}} {\end{vmatrix*}}
768   \setmatrixtype {V*} {\begin{Vmatrix*}} {\end{Vmatrix*}}
769   \setmatrixtype {sm*} {\begin{smallmatrix*}} {\end{smallmatrix*}}
770   \setmatrixtype {sp} {\begin{psmallmatrix}} {\end{psmallmatrix}}
771   \setmatrixtype {sb} {\begin{bsmallmatrix}} {\end{bsmallmatrix}}
772   \setmatrixtype {sB} {\begin{Bsmallmatrix}} {\end{Bsmallmatrix}}
773   \setmatrixtype {sv} {\begin{vsmallmatrix}} {\end{vsmallmatrix}}
774   \setmatrixtype {sV} {\begin{Vsmallmatrix}} {\end{Vsmallmatrix}}
775   \setmatrixtype {sp*} {\begin{psmallmatrix*}} {\end{psmallmatrix*}}
776   \setmatrixtype {sb*} {\begin{bsmallmatrix*}} {\end{bsmallmatrix*}}
777   \setmatrixtype {sB*} {\begin{Bsmallmatrix*}} {\end{Bsmallmatrix*}}
778   \setmatrixtype {sv*} {\begin{vsmallmatrix*}} {\end{vsmallmatrix*}}
779   \setmatrixtype {sV*} {\begin{Vsmallmatrix*}} {\end{Vsmallmatrix*}}
780 }

```

`\setmatrixdata` Set matrix data, one can use ‘`...-data`’ key to use it.

```

781 \cs_new_protected_nopar:Npn \setmatrixdata #1#2
782 { \clist_set:cn { physicx@ #1 data@ #2 } }
783 \cs_new_protected_nopar:Npn \__physicx_matrix_set_data:nn #1#2
784 {
785   \clist_clear:c { l__physicx_matrix_ #1 _clist }
786   \__physicx_matrix_add_data:nn {#1} {#2}
787 }
788 \cs_new_protected_nopar:Npn \__physicx_matrix_add_data:nn #1#2
789 {
790   \clist_map_inline:nn {#2}
791   {
792     \clist_concat:ccc
793     { l__physicx_matrix_ #1 _clist }
794     { l__physicx_matrix_ #1 _clist }
795     { physicx@ #1 data@ #2 }
796   }
797 }

```

(End definition for `\setmatrixdata`. This function is documented on page ??.)



Initial settings.

```

798 \keys_set:nn { physicx/matrix }
799 {
800     type = m ,
801     saveto = ? ,
802 }

```

\qxmatrix

```

803 %% basically, https://tex.stackexchange.com/questions/486154/is-there-a-way-to-define-
      xmatmnm-in-the-physics-package, but changed some
804 % #1 = boolean, saveto matrix
805 % #2 = star, infinite
806 % #3 = options
807 % #4 = letter for the entries
808 % #5 = number of rows
809 % #6 = number of explicit rows, default = 3
810 % #7 = number of columns
811 % #8 = number of explicit columns, default = 3
812 \DeclareDocumentCommand \qxmatrix { t= s 0{type=p} m m 0{3} m 0{3} }
813 {
814     \group_begin:
815     \IfBooleanTF { #2 }
816     { \bool_set_true:N \l__physicx_matrix_infinite_bool }
817     { \bool_set_false:N \l__physicx_matrix_infinite_bool }
818     \int_set:Nn \l__physicx_matrix_rows_int {#6}
819     \int_set:Nn \l__physicx_matrix_cols_int {#8}
820     \IfBooleanTF {#1}
821     { \keys_set:nn { physicx/matrix } { #3 , saveto = \physicxtmp } }
822     { \keys_set:nn { physicx/matrix } {#3} }
823     \physicx_qxmatrix:nnn {#4} {#5} {#7}
824     \__physicx_matrix_save_or_print:
825     \group_end:
826 }
827 \cs_new_protected:Nn \physicx_qxmatrix:nnn
828 {
829     \bool_if:NTF \l__physicx_matrix_expand_element_bool
830     {
831         \cs_set_eq:NN \__physicx_qxmatrix_appto_body:nnn
832         \__physicx_matrix_appto_body_e:nnn
833     }
834     {
835         \cs_set_eq:NN \__physicx_qxmatrix_appto_body:nnn
836         \__physicx_matrix_appto_body_ne:nnn
837     }
838     % clear the variable containing the body of the matrix
839     \tl_clear:N \l__physicx_matrix_body_tl
840     % set the tentative number of explicit rows
841     \physicx_if_num:nTF { #2 }
842     {% number of rows is an integer
843         \int_compare:nTF { #2 <= \l__physicx_matrix_rows_int }
844         {% if #2 <= rows, we don't want a row of dots
845             \bool_set_false:N \l__physicx_matrix_dotrow_bool
846             \int_set:Nn \l__physicx_matrix_rows_int { #2 }
847         }

```

