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Motivic Euler numbers and an arithmetic count of the lines on a cubic surface

A celebrated 19th century result of Cayley and Salmon is that a smooth cubic surface over the complex numbers contains exactly 27 lines. Over the real numbers, the number of lines depends on the surface, but work of Finashin-Kharlamov, Okonek-Teleman, and Segre shows that a certain signed count is always 3. We extend this count to an arbitrary field using A1-homotopy theory: we define an Euler number in the Grothendieck-Witt group for a relatively oriented algebraic vector bundle as a sum of local degrees, and then generalize the count of lines to a cubic surface over an arbitrary field. This is joint work with Jesse Leo Kass.