The **HEP-MATH-FONT** package*

Extended Greek and sans-serif math

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2021/09/01

Abstract

The **HEP-MATH-FONT** package adjust the math fonts to be italic sans-serif if the document is sans-serif. Additionally Greek letters are redefined to be always italic and upright in math and text mode, respectively. Some math font macros are adjusted to give more consistently the naively expected results.

The package is loaded using \texttt{\usepackage{hep-math-font}}.

If the document \texttt{\familydefault} font is switched to the sansserif \texttt{\sfdefault} font the math font is adjusted accordingly using fonts compatible to latin modern (LM) and computer modern (CM). In order to be able to easily switch large chunks of math from serif to sans-serif documents the meaning of \texttt{\mathrm} and \texttt{\mathsf} is adjusted so that the first generates upright sans-serif math and the second serif math. This is is neither the literal meaning of the macros nor the best behaviour if a single large document is written in sans-serif. However, it simplifies working in an environment where one copies pieces of math between serif and sans-serif documents e.g. publications vs. talks and funding applications.

Using the \texttt{fixmath} [1] and \texttt{textalpha} [2] packages Greek letter are adjusted so that they are always italic and upright in math and text mode, respectively. Greek letters can be written by using their unicode characters.

\texttt{\textalpha} The \texttt{symbols=\{family\}} sets the family of the symbol fonts. \texttt{symbols=ams} loads the two \texttt{\AMS} fonts [3] and the \texttt{\BM} bold fonts. The default \texttt{symbols=true} replaces additionally the blackboard font with the \texttt{\dsfont} [4]. \texttt{symbols=minion} switches the symbol fonts to the Adobe MinionPro companion font from the \texttt{\msfont} package [5]. \texttt{symbols=false} deactivates loading any additional symbol fonts, effectively restricting the package to only switch the math font according to the sans-serif property of the main text.

1 Macros

\texttt{\text\{} The \texttt{\mathrm\{}⟨math⟩\text\{} macro and the \texttt{\text\{}⟨text⟩\text\{}) macro from \texttt{amstext} [6] are

\texttt{\mathrm}\* This document corresponds to \texttt{HEP-MATH-FONT v1.0}.

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adjusted to produce upright Greek letters, \textit{i.e.} \((\mathrm{Ab}\Gamma\delta\mathrm{Ab}\Gamma\delta)\), by adjusting the code from the \textsc{alphabeta} \cite{7} package.

\texttt{\textbf{mathbf}} Bold math, via \texttt{\textbf{mathbf}} is improved with the \texttt{bm} package \cite{8}, \textit{i.e.} \((\mathrm{Ab}\Gamma\delta\mathrm{Ab}\Gamma\delta)\). Macros switching to \texttt{bfseries} such as \texttt{\section{⟨(text)⟩}} are ensured to also typeset math in bold.

\texttt{\textsf{mathsf}} The math sans-serif alphabet is redefined to be italic sans-serif if the main text is serif and italic serif if the main text is sans-serif, \textit{i.e.} \((\mathrm{Ab}'\mathrm{b}\mathrm{Γ}'\mathrm{b})\). Ensuring that the distinction between these fonts is also kept if the (sans-)serif option of the document is switched.

\texttt{\textsc{mathsc}} The \texttt{\textsc{mathcal}} font \textit{i.e.} \((\mathrm{ABC\,D})\) is accompanied by the \texttt{\textsc{mathscr}} font \textit{i.e.} \((\mathbb{A\,B}\mathrm{CD})\).

\texttt{\texttt{mathbb}} The \texttt{\texttt{mathbb}} font is improved by the \texttt{doublestroke} package \cite{4} and adjusted depending on the (sans-)serif option of the document \textit{i.e.} \((\mathrm{Ah}1)\).

\texttt{\texttt{mathtt}} The \texttt{\texttt{mathtt}} macro switches to LM typewriter font \textit{i.e.} \((\mathrm{Ab}\Gamma\mathrm{b})\).

\texttt{\texttt{mathfrak}} Finally, the \texttt{\texttt{mathfrak}} font is also available \textit{i.e.} \((\mathrm{AaBb12})\).

