An updated survey of OpenType math fonts

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Abstract

OpenType math fonts were introduced more than 15 years ago. Over the years, more and more math fonts have been developed and added to the font collection. In this paper, we review some of the more recent additions, comparing them to previous choices of OpenType math fonts such as Cambria, Lucida, Latin Modern, and TEX Gyre.

In our analysis, we focus on completeness of math symbols and alphabets, and on design choices of math alphabets. A detailed technical study of glyph and font metrics is beyond the scope of this paper, but some aspects of this have been recently addressed by other contributions.

1 Introduction

OpenType math fonts were introduced more than 15 years ago. It started when Microsoft added support for math typesetting in Office 2007 [1] and proposed an extension of the OpenType font format, adding a MATH table. This eventually became part of the OpenType standard [2].

It did not take long before the TEX community recognized the potential of OpenType math fonts [3, 4] and started adopting the font technology for their own purposes.

XeTEX started in 2008 to introduce limited support for OpenType math in the scope of an extended TEX math engine [5]. LuaTEX followed in 2009 with a more complete implementation, aiming to provide a full-featured OpenType math engine [6, 7].

Since 2010 both engines and supporting macro packages and font loaders have been available in the mainstream TEX Live distribution. At this point, the technology for OpenType math typesetting was essentially ready for use, except that there weren't many OpenType math fonts available yet.

2 Overview of available math fonts

When OpenType math was introduced, only a single math font was available: Cambria Math [8] by Tiro Typeworks, commissioned by Microsoft and distributed as a system font with Office 2007. Cambria Math was intended as a reference implementation showcasing the features of OpenType math, illustrated in a promotional booklet.

This was followed in 2008 by Asana Math [9] by Apostolos Syropoulos as the first independently developed OpenType math font, which was based on `pxfonts` by Young Ryu.

When the STIX fonts 1.0 were released in 2010, they were quickly assembled as an OpenType math font and released as the XITS fonts [10]. It was only years later that OpenType versions of STIX fonts were released with STIX fonts 1.1.1 in 2013 and the much revised STIX2 fonts in 2016 [11, 12]. At this time, the earlier XITS and STIX fonts are considered obsolete; only the STIX2 fonts are maintained.

Perhaps the most significant contribution to the collection of math fonts came in 2011–2014 with the development of the Latin Modern and TEX Gyre math fonts by the GUST font team with support from various TEX user groups [13, 14, 15, 16].

Another contribution by the GUST team was the development of a math font for DejaVu in 2015, which was added to the TEX Gyre collection.

During this same time also came the development of Lucida OpenType text and math fonts in 2011–2012, initiated as a TUG project with support from Bigelow & Holmes and a group of volunteers. While the Lucida fonts are not free (in either sense), they are available at a very reasonable price from TUG [17].

With these developments, there were already more than 10 choices of OpenType math fonts in 2015, while there had been just a few in 2010.

But there was more to come: In the following years, more math fonts were added, complementing various freely available OpenType text fonts.

Starting in 2016, Khaled Hosny developed the Libertinus OTF fonts [18], derived from Libertine and Biolinum, and added a Libertinus Math font, borrowing some symbols and alphabets from other existing fonts such as the STIX fonts.

A Garamond Math font [19] followed in 2018, developed by Yuansheng Zhao, using alphabets from EB Garamond and borrowing a sans-serif alphabet from Libertinus Math.

Daniel Flipo provided the Erewhon Math and XCharter Math fonts [20, 21], using alphabets from Michael Sharpe's Erewhon[1] and XCharter text fonts, which, in turn, are derived from extended versions of Adobe Utopia and Bitstream Charter. The math symbols for Utopia and Charter are based on the Fourier-GUT and MathDesign packages by Michel Bovani and Paul Pichaureau.

Another recent contribution by Daniel Flipo is the KpFonts OTF collection [22], based on KpFonts by Christophe Caignaert, which, in turn, is derived from a version of URW Palladio (not Kepler!) and complemented by a sans-serif and a monospace to make a complete font family.

[1] *erewhon* backwards is *nowhere*, which alludes to Utopia.

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font name	first	latest	version	release	sources	developer, maintainer	ref.
Cambria Math	2007	2019	6.99	MS	—	Microsoft, Tiro Typeworks	[8]
Asana Math	2008	2019	0.958	CTAN	—	Apostolos Syropoulos	[9]
XITS Math	2010	2020	1.302	CTAN	Github	Khaled Hosny	[10]
STIX Math (obsolete)	2010	2014	1.1.1	CTAN	Github	David Jones, STIpub	[11]
STIX Two Math	2016	2021	2.13	CTAN	Github	David Jones, STIpub	[12]
Latin Modern Math	2011	2014	1.959	CTAN	GUST	GUST font team	[13]
TEX Gyre Pagella Math	2012	2016	1.632	CTAN	GUST	GUST font team	[14]
TEX Gyre Termes Math	2012	2016	1.543	CTAN	GUST	GUST font team	[14]
TEX Gyre Bonum Math	2013	2016	1.005	CTAN	GUST	GUST font team	[14]
TEX Gyre Schola Math	2014	2016	1.533	CTAN	GUST	GUST font team	[14]
TEX Gyre DejaVu Math	2015	2016	1.106	CTAN	GUST	GUST font team	[14]
Lucida Bright Math	2012	2023	1.901	TUG	—	Bigelow & Holmes, TUG	[17]
Libertinus Math	2016	2021	7.040	CTAN	Github	Khaled Hosny	[18]
Garamond Math	2018	2022	2022-01	CTAN	Github	Yuansheng Zhao	[19]
Erewhon Math	2019	2023	0.63	CTAN	—	Daniel Flipo	[20]
XCharter Math	2022	2023	0.50	CTAN	—	Daniel Flipo	[21]
KpFonts (Roman, Sans)	2020	2023	0.55	CTAN	—	Daniel Flipo	[22]
GFS Neohellenic Math	2016	2022	1.02	CTAN	—	Antonis Tsolomitis, GFS	[23]
Fira Math	2018	2020	0.3.4	CTAN	Github	Xiangdong Zeng	[24]
Lato Math	2020	2020	0.1	—	Github	Chenjing Bu	[25]
Noto Math	2020	2023	2.539	—	Github	Noto Fonts Project	[27]
New CM Math	2019	2023	4.6	CTAN	—	Antonis Tsolomitis	[29]
Concrete Math	2022	2023	0.50	CTAN	—	Daniel Flipo	[30]
Euler Math	2022	2023	0.50	CTAN	—	Daniel Flipo, Khaled Hosny	[31]

Table 1: List of available OpenType math font packages with dates of first and latest releases, latest versions, availability of releases and sources, developer or maintainer, as well as links to resources.

While KpFonts also includes a sans-serif design, it is not the only sans-serif math font available.

There is GFS Neohellenic Math [23], maintained by Antonis Tsolomitis, which is based on a sans-serif font in neo-hellenic style that was developed by the Greek Font Society (GFS).

Another example is Fira Math [24] developed by Xiangdong Zeng in 2018, using alphabets from Fira Sans and corresponding math symbols.

There also exists a project for Lato Math [25], using alphabets from Lato [26] by Łukasz Dziedzic combined with symbols borrowed from Fira Math. Unfortunately, the project seems unfinished and is unsuitable for distribution in the current state.

Another very recent project, started in 2023, aims to provide OpenType math functionality for Noto Math [27]. While the font already exists for some years, it only provided the glyphs, but it didn't come with a MATH table, so was lacking usable math typesetting functionality. When the project is done, it will provide another important addition to the collection of sans-serif math fonts.

Finally, besides all the developments to provide math support for various existing OpenType fonts, there has also been renewed interest in extending and reviving some traditional TEX fonts.

A significant extension is the New Computer Modern font family [28, 29] by Antonis Tsolomitis, which extends Latin Modern fonts in many ways. Besides numerous additions to the text fonts, it also adds additional Unicode blocks of mathematical and technical symbols to the math fonts. As a result, these fonts are now the most complete math fonts, even more complete than STIX fonts.

Another recent contribution by Daniel Flipo has revived some traditional TEX fonts, providing OTF versions of Concrete Math and Euler Math [30, 31]. While Concrete Math was generated from sources, Euler Math is based on Neo Euler [32] by Khaled Hosny, started in 2009, which originated from a collaboration with Hermann Zapf more than a decade ago but was long since abandoned [33].

