The HEP-MATH package*

Extended math macros

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2021/09/01

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.

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].

\left
\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

\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.* $\overleftrightarrow{\partial}$ using a new `\oset{`⟨*over*⟩`}{`⟨*math*⟩`}` functionality.

\diag

\sgn

\Re

\Im

\sin

\cos

\tan

\accsc

\unit

\inv

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

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

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

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

1.1 Fractions and units

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

*This document corresponds to HEP-MATH v1.0.

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

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

`\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~~ math and use the Dirac slash notation *i.e.* $\not{\emptyset}$, respectively.

1.3 Paired delimiters

`\abs`

`\norm`

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

\eval

\order

\order x	\eval x_0^\infty	\eval* x_0^\infty
$\mathcal{O}(x)$	$x\rvert_0^\infty$	$x\big\rvert_0^\infty$

\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

\bra x	\ket x	\braket xy	\ketbra xy
$\langle x\rvert$	$\lvert x\rangle$	$\langle x\rvert y\rangle$	$\lvert x\rangle\langle y\rvert$
\mel xyz	\ev x	\ev[\Omega] x	\vev x
$\langle x\rvert y\rvert z\rangle$	$\langle x\rangle$	$\langle \Omega\rvert x\rvert \Omega\rangle$	$\langle 0\rvert x\rvert 0\rangle$

\mel

\ev

\vev

\column

\row

\column{x,y,z}	\row{x,y,z}
$\begin{pmatrix} x \\ y \\ z \end{pmatrix}$	$(x,\, y,\, z)$

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}
```

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

multline Use the multline environment for longer equations.

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

$$\boxed{\text{left}} = \boxed{\text{right 1}}$$
$$\boxed{\text{+ right 2}}\ . \tag{2}$$

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}
```

$$\boxed{\text{left}} = \boxed{\text{right 1}} \\ = \boxed{\text{right 2}} \ . \tag{3}$$

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}
```

$$\boxed{\text{left}} = \boxed{\text{right}} \ , \quad \boxed{\text{left}} = \boxed{\text{right}} \ , \tag{4a}$$
$$\boxed{\text{left}} = \boxed{\text{right}} \ , \quad \boxed{\text{left}} = \boxed{\text{right}} \ . \tag{4b}$$

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}
```

$$\boxed{\text{left}} = \boxed{\text{right 1}} \\ = \boxed{\text{right 2}} \\ \boxed{\text{+ right 3}} \ . \tag{5}$$

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}
```

$$\boxed{\text{left}} = \boxed{\text{long right}} \ , \tag{6a}$$
$$\boxed{\text{le. 2}} = \boxed{\text{ri. 2}} \ , \qquad \boxed{\text{le. 3}} = \boxed{\text{ri. 3}} \ . \tag{6b}$$

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.

References

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