

physics2 manual for the legacy physics users

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2023/10/24 Version 1.0.0*

Abstract

This short document describes `physics2` package for those who are used to the `physics` package. This document is only a simple reference manual for:

- Frequent users of the legacy `physics` package;
- Those who have to maintain a document written with `physics`;
- Users who failed to use `unicode-math` with `physics`.

It seems no reason for any other user to read *this* document instead of the [package documentation](#) of `physics2`, because this document cannot describe the package in detail.

In this document, the modules of `physics2` will be introduced in the same order as the `physics` documentation.

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*<https://www.github.com/AlphaZTX/physics2>

1 Before you start

1.1 Legacy problems with `physics` package

The `physics` package provides `\qty` command for automatic-sizing braces. The `\qty` command would cause conflict with the `siunitx` package, which provides a unified method to typeset numbers and units correctly.

Besides, after you loaded `physics`, when you type `\homework` you will get Maxwell equations and Schrödinger equation. The `\homework` command is “declared” in `physics.sty` but it was not described in the documentation. That is, if you have defined `\homework` before loading `physics` package, `physics` would overwrite the definition “silently”.

The vector-notation part of `physics` uses `amsmath`’s (more exactly, `amsbsy.sty`’s) `\boldsymbol` command to generate bold vectors. Commands for cross/dot product are defined with `\boldsymbol`. `\boldsymbol` uses `\mathversion`, a \LaTeX 2_ϵ kernel command that works well with traditional TFM-based fonts but fails when using `unicode-math`.

In the definition of `\imat`, `\xmat`, `\dmat` and `\admat` commands from `physics`, there is a `\newtoks` command which allocates a token list register and two `\newcount` commands allocating two count registers. Every time you write a command like `\imat` in your document, then one token list register and two count registers will be wasted. What’s even worse is that, if you wrote really too many matrix commands from `physics` (for example, 32767 `\imats` in \LaTeX), there’d be no room for a new `\count`.

`physics` integrated all the functions in one file (`physics.sty`), that is, you cannot load one of the total seven parts of functions; you have to load the seven parts altogether, even included the extra `\homework` command we mentioned in the first paragraph.

Moreover, the code of `physics.sty` “abuses” the g-type arguments of `xparse` package. Therefore the syntax of `physics` package looks kind of weird. See [here](#) for more.

1.2 Loading `physics2`

The `physics2` package includes different modules, among which every module focuses on one single function.

Write the following line in the preamble to load `physics2`:

```
\usepackage{physics2}
```

But this is not enough. `physics2` contains different modules. If you want to load any module of `physics2`, write this line after loading `physics2` package:

```
\usephysicsmodule{<module list>}
```

For example, “`\usephysicsmodule{ab,doubleprod}`” loads the `ab` module and the `doubleprod` module.

You can also load a module with options:

```
\usephysicsmodule[<option list>]{<module>}
```

For example, “`\usephysicsmodule[legacy]{ab}`” loads `ab` with the option “`legacy`”.



Attention, if you used any font package in your document, remember that `physics2` requires to be loaded *after* font packages.

2 List of commands

2.1 Automatic bracing

As mentioned in §1.1, the `\qty` command from `physics` would cause conflicts with `siunitx`. The command for automatic braces in `physics2` is `\ab`, a shorthand for automatic braces.

The `\ab` command requires the `ab` module, so don’t forget to write `\usephysicsmodule{ab}` in the preamble after you loaded `physics2`. Always remember, *do not put an `\ab` separately in the end of a math formula*. Take some examples:

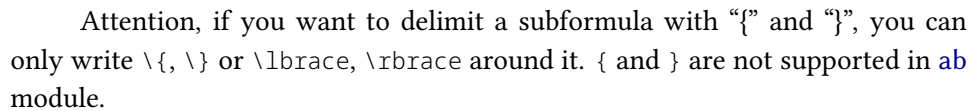
[2.1.1] `\[\ab (\frac{1}{2}) \quad`
 `\ab [\frac{1}{2}] \quad`
 `\ab{ \frac{1}{2} } \]`

$$\left(\frac{1}{2}\right) \quad \left[\frac{1}{2}\right] \quad \left\{\frac{1}{2}\right\}$$

`\ab` can modify a delimiter-braced subformula. But the delimiters should not be out of the range described by the following chart:

<code>(,)</code>	
<code>[,]</code>	
<code>\{, \}</code>	or <code>\lbrace, \rbrace</code>
<code><, ></code>	or <code>\langle, \rangle</code>
<code> , </code>	or <code>\vert, \vert</code>
<code>\ , \ </code>	or <code>\Vert, \Vert</code>

For example, `\ab{foo}` and `\ab(foo)` are illegal, but `\ab\{foo\}` and `\ab([foo])` are okay; `\ab()` is okay but `\ab()` is illegal.



