

The State-Test Technique on Differential Attacks: a 26-Round Attack on CRAFT and Other Applications

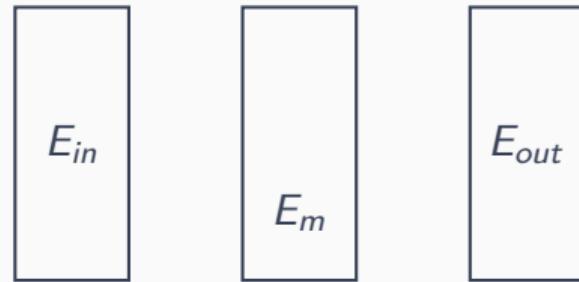
Dounia M'Foukh María Naya-Plasencia Patrick Neumann

Asiacrypt, December 10, 2025

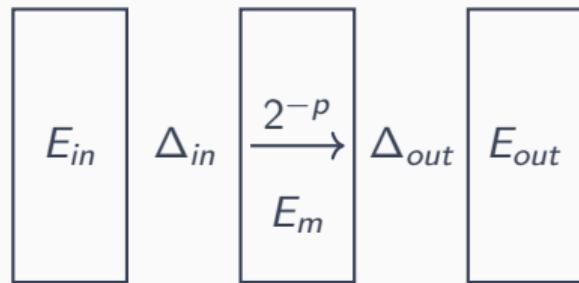
Inria Paris, France



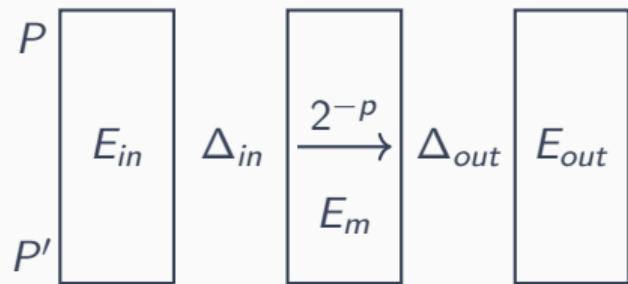
Key Recovery in Differential Attacks



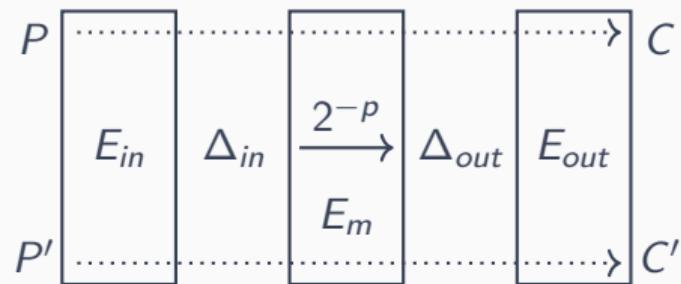
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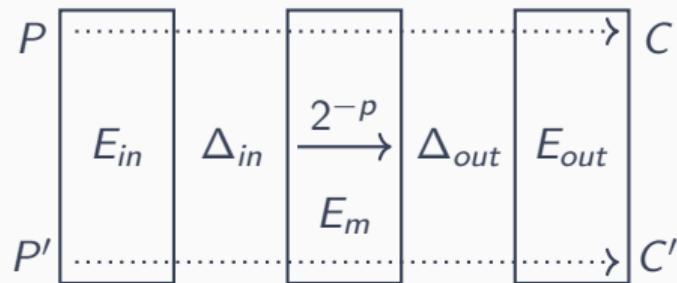
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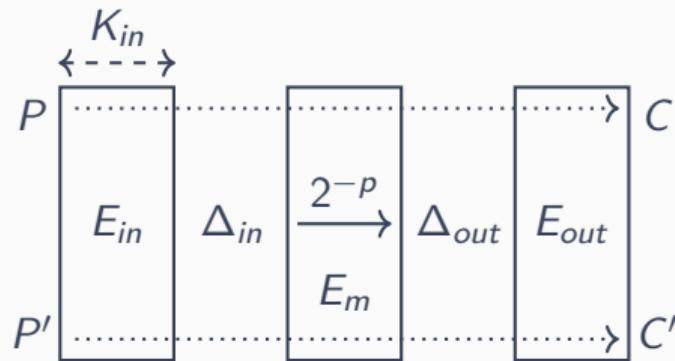


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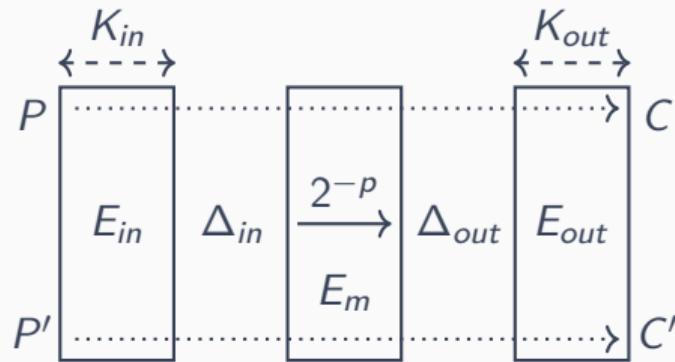
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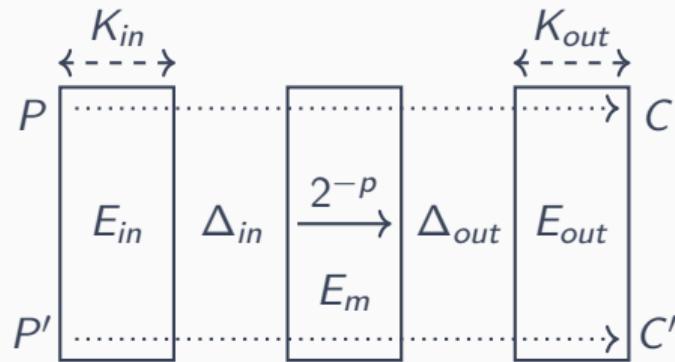
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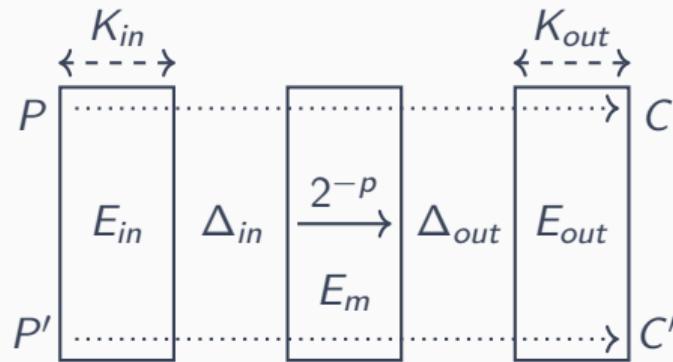


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(Classical) Differential Attacks

