

# Shortening a Short Possible Solution to Fermat's Last Theorem

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**Following on from the original paper on relativistic addition of velocities and a possible short Fermat solution, it has become apparent that there is an even shorter possible solution.**

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## I. SHORTENING THE FLT SOLUTION

Considering the solution in the original paper <sup>[1]</sup>, which only covered equilateral triangular number sets, the starting point is again to recast the Fermat formula for real integers (using  $N$  for the FLT power, rather than  $n$ , and  $g$  rather than  $c$  in the FLT equation, for consistency with the original paper)

$$a^N + b^N = g^N$$

into real fractions, limited to a maximum of 1, by dividing each term by  $g^N$  so that

$$\left\{\frac{a}{g}\right\}^N + \left\{\frac{b}{g}\right\}^N = 1$$

and then with  $a < b < g$  and defining  $b/g = \beta$  and  $g/a = \gamma$ , the equation looks like

$$\frac{1}{\gamma^N} = 1 - \beta^N$$

This can be restated as

$$\frac{1}{\gamma^N} = (1 - \beta^{\frac{N}{2}})(1 + \beta^{\frac{N}{2}})$$

which is the crucial shortening step. The point is that for  $\beta$  to be a real fraction and the result to contain only real parts,  $N$  must be an even number, with the smallest power term corresponding to  $\frac{N}{2} = 1$  and both  $(1 - \beta)$  and  $(1 + \beta)$  must have that same power term. This excludes all primes except  $N = 2$ .

For even  $N > 2$  there are expansions of the 'negative' brackets possible, but there is always at least one remaining 'positive' bracket which has a higher power term, leading to irrational or complex solutions. The expansion of  $N = 4$  shows this for

$N$ , where  $N$  is part of a geometric sequence of common ratio 2 starting at 1,

$$\begin{aligned} \frac{1}{\gamma^4} &= (1 - \beta^{\frac{4}{2}})(1 + \beta^{\frac{4}{2}}) \\ &= (1 - \beta)(1 + \beta)(1 + \beta^2) \end{aligned}$$

and the expansion of  $N = 6$  is an example of this for all other even  $N$

$$\begin{aligned} \frac{1}{\gamma^6} &= (1 - \beta^{\frac{6}{2}})(1 + \beta^{\frac{6}{2}}) \\ &= (1 - \beta^3)(1 + \beta^3)(1 + \beta^3) \end{aligned}$$

In both cases, there remains a 'positive' bracket whose power terms are not 1.

So in order satisfy FLT in this new reduced three-variable form above for  $N \geq 2$  there need to be positive values for each of  $a$ ,  $b$ , and  $g$  and

$$\left(\frac{a}{g}\right), \left(\frac{b}{g}\right) < 1$$

$$\left(\frac{a}{g}\right), \left(\frac{b}{g}\right) > 0$$

and

$$\left(\frac{a}{g}\right), \left(\frac{b}{g}\right) \neq \text{complex or irrational numbers.}$$

What this means is that for  $a$ ,  $b$ ,  $g$ , as integers required by FLT, there are no rational fractions that are solutions for  $N > 2$ . In terms of  $a$ ,  $b$ ,  $g$ , if any fractions are solutions that are irrational or complex, then at least one of  $a$ ,  $b$ ,  $g$  could not be integers.

So there is no requirement for the unpacking of the fractional values of  $\beta$  or  $\gamma$  and there are no

rational fractions which satisfy the equations when  $N > 2$ , and so no integers which satisfy the FLT in its original format.

## II. CONCLUSION

The highest value of  $N$  for which the FLT formulae work for all possible values, in its reduced form, of  $\beta$  and thus  $a, b, g$ , is  $N = 2$ , and it is trivial to show that there are integer solutions that can be unpacked from the fractional values that satisfy the equations.

This possible solution to FLT is suggested for discussion.

## III. REFERENCES

1 Lawrence M (2017) The Relativistic Addition of n (Scalar) Relative Velocities and a Short Possible Solution to Fermat's Last Theorem J Phys Math 8:251.  
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