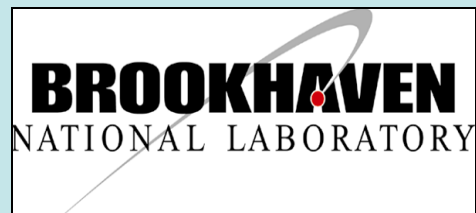


*Creutzfest 2014*  
*A Lattice Gauge Theory Celebration*  
*“Formalism vs Phenomenology”*

*William J. Marciano*  
*High Energy Theory*



**A Narrow 33 year perspective**  
**on**  
**Lattice QCD**

I joined the BNL HEP Theory Group in 1981  
Isabelle (800 GeV pp Collider) was under construction  
It would later be abandoned by HEP → Nuclear RHIC

HEP Theory Group – Very Strong Lattice Effort  
(Mike Creutz & Claudio Rebbi)

Monte Carlo study of quantized SU(2) gauge theory

Phys. Rev. D **21**, 2308 – Published 15 April 1980 Michael Creutz

**870 Citations!**

In 2004, After 23 years and more than 100 lattice seminars, I finally wrote a paper with **“lattice”** in the title. Using precise lattice calculations of  $f_K/f_\pi$  to determine the Cabibbo Angle (***Ratios are more precise!***)

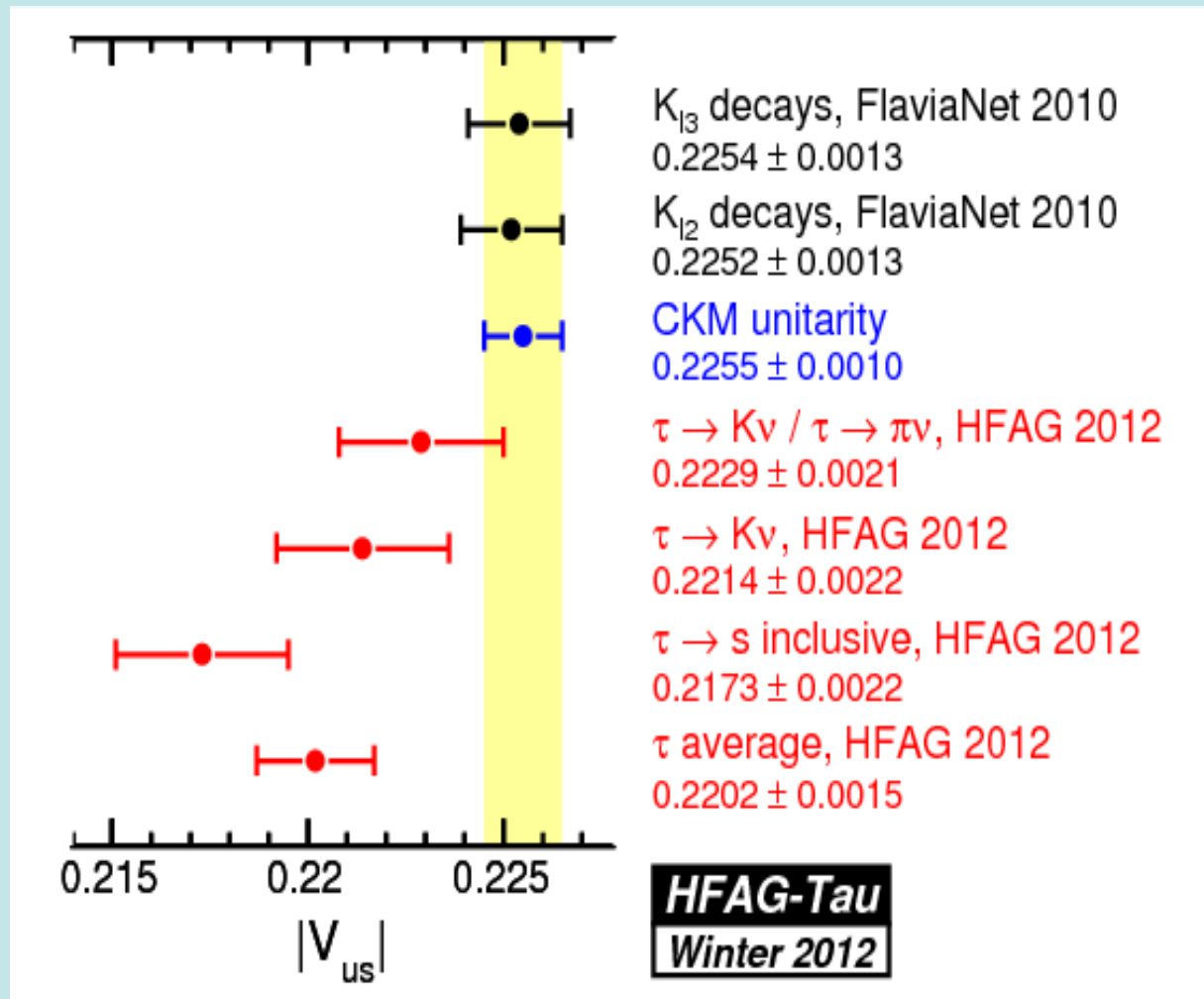
***I must have been paying attention***

***Precise determination of  $|V(us)|$  from lattice calculations of pseudoscalar decay constants William J. Marciano (Brookhaven). Feb 2004. 4 pp. Published in Phys.Rev.Lett. 93 (2004) 231803***

***I expected this  $K_{l2}$  approach ( $K \rightarrow \mu\nu/\pi \rightarrow \mu\nu$ ) to become the standard, replacing  $K_{l3}$  ( $K \rightarrow \pi l\nu$ ) decays***

***$f_K/f_\pi$  vs  $f_+(0)$  lattice approaches***

# $V_{us}$ from K & tau decays 2012 (Kaneko & Sciascia)



## **Some Recent Lattice (2014) Developments**

MILC  $f_+(0)$  getting larger

$K_{l3} V_{us}=0.2254(13) \rightarrow 0.22290(90)$  **CKM Unitarity?**

MILC  $(f_K/f_\pi)$  stable

$K_{l2} V_{us}=0.2252(13) \rightarrow \mathbf{0.22487(62)}$  Very Little Shift

HPQCD  $(f_K/f_\pi)$  most precise

$K_{l2} V_{us}=0.2252(13) \rightarrow \mathbf{0.22564(53)}$

Combined with Nuclear beta decays  $V_{ud}=\mathbf{0.97425(22)}$

$|V_{ud}|^2 + |V_{us}|^2 + |V_{ub}|^2 = \mathbf{1.00009(51)}$  **Major Lattice Success**

**Constrains “New Physics”**

Still some loose ends but

**Precision Lattice QCD has come of age**