Mathoid
Robust, Scalable, Fast and Accessible Math Rendering for Wikipedia

Moritz Schubotz and

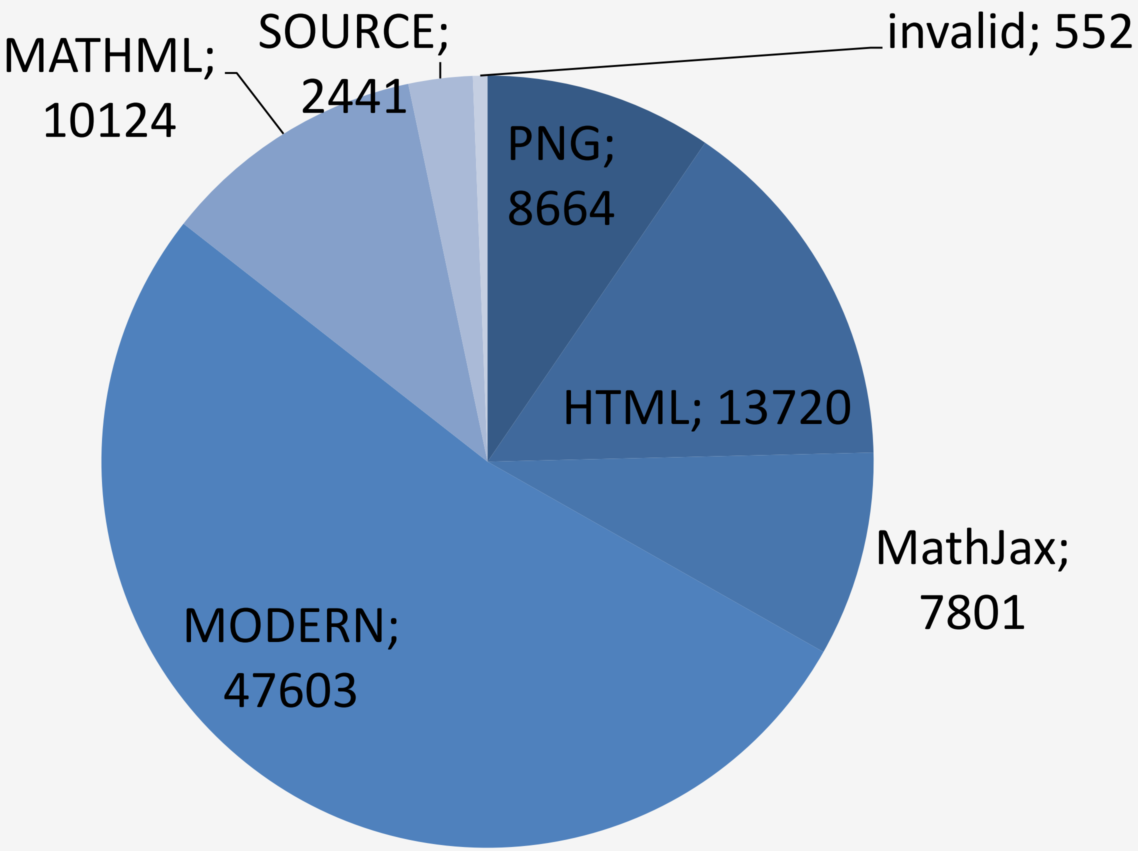
Gabriel Wicke

$$E = mc^2 \quad E = mc^2$$

History of Math and Wikipedia

- Math support since 2003
- 10-2010 Client side MathJax support
- 11-2011 MathML setting is removed
- 10-2013 Mathoid implementation ready
- 06-2014 Majority of the new code is reviewed

The users preferences



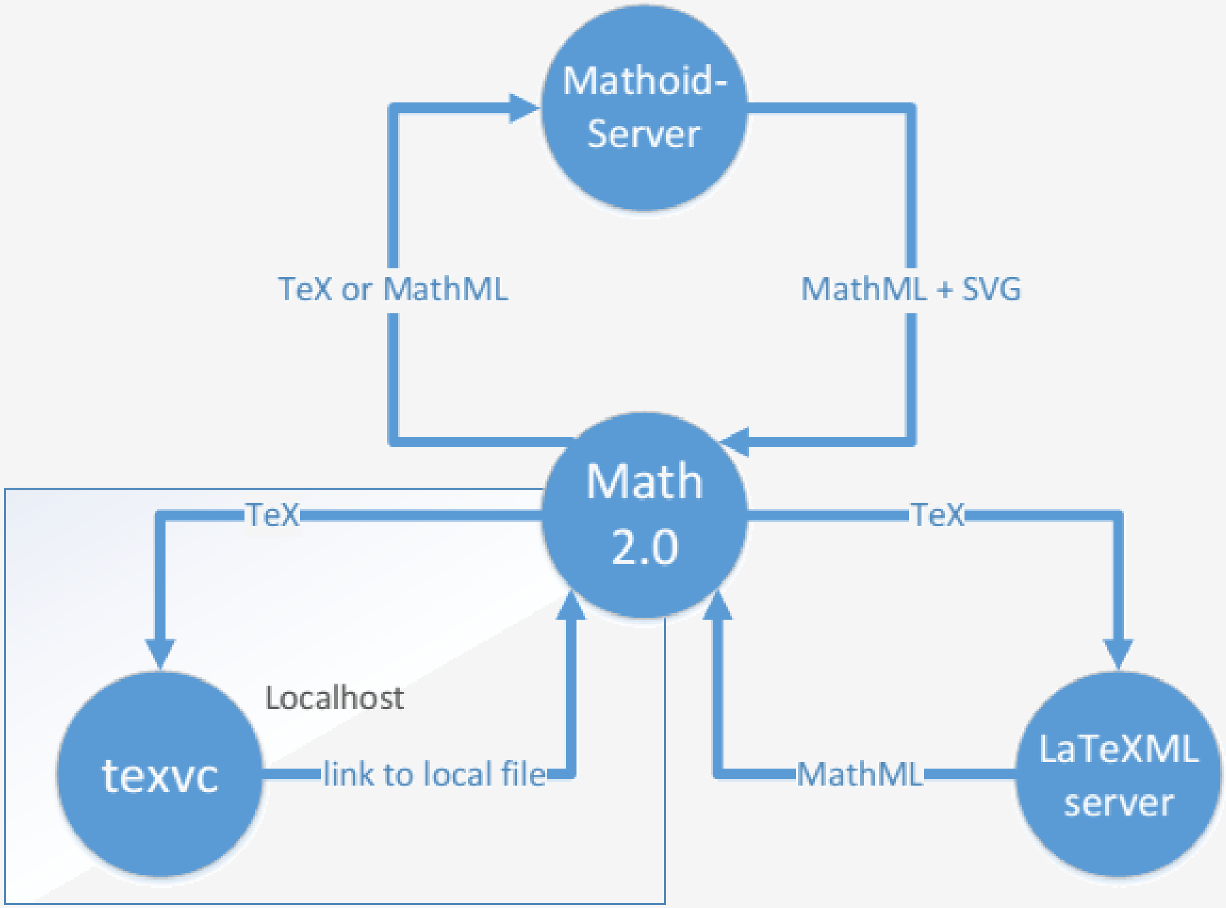
Bringing MathML to Wikipedia

- Dimensions
  - Coverage
  - Speed
  - Robustness
  - Maintainability
  - Accessibility

