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Applying pairings in isogeny crypto

✓ **fast pairings**

Optimized pairing computation for the specific scenario $P \in E(\mathbb{F}_p), Q \in E^t(\mathbb{F}_p)$

&

✓ **core idea**

For $P \in E(\mathbb{F}_p)$ and $Q \in E^t(\mathbb{F}_p)$, don't use curve arithmetic but pairing $e(P, Q)$ to get overlap in orders!

Faster isogeny subroutines

verify full torsion P

In some CSIDH variants, we are given $P \in E(\mathbb{F}_p)$ and $Q \in E^t(\mathbb{F}_p)$.

Q: verify that both P and Q have order $p + 1$, e.g. full torsion points

A: compute $\zeta = e(P, Q)$ and check that order ζ is $p + 1$.

speedup: -75% ✓

compute full torsion P

In some CSIDH variants, we get E

Q: find $P \in E(\mathbb{F}_p)$ and $Q \in E^t(\mathbb{F}_p)$ of order $p + 1$, e.g. full torsion points

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compute full torsion P

In some CSIDH variants, we get E

Q: find $P \in E(\mathbb{F}_p)$ and $Q \in E^t(\mathbb{F}_p)$ of order $p + 1$, e.g. full torsion points

A: take random, P, Q, then find $\zeta = e(P, Q)$. Compute order ζ and apply Gauss' algorithm.

Radboud University