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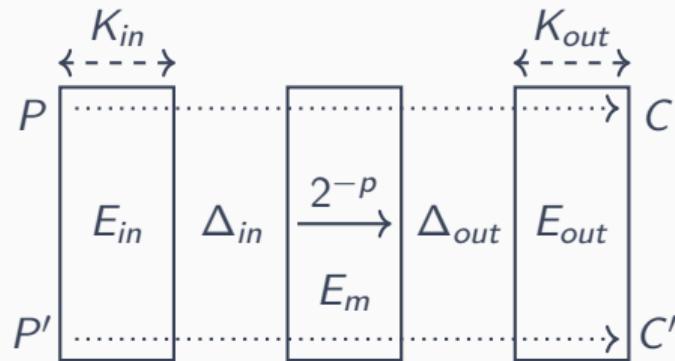
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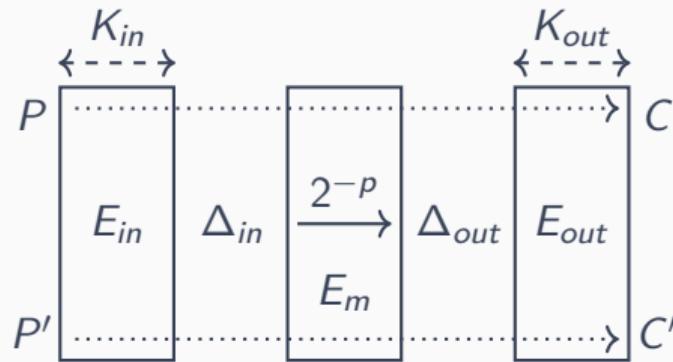
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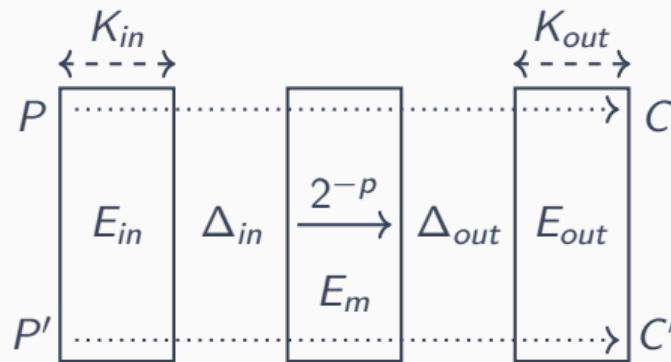
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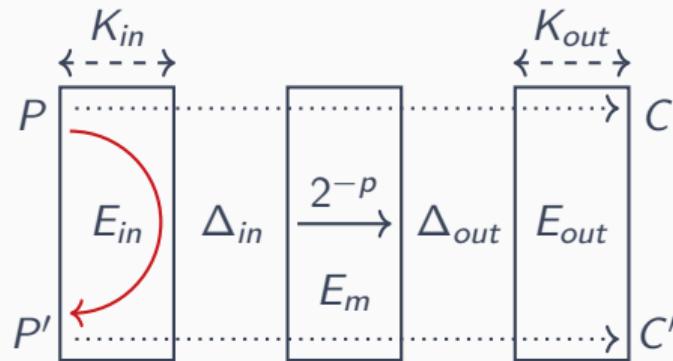
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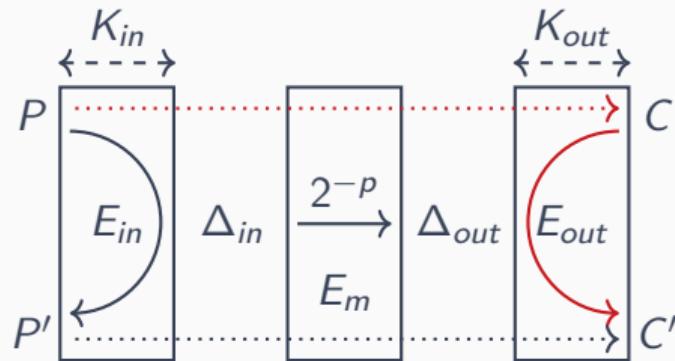
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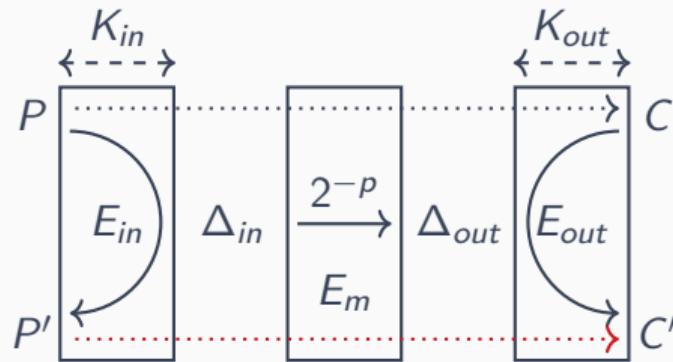
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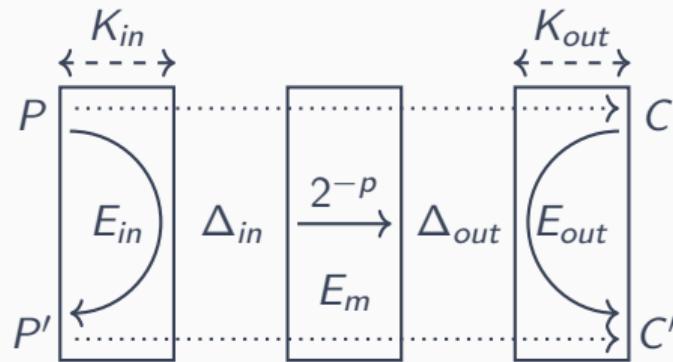
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Our Contribution

State-Test Technique in Differential & Differential-Linear Attacks

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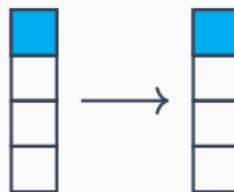
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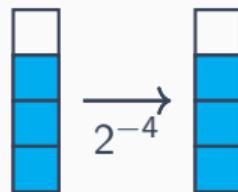
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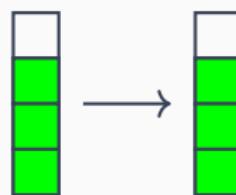
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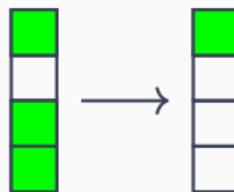
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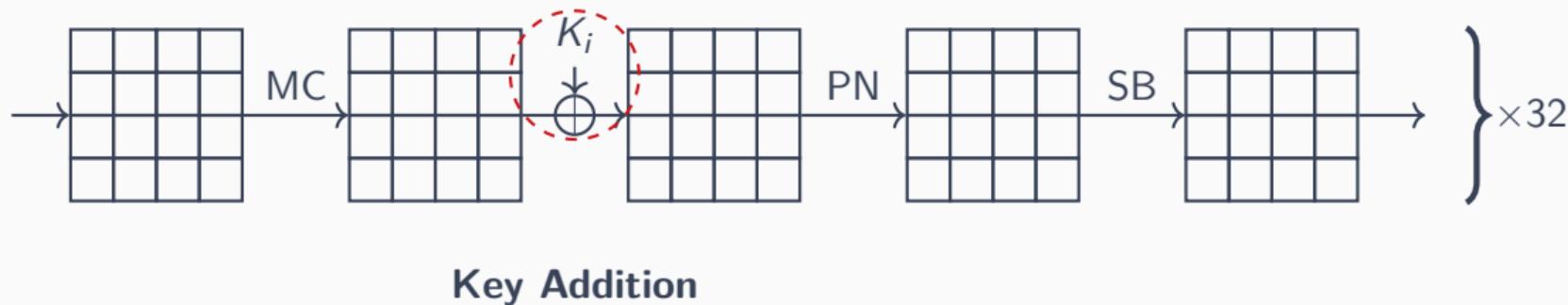
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A diagram illustrating the Mix Columns operation. On the left is a 4x1 column vector. An arrow points from this vector to a 4x1 column vector where the second element is orange, indicating a non-zero value. This visualizes how the input vector is transformed by the Mix Columns matrix.

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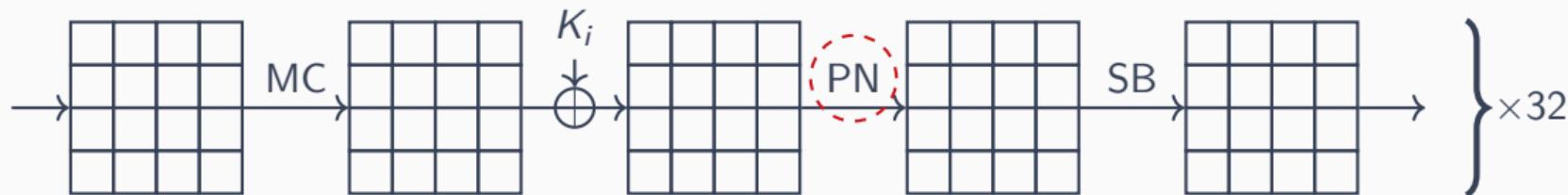


Key Addition

Add $K_{i \bmod 2}$ in round i

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Permute Nibbles

The diagram shows a 4x4 matrix being permuted. On the left, the matrix is arranged in rows 0-3 and columns 0-3, with values from 0 to 15. An arrow points to the right, where the matrix is shown in a new arrangement: rows 15-11 and columns 3-0, with values 15, 12, 13, 14; 10, 9, 8, 11; 6, 5, 4, 7; 1, 2, 3, 0 respectively.