Browser support

- MathML support in Firefox
- No MathML support in Chrome
- Fallback SVG images

Mathoid



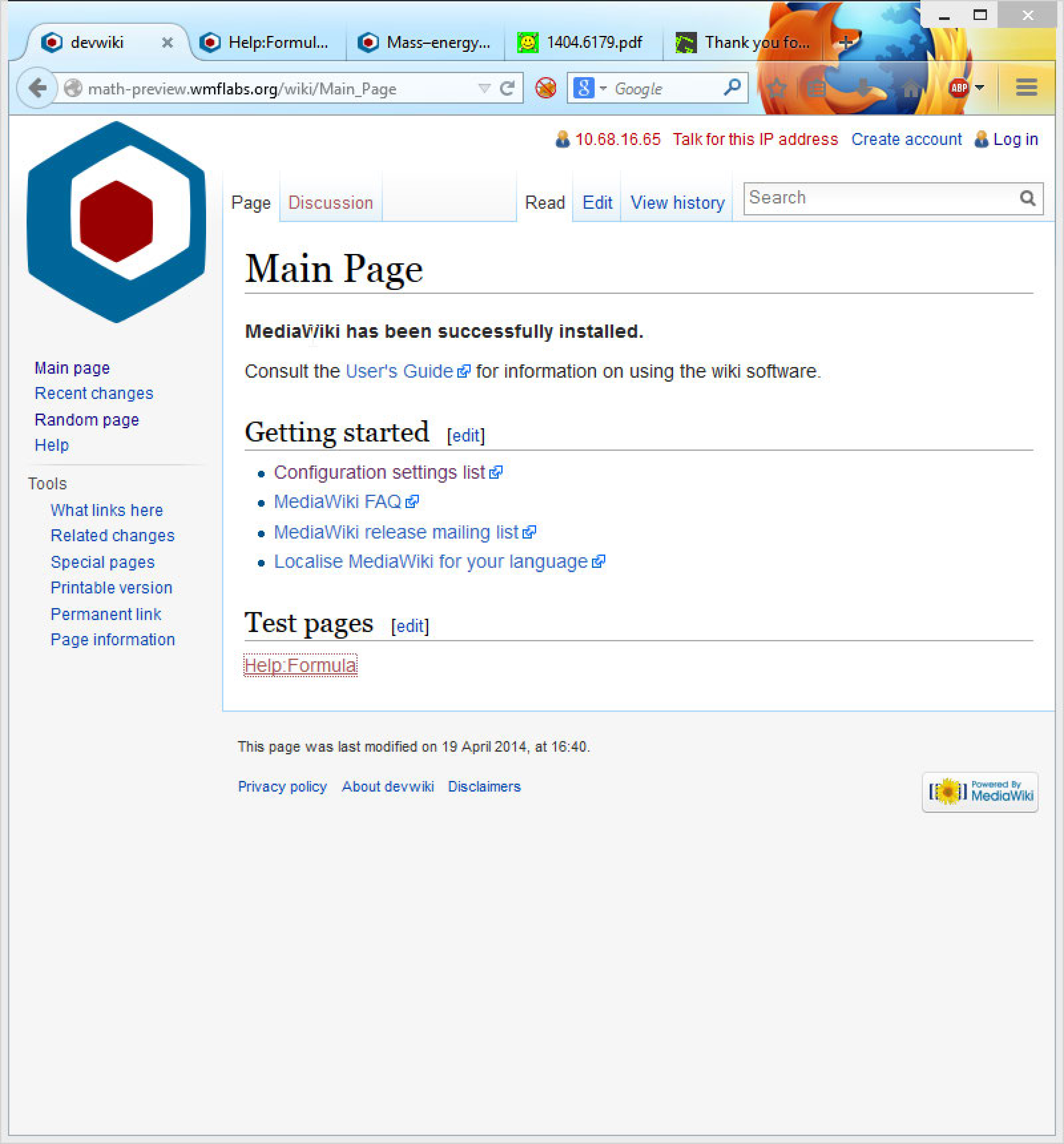
Mathoid-
Server
TeX or MathML
MathML + SVG
Math
2.0
TeX
TeX
Localhost
texvc
link to local file
MathML
LaTeXML
server

Wikipedia Dataset

- Wikipedia (en) 446 485 formulae (27 671 pages)
  - ~280k distinct formula
  - ~3GB formulae (presentation + content markup)
  - Generation on workstation 150MB source data

Comparison of rendering methods

	texvc	LaTeXML	Mathoid
relative speed	1	0.3	5
image output	PNG	PNG	SVG
presentation MathML coverage	low	high	high
content MathML output	no	no	yes
webservice	no	yes	yes
approximate space required on webserver	1GB	0	0
language	OCaml	Perl	JavaScript
maintained by	nobody	NIST	MathJax



Main Page

MediaWiki has been successfully installed.

Consult the User's Guide for information on using the wiki software.

Getting started [edit]

- Configuration settings list
- MediaWiki FAQ
- MediaWiki release mailing list
- Localise MediaWiki for your language

Test pages [edit]

Help:Formula

This page was last modified on 19 April 2014, at 16:40.

