

# The HEP-MATH package\*

## Extended math macros

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### Abstract

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

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

The MATHTOOLS [1] package is loaded, which in turn loads the  $\mathcal{A}\mathcal{M}\mathcal{S}$ - $\mathcal{L}\mathcal{A}\mathcal{T}\mathcal{E}\mathcal{X}$  AMSMATH [2] package. Horizontal spacing in inline equations and page breaks in block equations are marginally adjusted.

`\left` Spacing around `\left` and `\right` is fixed with the MLEFTRIGHT package [3].

`\right`

## 1 Macros

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

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

`\d` The `\overline` macro is adjusted to work also outside of math mode using the SOUL [4] package.

`\overline` A better looking over left right arrow is defined i.e.  $\overrightarrow{\partial}$  using a new `\oset{<over>}{<math>}` functionality.

`\oset`

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

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

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

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

`\sgn`

### 1.1 Fractions and units

`\Re`

`\Im` The correct spacing for units is provided by the macro `\unit{<value>}{<unit>}` 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  $5 \text{ fb}^{-1}$  typeset via `\unit[5]{\inv{fb}}`.

`\sin`

`\cos` The `\frac{<number>}{<number>}` macro is accompanied by `\nicefrac{<number>}{<number>}`, `\tan` `\textfrac{<number>}{<number>}`, and `\flatfrac{<number>}{<number>}` leading to  $\frac{1}{2}$ ,  $\frac{1}{2}$ ,  $\frac{1}{2}$ , and  $\frac{1}{2}$ . The `\textfrac` macro is mostly intended if a font with oldstyle numerals is used.

`\accsc`

`\unit` 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].

`\inv`

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\*This document corresponds to HEP-MATH v1.4.

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`\nicefrac`

`\flatfrac`

`\textfrac`

## 1.2 Differentials and derivatives

`\differential` 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.

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

<code>\d</code>	<code>\dv[f]x</code>	<code>\dv*[f]x^n</code>	<code>\dv[f]x*x^n</code>	<code>\dv*[f]x*x^n</code>
<code>\dv</code>	$\frac{df}{dx}$	$d^n f/dx^n$	$\frac{d^n f}{dx^n}$	$d^n f/dx^n$
	<code>\dv xf</code>	<code>\dv*xf</code>	<code>\dv x*f</code>	<code>\dv*x*f</code>
	$\frac{d}{dx}f$	$d/dx f$	$\frac{d}{dx}f$	$d/dx f$

via `\dv*{⟨f⟩}{⟨x⟩}^{⟨n⟩}`. Upright differential can be produced via `\renewcommand{\diffsymbol}{\mathrm d}`. The differential takes care of the correct spacing as long as it is placed at the end of the integral  $\int f(x) dx$ . In order to archive correct spacing when it is placed at the beginning of the integral it is advisable to place the whole expression in a `\mathop{\int\mathrm d x} f(x)` such that  $\int dx f(x)$ .

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

<code>\pdv[f]x</code>	<code>\pdv[f]x[y]</code>	<code>\pdv[f]x^3</code>	<code>\pdv[f]x^2[y]</code>
$\frac{\partial f}{\partial x}$	$\frac{\partial^2 f}{\partial x \partial y}$	$\frac{\partial^3 f}{\partial x^3}$	$\frac{\partial^3 f}{\partial x^2 \partial y}$
<code>\pdv[f]x^2[y]^3</code>	<code>\pdv[f]x[y]^3</code>	<code>\pdv x[y]f</code>	
$\frac{\partial^5 f}{\partial x^2 \partial y^3}$	$\frac{\partial^4 f}{\partial x \partial y^3}$	$\frac{\partial^2}{\partial x \partial y} f$	

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

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

## 1.3 Paired delimiters

`\abs`

`\norm` `\abs x` `\norm x` `\norm[2]x` `\norm*[2]x`  
 $|x|$   $\|x\|$   $\|x\|_2$   $\|x\|_2$

`\eval`

`\order` `\order x` `\eval x_0^{\infty}` `\eval* x_0^{\infty}`  
 $\mathcal{O}(x)$   $x|_0^\infty$   $x|_0^\infty$

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

`\comm`

`\acomm` `\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` Macros for the bra-ket notation are introduced.

