e, μ and τ

- e, μ:
  - Encoder: C. Grab (ETH Zuerich)
  - Overseer: J. Beringer (LBNL)
  - Review authors: W. Fetscher, H.-J. Gerber (ETH Zuerich) (decay param.)
    A. Hoecker (CERN), W.J. Marciano (BNL) (muon g-2)

- τ:
  - Encoder: K.G. Hayes (Hillsdale College)
  - Overseer: K. Moenig (DESY)
  - Coordinator: J. Beringer (LBNL)
  - Review authors: K.G. Hayes (Hillsdale College) (branching fractions)
    A. Stahl (RWTH Aachen) (decay parameters)

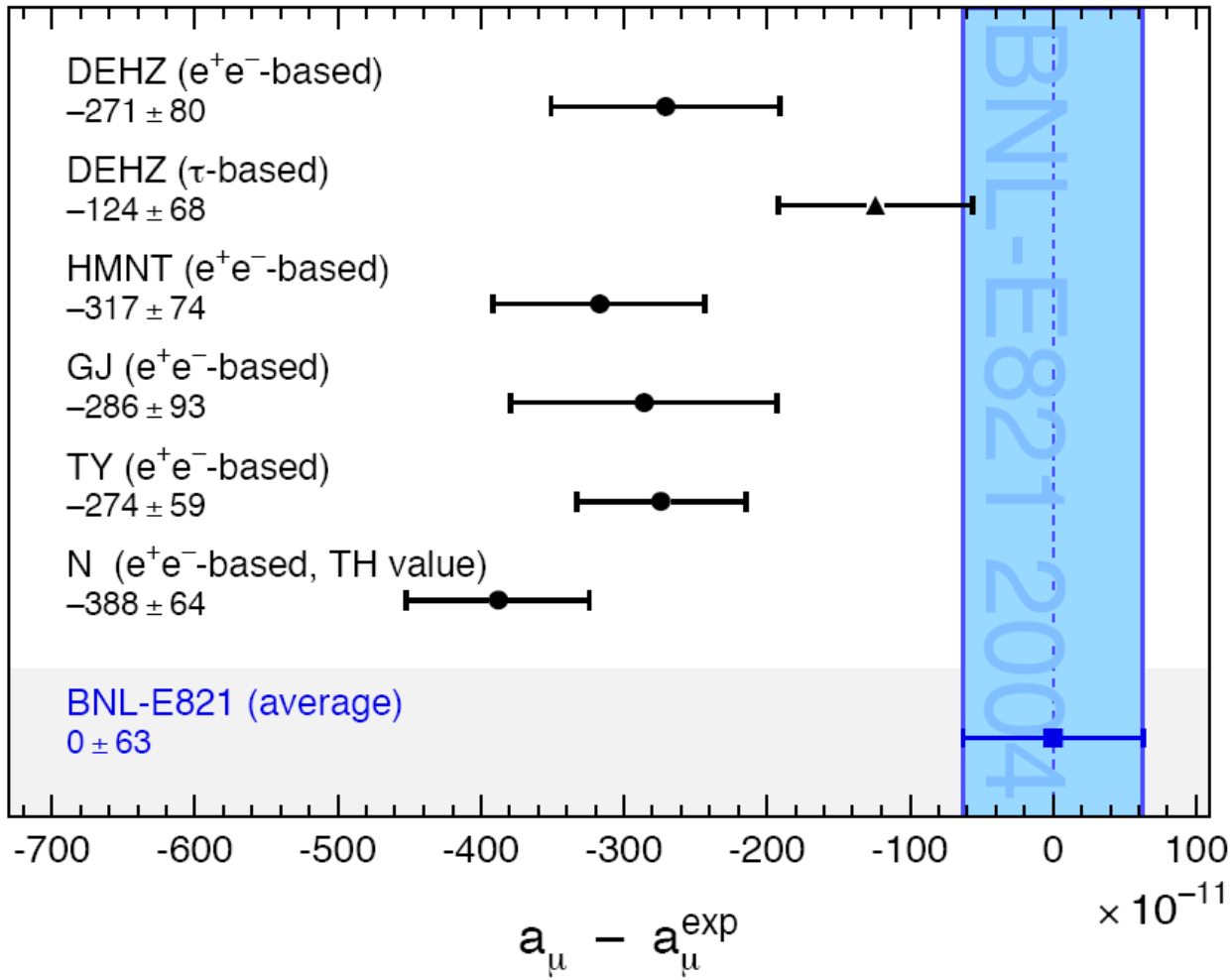
New in RPP 2006

- e, μ:
  - No update of fundamental constants taken from CODATA (2002 CODATA value are still the latest ones available)
  - 1 paper ($a_{\mu^-}^{exp}$ from BNL E821)
  - 4 papers with 10 measurements of muon decay parameters
  - New review on muon anomalous magnetic moment
  - Updated muon decay parameters review
- τ:
  - 19 papers with 68 new measurements
    - About half of the new τ measurements came from B factories
    - Many limits for neutrinoless τ decays greatly improved (average factor of 24)
  - Updated branching ratios review