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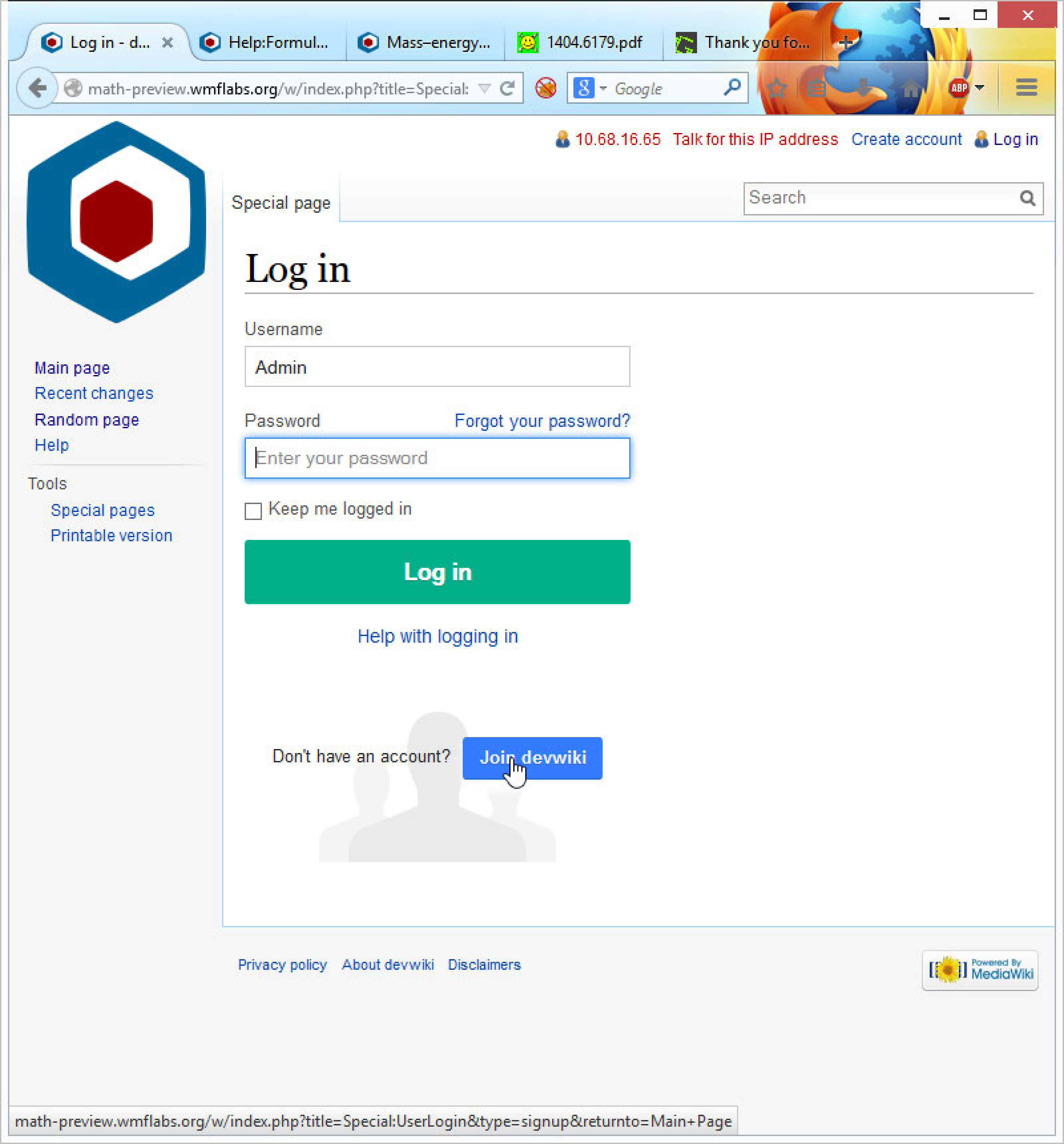
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Enter your password
Keep me logged in
Log in
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Recent changes
Random page
Help
Tools
Special pages
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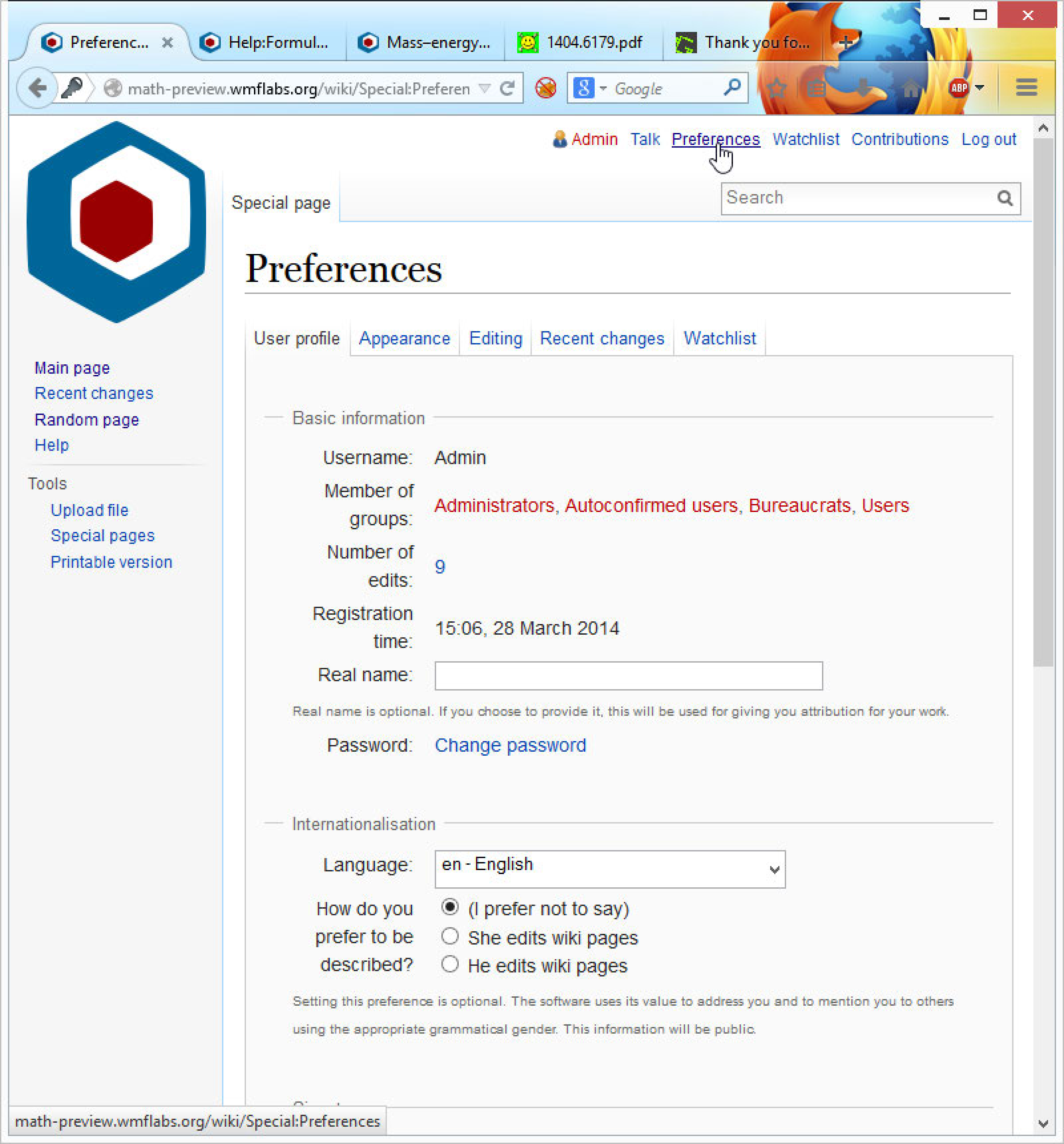
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Help
Tools
Upload file
Special pages
Printable version
Basic information
Username: Admin
Member of groups: Administrators, Autoconfirmed users, Bureaucrats, Users
Number of edits: 9
Registration time: 15:06, 28 March 2014
Real name:
Real name is optional. If you choose to provide it, this will be used for giving you attribution for your work.
Password: Change password
Internationalisation
Language: en - English
How do you prefer to be described?
(I prefer not to say)
She edits wiki pages
He edits wiki pages
Setting this preference is optional. The software uses its value to address you and to mention you to others using the appropriate grammatical gender. This information will be public.
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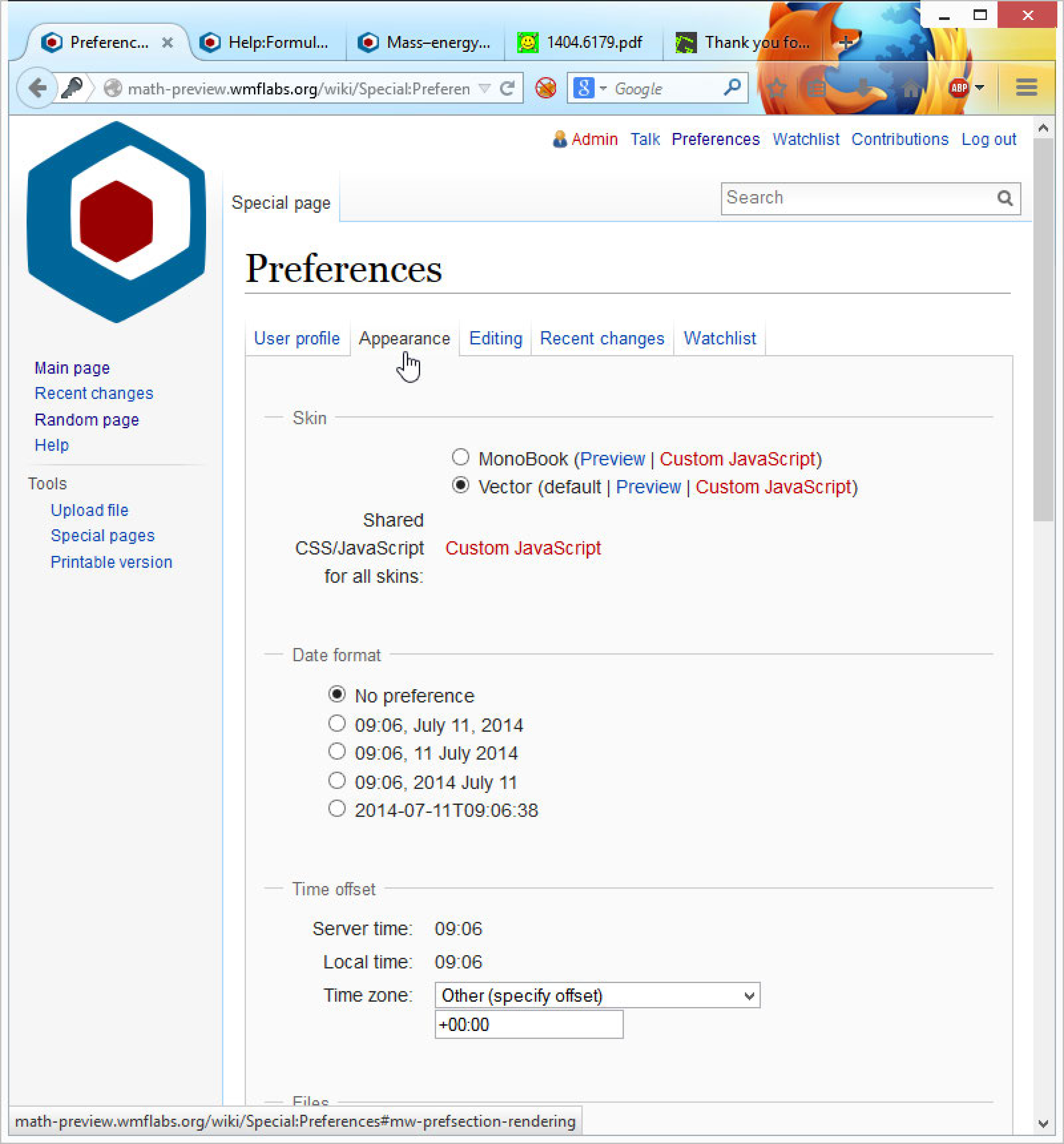
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Main page
Recent changes
Random page
Help
Tools
Upload file
Special pages
Printable version
Skin
MonoBook (Preview | Custom JavaScript)
Vector (default | Preview | Custom JavaScript)
Shared CSS/JavaScript for all skins:
Custom JavaScript
Date format
No preference
09:06, July 11, 2014
09:06, 11 July 2014
09:06, 2014 July 11
2014-07-11T09:06:38
Time offset
Server time: 09:06
Local time: 09:06
Time zone: Other (specify offset)
+00:00
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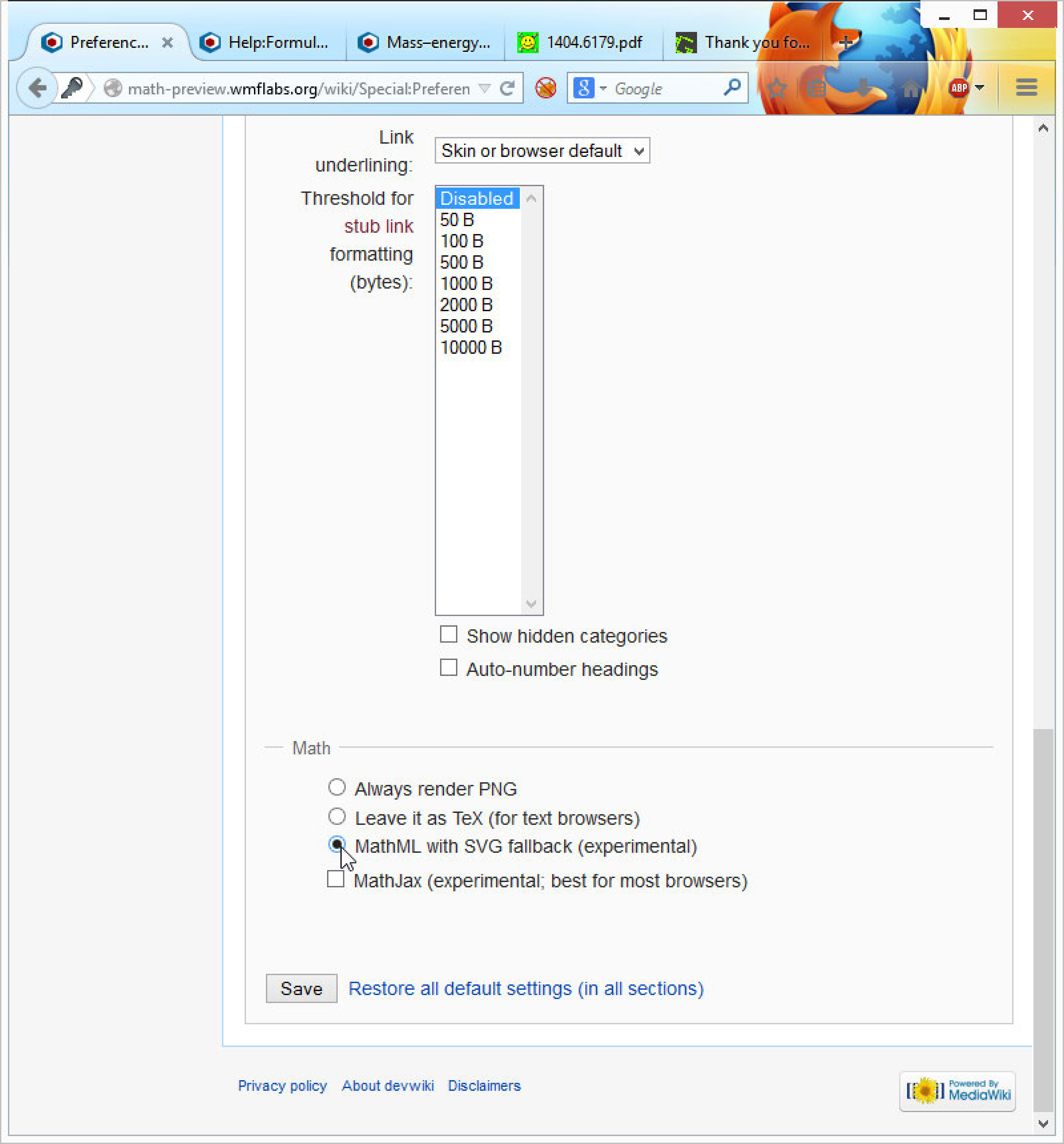
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Math
Always render PNG
Leave it as TeX (for text browsers)
MathML with SVG fallback (experimental)
MathJax (experimental; best for most browsers)
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Mass–energy equivalence