`\ket`

`\braket`

`\ketbra`

`\mel`

`\ev`

`\vev`

<code>\bra x</code>	<code>\ket x</code>	<code>\braket xy</code>	<code>\ketbra xy</code>
$\langle x $	$ x\rangle$	$\langle x y\rangle$	$ x\rangle\langle y $
<code>\mel xyz</code>	<code>\ev x</code>	<code>\ev[\Omega] x</code>	<code>\vev x</code>
$\langle x y z\rangle$	$\langle x\rangle$	$\langle \Omega x \Omega\rangle$	$\langle 0 x 0\rangle$

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

<code>\row</code>	<code>\column{x,y,z}</code>	<code>\row{x,y,z}^\trans</code>
	$\begin{pmatrix} x \\ y \\ z \end{pmatrix}$	$(x, y, z)^\top$

## 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}
```

$$\boxed{\text{left}} = \boxed{\text{right}} . \quad (1)$$

`multline` Use the `multline` environment for longer equations.

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

$$\boxed{\text{left}} = \boxed{\text{right 1}} + \boxed{\text{right 2}} . \quad (2)$$

`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}
```

$$\begin{aligned} \boxed{\text{left}} &= \boxed{\text{right 1}} \\ &= \boxed{\text{right 2}} . \end{aligned} \quad (3)$$

`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}
```

$$\boxed{\text{left}} = \boxed{\text{right}} , \quad \boxed{\text{left}} = \boxed{\text{right}} , \quad (4a)$$

$$\boxed{\text{left}} = \boxed{\text{right}} , \quad \boxed{\text{left}} = \boxed{\text{right}} . \quad (4b)$$

`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}
```

$$\begin{aligned} \boxed{\text{left}} &= \boxed{\text{right 1}} \\ &= \boxed{\text{right 2}} \\ &\quad + \boxed{\text{right 3}} . \end{aligned} \quad (5)$$

`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 & \ , \ \ & \left = \boxed{\text{long right}} , & (6a)
le. 2 &= ri. 2 \ , & & \boxed{le. 2} = \boxed{ri. 2} , & \boxed{le. 3} = \boxed{ri. 3} . & (6b)
\mathllap{le. 3 = ri. 3} & \ .
\end{alignat}
\end{subequations}

```

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.

```

1 \RequirePackage{mathtools}
2 \mathtoolsset{centercolon}
3 \allowdisplaybreaks[1]
4 \thickmuskip=5mu plus 3mu minus 1mu
5 \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].

```

6 \RequirePackage{xparse}
7 \DeclareDocumentCommand{\mathdef}{mO{0}om}{%
8   \expandafter\let\csname hep@text\string#1\endcsname=#1
9   \expandafter\newcommand\expandafter*\csname hep@math\string#1%
10  \IfNoValueTF{#3}{\endcsname[#2]}{\endcsname[#2][#3]}{#4}
11  \DeclareRobustCommand#1{%
12    \ifmmode
13      \expandafter\let\expandafter\next\csname%
14      hep@math\string#1\endcsname%
15    \else
16      \expandafter\let\expandafter\next\csname%
17      hep@text\string#1\endcsname%
18    \fi
19    \next
20  }%
21 }

```

`\i` Provide an upright imaginary unit in math mode.

```

22 \newcommand*\imaginaryunit{\text{i}}
23 \AtBeginDocument{\mathdef{\i}{\imaginaryunit}}

```

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

```

24 \RequirePackage{soul}
25 % \def\overline#1{{\renewcommand*{\ULdepth}{-1.9ex}}{\uline{#1}}}
26 \newcommand*\textoverline[1]{{\setul{-1.9ex}}{\ul{#1}}}
27 \let\overline\textoverline
28 \DeclareRobustCommand{\over@line}[1]{\@@overline{#1}}
29 \mathdef{\overline}{\over@line}
30 \newcommand*\hep@widebar[1]{%
31   \mkern2.5mu\overline{\mkern-2.5mu#1\mkern-.5mu}\mkern.5mu%
32 }
33 \newcommand*\widebar[1]{%
34   \settowidth{\dimen0}{\ensuremath{#1}}%
35   \ifdim\dimen0>.475em\hep@widebar{#1}\else\bar{#1}\fi%
36 }

