The HEP-MATH package[*]

Extended math macros

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Abstract

The HEP-MATH package provides some additional features beyond the MATHTOOLS and AMSMATH packages.

To use the package place `\usepackage{hep-math}` in the preamble.

`\left`
`\right`

The MATHTOOLS [1] package is loaded, which in turn loads the $\mathcal{AMS}$-LaTeX AMSMATH [2] package. Horizontal spacing in inline equations and page breaks in block equations are marginally adjusted. Spacing around `\left` and `\right` is fixed with the MLEFTRIGHT package [3].

1 Macros

`\mathdef`

The `\mathdef{`⟨*name*⟩`}[`⟨*arguments*⟩`]{`⟨*code*⟩`}` macro (re-)defines macros only within math mode without changing the text mode definition.

`\i`
`\d`

The imaginary unit `\i` and the differential `\d` are defined using this functionality.

`\overline`

The `\overline` macro is adjusted to $\overline{\text{work also outside}}$ of math mode using the SOULUTF8 [4] package.

`\oset`
`\overleft`
`\overright`
`\overleftright`

A better looking over left right arrow is defined i.e. $\overset{\leftrightarrow}{\partial}$ using a new `\oset{`⟨*over*⟩`}{`⟨*math*⟩`}` functionality.

`\diag`
`\sgn`

Diagonal matrix `\diag`, signum `\sgn`, trace `\tr`, `\Tr`, and `\rank` operators are defined.

`\Re`
`\Im`

The real and imaginary projectors are redefined to look like ordinary operators.

`\sin`
`\cos`
`\tan`

`\cos` and `\tan` are adjusted to have the same height as `\sin`.

`\accsc`

`\arccsc` and other inverse trigonometric functions are defined.

1.1 Fractions and units

`\unit`
`\inv`

The correct spacing for units is provided by the macro `\unit[`⟨*value*⟩`]{`⟨*unit*⟩`}`

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[*] This document corresponds to HEP-MATH v1.1.

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from the UNITS package [5] which can also be used in text mode. The macro `\inv[⟨power⟩]{⟨text⟩}` allows to avoid math mode also for inverse units such as $5\,\mathrm{fb}^{-1}$ typeset via `\unit[5]{\inv{fb}}`.

`\nicefrac` `\flatfrac` `\textfrac` The `\frac{⟨number⟩}{⟨number⟩}` macro is accompanied by `\nicefrac{⟨number⟩}{⟨number⟩}`, `\textfrac{⟨number⟩}{⟨number⟩}`, and `\flatfrac{⟨number⟩}{⟨number⟩}` leading to $\frac{1}{2}$, $^1/_2$, $^1/_2$, and $1/2$. The `\textfrac` macro is mostly intended if a font with oldstyle numerals is used.

Some macros of the PHYSICS package [6] are reimplemented with a more conventional typesetting in mind. Finer details about mathematical typesetting can be found in [7].

1.2 Differentials and derivatives

`\differential` `\newderivative` `\newpartialderivative` The three macros `\differential{⟨symbol⟩}`, `\newderivative{\name}{⟨symbol⟩}`, and `\newpartialderivative{\name}{⟨symbol⟩}` allow to define a differential with correct spacing, a derivative using this differential, and if necessary a partial derivative that can handle three dimensional derivatives.

`\d` `\dv` These macros are used for the usual differential and derivative, producing dx via `\d x` and

`\dv[f]x`	`\dv*[f]x^n`	`\dv[f]x*^n`	`\dv*[f]x*^n`
$\frac{df}{dx}$	d^nf/dx^n	$\tfrac{d^nf}{dx^n}$	$^{d^nf}/_{dx^n}$
`\dv xf`	`\dv*xf`	`\dv x*f`	`\dv*x*f`
$\frac{d}{dx}f$	$d/dx\,f$	$\tfrac{d}{dx}f$	$^{d}/_{dx}f$

via `\dv*[⟨f⟩]{⟨x⟩}*^{⟨n⟩}`. Upright differential can be produced via `\renewcommand{\diffsymbol}{\mathrm d}`.