Status of Muon Anomalous Magnetic Moment

- Final results from BNL E821 (Muon g-2 collaboration) available
- SM calculation discussed in new review
  - Use of e^+e^- vs τ for calculating $a_\mu^{Had}[LO]$
- For e^+e^- - based SM prediction review finds:

$$a_\mu^{\rm exp} - a_\mu^{\rm SM} = 22(10) \times 10^{-10}$$

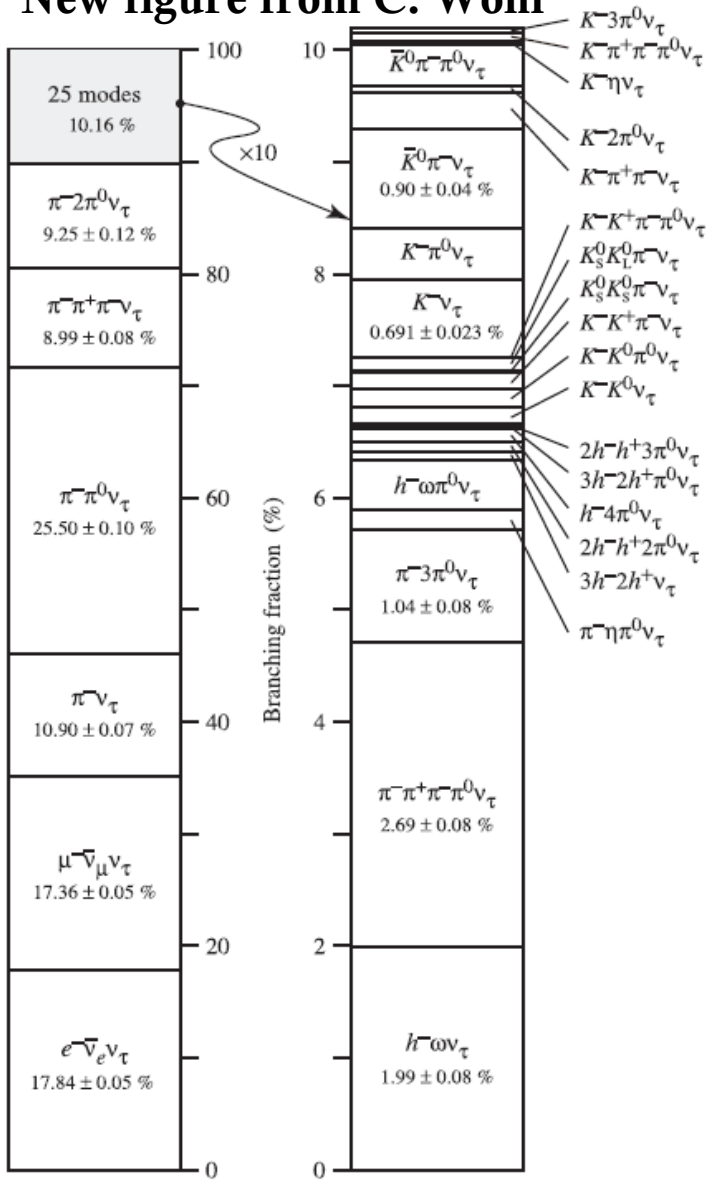


Basis Modes for τ Branching Fraction Fit

Table 1: Basis modes for the 2006 fit to τ branching fraction data.

$e^-\overline{\nu}_e\nu_\tau$	$K^-K^0\pi^0\nu_\tau$
$\mu^-\overline{\nu}_\mu\nu_\tau$	$\pi^-\pi^+\pi^-\nu_\tau$ (ex. K^0,ω)
$\pi^-\nu_\tau$	$\pi^-\pi^+\pi^-\pi^0\nu_\tau$ (ex. K^0,ω)
$\pi^-\pi^0\nu_\tau$	$K^-\pi^+\pi^-\nu_\tau$ (ex. K^0)
$\pi^-2\pi^0\nu_\tau$ (ex. K^0)	$K^-\pi^+\pi^-\pi^0\nu_\tau$ (ex. K^0,η)
$\pi^-3\pi^0\nu_\tau$ (ex. K^0)	$K^-K^+\pi^-\nu_\tau$
$h^-4\pi^0\nu_\tau$ (ex. K^0,η)	$K^-K^+\pi^-\pi^0\nu_\tau$
$K^-\nu_\tau$	$h^-h^-h^+2\pi^0\nu_\tau$ (ex. K^0,ω,η)
$K^-\pi^0\nu_\tau$	$h^-h^-h^+3\pi^0\nu_\tau$
$K^-2\pi^0\nu_\tau$ (ex. K^0)	$3h^-2h^+\nu_\tau$ (ex. K^0)
$K^-3\pi^0\nu_\tau$ (ex. K^0,η)	$3h^-2h^+\pi^0\nu_\tau$ (ex. K^0)
$\pi^-\overline{K}^0\nu_\tau$	$h^-\omega\nu_\tau$
$\pi^-\overline{K}^0\pi^0\nu_\tau$	$h^-\omega\pi^0\nu_\tau$
$\pi^-K^0_SK^0_S\nu_\tau$	$\eta\pi^-\pi^0\nu_\tau$
$\pi^-K^0_SK^0_L\nu_\tau$	$\eta K^-\nu_\tau$
$K^-K^0\nu_\tau$	