```

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

```

37 \newcommand*\oset}[3] [-1pt]{%
38   \text{\raisebox{.2ex}{\mathop{#3}\limits^{\%
39     \vbox to#1{\kern-2\ex@\hbox{\scriptscriptstyle#2}\vss}%
40   }}}}%
41 }

```

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

```

42 \newcommand*\overleft}[1]{\oset{\leftarrow}{#1}}
43 \newcommand*\overrightarrow}[1]{\oset{\rightarrow}{#1}}
44 \newcommand*\overleftright}[1]{\oset{\leftrightarrow}{#1}}

```

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

```

45 % \newif\ifhep@eqnarray\hep@eqnarraytrue
46 % \ifhep@eqnarray\else
47 %   \let\eqnarray\@undefined
48 %   \let\endeqnarray\@undefined
49 % \fi

```

## A.1 Operators

`\tr` Provide the `\diag`, `\sgn`, and some other operators.

```

\Tr
\rank 50 \DeclareMathOperator{\tr}{tr}
\erf 51 \DeclareMathOperator{\Tr}{Tr}
\Res 52 \DeclareMathOperator{\rank}{rank}
\sgn 53 \DeclareMathOperator{\erf}{erf}
\sgn 54 \DeclareMathOperator{\Res}{Res}
\diag 55 \DeclareMathOperator{\sgn}{sgn}
56 \DeclareMathOperator{\diag}{diag}
57 \let\det\relax\DeclareMathOperator{\det}{det}

```

`\Re` Redefine the real and imaginary projectors.

```

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

```

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

`\transpose` Define a transpose symbol.

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

### A.1.1 Trigonometric functions

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

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

`\arccsc` Define arc operators.

```
\arcsec
\arccot 66 \DeclareMathOperator{\arccsc}{arccsc}
67 \DeclareMathOperator{\arcsec}{arcsec}
68 \DeclareMathOperator{\arccot}{arccot}
```

`\asin` Define shorthand for arc operators.

```
\acos
\atan 69 \DeclareMathOperator{\asin}{asin}
\acsc 70 \DeclareMathOperator{\acos}{acos}
\asec 71 \DeclareMathOperator{\atan}{atan}
\acot 72 \DeclareMathOperator{\acsc}{acsc}
73 \DeclareMathOperator{\asec}{asec}
74 \DeclareMathOperator{\acot}{acot}
```

`\csch` Define csch and sech operators.

```
\sech
75 \DeclareMathOperator{\csch}{csch}
76 \DeclareMathOperator{\sech}{sech}
```

## A.2 Units and fractions

`\unit` Load the UNITS package [5] which provides the `\units` and `\nicefrac` macros. Patch the `\unit` macros to behave like `\mathinner` within an equation

```
77 \RequirePackage{units}
78 \let\oldunit\unit
79 \renewcommand*{\unit}[2] [] {%
80   \ifthenelse{\boolean{mmode}}{%
81     \mathinner{\oldunit[#1]{#2}}%
82   }{%
83     \oldunit[#1]{#2}%
84   }%
85 }
86 \let\oldunitfrac\unitfrac
87 \renewcommand*{\unitfrac}[3] [] {%
```

```

88 \ifthenelse{\boolean{mmode}}{%
89   \mathinner{\oldunitfrac[#1]{#2}{#3}}%
90 }{%
91   \oldunitfrac[#1]{#2}{#3}%
92 }%
93 }

```

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

```

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

```

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

```

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

