The Mathematics of the Transforms between Real (linear) and Imaginary Time, Positive and Negative: The Lorentz Transforms and Mathematical Spaces bigger than The Complex Numbers.

The Lorentz Transform can be expanded into its Imaginary conjugate form, which yields the Space of Imaginary time when velocity v is faster than the speed of Light c. Thus :-

Lorentz:-

t ' = [t - vx / c (power 2)] / [Square Root (1- (v power 2 / c power 2))]

We see that the RHS and the LHS of the simple Lorentz Transform above can be used separately to deduce a factor relating each side and which allows transformation between REAL TIME and IMAGINARY TIME, both Positive and Negative.

This is The Lorentz Transforms thus:-

t ' = [t - vx / c (power 2)] / [Square Root (1- (v power 2 / c power 2))], for each of the values +ve Real, -ve Real, +ve Imaginary and –ve Imaginary Times t and t', as Lorentz transforms between Times t and t'.

Thus we ask, does the Lorentz Transform generate each Factor which transforms between each of the following four sectors:-

~The POSITIVE REALS

~THE NEGATIVE REALS

~THE POSITIVE IMAGINARIES

~THE NEGATIVE IMAGINARIES

If so, this gives SIX transformations to navigate between each of the FOUR sectors above, thus:-

~The POSITIVE REALS ⇔ ~THE NEGATIVE IMAGINARIES	Alpha
~The POSITIVE REALS ⇔ ~THE NEGATIVE REALS	Beta
~The POSITIVE REALS ⇔ ~THE POSITIVE IMAGINARIES	Gamma
~THE POSITIVE IMAGINARIES ⇔ ~THE NEGATIVE REALS	Delta
~THE POSITIVE IMAGINARIES ⇔ ~THE NEGATIVE IMAGINARIES	Epsilon
~THE NEGATIVE REALS ⇔ ~THE NEGATIVE IMAGINARIES	Zeta

Note how each of these six transforms is distinct and unique, from each of the four sectors which are also distinct and unique. I have labelled the Transform factor needed for each Lorentz Transform, Alpha to Zeta.

Then we treat each set of The Lorentz Function's Factors, and the Transformations between each, as Groups. Further, we note that the simple Group which defines the Complex numbers has four members as follows: {1, i, -1, -i}

Then we simply see that there are SIX Lorentz Factors {Alpha to Zeta} needed for the full set Group to define each of the SIX distinct Transforms, and there are FOUR members which define the Set of Complex Numbers, {1, i, -1, -i}.

Thus the Set of Complex Numbers is able (being Four in Number) to define the Factors of the Lorentz Transformations, and hence to do so, the Mathematical Space Set of Complex Numbers is sufficient to define the six Transformations (being Six in Number), plus the two simple identities, between each sector, because TABLE 1 is the complete set.

The proof is complete: a Mathematical Space Set no Larger than the Complex Numbers is needed to transform each of the four sectors to each other, and themselves.

TABLE 1: The Transforms:-

Factor	Start	Finish	Factor F	Inverse Factor F(-1)	FxF(-1)
Alpha	Re [1]	-Im [-i]	-i	i	1
Delta	-Re [-1]	Im [i]	-i	i	1
Beta	Re [1]	-Re [-1]	-1	-1	1
Epsilon	Im [i]	-Im [-i]	-1	-1	1
Gamma	Re [1]	Im [i]	i	-i	1
Zeta	-Re [-1]	-Im [-i]	i	-i	1
Eta	Re [1]	Re [1]	1	1	1
Theta	Im [i]	Im [i]	1	1	1

I have included Eta and Theta, the simple Identity Transforms Re$\Leftrightarrow$Re and Im$\Leftrightarrow$Im in the table, making 16 Transform Factors and Inverse (Back to same) in total.

Notice how Factor F x Inverse Factor F (-1) gives Identity, that is to say, 1, and that the multiplication of F(-1) x Finish gets back to the Start, so that the INVERSE Factor F(-1) is also the Return to start (Back to Same) Function. I have put this in TABLE 2 thus:-

TABLE 2:-

Start x F = Finish

Finish x F(-1) = Start

F x F(-1)= Identity 1 in all cases.

We then note that from the equation F x F(-1)= Identity 1, that we pair up the following Sub-groups which give the Identity in each case, thus:-

[-1, -1]

[i, -i]

[-i, i]

[1, 1]

Also note that these subgroups can be permutated in any order, but for the identity each member must pair strictly with its Conjugate i.e. within each sub-group to give back its Identity. Thus the set [1,-i, i, -1] is necessary and sufficient, (with each and with all the four components).

Finally we note that provided this Rule is observed, this Unitary Matrix will always return the Identity, ('to cross and Uncross whilst always remaining and returning Uncrossed') from each Factor F and Inverse Factor F(-1), for all Matrices with conjugates.