With these developments, we now have more than 20 choices of OpenType math fonts in 2023 (not counting variants). This is a significant increase compared to the numbers of 2015 or 2010.

A summary of available OpenType math font packages is provided in table 1.

font name	weights
XITS Math	Regular, Bold
Lucida Bright Math	Regular, Demi
Erewhon Math	Regular, Bold (minimal)
XCharter Math	Regular, Bold (minimal)
KpRoman Math	Light, Semibold
	Regular, Bold
KpSans Math	Regular, Bold
New CM Math	Regular, Book

Table 2: List of available OpenType math fonts which provide bold versions or additional weights.

Some OpenType math font packages come with multiple weights, so the total number of individual font shapes is now more than 30.

In some cases, there is a fairly complete bold math font, in other cases, only a bare minimum is provided, suitable for inline math only.

Besides bold math fonts, there are also some font packages which provide multiple weights of the base fonts, such as light or book variants. A summary of OpenType math fonts with bold or additional weights is provided in table 2.

Nearly all OpenType math fonts discussed in this paper are free and readily available from CTAN or TEX Live. However, some unfinished projects are currently only available from Github.

The only non-free fonts discussed in this paper are Cambria Math, which comes as a system font on Windows, and Lucida, which are sold via TUG. We have excluded other non-free fonts since we don't have any up-to-date information.

In this paper, we want to analyze how the available math fonts compare with regard to coverage of symbols and alphabets, and with regard to design choices of alphabets.

Some of these topics have also been considered in an earlier review [34], which reflected the state of math fonts in 2012, when just a few OpenType math fonts were available, such as Cambria, Lucida, Latin Modern, and some TEX Gyre fonts.

In this review, we provide an update on the state of OpenType math fonts in 2023 with many updated and many additional fonts available. Given the number of available fonts, a detailed technical study of font parameters and glyph metrics is beyond the scope of this paper.

Fortunately, some recent studies by the LuaMetaTEX developers[2] have covered this topic in detail and have also resulted in improvements or repairs of several OpenType math fonts [35, 36, 37].

[2] LuaMetaTEX (LMTX) is a follow-up of LuaTEX.

3 Completeness of available math fonts

In the following sections, we want to analyze how the available math fonts compare with regard to completeness of symbols and alphabets. In order to determine the range of coverage, we are essentially counting the number of Unicode slots provided in a given OpenType font.

This could be done using a test script such as Frank Mittelbach's `unicodefonttable` package [38, 39], which generates a Unicode font table for a given font and counts the available glyphs.

A similar approach, more specific to math fonts, would be to adapt the `unimath-symbols.ltx` table from the documentation of the `unicode-math` package [40], which typesets a font table of Unicode math symbols encoded in `unicode-math-table.tex` and counts the available glyphs.

For our project, we used a modified version of the latter, providing separate counts for symbols and alphabetic characters. We have also used a modified version of the symbol table.

The numbers determined this way represent a lower estimate for the available glyphs, since we are only counting the base glyphs in Unicode slots and only the known symbols.

In most cases, OpenType math fonts provide more than the base glyphs. For big operators, big delimiters, wide accents, and similar objects, there are multiple sizes and extensible versions.

Besides additional sizes, many OpenType math fonts also provide additional glyph variants that can be accessed via stylistic sets.

It is difficult to determine an exact number of glyphs that should be provided to make a math font complete. The boundary between mathematical and technical symbols is a little vague and the decision of which symbols to include or exclude in the encoding table is somewhat subjective.

Furthermore, Unicode makes new releases every year, so there could be additional symbols added from time to time, which could be overlooked if they are missing in the symbol table.

Some of the most complete OpenType math fonts amount to 1270 symbols and 1170 alphabetic characters, so there would be 2440 glyphs in total, not counting any sizes or variants. If we include the additional sizes and variants, there will be even more glyphs needed for a complete math font.

While the glyph variants are usually hidden and excluded from the count, some font designers also make them available in the private-use area, which would add them to the count of Unicode slots, and the total count could be misleading.

3.1 Completeness of math symbols

When analyzing the counts regarding completeness of math symbols, we find that there are essentially two groups of OpenType math fonts.

The first group aims for completeness, covering more or less the complete range of Unicode math, providing some 1150–1270 math symbols:

New CM Math	1270 symbols
STIX Two Math	1256 symbols
XITS Math	1253 symbols
Lato Math	1221 symbols
Asana Math	1211 symbols
GFS Neohellenic Math	1175 symbols
Noto Math	1162 symbols
Cambria Math	1157 symbols
Lucida Bright Math	951 symbols

In this group we find fonts that were designed for completeness such as STIX/XITS, Noto, or Lato, but also some new entries such as New CM Math, which is currently the most complete math font. Cambria is also fairly complete by now, after being much less complete in earlier versions. Lucida is somewhere in between: It is a little behind the first group, but way ahead of the second group.

The second group does not aim for completeness and covers only a subset of symbols, providing some 500–600 math symbols:

Erewhon Math	607 symbols
Garamond Math	604 symbols
Euler Math	602 symbols
Concrete Math	600 symbols
XCharter Math	600 symbols
KpFonts (Roman, Sans)	589 symbols
Libertinus Math	560 symbols
TEX Gyre Math (5×)	556 symbols
Latin Modern Math	554 symbols
Fira Math	508 symbols

Among this group, the Latin Modern and TEX Gyre math fonts by the GUST font team provide a consistent subset across all fonts, which could be taken as a starting point for a common subset encoding. Unfortunately, there is not much agreement among other fonts, so the details of symbol coverage will be slightly different for each font.

While a subset of 500–600 math symbols may seem small compared to the full Unicode symbol range, it is not that small in practice. If we consider that a traditional TEX with AMS fonts had no more than 5 fonts of 128 slots to encode all the math symbols and alphabets, any OpenType font with 500–600 symbols (not including alphabets) will be as good as any traditional TEX font.

Finally, it is interesting to note how bold math fonts compare, if they are provided at all.

Since the regular math fonts already include bold alphabets for markup, separate bold fonts are only needed in the context of headings, when formulas are switched to bold as a whole.

As shown in table 2, only a few font packages provide a separate bold math font, and these bold versions come with a smaller range of math symbols compared to the regular versions:

XITS Math Bold	499 symbols
KpFonts (Roman, Sans)	495 symbols
Lucida Bright Math Demi	478 symbols
Erewhon Math Bold	124 symbols
XCharter Math Bold	116 symbols

In the cases of Erewhon Math and XCharter Math, the idea of only providing support for inline math was taken to the extreme, omitting most of the big operators and big delimiters, and only including the basic sizes of the most common symbols.

3.2 Completeness of math alphabets

When analyzing the counts regarding completeness of math alphabets, we find that there are again several groups of OpenType math fonts.

The first group aims for completeness, covering all of the math alphabets, providing some 1150–1170 alphabetic symbols:

New CM Math	1170 alphabetic
STIX Two Math	1170 alphabetic
XITS Math	1170 alphabetic
Cambria Math	1170 alphabetic
Asana Math	1167 alphabetic
Noto Math	1164 alphabetic
TEX Gyre Math (5×)	1163 alphabetic

The second group is a little less complete, covering most of the math alphabets with some limitations, providing some 1050–1150 alphabetic symbols:

Libertinus Math	1145 alphabetic
Erewhon Math	1117 alphabetic
Latin Modern Math	1111 alphabetic
XCharter Math	1108 alphabetic
Concrete Math	1107 alphabetic
Garamond Math	1100 alphabetic
Euler Math	1088 alphabetic
KpFonts (Roman, Sans)	1070 alphabetic
Lucida Bright Math	1038 alphabetic

Among the most common omissions are lowercase Script and BBold, which are missing in several fonts. Lucida Math is missing only lowercase bold Script and bold Fraktur. Garamond Math is missing lowercase Greek in sans serif bold italic.

