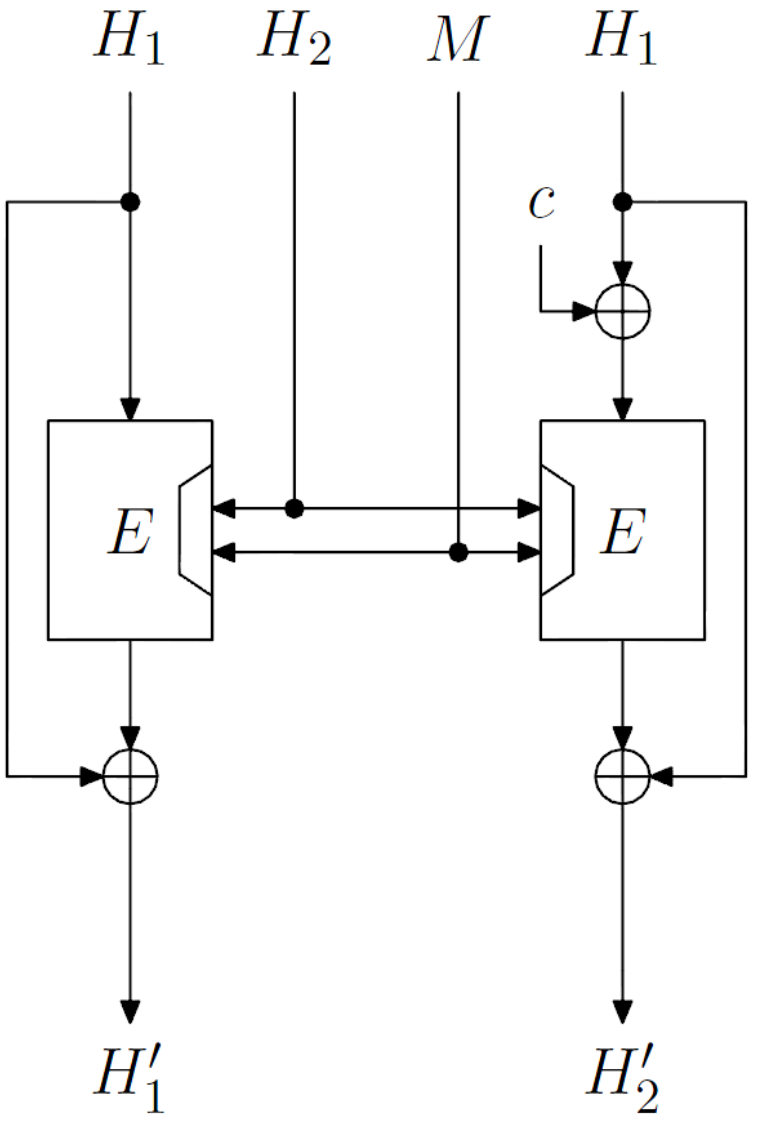
Observations on H-PRESENT-128

Niels Ferguson
Microsoft

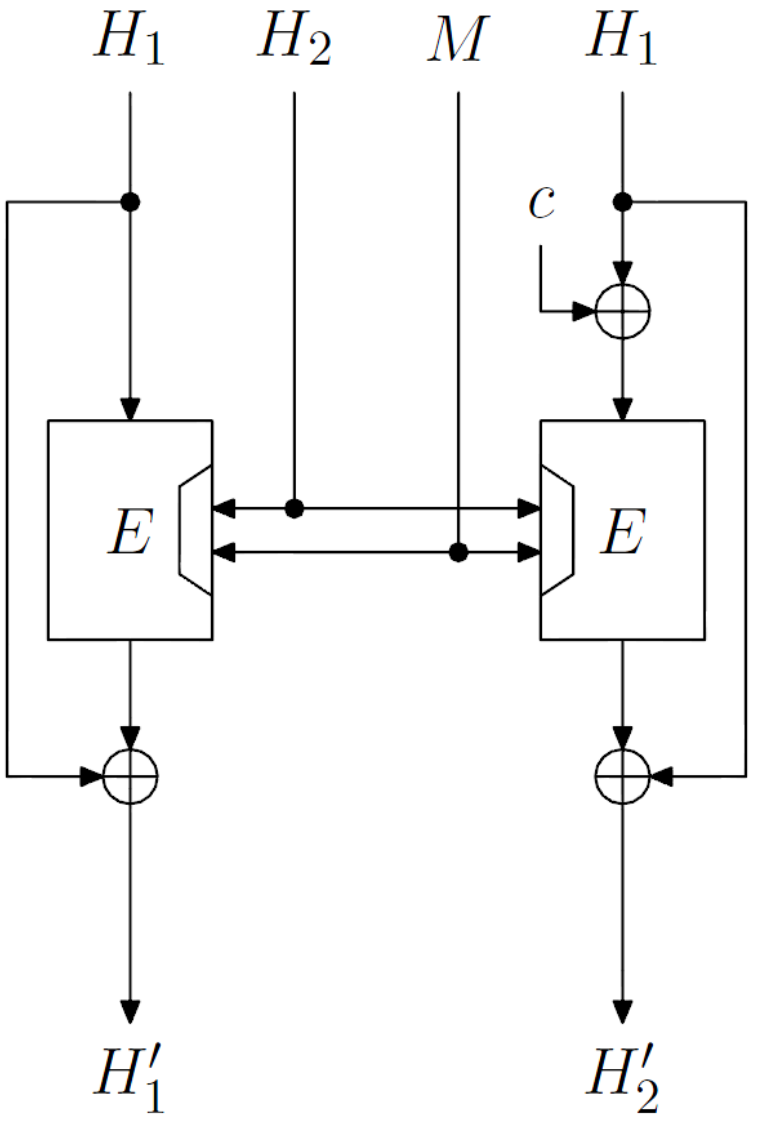
H-PRESENT-128 hash function

- Proposed by Bogdanov, Leander, Paar, Poschmann, Robshaw, and Seurin at CHES 2008.
