The **HEP-MATH-FONT** package

Extended Greek and sans-serif math

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2022/11/01

**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 `\usepackage{hep-math-font}`.

If the document `\familydefault` font is switched to the sansserif `\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 chucks of math from serif to sans-serif documents the meaning of `\mathrm` and `\mathsf` is adjusted in this case 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 **fixmath** [1] and **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.

## Symbols

The `symbols=⟨family⟩` class option sets the family of the symbol fonts. `symbols=ams` loads the two AMS fonts [3] and the BM bold fonts. The default `symbols=true` replaces additionally the blackboard font with the `dsfont` [4]. `symbols=minion` switches the symbol fonts to the Adobe MinionPro companion font from the MnSymbol package [5]. `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.

## Macros

\text The `\mathrm{(math)}` macro and the `\text{(text)}` macro from **amstext** [6] are

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adjusted to produce upright Greek letters, i.e. (AbΓδAbΓδ), by adjusting the code from the alphabeta [7] package.

\mathbf Bold math, via \textbf is improved with the bm package [8], i.e. (AbΓδAbΓδ). Macros switching to \textit such as \texttt are ensured to also typeset math in bold.

\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, i.e. (AbΓδAbΓδ). Ensuring that the distinction between these fonts is also kept if the (sans-)serif option of the document is switched.

\mathcal The \textit font i.e. (ABCD) is accompanied by the \textsf font i.e. (ABCD).

\mathbf The \textit font is improved by the doublestroke package [4] and adjusted depending on the (sans-)serif option of the document i.e. (Ah1).

\mathbb The \textit macro switches to LM typewriter font i.e. (AbΓ).

\mathfrak Finally, the \textfrak font is also available i.e. (AaBb12).

Details about the font handling in \LaTeX{} can be found in reference [9].

2 Math alphabet allocation

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

0) OT1 Text (latin, upper case greek, numerals, text symbols)

The text font 0) of CM is cmr10 \texttt{OT1/cmr/m/n/10}, which is replaced by LM to be rm-lmr10 \texttt{OT1/lmr/m/n/10}, the sansserif option uses rm-lmss10 \texttt{OT1/lmss/m/n/10}.

1) OML Math Italic (latin, greek, numerals, text symbols)

The italic math font 1) of CM is cmmi10 \texttt{OML/cmm/m/it/10}, and is replaced by LM to be lmmi10 \texttt{OML/lmm/m/it/10}, the sansserif options uses cmssmi10 \texttt{OML/cmssrm/m/it/10} from the sansmathfonts package [10].

2) OMS Symbol (\textit, operators)

The symbol font 2) of CM is cmsy10 \texttt{OMS/cmsy/m/n/10}, and is replaced by LM to be lmsy10 \texttt{OMS/lmsy/m/n/10}, the sansserif options uses cmssy10 \texttt{OMS/cmsssy/m/n/10} from the sansmathfonts package [10].

3) OMX Math Extension (big operators, delimiters)

The extension font 3) of CM is cmex10 \texttt{OMX/cmex/m/n/5}, and is replaced by the exscale package [11] to be cmex10 \texttt{OMX/cmex/m/n/10}, the sansserif option loads cmsex10 \texttt{OMX/cmsex/m/n/10}.

The amsymb (amsfonts) packages [12] load two more symbol fonts
(a) Text

Figure 1: Basic math fonts
Figure 2: Math extension fonts
Figure 3: Minion symbol fonts
4) \texttt{msam10} \ U/msa/m/n/10 AMS symbol font A (special math operators)
5) \texttt{msbm10} \ U/msb/m/n/10 AMS symbol font B (\texttt{mathbb}, negated operators)

The \texttt{sansserif} option replaces them with \texttt{ssmsam10} \ U/ssmsa/m/n/10 and \texttt{ssmsbm10} \ U/ssmsb/m/n/10 from the \texttt{sansmathfonts} package [10], respectively.

The \texttt{bm} package [8] loads the bold version for the fonts 0) to 2).

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

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

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

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

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

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

The \texttt{hep-math-font} package uses nine of the available 16 math alphabets. This number can be reduced by three using \texttt{\newcommand{\bmmax}{0}} from the \texttt{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 \texttt{MnSymbol} package [5]. Additionally, two more symbol alphabets are allocated, the \texttt{bm} package [8] loads one more font and now \texttt{mathcal} triggers the use of one additional alphabet. Hence, the minion option uses three to four more math alphabets than a usual setup.