Template:Redirect

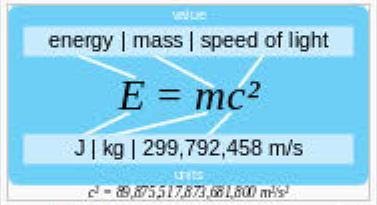
Template:Special relativity

4-meter-tall sculpture of Einstein's 1905 $E = mc^2$ formula at the 2006 Walk of Ideas, Berlin, Germany.

In physics, **mass–energy equivalence** is the concept that the mass of an object or system is a measure of its energy content. For instance, adding 25 kilowatt-hours (90 megajoules) of *any* form(s) of energy to any object increases its mass by 1 microgram.

A physical system has a property called energy and a corresponding property called mass; the two properties are equivalent in that they are always both present in the same (i.e. constant) proportion to one another. Mass–energy equivalence arose originally from special relativity, as developed by Albert Einstein, who proposed this equivalence in 1905 in one of his *Annus Mirabilis* papers entitled "Does the inertia of an object depend upon its energy content?"<ref name="inertia">Template:Citation. See also the English translation.</ref> The equivalence is described by the famous equation:

$$E = mc^2$$



Explication

where E is energy, m is mass, and c is the speed of light. Thus, this mass–energy relation states that the universal proportionality factor between equivalent amounts of energy and mass is equal to the speed of light squared. This also serves to convert units of mass to units of energy, no matter what system of measurement units is used.

If a body is stationary, it still has some internal or intrinsic energy, called its rest energy. Rest mass and rest energy are equivalent and remain proportional to one another. When the body is in motion (relative to an observer), its total energy is greater than its rest energy. The rest mass (or rest energy) remains an important quantity in this case because it remains the same regardless of this motion, even for the extreme speeds or gravity considered in special and general relativity; thus it is also called the invariant mass.

On the one hand, the equation Template:Nowrap can be applied to rest mass (m or mTemplate:Ssub) and rest energy (ETemplate:Ssub) to show their proportionality as Template:Nowrap.<ref name=Okun />

On the other hand, it can also be applied to the total energy (ETemplate:Ssub or simply E) and total mass of a moving body. The total mass is also called the relativistic mass mTemplate:Ssub as it is not significantly greater than the rest mass until the speed approaches that of light, where special relativity should be used in order to describe the motion. Therefore, the total energy and total mass are related by Template:Nowrap.<ref name="tipler">Template:Citation</ref>

Thus, the mass–energy relation Template:Nowrap can be used to relate the rest energy to the rest mass, or to relate the total energy to the total mass. To instead relate the *total* energy or mass to the *rest* energy or mass, a generalization of the mass–energy relation is required: the energy–momentum relation.

Template:Nowrap has frequently been used as an explanation for the origin of energy in nuclear processes, but such processes can be understood as simply converting nuclear potential energy, without the need to invoke mass–energy equivalence. Instead, mass–energy equivalence merely indicates that the large amounts of energy released in such reactions may exhibit enough mass that the mass loss may be measured, when the released energy (and its mass) have been removed from the system. For example, the loss of mass to an atom and a neutron, as a result of the capture of the neutron and the production of a gamma ray, kinetic energy never exhibit weighable mass under any circumstances.

Just as the relativistic mass of isolated system is conserved through time, so also is its invariant mass. It is this property which allows the conservation of all types of mass in systems, and also conservation of all types of mass in reactions where matter is destroyed (annihilated), leaving behind the energy that was associated with it (which is now in non-material form, rather than material form). Matter may appear and disappear in various reactions, but mass and energy are both unchanged in this process.

Applicability of the strict mass–energy equivalence formula, $E = mc^2$ [edit]

As is noted above, two different definitions of mass have been used in special relativity, and also two different definitions of energy. The simple equation $E = mc^2$ is not generally applicable to all these types of mass and energy, except in the special case that the total additive momentum is zero for the system under consideration. In such a case, which is always guaranteed when observing the system from either its center of mass frame or its center of momentum frame, $E = mc^2$ is always true for any type of mass and energy that are chosen. Thus, for example, in the center of mass frame, the total energy of an object or system is equal to its rest mass times c^2, a useful equality. This is the relationship used for the container of gas in the previous example. It is *not* true in other reference frames where the center of mass is in motion. In these systems or for such an object, its total energy will depend on both its rest (or invariant) mass, and also its (total) momentum.<ref>Relativity DeMystified, D. McMahon, Mc Graw Hill (USA), 2006, ISBN 0-07-145545-0</ref>

In inertial reference frames other than the rest frame or center of mass frame, the equation Template:Nowrap remains true if the energy is the relativistic energy *and* the mass the relativistic mass. It is also correct if the energy is the rest or invariant energy (also the minimum energy), *and* the mass is the rest mass, or the invariant mass. However, connection of the **total or relativistic energy** (E_r) with the **rest or invariant mass** (m_0) requires consideration of the system total momentum, in systems and reference frames where the total momentum has a non-zero value. The formula then required to connect the two different kinds of mass and energy, is the extended version of Einstein's equation, called the relativistic energy–momentum relation:<ref>Dynamics and Relativity, J.R. Forshaw, A.G. Smith, Wiley, 2009, ISBN 978-0-470-01460-8</ref>

$$E_r^2 - |\vec{p}\,|^2 c^2 = m_0^2 c^4$$

$$E_r^2 - (pc)^2 = (m_0 c^2)^2$$

or

$$E_r = \sqrt{(m_0 c^2)^2 + (pc)^2}$$

Here the $(pc)^2$ term represents the square of the Euclidean norm (total vector length) of the various momentum vectors in the system, which reduces to the square of the simple momentum magnitude, if only a single particle is considered. This equation reduces to Template:Nowrap when the momentum term is zero. For photons where Template:Nowrap, the equation reduces to Template:Nowrap.

View a video explanation of the full equation at Minute Physics on Youtube

Meanings of the strict mass–energy equivalence formula, $E = mc^2$ [edit]

Mass–energy equivalence states that any object has a certain energy, even when it is stationary. In Newtonian mechanics, a motionless body has no kinetic energy, and it may or may not have other amounts of internal stored energy, like chemical energy or thermal energy, in addition to any potential energy it may have from its position in a field of force. In Newtonian mechanics, all of these energies are much smaller than the mass of the object times the speed of light squared.

In relativity, all of the energy that moves along with an object (that is, all the energy which is present in the object's rest frame) contributes to the total mass of the body, which measures how much it resists acceleration. Each potential and kinetic energy makes a proportional contribution to the mass. As noted above, even if a box of ideal mirrors "contains" light, then the individually massless photons still contribute to the total mass of the box, by the amount of their energy divided by c^2.<ref>Template:Citation, Chapter 12 page 433
</ref>

system, it will always be found that both have simply moved off to another place, where they may both be measured as an increase of both energy and mass corresponding to the loss in the first system.