`\pd` `\pdv` Similarly a partial differential and derivative are defined that can be used according to `\pdv*[⟨f⟩]{⟨x⟩}*^{⟨a⟩}[⟨y⟩]^{⟨b⟩}[⟨z⟩]^{⟨c⟩}`.

`\pdv[f]x`	`\pdv[f]x[y]`	`\pdv[f]x^3`	`\pdv[f]x^2[y]`
$\frac{\partial f}{\partial x}$	$\frac{\partial^2 f}{\partial x\partial y}$	$\frac{\partial^3 f}{\partial x^3}$	$\frac{\partial^3 f}{\partial x^2\partial y}$
`\pdv[f]x^2[y]^3`	`\pdv[f]x[y]^3`	`\pdv x[y]f`	
$\frac{\partial^5 f}{\partial x^2\partial y^3}$	$\frac{\partial^4 f}{\partial x\partial y^3}$	$\frac{\partial^2}{\partial x\partial y}f$	

`\var` Similarly a functional variation and functional derivative are defined.

`\fdv` `\cancel` `\slashed` The `\cancel{⟨characters⟩}` macro from the CANCEL package [8] and the `\slashed{⟨character⟩}` macro from the SLASHED package [9] allow to $\cancel{cancel}$ math and use the Dirac slash notation i.e. $\slashed{\partial}$, respectively.

1.3 Paired delimiters

`\abs` `\norm` `\eval` `\order`

`\abs x`	`\norm x`	`\norm[2]x`	`\norm*[2]x`
$\lvert x\rvert$	$\lVert x\rVert$	$\lVert x\rVert_2$	$\lVert x\rVert_2$

`\order x`	`\eval x_o^\infty`	`\eval* x_o^\infty`
$\mathcal{O}(x)$	$x\vert_0^\infty$	$x\big\vert_0^\infty$

`\newpair` `\comm` `\acomm`

The `\newpair{`⟨*name*⟩`}{`⟨*left delim*⟩`} {`⟨*right delim*⟩`}_{`⟨*subscript*⟩`}^{`⟨*superscript*⟩`}` macro is defined and used for the definition of (anti-)commutators and Poisson brackets.

`\pb xy`	`\comm xy`	`\acomm xy`
$\{x, y\}$	$[x, y]$	$\{x, y\}$

They can easily be redefined using e.g. `\newpair\comm\lbrack\rbrack_-`.

`\bra` `\ket` `\braket` `\ketbra` `\mel` `\ev` `\vev` `\column` `\row`

Macros for the bra-ket notation are introduced.

`\bra x`	`\ket x`	`\braket xy`	`\ketbra xy`
$\langle x\,\vert$	$\vert\,x\rangle$	$\langle x\,\vert\,y\rangle$	$\vert\,x\rangle\langle y\,\vert$
`\mel xyz`	`\ev x`	`\ev[\Omega] x`	`\vev x`
$\langle x\,\vert\,y\,\vert\,z\rangle$	$\langle x\rangle$	$\langle \mathit{\Omega}\,\vert\,x\,\vert\,\mathit{\Omega}\rangle$	$\langle 0\,\vert\,x\,\vert\,0\rangle$

Macros for row and column vectors are introduced together with a symbol for transpose vectors.

`\column{x,y,z}`	`\row{x,y,z}^\trans`
$\begin{pmatrix} x \\ y \\ z \end{pmatrix}$	$(x,\ y,\ z)^\mathsf{T}$

2 Environments

`eqnarray`

The `eqnarray` environment is depreciated, the `split`, `multline`, `align`, `multlined`, `aligned`, `alignedat`, and `cases` environments of the AMSMATH and MATHTOOLS packages should be used instead.