Details about the font handling in \TeX{} can be found in reference \cite{9}.

\section{Math alphabet allocation}

Of the 16 available math alphabets, \TeX{} loads four by default

\begin{enumerate}
  \item \texttt{\texttt{OT1}} Text (latin, upper case greek, numerals, text symbols)
  \item \texttt{\texttt{OML}} Math Italic (latin, greek, numerals, text symbols)
  \item \texttt{\texttt{OMS}} Symbol (\texttt{\textsc{mathcal}}, operators)
  \item \texttt{\texttt{OMX}} Math Extension (big operators, delimiters)
\end{enumerate}

The text font 0) of CM is \texttt{cmr10} \texttt{/OT1/cmr/m/n/10}, which is replaced by LM to be \texttt{rm-lmr10} \texttt{/OT1/lmr/m/n/10}, the \texttt{sansserif} option uses \texttt{rm-lmss10} \texttt{/OT1/lmss/m/n/10}. The italic math font 1) of CM is \texttt{cmmi10} \texttt{/OML/cmm/m/it/10}, and is replaced by LM to be \texttt{lmni10} \texttt{/OML/lmn/m/it/10}, the \texttt{sansserif} options uses \texttt{cmssmi10} \texttt{/OML/cmssrm/m/it/10} from the \texttt{sansmathfonts} package \cite{10}. The symbol font 2) of CM is \texttt{cmssy10} \texttt{/OMS/cmssy/m/n/10}, and is replaced by LM to be \texttt{lmssy10} \texttt{/OMS/lmssy/m/n/10}, the \texttt{sansserif} options uses \texttt{cmsssy10} \texttt{/OMS/cmssymy/m/n/10} from the \texttt{sansmathfonts} package \cite{10}. The extension font 3) of CM is \texttt{cmex10} \texttt{/OMX/cmex/m/n/5}, and is replaced by the \texttt{exscale} package \cite{11} to be \texttt{cmex10} \texttt{/OMX/cmex/m/n/10}, the \texttt{sansserif} option loads \texttt{cmsex10} \texttt{/OMX/cmsex/m/n/10}. The \texttt{amssymb} (\texttt{amsfonts}) packages \cite{12} load two more symbol fonts

\begin{enumerate}
  \item \texttt{msam10} \texttt{/U/msa/m/n/10} AMS symbol font A (special math operators)
  \item \texttt{msbm10} \texttt{/U/msb/m/n/10} AMS symbol font B (\texttt{mathbb}, negated operators)
\end{enumerate}
Figure 2: Math extension fonts
Figure 3: Minion symbol fonts
The `sansserif` option replaces them with `ssmsam10 \U/ssmsa/m/n/10` and `ssmsbm10 \U/ssmsb/m/n/10` from the `sansmathfonts` package [10], respectively. The `bm` package [8] loads the bold version for the fonts 0) to 2).

Other math alphabets are only loaded on demand, *e.g.* \texttt{\textbackslash mathsf} uses a sans-serif font and \texttt{\textbackslash mathbf} without the \texttt{bm} package uses a bold font. The \texttt{\textbackslash mathscr} macro uses the script font from the `mathrsfs` package [13]

9) \texttt{rsfs10 \U/rsfs/m/n/10} Math script font (capital letters)

The \texttt{\textbackslash mathbb} macro loads the double stroke font from the `dsfont` package [4], this can be prevented with the \texttt{symbols=\texttt{ams}} option.

10) \texttt{dsrom10 \U/dsrom/m/n/10} Double stroke font

The \texttt{\textbackslash mathfrak} macro loads the fractur font from the `amssymb` package [12]

11) \texttt{eufm10 \U/euf/m/n/10} Math fraktur (Basic Latin)

The hep-math-font package uses nine of the available 16 math alphabets. This number can be reduced by three using \texttt{\texttt{newcommand}\{bmmax\}\{0\}} from the `bm` package [8] and brought down to the default of four with the option \texttt{symbols=false}.