Fast-moving objects and systems of objects [edit]

When an object is pulled in the direction of motion, it gains momentum and energy, but when the object is already traveling near the speed of light, it cannot move much faster, no matter how much energy it absorbs. Its momentum and energy continue to increase without bounds, whereas its speed approaches a constant value—the speed of light. This implies that in relativity the momentum of an object cannot be a constant times the velocity, nor can the kinetic energy be a constant times the square of the velocity.

A property called the relativistic mass is defined as the ratio of the momentum of an object to its velocity.<ref>Note that the relativistic mass, in contrast to the rest mass m_0, *is not a relativistic invariant, and that the velocity* $v = dx^{(4)}/dt$ *is not a Minkowski four-vector, in contrast to the quantity* $\tilde{v} = dx^{(4)}/d\tau$ *, where* $d\tau = dt \cdot \sqrt{1-(v^2/c^2)}$ *is the differential of the proper time. However, the energy–momentum four-vector* $p^{(4)} = m_0 \cdot dx^{(4)}/d\tau$ *is a genuine Minkowski four-vector, and the intrinsic origin of the square root in the definition of the relativistic mass is the distinction between **dτ** and **dt**.</ref> Relativistic mass depends on the motion of the object, so that different observers in relative motion see different values for it. If the object is moving slowly, the relativistic mass is nearly equal to the rest mass and both are nearly equal to the usual Newtonian mass. If the object is moving quickly, the relativistic mass is greater than the rest mass by an amount equal to the mass associated with the kinetic energy of the object. As the object approaches the speed of light, the relativistic mass grows infinitely, because the kinetic energy grows infinitely and this energy is associated with mass.*

The relativistic mass is always equal to the total energy (rest energy plus kinetic energy) divided by c^2.<ref name="tipler"/> Because the relativistic mass is exactly proportional to the energy, relativistic mass and relativistic energy are nearly synonyms; the only difference between them is the units. If length and time are measured in natural units, the speed of light is equal to 1, and even this difference disappears. Then mass and energy have the same units and are always equal, so it is redundant to speak about relativistic mass, because it is just another name for the energy. This is why physicists usually reserve the useful short word "mass" to mean rest mass, or invariant mass, and not relativistic mass.

The relativistic mass of a moving object is larger than the relativistic mass of an object that is not moving, because a moving object has extra kinetic energy. The *rest mass* of an object is defined as the mass of an object when it is at rest, so that the rest mass is always the same, independent of the motion of the observer: it is the same in all inertial frames.

For things and systems made up of many parts, like an atomic nucleus, planet, or star, the relativistic mass is the sum of the relativistic masses (or energies) of the parts, because energies are additive in isolated systems. This is not true in systems which are open, however, if energy is subtracted. For example, if a system is *bound* by attractive forces, and the energy gained due to the forces of attraction in excess of the work done is removed from the system, then mass will be lost with this removed energy. For example, the mass of an atomic nucleus is less than the total mass of the protons and neutrons that make it up, but this is only true after this energy from binding has been removed in the form of a gamma ray (which in this system, carries away the mass of the energy of binding). This mass decrease is also equivalent to the energy required to break up the nucleus into individual protons and neutrons (in this case, work and mass would need to be supplied). Similarly, the mass of the solar system is slightly less than the masses of sun and planets individually.

For a system of particles going off in different directions, the invariant mass of the system is the analog of the rest mass, and is the same for all observers, even those in relative motion. It is defined as the total energy (divided by c^2) in the center of mass frame (where by definition, the system total momentum is zero). A simple example of an object with moving parts but zero total momentum is a container of gas. In this case, the mass of the container is given by its total energy (including the kinetic energy of the gas molecules), since the system total energy and invariant mass are the same in any reference frame where the momentum is zero, and such a reference frame is also the only frame in which the object can be weighed. In a similar way, the theory of special relativity posits that the thermal energy in all objects (including solids) contributes to their total masses and weights, even though this energy is present as the kinetic and potential energies of the atoms in the object, and it (in a similar way to the gas) is not seen in the rest masses of the atoms that make up the object.

In a similar manner, even photons (light quanta), if trapped in a container space (as a photon gas or thermal radiation), would contribute a mass associated with their energy to the container. Such an extra mass, in theory, could be weighed in the same way as any other type of rest mass. This is true in special relativity theory, even though individually photons have no rest mass. The property that trapped energy *in any form* adds weighable mass to systems that have no net momentum is one of the characteristic and notable consequences of relativity. It has no counterpart in classical Newtonian physics, in which radiation, light, heat, and true.<ref> There followed also the principle of the equivalence of mass and energy, with the laws of conservation of mass and energy becoming one and the same.", Albert Einstein, "Considerations Concerning the Fundaments of Theoretical Physics", Science, Washington, DC, vol. 91, no. 2369, May 24th, 1940 scanned image online</ref><ref>"the principle of the conservation of mass. ... proved inadequate in the face of the special theory of relativity. It was therefore merged with the energy [conservation] principle... We might say that the principle of the conservation of energy, having previously swallowed up that of the conservation of heat [thermal energy], now proceeded to swallow that of the conservation of mass—and [now] holds the field alone.", page 14 (preview online) of Albert Einstein, **The Theory of Relativity (And Other Essays)**, Citadel Press, 1950.</ref>

On the other hand, if the conservation of mass law is interpreted as conservation of *rest* mass, this does not hold true in general. The *rest* energy (equivalently, rest mass) of a particle can be converted, not "to energy" (it already *is* energy (mass)), but rather to *other* forms of energy (mass) which require motion, such as kinetic energy, thermal energy, or radiant energy; similarly, kinetic or radiant energy can be converted to other kinds of particles which have rest energy (rest mass). In the transformation process, neither the total amount of mass nor the total amount of energy changes, since both are properties which are connected to each other via a simple constant.<ref>In F. Fernflores. The Equivalence of Mass and Energy. Stanford Encyclopedia of Philosophy. [1]</ref> This view requires that if either energy or (total) mass disappears from a system, it will always be found that both have simply moved off to another place, where they may both be measured as an increase of both energy and mass corresponding to the loss in the first system.

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View a video explanation of the full equation at Minute Physics on Youtube

Meanings of the strict mass–energy equivalence formula, $E = mc^2$ [edit]


The mass–energy

Mass–energy equivalence states that any object has a certain energy, even when it is stationary. In Newtonian mechanics, a motionless body has no kinetic energy, and it may or may not have other amounts of internal stored energy, like chemical energy or thermal energy, in addition to any potential energy it may have from its position in a field of force. In Newtonian mechanics, all of these energies are much smaller than the mass of the object times the speed of light squared.

In relativity, all of the energy that moves along with an object (that is, all the energy which is present in the object's rest frame) contributes to the total mass of the body, which measures how much it resists acceleration. Each potential and kinetic energy makes a proportional contribution to the mass. As noted above, even if a box of ideal mirrors "contains" light, then the individually massless photons still contribute to the total mass of the box, by the amount of their energy divided by c^2.<ref>Template:Citation, Chapter 12 page 433 </ref>

In relativity, removing energy is removing mass, and for an observer in the center of mass frame, the formula Template:Nowrap indicates how much mass is lost when energy is removed. In a nuclear reaction, the mass of the atoms that come out is less than the mass of the atoms that go in, and the difference in mass shows up as heat and light which has the same relativistic mass as the difference (and also the same invariant mass in the center of mass frame of the system). In this case, the *E* in the formula is the energy released and removed, and the mass *m* is how much the mass decreases. In the same way, when any sort of energy is added to an isolated system, the increase in the mass is equal to the added energy divided by c^2. For example, when water is heated it gains about Template:Val of mass for every joule of heat added to the water.

Mass–energy equivalence

Template:Redirect

Template:Special relativity

4-meter-tall sculpture of Einstein's 1905 $E = mc^2$ formula at the 2006 Walk of Ideas, Berlin, Germany.

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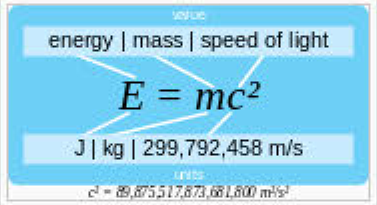

Explication

where E is energy, m is mass, and c is the speed of light. Thus, this mass–energy relation states that the universal proportionality factor between equivalent amounts of energy and mass is equal to the speed of light squared. This also serves to convert units of mass to units of energy, no matter what system of measurement units is used.

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On the one hand, the equation Template:Nowrap can be applied to rest mass (m or mTemplate:Ssub) and rest energy (ETemplate:Ssub) to show their proportionality as Template:Nowrap.<ref name=Okun />

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Main page
Recent changes
Random page
Help
Tools
What links here
Related changes
Upload file
Special pages
Printable version
Permanent link
Page information

Mass–energy equivalence

Template:Redirect

Template:Special relativity

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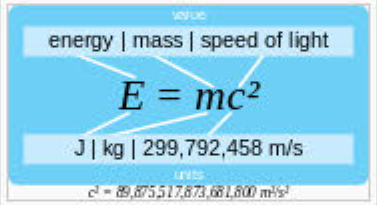

Explication

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Mass–energy equivalence × | math-preview.wmflabs.or × | view-source:math-previe ×

view-source:math-preview.wmflabs.org/w/index.php?title=Special:MathShowImage&hash=d93c5e124d413e53755d9e47ca43e7ff&mode=5


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Main page
Recent changes
Random page
Help
Tools
What links here
Related changes
Upload file
Special pages
Printable version
Permanent link
Page information

Mass–energy equivalence

Template:Redirect

Template:Special relativity

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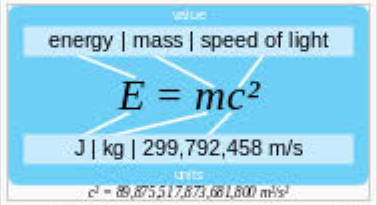

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Datei Bearbeiten Ansicht Hilfe

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Mass–energy equivalence

"E=MC2" redirects here. For other uses, see E=MC2 (disambiguation).