`equation`

Use the `equation` environment for short equations.

```
\begin{equation}
  left = right \ .
\end{equation}
```

$$\boxed{\text{left}} = \boxed{\qquad\text{right}\qquad} \ . \tag{1}$$

`multline`

Use the `multline` environment for longer equations.

```
\begin{multline}
  left = right 1 \\
  + right 2 \ .
\end{multline}
```

$$\begin{multline}\boxed{\text{left}} = \boxed{\qquad\text{right 1}\qquad} \\ \boxed{\qquad+\text{ right 2}\qquad} \ . \tag{2}\end{multline}$$

split Use the split sub environment for equations in which multiple equal signs should be aligned.

```
\begin{equation} \begin{split}
  left &= right 1 \\
  &= right 2 \ .
\end{split} \end{equation}
```

$$\begin{split}\boxed{\text{left}} &= \boxed{\quad\text{right 1}\quad} \\ &= \boxed{\quad\text{right 2}\quad}\ .\end{split} \tag{3}$$

align Use the align environment for the vertical alignment and horizontal distribution of multiple equations.

```
\begin{subequations} \begin{align}
  left &= right \ , &
  left &= right \ , \\
  left &= right \ , &
  left &= right \ .
\end{align} \end{subequations}
```

$$\begin{aligned}\boxed{\text{left}} &= \boxed{\text{right}}\ , & \boxed{\text{left}} &= \boxed{\text{right}}\ , && \text{(4a)} \\ \boxed{\text{left}} &= \boxed{\text{right}}\ , & \boxed{\text{left}} &= \boxed{\text{right}}\ . && \text{(4b)}\end{aligned}$$

aligned Use the aligned environment within a equation environment if the aligned equations should be labeled with a single equation number.

multlined Use the multlined environment if either split or align contain very long lines.

```
\begin{equation} \begin{split}
  left &= right 1 \\ &=
  \begin{multlined}[t]
    right 2 \\ + right 3 \ .
  \end{multlined}
\end{split} \end{equation}
```

$$\begin{split}\boxed{\text{left}} &= \boxed{\quad\text{right 1}\quad} \\ &= \boxed{\quad\text{right 2}\quad} \\ &\qquad\quad \boxed{\quad + \text{right 3}\quad}\ .\end{split} \tag{5}$$

alignat Use the alignat environment together with the `\mathllap` macro for the alignment of multiple equations with vastly different lengths.

```
\begin{subequations}
\begin{alignat}{2}
  left &= long right && \ , \\
  le. 2 &= ri. 2 \ , &
  \mathllap{le. 3 = ri. 3} & \ .
\end{alignat}
\end{subequations}
```

$$\begin{alignedat}{2}\boxed{\text{left}} &= \boxed{\qquad\quad\text{long right}\qquad\quad} &&\ , && \text{(6a)} \\ \boxed{\text{le. 2}} &= \boxed{\text{ri. 2}}\ , \qquad & \boxed{\text{le. 3}} = \boxed{\text{ri. 3}} &\ . && \text{(6b)}\end{alignedat}$$

As a rule of thumb if you have to use `\notag`, `\nonumber`, or perform manual spacing via `\quad` you are probably using the wrong environment.

A Implementation

<*package>

Load the MATHTOOLS package [1] which loads the AMSMATH package [2]. Allow page breaks within equations if necessary. Adjust the thick and med mu skips slightly.

```
\RequirePackage{mathtools}
\mathtoolsset{centercolon}
\allowdisplaybreaks[1]
```

```
\thickmuskip=5mu plus 3mu minus 1mu
\medmuskip=4mu plus 2mu minus 3mu
```