font name	regular	sans-serif	Script	Calligr.	Fraktur	BBold	Mono
	up it bf bi	up it bf bi	scr bscr	cal bcal	frak bfrak	bb	tt
Cambria Math	● ● ● ●	● ● ● ●	● ● ● ●	– – – –	● ● ● ●	● ●	● ●
Asana Math	● ● ● ●	● ● ● ●	● ● ● ●	– – – –	● ● ● ●	● ●	● ●
XITS Math	● ● ● ●	● ● ● ●	● ● ● ●	● – ● –	● ● ● ●	● ●	● ●
STIX Two Math	● ● ● ●	● ● ● ●	● ● ● ●	● – ● –	● ● ● ●	● ●	● ●
Latin Modern Math	● ● ● ●	● ● ● ●	● – ● –	– – – –	● ● ● ●	● ●	● ●
TEX Gyre Math (5×)	● ● ● ●	● ● ● ●	● ● ● ●	– – – –	● ● ● ●	● ●	● ●
Lucida Bright Math	● ● ● ●	● ● ● ●	● ● ● –	● – ● –	● ● – –	● –	● ●
Libertinus Math	● ● ● ●	● ● ● ●	● ● ● ●	– – – –	● ● ● ●	● ●	● ●
Garamond Math	● ● ● ●	● ● ● ○	● ● ● ●	● – ● –	● ● ● ●	● ●	● ●
Erewhon Math	● ● ● ●	● ● ● ●	● – ● –	– – – –	● ● ● ●	● ●	● ●
XCharter Math	● ● ● ●	● ● ● ●	● – ● –	– – – –	● ● ● ●	● ●	● ●
KpRoman Math	● ● ● ●	● ● ● ●	● – ● –	● – ● –	● ● ● ●	● –	● ●
KpSans Math	● ● ● ●	● ● ● ●	● – ● –	● – ● –	● ● ● ●	● –	● ●
GFS Neohellenic Math	● ● ● ●	– – – –	● – – –	– – – –	● – – –	● –	– –
Fira Math	● ● ● ●	– – – –	– – – –	– – – –	– – – –	● ●	● ●
Lato Math	● ● ● ●	– – – –	– – – –	– – – –	– – – –	● ●	● ●
Noto Math	● ● ● ●	● ● ● ●	● ● ● ●	– – – –	● ● ● ●	● ●	● ●
New CM Math	● ● ● ●	● ● ● ●	● ● ● ●	– – – –	● ● ● ●	● ●	● ●
Concrete Math	● ● ● ●	● ● ● ●	● – ● –	– – – –	● ● ● ●	● ●	● ●
Euler Math	● ● ● ●	● ● ● ●	● – ● –	– – – –	● ● ● ●	● ●	● ●

Table 3: List of available OpenType math fonts with coverage of math alphabets.
For regular and sans-serif the columns indicate upright, italic, bold and bold italic.
For Script, Calligraphic, Fraktur, BBold, the columns indicate upper- and lowercase.

In previous versions, Concrete and Euler lacked the sans-serif and typewriter alphabets, but these have recently been added.

Since Euler is an upright design, it used to have a special setup, which only provided the upright and bold slots, while it left out the italic and bold italic slots. In the most recent version, the italic slots are now substituted with the upright symbols.

The third group consists of sans-serif designs, which leave out the sans-serif slots, resulting in much lower numbers:

Lato Math	606 alphabetic
Fira Math	584 alphabetic
GFS Neohellenic Math	568 alphabetic

Again, the most common omissions are lowercase Script and BBold, which are missing in several fonts. GFS Neohellenic is missing lowercase and bold Script and Fraktur, as well as lowercase BBold. Lato and Fira are missing all of Script and Fraktur, but they do provide a full set of BBold.

While many sans-serif fonts provide a reduced set of math alphabets, Noto is an exception: it provides the complete range of math alphabets, but uses an inconsistent setup. While the upright uses a sans-serif, the italic, bold, and bold italic use a serif variant.

Finally, it is interesting to note how bold math fonts compare in terms of math alphabets.

When formulas are switched to bold as a whole in the context of headings, regular alphabets should be replaced by bold alphabets, and bold alphabets should ideally become ultrabold, if available, but in most cases they just remain bold.

The numbers of alphabetic symbols for bold fonts, which sometimes leave out typewriter slots, are usually a little lower than for regular fonts:

XITS Math Bold	1093 alphabetic
KpFonts (Roman, Sans)	1066 alphabetic
Erewhon Math Bold	1001 alphabetic
XCharter Math Bold	1001 alphabetic
Lucida Bright Math Demi	961 alphabetic

Gaps in the regular fonts are usually reflected in the bold fonts: Lucida is already missing lowercase bold Script and bold Fraktur in the regular font, so the bold font is also missing Script and Fraktur.

Finally, some bold fonts which only provided a minimal set used to leave out the bold alphabets when the regular alphabets were switched to bold, but this practice has now been discontinued.

A summary of available or missing alphabets in the various math fonts and bold math fonts is provided in tables 3 and 4.

font name	regular	sans-serif	Script	Calligr.	Fraktur	BBold	Mono
	up it bf bi	up it bf bi	scr bscr	cal bcal	frak bfrak	bb	tt
XITS Math Bold	● ● ● ●	● ● ● ●	● ● ● ●	● – ● –	● ● ● ●	● ●	– –
Lucida Bright Math Demi	● ● ● ●	● ● ● ●	● – ● –	● – ● –	– – – –	● –	● ●
Erewhon Math Bold	● ● ● ●	● ● ● ●	● – ● –	– – – –	● ● ● ●	● –	– –
XCharter Math Bold	● ● ● ●	● ● ● ●	● – ● –	– – – –	● ● ● ●	● –	– –
KpRoman Math Bold	● ● ● ●	● ● ● ●	● – ● –	● – – –	● ● ● ●	● –	● ●
KpSans Math Bold	● ● ● ●	● ● ● ●	● – ● –	● – – –	● ● ● ●	● –	● ●

Table 4: List of available OpenType bold fonts with coverage of math alphabets.
For regular and sans-serif the columns indicate upright, italic, bold and bold italic.
For Script, Calligraphic, Fraktur, BBold, the columns indicate upper- and lowercase.

While it may be difficult to keep track of the details, users of OpenType math fonts shouldn't be too concerned about missing alphabets, unless they have special requirements.

In general, OpenType math fonts provide more math alphabets than traditional TEX math fonts, and most of the gaps only affect specific alphabets, which may not be used much.

It should be safe to assume that nearly all OpenType math fonts provide at least the main alphabet in 4 shapes, including Latin and Greek, as well as a basic set of Script, Fraktur, and BBold.

There may be gaps when it comes to lowercase Script, lowercase BBold, bold Script or bold Fraktur, but these are much less used. There may also be gaps in the sans-serif or typewriter alphabets.

4 Design choices of math alphabets

For a full-featured OpenType math font, a number of math alphabets are required:

- 4 shapes of the main font (upright, italic, bold, bold italic), each including Latin and Greek,
- 4 shapes of a sans-serif (upright, italic, bold, bold italic), some including Latin and Greek,
- 2 shapes of Script/Calligraphic (regular, bold), each including upper- and lowercase,
- 2 shapes of Fraktur/Blackletter (regular, bold), each including upper- and lowercase,
- 1 shape of Blackboard bold or BBold (regular), also including upper- and lowercase,
- 1 shape of a monospace/typewriter (regular), also including upper- and lowercase.

To provide all these alphabets, it will be necessary to assemble glyphs from multiple sources and to adjust them to match the main font.

When dealing with a comprehensive font family, some choices may be obvious, such as choosing a sans-serif or a typewriter font, but in most cases some design decisions will be needed.

In the following sections, we want to consider how the available OpenType math fonts compare with regard to design choices of math alphabets for Script, Fraktur, and Blackboard Bold.

While some design choices in existing fonts may be unfortunate, it is hard to change anything, once a font has been released and put into use for some time. It is usually necessary to create a new variant when you want to revise some design choices.

This is what happened to the STIX fonts, which were renamed to STIX Two after a major revision to the glyph shapes and some math alphabets.

Similarly, the New Computer Modern fonts can be considered a new variant of Latin Modern. While New Computer Modern can choose to disagree with Latin Modern and use different choices, any future revisions of Latin Modern will likely have to respect previous choices for compatibility.

4.1 Design choices of sans-serif

When choosing a sans-serif font for use in math, it is important to keep in mind that math alphabets are not meant for generic font switches, but for semantic markup of symbols in a formula. In physics, for example, bold sans-serif italic might be used for tensors, while bold italic might be used for vectors.

Besides providing a suitable range of Latin and Greek, the sans-serif glyphs also need to be clearly distinguishable from the corresponding serif glyphs based on their font properties, such as weight, width, contrast or stroke thickness.