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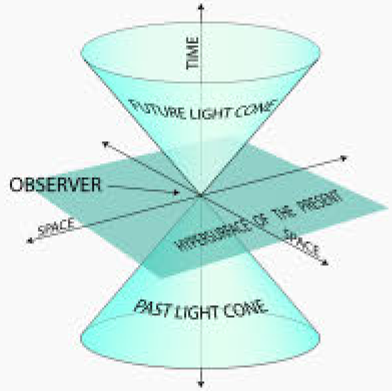
Thus, this mass–energy relation states that the universal proportionality factor between equivalent amounts of energy and mass is equal to the speed of light squared. This also serves to convert units of mass to units of energy, no matter what system of measurement units is used.

Part of a series on
Special relativity



- Principle of relativity
- Introduction to special relativity
- Theory of relativity
- Special relativity (alternative formulations)

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WIKIPEDIA
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Main page
Contents
Featured content
Current events
Random article
Donate to Wikipedia
Wikimedia Shop

Interaction
Help
About Wikipedia
Community portal
Recent changes
Contact page

Tools
What links here
Related changes
Upload file
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Print/export
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Languages
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"WP:MATH" and "WP:MATHS" redirects here. For the WikiProject on mathematics, see Wikipedia:WikiProject Mathematics. For Wikipedia's mathematics style manual, see Wikipedia:Manual of Style (mathematics).

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WP:MATH
WP:MATHS
Help:Math

MediaWiki uses a subset of AMS-LaTeX markup, a superset of LaTeX markup which is in turn a superset of TeX markup, for mathematical formulae. It generates PNG images by default. Alternatively, the MathJax renderer can be selected in the user preferences: this uses a combination of HTML and CSS to display the equation.

Although, in all cases mentioned, TeX is generated by compilation, and not by an interpreter program, there is one essential difference between, e.g., Knuth's TeX or Lamport's LaTeX and the present implementation: whereas in the first two cases the compiler typically generates an *all-in-one* printable output, which has the quality of a whole book with all chapters, sections and subsections, and where no line is "special", in the present case one has, typically, a mixture of TeX images (more precisely: PNG images) for the equations, embedded into usual text, and with short TeX elements usually replaced by HTML parts. As a consequence, in many cases TeX-elements, e.g. vector symbols, "stick out" below (or above) the text line. This "sticking out" is *not* the case in the above-mentioned original products, and the HTML-substitutes for small TeX additions to the text are often insufficient in quality for many readers. In spite of these shortcomings, the present product characterized by "many embedded PNG-images" should be preferred for small texts, where the equations do not dominate.

More precisely, MediaWiki filters the markup through Texvc, which in turn passes the commands to TeX or MathJax for the actual rendering. Thus, only a limited part of the full TeX language is supported; see below for details.

To have math rendered in a particular MediaWiki installation, one has to set `$wgUseTeX = true;` in LocalSettings.php.

Contents [hide]

1 Basics
1.1 LaTeX commands
1.2 Special characters
1.3 Spaces
1.4 LaTeX environments
1.5 Rendering
2 TeX vs HTML
2.1 Pros of HTML
2.2 Pros of TeX
2.3 Using MathJax
3 Formatting using TeX
3.1 Functions, symbols, special characters
3.1.1 Accents/diacritics

Help:Displaying a formula

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(Redirected from Wikipedia:TEX)

"WP:MATH" and "WP:MATHS" redirects here. For the WikiProject on mathematics, see Wikipedia:WikiProject Mathematics. For Wikipedia's mathematics style manual, see Wikipedia:Manual of Style (mathematics).

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Contents [hide]

1 Basics
1.1 LaTeX commands
1.2 Special characters
1.3 Spaces
1.4 LaTeX environments
1.5 Rendering
2 TeX vs HTML
2.1 Pros of HTML
2.2 Pros of TeX
2.3 Using MathJax
3 Formatting using TeX
3.1 Functions, symbols, special characters
3.1.1 Accents/diacritics

Main page
Contents
Featured content
Current events
Random article
Donate to Wikipedia
Wikimedia Shop

Interaction
Help
About Wikipedia
Community portal
Recent changes
Contact page

Tools
What links here
Related changes
Upload file
Special pages
Permanent link
Page information
Wikidata item

Print/export
Create a book
Download as PDF
Printable version

Languages
العربية
Беларуская (тарашкевіца)
Български
Català
Dansk

Typesetting math: 41%

Help:Displaying a formula

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Shortcuts:
WP:MATH
WP:MATHS
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Contents [hide]

1 Basics
1.1 LaTeX commands
1.2 Special characters
1.3 Spaces
1.4 LaTeX environments
1.5 Rendering
2 TeX vs HTML
2.1 Pros of HTML
2.2 Pros of TeX
2.3 Using MathJax
3 Formatting using TeX
3.1 Functions, symbols, special characters
3.1.1 Accents/diacritics

Help:Displaying a formula

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(Redirected from Wikipedia:TEX)

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Contents [hide]

1 Basics
1.1 LaTeX commands
1.2 Special characters
1.3 Spaces
1.4 LaTeX environments
1.5 Rendering
2 TeX vs HTML
2.1 Pros of HTML
2.2 Pros of TeX
2.3 Using MathJax
3 Formatting using TeX
3.1 Functions, symbols, special characters
3.1.1 Accents/diacritics

Help:Displaying a formula

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(Redirected from Wikipedia:TEX)

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Contents [hide]

1 Basics
1.1 LaTeX commands
1.2 Special characters
1.3 Spaces
1.4 LaTeX environments
1.5 Rendering
2 TeX vs HTML
2.1 Pros of HTML
2.2 Pros of TeX
2.3 Using MathJax
3 Formatting using TeX
3.1 Functions, symbols, special characters
3.1.1 Accents/diacritics

Help:Displaying a formula

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Contents [hide]

1 Basics
1.1 LaTeX commands
1.2 Special characters
1.3 Spaces
1.4 LaTeX environments
1.5 Rendering
2 TeX vs HTML
2.1 Pros of HTML
2.2 Pros of TeX
2.3 Using MathJax
3 Formatting using TeX
3.1 Functions, symbols, special characters
3.1.1 Accents/diacritics

Help:Displaying a formula

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Contents [hide]

1 Basics
  1.1 LaTeX commands
  1.2 Special characters
  1.3 Spaces
  1.4 LaTeX environments
  1.5 Rendering
2 TeX vs HTML
  2.1 Pros of HTML
  2.2 Pros of TeX
  2.3 Using MathJax
3 Formatting using TeX
  3.1 Functions, symbols, special characters
    3.1.1 Accents/diacritics

Help:Displaying a formula

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(Redirected from Wikipedia:TEX)

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WP:MATHS
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Contents [hide]

1 Basics
1.1 LaTeX commands
1.2 Special characters
1.3 Spaces
1.4 LaTeX environments
1.5 Rendering
2 TeX vs HTML
2.1 Pros of HTML
2.2 Pros of TeX
2.3 Using MathJax
3 Formatting using TeX
3.1 Functions, symbols, special characters
3.1.1 Accents/diacritics

Help:Displaying a formula

From Wikipedia, the free encyclopedia
(Redirected from Wikipedia:TEX)

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WP:MATH
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Help:Math

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Contents [hide]

1 Basics
1.1 LaTeX commands
1.2 Special characters
1.3 Spaces
1.4 LaTeX environments
1.5 Rendering
2 TeX vs HTML
2.1 Pros of HTML
2.2 Pros of TeX
2.3 Using MathJax
3 Formatting using TeX
3.1 Functions, symbols, special characters
3.1.1 Accents/diacritics

Wikipedia
The Free Encyclopedia

Main page
Contents
Featured content
Current events
Random article
Donate to Wikipedia
Wikimedia Shop

Interaction
Help
About Wikipedia
Community portal
Recent changes
Contact page

Tools
What links here
Related changes
Upload file
Special pages
Permanent link
Page information
Wikidata item

Print/export
Create a book
Download as PDF
Printable version

Languages
العربية
Беларуская (тарашкевіца)
Български
Català
Čeština
Dansk

Help page | Talk | Read | Edit source | Edit beta | View history | More | Search

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Contents [hide]