New figure from C. Wohl



Constrained Fit to τ Branching Fractions

- Branching fraction values for 82 out of 114 τ decay modes are derived from a constrained fit
  - Fit uses 31 basis modes forming an exclusive set whose BFs sum to 1
  - Constrained fit has χ^2 of 77.5 for 95 degrees of freedom
- Two precise new measurements led to significant (> 2σ) changes in several τ branching fractions
  - $B(\tau^- \rightarrow K^-K^+\pi^-\pi^0\nu)$ changed from $(4.2 \pm 1.6)\times10^{-4}$ to $(0.61 \pm 0.2)\times10^{-4}$ due to a new measurement from CLEO3 (99% weight in average)
  - ALEPH published complete set of τ branching fraction measurements which supersede their earlier published results
- Fit uses new scale factor procedure (developed mostly for kaon fit) which leads to minor improvement of scale factors

Overconsistency of Leptonic τ BF

- Discussed in detail 2 years ago
- Situation is more or less unchanged:
  - $P(\chi^2 < \chi^2(B_e)) = 1.3\%$ (was 0.75%) for $B_e \equiv B(\tau^- \to e^- \overline{\nu}_e \nu_\tau)$
  - $P(\chi^2 < \chi^2(B_\mu)) = 0.08\%$ (was 0.09%) for $B_\mu \equiv B(\tau^- \to \mu^- \overline{\nu}_\mu \nu_\tau)$

Relationship Coefficients

- In some fits, branching fractions from other particles used as coefficients
- These coefficients are currently input manually and are not linked to the corresponding branching fractions in the database
  - If corresponding branching fractions change, coefficients should be updated
  - Since the two particles concerned are often handled by different people, this is likely to be forgotten
- As part of the computing upgrade, Slava wrote a program to at least check the consistency of coefficients and corresponding branching fractions
  - Plan to add mechanism to link coefficients to branching fractions in database
- Most significant inconsistencies in τ and $\psi(2S)$ fits
  - A few smaller inconsistencies
  - Effect of all inconsistencies relatively small

Example from τ Fit in RPP 2005

$\Gamma(h^- h^- h^+ \nu_\tau)/\Gamma_{\text{total}}$ Γ_{54}/Γ

$$\Gamma_{54}/\Gamma = (0.3431\Gamma_{33} + 0.3431\Gamma_{35} + \Gamma_{60} + \Gamma_{82} + \Gamma_{89} + 0.0221\Gamma_{137})/\Gamma$$

?

$\Gamma(h^- \omega \nu_\tau)/\Gamma_{\text{total}}$

$\omega(782)$ DECAY MODES

	Mode	Fraction (Γ_i/Γ)	Scale factor/ Confidence level
Γ_1	$\pi^+\pi^-\pi^0$	(89.1 ±0.7) %	S=1.1
Γ_2	$\pi^0\gamma$	(8.90 $^{+0.27}_{-0.23}$) %	S=1.1
Γ_3	$\pi^+\pi^-$	(1.70±0.27) %	S=1.4

59 τ S035R28 $\Gamma(h^- h^- h^+ \nu_\tau)$ / Γ_{total} Γ_{54}/Γ = (0.3431Γ_{33} + Γ_{60} + Γ_{82} + Γ_{89} + 0.3431Γ_{35} + 0.0221Γ_{137})/ Γ

coefficient DecayMode	*Current value*		*Unstable particle mode, link*(pc|des)		
0.3431Γ_{33} $\tau^- \to h^- \bar{K}^0 \nu_\tau$	0.5*(68.95 ± 0.14) × 10^{-2}	0.34475	$K^0_S \to \pi^+ \pi^-$ S012|1	0.00165	0.5%
0.3431Γ_{35} $\tau^- \to K^- K^0 \nu_\tau$	0.5*(68.95 ± 0.14) × 10^{-2}	0.34475	$K^0_S \to \pi^+ \pi^-$ S012|1	0.00165	0.5%
0.0221Γ_{137} $\tau^- \to h^- \omega \nu_\tau$	(1.70 ± 0.27) × 10^{-2}	0.017	$\omega(782) \to \pi^+ \pi^-$ M001|2	-0.0051	26.1%