While having some contrast between serif and sans-serif can be helpful, the sans-serif design should not be too incompatible with the main font, since the symbols from different alphabets should work together in a formula.

In general, it is better to combine serif and sans-serif fonts of similar weight and width, having just enough contrast in between to make them clearly distinguishable. It is also a good idea to use familiar shapes and to avoid any unusual shapes.

4.2 Design choices of Script/Calligraphic

When it comes to choices for Script or Calligraphic, there are two different styles how users expect a mathematical Script to look like.

The first group uses a restrained style of Script or Calligraphic. This includes the traditional styles used in Computer Modern, Euler Script, and Lucida Calligraphic:[3]

Neohellenic	$\mathcal{ABCXYZ}$
Concrete	$\mathcal{ABCXYZ}$
Garamond	$\mathcal{ABCXYZ}$ (StylisticSet=3)
KpFonts	$\mathcal{ABCXYZ}$ (StylisticSet=1)
XITS	$\mathcal{ABCXYZ}$ (StylisticSet=3)
Lucida	$\mathcal{ABCXYZ}$ (StylisticSet=4)
Euler	$\mathcal{ABCXYZ}$
LM	$\mathcal{ABCXYZ}$
New CM	$\mathcal{ABCXYZabcxyz}$
STIX Two	$\mathcal{ABCXYZabcxyz}$
Cambria	$\mathcal{ABCXYZabcxyz}$
TG DejaVu	$\mathcal{ABCXYZabcxyz}$

The second group uses a more fancy and elaborate style of formal Script. This includes the new design of Lucida Script:

Erewhon	$\mathscr{ABCXYZ}$
XCharter	$\mathscr{ABCXYZ}$
KpFonts	$\mathscr{ABCXYZ}$
STIX Two	$\mathscr{ABCXYZ}$ (StylisticSet=1)
XITS	$\mathscr{ABCXYZabcxyz}$
Libertinus	$\mathscr{ABCXYZabcxyz}$
Garamond	$\mathscr{ABCXYZabcxyz}$
Noto	$\mathscr{ABCXYZabcxyz}$
TG Termes	$\mathscr{ABCXYZabcxyz}$
TG Schola	$\mathscr{ABCXYZabcxyz}$
Lucida	$\mathscr{ABCXYZabcxyz}$

TeX Gyre Pagella uses a unique style, which could make this font's Script less usable:

TG Pagella	$\mathscr{ABCXYZabcxyz}$

Several OpenType math fonts also provide an alternate style of Script or Calligraphic, which can be accessed using stylistic sets. These variants have also been included in the overview.

It is interesting to note that the STIX Two fonts have reversed a design decision of the XITS fonts regarding the choice of Script, and the designs have also been modified. New Computer Modern extends the Script from Latin Modern using the same style, while Concrete Math has adopted the original style of Calligraphic from Computer Modern.

[3] Some fonts have been scaled to match the size of other fonts: Lucida Calligraphic to 90% and Lucida Script to 85%, DejaVu to 90%, Termes, Pagella, and Schola to 95%.

4.3 Design choices of Fraktur/Blackletter

When it comes to choices for Fraktur or Blackletter, there is only one preferred style for how users expect a mathematical Fraktur to look.

The first group includes a majority of math font packages which use this typical style of Fraktur. Many fonts make use of Euler Fraktur, such as Latin Modern, New Computer Modern, and Pagella:[4]

LM	$\mathfrak{ABCXYZabcxyz}$
New CM	$\mathfrak{ABCXYZabcxyz}$
Concrete	$\mathfrak{ABCXYZabcxyz}$
Euler	$\mathfrak{ABCXYZabcxyz}$
Erewhon	$\mathfrak{ABCXYZabcxyz}$
XCharter	$\mathfrak{ABCXYZabcxyz}$
TG Pagella	$\mathfrak{ABCXYZabcxyz}$
TG Termes	$\mathfrak{ABCXYZabcxyz}$
Noto	$\mathfrak{ABCXYZabcxyz}$
Garamond	$\mathfrak{ABCXYZabcxyz}$
Cambria	$\mathfrak{ABCXYZabcxyz}$
Libertinus	$\mathfrak{ABCXYZabcxyz}$
STIX Two	$\mathfrak{ABCXYZabcxyz}$
XITS	$\mathfrak{ABCXYZabcxyz}$
TG Schola	$\mathfrak{ABCXYZabcxyz}$
TG DejaVu	$\mathfrak{ABCXYZabcxyz}$

The second group uses a Blackletter style instead of Fraktur, which is fairly unusual and could make these fonts less usable for this variant:

Neohellenic	$\mathfrak{ABCXYZ}$
Lucida	$\mathfrak{ABCXYZabcxyz}$
KpFonts	$\mathfrak{ABCXYZabcxyz}$

These designs could be just a fallback option when no suitable design of Fraktur was available.

4.4 Design choices of Blackboard Bold

When it comes to choices for Blackboard Bold, there are again two styles using a sans-serif or serif style of the BBold letters.

The first group uses a sans-serif style of BBold:

LM	$\mathbb{ABCNOPQRXYZ}$ abc 012
Euler	$\mathbb{ABCNOPQRXYZ}$ abc 012
Erewhon	$\mathbb{ABCNOPQRXYZ}$ abc 012
STIX Two	$\mathbb{ABCNOPQRXYZ}$ abc 012
XITS	$\mathbb{ABCNOPQRXYZ}$ abc 012
Lucida	$\mathbb{ABCNOPQRXYZ}$
KpSans	$\mathbb{ABCNOPQRXYZ}$
Neohellenic	$\mathbb{ABCNOPQRXYZ}$
Fira	$\mathbb{ABCNOPQRXYZ}$ abc
Noto	$\mathbb{ABCNOPQRXYZ}$ abc 012
Lato	$\mathbb{ABCNOPQRXYZ}$ abc 012

[4] Some fonts have been scaled to match the size of other fonts: DejaVu to 90%, Schola to 95%. Termes, Pagella, and Lucida Blackletter are not scaled and shown at 100%.

The second group uses a serif style of BBold:[5]

New CM	ABCNOPQRXYZ abc 012
Concrete	ABCNOPQRXYZ abc 012
XCharter	ABCNOPQRXYZ abc 012
KpRoman	ABCNOPQRXYZ
Garamond	ABCNOPQRXYZ abc 012
Libertinus	ABCNOPQRXYZ abc 012
Cambria	ABCNOPQRXYZ abc 012
TG Schola	ABCNOPQRXYZ abc 012
TG Termes	ABCNOPQRXYZ abc 012
TG Pagella	ABCNOPQRXYZ abc 012
TG DejaVu	ABCNOPQRXYZ abc 012

While Latin Modern has adopted a sans-serif BBold, which also includes lowercase and numerals, New Computer Modern and Concrete Math have reverted to the traditional style of BBold from AMS fonts, at least for the uppercase. Many other fonts have chosen a scaled or adjusted variant of the sans-serif BBold from STIX/XITS.

5 Summary and conclusions

OpenType math fonts were introduced more than 15 years ago. Over the years, more math fonts have been developed and added to the font collection. As of this year, we have more than 20 choices of OpenType math fonts available (not counting variants) and more than 30 individual fonts (including variants and additional weights).

Nearly all OpenType math fonts discussed in this paper are free and readily available from CTAN or TeX Live, except for some non-free fonts and some unfinished projects from Github.

The available choices of OpenType math fonts cover most of what was previously available in other formats, including traditional TeX fonts (Computer Modern, Concrete, Euler), standard PostScript fonts (Times, Palatino), and other free PostScript fonts (Garamond, Utopia, Charter, DejaVu).

In our analysis, we have analyzed the coverage of math symbols and alphabets, as well as design choices and available font features.

While the range of symbols and alphabets may vary for each font, most available fonts will be good enough for general use, providing at least as much as traditional TeX fonts or even more.

Regarding design choices, most available font packages follow typical styles of how users expect mathematical Script, Fraktur, or Blackboard Bold to look. There are only few exceptions which use a unique or unusual style.

[5] Some fonts have been scaled to match the size of other fonts: DejaVu to 85%, Termes, Pagella, and Schola to 90%. Lucida is not scaled and shown at 100%.

In general, OpenType math fonts are not expected to provide the same level of stability and compatibility as traditional TeX fonts. While it should be possible to reprocess existing documents, you cannot expect the exact same line breaks, unless you archive and use specific versions of fonts.