Between `\ab` and the first delimiter can be a “biggg” command, that is, from `\big` to `\Bigg`. Actually, you can also write `\biggg` and `\Biggg` because `physics2` defines these after you load it. For example,

$$\left\| \frac{1}{2} \right\| \quad \left\langle \frac{1}{2} \right\rangle \quad \left| \frac{1}{2} \right|$$

Between `\ab` and the first delimiter can also be a star (*), which means “use the default size of delimiters”. But in this situation, you needn’t use the `\ab` command at all.

The `physics` package provides commands like `\pqty`, `\bqty`. In the `ab` module of `physics2`, these commands have changed to `\pab`, `\bab`, etc. The following example shows all the `\Xab` commands in `ab` module:

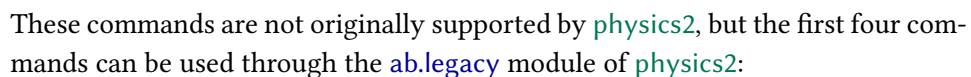
$$\begin{array}{ccc} \left(\frac{1}{2}\right) & \left[\frac{1}{2}\right] & \left\{\frac{1}{2}\right\} \\ \left\langle\frac{1}{2}\right\rangle & \left|\frac{1}{2}\right| & \left\|\frac{1}{2}\right\| \end{array}$$

`\Xab` can take an optional star and an optional [*biggg*] argument. For example,

$$\begin{pmatrix} 1 \\ 2 \end{pmatrix} \quad \begin{bmatrix} 1 \\ 2 \end{bmatrix}$$

physics also provides the following commands:

\abs \norm \eval \order \comm \acomm \pb


$$\backslash\mathrm{usephysicsmodule}\{ab.\mathrm{legacy}\}$$

For example,

$$\left| \frac{1}{2} \right| \quad \left| \frac{1}{2} \right| \quad \left| \frac{1}{2} \right|$$

Users of the legacy `physics` package should notice that the syntax of `\eval` has been changed. The `ab.legacy` module abandoned the `\eval(foo|`-like syntax. The new `\eval`’s syntax is just like other commands in this module. There are also two variants of `\eval` — `\peval` and `\beval`. For example,

[2.1.6]

```

\def\0{1+\frac{1}{2}x}
\[\eval{\0}_a^b \quad
\peval*{\0}_a^b \quad
\beval[big]{\0}_a^b \quad \]
```

$$1 + \frac{1}{2}x \Big|_a^b \quad \left(1 + \frac{1}{2}x\right)_a^b \quad \left[1 + \frac{1}{2}x\right]_a^b$$

The `\comm`, `\acomm` and `\pb` (Poisson bracket) are not supported. But you can write like `\ab[foo,baz]` or `\bab{foo,baz}` instead.

By the way, you can set the “order” symbol in `ab.legacy` through the `order` option like this:

```
\usephysicsmodule[order=0]{ab.legacy}
```

Then `\order(N)` yields $O(N)$.

2.2 Vector notation

Unfortunately, there is not a plan for `physics2` to support this part of `physics` completely, but the rest of this section will show some methods to maintain the document written with `physics`.

The `\vb(*)`, `\va(*)` and `\vu(*)` are not supported in any module of `physics2`. But these commands can be defined by copying the following lines below and pasting them in the preamble:

```

\makeatletter
\newcommand\vb{\@ifstar\boldsymbol\mathbf}
\newcommand\va[1]{\@ifstar{\vec{#1}}{\vec{\mathrm{#1}}}}
\newcommand\vu[1]{%
  \@ifstar{\hat{\boldsymbol{#1}}}{\hat{\mathbf{#1}}}}
\makeatother
```

The `\boldsymbol` command requires the `amsmath` or `bm` package. If you prefer to use `bm`, you can also use the `\bm` command. What’s more, if you tried the commands above, you might find that, the result of `\va` above is different from that of `physics`. This is because, if you choose to present a vector in bold, there’s almost no need to put a `\vec` (“”) sign above it.

