THE CABIBBO MIXING ANGLE (CMA) DERIVATION: IS OUR MATHEMATICAL DERIVATION OF THE CABIBBO MIXING ANGLE (CSMA) EQUIVALENT?

Edward R. Close PhD and Vernon M. Neppe MD, PhD, FRSSAf [abcd]

PERSPECTIVE

What is the CMA?

The Cabibbo mixing angle (CMA) in Particle Physics refers to an esoteric mixing angle that was originally described in quarks. For fifty years scientists unsuccessfully tried to derive this angle knowing empirically that it was about 13.04 degrees. [1-3] But no-one could derive the CMA on quarks. There are 2 major reasons why angle could not be derived.

1. 3S-1t was insufficient to calculate the CMA

Scientists regarded our reality as made up of 3 dimensions of space in a moment in time (3S-1t). This makes the CMA impossible to derive.

Furthermore, even if they went outside 3S-1t, there was only one solution: Applying a 9-dimensional spin paradigm. But this solution was unknown to them.

2. Quarks cannot easily be measured

The second reason is this might be partly because the size of quarks, on which the CMA is calculated, cannot be exactly measured at this point, possibly because quarks are tightly contained only as small elementary particles within the protons and neutrons. [4] This would make such measurements impossible at this time, unless an alternative technique was applied. The inability to measure quark size, therefore, does not allow derivation mathematically of the CMA directly from quarks. Moreover, there are unstable particles such as the charm quarks and strange quarks which empirically in a stable environment could not and should not be taken into account because they're unstable, however, at any point, they might slightly impact the calculated 13.04 CMA range, and hence possibly the original large given range was ±0.05 so 12.99 to 13.09).

The electron approach and 9-dimensional spin

---

[a] Vernon M. Neppe MD, PhD, Fellow Royal Society (SAf) **, DSPE, Pacific Neuropsychiatric Institute, Seattle; and Exceptional Creative Achievement Organization (Distinguished Fellow *, Distinguished Professor **) and Edward R. Close PhD, PE *. For perspective, Prof. Neppe is a Behavioral Neurologist, Neuropsychiatrist, Neuroscientist, Psychopharmacologist, Forensic specialist, Psychiatrist, Phenomenologist, Neuroscientist, Epileptologist, Consciousness Researcher, Philosopher, Creativity expert, and Dimensional Biopsychophysicist. His CV includes 10+ books, 2 plays, 650+ publications, 1000+ invited lectures and media interactions worldwide (http://www.vernonneppe.org/about.php), Dr. Close is physicist, mathematician, cosmologist, environmental engineer and Dimensional Biopsychophysicist. *Transcendental Physics* is one of Dr. Close's 8+ books. (www.erclosetphysics.com).

[b] The material in this article has been peer-reviewed.

[d] We gratefully acknowledge the editorial assistance of Jacqueline Slade.

Importantly, we could apply a different method. We use the phrase "Cabibbo-spin mixing angle" (CSMA), instead, because we examine a group of another fermion elementary particles, namely electrons, not quarks. Empirically, electrons do not manifest a CMA, so this derivation would be theoretical. Therefore, theoretically, there might be differences between the equivalence of the size of the CSMA in electrons to the size of the CMA in quarks. However, we postulated that this difference would not be pertinent and that the calculations would remain in the very narrow 13.03 to 13.05 degree range.

But the question has, nevertheless, come up regarding the application of why we apply the Cabibbo mixing angle in our electron derivation. There are two answers: a more general one, and a more specific one.

GENERAL REASONING:

Why the spinning electron is justified:

A critique of the limiting volume of the spinning electron to particles other than electrons, namely other fermions comprised of quarks, is probably because one or more of the following has not been taken into account:

1. The fact, proved by Einstein, that the light-speed limitation is absolute in the 3-D space of physical observation for *any* spinning particle, not just electrons [5-8];
2. The absolute necessity of normalizing all measurements to integer multiples of a minimal TRUE unit, required by Planck's discovery that reality is quantized [9; 10] ; and
3. Because of #2, many scientists based on their training with the only "calculus" they know, namely Newton-Leibniz calculus [11], don't realize that applying statistical values and vanishing infinitesimals [12] to derive fractional, irrational and imaginary numbers in the matrices describing quantum reality, is inappropriate because quantized reality requires integers to represent basic quantities in real space. [11]

To understand why the Close-Neppe derivation of the Cabibbo angle from particle spin (the CSMA) is equivalent to the Cabibbo mixing angle of particle physics, one must first understand what the Cabibbo angle actually *is*.