```

`\flatfrac` Provide a flat fraction.

```

96 \DeclarePairedDelimiterX{\hep@flatfrac}[2]{.}{.}{%
97   \kern-\nulldelimiterspace#1\delimspace/%
98   \hep@left@delim#2\kern-\nulldelimiterspace%
99 }
100 \NewDocumentCommand{\flatfrac}{somm}{%
101   \mathinner{%
102     \IfBooleanTF{#1}{%
103       \hep@flatfrac*{#3}{#4}%
104     }{%
105       \IfNoValueTF{#2}{\hep@left@delim#3/\hep@left@delim#4%
106       }{%
107         \hep@flatfrac[#2]{#3}{#4}%
108       }%
109     }%
110   }%
111 }

```

### A.2.1 Differentials and derivatives

`\int` Redefine `\int`.

```

112 % \let\hep@int\int
113 % \RenewDocumentCommand{\int}{oe{~}}{%
114 %   \def\temp{\hep@int_{\IfValueT{#2}{#2}}^{\IfValueT{#3}{#3}}}%
115 %   \IfValueTF{#1}{\mathop{\temp#1}}{\temp}%
116 % }

```

`\differential` Define a generic differential `\differential`.

```

117 \newcommand*\differential[1]{\mathop{\!#1}

```

`\newderivative` Define a generic derivative.

```

118 \newcommand*\newderivative[2]{
119   \NewDocumentCommand{#1}{somse{~}}{%

```

```

120 \IfBooleanTF{##4}{%
121 \IfBooleanTF{##1}{\nicefrac}{\frac}%
122 }{%
123 \IfBooleanTF{##1}{\flatfrac}{\dfrac}%
124 }{%
125 \differential#2\IfValueT{##5}{~{##5\!}}\IfValueT{##2}{##2}%
126 }{%
127 \differential#2{##3}\IfValueT{##5}{~{##5}}%
128 }%
129 }
130 }

```

`newpartialderivative` Define a generic partial derivative

```

131 \newcommand*{newpartialderivative}[2]{
132 \NewDocumentCommand{##1}{somsE{^}{1}oE{^}{1}oE{^}{1}}{%
133 \def\hep@one{\IfValueTF{##6}{##7}{0}}
134 \def\hep@two{\IfValueTF{##8}{##9}{0}}
135 \def\hep@sum{\the\numexpr##5+\hep@one+\hep@two\relax}
136 \IfBooleanTF{##4}{%
137 \IfBooleanTF{##1}{\nicefrac}{\frac}%
138 }{%
139 \IfBooleanTF{##1}{\flatfrac}{\dfrac}%
140 }{%
141 \differential#2\ifnum\hep@sum=1\relax\else{~{\hep@sum\!}}\fi
142 \IfValueT{##2}{##2}%
143 }{%
144 \differential#2{##3}\ifnum##5=1\relax\else{~{##5}}\fi%
145 \IfValueT{##6}{#2##6\ifnum##7=1\relax\else{~{##7}}\fi}%
146 \IfValueT{##8}{#2##8\ifnum##9=1\relax\else{~{##9}}\fi}%
147 }%
148 }
149 }

```

`\diffsymbol` Define the differential `\d` and the usual derivative.

```

\diff
\d 150 \providecommand*{\diffsymbol}{d}
\derivative 151 \newcommand*{\diff}{\differential\diffsymbol}
\dv 152 \AtBeginDocument{\mathdef{\d}{\diff}}
153 \newderivative{\derivative}{\diffsymbol}
154 \newcommand*{dv}{\derivative}

```

`\partialdifferential` Define the partial differential and derivative.

```

\pd
\partialderivative 155 \newcommand*{\partialdifferential}{\differential\partial}
\pdv 156 \newcommand*{\slashedpartialdifferential}{\differential{\slashed\partial}}
157 \newcommand*{\spd}{\slashedpartialdifferential}
158 \newcommand*{\pd}{\partialdifferential}
159 \newpartialderivative{\partialderivative}{\partial}
160 \newcommand*{\pdv}{\partialderivative}

```



`\gaugediffsymbol` Define the gauge covariant differential `\D`.  
`\gaugediff`  
`\D` 161 `\providecommand*\gaugediffsymbol{D}`  
162 `\newcommand*\gaugediff{\differential\gaugediffsymbol}`  
163 `\newcommand*\D{\gaugediff}`