The \texttt{symbols=minion} options replaces the fonts 2) to 5) with corresponding fonts from the MnSymbol package [5]. Additionally, two more symbol alphabets are allocated, the \texttt{bm} package [8] loads one more font and now \texttt{\textbackslash mathcal} triggers the use of one additional alphabet. Hence, the minion option uses three to four more math alphabets than a usual setup.

### A Implementation

<\*package>

Use the \texttt{kvoptions} package [14].

1 \texttt{\texttt{RequirePackage}}\{\texttt{kvoptions}\}
2 \texttt{\texttt{SetupKeyvalOptions}}{
3 \hspace{1em} \texttt{family=hepmathfont,}
4 \hspace{1em} \texttt{prefix=hepmathfont@}
5 }\}

\texttt{symbols} Provide the \texttt{symbols} option allowing to switch the symbol font.

6 \texttt{\texttt{DeclareStringOption}}\{\texttt{true}\}\{\texttt{symbols}\}
7 \texttt{\texttt{ProcessKeyvalOptions}*}

\texttt{\texttt{\textbackslash ifxetexorluatex}} Load the \texttt{\textbackslash ifluatex} [15] and \texttt{\textbackslash ifxetex} [16] packages. Define the \texttt{\textbackslash ifxetexorluatex} conditional checking if the package is executed by \texttt{Lua\TeX} or \texttt{Xe\TeX}.

8 \texttt{\texttt{RequirePackage}}\{\texttt{ifluatex}\}


Define conditionals based on the `symbols` package option.

```latex
\RequirePackage{pdftexcmds}
\newif\ifhepmathfont@symbols
\ifnum\pdf@strcmp{\hepmathfont@symbols}{false}=0\else\hepmathfont@symbolstrue\fi
\newif\ifhep@ams
\ifnum\pdf@strcmp{\hepmathfont@symbols}{ams}=0 \hep@amstrue\fi
\newif\ifhep@minion
\ifnum\pdf@strcmp{\hepmathfont@symbols}{minion}=0 \hep@miniontrue\fi
```

A.1 Sans serif

Check if document is set to sans-serif using the `xstring` package [17].

```latex
\ RequirePackage{xstring} 
\IfStrEq{\familydefault}{\sfdefault}{\hepmathfont@seriffalse}{\hepmathfont@seriftrue} 
```

If the `sansserif` package option is active use code adjusted from the `sansmath-fonts` package [10]. Ensure that \texttt{\mathsf} is italic as well as sans-serif and sans for sans and sans-serif documents, respectively.

```latex
\ifhepmathfont@serif \mathsf
```

\texttt{\mathsf} Declare \texttt{\mathsf} for serif documents.

```latex
\DeclareMathAlphabet{\mathsf}{OML}{\hep@font@sf}{m}{it}
\SetMathAlphabet{\mathsf}{bold}{OML}{\hep@font@sf}{b}{it}
```

Define fonts for sans-serif documents.

```latex
\else
\newcommand{\hep@font@sf}{lmr}
\newcommand{\hep@font@text}{lmss}
\newcommand{\hep@font@math}{cmssm}
\newcommand{\hep@font@symbol}{cmsssy}
\newcommand{\hep@font@extra}{cmssex}
```

Declare font substitutions.

```latex
\DeclareFontSubstitution{OML}{\hep@font@math}{m}{it}
```

Declare the symbol fonts.

\DeclareSymbolFont{operators}{OT1}{\hep@font@text}{m}{n}
\DeclareSymbolFont{letters}{OML}{\hep@font@math}{m}{it}
\ifhepmathfont@symbols\ifhep@minion\else
\DeclareSymbolFont{symbols}{OMS}{\hep@font@symbol}{m}{n}
\fi\fi
\DeclareSymbolFont{largesymbols}{OMX}{\hep@font@extra}{m}{n}
\fi\fi

Set bold symbol fonts.

\SetSymbolFont{operators}{bold}{OT1}{\hep@font@text}{b}{n}
\SetSymbolFont{letters}{bold}{OML}{\hep@font@math}{b}{it}
\ifhepmathfont@symbols\ifhep@minion\else
\SetSymbolFont{symbols}{bold}{OMS}{\hep@font@symbol}{b}{n}
\fi\fi

Adjust the fonts loaded by the \texttt{amsfonts} [3] and \texttt{esint} [18] packages.