To understand what the Cabibbo angle is, one must look at how the Cabibbo angle was originally derived from the matrix algebra analysis of particle decay. [3; 13-16]

What do we apply?

Specifically, we use the concept of mass/energy equivalence at the quantum level. We need to apply:

- Integer solutions of Schrödinger's wave equation [17]
- Louis de Broglie's matter-wave concept of photons and electrons 1, with De Broglie's wave equation: $\lambda = h/mv$ [18]
- Werner Heisenberg's matrix algebra description of quantum states [19]
- Equivalent ways of quantizing the probability distribution of the location of a particle in 3-D space and its angular momentum (energy) at any point in time. [20; 21]

We must also understand matrix algebra and vectors in regard to particle physics:

- A matrix describing the quantum state of a particle is simply an array of numbers. In the current particle physics paradigm, these numbers for a given particle are expected values derived statistically from the raw data from particle colliders like the LHC [22].
- Any symmetric matrix (a square array in 2-D or a cubic array in 3-D, etc.) has a characteristic vector associated with it that depends upon the values of the individual numbers in the array. A matrix involves a rectangular array of quantities or expressions in rows and columns that is treated as a single entity and manipulated according to particular rules.
- The direction of this vector, called the eigenvector of the matrix, does not change when the matrix is involved in geometric and mathematical operations.

The case of quarks:
When the matrix algebra approach is applied to quarks, the angular difference in the direction of the eigenvectors for down quarks and up quarks represents the probability that a down quark created in a particle collider collision will decay into an up quark. To properly define the numbers in the matrices in the current paradigm, the matrix representation of a particle or system of particles is a Lagrangian or Hamiltonian matrix, depending on the way the mathematical relationships are expressed. [23] The magnitude and direction of mass eigenvectors define a vector "space", but this is not a real space. It is a pseudo-space, since it is defined by variables of content: mass and energy.

The case of spin in electrons:
This is part of what makes the concept of a "mixing angle" as conceived in the current paradigm so confusing and hard to relate to rotation and particle spin. Cabibbo spin mixing angles measure the probability of one elementary fermion changing to another, e.g. an electron to an electron neutrino, or an up quark to a down quark, under the influence of the so-called "weak force". [15; 24-27]

The conceptual approach to 9-D spin:
In our 9-D spin paradigm, we describe all of this in a very different way: *We conceptualize this as exhibiting symmetric stability and linkage through sequentially encompassing dimensional domains* that hold quarks, protons and neutrons, atoms and molecules together, not a 'force'. We concentrate now more on the specific CSMA issue.

THE SPECIFIC PRICIPLES:
CMA vs CSMA
Pragmatically, we regard the derivation of the CSMA with electrons as equivalent to the CMA with quarks, because both are fermions with half-spin when experienced from the framework of the 3S-1t dimensional domain. [28-30] Using electrons has the major advantage that they are measurable particles, and their sizes have been established by years of data. [22]

We postulated that the same theoretical principles would be applicable to all fermions. However, when one does calculations with our usual 3S-1t, we cannot derive any CSMA. *Similarly, we cannot derive such an angle with any dimensional calculation other than using a finite 9-dimensional spinning model.*
Historically, Close and Neppe proposed in the 2nd Edition of their book *Reality Begins with Consciousness* in 2012 [31] that our finite reality consisted of 9-dimensional spin when applying their TDVP model [e]. Therefore, the CSMA derivation was a validation of two hypotheses:

- 9-D spin plus that
- 9-D spin was an important part of TDVP.

The 9-D spin hypothesis:
Effectively, if any test of the CSMA proved correct when applying only the properties of a specific 9-dimensional spin mathematical derivation and not when derivable from other number of dimensions. This:

1. would illustrate that the derivation of the CSMA is related to 9-dimensional spin and provide strong evidence for the theoretical existence of a 9D spin model;
2. would strongly confirm the presence of a theoretical 9D spin model;
3. would demonstrate the proposed prior major hypothesis that 9D spin can exist as part of the model of TDVP;
4. this finding would be huge because it suggests that 9D spin models are appropriate. But it really is exceedingly important whether or not it's argued that the CSMA and the CMA are the same, because either way they illustrate 9-D spin;
5. if the CSMA and CMA are regarded as very close to mathematically equal in derivation, this finding would strongly support the 9-D derivation of the CMA as well as the CSMA because of their equivalence.