In some cases, OpenType math fonts happen to be stable simply because they haven't been updated for years, but they may still exhibit the same bugs or limitations. Over time, it becomes more and more difficult to change anything. The longer a font has been left unchanged, the more likely that it will be necessary to introduce new variants for major revisions.

While font development is ongoing, OpenType math fonts are readily available for use today.

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Appendix: Font samples

As requested by conference participants, a selection of font samples has been included as an appendix.

The font samples show some typical equations from theoretical physics, using the proper notation conventions, such as bold italic for vectors.

These examples only use the main alphabets and don't use any Script, Fraktur or BBold. A much wider variety of examples would be needed to cover other notations. Other resources often use mathematical theorems in font samples, which may appear differently since they focus on other material.

Cambria and Lucida fonts

This section shows font samples for Cambria Math [8] and Lucida Bright Math [17], both of which are unique designs and also not free. Since Lucida tends to run larger and wider, the font samples had to be reduced to fit the column width.

Cambria Math:

$$\Delta\boldsymbol{E} - \frac{1}{c^2}\frac{\partial^2\boldsymbol{E}}{\partial t^2} = \frac{1}{\varepsilon_0}\boldsymbol{\nabla}\lambda + \mu_0\frac{\partial\boldsymbol{j}}{\partial t}$$

$$\Delta\boldsymbol{B} - \frac{1}{c^2}\frac{\partial^2\boldsymbol{B}}{\partial t^2} = -\mu_0\boldsymbol{\nabla}\times\boldsymbol{j}$$

$$\mathrm{i}\hbar\frac{\partial\psi}{\partial t} = \frac{1}{2m}\left(\frac{\hbar}{\mathrm{i}}\boldsymbol{\nabla} - q\boldsymbol{A}(\boldsymbol{r})\right)^2\psi + q\phi(\boldsymbol{r})\,\psi$$

$$\gamma^\alpha\left(\frac{\hbar}{\mathrm{i}}\partial_\alpha - qA_\alpha\right)\psi + m_0c\,\psi = 0$$

$$R^{\mu\nu} - \frac{1}{2}Rg^{\mu\nu} + \Lambda g^{\mu\nu} = -\frac{8\pi G}{c^2}M^{\mu\nu}$$

Lucida Bright Math (95%):

$$\Delta\boldsymbol{E} - \frac{1}{c^2}\frac{\partial^2\boldsymbol{E}}{\partial t^2} = \frac{1}{\varepsilon_0}\boldsymbol{\nabla}\lambda + \mu_0\frac{\partial\boldsymbol{j}}{\partial t}$$

$$\Delta\boldsymbol{B} - \frac{1}{c^2}\frac{\partial^2\boldsymbol{B}}{\partial t^2} = -\mu_0\boldsymbol{\nabla}\times\boldsymbol{j}$$

$$\mathrm{i}\hbar\frac{\partial\psi}{\partial t} = \frac{1}{2m}\left(\frac{\hbar}{\mathrm{i}}\boldsymbol{\nabla} - q\boldsymbol{A}(\boldsymbol{r})\right)^2\psi + q\phi(\boldsymbol{r})\,\psi$$

$$\gamma^\alpha\left(\frac{\hbar}{\mathrm{i}}\partial_\alpha - qA_\alpha\right)\psi + m_0c\,\psi = 0$$

$$R^{\mu\nu} - \frac{1}{2}Rg^{\mu\nu} + \Lambda g^{\mu\nu} = -\frac{8\pi G}{c^2}M^{\mu\nu}$$

Variants of traditional TEX fonts

This section shows samples for variants of traditional TEX fonts, derived from Computer Modern, such as Latin Modern [13], New Computer Modern [29], and Concrete Math [30]. It also includes font samples for Euler Math [31] using an upright style.

Latin Modern (regular):

$$\Delta\boldsymbol{E} - \frac{1}{c^2}\frac{\partial^2\boldsymbol{E}}{\partial t^2} = \frac{1}{\varepsilon_0}\boldsymbol{\nabla}\lambda + \mu_0\frac{\partial\boldsymbol{j}}{\partial t}$$

$$\Delta\boldsymbol{B} - \frac{1}{c^2}\frac{\partial^2\boldsymbol{B}}{\partial t^2} = -\mu_0\boldsymbol{\nabla}\times\boldsymbol{j}$$

$$\mathrm{i}\hbar\frac{\partial\psi}{\partial t} = \frac{1}{2m}\left(\frac{\hbar}{\mathrm{i}}\boldsymbol{\nabla} - q\boldsymbol{A}(\boldsymbol{r})\right)^2\psi + q\phi(\boldsymbol{r})\,\psi$$

$$\gamma^\alpha\left(\frac{\hbar}{\mathrm{i}}\partial_\alpha - qA_\alpha\right)\psi + m_0c\,\psi = 0$$

$$R^{\mu\nu} - \frac{1}{2}Rg^{\mu\nu} + \Lambda g^{\mu\nu} = -\frac{8\pi G}{c^2}M^{\mu\nu}$$

New Computer Modern (book):

$$\Delta\boldsymbol{E} - \frac{1}{c^2}\frac{\partial^2\boldsymbol{E}}{\partial t^2} = \frac{1}{\varepsilon_0}\boldsymbol{\nabla}\lambda + \mu_0\frac{\partial\boldsymbol{j}}{\partial t}$$

$$\Delta\boldsymbol{B} - \frac{1}{c^2}\frac{\partial^2\boldsymbol{B}}{\partial t^2} = -\mu_0\boldsymbol{\nabla}\times\boldsymbol{j}$$

$$\mathrm{i}\hbar\frac{\partial\psi}{\partial t} = \frac{1}{2m}\left(\frac{\hbar}{\mathrm{i}}\boldsymbol{\nabla} - q\boldsymbol{A}(\boldsymbol{r})\right)^2\psi + q\phi(\boldsymbol{r})\,\psi$$

$$\gamma^\alpha\left(\frac{\hbar}{\mathrm{i}}\partial_\alpha - qA_\alpha\right)\psi + m_0c\,\psi = 0$$

$$R^{\mu\nu} - \frac{1}{2}Rg^{\mu\nu} + \Lambda g^{\mu\nu} = -\frac{8\pi G}{c^2}M^{\mu\nu}$$

Concrete Math:

$$\Delta E - \frac{1}{c^2}\frac{\partial^2 E}{\partial t^2} = \frac{1}{\varepsilon_0}\nabla\lambda + \mu_0\frac{\partial j}{\partial t}$$

$$\Delta B - \frac{1}{c^2}\frac{\partial^2 B}{\partial t^2} = -\mu_0\nabla\times j$$

$$\mathrm{i}\hbar\frac{\partial\psi}{\partial t} = \frac{1}{2m}\left(\frac{\hbar}{\mathrm{i}}\nabla - q\boldsymbol{A}(\boldsymbol{r})\right)^2\psi + q\phi(\boldsymbol{r})\,\psi$$

$$\gamma^\alpha\left(\frac{\hbar}{\mathrm{i}}\partial_\alpha - qA_\alpha\right)\psi + m_0c\,\psi = 0$$

$$R^{\mu\nu} - \frac{1}{2}Rg^{\mu\nu} + \Lambda g^{\mu\nu} = -\frac{8\pi G}{c^2}M^{\mu\nu}$$

Euler Math:

$$\Delta\mathrm{E} - \frac{1}{\mathrm{c}^2}\frac{\partial^2\mathrm{E}}{\partial \mathrm{t}^2} = \frac{1}{\varepsilon_0}\boldsymbol{\nabla}\lambda + \mu_0\frac{\partial\mathrm{j}}{\partial \mathrm{t}}$$

$$\Delta\mathbf{B} - \frac{1}{\mathrm{c}^2}\frac{\partial^2\mathbf{B}}{\partial \mathrm{t}^2} = -\mu_0\boldsymbol{\nabla}\times\mathrm{j}$$

$$\mathrm{i}\hbar\frac{\partial\psi}{\partial \mathrm{t}} = \frac{1}{2\mathrm{m}}\left(\frac{\hbar}{\mathrm{i}}\boldsymbol{\nabla} - \mathrm{q}\mathbf{A}(\mathbf{r})\right)^2\psi + \mathrm{q}\phi(\mathbf{r})\,\psi$$

$$\gamma^\alpha\left(\frac{\hbar}{\mathrm{i}}\partial_\alpha - \mathrm{q}\mathrm{A}_\alpha\right)\psi + \mathrm{m}_0\mathrm{c}\,\psi = 0$$

$$\mathrm{R}^{\mu\nu} - \frac{1}{2}\mathrm{R}\mathrm{g}^{\mu\nu} + \Lambda \mathrm{g}^{\mu\nu} = -\frac{8\pi \mathrm{G}}{\mathrm{c}^2}\mathrm{M}^{\mu\nu}$$

Variants of fonts derived from Times

This section shows samples of variants of traditional PostScript fonts derived from Times, such as TEX Gyre Termes [14], XITS (based on STIX 1.0) [10], and STIX Two [12].

