NIST's Post-Quantum Cryptography Project

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NUTMIC, Warsaw
September 12, 2017

Quantum Computers

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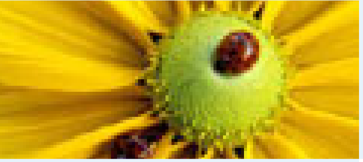
  but can we build them?.



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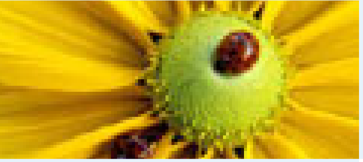

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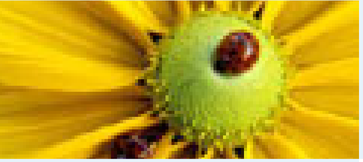
- They will be able to factor integers and solve discrete logarithms.
- They will be able to invert functions asymptotically faster than classical computers.
  how much faster?

Implications for Crypto

- RSA, Diffie-Hellman key exchange, elliptic curve crypto would be broken.



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- Symmetric crypto will need longer keys.
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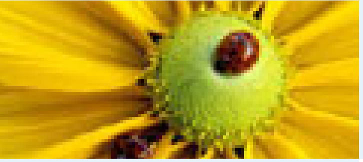

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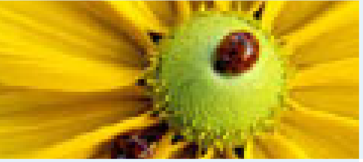

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- Today's data needs to remain secure 5-10 years.
  longer in some cases, such as medical data

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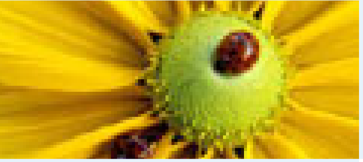

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- To ensure transparency of the process, community involvement, and legitimacy of the outcome.

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- We may standardize several algorithms.
- The evaluation criteria is not set in stone, it may evolve during the next few years.

The Call For Proposals

- Candidate algorithms may now be submitted **here**.
- Deadline is November 30, 2017

The PQC Forum

- The wording of the CFP followed public discussion on the **pqc-forum** (email:pqc-forum@nist.gov).
- This is also where submissions and germane issues -such as evaluation criteria is discussed.
- To join send mail to pqc-forum-request@nist.gov with subject=subscribe.

Proposals Sought For

- Public-key encryption
- Key-encapsulation
- Digital signatures

Security

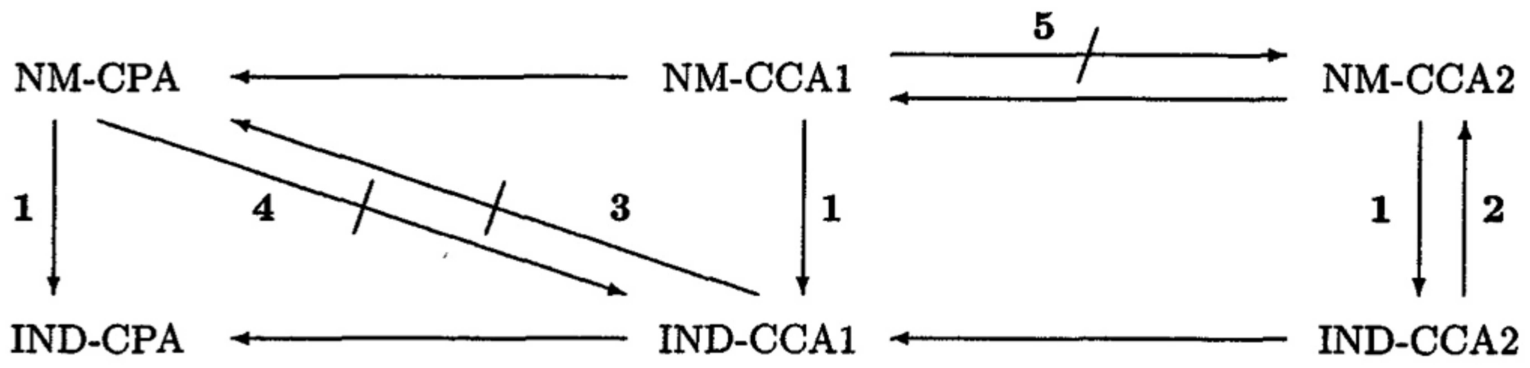

Figure 1: Current security definitions are precise and not easy to meet (drawing by Bellare).