The acceptable derived CSMA size range:
What CSMA size would appropriately confirm the derived figure? The usual acceptable range has been argued to be between 12.99 to 13.09 degrees based on the reported Collider data [22], but mathematically, this range had never before been theoretically derived.
However, we wanted to be more stringent, and post hoc, preferred a derivation of 13.04 degrees ± 0.01 so to us an acceptable range would have been 13.03 to 13.05. This is particularly so as we were assuming that the CSMA and CMA would be equivalent so one wants a narrower range.
As it happens the original derivation was 13.032 within the accepted range. This proved the mathematical derivation of the CSMA.

There are several further lines of evidence supporting this 9-D spin derivation.

---

[e] See p 90, p92, p94, p104, p115, p129, p131; chapter 30, p203-4, p 219, p253, p222, p223, p230, p256 RBC 2 Chapter 36; postulate of at least 9 dimensions and spin [31]

First, there are several lines of further evidence for 9-D-spin that we have reported using other derivations, such as angular momentum. [32 33-35] That further supports our hypothesis of 9-D-spin and supports this as in the TDVP 9-D finite model.
This further replication by a separate technique produced a figure of 13.0392 based on a thought experiment. [36]
Second, we hypothesized that there would be other evidence for 9D-spin: Indeed there is and we have been able to demonstrate

- intrinsic electron spin, and extrinsic angular momentum, [21]
- the conundrums with possibly non-spherical electron shape, [37] and
- the disappearing electron cloud. [22; 38; 39]

These all support the 9D model.

Therefore there is more than just the CSMA and CMA equivalence, though these other factors (angular momentum, electron spin, shape and cloud) all intercorrelated somewhat with CSMA findings, but support the model. [29 1]

Further implications:
The hypothesized confirmation of the finding that the angles of fermions, be they quarks or electrons, are the same order of magnitude and likely to be equivalent was shown to be true:

It is very likely that this implies real Cabibbo mixing angle equivalence in both quarks and electrons, and is not just a bizarre coincidence. This is even more so when other support is provided for 9D spin, as above. The fact that empirically the CSMA is not required with electrons is largely irrelevant, because this derivation is purely theoretical.

The CMA is quoted when the empirical mixing angle is derived artificially from atom-smasher collider data. Collider data in itself are artificial producing unstable particles and therefore all empirical collider data, even the Higgs boson and including the CMA, could be regarded as "not natural". In fact, physicists even differ as to what the CMA is and how it relates to frequency in collider data. [40 41 42 14 15 16 43 3 44]

This might explain the wide variation proposed for the CMA. This may be why the CMA, as originally proposed, applied a very large measurable range 13.04 degree ± 0.5 figure (so 12.90 to 13.09) —a variation of up to 1/250! Yet, no-one in 50 years could solve the reason for the size of this strange CMA even when using the much larger ± 0.5 degree range.

This is why we regarded a variation of ±0.1 as more logical so 13.03 to 13.05 with a variation of 1/1250 our data easily fit. In fact, as it happens, the CSMA derivation is almost identical to the CMA.

Is our derivation of the CSMA real?
Some could argue our CSMA derivation result is coincidental, but it is very unlikely given a

hypothesis was being tested and the numbers derived so accurately reflect the CMA from collider data.

Our CSMA figure was 13.032 (0.08 less [only 1/1500 variation from the original derivation]. However, the CMA was never quoted to five figures and our figure might turn out to be a far closer derivation than the given possible range.
Moreover, the later separate thought-experiment calculation, again based on a 9-dimensional spin model, derived what we regard as the most accurate figure to six significant figures for the CSMA of 13.0392 degrees. This might be the most accurate method [36] and the technique certainly correlates with the original derivation [1; 29; 45].
We have therefore taken into account the differences from CMA and CSMA in these fermions.

However, there is a difference between electrons and quarks: electron orbits are different because they widely rotate round the atom. This difference has been postulated to reflect different strong and weak electromagnetic forces. However, we see no reason why this should be relevant to our derivation. We argue that variables relating to unique electron properties were taken into account and its differing from quarks.

Same or different?
So the debate is “would this difference be relevant”?

Therefore we look for further evidence: The further findings we've showed of several other models applying the 9-D spin concept (intrinsic angular momentum and spin, electron cloud, non-spherical electron) make the 9-spin concept replicated even without the CSMA derivation. There is a likely inter-correlations, but we regard the derivations as independent of the Cabibbo derivation.

Does the CSMA reflect the CMA? Precedents.
We have equated the CSMA from the electron with the CMA from the quark. Is this appropriate?