- Uses the PRESENT-128 64-bit block cipher in Hirose's double-length mode.



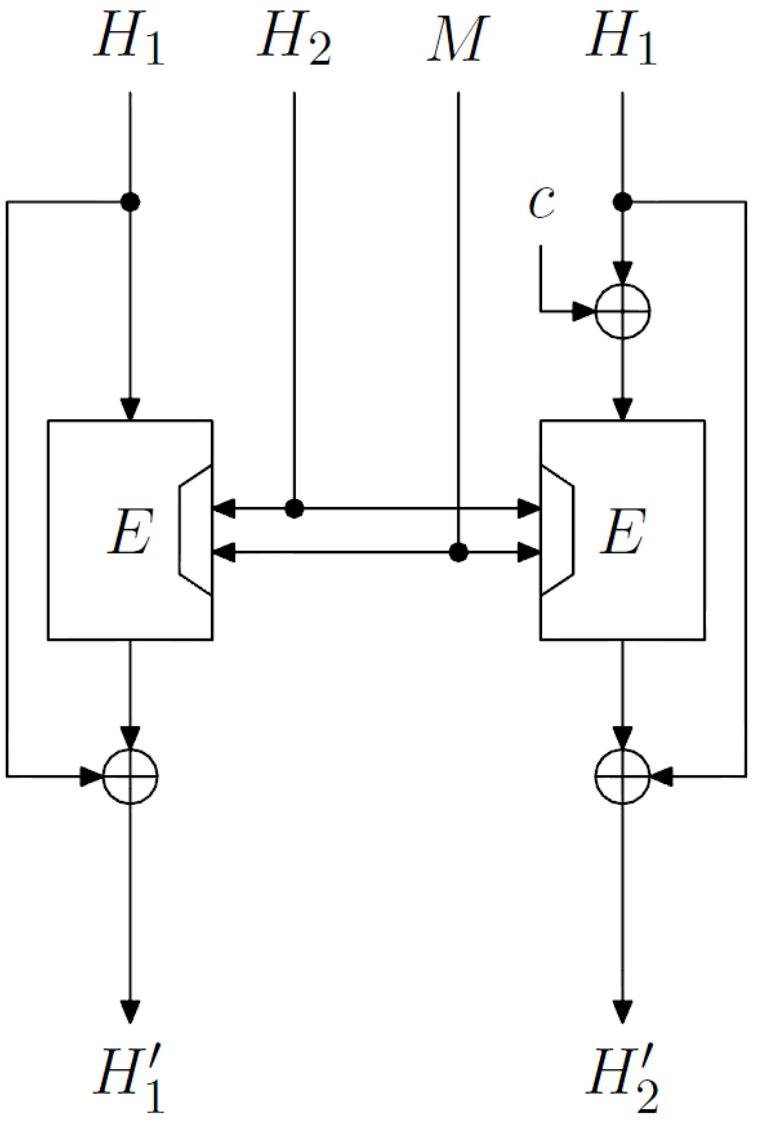
Details

- All values 64 bits
- (H_1,H_2) = chaining state
- M = message block
- c = public constant