However, the method above may not work well with `unicode-math` because there are so many OpenType math fonts without a bold version. When using

The `\vdot` and `\cross` commands are not supported in any module of `physics2`. Actually, there is no need to use a bold “ \cdot ” or “ \times ” for the products of two vectors. Using `\cdot` and `\times` is enough.

[illegible]

$$\begin{array}{c} \nabla F \quad \nabla\left(\frac{G}{2}\right) \\ \nabla \cdot\left[X\right] \quad \nabla \times\left\{\frac{Y}{2}\right\} \\ 2 \div 1 \end{array}$$

The `nabla.legacy` requires the `fixdif` package at least version 2.0 (file date: 2023/01/31 or after 2023/01/31).

2.3 Operators

It's suggested to write like this if you used the `ab` module:

$$\sin^2 \left(\frac{\alpha}{2} \right)$$

The `physics` package provides a bundle of commands for log-like functions that have not been defined in the $\text{\LaTeX}_{\mathcal{E}}$ kernel. Those log-like functions can be used with the `op.legacy` module; this module does not support the syntax of `physics` either. For example:

[2.3.1] `% \usephysicsmodule{op.legacy}`
`\[\asin^2 x \quad \rank \{ A \} \]`

$$\asin^2 x \quad \rank\{A\}$$

The `\Re` and `\Im` commands are redefined as operators “Re” and “Im”, while \Re and \Im are reserved as `\Resymbol` and `\Imsymbol`. \Re and \Im are ordinary symbols but `Re` and `Im` are operators.

2.4 Quick quad text

The `qtext.legacy` module provides the `\q{foo}` commands for `\quad`-wrapped texts. These commands have the same syntax as `physics`. For example,

[2.4.1] `% \usephysicsmodule{qtext.legacy}`
`\[A \qq {foo bar} B \]`
`\[A \qq*{foo bar} B \]`
`\[C \qcc D \qcc* E \]`
`\[F \qif G \qthen H \]`

$$\begin{array}{l} A \quad \text{foo bar} \quad B \\ A \text{foo bar} \quad B \\ C \quad \text{c.c} \quad D \text{c.c} \quad E \\ F \quad \text{if} \quad G \quad \text{then} \quad H \end{array}$$

All the commands described in §2.4 of [physics documentation](#) are supported when using `qtext.legacy` module, but I don’t recommend using this module unless you are maintaining a document written with `physics`’s `\q{foo}` commands.

2.5 Derivatives

There is no plan for `physics2` to support this part of `physics`. If you want to typeset the differential operators on a better sense, you can try the `fixdif` package; if you want an easy way to type derivatives, you can try the `derivative` package. These two packages can be used together. For example,

[2.5.1] `% \usepackage{fixdif,derivative}`
`\[\pdv{f}{x,y,z} \d x \]`
`Math (\d x) v.s. \ Text (\d x)`

$$\frac{\partial^3 f}{\partial x \partial y \partial z} dx$$

Math (dx) v.s. Text (x)

Here are the documentations of [fixdif](#) and [derivative](#).

[fixdif](#)’s commands behave better in superscripts and subscripts.

2.6 Dirac bra-ket notation

There are two solutions to Dirac bra-ket in `physics2` — `ab.braket` and `braket`. These two modules are *not* compatible and neither of them supports `physics`’s syntax completely. Click [here](#) to see the `ab.braket` module and [here](#) to see the `braket` module.

The `ab.braket` module This module provides four commands — `\bra`, `\ket`, `\braket` and `\ketbra`. After these commands can be a star (*) or a “biggg” command. These commands share similar syntaxes like `\ab`’s syntax. But, *the bra-ket commands from `ab.braket` module are completely different from `\ab`*. Their internal structures are different.