We must examine methods in particle physics applying other metaphors: Importantly, particle physics commonly applies sometimes arbitrary assumptions to describe phenomena. Color is one example, and a second is the use of concepts like "half-spin" in a 3S-1t environment. These are theoretical concepts, as well. The physicist’s concepts of spin is rather esoteric: it is not really spin, just a name related to how all the types of subatomic particles are made up of quarks that have to have fractional spin and so forth. If there is an analogy it may be only vague or unclear one correlates the mathematics involved. [31]

We apply conceptual metaphors in mathematics, as well: Mathematically, we graph the complex plane though there is no such thing; it is just represented only as a 2-D graph. [46]
Hyperspaces in Matrix Algebra and Vector Multidimensional Spaces are represented by

numbers that can be organized. [47; 48]. These are simply ways of representing the numbers as pseudo-dimensions.
In the *Laws of Form in Logical Systems*: Existence has no meaning logically for Spencer Brown : [49]:
Yet, we argue that Form is very much a part of existing reality. Therefore, the conceptual jump from CMSA and CMA appears justified. When there are significant indications of equivalence such a justification appears to be appropriate. [11]

1. Close ER, Neppe VM: The Cabibbo mixing angle and other particle physics paradoxes solved by applying the TDVP multidimensional spin model. *IQNexus Journal* 14: 1; 13-50, 2014
2. Morisi S, Peinado E, Shimizu Y, et al.: Relating quarks and leptons without grand unification. *Physical Review D, vol. 84, Issue 3, id. 036003* 84: 3; 036003, 2011.
3. Fritzsch H: Calculating the Cabibbo angle. *Physics Letters B* 70: 4; 436–440, 1977
4. Shifman M, Loffe BL: *The frontier of particle physics: Handbook of QCD*, Vol. 4. Singapore: World Scientific Publishing 2002.
5. Einstein A: *Relativity, the special and the general theory—a clear explanation that anyone can understand*. London: Routledge and Kegan Paul, 2001.
6. Minkowski H, Lorentz HA, Einstein A, et al.: *The principle of relativity: a collection of original memoirs*: Dover, 1952.
7. Einstein A: *Physics and Reality*. http://www.kostic.niu.edu/: Monograph, 1936.
8. Einstein A, Podolsky B, Rosen N: Can quantum-mechanical description of physical reality be considered complete? *Phys. Rev.* 47: 10; 777-780, 1935.
9. Heilbron JL: *The dilemmas of an upright man: Max Planck and the fortunes of German science.* . Cambridge, MA: Harvard University Press., 2000.
10. Planck M: *Max Planck: Scientific Autobiography and Other Papers*. New York: Harper 1949.
11. Close ER, Neppe VM: The Calculus of Distinctions: A workable mathematicologic model across dimensions and consciousness. *Dynamic International Journal of Exceptional Creative Achievement* 1210: 1210; 2387 -2397, 2012.
12. Lamb H: *An elementary course in infinitesimal calculus*. Cambridge, UK.: Cambridge University Press, 1924.
13. BloggerAnonymous: Theoretical calculation of Cabibbo and Weinberg angles 2011.
14. Hughes IS: Cabibbo Mixing, in *Hughes, I.S.*, Vol. Elementary Particles (3rd ed.). Edited by Hughes IS. Cambridge University Press.: Cambridge, England. pp. 242–243 1991.
15. Reifler F, Morris R: Prediction of the Cabibbo angle in the vector model for electroweak interactions. *J. Math. Phys.* 26: 8; 2059-2066, 1985.
16. Yang GC, Liu HC, Luo LF: A derivation of the cabibbo angle and quark-lepton masses from a composite model. *Lettere Al Nuovo Cimento Series 2* 37: 3; 111-115, 1983.
17. Sherwin CW: *Introduction to quantum mechanics*, Vol. Appendix VI. New York: Holt, Rinehart and Winston, 1960.

