The New PDG Python API

Part 1: Introduction

Part 2: Tutorial (Jupyter notebook)

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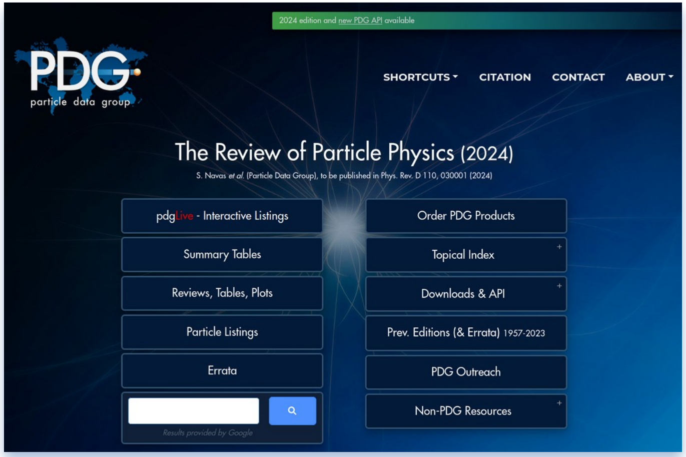
PDG and the *Review of Particle Physics*

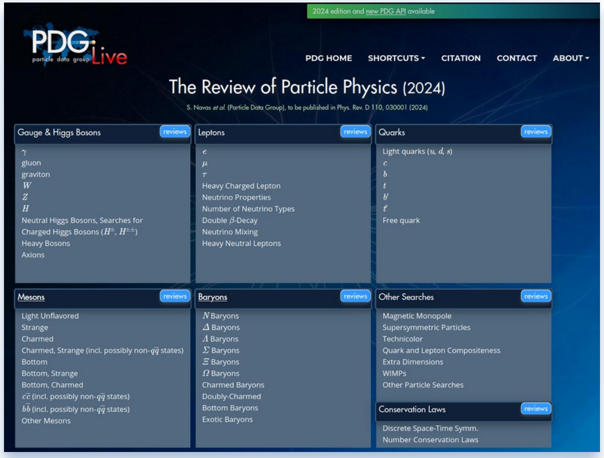
- **The Particle Data Group provides a comprehensive summary of particle physics and related areas (cosmology, astrophysics) in a single publication, the *Review of Particle Physics***
  - International collaboration with 240 scientific authors from 173 institutions and 25 countries
  - Available online at pdg.lbl.gov and pdglive.lbl.gov
  - Also PDG Book, Particle Physics Booklet, Booklet App, PDF files, and various downloadable data files

- ***Review of Particle Physics* consists of**
  - **Summary Tables**
  - **Particle Listings**
  - 120 review articles covering a wide range of topics (Standard Model, searches, cosmology, experimental methods, mathematical tools, atomic and nuclear properties, ...)



The Review of Particle Physics (2024)

S. Navas *et al.* (Particle Data Group), to be published in Phys. Rev. D 110, 030001 (2024)


2024 edition and new PDG API available
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The Review of Particle Physics (2024)

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Gauge & Higgs Bosons

γ
gluon
graviton
W
Z
H
Neutral Higgs Bosons, Searches for
Charged Higgs Bosons ($H^{\pm}$, $H^{\pm\pm}$)
Heavy Bosons
Axions

Leptons

e
μ
τ
Heavy Charged Lepton
Neutrino Properties
Number of Neutrino Types
Double β-Decay
Neutrino Mixing
Heavy Neutral Leptons

Quarks

Light quarks (u, d, s)
c
b
t
b'
t'
Free quark

Mesons

Light Unflavored
Strange
Charmed
Charmed, Strange (incl. possibly non-$q\bar{q}$ states)
Bottom
Bottom, Strange
Bottom, Charmed
$c\bar{c}$ (incl. possibly non-$q\bar{q}$ states)
$b\bar{b}$ (incl. possibly non-$q\bar{q}$ states)
Other Mesons