```

848     {% we want a row of dots
849     \bool_set_true:N \l__physicx_matrix_dotrow_bool
850   }
851 }
852 {% number of rows is symbolic, we want a row of dots
853 \bool_set_true:N \l__physicx_matrix_dotrow_bool
854 }
855 % set the tentative number of explicit columns
856 \physicx_if_num:nTF { #3 }
857 {% number of cols is an integer
858 \int_compare:nTF { #3 <= \l__physicx_matrix_cols_int }
859 {% if #3 <= cols, we don't want a column of dots
860 \bool_set_false:N \l__physicx_matrix_dotcol_bool
861 \int_set:Nn \l__physicx_matrix_cols_int { #3 }
862 }
863 {% we want a column of dots
864 \bool_set_true:N \l__physicx_matrix_dotcol_bool
865 }
866 }
867 {% number of columns is symbolic, we want a column of dots
868 \bool_set_true:N \l__physicx_matrix_dotcol_bool
869 }
870 % loop through the rows
871 \int_step_inline:nn { \l__physicx_matrix_rows_int }
872 {
873   % add the first entry in the row
874   %%\tl_put_right:Nn \l__physicx_matrix_body_tl { #1\sb{##1 1} }
875   \__physicx_qxmatrix_appto_body:nnn {#1} {##1} { 1 }
876   % add the further entries in the explicit columns
877   \int_step_inline:nnn { 2 } { \l__physicx_matrix_cols_int }
878   {
879     %%\tl_put_right:Nn \l__physicx_matrix_body_tl { & #1\sb{##1 ####1} }
880     \tl_put_right:Nn \l__physicx_matrix_body_tl { & }
881     \__physicx_qxmatrix_appto_body:nnn {#1} {##1} {####1}
882   }
883   % if we have a column of dots, add \cdots and the last entry
884   \bool_if:NT \l__physicx_matrix_dotcol_bool
885   {
886     %%\tl_put_right:Nn \l__physicx_matrix_body_tl { & \cdots & #1\sb{##1 #3} }
887     \tl_put_right:Nn \l__physicx_matrix_body_tl { & \cdots & }
888     \__physicx_qxmatrix_appto_body:nnn {#1} {##1} {#3}
889   }
890   % infinite matrix, add \cdots
891   \bool_if:NT \l__physicx_matrix_infinite_bool
892   { \tl_put_right:Nn \l__physicx_matrix_body_tl { & \cdots } }
893   \if_int_compare:w ##1 = \l__physicx_matrix_rows_int
894     \scan_stop:
895   \else:
896     % finish up the row
897     \tl_put_right:Nx \l__physicx_matrix_body_tl { \[\dim_use:N \l__physicx_matrix_sep
898   \fi:
899 }
900 % finish up the rows
901 \bool_if:NT \l__physicx_matrix_dotrow_bool

```

```

902 {
903   % finish up the row
904   \tl_put_right:Nx \l__physicx_matrix_body_tl { \[\dim_use:N \l__physicx_matrix_sep_d
905   % if we have a row of dots, fill it in
906   \tl_put_right:Nn \l__physicx_matrix_body_tl { \vdots }
907   \prg_replicate:nn { \l__physicx_matrix_cols_int - 1 }
908     { \tl_put_right:Nn \l__physicx_matrix_body_tl { & \vdots } }
909   \bool_if:NT \l__physicx_matrix_dotcol_bool
910     { \tl_put_right:Nn \l__physicx_matrix_body_tl { & \ddots & \vdots } }
911   \tl_put_right:Nx \l__physicx_matrix_body_tl { \[\dim_use:N \l__physicx_matrix_sep_d
912   % fill the last row
913   %%\tl_put_right:Nn \l__physicx_matrix_body_tl { #1\sb{#2 1} }
914   \__physicx_qxmatrix_appto_body:nnn {#1} {#2} { 1 }
915   \int_step_inline:nnn { 2 } { \l__physicx_matrix_cols_int }
916     {
917       %%\tl_put_right:Nn \l__physicx_matrix_body_tl { & #1\sb{#2 ##1} }
918       \tl_put_right:Nn \l__physicx_matrix_body_tl { & }
919       \__physicx_qxmatrix_appto_body:nnn {#1} {#2} {##1}
920     }
921   \bool_if:NT \l__physicx_matrix_dotcol_bool
922     {
923       %%\tl_put_right:Nn \l__physicx_matrix_body_tl { & \cdots & #1\sb{#2 #3} }
924       \tl_put_right:Nn \l__physicx_matrix_body_tl { & \cdots & }
925       \__physicx_qxmatrix_appto_body:nnn {#1} {#2} {#3}
926     }
927   % if the matrix is infinite, add a further column with \cdots
928   \bool_if:NT \l__physicx_matrix_infinite_bool
929     { \tl_put_right:Nn \l__physicx_matrix_body_tl { & \cdots } }
930 }
931 % if the matrix is infinite, add a final row
932 \bool_if:NT \l__physicx_matrix_infinite_bool
933 {
934   % finish up the row
935   \tl_put_right:Nx \l__physicx_matrix_body_tl { \[\dim_use:N \l__physicx_matrix_sep_d
936   \tl_put_right:Nn \l__physicx_matrix_body_tl { \vdots }
937   \prg_replicate:nn { \l__physicx_matrix_cols_int - 1 }
938     { \tl_put_right:Nn \l__physicx_matrix_body_tl { & \vdots } }
939   \bool_if:NT \l__physicx_matrix_dotcol_bool
940     { \tl_put_right:Nn \l__physicx_matrix_body_tl { & & \vdots } }
941   \tl_put_right:Nn \l__physicx_matrix_body_tl { & \ddots }
942   % update cols
943   \bool_if:NTF \l__physicx_matrix_dotcol_bool
944     { \tex_advance:D \l__physicx_matrix_cols_int by 3 }
945     { \tex_advance:D \l__physicx_matrix_cols_int by 2 }
946 }
947 }

```

(End definition for \qxmatrix. This function is documented on page ??.)

```

\physicx_matrix_diag_parse:n Parse 'diag...' keys.
\physicx_matrix_diag_parse:o
948   \cs_new:Npn \physicx_matrix_diag_parse:n #1
949   {
950     \keyval_parse:nnn
951     \__physicx_matrix_diag_parse_aux:n

```