While TEX Gyre and XITS follow the traditional look of Times, STIX Two includes a comprehensive redesign of the letter shapes for improved readability, which looks clearly different.

Further information about the redesign can be found in the package documentation, but it should be clear that STIX Two has been much improved, although it deviates from the traditional look.

TEX Gyre Termes:

$$\Delta\boldsymbol{E} - \frac{1}{c^2}\frac{\partial^2\boldsymbol{E}}{\partial t^2} = \frac{1}{\varepsilon_0}\boldsymbol{\nabla}\lambda + \mu_0\frac{\partial\boldsymbol{j}}{\partial t}$$

$$\Delta\boldsymbol{B} - \frac{1}{c^2}\frac{\partial^2\boldsymbol{B}}{\partial t^2} = -\mu_0\boldsymbol{\nabla}\times\boldsymbol{j}$$

$$\mathrm{i}\hbar\frac{\partial\psi}{\partial t} = \frac{1}{2m}\left(\frac{\hbar}{\mathrm{i}}\boldsymbol{\nabla} - q\boldsymbol{A}(\boldsymbol{r})\right)^2\psi + q\phi(\boldsymbol{r})\,\psi$$

$$\gamma^\alpha\left(\frac{\hbar}{\mathrm{i}}\partial_\alpha - qA_\alpha\right)\psi + m_0c\,\psi = 0$$

$$R^{\mu\nu} - \frac{1}{2}Rg^{\mu\nu} + \Lambda g^{\mu\nu} = -\frac{8\pi G}{c^2}M^{\mu\nu}$$

XITS (based on STIX 1.0):

$$\Delta\boldsymbol{E} - \frac{1}{c^2}\frac{\partial^2\boldsymbol{E}}{\partial t^2} = \frac{1}{\varepsilon_0}\boldsymbol{\nabla}\lambda + \mu_0\frac{\partial\boldsymbol{j}}{\partial t}$$

$$\Delta\boldsymbol{B} - \frac{1}{c^2}\frac{\partial^2\boldsymbol{B}}{\partial t^2} = -\mu_0\boldsymbol{\nabla}\times\boldsymbol{j}$$

$$\mathrm{i}\hbar\frac{\partial\psi}{\partial t} = \frac{1}{2m}\left(\frac{\hbar}{\mathrm{i}}\boldsymbol{\nabla} - q\boldsymbol{A}(\boldsymbol{r})\right)^2\psi + q\phi(\boldsymbol{r})\,\psi$$

$$\gamma^\alpha\left(\frac{\hbar}{\mathrm{i}}\partial_\alpha - qA_\alpha\right)\psi + m_0c\,\psi = 0$$

$$R^{\mu\nu} - \frac{1}{2}Rg^{\mu\nu} + \Lambda g^{\mu\nu} = -\frac{8\pi G}{c^2}M^{\mu\nu}$$

STIX Two:

$$\Delta\boldsymbol{E} - \frac{1}{c^2}\frac{\partial^2\boldsymbol{E}}{\partial t^2} = \frac{1}{\varepsilon_0}\boldsymbol{\nabla}\lambda + \mu_0\frac{\partial\boldsymbol{j}}{\partial t}$$

$$\Delta\boldsymbol{B} - \frac{1}{c^2}\frac{\partial^2\boldsymbol{B}}{\partial t^2} = -\mu_0\boldsymbol{\nabla}\times\boldsymbol{j}$$

$$\mathrm{i}\hbar\frac{\partial\psi}{\partial t} = \frac{1}{2m}\left(\frac{\hbar}{\mathrm{i}}\boldsymbol{\nabla} - q\boldsymbol{A}(\boldsymbol{r})\right)^2\psi + q\phi(\boldsymbol{r})\,\psi$$

$$\gamma^\alpha\left(\frac{\hbar}{\mathrm{i}}\partial_\alpha - qA_\alpha\right)\psi + m_0c\,\psi = 0$$

$$R^{\mu\nu} - \frac{1}{2}Rg^{\mu\nu} + \Lambda g^{\mu\nu} = -\frac{8\pi G}{c^2}M^{\mu\nu}$$

Variants of fonts derived from Palatino

This section shows samples of variants of traditional PostScript fonts derived from Palatino, such as TEX Gyre Pagella [14], KpRoman [22] derived from URW Palladio, and Asana Math [9].

While the letter shapes should be expected to be similar, there are significant differences in the design, sizing, and spacing of delimiters, and also in the placement of superscripts and subscripts.

Besides the differences in quality, KpFonts also provides a choice of additional weights, but only the regular version is shown here for comparison.

TEX Gyre Pagella:

$$\Delta\boldsymbol{E} - \frac{1}{c^2}\frac{\partial^2\boldsymbol{E}}{\partial t^2} = \frac{1}{\varepsilon_0}\boldsymbol{\nabla}\lambda + \mu_0\frac{\partial\boldsymbol{j}}{\partial t}$$

$$\Delta\boldsymbol{B} - \frac{1}{c^2}\frac{\partial^2\boldsymbol{B}}{\partial t^2} = -\mu_0\boldsymbol{\nabla}\times\boldsymbol{j}$$

$$\mathrm{i}\hbar\frac{\partial\psi}{\partial t} = \frac{1}{2m}\left(\frac{\hbar}{\mathrm{i}}\boldsymbol{\nabla} - q\boldsymbol{A}(\boldsymbol{r})\right)^2\psi + q\phi(\boldsymbol{r})\,\psi$$

$$\gamma^\alpha\left(\frac{\hbar}{\mathrm{i}}\partial_\alpha - qA_\alpha\right)\psi + m_0c\,\psi = 0$$

$$R^{\mu\nu} - \frac{1}{2}Rg^{\mu\nu} + \Lambda g^{\mu\nu} = -\frac{8\pi G}{c^2}M^{\mu\nu}$$

KpRoman Math (regular):

$$\Delta\boldsymbol{E} - \frac{1}{c^2}\frac{\partial^2\boldsymbol{E}}{\partial t^2} = \frac{1}{\varepsilon_0}\boldsymbol{\nabla}\lambda + \mu_0\frac{\partial\boldsymbol{j}}{\partial t}$$

$$\Delta\boldsymbol{B} - \frac{1}{c^2}\frac{\partial^2\boldsymbol{B}}{\partial t^2} = -\mu_0\boldsymbol{\nabla}\times\boldsymbol{j}$$

$$\mathrm{i}\hbar\frac{\partial\psi}{\partial t} = \frac{1}{2m}\left(\frac{\hbar}{\mathrm{i}}\boldsymbol{\nabla} - q\boldsymbol{A}(\boldsymbol{r})\right)^2\psi + q\phi(\boldsymbol{r})\,\psi$$

$$\gamma^\alpha\left(\frac{\hbar}{\mathrm{i}}\partial_\alpha - qA_\alpha\right)\psi + m_0c\,\psi = 0$$

$$R^{\mu\nu} - \frac{1}{2}Rg^{\mu\nu} + \Lambda g^{\mu\nu} = -\frac{8\pi G}{c^2}M^{\mu\nu}$$

Asana Math:

$$\Delta\boldsymbol{E} - \frac{1}{c^2}\frac{\partial^2\boldsymbol{E}}{\partial t^2} = \frac{1}{\varepsilon_0}\boldsymbol{\nabla}\lambda + \mu_0\frac{\partial\boldsymbol{j}}{\partial t}$$

$$\Delta\boldsymbol{B} - \frac{1}{c^2}\frac{\partial^2\boldsymbol{B}}{\partial t^2} = -\mu_0\boldsymbol{\nabla}\times\boldsymbol{j}$$

$$\mathrm{i}\hbar\frac{\partial\psi}{\partial t} = \frac{1}{2m}\left(\frac{\hbar}{\mathrm{i}}\boldsymbol{\nabla} - q\boldsymbol{A}(\boldsymbol{r})\right)^2\psi + q\phi(\boldsymbol{r})\,\psi$$

$$\gamma^\alpha\left(\frac{\hbar}{\mathrm{i}}\partial_\alpha - qA_\alpha\right)\psi + m_0c\,\psi = 0$$

$$R^{\mu\nu} - \frac{1}{2}Rg^{\mu\nu} + \Lambda g^{\mu\nu} = -\frac{8\pi G}{c^2}M^{\mu\nu}$$

Other choices of serif fonts

This section shows font samples of other serif fonts, derived from traditional PostScript fonts or other freely available fonts. These include several of the TeX Gyre fonts [14], such as Schola, Bonum, and DejaVu, as well as other fonts such as Libertinus [18], Garamond Math [19], Erewhon, and XCharter Math [20, 21].