Baryons

N Baryons
Δ Baryons
Λ Baryons
Σ Baryons
Ξ Baryons
Ω Baryons
Charmed Baryons
Doubly-Charmed
Bottom Baryons
Exotic Baryons

Other Searches

Magnetic Monopole
Supersymmetric Particles
Technicolor
Quark and Lepton Compositeness
Extra Dimensions
WIMPs
Other Particle Searches

Conservation Laws

Discrete Space-Time Symm.
Number Conservation Laws

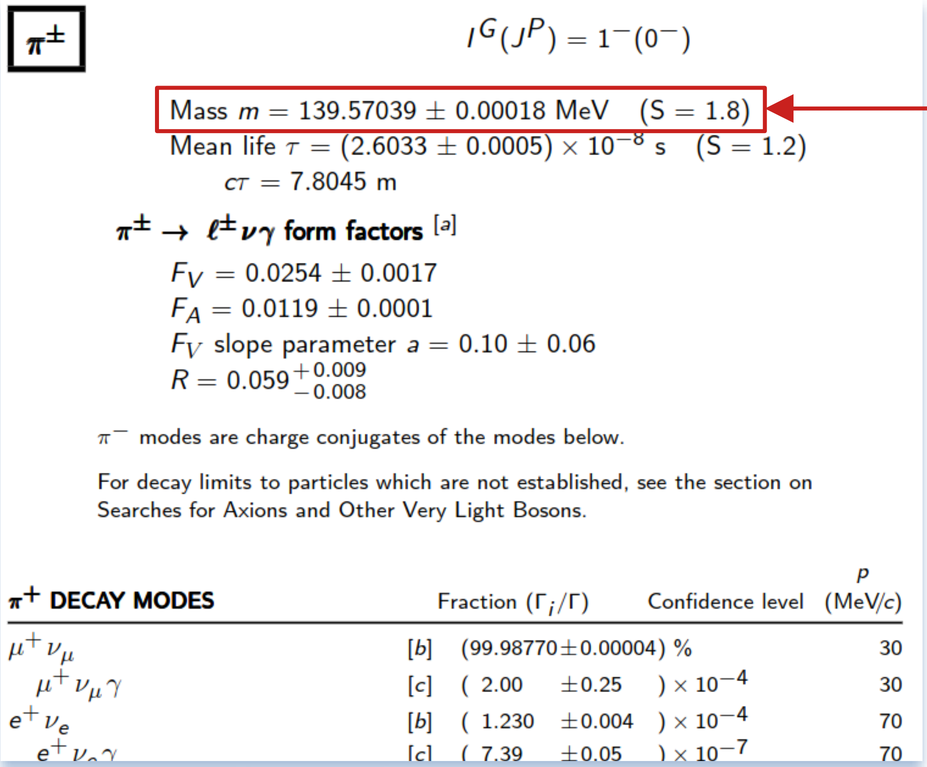
Summary Tables and Particle Listings

Summary Tables:

- PDG world averages (or best limits)
- For all relevant quantities of a given particle

Particle Listings:

- Detailed information on how PDG arrived at a given average



$\boxed{\pi^\pm}$

$I^G(J^P) = 1^-(0^-)$

Mass $m = 139.57039 \pm 0.00018$ MeV (S = 1.8)

Mean life $\tau = (2.6033 \pm 0.0005) \times 10^{-8}$ s (S = 1.2)

$c\tau = 7.8045$ m

$\pi^\pm \to \ell^\pm \nu \gamma$ form factors [a]