\ifhepmathfont@symbols\ifhep@minion\else
\DeclareSymbolFont{AMSa}{U}{ssmsa}{m}{n}
\DeclareSymbolFont{AMSb}{U}{ssmsb}{m}{n}
\fi\fi
\AtBeginDocument{%
@ifpackageloaded{esint}{%
\DeclareSymbolFont{largesymbolsA}{U}{ssesint}{m}{n}
%
}
%
}

\DeclareSymbolFontAlphabet{\mathrm}{operators}
\DeclareSymbolFontAlphabet{\mathnormal}{letters}
\ifhep@minion\else
\DeclareSymbolFontAlphabet{\mathcal}{symbols}
\fi

\DeclareMathAlphabet{\mathit}{OML}{\hep@font@text}{m}{it}
\SetMathAlphabet{\mathit}{bold}{OML}{\hep@font@text}{bx}{it}
\DeclareMathAlphabet{\mathsf}{OML}{\hep@font@sf}{m}{it}
\SetMathAlphabet{\mathsf}{bold}{OML}{\hep@font@sf}{bx}{it}

\DeclareMathAlphabet\mathit{OML}{\hep@font@text}{m}{it}
\SetMathAlphabet\mathit{bold}{OML}{\hep@font@text}{bx}{it}
\DeclareMathAlphabet\mathsf{OML}{\hep@font@sf}{m}{it}
\SetMathAlphabet\mathsf{bold}{OML}{\hep@font@sf}{bx}{it}
A.2 Greek letters

Load the fixmath [1] and textalpha [2] packages ensuring that upper Greek letters in math mode are italic and providing upright Greek letters in text mode, respectively. Define the hep@greek macro ensuring that both \text and \mathrm produce upright Greek letters.

The following code follows closely the alphabeta package [7].

A.2.1 Commands to access Greek letters by name

For letters defined in math mode, the commands work in both, text and math. Some Greek letters look identical to Latin letters and can therefore not be used as variable symbols in math formulas. These letters are not defined in TeX’s math mode, we provide an alias to the corresponding \text... command.

Mathematical notation distinguishes ‘variant shape symbols’ for pi, phi, rho, theta (small and capital), beta, and kappa (characters for the latter three symbols are not included in TeX’s math fonts). These variations have no syntactic meaning in Greek text and are not given code-points in the LGR encoding while Unicode defines separate code points for the symbol variants.

A.2.2 Greek Alphabet

Macros keep their meaning in mathematical mode (\emph{i.e.} use the same shape as without this package) and refer to greek letter ... in text. For \epsilon and \phi, this means that the selected symbol variant differs in text vs. math mode. Use \varepsilon and \varphi (see section ‘variant shape symbols’ below) to select the greek letter ... in both, text and math mode.
Apply to minuscule Greek letters.

\providecommand*{\zeta}{\textZeta}
\providecommand*{\eta}{\textEta}
\hepgreek\theta\textTheta
\providecommand*{\iota}{\textIota}
\providecommand*{\kappa}{\textKappa}
\hepgreek\lambda\textLambda
\providecommand*{\mu}{\textMu}
\providecommand*{\nu}{\textNu}
\hepgreek\xi\textXi
\providecommand*{\omicron}{\textOmicron}
\hepgreek\pi\textPi
\providecommand*{\rho}{\textRho}
\hepgreek\sigma\textSigma
\providecommand*{\tau}{\textTau}
\hepgreek\upsilon\textUpsilon
\hepgreek\phi\textPhi
\hepgreek\chi\textChi
\hepgreek\psi\textPsi
\hepgreek\omega\textOmega

Archaic letters
A.2.3 Variant shape symbols

TeX’s concept of “standard” vs. “variant” math symbols does not map to the distinction between \textgreek{greek letter} ... vs. \textgreek{greek symbol} in the Unicode standard (see test-tuenc-greek.pdf).

The \...\symbol macros select the \textgreek{greek symbol} in both, text and math mode. For \textgreek{epsilon} and \textgreek{phi} this is the default shape in math mode. The \var... macros select the shape used by TeX math (or, if not supported, the \symbol shape) ...