18. De Broglie L: *The reinterpretation of wave mechanics*. Paris, France: Académie des Sciences, Institut de France, 1924.
19. Sherwin CW: *Introduction to quantum mechanics*. New York: Holt, Rinehart and Winston, 1960.
20. Close ER, Neppe VM: The eighth conundrum: angular momentum and intrinsic electron spin. *IQNexus Journal* 7: 2; 44-45, 2015.
21. Anonymous: Angular momentum http://en.wikipedia.org/wiki/Angular_momentum,2013.
22. Fischer W, Blaskiewicz M, Brennan M, et al.: Electron cloud measurements and simulations for the Brookhaven Relativistic Heavy Ion Collider. *PRST-AB 5* 124401 2002.
23. Arnold VI: *Mathematical methods of classical mechanics*. New York: Springer-Verlag, 1989.
24. Close ER, Neppe VM: The tenth conundrum: weak universality based on the 9D findings. *IQNexus Journal* 7: 2; 50, 2015.
25. Anonymous: June 11, 2011). Weak interaction. 2011, from http://en.wikipedia.org/wiki/Weak_force. 2011.
26. Kobayashi M, Maskawa T: CP-Violation in the renormalizable theory of weak interaction. *Progress of Theoretical Physics* 49: 2; 652–657, 1973.
27. Glashow SL, Iliopoulos J, Maiani L: Weak interactions with lepton–hadron symmetry. *Physical Review D* 2: 7; 1285–1292, 1970.
28. Biggio C, Feruglio F, Masina I, et al.: Fermion generations, masses and mixing angles from extra dimensions. *J. Nuclear Physics* B DOI:10.1016: 10.052; 1-22, http://www.researchgate.net/researcher/9966595_Carla_Biggio/.2003.
29. Close ER, Neppe VM: The seventh conundrum: the mathematical derivation of the Cabibbo mixing angle in fermions. *IQNexus Journal* 7: 2; 41-43, 2015.
30. Close ER, Neppe VM: Mathematical and theoretical physics feasibility demonstration of the finite nine dimensional vortical model in fermions. *Dynamic International Journal of Exceptional Creative Achievement* 1301: 1301; 1-55, 2013.
31. Neppe VM, Close ER: *Reality begins with consciousness: a paradigm shift that works (Second Edition)* 1 Edition. Seattle: Brainvoyage.com, 2012.
32. Neppe VM, Close ER: How some conundrums of reality can be solved by applying a finite 9-D spinning mode1. *IQNexus Journal* 7: 2; 7-88, 2015.
33. Close ER, Neppe VM: Translating fifteen mysteries of the universe: Nine dimensional mathematical models of finite reality, Part II. *Neuroquantology* 13: 3; 348-360, 2015.
34. Close ER, Neppe VM: Fifteen mysteries of 9 dimensions: on Triadic Rotational Units of Equivalence and new directions, Part III. *Neuroquantology* 13: 4; , 2015.
35. Close ER, Neppe VM: Translating fifteen mysteries of the universe by applying a nine dimensional spinning model of finite reality: A perspective, the standard model and TDVP. Part 1. *Neuroquantology* 13: 2; 205-217, 2015.
36. Close ER, Neppe VM: The twelfth conundrum: The thought experiment replication of 9 dimensional spin. *IQNexus Journal* 7: 2; 57-59, 2015.
37. Close ER, Neppe VM: The ninth conundrum: two different solutions to electron rotation *IQNexus Journal* 7: 2; 46-49, 2015.

38. Close ER, Neppe VM: The eleventh conundrum: The double Bell normal curve and its applications to electron cloud distribution *IQNexus Journal* 7: 2; 51-56, 2015.
39. Iriso U, Peggs S: Electron Cloud Phase Transitions http://public.bnl.gov/docs/cad/Documents/Electron Cloud Phase Transitions.pdf,2004.
40. Anonymous: Cabibbo–Kobayashi–Maskawa matrix JS Cabibbo15120402V323V16v09V0223V16V with 113012Use2 with corrections.doc.
41. Duret Q, Machet B). The Cabibbo angle: An algebraic calculation (unpublished?). 2006.
42. Close FE, Lipkin HJ: Puzzles in Cabibbo-suppressed charm decays. *Physics Letters B* 551: 3-4; 337-342, 2003.
43. Azuelos G, Rao GR, Taras P: 3 5Cl(p,n)3 5 Ar threshold energy and its relation to the vanishing Cabibbo angle. *Physical Review C (Nuclear Physics)* 17: 2; 443-446, 1978.
44. Palmer WF: Cabibbo angle and rotation projection. *Phys. Rev., D* 8: 4; 1156-1159, 1973.
45. Neppe VM, Close ER: The Cabibbo mixing angle (CMA) derivation: Is our mathematical derivation of the Cabibbo spin mixing angle (CSMA) equivalent? *IQNexus Journal* 7: 4; 119-128, 2015.
46. Virtual Nerd: How do you graph complex numbers? http://www.virtualnerd.com/algebra-2/quadratics/complex-numbers/complex-numbers-graphing/complex-numbers-graph,2015.
47. Oracle OLAP application developer's guide: 2 The multidimensional data model http://web.stanford.edu/dept/itss/docs/oracle/10g/olap.101/b10333/multimodel.htm,2015.
48. Nakamura K: Review of particles physics: The CKM quark-mixing "matrix". *Journal of Physics G* 37: 075021; 150, 2010.
49. Brown GS: *Laws of form*. New York: Julian Press, 1977.