$F_V = 0.0254 \pm 0.0017$

$F_A = 0.0119 \pm 0.0001$

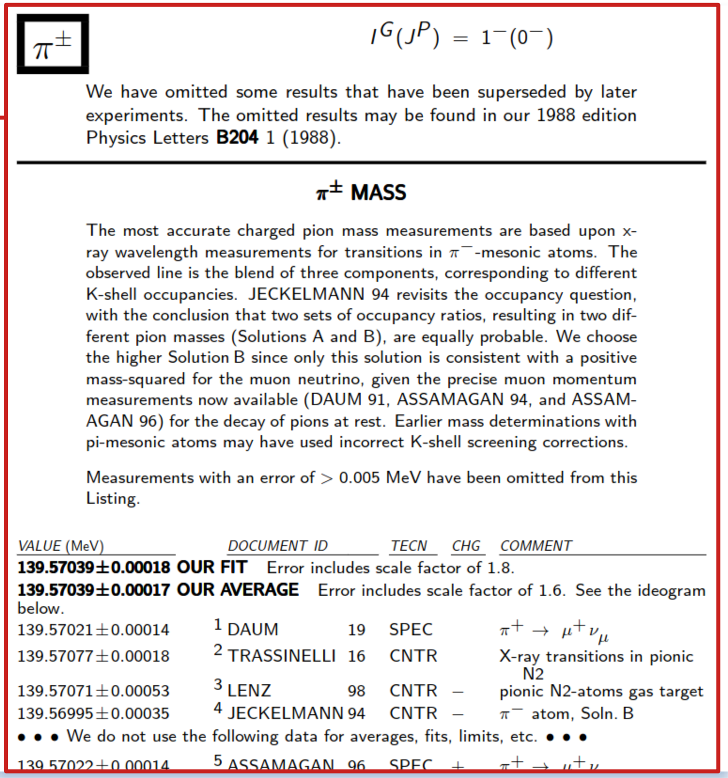
F_V slope parameter $a = 0.10 \pm 0.06$

$R = 0.059^{+0.009}_{-0.008}$

π^- modes are charge conjugates of the modes below.

For decay limits to particles which are not established, see the section on Searches for Axions and Other Very Light Bosons.

π^+ DECAY MODES		Fraction (Γ_i/Γ)	Confidence level	p (MeV/c)
$\mu^+\nu_\mu$	[b]	(99.98770 ± 0.00004) %		30
$\mu^+\nu_\mu\gamma$	[c]	$(2.00 \pm 0.25) \times 10^{-4}$		30
$e^+\nu_e$	[b]	$(1.230 \pm 0.004) \times 10^{-4}$		70
$e^+\nu_e\gamma$	[c]	$(7.39 \pm 0.05) \times 10^{-7}$		70



$\boxed{\pi^\pm}$

$I^G(J^P) = 1^-(0^-)$

We have omitted some results that have been superseded by later experiments. The omitted results may be found in our 1988 edition Physics Letters **B204** 1 (1988).

$\pi^\pm$ MASS

The most accurate charged pion mass measurements are based upon x-ray wavelength measurements for transitions in π^--mesonic atoms. The observed line is the blend of three components, corresponding to different K-shell occupancies. JECKELMANN 94 revisits the occupancy question, with the conclusion that two sets of occupancy ratios, resulting in two different pion masses (Solutions A and B), are equally probable. We choose the higher Solution B since only this solution is consistent with a positive mass-squared for the muon neutrino, given the precise muon momentum measurements now available (DAUM 91, ASSAMAGAN 94, and ASSAMAGAN 96) for the decay of pions at rest. Earlier mass determinations with pi-mesonic atoms may have used incorrect K-shell screening corrections.

Measurements with an error of > 0.005 MeV have been omitted from this Listing.