Since the Schola, Bonum, DejaVu and XCharter designs tend to run larger and wider, several font samples had to be reduced to fit the column width.

Along with the scaling also comes a reduction in height, which may not always be desirable.

TeX Gyre Schola (95%):

$$\Delta\boldsymbol{E} - \frac{1}{c^2}\frac{\partial^2\boldsymbol{E}}{\partial t^2} = \frac{1}{\varepsilon_0}\boldsymbol{\nabla}\lambda + \mu_0\frac{\partial\boldsymbol{j}}{\partial t}$$

$$\Delta\boldsymbol{B} - \frac{1}{c^2}\frac{\partial^2\boldsymbol{B}}{\partial t^2} = -\mu_0\boldsymbol{\nabla}\times\boldsymbol{j}$$

$$\mathrm{i}\hbar\frac{\partial\psi}{\partial t} = \frac{1}{2m}\left(\frac{\hbar}{\mathrm{i}}\boldsymbol{\nabla} - q\boldsymbol{A}(\boldsymbol{r})\right)^2\psi + q\phi(\boldsymbol{r})\,\psi$$

$$\gamma^\alpha\left(\frac{\hbar}{\mathrm{i}}\partial_\alpha - qA_\alpha\right)\psi + m_0c\,\psi = 0$$

$$R^{\mu\nu} - \frac{1}{2}Rg^{\mu\nu} + \Lambda g^{\mu\nu} = -\frac{8\pi G}{c^2}M^{\mu\nu}$$

TeX Gyre Bonum (95%):

$$\Delta\boldsymbol{E} - \frac{1}{c^2}\frac{\partial^2\boldsymbol{E}}{\partial t^2} = \frac{1}{\varepsilon_0}\boldsymbol{\nabla}\lambda + \mu_0\frac{\partial\boldsymbol{j}}{\partial t}$$

$$\Delta\boldsymbol{B} - \frac{1}{c^2}\frac{\partial^2\boldsymbol{B}}{\partial t^2} = -\mu_0\boldsymbol{\nabla}\times\boldsymbol{j}$$

$$\mathrm{i}\hbar\frac{\partial\psi}{\partial t} = \frac{1}{2m}\left(\frac{\hbar}{\mathrm{i}}\boldsymbol{\nabla} - q\boldsymbol{A}(\boldsymbol{r})\right)^2\psi + q\phi(\boldsymbol{r})\,\psi$$

$$\gamma^\alpha\left(\frac{\hbar}{\mathrm{i}}\partial_\alpha - qA_\alpha\right)\psi + m_0c\,\psi = 0$$

$$R^{\mu\nu} - \frac{1}{2}Rg^{\mu\nu} + \Lambda g^{\mu\nu} = -\frac{8\pi G}{c^2}M^{\mu\nu}$$

TeX Gyre DejaVu (95%):

$$\Delta\boldsymbol{E} - \frac{1}{c^2}\frac{\partial^2\boldsymbol{E}}{\partial t^2} = \frac{1}{\varepsilon_0}\boldsymbol{\nabla}\lambda + \mu_0\frac{\partial\boldsymbol{j}}{\partial t}$$

$$\Delta\boldsymbol{B} - \frac{1}{c^2}\frac{\partial^2\boldsymbol{B}}{\partial t^2} = -\mu_0\boldsymbol{\nabla}\times\boldsymbol{j}$$

$$\mathrm{i}\hbar\frac{\partial\psi}{\partial t} = \frac{1}{2m}\left(\frac{\hbar}{\mathrm{i}}\boldsymbol{\nabla} - q\boldsymbol{A}(\boldsymbol{r})\right)^2\psi + q\phi(\boldsymbol{r})\,\psi$$

$$\gamma^\alpha\left(\frac{\hbar}{\mathrm{i}}\partial_\alpha - qA_\alpha\right)\psi + m_0c\,\psi = 0$$

$$R^{\mu\nu} - \frac{1}{2}Rg^{\mu\nu} + \Lambda g^{\mu\nu} = -\frac{8\pi G}{c^2}M^{\mu\nu}$$

Libertinus Math:

$$\Delta\boldsymbol{E} - \frac{1}{c^2}\frac{\partial^2\boldsymbol{E}}{\partial t^2} = \frac{1}{\varepsilon_0}\boldsymbol{\nabla}\lambda + \mu_0\frac{\partial\boldsymbol{j}}{\partial t}$$

$$\Delta\boldsymbol{B} - \frac{1}{c^2}\frac{\partial^2\boldsymbol{B}}{\partial t^2} = -\mu_0\boldsymbol{\nabla}\times\boldsymbol{j}$$

$$\mathrm{i}\hbar\frac{\partial\psi}{\partial t} = \frac{1}{2m}\left(\frac{\hbar}{\mathrm{i}}\boldsymbol{\nabla} - q\boldsymbol{A}(\boldsymbol{r})\right)^2\psi + q\phi(\boldsymbol{r})\,\psi$$

$$\gamma^\alpha\left(\frac{\hbar}{\mathrm{i}}\partial_\alpha - qA_\alpha\right)\psi + m_0c\,\psi = 0$$

$$R^{\mu\nu} - \frac{1}{2}Rg^{\mu\nu} + \Lambda g^{\mu\nu} = -\frac{8\pi G}{c^2}M^{\mu\nu}$$

Garamond Math:

$$\Delta\boldsymbol{E} - \frac{1}{c^2}\frac{\partial^2\boldsymbol{E}}{\partial t^2} = \frac{1}{\varepsilon_0}\boldsymbol{\nabla}\lambda + \mu_0\frac{\partial\boldsymbol{j}}{\partial t}$$

$$\Delta\boldsymbol{B} - \frac{1}{c^2}\frac{\partial^2\boldsymbol{B}}{\partial t^2} = -\mu_0\boldsymbol{\nabla}\times\boldsymbol{j}$$

$$\mathrm{i}\hbar\frac{\partial\psi}{\partial t} = \frac{1}{2m}\left(\frac{\hbar}{\mathrm{i}}\boldsymbol{\nabla} - q\boldsymbol{A}(\boldsymbol{r})\right)^2\psi + q\phi(\boldsymbol{r})\,\psi$$

$$\gamma^\alpha\left(\frac{\hbar}{\mathrm{i}}\partial_\alpha - qA_\alpha\right)\psi + m_0c\,\psi = 0$$

$$R^{\mu\nu} - \frac{1}{2}Rg^{\mu\nu} + \Lambda g^{\mu\nu} = -\frac{8\pi G}{c^2}M^{\mu\nu}$$

Erewhon Math (Utopia):

$$\Delta\boldsymbol{E} - \frac{1}{c^2}\frac{\partial^2\boldsymbol{E}}{\partial t^2} = \frac{1}{\varepsilon_0}\boldsymbol{\nabla}\lambda + \mu_0\frac{\partial\boldsymbol{j}}{\partial t}$$

$$\Delta\boldsymbol{B} - \frac{1}{c^2}\frac{\partial^2\boldsymbol{B}}{\partial t^2} = -\mu_0\boldsymbol{\nabla}\times\boldsymbol{j}$$

$$\mathrm{i}\hbar\frac{\partial\psi}{\partial t} = \frac{1}{2m}\left(\frac{\hbar}{\mathrm{i}}\boldsymbol{\nabla} - q\boldsymbol{A}(\boldsymbol{r})\right)^2\psi + q\phi(\boldsymbol{r})\,\psi$$

$$\gamma^\alpha\left(\frac{\hbar}{\mathrm{i}}\partial_\alpha - qA_\alpha\right)\psi + m_0c\,\psi = 0$$

$$R^{\mu\nu} - \frac{1}{2}Rg^{\mu\nu} + \Lambda g^{\mu\nu} = -\frac{8\pi G}{c^2}M^{\mu\nu}$$