\section*{A Implementation}

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

\begin{verbatim}
1 \RequirePackage{kvoptions}
2 \SetupKeyvalOptions{
3  family=hepmathfont,
4  prefix=hepmathfont@
5 }

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

6 \DeclareStringOption[true]{symbols}
7 \ProcessKeyvalOptions*
Load the \texttt{ifluatex} \[15\] and \texttt{ifxetex} \[16\] packages. Define the \texttt{ifxetexorluatex} conditional checking if the package is executed by \LaTeX\ or \XeLaTeX.

\begin{verbatim}
  8 \RequirePackage{ifluatex}
  9 \RequirePackage{ifxetex}
 10 \newif\ifxetexorluatex
 11 \ifxetex\xetexorluatexitrue
 12 \else\ifluatex\xetexorluatexitrue
 13 \else\xetexorluatexitruefalse\fi
 14 \fi
\end{verbatim}

Define conditionals based on the \texttt{symbols} package option using the \texttt{pdftexcmds} package \[17\].

\begin{verbatim}
 15 \RequirePackage{pdftexcmds}
 16 \newif\ifhepmathfont@symbols
 17 \ifnum\pdf@strcmp{\hepmathfont@symbols}{false}=0\else\hepmathfont@symbolstrue\fi
 18 \newif\ifhep@ams
 19 \ifnum\pdf@strcmp{\hepmathfont@symbols}{ams}=0 \hep@amstrue\fi
 20 \newif\ifhep@minion
 21 \ifnum\pdf@strcmp{\hepmathfont@symbols}{minion}=0 \hep@miniontrue\fi
\end{verbatim}

A.1 Sans serif

Check if document is set to sans-serif using the \texttt{xstring} package \[18\].

\begin{verbatim}
 22 \newif\ifhepmathfont@serif
 23 \RequirePackage{xstring}
 24 \IfStrEq{\familydefault}{\sfdefault}{%
 25 \hepmathfont@seriffalse{\hepmathfont@seriftrue%
 26 }
\end{verbatim}

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

\begin{verbatim}
 27 \ifhepmathfont@serif
\end{verbatim}

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

\begin{verbatim}
 28 \newcommand\hep@font@sf{cmssm}
 29 \DeclareMathAlphabet\mathsf{OML}{\hep@font@sf}{m}{it}
 30 \SetMathAlphabet\mathsf{bold}{OML}{\hep@font@sf}{b}{it}
\end{verbatim}

Define fonts for sans-serif documents.

\begin{verbatim}
 31 \else
 32 \newcommand\hep@font@sf{lmr}
 33 \newcommand\hep@font@text{lmss}
 34 \newcommand\hep@font@math{cmssm}
\end{verbatim}
\newcommand\hep@font@symbol{cmsssy}
\newcommand\hep@font@extra{cmssx}

Declare font substitutions.
\DeclareFontSubstitution{OML}{\hep@font@math}{m}{it}
\ifhepmathfont@symbols\ifhep@minion
\else
\DeclareFontSubstitution{OMS}{\hep@font@symbol}{m}{n}
\DeclareFontSubstitution{OMX}{\hep@font@extra}{m}{n}
\fi\fi
\fi

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}
\DeclareSymbolFont{largesymbols}{OMX}{\hep@font@extra}{m}{n}
\fi\fi
\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
\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}

\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}

\mbox{\textnormal}{\textbf}{\textit}
\textsf{Declare} \textsf{mathsf} for sans-serif documents to produce serif.

69 \DeclarMathAlphabet{\mathsf}{OML}{\hep@font@sf}{m}{it}
70 \SetMathAlphabet{\mathsf}{bold}{OML}{\hep@font@sf}{bx}{it}

End of sansserif.

71 \fi

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 \texttt{mathrm} produce upright
Greek letters using the \amssymb [12] and \amstext [6] packages.

72 \ifhepmathfont@symbols
73 \RequirePackage{amssymb}
74 \RequirePackage{amstext}
75 \RequirePackage{fixmath}
76 \RequirePackage{textalpha}
77 \def\hep@Greek#1#2#3{
78 \protected\def\TextOrMath{#3}{\ifnum\fam=0 \text{#3}\else#2\fi}\
79 }  
80 \def\hep@Greek#1#2#3{\let#2=#1\hep@Greek#1#2#3}

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 (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.
Archaic letters