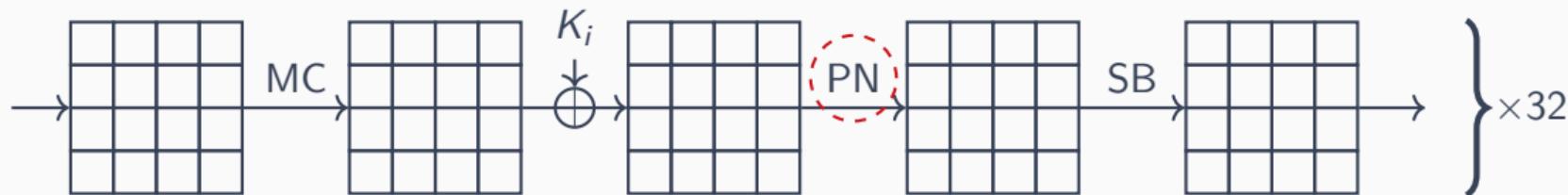
0	1	2	3
4	5	6	7
8	9	10	11
12	13	14	15

→

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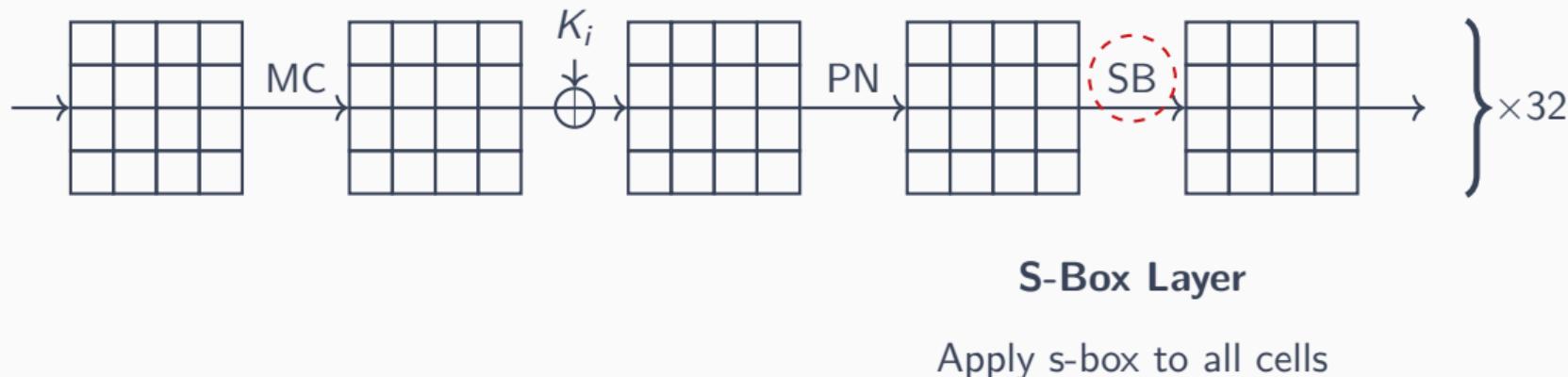
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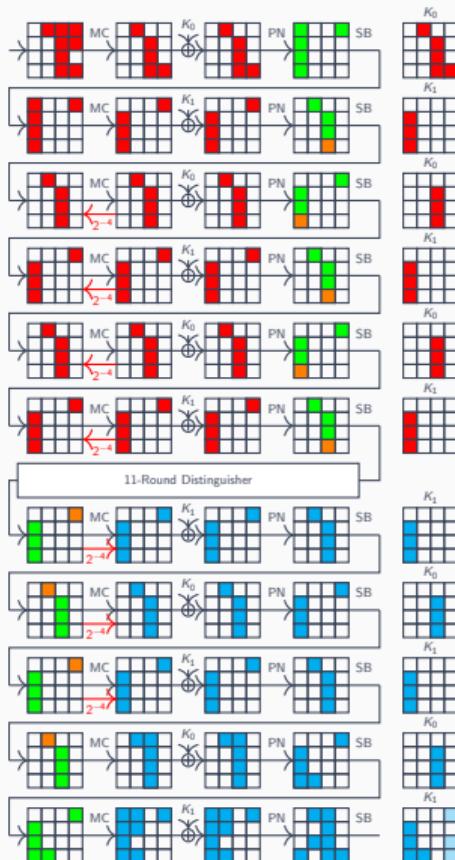
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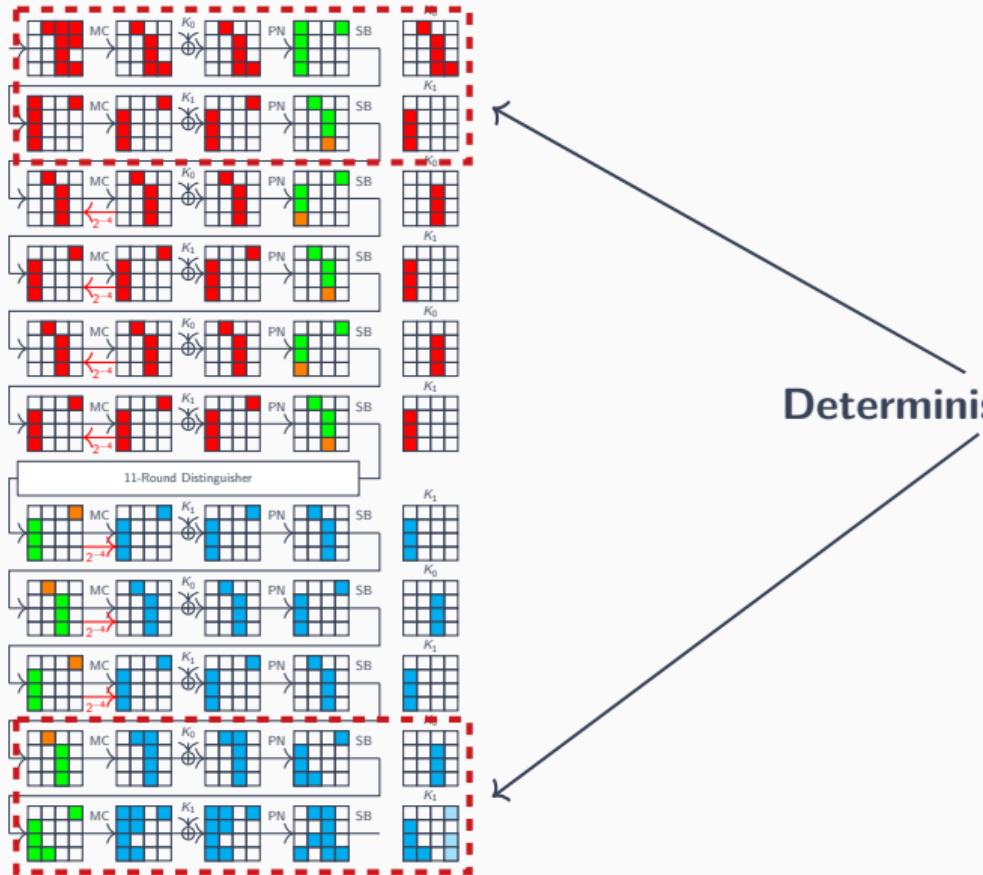
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Differential Meet-in-the-Middle Attack on 23-Rounds [AKMMNP24]