```

952     \__physicx_matrix_diag_parse_aux:nn
953     {#1}
954 }
955 \cs_generate_variant:Nn \physicx_matrix_diag_parse:n { o }
956 \cs_new:Npn \__physicx_matrix_diag_parse_aux:n #1
957 {
958     \str_case_e:nnF {#1}
959     {
960         { auto-update }
961         {
962             \cs_set_eq:NN \__physicx_matrix_diag_calc:nn
963             \__physicx_matrix_calc:nn
964         }
965         { noauto-update }
966         {
967             \cs_set_eq:NN \__physicx_matrix_diag_calc:nn \use_none:nn
968         }
969         { true }
970         {
971             \bool_set_true:N \l__physicx_matrix_diag_bool
972             \cs_set_eq:NN \__physicx_diagonalmatrix_diag_main:
973             \__physicx_diagonalmatrix_set_diag:
974         }
975         { false }
976         {
977             \bool_set_false:N \l__physicx_matrix_diag_bool
978             \cs_set_eq:NN \__physicx_diagonalmatrix_diag_main:
979             \__physicx_diagonalmatrix_no_diag:
980         }
981     }
982     { \msg_error:nnn { physicx } { diag-key } {#1} }
983 }
984 \cs_new:Npn \__physicx_matrix_diag_parse_aux:nn #1#2
985 {
986     \tl_set:Nn \l__cwamcro_physics_tmpdiag_tl {#2}
987     \tl_set:Nx \l__cwamcro_physics_tmpdiag_tl
988     { \__physicx_expand:w \l__cwamcro_physics_tmpdiag_tl }
989     \seq_set_split:NVV \l__cwamcro_physics_tmpdiag_seq \physicx@sep \l__cwamcro_physics_tmpdiag_tl
990     \tl_if_head_eq_charcode:nNTF {#1} '
991     {
992         \exp_args:Nf \__physicx_matrix_diag_parse_aux_anti:n
993         { \tl_tail:n {#1} }
994     }
995     { \__physicx_matrix_diag_parse_aux_regu:n {#1} }
996 }
997 \cs_new:Npn \__physicx_diagonalmatrix_set_diag:
998 {
999     \int_zero:N \l__physicx_matrix_cols_int
1000     \seq_map_indexed_inline:Nn \l__cwamcro_physics_tmpdiag_seq
1001     {
1002         \int_incr:N \l__physicx_matrix_cols_int
1003         \physicx_matrix_set_r_c:nnn {##1} {##1} {##2}
1004     }
1005     \int_set_eq:NN \l__physicx_matrix_rows_int

```

```

1006     \l__physicx_matrix_cols_int
1007 }
1008 \cs_new:Npn \__physicx_diagonalmatrix_no_diag:
1009 {
1010   \seq_map_indexed_inline:Nn \l__cwamcro_physics_tmpdiag_seq
1011   { \physicx_matrix_set_r_c:nnn {##1} {##1} {##2} }
1012   \__physicx_matrix_diag_calc:nn
1013   { \seq_count:N \l__cwamcro_physics_tmpdiag_seq }
1014   { \seq_count:N \l__cwamcro_physics_tmpdiag_seq }
1015 }
1016 \cs_new_eq:NN \__physicx_diagonalmatrix_diag_main:
1017   \__physicx_diagonalmatrix_no_diag:
1018 \cs_new:Npn \__physicx_matrix_diag_parse_aux_regu:n #1
1019 {
1020   \if_int_compare:w #1 = 0 \exp_stop_f:
1021     \__physicx_diagonalmatrix_diag_main:
1022   \else:
1023     \if_int_compare:w #1 > 0 \exp_stop_f:
1024       \seq_map_indexed_inline:Nn \l__cwamcro_physics_tmpdiag_seq
1025       {
1026         \physicx_matrix_set_r_c:nnn
1027         {##1} { \int_eval:n { ##1 + #1 } } {##2}
1028       }
1029       \__physicx_matrix_diag_calc:nn
1030       { \seq_count:N \l__cwamcro_physics_tmpdiag_seq }
1031       { \seq_count:N \l__cwamcro_physics_tmpdiag_seq + #1 }
1032     \else:
1033       \seq_map_indexed_inline:Nn \l__cwamcro_physics_tmpdiag_seq
1034       {
1035         \physicx_matrix_set_r_c:nnn
1036         { \int_eval:n { ##1 - #1 } } {##1} {##2}
1037       }
1038       \__physicx_matrix_diag_calc:nn
1039       { \seq_count:N \l__cwamcro_physics_tmpdiag_seq - #1 }
1040       { \seq_count:N \l__cwamcro_physics_tmpdiag_seq }
1041     \fi:
1042   \fi:
1043 }
1044 \cs_new:Npn \__physicx_matrix_diag_parse_aux_anti:n #1
1045 {
1046   \if_int_compare:w #1 = 0 \exp_stop_f:
1047     \__physicx_matrix_diag_calc:nn
1048     { \seq_count:N \l__cwamcro_physics_tmpdiag_seq }
1049     { \seq_count:N \l__cwamcro_physics_tmpdiag_seq }
1050   \seq_map_indexed_inline:Nn \l__cwamcro_physics_tmpdiag_seq
1051   {
1052     \physicx_matrix_set_r_c:nnn
1053     {##1}
1054     { \int_eval:n { \l__physicx_matrix_cols_int - ##1 + 1 } }
1055     {##2}
1056   }
1057   \else:
1058     \if_int_compare:w #1 > 0 \exp_stop_f:
1059     \__physicx_matrix_diag_calc:nn

```

```

1060         { \seq_count:N \l__cwamcro_physics_tmpdiag_seq }
1061         { \seq_count:N \l__cwamcro_physics_tmpdiag_seq + #1 }
1062     \seq_map_indexed_inline:Nn \l__cwamcro_physics_tmpdiag_seq
1063     {
1064         \physicx_matrix_set_r_c:nnn
1065         {##1}
1066         { \int_eval:n { \l__physicx_matrix_cols_int - ##1 - #1 + 1 } }
1067         {##2}
1068     }
1069     \else:
1070     \__physicx_matrix_diag_calc:nn
1071     { \seq_count:N \l__cwamcro_physics_tmpdiag_seq - #1 }
1072     { \seq_count:N \l__cwamcro_physics_tmpdiag_seq }
1073     \seq_map_indexed_inline:Nn \l__cwamcro_physics_tmpdiag_seq
1074     {
1075         \physicx_matrix_set_r_c:nnn
1076         { \int_eval:n { ##1 - #1 } }
1077         { \int_eval:n { \l__physicx_matrix_cols_int - ##1 + 1 } }
1078         {##2}
1079     }
1080     \fi:
1081     \fi:
1082 }
1083 \cs_new:Npn \__physicx_matrix_diag_calc:nn
1084 { \__physicx_matrix_autocalc:nn }

```

(End definition for \physicx\_matrix\_diag\_parse:n. This function is documented on page ??.)