\mathdef Define the `\mathdef{⟨name⟩}[⟨arguments⟩]{⟨macro⟩}` macro which (re-)defines macros in math mode only. This macro is implemented using the xparse package [10].

```
\RequirePackage{xparse}
\DeclareDocumentCommand{\mathdef}{mO{0}om}{%
  \expandafter\let\csname hep@text\string#1\endcsname=#1
  \expandafter\newcommand\csname hep@math\string#1%
  \IfNoValueTF{#3}{\endcsname[#2]}{\endcsname[#2][#3]}{#4}
  \DeclareRobustCommand#1{%
    \ifmmode
      \expandafter\let\expandafter\next\csname%
      hep@math\string#1\endcsname%
    \else
      \expandafter\let\expandafter\next\csname%
      hep@text\string#1\endcsname%
    \fi
    \next
  }%
}
```

\i Provide an upright imaginary unit in math mode.

```
\AtBeginDocument{\mathdef{\i}{\operatorname{i}}}
```

\overline Redefine `\overline` to be a text macro using the soulutf8 package [4]. Extend it as a math macro with the original definition from the amsmath package [2].

```
\RequirePackage{soulutf8}
% \def\overline#1{{\renewcommand{\ULdepth}{-1.9ex}{}\uline{#1}}}
\newcommand\textoverline[1]{{\setul{-1.9ex}{}\ul{#1}}}
\let\overline\textoverline
\DeclareRobustCommand{\over@line}[1]{\@@overline{#1}}
\mathdef{\overline}{\over@line}
\newcommand\hep@widebar[1]{%
  \mkern2.5mu\overline{\mkern-2.5mu#1\mkern-.5mu}\mkern.5mu%
}
\newcommand\widebar[1]{%
  \settowidth{\dimen0}{\ensuremath{#1}}%
  \ifdim\dimen0>.475em\hep@widebar{#1}\else\bar{#1}\fi%
}
```

\oset Define a new overset macro `\oset[⟨offset⟩]{⟨over⟩}{⟨base⟩}`

```
\newcommand{\oset}[3][-1pt]{%
  \text{\raisebox{.2ex}{$\mathop{#3}\limits^{%
    \vbox to#1{\kern-2\ex@\hbox{$\scriptscriptstyle#2$}\vss}%
  }$}}%
}
```

`\overleftright` Define a over left right arrow `\overleftright{`⟨*base*⟩`}`.

```
\newcommand{\overleft}[1]{\oset{\leftarrow}{#1}}
\newcommand{\overright}[1]{\oset{\rightarrow}{#1}}
\newcommand{\overleftright}[1]{\oset{\leftrightarrow}{#1}}
```

`eqnarray` Undefine the `eqnarray` environment if not prevented by package option.

```
% \newif\ifhep@eqnarray\hep@eqnarraytrue
% \ifhep@eqnarray\else
%   \let\eqnarray\@undefined
%   \let\endeqnarray\@undefined
% \fi
```

A.1 Operators

`\tr` `\Tr` `\rank` `\erf` `\Res` `\sgn` `\sgn` `\diag` Provide the `\diag`, `\sgn`, and some other operators.

```
\DeclareMathOperator{\tr}{tr}
\DeclareMathOperator{\Tr}{Tr}
\DeclareMathOperator{\rank}{rank}
\DeclareMathOperator{\erf}{erf}
\DeclareMathOperator{\Res}{Res}
\DeclareMathOperator{\sgn}{sgn}
\DeclareMathOperator{\diag}{diag}
\let\det\relax\DeclareMathOperator{\det}{det}
```

`\Re` `\Im` Redefine the real and imaginary projectors.

```
\let\Re\relax\DeclareMathOperator{\Re}{Re}
\let\Im\relax\DeclareMathOperator{\Im}{Im}
```

`\transpose` `\trans` Define a transpose symbol.

```
\RequirePackage{amssymb}
\newcommand*{\hep@transpose}[2]{\raisebox{\depth}{$\m@th#1\intercal$}}
\newcommand*{\transpose}{{\mathpalette\hep@transpose{}}}
\let\trans\transpose
```