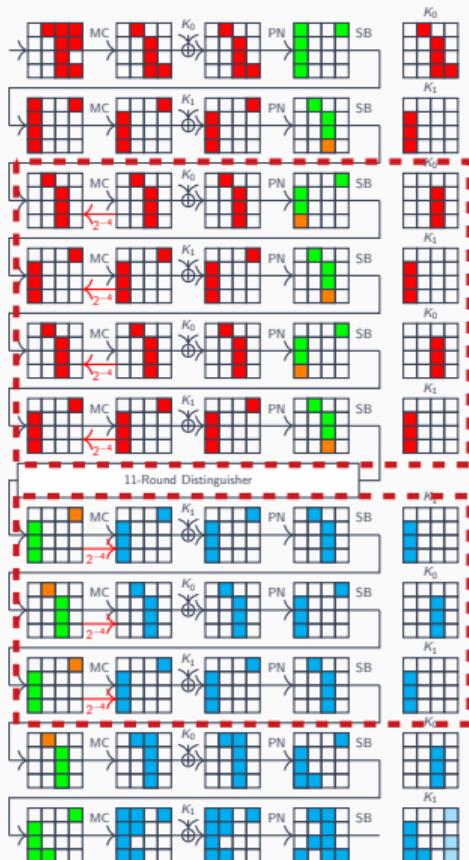


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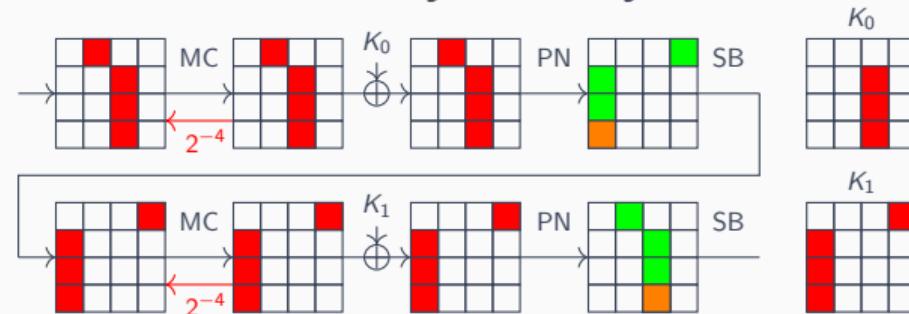


Deterministic Extension

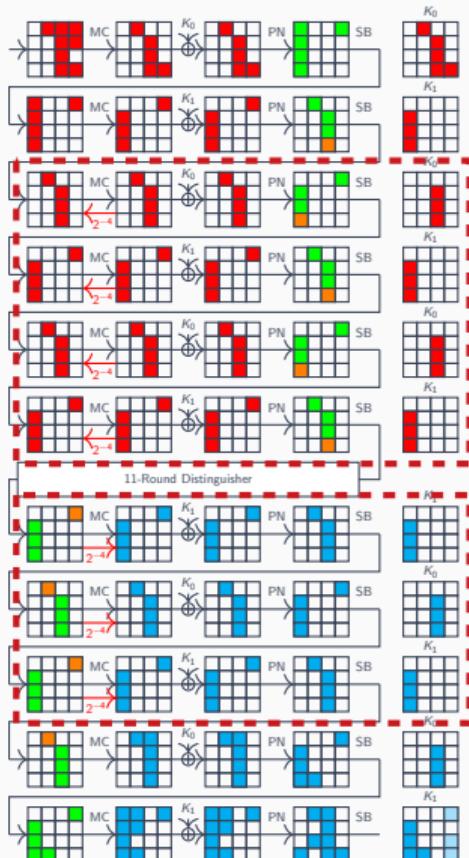
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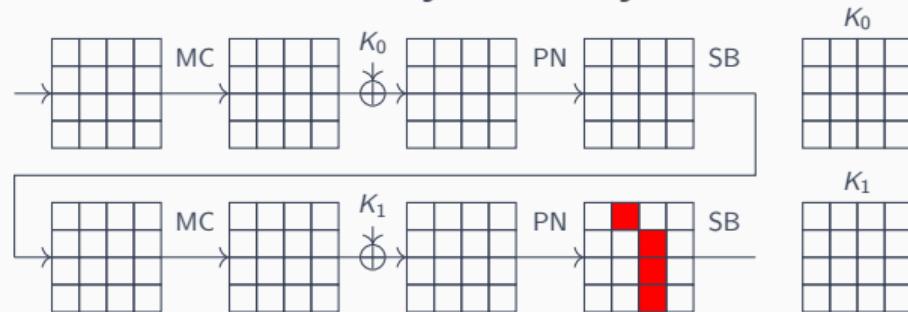
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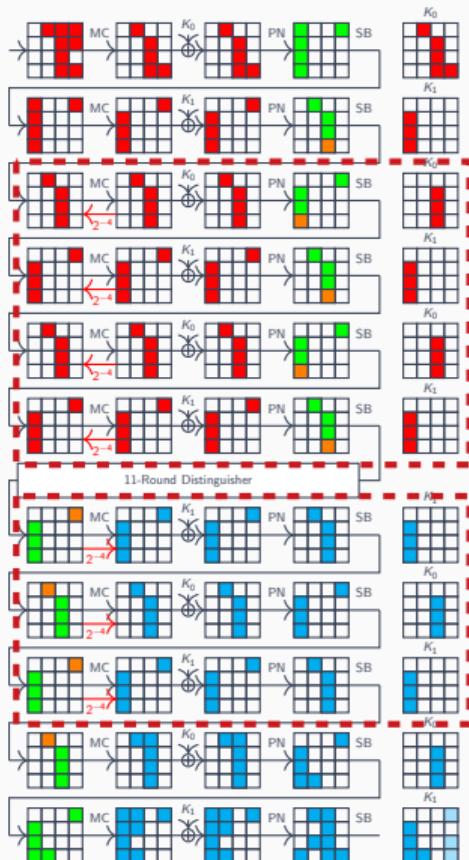
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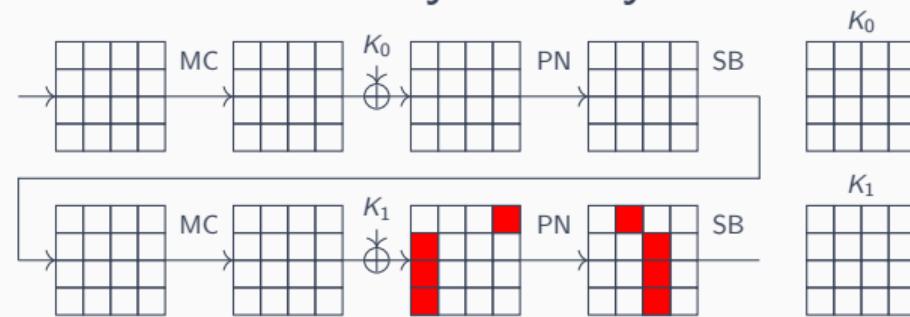
Probabilistic Key Recovery



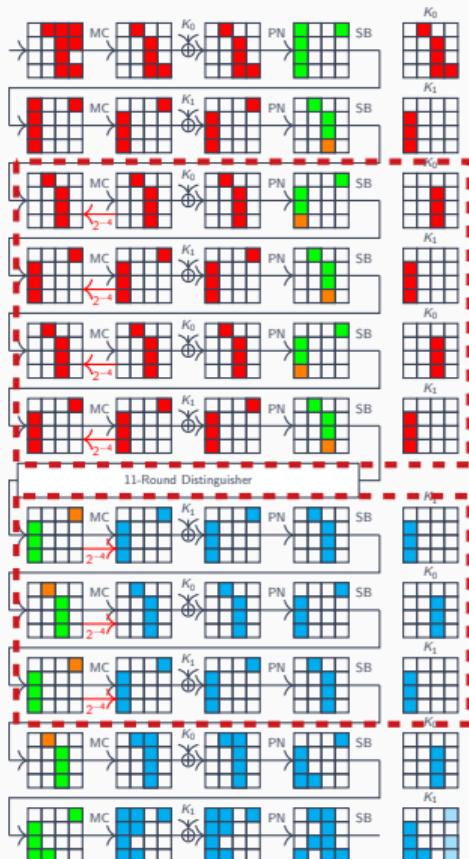
Differential Meet-in-the-Middle Attack on 23-Rounds [AKMMNP24]