`\covariantdiff` Define the covariant differential `\cd`.  
`\cd`  
164 `\newcommand*\covariantdiff{\differential\nabla}`  
165 `\newcommand*\cd{\covariantdiff}`

`\variation` Define the functional variation and derivative.  
`\var`  
`\functionalderivative` 166 `\newcommand*\variation{\differential\delta}`  
`\fdv` 167 `\newcommand*\var{\variation}`  
168 `\newpartialderivative{\functionalderivative}{\delta}`  
169 `\newcommand*\fdv{\functionalderivative}`

`\cancel` Load the CANCEL [8] and SLASHED [9] packages which provide the `\cancel` and `\slashed` macros.  
`\slashed`  
170 `\RequirePackage{cancel}`  
171 `\RequirePackage{slashed}`  
172 `\declareslashed{/}{.14}{0}{L}`  
173 `\declareslashed{/}{.055}{0}{\partial}`  
174 `\declareslashed{/}{.06}{0}{\gaugediff}`  
175 `\declareslashed{/}{.055}{0}{\partialdifferential}`

### A.3 Paired delimiters

`\left` Load the MLEFTRIGHT package [3] and adjust the spacing around `\left` and `\right`.  
`\right`  
176 `\RequirePackage{mleftright}`  
177 `\mleftright`

`\noargumentsymbol` Allow for macros to have an empty argument using the ETOOLBOX package [11].  
`\optionalargument`  
178 `\RequirePackage{etoolbox}`  
179 `\newcommand*\noargumentsymbol{\:\cdot\}`  
180 `\newcommand*\optionalargument[1]{\ifblank{#1}{\noargumentsymbol}{#1}}`

`\abs` Absolute value and norm.  
`\norm`  
181 `\DeclarePairedDelimiterX\abs[1]\lvert\rvert{\optionalargument{#1}}`  
182 `\DeclarePairedDelimiterX\hep@norm[1]\lVert\rVert{\optionalargument{#1}}`  
183 `\DeclarePairedDelimiterXPP\hep@pnorm[2]{\lVert\rVert}_{#1}{#2}`  
184 `\NewDocumentCommand{\norm}{som}{%`  
185 `\IfValueTF{#2}{%`  
186 `\IfBooleanTF{#1}{\hep@pnorm*}{\hep@pnorm}{#2}%`  
187 `}{%`  
188 `\IfBooleanTF{#1}{\hep@norm*}{\hep@norm}%`  
189 `}{\optionalargument{#3}}%`  
190 `}`

`\floor` Floor and ceiling paired delimiters.

```
\ceil
191 \DeclarePairedDelimiter\ceil{\lceil}{\rceil}
192 \DeclarePairedDelimiter\floor{\lfloor}{\rfloor}
```

`\ordersymbol` Order symbol and macro.

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

`\evaluated` Vertical evaluation bar

```
\eval
195 \DeclarePairedDelimiter{\hep@evaluated}{.}{\rvert}
196 \NewDocumentCommand{\evaluated}{som}{%
197   \IfBooleanTF{\#1}{%
198     \hep@evaluated*{\#3}%
199   }{%
200     \IfNoValueTF{\#2}{\#3\rvert}{\hep@evaluated[\#2]{\#3}}%
201   }%
202 }
203 \newcommand*\eval{\evaluated}
```