The argument of `\bra` should be delimited with `<` and `|`, that is,

$$\backslash\mathrm{bra} < \langle \mathit{subformula} \rangle |$$

For example,

[2.6.1] `\[\bra < \frac \phi 2 | \]`
`\[\bra* < \frac \phi 2 | \]`
`\[\bra\Big < \phi | \]`

$$\begin{array}{c} \left\langle \frac{\phi}{2} \right| \\ \left\langle \frac{\phi}{2} \right| \\ \left\langle \phi \right| \end{array}$$

The argument of `\ket` should be delimited with `|` and `>`, that is,

$$\backslash\mathrm{ket} | \langle \mathit{subformula} \rangle >$$

For example,

[2.6.2] `\[\ket | \frac \psi 2 > \]`
`\[\ket* | \frac \psi 2 > \]`
`\[\ket\Big | \psi > \]`

$$\begin{array}{c} \left| \frac{\psi}{2} \right\rangle \\ \left| \frac{\psi}{2} \right\rangle \\ \left| \psi \right\rangle \end{array}$$



If you want to write “>” and “<” for relations in the argument of `\bra` and `\ket`, you can write `\mathrel{>}` and `\mathrel{<}` (although there is almost no such need).

The argument of `\braket` should be delimited with `<` and `>`, that is,

$$\backslash\mathrm{braket} < \langle \mathit{subformula} \rangle >$$

In the $\langle \mathit{subformula} \rangle$ argument, every “|” will be regarded as an extensible vertical bar. For example,

[2.6.3] `\[\braket< \phi > \]`
`\[\braket< \phi | \psi > \]`
`\[\braket< \phi | A | \psi > \]`

$$\langle \phi \rangle$$

$$\langle \phi | \psi \rangle$$

$$\langle \phi | A | \psi \rangle$$

[2.6.4] `\def\0{\frac\phi2}`
`\[\braket < \0 | \psi > \]`
`\[\braket* < \0 | \psi > \]`
`\[\braket\Bigg< \0 | \psi > \]`

$$\left\langle \frac{\phi}{2} \middle| \psi \right\rangle$$

$$\left\langle \frac{\phi}{2} \right| \psi \rangle$$

$$\left\langle \frac{\phi}{2} \middle| \psi \right\rangle$$

The argument of `\ketbra` should be delimited with `|` and `|`. In the argument, `>` and `<` will be regarded as extensible `\rangle` and `\langle`. That is,

$$\ketbra{| \langle subformula_1 \rangle > \langle optional \rangle < \langle subformula_2 \rangle |}$$

For example,

[2.6.5] `\def\0{\frac\phi2}`
`\[\ketbra | \0 > \psi | \]`
`\[\ketbra* | \0 > \psi | \]`
`\[\ketbra\Bigg| \0 > \psi | \]`

$$\left| \frac{\phi}{2} \right\rangle \langle \psi |$$

$$\left| \frac{\phi}{2} \right\rangle \langle \psi |$$

$$\left| \frac{\phi}{2} \right\rangle \langle \psi |$$

[2.6.6] `\def\0{\frac\phi2}`
`\[\ketbra| \0 >_x^y < \psi | \]`

$$\left| \frac{\phi}{2} \right\rangle_x^y \langle \psi |$$



If you want to write “ $>$ ” and “ $<$ ” for relations in the argument of `\braket` and `\ketbra`, you can write `\>` and `\<` (although there is almost no such need). It is quite different from `\mathrel{>}` or `\mathrel{<}` because in these commands’ argument, `>` and `<` will be redefined.

The `braket` module This module contains four commands — `\bra`, `\ket`, `\braket` and `\ketbra`. After these commands can be a star (*) or a square-bracket-delimited size option, the size option can take the following values:

big, Big, bigg, Bigg, biggg or Biggg.

Star stands for “do not size the bra-ket automatically”.

The argument(s) of these four commands are braced with { and }. \bra and \ket take one mandatory argument. For example,

[2.6.7]

```
\def\0{\frac\phi2}
\[ \bra {\0} \quad \bra* {\0}
\quad \bra[Big] {\0} \]
\[ \ket {\0} \quad \ket* {\0}
\quad \ket[Big] {\0} \]
```

$$\begin{array}{ccc} \left\langle \frac{\phi}{2} \right| & \left\langle \frac{\phi}{2} \right| & \left\langle \frac{\phi}{2} \right| \\ \left| \frac{\phi}{2} \right\rangle & \left| \frac{\phi}{2} \right\rangle & \left| \frac{\phi}{2} \right\rangle \end{array}$$

The \braket command, in default, can take two arguments.