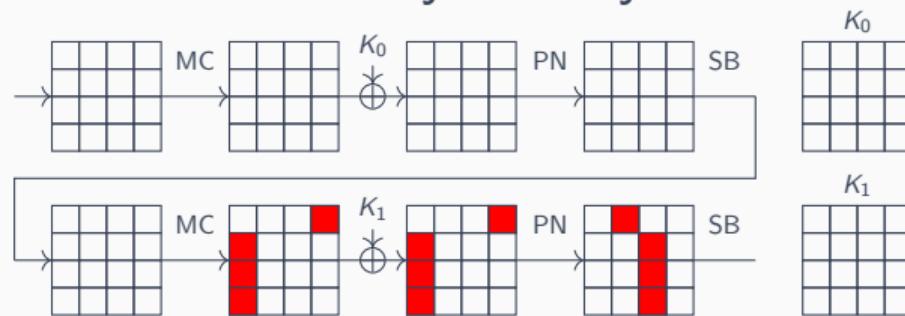
Probabilistic Key Recovery



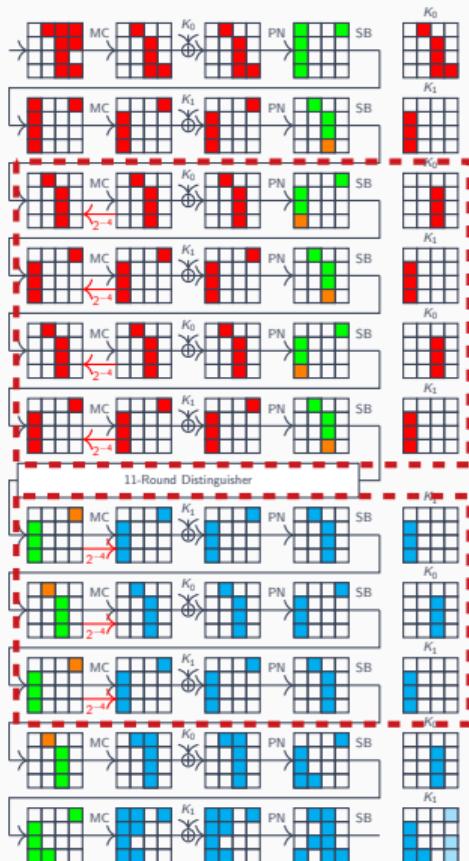
Differential Meet-in-the-Middle Attack on 23-Rounds [AKMMNP24]



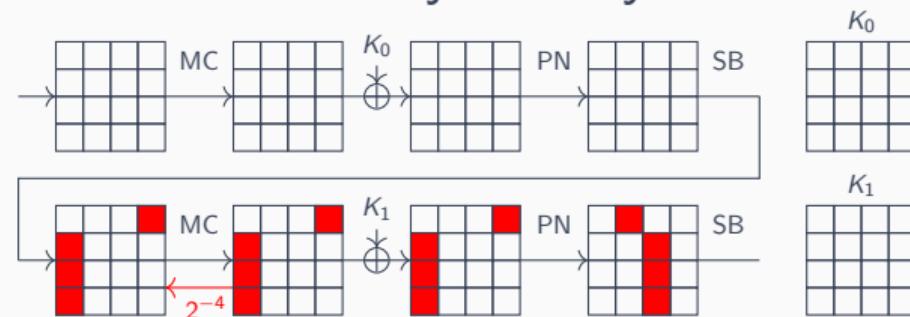
Probabilistic Key Recovery



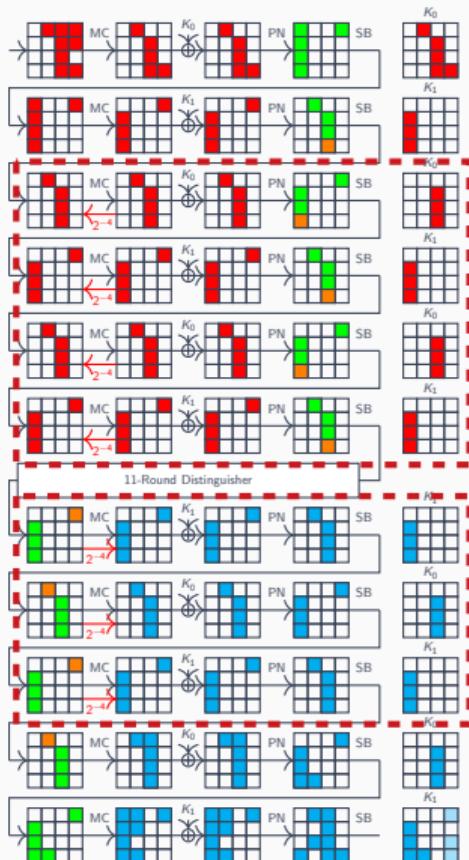
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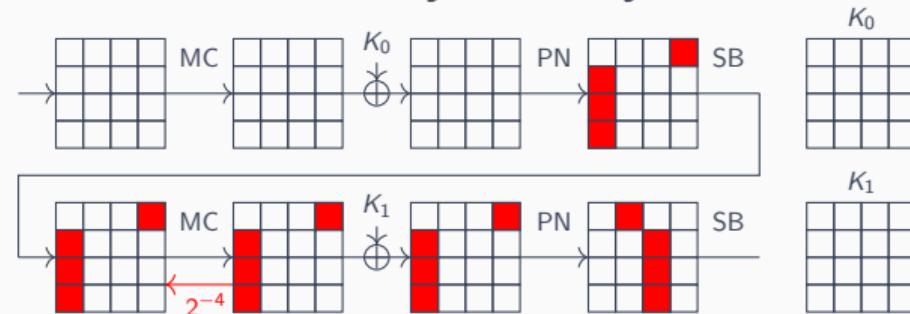
Probabilistic Key Recovery



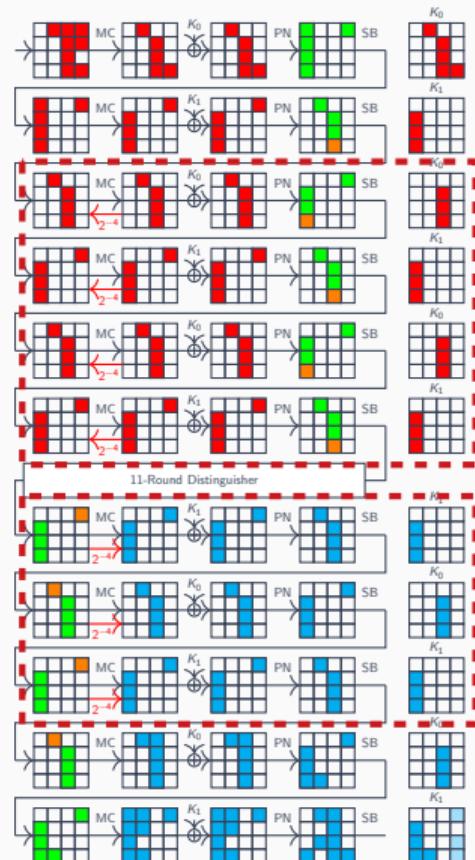
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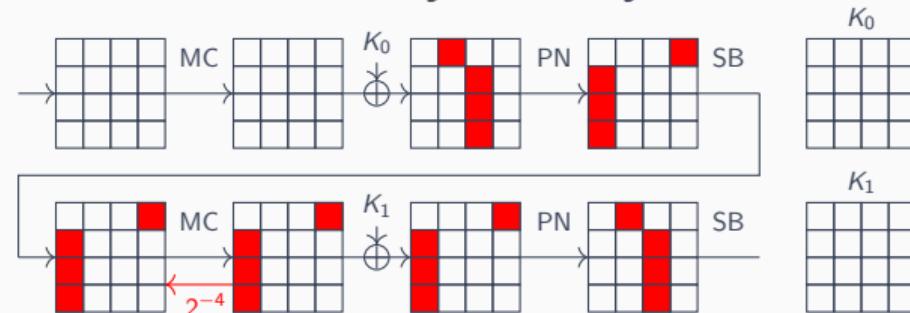
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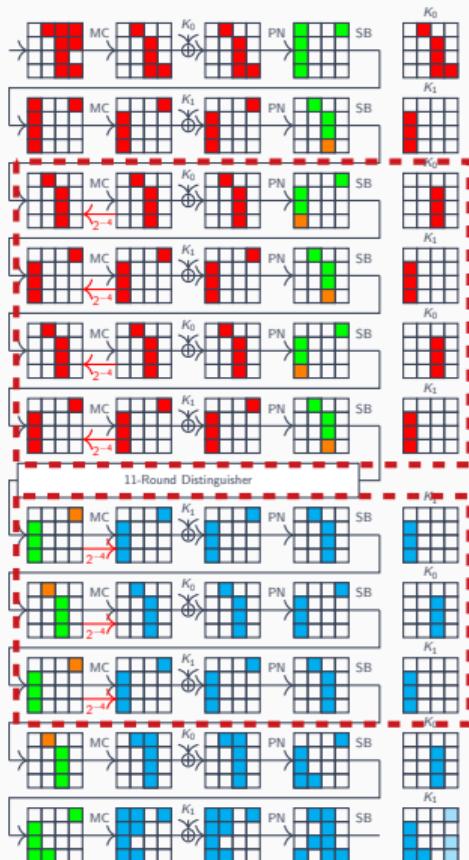
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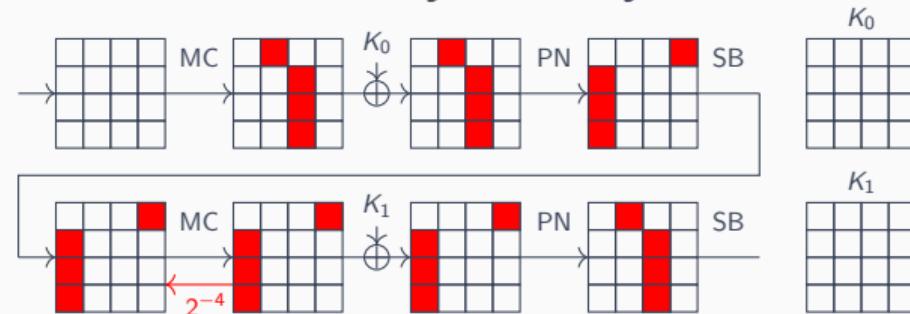
Probabilistic Key Recovery



