Some personal comments on an interesting paper

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A good theoretical paper from N. Cabibbo

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Semileptonic Hyperon Decays and Cabibbo-Kobayashi-Maskawa Unitarity

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Using a technique that is not subject to first-order SU(3) symmetry breaking effects, we determine the V_{us} element of the Cabibbo-Kobayashi-Maskawa matrix from data on semileptonic hyperon decays. We obtain $V_{us} = 0.2250(27)$, where the quoted uncertainty is purely experimental. This value is of similar experimental precision to the one derived from K_{l3}, but it is higher and thus in better agreement with the unitarity requirement, $|V_{ud}|^2 + |V_{us}|^2 + |V_{ub}|^2 = 1$. An overall fit, including the axial contributions and neglecting SU(3) breaking corrections, yields $F + D = 1.2670 \pm 0.0035$ and $F - D = -0.341 \pm 0.016$ with $\chi^2 = 2.96/3$ degrees of freedom.

Is precision the only important thing?

While a lot of attention has recently been justly devoted to the higher mass sector of the CKM matrix, it is the low mass sector, in particular, V_{ud} and V_{us}, where the highest precision can be attained. The most sensitive test of the unitarity of the CKM matrix is provided by the relation $|V_{ud}|^2 + |V_{us}|^2 + |V_{ub}|^2 = 1 - \Delta$. Clearly, the unitarity condition is $\Delta = 0$. The $|V_{ub}|^2$ contribution [7] is negligible (10^{-5}) at the current level of precision. The value $V_{ud} = 0.9740 \pm 0.0005$ is obtained from superallowed pure Fermi nuclear decays [8]. In combination with $V_{us} = 0.2196 \pm 0.0023$, derived from K_{e3} decay [9,10], this yields $\Delta = 0.0032 \pm 0.0014$. At face value, this represents a 2.3 standard deviation departure from unitarity [8].

Contribution from new physics overestimated!

TABLE I. Results from V_{us} analysis using measured g_1/f_1 values.

Decay Process	Rate (μsec^{-1})	g_1/f_1	V_{us}
$\Lambda \to pe^-\overline{\nu}$	3.161(58)	0.718(15)	0.2224 ± 0.0034
$\Sigma^- \to ne^-\overline{\nu}$	6.88(24)	$-0.340(17)$	0.2282 ± 0.0049
$\Xi^- \to \Lambda e^-\overline{\nu}$	3.44(19)	0.25(5)	0.2367 ± 0.0099
$\Xi^0 \to \Sigma^+ e^-\overline{\nu}$	0.876(71)	$1.32(+.22/-.18)$	0.209 ± 0.027
Combined			0.2250 ± 0.0027

The four values are clearly consistent ($\chi^2 = 2.26/3$ DOF) with the combined value of $V_{us} = 0.2250 \pm 0.0027$. This value is nearly as precise as that obtained from kaon decay ($V_{us} = 0.2196 \pm 0.0023$) and, as observed in previous analyses [15–17], is somewhat larger. In combination with $V_{ud} = 0.9740 \pm 0.0005$ obtained from superallowed pure Fermi nuclear decays [8], the larger V_{us} value from hyperon decays beautifully satisfies the unitarity constraint $|V_{ud}|^2 + |V_{us}|^2 + |V_{ub}|^2 = 1$.

pdg.lbl.gov/2018/reviews/rpp2018-rev-ckm-matrix.pdf

where the accuracy is limited by the knowledge of the ratio of the decay constants. The average of these two determinations is quoted as [10]

$$|V_{us}| = 0.2243 \pm 0.0005. \quad (12.8)$$

Some comments

- precision is not the only important thing
  - Unbiasedness is also very important
- Independent measurements are worth of performing, even results with higher precisions already released.
- **What kind of paper is a good/important one?**
  - It is about **physics**, not impact factor or whether published on Nature or Science.
  - Rise an important question
  - Or answer an important question.