BIG QUAKE

(BInary Goppa QUAsi–cyclic Key Encapsulation)

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Outline

1. Presentation
2. Security
3. Suggested parameters

General presentation

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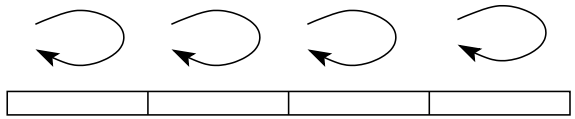

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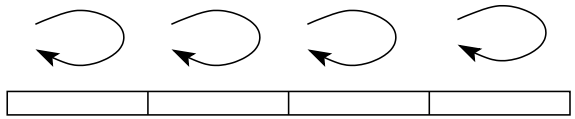

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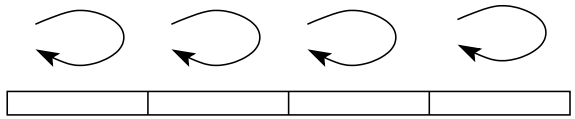

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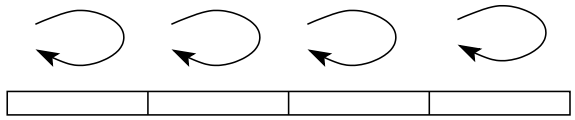

  - The cost of message recovery attack is mostly unchanged;
  - The cost of key-recovery attacks is reduced but remains significantly above that of message recovery attacks.
  - $\Rightarrow$ Same security as classic McEliece but with shorter keys (size divided by a factor between 3 and 19).

Semantic security

BIG QUAKE is proved to be OW IND–CPA in the Random Oracle Model under the following assumptions:

- Decoding ℓ–quasi–cyclic (ℓ–QC) codes is hard;
- Distingushing ℓ–QC Goppa codes from arbitrary ℓ–QC codes is hard.

Known attacks

Definition

Let $\mathscr{C}$ be an ℓ–QC code, we denote by $\mathscr{C}^{\sigma_\ell}$ the code:

$$\mathscr{C}^{\sigma_\ell} \stackrel{\text{def}}{=} \{\boldsymbol{c} \in \mathscr{C} \mid \sigma_\ell(\boldsymbol{c}) = \boldsymbol{c}\}$$

where σ_ℓ denotes the ℓ–blockwise cyclic shift.

Proposition

Let $\mathscr{C}$ be an ℓ–QC Goppa code, then $\mathscr{C}^{\sigma_\ell}$ is a Goppa code (whose length and dimension are divided by ℓ).

Security with respect to known attacks

- **Message recovery attacks.** We chose our parameters to resist to any known variant of ISD.
- **Key recovery attacks**. Our parameters are computed in order to resist to:

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  - Attacks based on polynomial systems solving (conservative analysis).
  - Additional cautions : ℓ primitive modulo 2 to limit the number of intermediary codes that an attacker can compute.

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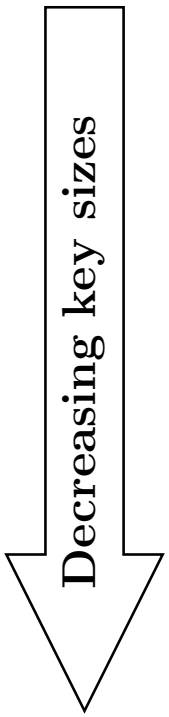
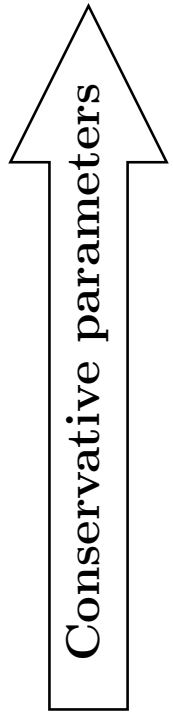
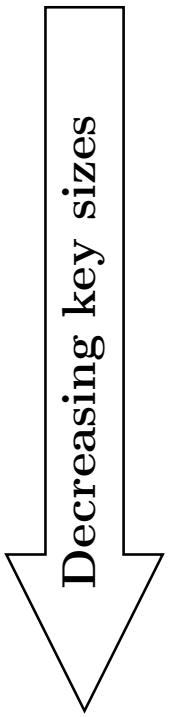
Suggested parameters

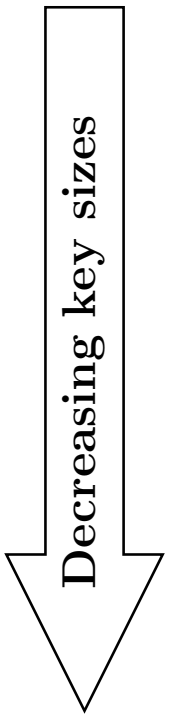
Security Level	m	Length	Dimension	ℓ	Public key size (kBytes)
1	12	3510	2418	13	25.3
3	18	7410	4674	19	84.1
5	18	10070	6650	19	149.6


Decreasing key sizes


Conservative parameters



Classic McEliece, NTS KEM



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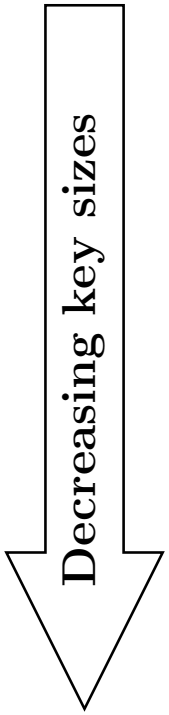

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Thanks for your attention!