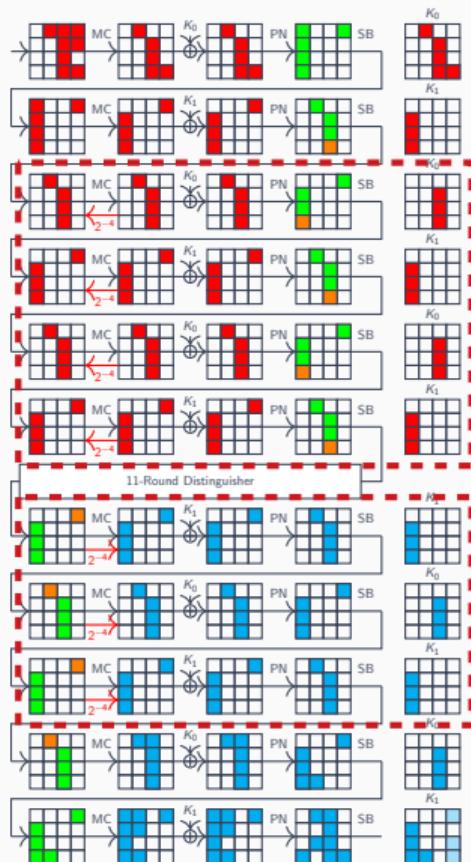
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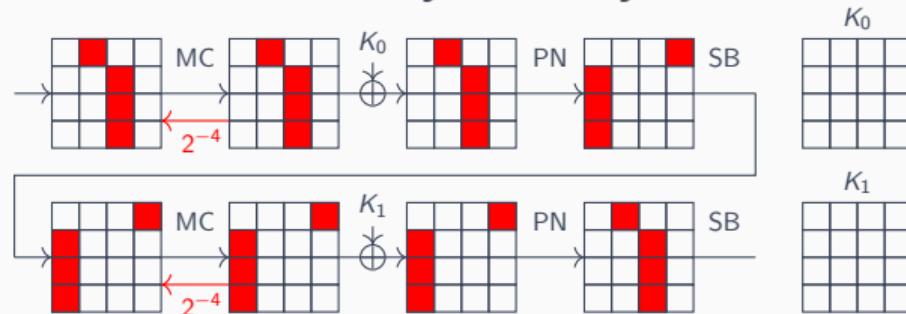
Probabilistic Key Recovery



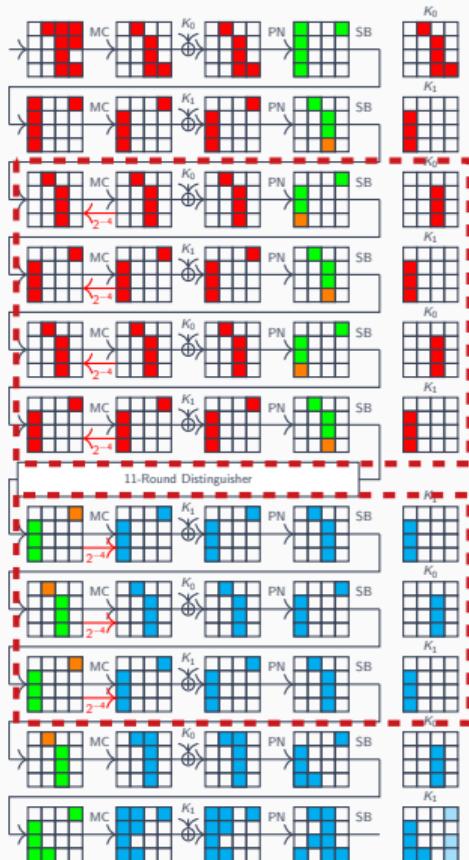
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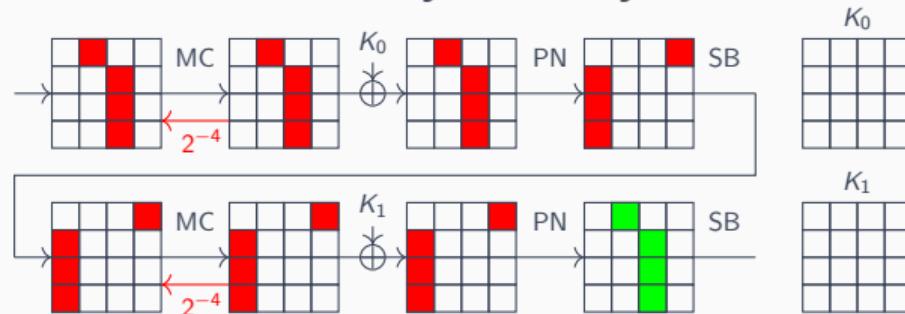
Probabilistic Key Recovery