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*CHG*	*COMMENT*
139.57039±0.00018 OUR FIT	Error includes scale factor of 1.8.				
139.57039±0.00017 OUR AVERAGE	Error includes scale factor of 1.6. See the ideogram below.				
139.57021±0.00014	[1] DAUM	19	SPEC		$\pi^+ \to \mu^+\nu_\mu$
139.57077±0.00018	[2] TRASSINELLI	16	CNTR		X-ray transitions in pionic N2
139.57071±0.00053	[3] LENZ	98	CNTR	−	pionic N2-atoms gas target
139.56995±0.00035	[4] JECKELMANN	94	CNTR	−	π^- atom, Soln. B
• • • We do not use the following data for averages, fits, limits, etc. • • •					
139.57022±0.00014	[5] ASSAMAGAN	96	SPEC	+	$\pi^+ \to \mu^+\nu$

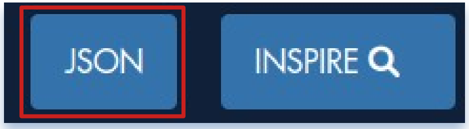
New PDG API with Three Tools

To make PDG data available in machine-readable format, PDG has been developing a new API with three related tools, aimed at different use cases

- **Python API – discussed today**
  - High-level API for programmatic access to PDG data
  - Includes local data store
- **Database files**
  - SQLite files with part of or whole PDG dataset
  - Aimed primarily at software developers
  - Provide the local data store for Python API
- **REST API**
  - Download JSON data directly from pdgLive
  - Can also be used in scripts/programs
  - Intended for incidental, rate-limited use

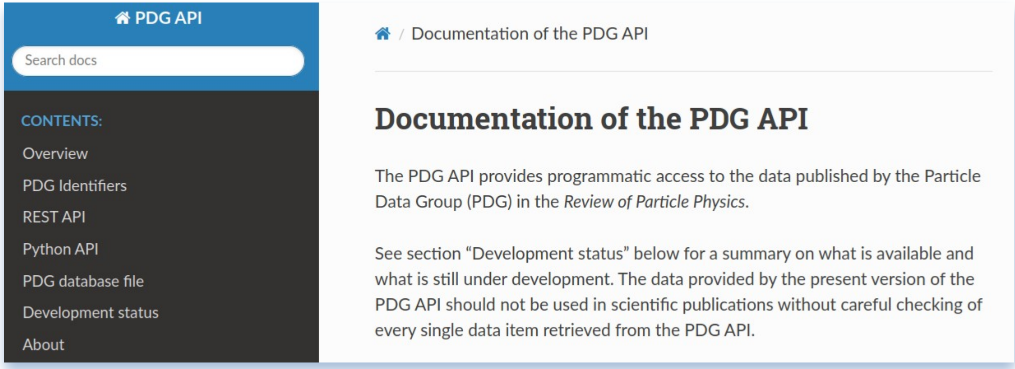
Status:

- First production release with 2024 publication on May 31 (beta version since June 2023)
- Access to Summary Table Data
- Access to Listings data available soon



Python API

- **Implemented in Python package pdg**
  - Supports Python 3 (and for now also 2.7)
  - Installed like any other package
    - For example: `python -m pip install pdg`
  - Released as open-source software
    - github.com/particledatagroup/api
- **Documentation at pdgapi.lbl.gov**