\...\symbol \text{=} \var...

\...\symbol \neq \var...

only text (in standard 8-bit TeX, may be defined with additional packages):

\ifdef\varbeta
  \textgreek{varbeta}\text{=}\varbeta
\else
  \providecommand*{\varbeta}{\betasymbol}
\fi

\ifdef\varkappa
  \textgreek{varkappa}\text{=}\varkappa
\else
  \providecommand*{\varkappa}{\kappasymbol}
\fi
\providecommand*{\kappasymbol}{\varkappa}
\providecommand*{\Thetasymbol}{\textThetasymbol}

A.2.4 TextCompositeCommands for the generic macros

The NFSS TextComposite mechanism looks for the next token without expanding it. In order to let compositions like \ensuregreek{\Alpha} or \ensuremath{\alpha} work as expected we define TextComposites with the ‘letter name commands’. (Composition only works if the active font encoding is LGR).

\@ifl@aded{def}{tuenc-greek}\{input{alphabeta-tuenc.def}\}\{}
\@ifl@aded{def}{lgrenc}\{input{alphabeta-lgr.def}\}\{}

A.2.5 Re-definition for Greek Unicode input in math mode

Check with \ifdefined for the definition of \DeclareUnicodeCharacter. In contrast to \@ifdefined, this works without side-effects. It makes the package dependent on the ε-TEx extensions but these are standard in all current TeX distributions anyway. Map Greek characters that are also defined in math mode to the generic macros.

\ifdefined\DeclareUnicodeCharacter
\DeclareUnicodeCharacter{0393}{\Gamma}
\DeclareUnicodeCharacter{0394}{\Delta}
\DeclareUnicodeCharacter{0398}{\Theta}
\DeclareUnicodeCharacter{039B}{\Lambda}
\DeclareUnicodeCharacter{039E}{\Xi}
\DeclareUnicodeCharacter{03A0}{\Pi}
\DeclareUnicodeCharacter{03A3}{\Sigma}
\DeclareUnicodeCharacter{03A5}{\Upsilon}
\DeclareUnicodeCharacter{03A6}{\Phi}
\DeclareUnicodeCharacter{03A8}{\Psi}
\DeclareUnicodeCharacter{03A9}{\Omega}
\ DeclareUnicodeCharacter{03B1}{\alpha}
\ DeclareUnicodeCharacter{03B2}{\beta}
\ DeclareUnicodeCharacter{03B3}{\gamma}
\ DeclareUnicodeCharacter{03B4}{\delta}
\ DeclareUnicodeCharacter{03B5}{\varpsilon}
\ DeclareUnicodeCharacter{03B6}{\zeta}
\ DeclareUnicodeCharacter{03B7}{\eta}
\ DeclareUnicodeCharacter{03B8}{\theta}
\ DeclareUnicodeCharacter{03B9}{\iota}
\ DeclareUnicodeCharacter{03BA}{\kappa}
\ DeclareUnicodeCharacter{03BB}{\lambda}
\ DeclareUnicodeCharacter{03BC}{\mu}
\ DeclareUnicodeCharacter{03BD}{\nu}
\ DeclareUnicodeCharacter{03BE}{\xi}
\ DeclareUnicodeCharacter{03C0}{\pi}
\DeclareUnicodeCharacter{03C1}\rho
\DeclareUnicodeCharacter{03C2}\varsigma
\DeclareUnicodeCharacter{03C3}\sigma
\DeclareUnicodeCharacter{03C4}\tau
\DeclareUnicodeCharacter{03C5}\upsilon
\DeclareUnicodeCharacter{03C6}\varphi
\DeclareUnicodeCharacter{03C7}\chi
\DeclareUnicodeCharacter{03C8}\psi
\ DeclareUnicodeCharacter{03C9}\omega
\DeclareUnicodeCharacter{03D1}\thetasymbol
\DeclareUnicodeCharacter{03D5}\phisymbol
\DeclareUnicodeCharacter{03D6}\pisymbol
\DeclareUnicodeCharacter{03DD}\digamma
\DeclareUnicodeCharacter{03F1}\rhosymbol
\DeclareUnicodeCharacter{03F5}\epsilonsymbol
\fi

