The LUA-PHYSICAL library

Version 0.1

Thomas Jenni

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Abstract

`lua-physical` is a pure Lua library which provides functions and object for doing computation with physical quantities. This package provides a standard set of units of the SI and the imperial system. It is possible to give a number a mesurement uncertainty.

is also integrated and is calculated by gaussian error propagation. The package includes some

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1 Introduction

The author of this package is a teacher at the *Kantonsschule Zug, Switzerland*, a high-school. The main use of this package is to write physics problem sets and integrate the calculation directly into the luatex-file. The package is now in use for more than two years and a lot of bugs have been found and crushed. Nevertheless it could be possible that some bugs are still there, living uncovered. Therefore I recommend not to use this library productively in industry or science. If one does so, it's the responsability of the user to check results for plausability. If the user finds some bugs, please report them on github.com or directly to the author.

E-Mail: `thomas.jenni(at)ksz.ch`

2 Basic usage

Since this package is pure lua library one has to require it explicitly by calling `require("physical")`. For printing results the **siunitx** package is used. It's recommended to define a shortcut like `\q` or `\Qty` to convert the lua quantity object to a siunitx expression. An example preamble is shown in the following.

basic preamble

```latex
\usepackage{siunitx}

% configure siunitx
\sisetup{
  output-decimal-marker = {.},
  per-mode = symbol,
  separate-uncertainty = false,
  add-decimal-zero = true,
  exponent-product = \cdot,
  round-mode = off
}

% load lua-physical
\begin{luacode*}
  physical = require("physical")
\end{luacode*}

% shortcut for printing physical quantities
\newcommand{\q}[1]{%
  \directlua{tex.print(physical.Quantity.tosiunitx(#1,"
        scientific-notation=fixed,exponent-to-prefix=false"))}%
}
```

Given the preamble one can use now units in lua code and insert results in the latex code.

basic example

```
\begin{luacode}
  s = 10 * _m
  t = 2 * _s
  v = s/t
\end{luacode}

A car travels $\q{s}$ in $\q{t}$. calculate its velocity.
$$
  v=\frac{s}{t} = \frac{\q{s}}{\q{t}} = \q{v} = \q{v:to(_km/_h)}
$$
```

A car travels $10\,\mathrm{m}$ in $2\,\mathrm{s}$. calculate its velocity.

$$v = \frac{s}{t} = \frac{10\,\mathrm{m}}{2\,\mathrm{s}} = 5\,\mathrm{m/s} = 18\,\mathrm{km/h}$$

3 Supported Units

There are a few

Unit	Symbol	Definition
number	`_1`	The number one.
percent %	`_percent`	`1e-2*_1`
permille ‰	`_permille`	`1e-3*_1`
parts-per-million	`_ppm`	`1e-6*_1`
parts-per-billion	`_ppb`	`1e-9*_1`
parts-per-trillion	`_ppt`	`1e-12*_1`
parts-per-quadrillion	`_ppq`	`1e-15*_1`
decibel	`_dB`	`_1`

Table 1: Dimensionless units

Quantity	Unit	Symbol	Dimension	Definition
length	meter	`_m`	L	The distance light travels in vacuum during 1/299 792 458 second.
mass	kilogram	`_kg`	M	The mass of the international protoype of the kilogram.
time	second	`_s`	T	Is 9 192 631 770 times the period of the radiation from the transition between the two hyperfine levels of the ground state of caesium-133.
electric current	ampere	`_A`	I	Is the constant current which, if maintained in two straight parallel conductors of infinte length, of negligible circular crosss-section, and placed 1 m apart in vacuum, would produce between these conductors a force equal to $2 \cdot 10^{-7}$ N/m.
thermodynamic temperature	kelvin	`_K`	Θ	Is the fraction 1/273.16 of the thermodynamic temperature of the triple point of water.
amount of substance	mole	`_mol`	N	Amount of substance that contains as many particles as there are atoms in 0.012 kg of carbon-12.
luminous intensity	candela	`_cd`	J	the luminous intensity, in a given direction, of a source that emits monochromatic radiation of frequenc $540 \cdot 10^{12}$ Hz and has a radiant intensity in that direction of (1/683) W/sr

Table 2: Base units of the International System of Units (SI)

Quantity	Unit	Symbol	Dimension	Definition
plane angle	radian	`_rad`	1	`_1`
solid angle	steradian	`_sr`	1	`_rad^2`
frequency	hertz	`_Hz`	T^{-1}	`1/_s`
force	newton	`_N`	MLT^{-2}	`_kg * _m / _s^2`
pressure	pascal	`_Pa`	$ML^{-1}T^{-2}$	`_N/_m^2`
energy	joule	`_J`	ML^2T^{-2}	`_N * _m`
power	watt	`_W`	ML^2T^{-3}	`_J/_s`
electric charge	coulomb	`_C`	TI	`_A * _s`
electric potential difference	volt	`_V`	$ML^2T^{-3}I^{-1}$	`_J / _C`
capacitance	farad	`_F`	$L^{-2}M^{-1}T^4I^2$	`_C/_V`
electric resistance	ohm	`_Ohm`	$L^2MT^{-3}I^{-2}$	`_V/_A`
electric conductance	siemens	`_S`	$L^{-2}M^{-1}T^3I^2$	`_A/_V`
magnetic flux	weber	`_Wb`	$L^2MT^{-2}I^{-1}$	`_V*_s`
magnetic flux density	tesla	`_T`	$MT^{-2}I^{-2}$	`_V*_s`
inductance	henry	`_H`	$L^2MT^{-2}I^{-2}$	`_Wb/_A`
Celsius temperature	degree Celsius	`_degC`	Θ	`_K`
luminous flux	lumen	`_lm`	J	`_cd * _sr`
illuminance	lux	`_lux`	$L^{-2}J$	`_lm/_m^2`
activity	becquerel	`_Bq`	T^{-1}	`1/_s`
absorbed dose	gray	`_Gy`	L^2T^{-2}	`_J/_kg`
dose equivalent	sievert	`_Sv`	L^2T^{-2}	`_J/_kg`
catalytic activity	katal	`_kat`	$T^{-1}N$	`_mol/_s`

Table 3: Derived units of the International System of Units (SI)