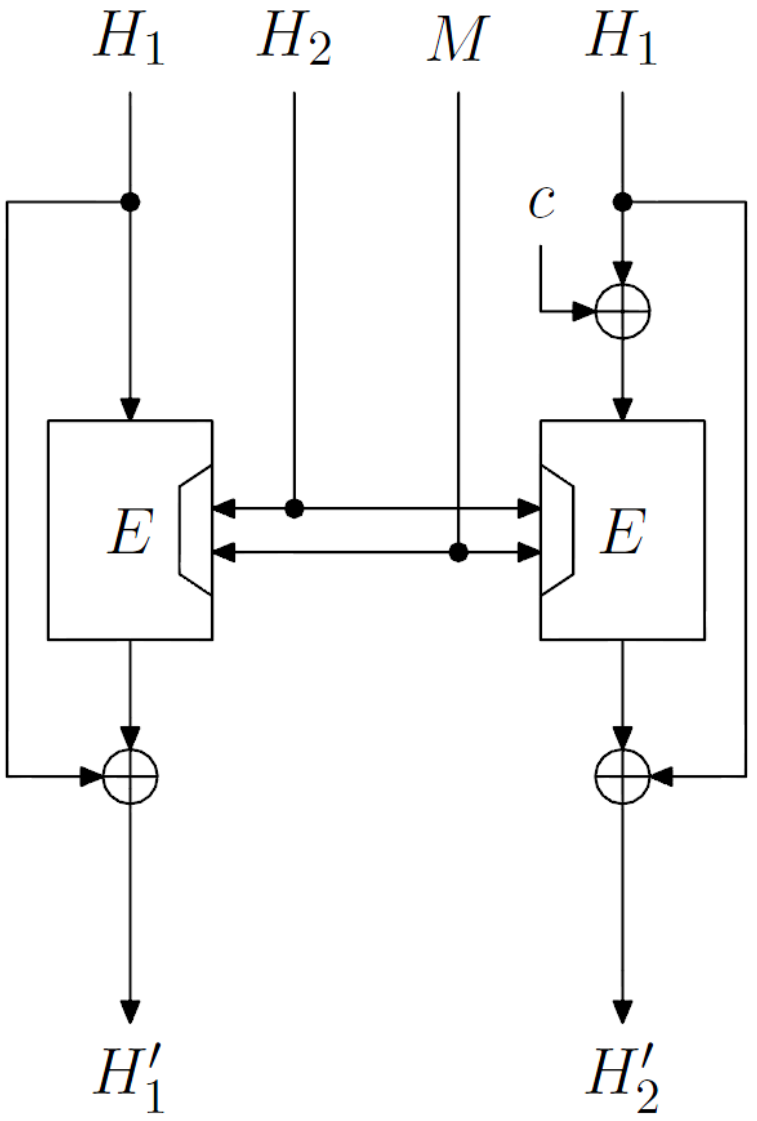
Distinguisher for compression function

- For any H_1, H_2, M, compute $(A_1,A_2)=F(H_1,H_2,M)$ and $(B_1,B_2)=F(H_1 \oplus c,H_2,M)$
- Check $(A_1,A_2) = (B_2 \oplus c, B_1 \oplus c)$
- Requires 2 chosen plaintexts