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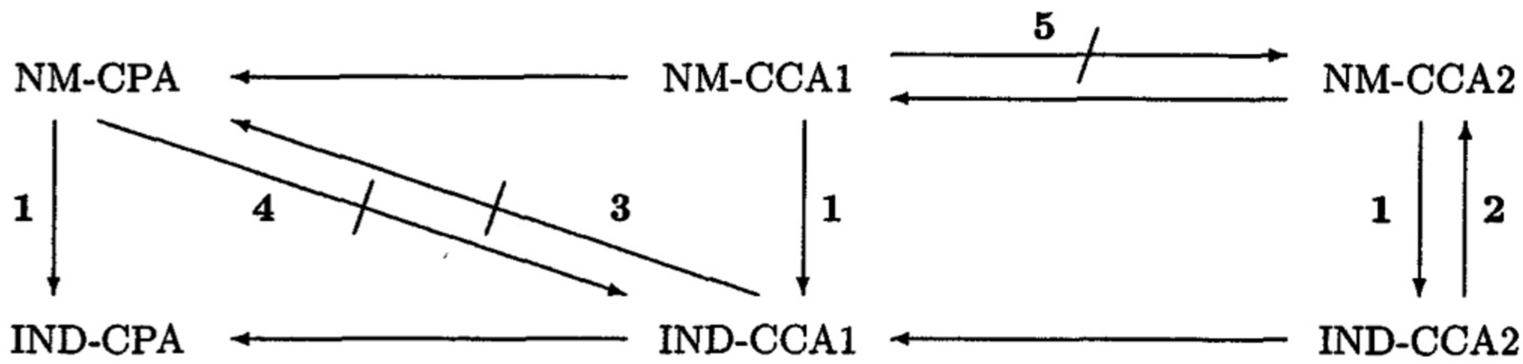

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These notions roughly say that encrypted messages can not be produced or even distinguished from random without the keys.

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  In practice we are likely to see two assertions:

  - An underlying problem is hard for classical computers;
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- Do you actually have a reduction to a hard primitive?

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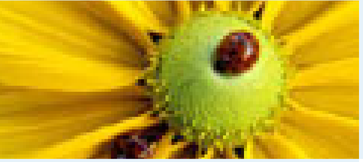

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- How hard to protect from side-channel attacks?

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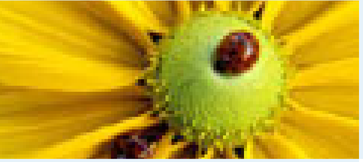

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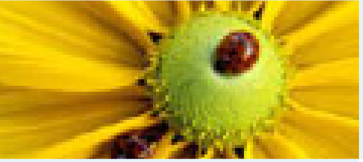

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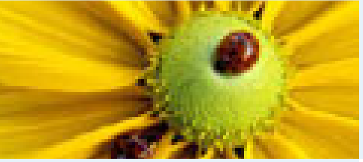
- Demands that future standards make bad implementations harder.



Timeline

- Dec 20, 2016 : Formal Call for Proposals.
- Nov 30 : Deadline for submissions.
- April 12-13 : Submitter's present their work at workshop in Ft. Lauderdale.
- next 3-5 years : Analysis phase - NIST will report findings in 1-2 workshops.
- 2 years later : Draft standards ready.

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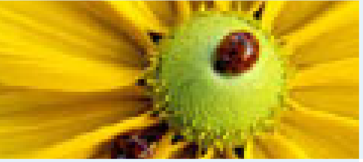

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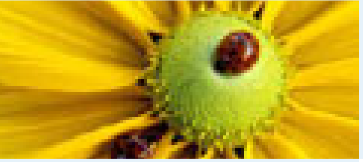

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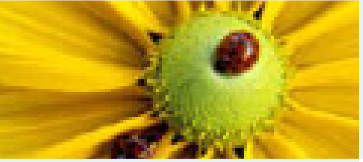
- This is just too risky.

Predicting The Future

We always overestimate the change that will occur in the next two years and underestimate the change that will occur in the next ten. Don't let yourself be lulled into inaction.
(Bill Gates)



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Do we know how to efficiently sample from hard distributions of multivariate equations?

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multiplicative-complexity problem: minimize the number of quadratic equations. Boyar,Courtois and others have done work on this. There was a meeting on multiplicative complexity co-located with Eurocrypt 2017.

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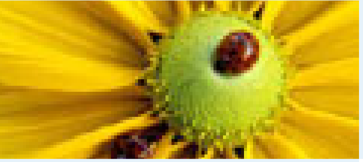
  Failed attempt to create a trapdoor cryptosystem based on an NP-Hard problem.



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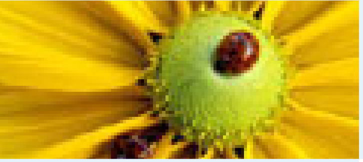

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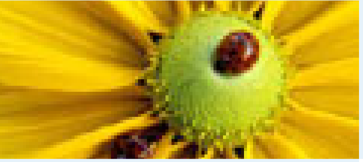
  Flip side: short vectors on a lattice are likely to be hard.



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- 1997 Ajtai, Dwork.
  A public-key cryptosystem in which average case is as bad as the worst case.

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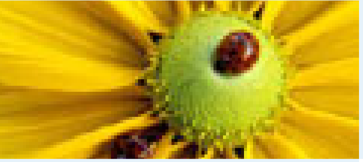

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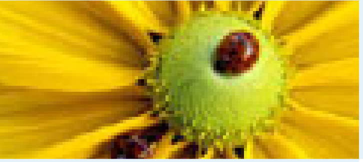

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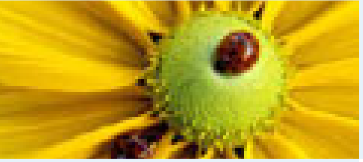

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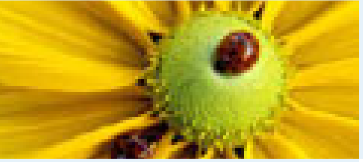

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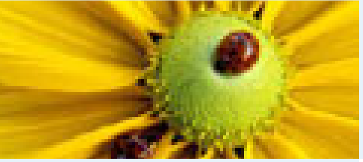

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