1 Basics
1.1 LaTeX commands
1.2 Special characters
1.3 Spaces
1.4 LaTeX environments
1.5 Rendering
2 TeX vs HTML
2.1 Pros of HTML
2.2 Pros of TeX
2.3 Using MathJax
3 Formatting using TeX
3.1 Functions, symbols, special characters
3.1.1 Accents/diacritics

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Contents [hide]

1 Basics
1.1 LaTeX commands
1.2 Special characters
1.3 Spaces
1.4 LaTeX environments
1.5 Rendering
2 TeX vs HTML
2.1 Pros of HTML
2.2 Pros of TeX
2.3 Using MathJax
3 Formatting using TeX
3.1 Functions, symbols, special characters
3.1.1 Accents/diacritics

Wikipedia
The Free Encyclopedia

Main page
Contents
Featured content
Current events
Random article
Donate to Wikipedia
Wikimedia Shop

Interaction
Help
About Wikipedia
Community portal
Recent changes
Contact page

Tools
What links here
Related changes
Upload file
Special pages
Permanent link
Page information
Wikidata item

Print/export
Create a book
Download as PDF
Printable version

Languages
العربية
Беларуская (тарашкевіца)
Български
Català
Čeština
Dansk

Help page | Talk | Read | Edit source | Edit beta | View history | More | Search

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(Redirected from Wikipedia:TEX)

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WP:MATHS
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Contents [hide]

1 Basics
1.1 LaTeX commands
1.2 Special characters
1.3 Spaces
1.4 LaTeX environments
1.5 Rendering
2 TeX vs HTML
2.1 Pros of HTML
2.2 Pros of TeX
2.3 Using MathJax
3 Formatting using TeX
3.1 Functions, symbols, special characters
3.1.1 Accents/diacritics

Help:Displaying a formula

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(Redirected from Wikipedia:TEX)

"WP:MATH" and "WP:MATHS" redirects here. For the WikiProject on mathematics, see Wikipedia:WikiProject Mathematics. For Wikipedia's mathematics style manual, see Wikipedia:Manual of Style (mathematics).

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WP:MATH
WP:MATHS
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Contents [hide]

1 Basics
1.1 LaTeX commands
1.2 Special characters
1.3 Spaces
1.4 LaTeX environments
1.5 Rendering
2 TeX vs HTML
2.1 Pros of HTML
2.2 Pros of TeX
2.3 Using MathJax
3 Formatting using TeX
3.1 Functions, symbols, special characters
3.1.1 Accents/diacritics

Main page
Contents
Featured content
Current events
Random article
Donate to Wikipedia
Wikimedia Shop
Interaction
Help
About Wikipedia
Community portal
Recent changes
Contact page
Tools
What links here
Related changes
Upload file
Special pages
Permanent link
Page information
Wikidata item
Print/export
Create a book
Download as PDF
Printable version
Languages
العربية
Беларуская (тарашкевіца)
Български
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"WP:MATH" and "WP:MATHS" redirects here. For the WikiProject on mathematics, see Wikipedia:WikiProject Mathematics. For Wikipedia's mathematics style manual, see Wikipedia:Manual of Style (mathematics).

Shortcuts:
WP:MATH
WP:MATHS
Help:Math

MediaWiki uses a subset of AMS-LaTeX markup, a superset of LaTeX markup which is in turn a superset of TeX markup, for mathematical formulae. It generates PNG images by default. Alternatively, the MathJax renderer can be selected in the user preferences: this uses a combination of HTML and CSS to display the equation.

Although, in all cases mentioned, $\TeX$ is generated by compilation, and not by an interpreter program, there is one essential difference between, e.g., Knuth's TeX or Lamport's LaTeX and the present implementation: whereas in the first two cases the compiler typically generates an *all-in-one* printable output, which has the quality of a whole book with all chapters, sections and subsections, and where no line is "special", in the present case one has, typically, a mixture of $\TeX$ images (more precisely: PNG images) for the equations, embedded into usual text, and with short $\TeX$ elements usually replaced by HTML parts. As a consequence, in many cases TeX-elements, e.g. vector symbols, "stick out" below (or above) the text line. This "sticking out" is *not* the case in the above-mentioned original products, and the HTML-substitutes for small $\TeX$ additions to the text are often insufficient in quality for many readers. In spite of these shortcomings, the present product characterized by "many embedded PNG-images" should be preferred for small texts, where the equations do not dominate.

More precisely, MediaWiki filters the markup through Texvc, which in turn passes the commands to $\TeX$ or MathJax for the actual rendering. Thus, only a limited part of the full $\TeX$ language is supported; see below for details.

To have math rendered in a particular MediaWiki installation, one has to set `$wgUseTeX = true;` in LocalSettings.php.

Contents [hide]

1 Basics
1.1 LaTeX commands
1.2 Special characters
1.3 Spaces
1.4 LaTeX environments
1.5 Rendering
2 TeX vs HTML
2.1 Pros of HTML
2.2 Pros of TeX
2.3 Using MathJax
3 Formatting using TeX
3.1 Functions, symbols, special characters
3.1.1 Accents/diacritics

Help:Displaying a formula

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1.3 Spaces
1.4 LaTeX environments
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2.2 Pros of TeX
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Main Page

This page is a preview for the new Math rendering that will get live at Wikipedia soon. Registered user will be able to chose between

Source

$ E=mc^{2} $(currently disabled via config)

PNG

$E = mc^2$ (currently active)

MathML

$E = mc^2$ (no Mathoid server can be accessed from the Wikimedia production cluster)

- In a first step MathML and SVG will be available to registered users only.
  - If you want to test please register an account here Register
    - You don't have to enter a email address nor any private information do not use a password that you use elsewhere
  - Change your Math rendering settings to MathML here
- Go to a random page or
- one of the test pages listed below.

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Test pages [edit]

- Displaystyle
- Unique ids
- Help:Formula
- Inputtypes (private Wikis only)
- Url2Image (private Wikis only)

Attribute:display [edit]

We introduce the new attribute display with the two options "inline" and "block".

Inline [edit]

If the the value of the display attribute is inline the render will render math in inline mode, i.e. there will be no new paragraph for the equation and the operators will be rendered consuming only little vertical space.

Example [edit]

The sum $\sum_{i=0}^\infty 2^{-i}$ converges to 2.

The next line-width is not disturbed by large operators.

The code for the math example reads:

```
<math display="inline">\sum_{i=0}^\infty 2^{-i}</math>
```

Technical implementation [edit]

Technically it will add the command *\textstyle* will be added to the user input before the tex command is passed to the renderer. The result will be displayed without further by outputting the image or MathMLelement to the page.

Remark [edit]

The convention https://en.wikipedia.org/wiki/Wikipedia:Manual_of_Style_(mathematics)#Using_HTML is really annoying. I'd prefer to use inline math for that, since it helps to differentiate between math and other elements.

Block [edit]

In block-style the equation is rendered in its own paragraph and the operator are rendered consuming less horizontal space.

Example [edit]

The equation

$$\text{geometric series:}\quad \sum_{i=0}^\infty 2^{-i}=2$$

is used in a joke about mathematicians entering a bar and ordering beer.

It was entered as

```
<math display="block">\text{geometric series:}\quad \sum_{i=0}^\infty 2^{-i}=2 </math>
```

Technical implementation [edit]

Technically it will add the command *\displaystyle* will be added to the user input, if the user input does not contain the string *\displaystyle' or \align before the tex command is passed to the renderer. The result will be*

$$\text{geometric series:}\quad \sum_{i=0}^\infty 2^{-i}=2$$

is used in a joke about mathematicians entering a bar and ordering beer.

It was entered as

```
<math display="block">\text{geometric series:}\quad \sum_{i=0}^\infty 2^{-i}=2 </math>
```

Technical implementation [edit]

Technically it will add the command *\displaystyle* will be added to the user input, if the user input does not contain the string *\displaystyle' or* \align *before the tex command is passed to the renderer. The result will be displayed in a new paragraph*. Therefore the style of the MathImage is altered i.e. the style attribute "display:block;margin:auto" is added. For MathML it is ensured that display=inline is replaced by display block which produces a new paragraph

Discussion [edit]

Fréderic Wang would prefer that displaystyle is always added in depended of the fact if \displaystlye is already in the equation. He remarks that it has to be checked if that works if the equation starts with \begin.

Not specified [edit]

If nothing is specified the current behavior is preserved. That means all equation are rendered in display style but not using a new paragraph.

Example [edit]

The sum $\displaystyle\sum_{i=0}^\infty 2^{-i}$ converges to 2.

The next line-width is disturbed by large operators.

The code for the math example reads:

```
<math>\sum_{i=0}^\infty 2^{-i}</math>
```

The equation

$$\text{geometric series:}\quad \sum_{i=0}^\infty 2^{-i}=2$$

is used in a joke about mathematicians entering a bar and ordering beer.

It was entered as

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Unique Ids

The attribute "id" is already live in all production Wikipedia systems. It allows to link to individual equation that have the id attribute set.

For example the code

```
<math id="MassEnergyEquivalence">E=mc^2</math>
```

can be accessed via appending #MassEnergyEquivalence to the Page URL.

