$E=mc^2$

We are told this famous equation was invented by Einstein and it follows from his special theory of relativity (SR). Neither of these claims seems true. In 1900 Poincare derived this relation between energy and mass by considering electromagnetic fields. The first person to assert its general applicability seems to have been the Italian Olinto de Pretto. The following is a translated extract from his paper dated 16 June 1903 taken from http://www.cartesio-episteme.net/st/mem-depr-vf.htm:

"The formula mv^2, taking into account the immense speed v of vibration of the ether, gives us, if not the measure, at least the idea of the immensity of the force [or power or strength] it represents. ... Therefore, given m = 1 [kilogramme] and v equal to three hundred thousand kilometres per second … one will be able to see that a quantity of calories is obtained represented by 10794 followed by 9 zeros that is, over ten million million."

So de Pretto was certainly talking about $E=mc^2$ even though at the time v was often used instead of c. (It seems one of de Pretto's brothers was a friend and co-worker of Beniamino Besso whose nephew, Michele Besso, was a close friend and a colleague of Einstein. Einstein was also acquainted with Italian, his family having lived in Milan for a few months.)

Einstein's later attempt in 1905 to derive $E=mc^2$ from SR was criticised by Max Planck. You can see the problem by looking at https://www.fourmilab.ch/etexts/einstein/E_mc2/e_mc2.pdf.

Near the end of page 2 Einstein derived an equation from SR beginning K_0-K_1. Beneath this is another beginning K_0-K_1 which is true if $E=mc^2$ (he used L for the energy of two photons not E). These two equations only agree exactly when the speed v is zero. At a relativistic speed of $v=0.9c$ for example they differ by a factor of 3.2. Einstein tried to derive $E=mc^2$ using the relative speed v of a moving observer, but at relativistic speeds Einstein's equation is wrong.

A Scientific American article in 2015 described the problem by saying Einstein had approximated away the relativistic bits leaving an answer one can get from classical physics. (https://www.scientificamerican.com/article/was-einstein-the-first-to-invent-e-mc2/) It says Einstein was aware of the problem and subsequently made half a dozen other attempts. Strangely, the article makes no mention of de Pretto.

The footnote to Einstein's paper says the constancy of the speed of light is contained in Maxwell's equations. However Maxwell based his equations on a physical ether of tiny vortices that permeated space. Observers moving at different speeds in relation to this ether would measure different speeds of light. So Maxwell's assumptions conflicted with Einstein's. Apart from this misleading footnote there is no attempt to justify applying Einstein's approach to Maxwell's ether based equations.

Einstein considers a stationary body that emits two photons in opposite directions. He compares the energy before and after the emission - as seen in the frames of the body and an observer in motion relative to the body. The kinetic energy, KE, of the body is greater in the observer's frame than in the body's frame where it is at rest. Einstein relates K_0 to the KE in the observer's frame minus the KE in the body's frame before it emits the photons. K_1 is similarly the KE difference between frames after the photon emission. He says $K_0 - K_1$ equals the photons' energy in the observer's frame minus their energy in the body's frame. This difference in photon energy is also shown as positive as the energy in the observer's frame is shown as increasing by a factor of gamma ($\gamma>1$). Yet SR predicts a body in relative motion to be time dilated in an observer's frame. So its atomic processes run slower and the frequency and energy of any light it emits should reduce not increase. Given the truth of $E=mc^2$ this seems to be another way to disprove SR.

Einstein's derivation also uses the principle of energy conservation, but SR doesn't conserve energy between moving frames, so this hampers efforts to derive de Pretto's equation from SR.