\providecommand*{\textDigamma}{\digamma}
\providecommand*{\textStigma}{\stigma}
\providecommand*{\textvarstigma}{\varstigma}
\providecommand*{\textkoppa}{\koppa}
\providecommand*{\textKoppa}{\Koppa}
\providecommand*{\textqoppa}{\qoppa}
\providecommand*{\textQoppa}{\Qoppa}
\providecommand*{\textSampi}{\sampi}
\providecommand*{\textsampi}{\sampi}

A.2.3 Variant shape symbols

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

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

\texttt{...symbol == var...}

\providecommand*{\textbetasymbol}{\betasymbol}

\providecommand*{\betasymbol}{\varbeta}

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

\ifdefined\varbeta
   \hepgreek\varbeta\mathvarbeta\textbetasymbol
\else
   \providecommand*{\textbetasymbol}{\betasymbol}
\fi
\providecommand*{\betasymbol}{\varbeta}
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 \ensuregreek{\alpha} work as expected we define TextComposites with the ‘letter name commands’. (Composition only works if the active font encoding is LGR).

\@ifladed{def}{tuenc-greek}{\input{alphabeta-tuenc.def}}{}
\@ifladed{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 \e-\TeX extensions but these are standard in all current Te\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}{\varepsilon}
\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

Ensure that this works also after loading other fonts packages such as cfr-lm using substitutefont [20].

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

A.3 Additional math fonts


\ifhep@minion
\RequirePackage{MnSymbol}
\fi
\mathbf Load the \texttt{bm} package \cite{bm} for superior boldmath. Make math symbols bold whenever they appear in bold macros such as \texttt{section\{(text)\}}.

\AtBeginDocument{\let\mathbf\bm}
\g@addto@macro\bfseries{\boldmath}

\mathtt Typewriter math font

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

\mathscr Provide the \texttt{mathscr} math script font from the \texttt{mathrsfs} package \cite{mathrsfs}.

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

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

\ifhep@minion
\DeclareMathAlphabet{\mathbb}{U}{\ifhepmathfont@serif dsrom\else dsss\fi}{m}{n}
\else
\ifhep@ams\else
\SetMathAlphabet{\mathbb}{normal}{U}{\ifhepmathfont@serif dsrom\else dsss\fi}{m}{n}
\fi
\fi
\fi

End of symbols conditional.

\fi

</package>

\section{Tests}

\begin{verbatim}
\documentclass{article}
\renewcommand{\familydefault}{\sfdefault}
\end{verbatim}

14
\usepackage{oldstyle}{hep-font}
\usepackage{hep-math-font}
\usepackage{fancyvrb}\DefineShortVerb{\|}
\begin{document}
\begin{vrb}
|| & $Ab\Gamma\delta123$ \\
|\mathbf | & $\mathbf{Ab\Gamma\delta123}$ \\
|\mathrm | & $\mathrm{Ab\Gamma\delta123}$ \\
| \mathbf | & $\mathbf{\mathrm{Ab\Gamma\delta123}}$ \\
| \text | & $\text{Ab\Gamma\delta123}$ \\
| \textbf | & $\textbf{\text{Ab\Gamma\delta123}}$ \\
| \mathsf | & $\mathsf{Ab\Gamma\delta123}$ \\
| \mathbf | & $\mathbf{\mathsf{Ab\Gamma\delta123}}$ \\
| \mathtt | & $\mathtt{Ab\Gamma123}$ \\
| \mathbf | & $\mathbf{\mathtt{Ab\Gamma123}}$ \\
| \mathcal | & $\mathcal{ABC}$ \\
| \mathscr | & $\mathscr{ABC123}$ \\
| \mathbb | & $\mathbb{ABC1}$ \\
| \mathfrak | & $\mathfrak{ABC123}$ \\
\end{vrb}
\Gamma\Delta\Lambda\Phi\Pi\Psi\Sigma\Theta\Upsilon\Xi\Omega
\Gamma\Delta\Lambda\Phi\Pi\Psi\Sigma\Theta\Upsilon\Xi\Omega
\alpha\beta\gamma\delta\epsilon\zeta\eta\theta\iota\kappa\lambda
\mu\nu\xi\pi\rho\sigma\varsigma\tau\upsilon\phi\chi\psi\omega
\Gamma\Delta\Lambda\Phi\Pi\Psi\Sigma\Theta\Upsilon\Xi\Omega
\alpha\beta\gamma\delta\epsilon\zeta\eta\theta\iota\kappa\lambda
\mu\nu\xi\pi\rho\sigma\varsigma\tau\upsilon\phi\chi\psi\omega
\end{document}
The 'hep-math-font' package adjust the math fonts to be 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 '{\usepackage{hep-math-font}}'.

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References