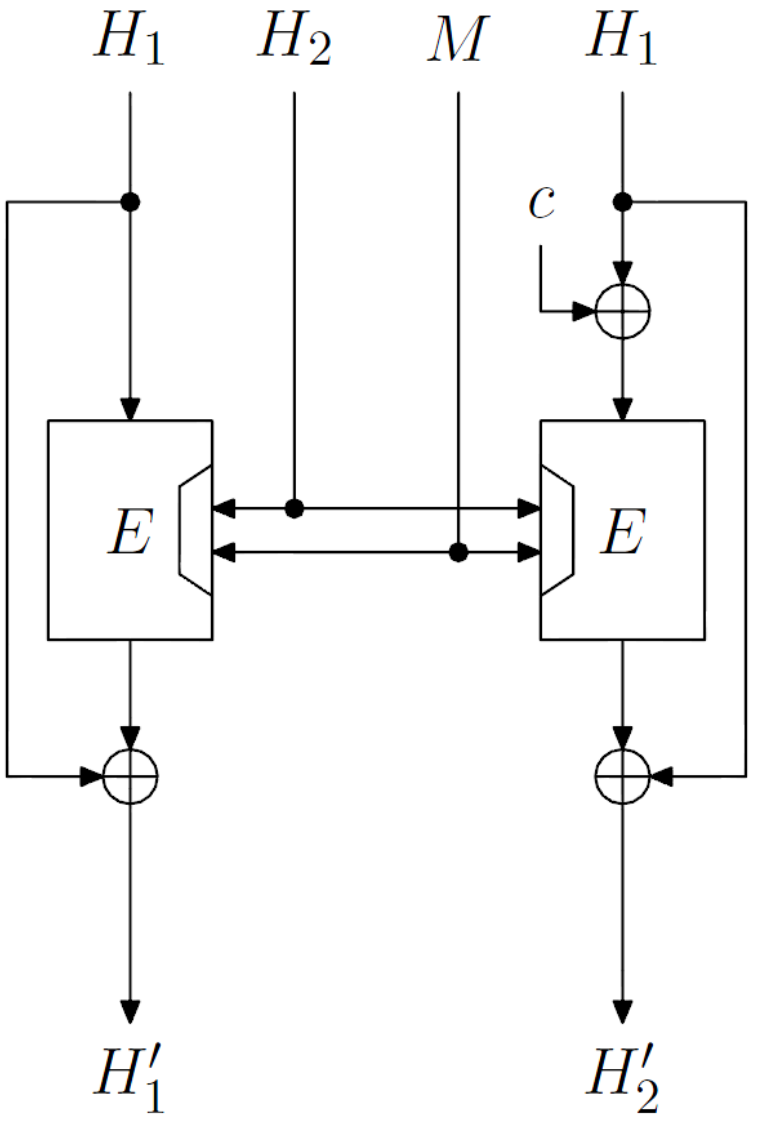
Distinguisher for hash function

- $H_1' = H_2'$ is impossible
- Ideal hash function has equal output halves with prob. 2^{-64}
- Distinguisher requires 2^{64} hash outputs.



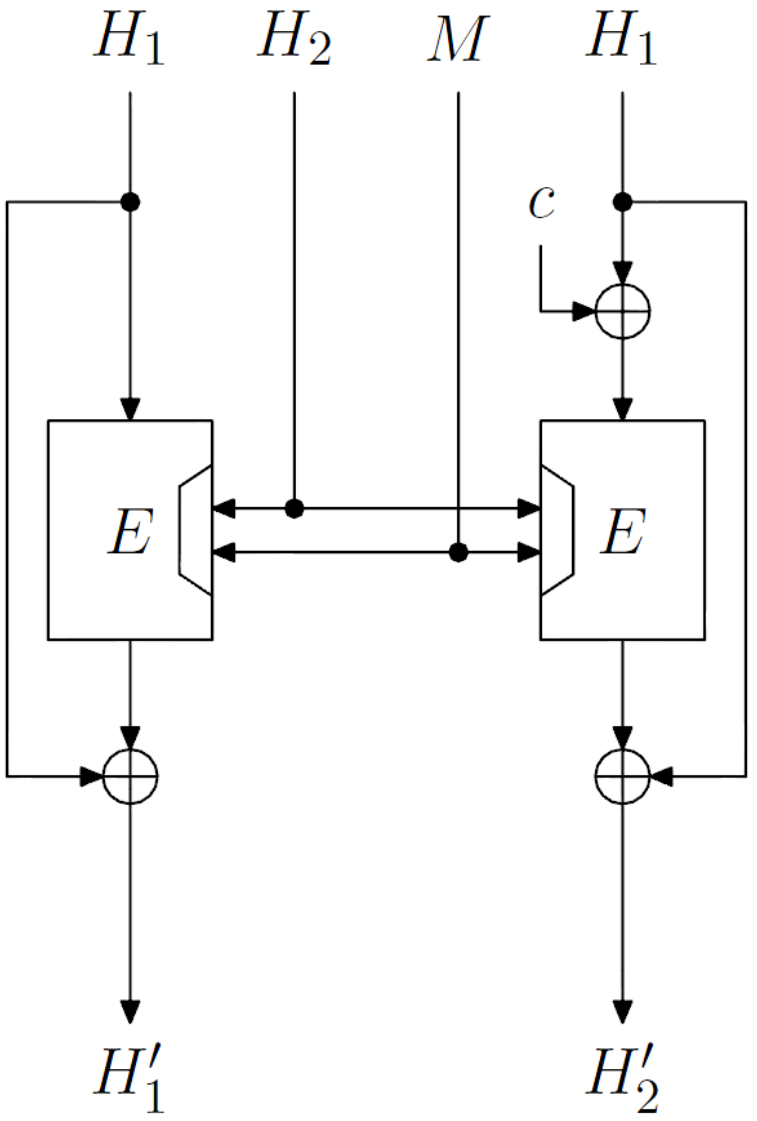
Pseudo-preimage

- Generic exhaustive search: 2^{128} tries using 2^{129} block cipher enc.
- Trivial Improvement: pick M, H1, H2, compute only left half to reject wrong choice. Uses 2^{128} block cipher enc.



Pseudo-preimage

- Improvement 2:
  A single encryption can rule out both H_1 (using left half) and $H_1 \oplus c$ (using right half)
- 2^{127} encryptions needed
- 4x faster then generic exhaustive search



Conclusion

- Distinguisher for compression function using 2 chosen inputs
- Distinguisher for hash function using 2^{64} hash outputs
- 4-fold speedup of pseudo-preimage search compared to generic algorithm