A.1.1 Trigonometric functions

`\cos` `\tan` Adjust the height of of cos and tan to be equal to sin.

```
\let\cos\undefined\DeclareMathOperator{\cos}{cos\vphantom{i}}
\let\tan\undefined\DeclareMathOperator{\tan}{tan\vphantom{i}}
```

`\arccsc` `\arcsec` `\arccot` Define arc operators.

```
\DeclareMathOperator{\arccsc}{arccsc}
\DeclareMathOperator{\arcsec}{arcsec}
\DeclareMathOperator{\arccot}{arccot}
```

`\asin` `\acos` `\atan` `\acsc` `\asec` `\acot` Define shorthand for arc operators.

```
\DeclareMathOperator{\asin}{asin}
\DeclareMathOperator{\acos}{acos}
\DeclareMathOperator{\atan}{atan}
\DeclareMathOperator{\acsc}{acsc}
\DeclareMathOperator{\asec}{asec}
\DeclareMathOperator{\acot}{acot}
```

`\csch` `\sech` Define csch and sech operators.

```
\DeclareMathOperator{\csch}{csch}
\DeclareMathOperator{\sech}{sech}
```

A.2 Units and fractions

`\unit` Load the UNITS package [5] which provides the `\units` and `\nicefrac` macros.

```
\RequirePackage{units}
```

`\inv` Provide a macro for the inverse, useful in combination with the unit macro in text mode.

```
\newcommand{\inv}[2][1]{#2\ensuremath{^{-#1}}}
```

`\textfrac` Provide the `\textfrac` macro useful in combination with a font using lining numerals.

```
\newcommand{\textfrac}[2]{\ensuremath{\nicefrac{\text{#1}}{\text{#2}}}}
```

`\flatfrac` Provide a flat fraction.

```
\DeclarePairedDelimiterX{\hep@flatfrac}[2]{.}{.}{%
  \kern-\nulldelimiterspace#1\delimsize/\hep@left@delim#2\kern-\nulldelimiterspace%
}
\NewDocumentCommand{\flatfrac}{somm}{%
  \mathop{
    \IfBooleanTF{#1}{%
      \hep@flatfrac*{#3}{#4}%
    }{%
      \IfNoValueTF{#2}{\hep@left@delim#3/\hep@left@delim#4%
      }{%
       \hep@flatfrac[#2]{#3}{#4}%
      }%
    }%
  }%
}
```

A.2.1 Differentials and derivatives

\differential

Define a generic differential \differential.

```
\newcommand{\differential}[1]{\mathop{}\!#1}
```

\newderivative

Define a generic derivative.

```
\newcommand\newderivative[2]{
  \NewDocumentCommand{#1}{somse{^}}{%
    \IfBooleanTF{##4}{%
      \IfBooleanTF{##1}{\nicefrac}{\frac}%
    }{%
      \IfBooleanTF{##1}{\flatfrac}{\dfrac}%
    }{%
      \differential#2\IfValueT{##5}{^{##5\!}}\IfValueT{##2}{##2}%
    }{%
      \differential#2{##3}\IfValueT{##5}{^{##5}}%
    }%
  }
}
```

\newpartialderivative

Define a generic partial derivative

```
\newcommand\newpartialderivative[2]{
  \NewDocumentCommand{#1}{somsE{^}{1}oE{^}{1}oE{^}{1}}{%
    \def\hep@one{\IfValueTF{##6}{##7}{0}}
    \def\hep@two{\IfValueTF{##8}{##9}{0}}
    \def\hep@sum{\the\numexpr##5+\hep@one+\hep@two\relax}
    \IfBooleanTF{##4}{%
      \IfBooleanTF{##1}{\nicefrac}{\frac}%
    }{%
      \IfBooleanTF{##1}{\flatfrac}{\dfrac}%
    }{%
      \differential#2\ifnum\hep@sum=1\relax\else{^{\hep@sum\!}}\fi
      \IfValueT{##2}{##2}%
    }{%
      \differential#2{##3}\ifnum##5=1\relax\else{^{##5}}\fi%
      \IfValueT{##6}{#2##6\ifnum##7=1\relax\else{^{##7}}\fi}%
      \IfValueT{##8}{#2##8\ifnum##9=1\relax\else{^{##9}}\fi}%
    }%
  }
}
```