```

\physicx_matrix_item_parse:n Parse 'item...' keys.
\physicx_matrix_item_parse:o
1085 \cs_new:Npn \physicx_matrix_item_parse:n #1
1086 {
1087     \clist_set_eq:NN \l__physicx_item_ignore_clist \c_empty_clist
1088     \keyval_parse:NNn
1089     \__physicx_matrix_item_parse_aux:n
1090     \__physicx_matrix_item_parse_aux:nn
1091     {#1}
1092 }
1093 \cs_generate_variant:Nn \physicx_matrix_item_parse:n { o }
1094 \cs_new:Npn \__physicx_matrix_item_parse_aux:n #1 { }
1095 \cs_new:Npn \__physicx_matrix_item_parse_aux:nn #1#2
1096 {
1097     \tl_set:Nn \l__physicx_tmpitem_tl {#2}
1098     \tl_set:Nx \l__physicx_tmpitem_tl
1099     { \__physicx_expand:w \l__physicx_tmpitem_tl }
1100     \physicx_parse_range:nxN \l__physicx_matrix_rows_int
1101     { \use_i:nn #1 } \l__physicx_tmp_rownum_seq
1102     \physicx_parse_range:nxN \l__physicx_matrix_cols_int
1103     { \use_ii:nn #1 } \l__physicx_tmp_colnum_seq
1104     \exp_args:No \tl_if_eq:nnTF
1105     { \l__physicx_tmpitem_tl } { \PHYSICXIGNORE }
1106     {
1107         \seq_map_inline:Nn \l__physicx_tmp_rownum_seq
1108         {
1109             \seq_map_inline:Nn \l__physicx_tmp_colnum_seq

```

```

1110         {
1111             \clist_put_right:Nn \l__physicx_item_ignore_clist { [##1][####1] }
1112         }
1113     }
1114 }
1115 {
1116     \seq_map_inline:Nn \l__physicx_tmp_rownum_seq
1117     {
1118         \seq_map_inline:Nn \l__physicx_tmp_colnum_seq
1119         {
1120             \clist_if_in:NnF \l__physicx_item_ignore_clist { [##1][####1] }
1121             {
1122                 \exp_args:Nnno \physicx_matrix_set_r_c:nnn
1123                 {##1} {####1} { \l__physicx_tmpitem_tl }
1124             }
1125         }
1126     }
1127 }
1128 }

```

(End definition for `\physicx_matrix_item_parse:n`. This function is documented on page ??.)

`\physicx_matrix_array_parse:n`

Parse ‘array...’ keys.

`\physicx_matrix_array_parse:o`

```

1129 \cs_new:Npn \physicx_matrix_array_parse:n #1
1130 {
1131     \tl_set:Nn \l__physicx_tmparr_tl {#1}
1132     \tl_set:Nx \l__physicx_tmparr_tl
1133     { \__physicx_expand:w \l__physicx_tmparr_tl }
1134     \seq_set_split:NVV \l__physicx_matrix_tmparr_r_sep \physicx@cr \l__physicx_tmparr_tl
1135     \__physicx_matrix_autocalc:nn
1136     { \seq_count:N \l__physicx_matrix_tmparr_r_sep }
1137     { 0 }
1138     \seq_map_indexed_inline:Nn \l__physicx_matrix_tmparr_r_sep
1139     {
1140         \seq_set_split:Non \l__physicx_matrix_tmparr_c_sep { \physicx@align } {##2}
1141         \__physicx_matrix_autocalc:nn
1142         { 0 }
1143         { \seq_count:N \l__physicx_matrix_tmparr_c_sep }
1144         \seq_map_indexed_inline:Nn \l__physicx_matrix_tmparr_c_sep
1145         {
1146             \physicx_matrix_set_r_c:nnn {##1} {####1} {####2}
1147         }
1148     }
1149 }
1150 \cs_generate_variant:Nn \physicx_matrix_array_parse:n { o }

```

(End definition for `\physicx_matrix_array_parse:n`. This function is documented on page ??.)

`\physicx_matrix_array_parse_main:`

Process ‘main’ key.

```

1151 \cs_new:Npn \physicx_matrix_array_parse_main:
1152 {
1153     \int_step_inline:nn \l__physicx_matrix_rows_int
1154     {
1155         \int_step_inline:nn \l__physicx_matrix_cols_int
1156         {

```

```

1157         \exp_args:Nnno \physicx_matrix_set_r_c:nnn
1158         {##1} {####1} \l__physicx_matrix_main_tl
1159     }
1160 }
1161 }

```

(End definition for \physicx\_matrix\_array\_parse\_main:. This function is documented on page ??.)

\\_physicx\_if\_can\_num:n Test if can num, one can use \int\_eval:n, \fp\_eval:n, and \inteval, \fpeval in xfp package (if loaded).

```

1162 \prg_new_conditional:Npnn \_physicx_if_can_num:n #1 { T, F, TF }
1163 {
1164     \physicx_if_num:nTF {#1}
1165     { \prg_return_true: }
1166     {
1167         \bool_case_true:nTF
1168         {
1169             { \tl_if_head_eq_meaning_p:nN {#1} \int_eval:n } { }
1170             { \tl_if_head_eq_meaning_p:nN {#1} \fp_eval:n } { }
1171             {
1172                 \bool_lazy_and_p:nn
1173                 { \cs_if_exist_p:N \inteval }
1174                 { \tl_if_head_eq_meaning_p:nN {#1} \inteval }
1175             } { }
1176             {
1177                 \bool_lazy_and_p:nn
1178                 { \cs_if_exist_p:N \fpeval }
1179                 { \tl_if_head_eq_meaning_p:nN {#1} \fpeval }
1180             } { }
1181         }
1182         { \prg_return_true: }
1183         { \prg_return_false: }
1184     }
1185 }

```

(End definition for \\_physicx\_if\_can\_num:n.)

\diagonalmatrix Define \diagonalmatrix.

