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The intersection of cyclic Kummer extensions with cyclotomic extensions

Antonella Perucca

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Let K be a field, and ℓ a prime number different from the characteristic of K . Consider an extension of K of the form $K(\zeta_{\ell^m}, \sqrt[\ell^n]{a})$, obtained by adding a root of unity of order ℓ^m and the ℓ^n -th root of some element of K , with $m \geq n$. We give a formula for the degree of this extension, which depends only on few parameters. As an application, if K is a number field we calculate the density of primes \mathfrak{p} of K such that the order of $(a \bmod \mathfrak{p})$ is coprime to ℓ . This work is based on a result by Schinzel of 1977 describing abelian radical extensions.

Comments: v3: revised expanded appendix; added alternative proof of Lorenz's result; 20 pages

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