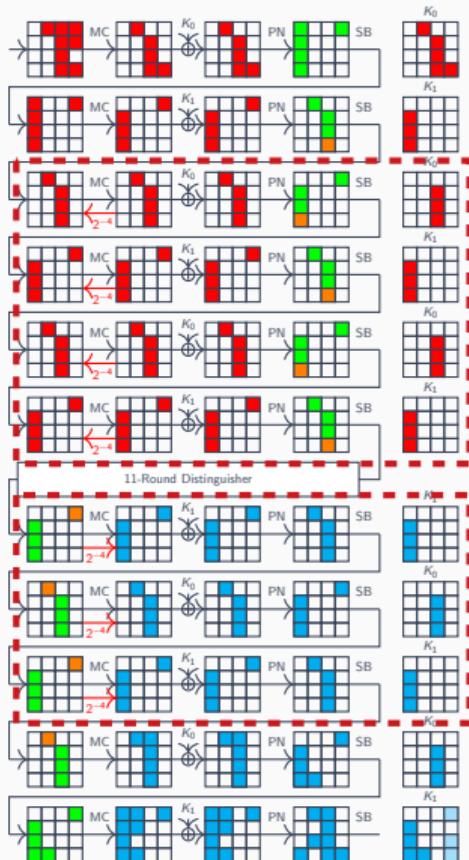
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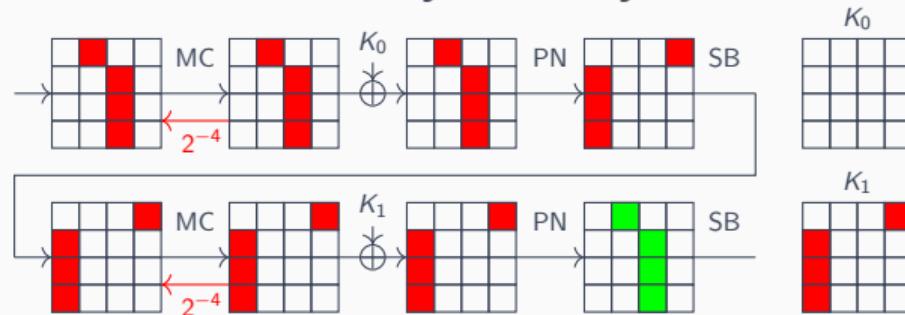
Probabilistic Key Recovery



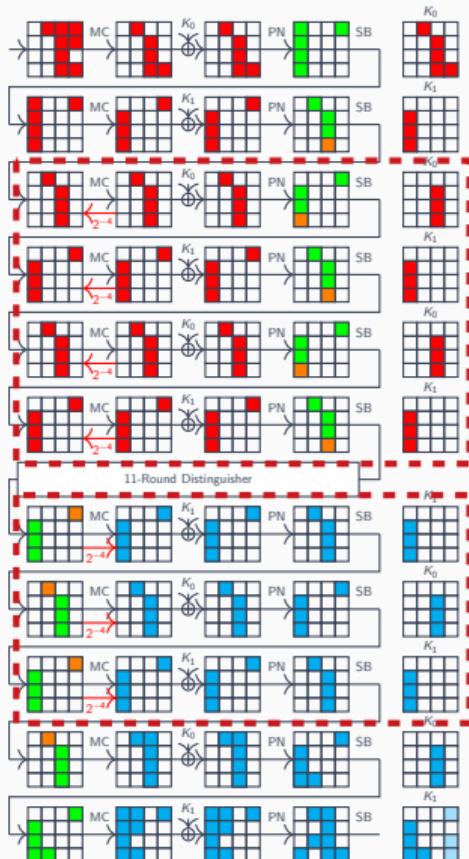
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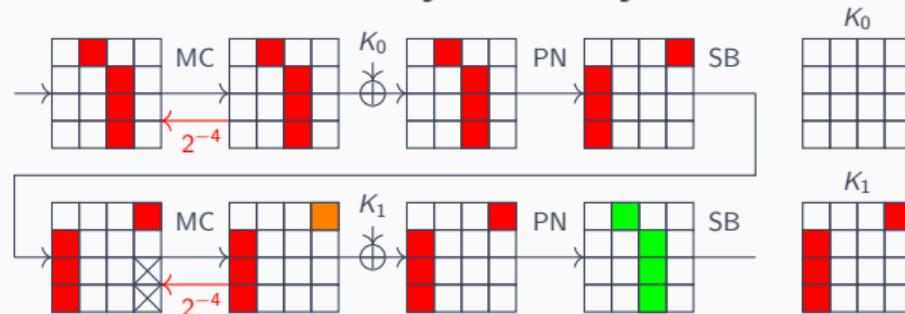
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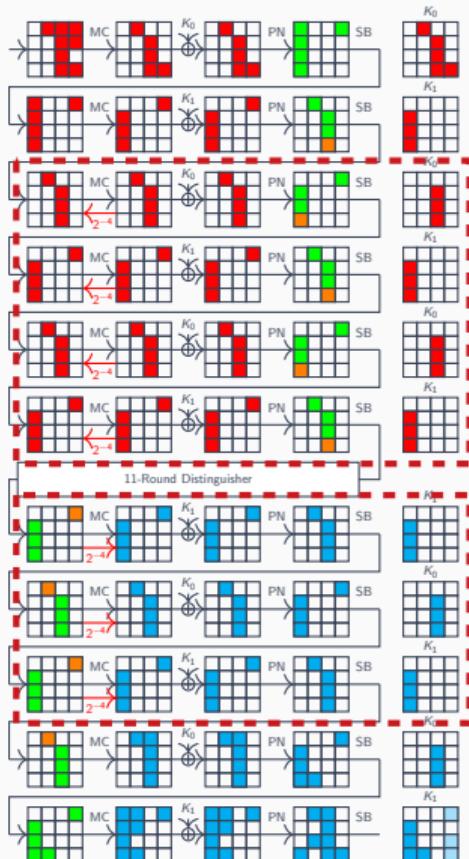
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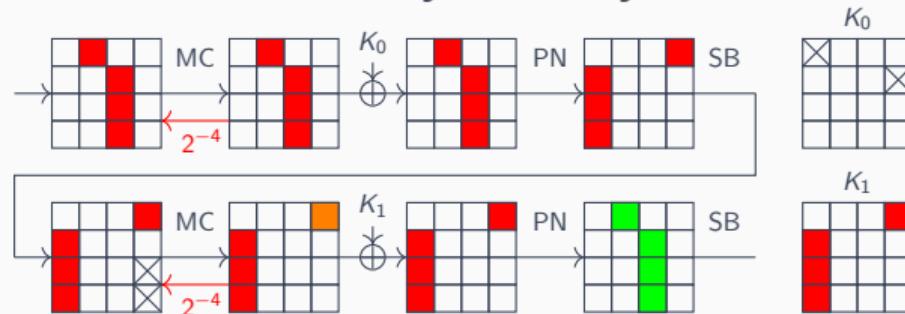
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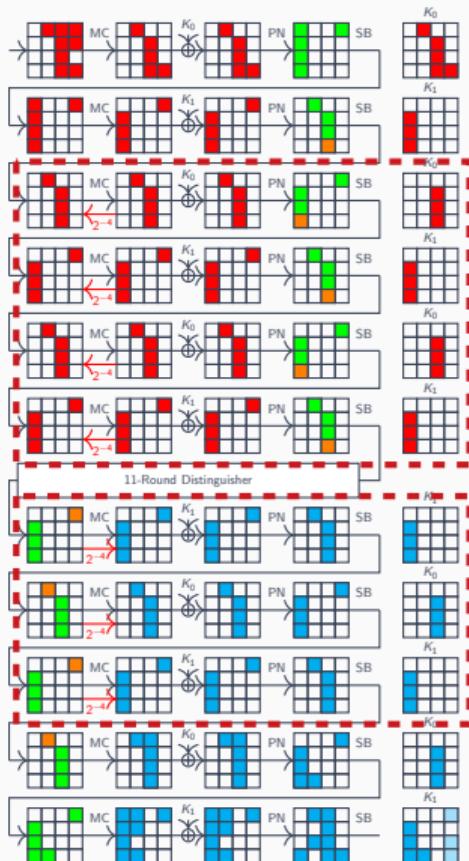
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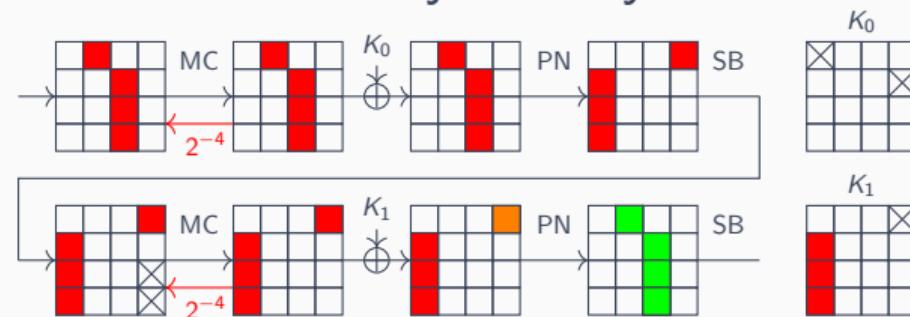
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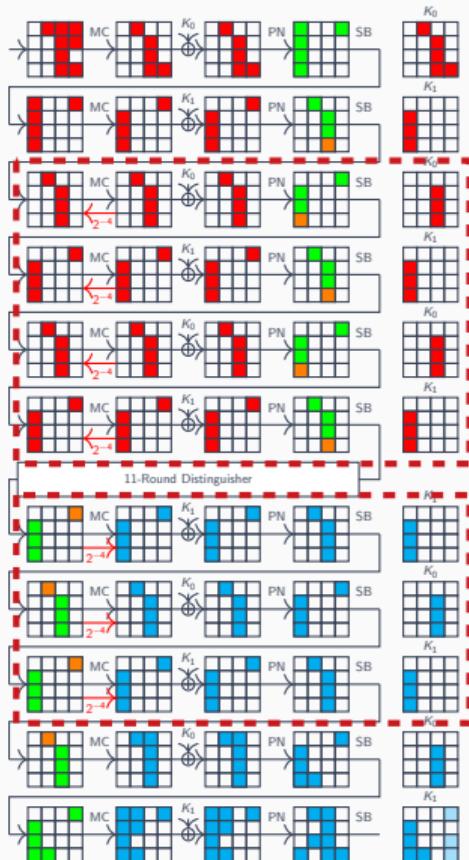
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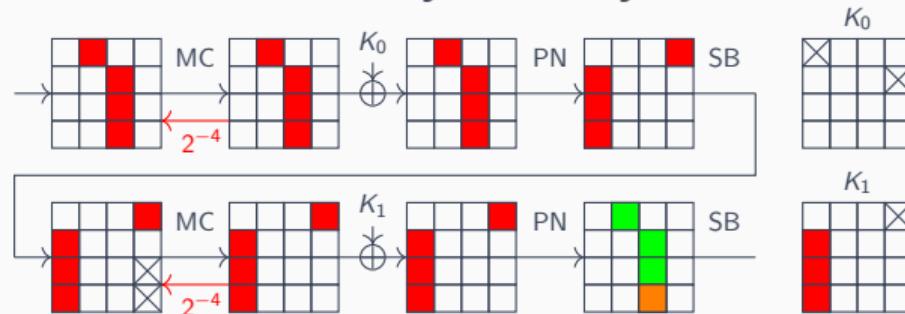
Probabilistic Key Recovery