```

1186 \DeclareDocumentCommand \diagonalmatrix { t= t+ 0{ } m }
1187 {
1188     \group_begin:
1189     \IfBooleanTF {#1}
1190     { \keys_set:nn { physicx/matrix } { #3 , saveto = \physicxtmp } }
1191     { \keys_set:nn { physicx/matrix } { #3 } }
1192     \physicx_construct:nnn { }
1193     {
1194         \physicx_matrix_diag_parse:o \l__physicx_matrix_diag_clist
1195         \tl_if_empty:nF {#4}
1196         {
1197             \_physicx_if_keyval:nTF {#4}
1198             { \physicx_matrix_diag_parse:n { true, #4 } }
1199             { \physicx_matrix_diag_parse:n { true, 0 = {#4} } }
1200         }
1201     }

```



```

1202     { \physicx_matrix_item_parse:o \l__physicx_matrix_item_clist }
1203 \bool_lazy_or:nnTF
1204   { \bool_if_p:n {#2} }
1205   { \bool_if_p:N \l__physicx_matrix_enhanced_bool }
1206   {
1207     \bool_if:NTF \l__physicx_matrix_expand_element_bool
1208     {
1209       \cs_set_eq:NN \__physicx_diagonalmatrix_enhanced:nnn
1210       \__physicx_matrix_appto_body_e:off
1211     }
1212     {
1213       \cs_set_eq:NN \__physicx_diagonalmatrix_enhanced:nnn
1214       \__physicx_matrix_appto_body_ne:off
1215     }
1216     \use_i_ii:nnn
1217   }
1218   { \use_i:nn }
1219   \__physicx_matrix_transpose:N
1220   \__physicx_diagonalmatrix_generate_enhanced_body:NNN
1221   \__physicx_diagonalmatrix_generate_body:NNN
1222 \__physicx_matrix_save_or_print:
1223 \group_end:
1224 }
1225 \cs_new:Npn \__physicx_diagonalmatrix_generate_enhanced_body:NNN #1#2#3
1226 {
1227   \__physicx_matrix_generate_body:NNNN #1#2#3
1228   \__physicx_diagonalmatrix_enhanced:nnn
1229 }
1230 \cs_new:Npn \__physicx_diagonalmatrix_generate_body:NNN #1#2#3
1231 {
1232   \int_step_inline:nn { #1 - 1 }
1233   {
1234     \int_step_inline:nn { #2 - 1 }
1235     {
1236       \tl_put_right:Nx \l__physicx_matrix_body_tl
1237       {
1238         \exp_after:wN
1239         \physicx_matrix_use_r_c:nn
1240         #3 {{##1}} {{####1}} &
1241       }
1242     }
1243     \tl_put_right:Nx \l__physicx_matrix_body_tl
1244     {
1245       \exp_after:wN
1246       \physicx_matrix_use_r_c:nn
1247       #3 {{##1}} {{ \int_use:N #2 }} \[\dim_use:N \l__physicx_matrix_sep_dim]
1248     }
1249   }
1250   \int_step_inline:nn { #2 - 1 }
1251   {
1252     \tl_put_right:Nx \l__physicx_matrix_body_tl
1253     {
1254       \exp_after:wN
1255       \physicx_matrix_use_r_c:nn

```

```

1256         #3 {{ \int_use:N #1 }} {{##1}} &
1257     }
1258 }
1259 \tl_put_right:Nx \l__physicx_matrix_body_tl
1260 {
1261     \exp_after:wN
1262     \physicx_matrix_use_r_c:nn
1263     #3 {{ \int_use:N #1 }} {{ \int_use:N #2 }}
1264 }
1265 }

```

(End definition for \diagonalmatrix. This function is documented on page ??.)

\\_\_physicx\_declare\_init:

```

1266 \cs_new:Npn \__physicx_matrix_enhanced_init:
1267 {
1268     \seq_if_empty:NF \l__physicx_row_list_seq
1269     {
1270         \bool_set_true:N \l__physicx_matrix_expand_element_bool
1271         \cs_set_nopar:Npn \__physicx_matrix_row_iterate:n ##1
1272         { \seq_item:Nn \l__physicx_row_list_seq {##1} }
1273     }
1274     \seq_if_empty:NF \l__physicx_col_list_seq
1275     {
1276         \bool_set_true:N \l__physicx_matrix_expand_element_bool
1277         \cs_set_nopar:Npn \__physicx_matrix_col_iterate:n ##1
1278         { \seq_item:Nn \l__physicx_col_list_seq {##1} }
1279     }
1280 }

```

(End definition for \\_\_physicx\_declare\_init:.)

\commamatrix Define \commamatrix.