XCharter Math (95%):

$$\Delta\boldsymbol{E} - \frac{1}{c^2}\frac{\partial^2\boldsymbol{E}}{\partial t^2} = \frac{1}{\varepsilon_0}\boldsymbol{\nabla}\lambda + \mu_0\frac{\partial\boldsymbol{j}}{\partial t}$$

$$\Delta\boldsymbol{B} - \frac{1}{c^2}\frac{\partial^2\boldsymbol{B}}{\partial t^2} = -\mu_0\boldsymbol{\nabla}\times\boldsymbol{j}$$

$$\mathrm{i}\hbar\frac{\partial\psi}{\partial t} = \frac{1}{2m}\left(\frac{\hbar}{\mathrm{i}}\boldsymbol{\nabla} - q\boldsymbol{A}(\boldsymbol{r})\right)^2\psi + q\phi(\boldsymbol{r})\,\psi$$

$$\gamma^\alpha\left(\frac{\hbar}{\mathrm{i}}\partial_\alpha - qA_\alpha\right)\psi + m_0c\,\psi = 0$$

$$R^{\mu\nu} - \frac{1}{2}Rg^{\mu\nu} + \Lambda g^{\mu\nu} = -\frac{8\pi G}{c^2}M^{\mu\nu}$$

Choices of sans-serif fonts

This section shows font samples of sans-serif fonts, derived from freely available fonts. These include KpSans [22], Neohellenic Math [23], Fira Math [24], Lato Math [25] (unsupported), and Noto Math [27]. Unfortunately, it isn't known which sans-serif design was chosen in the KpFonts distribution or from where it originates.

At the moment, Noto Math uses an inconsistent setup of sans-serif and serif alphabets, which has been partially corrected by substitutions in the example, but this isn't always possible.

KpSans Math:

$$\Delta E - \frac{1}{c^2}\frac{\partial^2 \boldsymbol{E}}{\partial t^2} = \frac{1}{\varepsilon_0}\nabla\lambda + \mu_0\frac{\partial \boldsymbol{j}}{\partial t}$$

$$\Delta B - \frac{1}{c^2}\frac{\partial^2 B}{\partial t^2} = -\mu_0\nabla \times \boldsymbol{j}$$

$$\mathrm{i}\hbar\frac{\partial\psi}{\partial t} = \frac{1}{2m}\left(\frac{\hbar}{\mathrm{i}}\boldsymbol{\nabla} - qA(\boldsymbol{r})\right)^2\psi + q\phi(\boldsymbol{r})\,\psi$$

$$\gamma^\alpha\left(\frac{\hbar}{\mathrm{i}}\partial_\alpha - qA_\alpha\right)\psi + m_0c\,\psi = 0$$

$$R^{\mu\nu} - \frac{1}{2}Rg^{\mu\nu} + \Lambda g^{\mu\nu} = -\frac{8\pi G}{c^2}M^{\mu\nu}$$

Neohellenic Math:

$$\Delta \boldsymbol{E} - \frac{1}{c^2}\frac{\partial^2 \boldsymbol{E}}{\partial t^2} = \frac{1}{\varepsilon_0}\boldsymbol{\nabla}\lambda + \mu_0\frac{\partial \boldsymbol{j}}{\partial t}$$

$$\Delta \boldsymbol{B} - \frac{1}{c^2}\frac{\partial^2 \boldsymbol{B}}{\partial t^2} = -\mu_0\boldsymbol{\nabla} \times \boldsymbol{j}$$

$$\mathrm{i}\hbar\frac{\partial\psi}{\partial t} = \frac{1}{2m}\left(\frac{\hbar}{\mathrm{i}}\boldsymbol{\nabla} - q\boldsymbol{A}(\boldsymbol{r})\right)^2\psi + q\phi(\boldsymbol{r})\,\psi$$

$$\gamma^\alpha\left(\frac{\hbar}{\mathrm{i}}\partial_\alpha - qA_\alpha\right)\psi + m_0c\,\psi = 0$$

$$R^{\mu\nu} - \frac{1}{2}Rg^{\mu\nu} + \Lambda g^{\mu\nu} = -\frac{8\pi G}{c^2}M^{\mu\nu}$$

Lato Math:

$$\Delta \boldsymbol{E} - \frac{1}{c^2}\frac{\partial^2 \boldsymbol{E}}{\partial t^2} = \frac{1}{\varepsilon_0}\boldsymbol{\nabla}\lambda + \mu_0\frac{\partial \boldsymbol{j}}{\partial t}$$

$$\Delta \boldsymbol{B} - \frac{1}{c^2}\frac{\partial^2 \boldsymbol{B}}{\partial t^2} = -\mu_0\boldsymbol{\nabla} \times \boldsymbol{j}$$

$$\mathrm{i}\hbar\frac{\partial\psi}{\partial t} = \frac{1}{2m}\left(\frac{\hbar}{\mathrm{i}}\boldsymbol{\nabla} - q\boldsymbol{A}(\boldsymbol{r})\right)^2\psi + q\phi(\boldsymbol{r})\,\psi$$

$$\gamma^\alpha\left(\frac{\hbar}{\mathrm{i}}\partial_\alpha - qA_\alpha\right)\psi + m_0c\,\psi = 0$$

$$R^{\mu\nu} - \frac{1}{2}Rg^{\mu\nu} + \Lambda g^{\mu\nu} = -\frac{8\pi G}{c^2}M^{\mu\nu}$$

Fira Math:

$$\Delta \boldsymbol{E} - \frac{1}{c^2}\frac{\partial^2 \boldsymbol{E}}{\partial t^2} = \frac{1}{\varepsilon_0}\boldsymbol{\nabla}\lambda + \mu_0\frac{\partial \boldsymbol{j}}{\partial t}$$

$$\Delta \boldsymbol{B} - \frac{1}{c^2}\frac{\partial^2 \boldsymbol{B}}{\partial t^2} = -\mu_0\boldsymbol{\nabla} \times \boldsymbol{j}$$

$$\mathrm{i}\hbar\frac{\partial\psi}{\partial t} = \frac{1}{2m}\left(\frac{\hbar}{\mathrm{i}}\boldsymbol{\nabla} - q\boldsymbol{A}(\boldsymbol{r})\right)^2\psi + q\phi(\boldsymbol{r})\,\psi$$

$$\gamma^\alpha\left(\frac{\hbar}{\mathrm{i}}\partial_\alpha - qA_\alpha\right)\psi + m_0c\,\psi = 0$$

$$R^{\mu\nu} - \frac{1}{2}Rg^{\mu\nu} + \Lambda g^{\mu\nu} = -\frac{8\pi G}{c^2}M^{\mu\nu}$$

Noto Math:

$$\Delta \boldsymbol{E} - \frac{1}{c^2}\frac{\partial^2 \boldsymbol{E}}{\partial t^2} = \frac{1}{\varepsilon_0}\boldsymbol{\nabla}\lambda + \mu_0\frac{\partial \boldsymbol{j}}{\partial t}$$

$$\Delta \boldsymbol{B} - \frac{1}{c^2}\frac{\partial^2 \boldsymbol{B}}{\partial t^2} = -\mu_0\boldsymbol{\nabla} \times \boldsymbol{j}$$

$$\mathrm{i}\hbar\frac{\partial\psi}{\partial t} = \frac{1}{2m}\left(\frac{\hbar}{\mathrm{i}}\boldsymbol{\nabla} - q\boldsymbol{A}(\boldsymbol{r})\right)^2\psi + q\phi(\boldsymbol{r})\,\psi$$

$$\gamma^\alpha\left(\frac{\hbar}{\mathrm{i}}\partial_\alpha - qA_\alpha\right)\psi + m_0c\,\psi = 0$$

$$R^{\mu\nu} - \frac{1}{2}Rg^{\mu\nu} + \Lambda g^{\mu\nu} = -\frac{8\pi G}{c^2}M^{\mu\nu}$$