`\row` Shortcuts for rows and columns

```
\column
204 \newcommand*\rowseparator{, \,}
205 \ExplSyntaxOn
206 \newcommand*\hep@row}[1]{
207   \seq_set_split:Nnn\hep@seq{,}{\#1}
208   \begin{matrix}\seq_use:Nn\hep@seq{\rowseparator}\end{matrix}
209 }
210 \newcommand*\hep@column}[1]{%
211   \seq_set_split:Nnn\hep@seq{,}{\#1}%
212   \begin{matrix}\seq_use:Nn\hep@seq{\}\}\end{matrix}%
213 }
214 \ExplSyntaxOff
215 \DeclarePairedDelimiterX{\hep@row@}[1]{(}{)}{\hep@row{\#1}}
216 \NewDocumentCommand{\hep@column@}{me{~}e_{}}{%
217   \left(\hep@column{\#1}\right)%
218   \IfValueT{\#2}{\!\!\!\#2}\IfValueT{\#3}{_{\!\!\!\#3}}%
219 }
220 \providecommand*\column{}
221 \providecommand*\row{}
222 \mathdef{\column}{\hep@column@}
223 \providecommand*\row{}
224 \mathdef{\row}{\hep@row@}
```

### A.3.1 Set and Probability

`\midbar` Define a generic midbar.

```
225 \newcommand*\hep@left@delim{\mathopen{}}
226 \providecommand*\midbar}[1] []{%
```

```

227 \nonscript\:#1\vert\allowbreak\nonscript\:\hep@left@delim%
228 }

```

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

```

229 \RequirePackage{xpatch}
230 \@ifundefined{exfs@merge@families}{-}{%
231 \xpatchcmd{\exfs@merge@families}{\set}{\cfr@set}{-}{-}%
232 \xpatchcmd{\exfs@merge@families}{\set}{\cfr@set}{-}{-}%
233 \xpatchcmd{\exfs@merge@families}{\set}{\cfr@set}{-}{-}%
234 }%

```

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

```

\set
235 \providecommand*\suchthat{\midbar}
236 \DeclarePairedDelimiterX\set[1]{\}{\}%
237 \renewcommand*\suchthat{\midbar[\delimsize]}#1%
238 }

```

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

```

\given
\Pr 239 \providecommand*{\probabilitysymbol}{\operatorname{\Pr}}
240 \providecommand*\given{\midbar}
241 \DeclarePairedDelimiterXPP\hep@Pr[1]{%
242 \probabilitysymbol}{-}{-}%
243 \renewcommand*\given{\midbar[\delimsize]}#1%
244 }
245 \let\Pr\relax
246 \NewDocumentCommand{\Pr}{so}{%
247 \IfValueTF{#2}{%
248 \IfBooleanTF{#1}{\hep@Pr*}{\hep@Pr}{#2}%
249 }{%
250 \probabilitysymbol%
251 }%
252 }

```

### A.3.2 Commutators

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

```

253 \NewDocumentCommand{\newpair}{mmme{_{}}e{^}}{%
254 \IfNoValueTF{#4}{%
255 \IfNoValueTF{#5}{%
256 \DeclarePairedDelimiterX{#1}[2]{#2}{#3}%
257 }{%
258 \DeclarePairedDelimiterXPP{#1}[2]{-}{#2}{#3}{^#5}%
259 }%
260 }{%
261 \DeclarePairedDelimiterXPP{#1}[2]{-}{#2}{#3}{_{#4}}%
262 }{%
263 \optionalargument{##1},\optionalargument{##2}%
264 }%

```

265 }

```
\innerproduct Poissonbracket, commutator and anti-commutator.
\poissonbracket
  \pb 266 \newpair\innerproduct\langle\rangle
  \commutator 267 \newpair\poissonbracket\lbrace\rbrace
  \comm 268 \newpair\commutator\lbrack\rbrack
\anticommutator 269 \newcommand*\pb{\poissonbracket}
  \acomm 270 \newcommand*\comm{\commutator}
  271 \newcommand*\acomm{\poissonbracket}
```

### A.3.3 Bra-ket notation

`\bracketspace` Define the space within braket notation.

```
272 % \providecommand*\bracketspace{\mskip1mu}
273 \providecommand*\braketouterspace{\mskip1mu}
274 \providecommand*\braketinnerspace{\mskip3mu}
275 \newcommand*\hep@midvert{%
276   \braketinnerspace\delimsize\vert\braketinnerspace\hep@left@delim%
277 }
```

`\braket` Define the braket macro.

```
278 \DeclarePairedDelimiterX\braket [2]{\langle}{\rangle}{%
279   \braketouterspace#1\hep@midvert#2\braketouterspace%
280 }
```

