CalcHEP: Calculator for High Energy Physics

born as a CompHEP in 1989: MSU-89-63/140

Comput.Phys.Commun. 184 (2013) 1729-1769, 1207.6082 [hep-ph]

Alexander Pukhov, AB, Neil Christensen http://theory.npi.msu.su/~pukhov/calchep.html

- **CalcHEP** is a powerful tool for efficient and effective studies of high-energy physics (HEP) phenomenology in Beyond the Standard Model (BSM) scenarios. It enables a high level of automation in going from your favourite model to physical observables such as decay widths, branching ratios, cross sections, kinematic distributions, and parton-level events.
- **Highlights**
  - Convenient graphical interface – to understand process in details
  - Output of symbolic results (Mathematica, REDUCE, FORM formats)
  - Calculates particle widths 'on the fly'
  - Easy to modify an existing model (GUI) or to implement the new one (LanHEP, FeynRules)
  - Batch interface: multidimensional scan of the the parameter space, produces LHE files in one run
  - Designed to study physics and present and future colliders: LHA PDF, ISR+Beamstrahlung for ILC
  - Modular structure: one can use it as a matrix element generator in other codes and packages (e.g.GAMBIT)
  - Has different modules for user modifications: user-defined cuts, user form factor etc.

CalcHEP installation guide

1. Download the code

a) **from Dark Tools github**

wget https://raw.githubusercontent.com/dimauromattia/darktools/main/calchep/calchep_3.9.2.tgz

or

b) **from the HEP Tools site**

→ Go to HEP TOOLS → calchep → download calchep_3.9.2.tgz

or

c) **from** http://theory.npi.msu.su/~pukhov/calchep.html

wget https://theory.sinp.msu.ru/~pukhov/CALCHEP/calchep_3.9.2.tgz

2. Unpack the archive: tar -zxvf calchep_3.9.2.tgz

3. Enter the directory: cd calchep_3.9.2

4. Compile: make

5. Start CalcHEP: cd work; ./calchep

Compilation, potential problems and solutions

- To compile the CalcHEP source code you need:
  C compiler, the X11 graphics library and the X11 include files
  "CalcHEP is compiled successfully and can be started " is a good sign

- Supported operating sytems: Linux, MacOS, SunOS, and Windows Subsystem for Linux (WSL)

- Potential problem
  - The most frequent compilation problem is due to the absence of the X11 include files: in this case CalcHEP will compile, however, it only runs in non-interactive mode: ./calchep will give
    Error: You have launched the interactive session for a version
    of CalcHEP that has been compiled without the X11 library.
    Presumably, the X11 development package is not installed on your computer.
  - the following additional package should be installed to run CalcHEP in GUI mode:
    libX11-devel on Fedora/Scientific; libX11-dev on Ubuntu/Debian; xorg-x11-devel on SUSE;
    for MAC: XQuartz is the official X11 server and client-side libraries for macOS
    get it from https://www.xquartz.org or brew install --cask xquartz
- Compilation for High Precision Calculations
  - Intel C compiler has a _Quad type, -D QUAD has to be added to FlagsForSh as
    CFLAGS="-D_QUAD_ -fPIC -fsigned-char -Qoption,cpp,--extended_float_type"