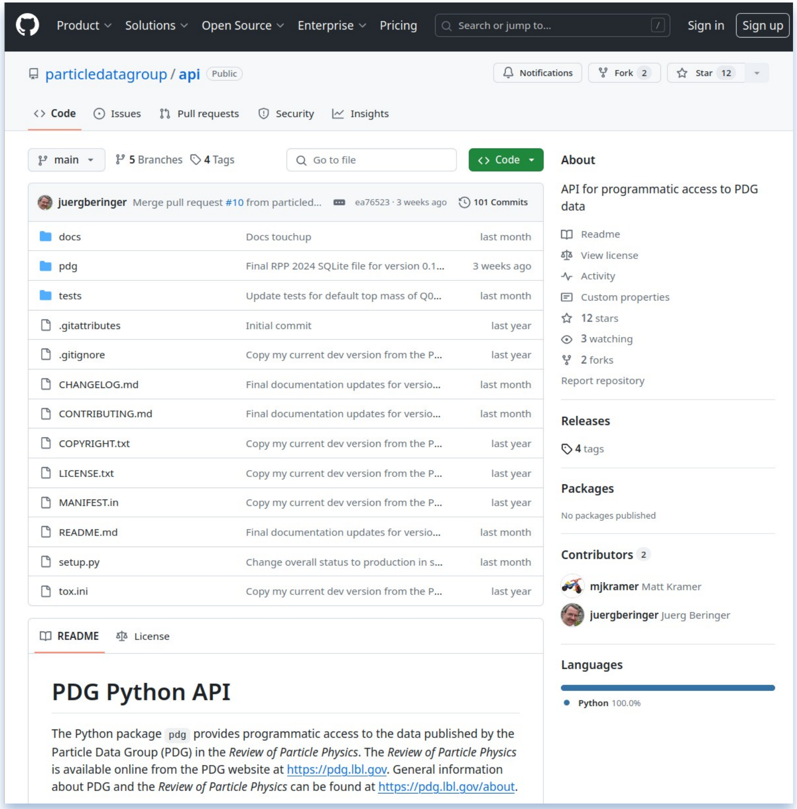


/ Documentation of the PDG API

Documentation of the PDG API

The PDG API provides programmatic access to the data published by the Particle Data Group (PDG) in the *Review of Particle Physics*.

See section “Development status” below for a summary on what is available and what is still under development. The data provided by the present version of the PDG API should not be used in scientific publications without careful checking of every single data item retrieved from the PDG API.



juergberinger Merge pull request #10 from particled... ea76523 · 3 weeks ago 101 Commits

docs	Docs touchup	last month
pdg	Final RPP 2024 SQLite file for version 0.1...	3 weeks ago
tests	Update tests for default top mass of Q0...	last month
.gitattributes	Initial commit	last year
.gitignore	Copy my current dev version from the P...	last year
CHANGELOG.md	Final documentation updates for versio...	last month
CONTRIBUTING.md	Final documentation updates for versio...	last month
COPYRIGHT.txt	Copy my current dev version from the P...	last year
LICENSE.txt	Copy my current dev version from the P...	last year
MANIFEST.in	Copy my current dev version from the P...	last year
README.md	Final documentation updates for versio...	last month
setup.py	Change overall status to production in s...	last month
tox.ini	Copy my current dev version from the P...	last year

README License

PDG Python API

The Python package `pdg` provides programmatic access to the data published by the Particle Data Group (PDG) in the *Review of Particle Physics*. The *Review of Particle Physics* is available online from the PDG website at https://pdg.lbl.gov. General information about PDG and the *Review of Particle Physics* can be found at https://pdg.lbl.gov/about.

About

API for programmatic access to PDG data

Readme
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Activity
Custom properties
12 stars
3 watching
2 forks
Report repository

Releases

4 tags

Packages

No packages published

Contributors 2

mjkramer Matt Kramer
juergberinger Juerg Beringer

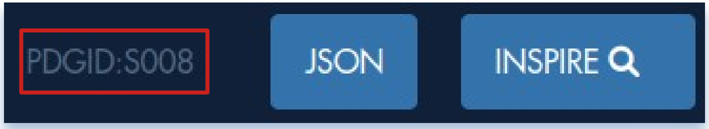
Languages

Python 100.0%

PDG Identifiers

How can one refer to desired particle physics quantities in a program?

- **Easy for some things, e.g. for the charged pion π^+**
  - ASCII name: pi+
  - MC particle number: 211
- **How about $B^0 \to J/\Psi(1S)K^*(892)^0\pi^+\pi^-$?**
- **PDG defines digital object identifiers (“PDG Identifiers”)**
  - Case-insensitive, alphanumeric strings
    - First 4 alphanumeric characters typically denote particle, additional characters for properties
    - STRING.NUMBER for branching fractions
  - Examples
    - S008 for π^+
    - S042.214 for the above decay
  - In most cases can e.g. iterate over quantities, but if PDG Identifier is needed, can look it up e.g. in pdgLive



Now let’s look at some examples

→ Part 2: tutorial Jupyter notebook