\ifetexorluatex
\else
\ RequirePackage{substitutefont}
\substitutefont{LGR}{\rmdefault}{lmr}
\DeclareFontFamily{LGR}{\rmdefault}{}
\DeclareFontShape{LGR}{\rmdefault}{b}{n}{<->ssub*lmr/bx/n}{}
\ DeclareFontShape{LGR}{\rmdefault}{b}{sc}{<->ssub*lmr/bx/sc}{}
\substitutefont{LGR}{\ttdefault}{lmtt}
\DeclareFontFamily{LGR}{\ttdefault}{}
\ DeclareFontShape{LGR}{\ttdefault}{b}{n}{<->ssub*lmtt/bx/n}{}
\substitutefont{LGR}{\sfdefault}{lmss}
\ DeclareFontFamily{LGR}{\sfdefault}{}
\ DeclareFontShape{LGR}{\sfdefault}{b}{n}{<->ssub*lmss/bx/n}{}
\ DeclareFontShape{LGR}{\sfdefault}{b}{sc}{<->ssub*lmss/bx/sc}{}
\fi

\ifhep@minion
\else
\ RequirePackage{MnSymbol}
\ RequirePackage{exscale}
\ RequirePackage{amssymb}
\fi

\ A.3 \ Additional math fonts

Either load the MnSymbol package [5] or the the exscale package in order to fix
Latin Modern lmex fonts. Additionally, load the amssymb package [3] which provides
further math symbols and also loads the amsfonts package [3].
\textbf{Load the \texttt{bm} package [8] for superior boldmath. Make math symbols bold whenever they appear in bold macros such as \texttt{section\{\textit{text}\}}.}

232 \texttt{\RequirePackage{bm}}
233 \texttt{\AtBeginDocument{\let\mathbf\bm}}
234 \texttt{\g@addto@macro\bfseries{\boldmath}}

\textbf{Typewriter math font}

235 \texttt{\DeclareMathAlphabet{\mathtt}{OT1}{lmtt}{m}{n}}
236 \texttt{\SetMathAlphabet{\mathtt}{bold}{OT1}{lmtt}{bx}{n}}

\textbf{Provid the \texttt{mathscr} math script font from the \texttt{mathrsfs} package [13].}

237 \texttt{\DeclareMathAlphabet{\mathscr}{U}{rsfs}{m}{n}}

\textbf{Redefine the \texttt{mathbb} math blackboard style font according to the (sans-)serif option with the font from the \texttt{dsfont} package [4].}

238 \texttt{\ifhep@minion}
239 \texttt{\DeclareMathAlphabet{\mathbb}{U}{\ifhepmathfont@serif dsrom\else dsss\fi}{m}{n}}
240 \texttt{\else}
241 \texttt{\ifhep@ams\else}
242 \texttt{\SetMathAlphabet{\mathbb}{normal}{U}{\ifhepmathfont@serif dsrom\else dsss\fi}{m}{n}}
243 \texttt{\fi}
244 \texttt{\fi}
245 \texttt{\fi}

\texttt{End of symbols conditional.}
249 \texttt{\fi}

</package>

\section{Tests}

\texttt{<testserif|testsans>}

250 \texttt{\documentclass{article}}
251 \texttt{\%<testsans>\renewcommand{\familydefault}{\sfdefault}}
252 \texttt{\usepackage[oldstyle]{hep-font}}
253 \texttt{\usepackage{hep-math-font}}
254 \texttt{\usepackage[fancyvrb]{DefineShortVerb{\|}}}
255 \texttt{\newenvironment{vrb}{\begin{tabular}{@{}p{6cm}l@{}}}{\end{tabular}}}
C Readme

The ‘hep-math-font’ package

Extended Greek and sans-serif math

## Introduction

Additionally Greek letters are redefined to be always italic and upright in math and text mode.
Some math font macros are adjusted to give more consistently the naively expected result. The package is loaded using ‘\usepackage{hep-math-font}’.

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References

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