This package is there to make it easier to make annotated equations in \LaTeX{}, such as in this example:

\begin{equation*}
  i \hbar \frac{\partial}{\partial t} \Psi(x, t) = \hat{H} \Psi(x, t)
\end{equation*}

\hbar = \frac{\hbar}{2\pi}, reduced Planck constant

\begin{tikzpicture}
  \node[above] {Wave function};
  \node[above] {Hamilton operator};
  \node[above] {\hbar};
  \node[above] {\hat{H}};
\end{tikzpicture}

There is still a bit of manual tweaking required (such as adding vertical space before/after the equation), but hopefully this package will already make it a bit more inviting to annotate your equations!

Note that this package relies on TikZ's \texttt{remember picture} option and therefore you have to compile your \LaTeX{} document at least twice to get everything in the right place (or just use \texttt{latexmk}).

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1 Marking annotation targets within your equation

Use \texttt{\eqnmarkbox\{\color\}\{\langle node name\rangle\}\{\langle equation term(s)\rangle\}} or \texttt{\eqnmark\{\color\}\{\langle node name\rangle\}\{\langle equation term(s)\rangle\}} to define the target of an annotation within your equation. \texttt{\eqnmarkbox} adds background shading, whereas \texttt{\eqnmark} changes the text color. (You can also use \texttt{\tikzmarknode\{\langle node name\rangle\}\{\langle equation term(s)\rangle\}}, but this is likely to end up with the arrow tip too close to the target, so you may want to also pass the \texttt{outer ysep} option, see section \ref{5.3}.)

\begin{equation*}
\eqnmarkbox[blue]{node1}{e_q^n}
\eqnmark[red]{node2}{f(x)}
\tikzmarknode{node3}{kT}
\end{equation*}

You generally need to manually adjust the \texttt{yshift} to move the annotations to an appropriate distance above (or negative values for below) the equation. If you want an annotation below the equation, with negative \texttt{yshift}, remember to also pass the \texttt{below} option (see section \ref{2.1}). (You can also adjust \texttt{xshift} if needed, also positive or negative.)

The annotation picks the same text color as given to \texttt{\eqnmarkbox} or \texttt{\eqnmark}, but you can also override it using \texttt{color} option.

One annotation can point to multiple targets, and multiple annotations can point to the same target.

2 Simple annotations

Once you have defined nodes within your equations, you can annotate them using \texttt{\annotate\{\langle tikz options\rangle\}\{\langle annotate keys\rangle\}\{\langle node name\rangle\}\{\langle annotation text\rangle\}}. \texttt{\langle tikz options\rangle} is passed through to the options for the TikZ node defining the annotation; its most important use is to set the \texttt{yshift}. For \texttt{\langle annotate keys\rangle}, see section \ref{2.1} \texttt{\langle node name\rangle} is the same name you used to mark the node within the equation, e.g. using \texttt{\eqnmarkbox}. \texttt{\langle annotation text\rangle} is the text of the annotation itself.

\begin{equation*}
\begin{align*}
\eqnmarkbox[blue]{node1}{e_q^n} \\
\eqnmark[red]{node2}{f(x)} \\
\tikzmarknode{node3}{kT}
\end{align*}
\end{equation*}

You generally need to manually adjust the \texttt{yshift} to move the annotations to an appropriate distance above (or negative values for below) the equation. If you want an annotation below the equation, with negative \texttt{yshift}, remember to also pass the \texttt{below} option (see section \ref{2.1}). (You can also adjust \texttt{xshift} if needed, also positive or negative.)

The annotation picks the same text color as given to \texttt{\eqnmarkbox} or \texttt{\eqnmark}, but you can also override it using \texttt{color} option.

One annotation can point to multiple targets, and multiple annotations can point to the same target.

2.1 Annotation options

\texttt{\langle annotate keys\rangle} can be empty, or contain one or more of:

- \texttt{above} (default) or \texttt{below},
- \texttt{right} (default) or \texttt{left},
- \texttt{label above} (default) or \texttt{label below}.

Note: currently only works for \texttt{\annotatetwo} (section \ref{3}).
3 Double annotations

\annotatetwo[(tikz options)]{(annotate keys)}{(first node name)}{(second node name)}{(annotation text)}. (tikz options) and (annotate keys) are as described above in sections 2 and 2.1. Note that (annotate keys) left/right have no effect in \annotatetwo.

\begin{equation*}
\eqnmarkbox[red]{a1}{a} \eqnmarkbox[blue]{b1}{b} = \eqnmarkbox[green]{b2}{b} \eqnmarkbox[blue]{a2}{a}
\end{equation*}
\annotatetwo[yshift=1.5em]{above, label below}{a1}{a2}{var 1}
\annotatetwo[yshift=0.5em]{above}{b1}{b2}{var 2}
\annotatetwo[yshift=-0.5em]{below}{b2}{b1}{var 2}

Color is picked from the first of the two nodes.

