Goldbach's Conjecture

In 1742, an amateur mathematician sent a letter to Euler who was then at the Court of Frederick the great at Potsdam. He noticed that all even numbers (except 4) could be made from adding two (odd) primes together. He wanted to know if this worked for any number no matter how big and could it be proved. Euler took no interest in the problem at all, considering it trivial, but it has remained one of the great unsolved problems in mathematics.

No one made much progress until the Russian number theorist Schnirelmann proved that any number could be represented as the sum of not more than 300 000 primes! That seems such an incredibly useless and extremely likely result and one wonders where on earth the figure 300 000 comes from. Why so high?

No one could do any better until another Russian, Vinogradov, established that a sufficiently large even number could be represented as the sum of no more than four primes. So that result seemed a lot better than Vinogradov's but what did he mean by "sufficiently large". It meant that only numbers bigger than some value, say v, could be represented this way – but he could give no idea how big v might be.

So in recent years there have been two approaches –

- can 300 000 be reduced? and
- how big might v be?

Well the good news is 300 000 is now down to 6 – that is for any even number over 4 you won't need more than 6 primes.

As for that "sufficiently large" number v, a man called Brodzkin showed in 1937 that it wouldn't be bigger than $10^{7000000}$ (that's 1 followed by 7000000 zeros which is still ***big***) and two mathematicians, Chen and Wang have recently managed to get that down to 10^{7194}.

With modern computing power it should soon be possible to check every even number up to that value and so immediately get the six prime number maximum down to four.

Faber and Faber, the publishers have offered a $1 million reward for a solution to Goldbach's conjecture that you only need two primes.

Footnote

The most famous unsolved problem in Maths is the Riemann Hypothesis, which is about proving a particular pattern does exist in all prime numbers. If that's solved, then the "four prime number" maximum is also immediately proved. (Don't ask why – it's too complicated). But that still leaves the field wide open to get it down to that elusive "two".

Don't waste too much time on it though. The smart money is on the fact that although in practice you never need more than two prime numbers, the best that could ever be proved is four.

There's another weird proof in mathematics that some things are true but not provable – and this conjecture could be one of them. But of course it will never be possible to prove that it's "true but not provable" because then you would have then proved it to be true – which can't be done!

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