\diffsymbol
\diff
\d
\derivative
\dv

Define the differential \d and the usual derivative.

```
\providecommand{\diffsymbol}{d}
```

```
\newcommand{\diff}{\differential\diffsymbol}
\AtBeginDocument{\mathdef{\d}{\diff}}
\newderivative{\derivative}{\diffsymbol}
\newcommand\dv{\derivative}
```

\partialdifferential
\pd
\partialderivative
\pdv

Define the partial differential and derivative.

```
\newcommand\partialdifferential{\differential\partial}
\newcommand\pd{\partialdifferential}
\newpartialderivative{\partialderivative}{\partial}
\newcommand\pdv{\partialderivative}
```

\gaugediffsymbol
\gaugediff
\D

Define the gauge covariant differential `\D`.

```
\providecommand{\gaugediffsymbol}{D}
\newcommand{\gaugediff}{\differential\gaugediffsymbol}
\newcommand{\D}{\gaugediff}
```

\covariantdiff
\cd

Define the covariant differential `\cd`.

```
\newcommand{\covariantdiff}{\differential\nabla}
\newcommand{\cd}{\covariantdiff}
```

\variation
\var
\functionalderivative
\fdv

Define the functional variation and derivative.

```
\newcommand\variation{\differential\delta}
\newcommand\var{\variation}
\newpartialderivative{\functionalderivative}{\delta}
\newcommand\fdv{\functionalderivative}
```

\cancel
\slashed

Load the CANCEL [8] and SLASHED [9] packages which provide the `\cancel` and `\slashed` macros.

```
\RequirePackage{cancel}
\RequirePackage{slashed}
\declareslashed{}{/}{.14}{0}{L}
\declareslashed{}{/}{.06}{0}{\D}
\declareslashed{}{/}{.055}{0}{\pd}
```

A.3 Paired delimiters

\left
\right

Load the MLEFTRIGHT package [3] and adjust the spacing around `\left` and `\right`.

```
\RequirePackage{mleftright}
\mleftright
```

\noargumentsymbol
\optionalargument

Allow for macros to have an empty argument using the ETOOLBOX package [11].

```
\RequirePackage{etoolbox}
\newcommand{\noargumentsymbol}{\:\cdot\:}
\newcommand{\optionalargument}[1]{\ifblank{#1}{\noargumentsymbol}{#1}}
```

`\abs` `\norm` Absolute value and norm.

```
\DeclarePairedDelimiterX\abs[1]\lvert\rvert{\optionalargument{#1}}
\DeclarePairedDelimiterX\hep@norm[1]\lVert\rVert{\optionalargument{#1}}
\DeclarePairedDelimiterXPP\hep@pnorm[2]{}\lVert\rVert{_{#1}}{#2}
\NewDocumentCommand{\norm}{som}{%
  \IfValueTF{#2}{%
    \IfBooleanTF{#1}{\hep@pnorm*}{\hep@pnorm}{#2}%
  }{%
    \IfBooleanTF{#1}{\hep@norm*}{\hep@norm}%
  }{\optionalargument{#3}}%
}
```

`\ordersymbol` `\order` Order symbol and macro.

```
\providecommand{\ordersymbol}{\mathcal{O}}
\DeclarePairedDelimiterXPP\order[1]{\ordersymbol}(){}{#1}
```

`\evaluated` `\eval` Vertical evaluation bar

```
\DeclarePairedDelimiter{\hep@evaluated}{.}{\rvert}
\NewDocumentCommand{\evaluated}{som}{%
  \IfBooleanTF{#1}{%
    \hep@evaluated*{#3}%
  }{%
    \IfNoValueTF{#2}{#3\rvert}{\hep@evaluated[#2]{#3}}%
  }%
}
\newcommand\eval{\evaluated}
```