```

1281 \DeclareDocumentCommand \commamatrix { t= t+ 0{ } m }
1282 {
1283     \group_begin:
1284     \keys_set:nn { physicx/matrix } {#3}
1285     \tl_if_empty:nF {#4}
1286     { \keys_set:nn { physicx/matrix } { array = {#4} } }
1287     \IfBooleanT {#1}
1288     { \keys_set:nn { physicx/matrix } { saveto = \physicxtmp } }
1289     \tl_set:Nx \l__physicx_matrix_array_tl
1290     { \__physicx_expand:w \l__physicx_matrix_array_tl }
1291     \bool_lazy_or:nnTF
1292     { \bool_if_p:n {#2} }
1293     { \bool_if_p:N \l__physicx_matrix_enhanced_bool }
1294     { \__physicx_commamatrix_enhanced: }
1295     {
1296         \tl_replace_all:Nox \l__physicx_matrix_array_tl
1297         { \physicx@cr } { \[\dim_use:N \l__physicx_matrix_sep_dim] }
1298         \tl_replace_all:Non \l__physicx_matrix_array_tl
1299         { \physicx@align } { & }
1300         \tl_set_eq:NN \l__physicx_matrix_body_tl
1301         \l__physicx_matrix_array_tl
1302     }

```

```

1303     \__physicx_matrix_save_or_print:
1304     \group_end:
1305 }
1306 \cs_new_nopar:Npn \__physicx_matrix_save_or_print:
1307 {
1308     \exp_after:wN \token_if_cs:NTF \l__physicx_matrix_save_tl
1309     {
1310         \exp_after:wN \tl_gset_eq:NN
1311         \l__physicx_matrix_save_tl
1312         \l__physicx_matrix_body_tl
1313     }
1314     {
1315         \if_int_compare:w \c@MaxMatrixCols < \l__physicx_matrix_cols_int
1316         \int_set_eq:NN \c@MaxMatrixCols \l__physicx_matrix_cols_int
1317         \fi:
1318         \exp_after:wN \__physicx_matrix_begin:w \l__physicx_matrix_args_tl \l__physicx_matrix_body_tl
1319         \l__physicx_matrix_body_tl
1320         \__physicx_matrix_end: \l__physicx_matrix_after_end_tl
1321     }
1322 }
1323 \cs_new:Npn \__physicx_commamatrix_enhanced:
1324 {
1325     \tl_clear:N \l__physicx_matrix_body_tl
1326     \int_zero:N \l__cwamcro_physics_tmpa_int
1327     \seq_set_split:NVV \l__cwamcro_physics_tmp_seq \physicx@cr
1328     \l__physicx_matrix_array_tl
1329     \int_set:Nn \l__physicx_matrix_rows_int
1330     { \seq_count:N \l__cwamcro_physics_tmp_seq }
1331     \__physicx_matrix_enhanced_init:
1332     \bool_if:NTF \l__physicx_matrix_expand_element_bool
1333     {
1334         \seq_map_tokens:Nn \l__cwamcro_physics_tmp_seq
1335         {
1336             \int_incr:N \l__cwamcro_physics_tmpa_int
1337             \exp_args:NV \__physicx_commamatrix_enhanced_aux:nNn
1338             \l__cwamcro_physics_tmpa_int \__physicx_commamatrix_enhanced_aux_e:nnn
1339         }
1340     }
1341     {
1342         \seq_map_tokens:Nn \l__cwamcro_physics_tmp_seq
1343         {
1344             \int_incr:N \l__cwamcro_physics_tmpa_int
1345             \exp_args:NV \__physicx_commamatrix_enhanced_aux:nNn
1346             \l__cwamcro_physics_tmpa_int \__physicx_commamatrix_enhanced_aux_ne:nnn
1347         }
1348     }
1349 }
1350 \cs_new:Npn \__physicx_commamatrix_enhanced_aux:nNn #1#2#3
1351 {
1352     \seq_set_split:Non \l__physicx_tmp_col_seq
1353     { \physicx@align } {#3}
1354     \seq_set_eq:NN \l__physicx_tmp_coled_seq \c_empty_seq
1355     \seq_map_indexed_inline:Nn \l__physicx_tmp_col_seq
1356     { #2 {##2} {#1} {##1} }

```

```

1357 \tl_put_right:Nx \l__physicx_matrix_body_tl
1358 {
1359   \seq_use:Nn \l__physicx_tmp_coled_seq { & }
1360   \if_int_compare:w \l__physicx_matrix_rows_int = #1
1361     \scan_stop:
1362   \else:
1363     \[\dim_use:N \l__physicx_matrix_sep_dim]
1364   \fi:
1365 }
1366 }
1367 \cs_new:Npn \__physicx_commamatrix_enhanced_aux_e:nnn #1#2#3
1368 {
1369   \seq_put_right:Nx \l__physicx_tmp_coled_seq
1370   {
1371     \text_expand:n % \text_expand:n do the magic thing, but slower
1372     {
1373       \physicx@matricelement { #1 }
1374       { \__physicx_matrix_row_iterate:n {#2} }
1375       { \__physicx_matrix_col_iterate:n {#3} }
1376     }
1377   }
1378 }
1379 \cs_new:Npn \__physicx_commamatrix_enhanced_aux_ne:nnn #1#2#3
1380 {
1381   \seq_put_right:No \l__physicx_tmp_coled_seq
1382   {
1383     \physicx@matricelement {#1}
1384     { \__physicx_matrix_row_iterate:n {#2} }
1385     { \__physicx_matrix_col_iterate:n {#3} }
1386   }
1387 }

```

(End definition for \commamatrix. This function is documented on page ??.)

\generalmatrix Define \generalmatrix.

```

1388 \DeclareDocumentCommand \generalmatrix { t= t+ s m }
1389 {
1390   \IfBooleanTF {#2}
1391   {
1392     \group_begin:
1393     \IfBooleanTF {#1}
1394     { \keys_set:nn { physicx/matrix } { #4 , saveto = \physicxtmp } }
1395     { \keys_set:nn { physicx/matrix } {#4} }
1396     \bool_set:Nn \l__physicx_matrix_infinite_bool {#3}
1397     \physicx_construct:nnn
1398     {
1399       \tl_if_empty:NTF \l__physicx_matrix_main_tl
1400       {
1401         \physicx_matrix_array_parse:o \l__physicx_matrix_array_tl
1402       }
1403       { \physicx_matrix_array_parse_main: }
1404     }
1405     { \physicx_matrix_diag_parse:o \l__physicx_matrix_diag_clist }
1406     { \physicx_matrix_item_parse:o \l__physicx_matrix_item_clist }

```

