Computation of the conductor for a family of Frey hyperelliptic curves

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After Andrew Wiles's proof of Fermat's Last Theorem, a significant amount of work has been devoted towards extending the modular methodology to other families of Fermat type equations $Ax^p + By^q = Cz^r$. Broadly speaking, these tentatives receive the name of the 'Darmon program', being initially pioneered by Henri Darmon, who introduced several families of Frey hyperelliptic curves to approach the resolution of the Diophantine equations.

Since the coefficients of Frey curves depend on a hypothetical solution to the Diophantine equation, it is a highly non-trivial problem to perform computations with them. In particular, we would need to compute the conductor in order to apply the modular methodology.

In this talk, we will see how commonly used Frey curves (those used for signatures (p, p, r), (r, r, p), $(2, r, p)$ and $(3, r, p)$) are particular instances of a more general biparametric family of curves $C(z, s)$. By combining the cluster picture method with other results in local field theory, we will then be able to compute the conductor of $C(z, s)$, allowing us to kill many birds with one stone!