
HFLAV-Tau subgroup status and prospects

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for the HFLAV Tau group

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Membership

▶ Members

- ▶ Swagato Banerjee, convener (University of Louisville)
- ▶ Marcin Chrzęszcz (IFJ PAN, Krakow, Poland)
- ▶ Kiyoshi Hayasaka (Niigata University)
- ▶ Alberto Lusiani, convener (Scuola Normale Superiore and INFN Pisa)
- ▶ Mike Roney (University of Victoria)
- ▶ Boris Shwartz (BINP)

▶ Past members

- ▶ Hisaki Hayashii (Nara Woman's University)

HFLAV Tau averages

- ▶ tau branching fractions fit
 - ▶ version with unitarity constraint provided to PDG
- ▶ tau mass (new)
- ▶ tau lifetime (new)
- ▶ elaborations of tau BR fit results
 - ▶ tau Lepton Flavour Universality tests
 - ▶ several $|V_{us}|$ determinations with tau BR measurements
 - ▶ CKM first row unitarity test with tau $|V_{us}|$
- ▶ tau Lepton Flavour Violating BRs upper limits combinations (new, omitted in previous last report)

2023 report changes w.r.t. former reports

Tau branching fractions fit

- ▶ using new Belle II measurement of $\mathcal{B}(\tau \rightarrow \mu \bar{\nu} \nu) / \mathcal{B}(\tau \rightarrow e \bar{\nu} \nu)$ [Adachi, 2024]
- ▶ now including **one nuisance variable** [$\mathcal{B}(a_1 \rightarrow \pi \gamma)$], with Gaussian constraint to its PDG WA
 - ▶ \Rightarrow HFLAV and PDG fits now equal except for unitarity constraint
 - ▶ \Rightarrow uncertainties on fit results now more accurate
 - ▶ \Rightarrow updated software framework, permits easy future improvements with additional nuisance variables
- ▶ now reporting also **results with unitarity constraint**

Tau mass

- ▶ new measurements [Belle II, 2023], [KEDR, 2023]

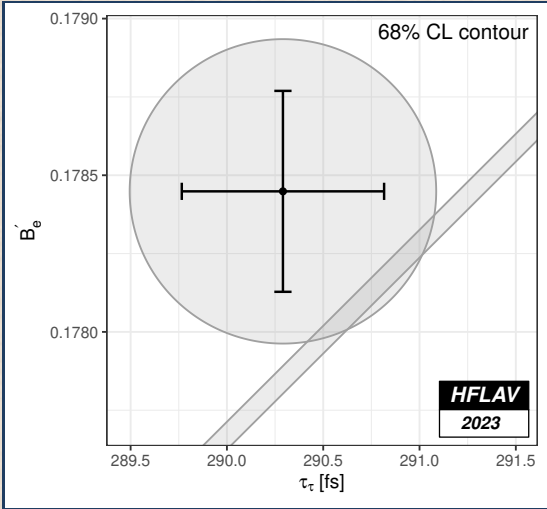
Tau Lepton Universality tests

- ▶ added “canonical” plot of experimental $\mathcal{B}(\tau \rightarrow e \bar{\nu} \nu)$ and tau lifetime vs. the Standard Model prediction

 $|V_{us}|$ determinations

- ▶ new $|V_{us}|$ determination using **lattice computation of $|V_{us}|^2 / R_{us}^T$** [Extended Twisted Mass collab., 2024]

Canonical Tau Lepton Flavour Universality plot



2023 report changes w.r.t. former reports

LFV upper limits combinations

- ▶ **new averaging procedure**
 - ▶ BR central values and uncertainties corresponding to LFV upper limits are obtained
 - ▶ BR measurements are averaged
 - ▶ upper limit on BR average computed assuming Gaussian uncertainty

Zenodo supplemental material

- ▶ **electronic archive of fits inputs and results in Zenodo** for tau BR fit, tau mass, tau lifetime
 - ▶ [doi:10.5281/zenodo.13989054](https://doi.org/10.5281/zenodo.13989054)

Web pages status

- ▶ web pages have been updated today to the 2023 report preprint

Plans for next report, improvements

- ▶ add 2nd order term to QED radiative corrections for LFU tests
 - ▶ negligible effect now but relevant for the future
- ▶ add uncertainty estimate for QED radiative corrections for LFU tests (now assumed exact)
- ▶ **document common systematics**
 - ▶ being evaluated, not full publication-quality plausible for next report
 - ▶ consider documenting most significant common systematics
 - ▶ documentation is available as short comments to text cards used as input to combination: could be published as supplemental material
- ▶ reproducibility
 - ▶ reproducibility well documented in text **except that common systematics are not documented**
 - ▶ considering publishing software + cards to reproduce the BR fit
- ▶ consider adding **more nuisance variables** to tau BR fit
 - ▶ uncertainties on η BRs presently disregarded though not entirely negligible