```

1407     \__physicx_generalmatrix:
1408     \__physicx_matrix_save_or_print:
1409     \group_end:
1410 }
1411 {
1412     \IfBooleanTF {#1}
1413     { \IfBooleanTF {#3} { } { \use_i_ii:nnn } }
1414     { \IfBooleanTF {#3} { \use_i:nn } { \use_i:nnn } }
1415     \qmatrix = * [#4]
1416 }
1417 }
1418 \cs_new:Npn \__physicx_generalmatrix:
1419 {
1420     \bool_if:NTF \l__physicx_matrix_expand_element_bool
1421     {
1422         \cs_set_eq:NN \__physicx_generalmatrix_generate:nnn
1423         \__physicx_matrix_appto_body_e:off
1424     }
1425     {
1426         \cs_set_eq:NN \__physicx_generalmatrix_generate:nnn
1427         \__physicx_matrix_appto_body_ne:off
1428     }
1429     \__physicx_matrix_transpose:N
1430     \__physicx_matrix_generate_body:NNNN
1431     \__physicx_generalmatrix_generate:nnn
1432 }

```

(End definition for `\generalmatrix`. This function is documented on page ??.)

`\__physicx_matrix_generate_body:NNNN`

```

1433 % row, col, \use:nn or \use_ii_i:nn, appto body cmd
1434 \cs_new:Npn \__physicx_matrix_generate_body:NNNN #1#2#3#4
1435 {
1436     \__physicx_matrix_enhanced_init:
1437     \int_step_inline:nn { #1 - 1 }
1438     {
1439         \int_step_inline:nn { #2 - 1 }
1440         {
1441             \tl_set:Nx \l__physicx_tmp_tl
1442             {
1443                 \exp_after:wN
1444                 \physicx_matrix_use_r_c:nn
1445                 #3 {{##1}} {{{##1}}}
1446             }
1447             #4 \l__physicx_tmp_tl {##1} {{{##1}}}
1448             \tl_put_right:Nn \l__physicx_matrix_body_tl { & }
1449         }
1450     }
1451     \tl_set:Nx \l__physicx_tmp_tl
1452     {
1453         \exp_after:wN
1454         \physicx_matrix_use_r_c:nn
1455         #3 {{{##1}}} {{ \int_use:N #2 }}
1456     }
1457     #4 \l__physicx_tmp_tl {##1} { \int_use:N #2 }

```

```

1457         \tl_put_right:Nx \l__physicx_matrix_body_tl
1458         { \[\dim_use:N \l__physicx_matrix_sep_dim] }
1459     }
1460     \int_step_inline:nn { #2 - 1 }
1461     {
1462         \tl_set:Nx \l__physicx_tmp_tl
1463         {
1464             \exp_after:wN
1465             \physicx_matrix_use_r_c:nn
1466             #3 {{ \int_use:N #1 }} {{##1}}
1467         }
1468         #4 \l__physicx_tmp_tl { \int_use:N #1 } {{##1}}
1469         \tl_put_right:Nn \l__physicx_matrix_body_tl { & }
1470     }
1471     \tl_set:Nx \l__physicx_tmp_tl
1472     {
1473         \exp_after:wN
1474         \physicx_matrix_use_r_c:nn
1475         #3 {{ \int_use:N #1 }} {{ \int_use:N #2 }}
1476     }
1477     #4 \l__physicx_tmp_tl { \int_use:N #1 } { \int_use:N #2 }
1478 }

```

(End definition for \\_\_physicx\_matrix\_generate\_body:NNNN.)

```

\__physicx_matrix_appto_body_e:nnn
\__physicx_matrix_appto_body_e:off
\__physicx_matrix_appto_body_e:xff
\__physicx_matrix_appto_body_ne:nnn
\__physicx_matrix_appto_body_ne:off
\__physicx_matrix_appto_body_ne:xff
1479 \cs_new:Npn \__physicx_matrix_appto_body_e:nnn #1#2#3
1480 {
1481     \tl_put_right:Nx \l__physicx_matrix_body_tl
1482     {
1483         \text_expand:n
1484         {
1485             \physicx@matricelement {#1}
1486             { \__physicx_matrix_row_iterate:n {#2} }
1487             { \__physicx_matrix_col_iterate:n {#3} }
1488         }
1489     }
1490 }
1491 \cs_generate_variant:Nn \__physicx_matrix_appto_body_e:nnn { off, xff }
1492 \cs_new:Npn \__physicx_matrix_appto_body_ne:nnn #1#2#3
1493 {
1494     \tl_put_right:No \l__physicx_matrix_body_tl
1495     {
1496         \physicx@matricelement {#1}
1497         { \__physicx_matrix_row_iterate:n {#2} }
1498         { \__physicx_matrix_col_iterate:n {#3} }
1499     }
1500 }
1501 \cs_generate_variant:Nn \__physicx_matrix_appto_body_ne:nnn { off, xff }

```

(End definition for \\_\_physicx\_matrix\_appto\_body\_e:nnn and \\_\_physicx\_matrix\_appto\_body\_ne:nnn.)

\\_\_physicx\_matrix\_transpose:N

```

1502 \cs_new:Npn \__physicx_matrix_transpose:N #1 % generate body command
1503 {

```

```

1504 \bool_if:NTF \l__physicx_matrix_transpose_bool
1505 {
1506     #1
1507     \l__physicx_matrix_cols_int
1508     \l__physicx_matrix_rows_int
1509     \use_ii_i:nn
1510 }
1511 {
1512     #1
1513     \l__physicx_matrix_rows_int
1514     \l__physicx_matrix_cols_int
1515     \use:nn
1516 }
1517 }

```

(End definition for \\_\_physicx\_matrix\_transpose:N.)

\physicx\_construct:nnn Final construct. First is adi (array, diag, item), then ‘last-col’, ‘last-row’ and dots, then infinite, then ‘ending’ key.