[2.6.8]

```
\def\0{\frac\phi2}
\[ \braket {\0} {\psi} \quad
\braket* {\0} {\psi} \quad
\braket[big] {\0} {\psi} \]
```

$$\left\langle \frac{\phi}{2} \right| \psi \rangle \quad \langle \frac{\phi}{2} | \psi \rangle \quad \langle \frac{\phi}{2} | \psi \rangle$$

If you want \braket to take one or three arguments, you can write the number of arguments in the square bracket. If you need to specify the size of bra-ket simultaneously, you need to separate the number and the size with a comma:

[2.6.9]

```
\def\0{\frac\phi2}
\[ \braket [1] {\0} \quad
\braket*[1] {\0} \]
\[ \braket [3] {\0}{A}{\psi} \]
\[ \braket[3,big] {\0}{A}{\psi}
\quad
\braket[Big,3] {\0}{A}{\psi} \]
```

$$\begin{array}{ccc} \left\langle \frac{\phi}{2} \right\rangle & \left\langle \frac{\phi}{2} \right\rangle & \\ \left\langle \frac{\phi}{2} \right| A | \psi \rangle & & \\ \left\langle \frac{\phi}{2} \right| A | \psi \rangle & \left\langle \frac{\phi}{2} \right| A | \psi \rangle & \end{array}$$

The \ketbra command takes two mandatory arguments. It can also take an optional argument between the two mandatory arguments. The optional argument will be placed between > and <:

[2.6.10]

```
\def\0{\frac\phi2}
\[ \ketbra {\0} {\psi} \quad
\ketbra* {\0} {\psi} \]
\[ \ketbra [Bigg] {\0} {\psi} \]
\[ \ketbra {\0} [_x^y] {\psi} \]
```

$$\begin{array}{ccc} \left| \frac{\phi}{2} \right\rangle \langle \psi | & \left| \frac{\phi}{2} \right\rangle \langle \psi | & \\ \left| \frac{\phi}{2} \right\rangle \langle \psi | & & \\ \left| \frac{\phi}{2} \right\rangle_x^y \langle \psi | & & \end{array}$$

2.7 Matrix macros

Unfortunately, **physics2** do not support the `\mqty` command from **physics**. If you are used to this command, you can write like this:

```
\newcommand\mqty[1]{\begin{matrix}#1\end{matrix}}
\newcommand\pmqty[1]{\begin{pmatrix}#1\end{pmatrix}}
$\ab(\mqty{foo})$ or $\pmqty{foo}$
```

These are equal to **physics**'s `\mqty(foo)` (require **amsmath**).

physics2's **diagmat** module provides `\diagmat` command for diagonal matrices. For example,

[2.7.1]

```
\[
  \diagmat { 1, 2, 3 }
\]
```

$$\begin{pmatrix} 1 & 0 & 0 \\ 0 & 2 & 0 \\ 0 & 0 & 3 \end{pmatrix}$$

[2.7.2]

```
\[
  \pdiagmat [ empty = {} ]
  { a, b, c, d }
\]
```

$$\begin{pmatrix} a & & & \\ & b & & \\ & & c & \\ & & & d \end{pmatrix}$$

`\pdiagmat`, `\bdiagmat`, `\Bdiagmat`, `\vdiagmat` and `\Vdiagmat` are also available.

physics2's **xmat** module provides `\xmat` command for matrices with formatted entries. For example,

[2.7.3]

```
\[
  \xmat{a}{2}{3}
\]
```

$$\begin{matrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \end{matrix}$$

[2.7.4]

```
% \usephysicsmodule
% [showleft=3,showtop=3]{xmat}
\[
  \pxmat{X}{m}{n}
\]
```

$$\begin{pmatrix} X_{11} & X_{12} & X_{13} & \cdots & X_{1n} \\ X_{21} & X_{22} & X_{23} & \cdots & X_{2n} \\ X_{31} & X_{32} & X_{33} & \cdots & X_{3n} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ X_{m1} & X_{m2} & X_{m3} & \cdots & X_{mn} \end{pmatrix}$$

[2.7.5]

```
\[
  \xmat [showleft=2,showtop=2,
  format=\texttt{\#1[\#2][\#3]}]
  {x}{m}{n}
\]
```

$$\begin{matrix} x[1][1] & x[1][2] & \cdots & x[1][n] \\ x[2][1] & x[2][2] & \cdots & x[2][n] \\ \vdots & \vdots & \ddots & \vdots \\ x[m][1] & x[m][2] & \cdots & x[m][n] \end{matrix}$$

`\pxmat`, `\bxmat`, `\Bxmat`, `\vxmat` and `\Vxmat` are also available.