Visually no difference can be seen in the output

$$E = mc^2$$

See for example kinetic Energy

Main page
Recent changes
Random page
Help

Tools
What links here
Related changes
Upload file
Special pages
Printable version
Permanent link
Page information

$$E_k = \frac{1}{2} m_0 v^2 + \cdots$$

Without this second term, there would be an additional contribution in the energy when the particle is not moving.

Einstein found that the total momentum of a moving particle is:

$$P = \frac{m_0 v}{\sqrt{1 - \frac{v^2}{c^2}}}.$$

and it is this quantity which is conserved in collisions. The ratio of the momentum to the velocity is the relativistic mass, m.

$$m = \frac{m_0}{\sqrt{1 - \frac{v^2}{c^2}}}$$

And the relativistic mass and the relativistic kinetic energy are related by the formula:

$$E_k = mc^2 - m_0 c^2.$$

Einstein wanted to omit the unnatural second term on the right-hand side, whose only purpose is to make the energy at rest zero, and to declare that the particle has a total energy which obeys:

$$E = mc^2$$

which is a sum of the rest energy m_0c^2 and the kinetic energy. This total energy is mathematically more elegant, and fits better with the momentum in relativity. But to come to this conclusion, Einstein needed to think carefully about collisions. This expression for the energy implied that matter at rest has a huge amount of energy, and it is not clear whether this energy is physically real, or just a mathematical artifact with no physical meaning.

In a collision process where all the rest-masses are the same at the beginning as at the end, either expression for the energy is conserved. The two expressions only differ by a constant which is the same at the beginning and at the end of the collision. Still, by analyzing the situation where particles are thrown off a heavy central particle, it is easy to see that the inertia of the central particle is reduced by the total energy emitted. This allowed Einstein to conclude that the inertia of a heavy particle is increased or diminished according to the energy it absorbs or emits.

Relativistic mass [edit]

Template:Main

After Einstein first made his proposal, it became clear that the word mass can have two different meanings. The rest mass is what Einstein called *m*, but others defined the *relativistic mass* with an explicit index:

This mass is the ratio of momentum to velocity, and it is also the relativistic energy divided by Template:Math (it is not Lorentz-invariant, in contrast to m_0). The equation Template:Math holds for moving objects. When the velocity is small, the relativistic mass and the rest mass are almost exactly the same.

- $E{=}mc^2$ either means $E{=}m_0c^2$ for an object at rest, or $E{=}m_{rel}c^2$ when the object is moving.

Also Einstein (following Hendrik Lorentz and Max Abraham) used velocity—and direction-dependent mass concepts (longitudinal and transverse mass) in his 1905 electrodynamics paper and in another paper in 1906.

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- Displaystyle
- Unique Ids
- Help:Formula
- Inputtypes (private Wikis only)
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Summation [edit]

$$\sum_{i=0}^{n-1} i$$

<source lang="text"> $\sum_{i=0}^{n-1} i$ </source>

$$\sum_{m=1}^{\infty}\sum_{n=1}^{\infty}\frac{m^2\,n}{3^m\left(m\,3^n+n\,3^m\right)}$$

<source lang="text"> $\sum_{m=1}^{\infty}\sum_{n=1}^{\infty}\frac{m^2\,n}{3^m\left(m\,3^n+n\,3^m\right)}$ </source>

Differential equation [edit]

$$u'' + p(x)u' + q(x)u=f(x),\quad x>a$$

<source lang="latex"> $u'' + p(x)u' + q(x)u=f(x),\quad x>a$ </source>

Complex numbers [edit]

$$|\bar{z}| = |z|, |(\bar{z})^n| = |z|^n, \arg(z^n) = n \arg(z)$$

<source lang="text"> $|\bar{z}| = |z|, |(\bar{z})^n| = |z|^n, \arg(z^n) = n \arg(z)$ </source>

Limits [edit]

$$\lim_{z\to z_0} f(z)=f(z_0)$$

<source lang="latex"> $\lim_{z\to z_0} f(z)=f(z_0)$ </source>

Integral equation [edit]

$$\phi_n(\kappa) = \frac{1}{4\pi^2\kappa^2} \int_0^\infty \frac{\sin(\kappa R)}{\kappa R} \frac{\partial}{\partial R} \left[R^2\frac{\partial D_n(R)}{\partial R}\right]\,dR$$

<source lang="text"> $\phi_n(\kappa) = \frac{1}{4\pi^2\kappa^2} \int_0^\infty \frac{\sin(\kappa R)}{\kappa R} \frac{\partial}{\partial R} \left[R^2\frac{\partial D_n(R)}{\partial R}\right]\,dR$ </source>

Example [edit]

Colors supported

Apricot	Undefined control sequence \pagecolor	Bittersweet	Black
Blue	BlueGreen	BlueViolet	BrickRed
Brown	BurntOrange	CadetBlue	CarnationPink
Cerulean	CornflowerBlue	Undefined control sequence \pagecolor	Dandelion
DarkOrchid	Emerald	ForestGreen	Fuchsia
Goldenrod	Gray	Green	Undefined control sequence \pagecolor
JungleGreen	Undefined control sequence \pagecolor	LimeGreen	Magenta
Mahogany	Maroon	Melon	MidnightBlue
Mulberry	NavyBlue	OliveGreen	Orange
OrangeRed	Orchid	Peach	Periwinkle
PineGreen	Plum	ProcessBlue	Purple
RawSienna	Red	RedOrange	RedViolet
Rhodamine	RoyalBlue	RoyalPurple	RubineRed
Salmon	SeaGreen	Sepia	SkyBlue
SpringGreen	Tan	TealBlue	Undefined control sequence \pagecolor
Turquoise	Violet	VioletRed	Undefined control sequence \pagecolor
WildStrawberry	Undefined control sequence \pagecolor	YellowGreen	YellowOrange

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Test pages [edit]

- Displaystyle
- Unique Ids
- Help:Formula
- Inputtypes (private Wikis only)
- Url2Image (private Wikis only)

Main page
Recent changes
Random page
Help
Tools
What links here
Related changes
Upload file
Special pages
Printable version
Permanent link
Page information

Inputtypes

If you run your private wiki you can allow that users can input formulae in different input formats. Therefore you have to add `$wgMathEnableExperimentalInputFormats = true;` to your local config. Afterwards you can use two additional input modes which can be enabled via one of the following `type` attribute

pmml
: Presentation MathML

ascii
: ASCIIMath

For example asciimath input can be entered via

`<math type="ascii">d/dxf(x)=lim_{h->0}(f(x+h)-f(x))/h</math>` and looks like $\frac{d}{dx}f(x) = \lim_{\{h \to 0\}} \frac{f(x+h) - f(x)}{h}$

Main page
Recent changes
Random page
Help
Tools
What links here
Related changes
Upload file
Special pages
Printable version
Permanent link
Page information

Main page
Recent changes
Random page
Help

Tools
What links here
Related changes
Upload file
Special pages
Printable version
Permanent link
Page information

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Url2Image

Url to image basically is the possibility to get the SVG or PNG output for a texvc input string specified in the URL to test navigate to [1] for a sample of equation $E = mc^2$ rendered in SVG.

Main page
Recent changes
Random page
Help
Tools
What links here
Related changes
Upload file
Special pages
Printable version
Permanent link
Page information

Mass–energy equivalence -... | Search results for "id" - Wi... | User contributions for Ad... | Recent changes - WikiDemo | Help:Formula - devwiki | http://math...c^2&mode=5

math-preview.wmflabs.org/w/index.php?title=Special:MathShowImage&tex=E=mc^2&mode=5

Google

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Mass–energy equivalence -... | Search results for "id" - Wi... | User contributions for Ad... | Recent changes - WikiDemo | Help:Formula - devwiki | index.php (PNG-Grafik, 77 ...

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Google

$E = mc^2$

Help:F × Url2Im × math-| × math-| × math-| × Inputt × Mass-| × Prefere × Merge × MathJ × User ta × View s × User:P × Enter E × asciim × ASCIIN ×

math-preview.wmflabs.org/w/index.php?title=Special:MathShowImage&asciimath=x/x={(1,if%20x!=0),(text{undefined},if%20x=0):}&mode=5

$$\frac{x}{x} = \begin{cases} 1 & \text{if } x \neq 0 \\ \text{undefined} & \text{if } x = 0 \end{cases}$$

Future work

- Discover hidden math markup
- Semantic macros
- Visual Editor
- Open Math CD for Wikidata

Mathoid needs you

- Help with testing of MathML in Wikipedia
- http://math-preview.wmflabs.org
- Report bugs
- Review code

Call for contribution

NTCIR
Math-2
Wikipedia
Task

- NTCIR-11 Math-2 Wikipedia subtask

	NTCIR-11-Math-Main task	NTCIR-11-Math-Wikipedia task
dataset name	arXiv	englisch wikipedia
number of pages	100K of ca 800K	35K of 4M
number of formulae	?	450K
topics	mathematics and physics	all pages that contain math
unique identifier	arxiv id	page title
target audience	researchers	everyone
evaluation	IR assement via result pooling	Automatic comparision of the results