`\bra` Define the bra macro.

```
281 \DeclarePairedDelimiterXPP\hep@bra [1]{%
282   }\langle}{\rvert}{\braketinnerspace%
283   }\braketouterspace#1\braketinnerspace%
284 }
285 \NewDocumentCommand{\bra}{smt\ket sgt\ketbra sgg}{%
286   \IfBooleanTF{#6}{%
287     \IfBooleanTF{#1}{\braket*{#2}{#8}}{\braket{#2}{#8}}%
288     \IfBooleanTF{#7}{\bra*{#9}}{\bra{#9}}%
289   }{
290     \IfBooleanTF{#3}{%
291       \IfBooleanTF{#1}{\braket*}{%
292         \IfBooleanTF{#4}{\braket*}{\braket}}{#2}{#5%
293       }%
294     }{
295       \IfBooleanTF{#1}{\hep@bra*}{\hep@bra}{#2}%
296     }%
297   }%
298 }
```

`\ket` Define the ket macro.

```
299 \DeclarePairedDelimiterXPP\ket [1]{%
```

```

300 \bracketinnerspace}{\lvert}{\rangle}{%
301 }{%
302 \bracketinnerspace\hep@left@delim#1\bracketouterspace%
303 }

```

`\ketbra` Define the ketbra macro.

```

304 \NewDocumentCommand{\ketbra}{smm}{%
305 \IfBooleanTF{#1}{%
306 \ket*{#2}\bra*{#3}%
307 }{%
308 \ket{#2}\bra{#3}%
309 }%
310 }

```

`\matricelement` Define the matricelement macro.

```

\mel
311 \DeclarePairedDelimiterX\matricelement[3]{%
312 \langle}{\rangle
313 }{%
314 \bracketouterspace#1\hep@midvert#2\hep@midvert#3\bracketouterspace%
315 }
316 \newcommand*\matrixel{\matricelement}
317 \newcommand*\mel{\matricelement}

```

`\expectationvalue` Define the expectationvalue and vev macros.

```

\ev
\vev 318 \DeclarePairedDelimiterX\hep@expvalue[1]{\langle}{\rangle}{%
319 \bracketouterspace#1\bracketouterspace%
320 }
321 \NewDocumentCommand{\expectationvalue}{som}{%
322 \IfNoValueTF{#2}{%
323 \IfBooleanTF{#1}{\hep@expvalue*}{\hep@expvalue}{#3}%
324 }{%
325 \IfBooleanTF{#1}{\matricelement*}{\matricelement}{#2}{#3}{#2}%
326 }%
327 }
328 \newcommand*\ev{\expectationvalue}
329 \newcommand*\vev[1]{\expectationvalue[0]{#1}}

```

`</package>`

## B Test

`<*test>`

```

330 \documentclass{article}
331
332 \usepackage{hep-math}
333
334 \begin{document}

```

```

335
336 \begin{gather}
337   \bra{x}\ket{y}
338   \braket*x{y}\!
339   \dv[f]{x}^3
340   \pdv[f]{x}[y]^2[z]^3
341   \fdv[f]{x}^3[y]\!
342   \set{x \suchthat x \in X}
343 \end{gather}
344
345 \end{document}
346
</test>

```

## C Readme

```
<*readme>
```

```

347 # The ‘hep-math’ package
348
349 Extended math macros
350
351 ## Introduction
352
353 The ‘hep-math’ package provides some additional features beyond the
354 ‘mathtools’ and ‘amsmath’ packages.
355
356 To use the package place ‘\usepackage{hep-math}’ in the preamble.
357
358 ## Author
359
360 Jan Hajer
361
362 ## License
363
364 This file may be distributed and/or modified under the conditions of the
365 ‘LaTeX’ Project Public License, either version 1.3c of this license or
366 (at your option) any later version. The latest version of this license is
367 in ‘http://www.latex-project.org/lppl.txt’ and version 1.3c or later is
368 part of all distributions of LaTeX version 2005/12/01 or later.
</readme>

```

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