`\row` `\column` Shortcuts for rows and columns

```
\newcommand*{\rowseperator}{,\,}
\ExplSyntaxOn
\newcommand*{\hep@row}[1]{
 \seq_set_split:Nnn\hep@seq{,}{#1}
 \begin{matrix}\seq_use:Nn\hep@seq{\rowseperator}\end{matrix}
}
\newcommand*{\hep@column}[1]{%
 \seq_set_split:Nnn\hep@seq{,}{#1}%
 \begin{matrix}\seq_use:Nn\hep@seq{\\}\end{matrix}%
}
\ExplSyntaxOff
\DeclarePairedDelimiterX{\row}[1]{(}{)}{\hep@row{#1}}
\NewDocumentCommand{\column}{me{^}e{_}}{%
  \left(\hep@column{#1}\right)%
  \IfValueT{#2}{^{\!\!\!#2}}\IfValueT{#3}{_{\!\!\!#3}}%
}
```

A.3.1 Set and Probability

\midbar

Define a generic midbar.

```
\newcommand\hep@left@delim{\mathopen{}}
\providecommand{\midbar}[1][]{%
  \nonscript\:#1\vert\allowbreak\nonscript\:\hep@left@delim%
}
```

Check if nfssect-cfr is loaeded and patch the global \set macro into the cfr namespace

```
\RequirePackage{xpatch}
\@ifundefined{exfs@merge@families}{}{%
  \xpatchcmd{\exfs@merge@families}{\set}{\cfr@set}{}{}%
  \xpatchcmd{\exfs@merge@families}{\set}{\cfr@set}{}{}%
  \xpatchcmd{\exfs@merge@families}{\set}{\cfr@set}{}{}%
}%
```

\suchthat
\set

Define a \set macro that allows a midbar via \suchthat.

```
\providecommand\suchthat{\midbar}
\DeclarePairedDelimiterX\set[1]\{\}{%
  \renewcommand\suchthat{\midbar[\delimsize]}#1%
}
```

\probabilitysymbol
\given
\Pr

Redefine the \Pr macro to a macro that takes a \given macro and generates a midbar.

```
\providecommand{\probabilitysymbol}{\operatorname{Pr}}
\providecommand\given{\midbar}
\DeclarePairedDelimiterXPP\hep@Pr[1]{%
  \probabilitysymbol}(){}{%
  \renewcommand\given{\midbar[\delimsize]}#1%
}
\let\Pr\relax
\NewDocumentCommand{\Pr}{so}{%
  \IfValueTF{#2}{%
    \IfBooleanTF{#1}{\hep@Pr*}{\hep@Pr}{#2}%
  }{%
    \probabilitysymbol%
  }%
}
```

A.3.2 Commutators

\newpair

Define the \newpair macro that generates pairs surrounded by brackets.

```
\NewDocumentCommand{\newpair}{mmme{_}e{^}}{%
  \IfNoValueTF{#4}{%
    \IfNoValueTF{#5}{%
      \DeclarePairedDelimiterX{#1}[2]{#2}{#3}%
    }{%
```

```
      \DeclarePairedDelimiterXPP{#1}[2]{}{#2}{#3}{^{#5}}%
    }%
  }{%
    \DeclarePairedDelimiterXPP{#1}[2]{}{#2}{#3}{_{#4}}%
  }{%
    \optionalargument{##1},\optionalargument{##2}%
  }%
}
```

\innerproduct
\poissonbracket
\pb
\commutator
\comm
\anticommutator
\acomm

Poissonbracket, commutator and anti-commutator.

```
\newpair\innerproduct\langle\rangle
\newpair\poissonbracket\lbrace\rbrace
\newpair\commutator\lbrack\rbrack
\newcommand\pb{\poissonbracket}
\newcommand\comm{\commutator}
\newcommand\acomm{\poissonbracket}
```