4 Package options

4.1 Size of highlight: shrink to content or always full height

\eqnhighlightheight is inserted into every \eqnhighlight, \eqncolor, \eqnmark, and \eqnmarkbox and by redefining it you can specify the minimum height for the corresponding box:

\renewcommand{\eqnhighlightheight}{} % package default
\begin{equation*}
\eqnmarkbox[red]{hbar}{\ hbar} \eqnmarkbox[blue]{q}{q}
\end{equation*}
\renewcommand{\eqnhighlightheight}{\mathstrut} % 0-width "constant" height
\begin{equation*}
\eqnmarkbox[red]{hbar}{\ hbar} \eqnmarkbox[blue]{q}{q}
\end{equation*}

\eqnhighlightheight is used in math mode.

Note that in some cases \mathstrut might not be enough, as in the introductory example:

\renewcommand{\eqnhighlightheight}{\mathstrut} % 0-width "constant" height
\begin{equation*}
\eqnmarkbox[red]{\hat{H}}{\ \hat{H}} \eqnmarkbox[blue]{\Psi}{\ \Psi}
\end{equation*}

You can create custom 0-width characters using \vphantom:

\renewcommand{\eqnhighlightheight}{\vphantom{\hat{H}}\mathstrut} % custom 0-width height
\begin{equation*}
\eqnmarkbox[red]{\hat{H}}{\ \hat{H}} \eqnmarkbox[blue]{\Psi}{\ \Psi}
\end{equation*}

(It looks more balanced if you still include the \mathstrut.)

4.2 Amount of shading of mark highlight

\eqnhighlightshade defines the percentage of the specified color to take:
By redefining this command, you can change the “alpha” value of the highlight:

\begin{equation*}
\textcolor{red}{hbar} \quad \textcolor{blue}{q}
\end{equation*}

4.3 Default formatting of annotation labels

\texttt{\eqnannotationfont} sets the font field of the TikZ annotation label and can be re-set to change its formatting:

\begin{equation*}
\textcolor{blue}{v}
\end{equation*}

\vspace{1em}

Alternatively, you can also change the style of annotate equations/text:

\texttt{\tikzset{annotate equations/text/.style={font=\bfseries\small}}}

\vspace{1em}

\texttt{\eqnannotationstrut} is defined to be a strut (zero-width height) to provide minimum distance between the text and the corresponding arrow line. By default it is \texttt{\strut}, which has a similar effect to \texttt{\mathstrut} in \texttt{\eqnhighlightshade}.

\begin{equation*}
\textcolor{blue}{size}
\end{equation*}

\vspace{1em}
4.4 Customize style

You can change the style of the annotation arrow line by setting the style of `annotate equations/arrow`:

\begin{equation*}
\eqnmarkbox[blue]{size}{s} = \eqnmarkbox[red]{other}{x}
\end{equation*}

\begin{tikzpicture}
\node[draw, circle, fill=red] at (0,0) (node1) {$s$};
\node[draw, circle, fill=blue] at (1,0) (node2) {$x$};
\draw[red, very thick, dashed] (node1) to (node2);
\end{tikzpicture}

\annotate[below]{size}{The size}
\annotatetwo[above]{size}{other}{the same}

Note that it applies to all `\annotate` and `\annotatetwo` arrows within the scope. You can also use this to change the arrow direction:

\begin{equation*}
\eqnmarkbox[blue]{size}{s} = \eqnmarkbox[red]{other}{x}
\end{equation*}

\begin{tikzpicture}
\node[draw, circle, fill=red] at (0,0) (node1) {$s$};
\node[draw, circle, fill=blue] at (1,0) (node2) {$x$};
\draw[red, very thick, dashed] (node1) to [out=90, in=90] (node2);
\end{tikzpicture}

\annotate[below, label below]{size}{other}{the same}
\annotatetwo[above]{size}{other}{one and}
\tikzset{annotate equations/arrow/.style={->}}

5 Recommendations, tips & tricks

5.1 Use `\colorlet` for consistent, easily changeable colors

5.2 Relations such as “=”

Wrapping a mathematical relation symbol such as \(=\) in, for example, `\tikzmarknode`, breaks how \TeX\ determines spacing in equations:

\[a = b\]
\[a \tikzmarknode{node1}{=} b\]
\[\annotate[yshift=-1em]{below}{node1}{equality}\]

This can be fixed by wrapping the `\tikzmarknode` in `\mathrel`:

\[a = b\]
\[a \mathrel{\tikzmarknode{node1}{=}} b\]
\[\annotate[yshift=-1em]{below}{node1}{equality}\]

5.3 Extra spacing between `\tikzmarknode` and arrow

If you want more space between arrow tip and annotated term, you can pass the `outer ysep` option to `\tikzmarknode`:
6 Known issues

- Annotations of mathematical relations require some manual patching to get the correct surrounding spacing (see section 5.2).

7 Backwards-incompatible changes

v0.2.0

\texttt{\textbackslash eqnannotationtext} removed

To make it easier to format multiline annotations, version 0.2.0 introduced the \texttt{\textbackslash eqnannotationfont} and \texttt{\textbackslash eqnannotationstrut} (zero-argument) commands (see section 4.3).

In exchange, the \texttt{\textbackslash eqnannotationtext} (one-argument) command was removed. To upgrade, replace for example

\begin{verbatim}
\renewcommand{\eqnannotationtext}{\sffamily\tiny#1\strut}
\end{verbatim}

with

\begin{verbatim}
\renewcommand{\eqnannotationfont}{\sffamily\tiny}
\renewcommand{\eqnannotationstrut}{\strut}
\end{verbatim}