```

1518 \cs_new:Npn \physicx_construct:nnn #1#2#3
1519 {
1520     \l__physicx_matrix_beginning_tl
1521     \__physicx_adi:nnn {#1} {#2} {#3}
1522     \tl_if_empty:NF \l__physicx_matrix_last_col_tl
1523     {
1524         \int_incr:N \l__physicx_matrix_cols_int
1525         \__physicx_matrix_last_aux_c:
1526         \int_incr:N \l__physicx_matrix_cols_int
1527     }
1528     \tl_if_empty:NF \l__physicx_matrix_last_row_tl
1529     {
1530         \int_incr:N \l__physicx_matrix_rows_int
1531         \__physicx_matrix_last_aux_r:
1532         \int_incr:N \l__physicx_matrix_rows_int
1533     }
1534     \bool_lazy_or:nnF
1535     { \tl_if_empty_p:N \l__physicx_matrix_last_row_tl }
1536     { \tl_if_empty_p:N \l__physicx_matrix_last_col_tl }
1537     {
1538         \physicx_matrix_set_r_c:nnn
1539         { \int_eval:n { \l__physicx_matrix_rows_int - 1 } }
1540         { \int_eval:n { \l__physicx_matrix_cols_int - 1 } }
1541         { \ddots }
1542     }
1543     \bool_if:NT \l__physicx_matrix_infinite_bool
1544     {
1545         \int_incr:N \l__physicx_matrix_rows_int
1546         \int_incr:N \l__physicx_matrix_cols_int
1547         \__physicx_matrix_last_aux_c:
1548         \__physicx_matrix_last_aux_r:
1549         \physicx_matrix_set_r_c:nnn
1550         { \int_use:N \l__physicx_matrix_rows_int }
1551         { \int_use:N \l__physicx_matrix_cols_int }
1552         { \ddots }

```

```

1553     }
1554     \l__physicx_matrix_ending_tl
1555   }
1556   \cs_new:Npn \__physicx_matrix_last_aux_c:
1557   {
1558     \int_step_inline:nn \l__physicx_matrix_rows_int
1559     {
1560       \physicx_matrix_set_r_c:nnn
1561       {##1} { \int_use:N \l__physicx_matrix_cols_int }
1562       { \cdots }
1563     }
1564   }
1565   \cs_new:Npn \__physicx_matrix_last_aux_r:
1566   {
1567     \int_step_inline:nn \l__physicx_matrix_cols_int
1568     {
1569       \physicx_matrix_set_r_c:nnn
1570       { \int_use:N \l__physicx_matrix_rows_int } {##1}
1571       { \vdots }
1572     }
1573   }

```

(End definition for `\physicx_construct:nnn`. This function is documented on page ??.)

### 1.3.3 Define new matrix command

```

\__physicx_new_matrix_cmd:NNN
  \newgeneralmatrix 1574 \cs_new:Npn \__physicx_new_matrix_cmd:NNN #1#2#3
  \NewGeneralMatrix 1575 {
  \newdiagonalmatrix 1576   \NewDocumentCommand #2 { t+ m o o m m }
  \NewDiagonalMatrix 1577   {
  \newcommamatrix 1578     \IfBooleanTF {##1}
  \NewCommaMatrix 1579     {
1580       \IfNoValueTF {##3}
1581       { \newcommand ##2 { #1 + [##5] {##6} } }
1582       {
1583         \IfNoValueTF {##4}
1584         { \newcommand ##2 [##3] { #1 + [##5] {##6} } }
1585         { \newcommand ##2 [##3] [##4] { #1 + [##5] {##6} } }
1586       }
1587     }
1588   {
1589     \IfNoValueTF {##3}
1590     { \newcommand ##2 { #1 [##5] {##6} } }
1591     {
1592       \IfNoValueTF {##4}
1593       { \newcommand ##2 [##3] { #1 [##5] {##6} } }
1594       { \newcommand ##2 [##3] [##4] { #1 [##5] {##6} } }
1595     }
1596   }
1597 }
1598 \NewDocumentCommand #3 { t+ m m m m }
1599 {
1600   \IfBooleanTF {##1}

```



```

1601         { \NewDocumentCommand ##2 {##3} { #1 + [##4] {##5} } }
1602         { \NewDocumentCommand ##2 {##3} { #1    [##4] {##5} } }
1603     }
1604 }
1605 \__physicx_new_matrix_cmd:NNN \diagonalmatrix \newdiagonalmatrix \NewDiagonalMatrix
1606 \__physicx_new_matrix_cmd:NNN \commamatrix \newcommamatrix \NewCommaMatrix
1607 \NewDocumentCommand \newgeneralmatrix { t+ m o o m }
1608 {
1609     \IfBooleanTF {#1}
1610     {
1611         \IfNoValueTF {#3}
1612         { \newcommand #2 { \generalmatrix + {#5} } }
1613         {
1614             \IfNoValueTF {#4}
1615             { \newcommand #2 [3] { \generalmatrix + {#5} } }
1616             { \newcommand #2 [3] [4] { \generalmatrix + {#5} } }
1617         }
1618     }
1619     {
1620         \IfNoValueTF {#3}
1621         { \newcommand #2 { \generalmatrix {#5} } }
1622         {
1623             \IfNoValueTF {#4}
1624             { \newcommand #2 [3] { \generalmatrix {#5} } }
1625             { \newcommand #2 [3] [4] { \generalmatrix {#5} } }
1626         }
1627     }
1628 }
1629 \NewDocumentCommand \NewGeneralMatrix { t+ m m m }
1630 {
1631     \IfBooleanTF {#1}
1632     { \NewDocumentCommand #2 {#3} { \generalmatrix + {#4} } }
1633     { \NewDocumentCommand #2 {#3} { \generalmatrix    {#4} } }
1634 }

(End definition for \__physicx_new_matrix_cmd:NNN and others. These functions are documented on
page ??.)

1635 </package>

```

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