A.3.3 Bra-ket notation

\braketspace Define the space within braket notation.

```
% \providecommand\braketspace{\mskip1mu}
\providecommand\braketouterspace{\mskip1mu}
\providecommand\braketinnerspace{\mskip3mu}
\newcommand\hep@midvert{%
  \braketinnerspace\delimsize\vert\braketinnerspace\hep@left@delim%
}
```

\braket Define the braket macro.

```
\DeclarePairedDelimiterX\braket[2]{\langle}{\rangle}{%
  \braketouterspace#1\hep@midvert#2\braketouterspace%
}
```

\bra Define the bra macro.

```
\DeclarePairedDelimiterXPP\hep@bra[1]{%
  }{\langle}{\rvert}{\braketinnerspace}{\braketouterspace#1\braketinnerspace%
}
\NewDocumentCommand{\bra}{smt\ket sgt\ketbra sgg}{%
  \IfBooleanTF{#6}{%
    \IfBooleanTF{#1}{\braket*{#2}{#8}}{\braket{#2}{#8}}%
    \IfBooleanTF{#7}{\bra*{#9}}{\bra{#9}}%
  }{
    \IfBooleanTF{#3}{%
      \IfBooleanTF{#1}{\braket*}{%
        \IfBooleanTF{#4}{\braket*}{\braket}}{#2}{#5%
      }%
    }{%
```

```
      \IfBooleanTF{#1}{\hep@bra*}{\hep@bra}{#2}%
    }%
  }%
}
```

\ket Define the ket macro.

```
\DeclarePairedDelimiterXPP\ket[1]{%
  \braketinnerspace}{\lvert}{\rangle}{%
}{%
  \braketinnerspace\hep@left@delim#1\braketouterspace%
}
```

\ketbra Define the ketbra macro.

```
\NewDocumentCommand{\ketbra}{smm}{%
  \IfBooleanTF{#1}{%
    \ket*{#2}\bra*{#3}%
  }{%
    \ket{#2}\bra{#3}%
  }%
}
```

\matrixelement
\mel
Define the matrixelement macro.

```
\DeclarePairedDelimiterX\matrixelement[3]{%
  \langle}{\rangle
}{%
  \braketouterspace#1\hep@midvert#2\hep@midvert#3\braketouterspace%
}
\newcommand\matrixel{\matrixelement}
\newcommand\mel{\matrixelement}
```

\expectationvalue
\ev
\vev
Define the expectationvalue and vev macros.

```
\DeclarePairedDelimiterX\hep@expvalue[1]{\langle}{\rangle}{%
  \braketouterspace#1\braketouterspace%
}
\NewDocumentCommand{\expectationvalue}{som}{%
  \IfNoValueTF{#2}{%
    \IfBooleanTF{#1}{\hep@expvalue*}{\hep@expvalue}{#3}%
  }{%
    \IfBooleanTF{#1}{\matrixelement*}{\matrixelement}{#2}{#3}{#2}%
  }%
}
\newcommand\ev{\expectationvalue}
\newcommand\vev[1]{\expectationvalue[0]{#1}}
```

</package>

B Test

<*test>

```
\documentclass{article}

\usepackage{hep-math}

\begin{document}

\begin{gather}
  \bra{x}\ket{y}
  \braket*{x}{y}\\
  \dv[f]{x}^3
  \pdv[f]{x}[y]^2[z]^3
  \fdv[f]{x}^3[y]\\
  \set{x \suchthat x \in X}
\end{gather}

\end{document}

```

</test>

C Readme

<*readme>

```
# The ‘hep-math‘ package

Extended math macros

## Introduction

The ‘hep-math‘ package provides some additional features beyond the ‘mathtools‘ and ‘ams

To use the package place ‘\usepackage{hep-math}‘ in the preamble.

## Author

Jan Hajer

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```

</readme>

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