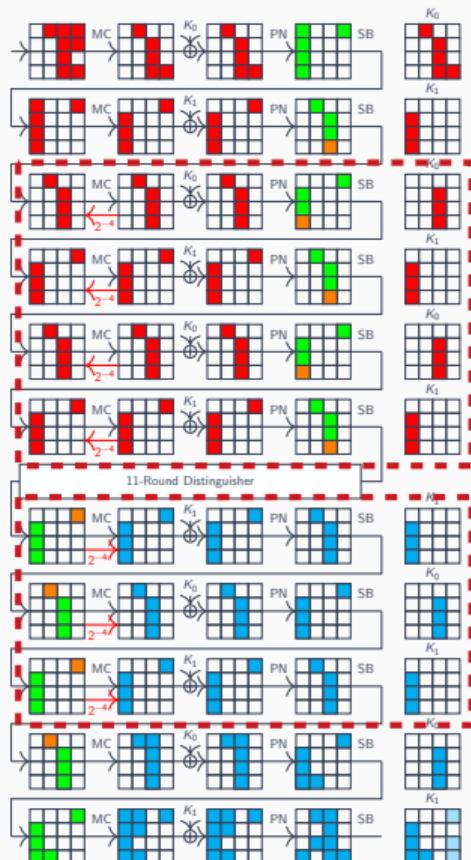
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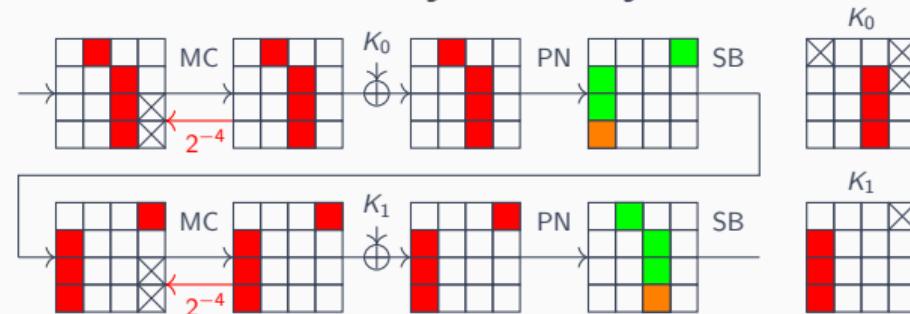
Probabilistic Key Recovery



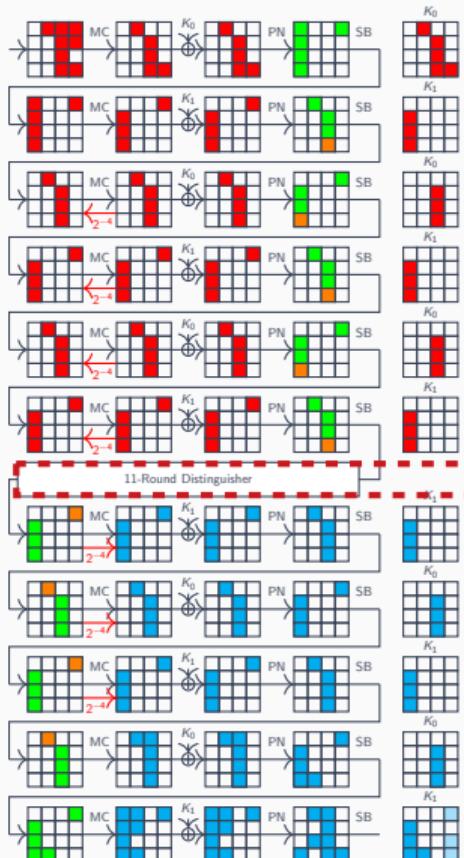
Differential Meet-in-the-Middle Attack on 23-Rounds [AKMMNP24]



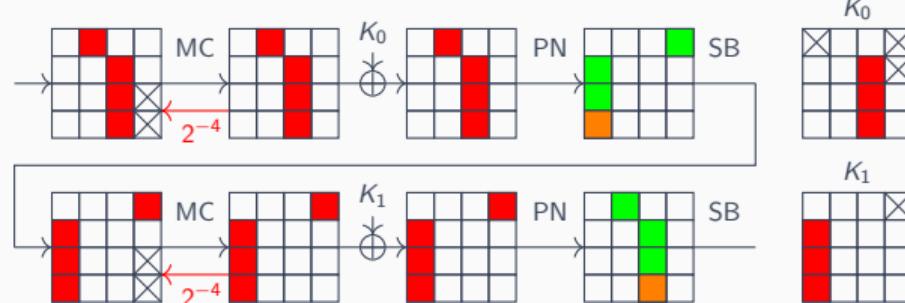
Probabilistic Key Recovery



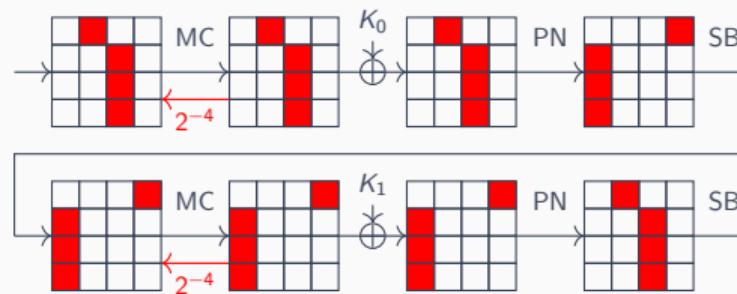
Differential Meet-in-the-Middle Attack on 23-Rounds [AKMMNP24]



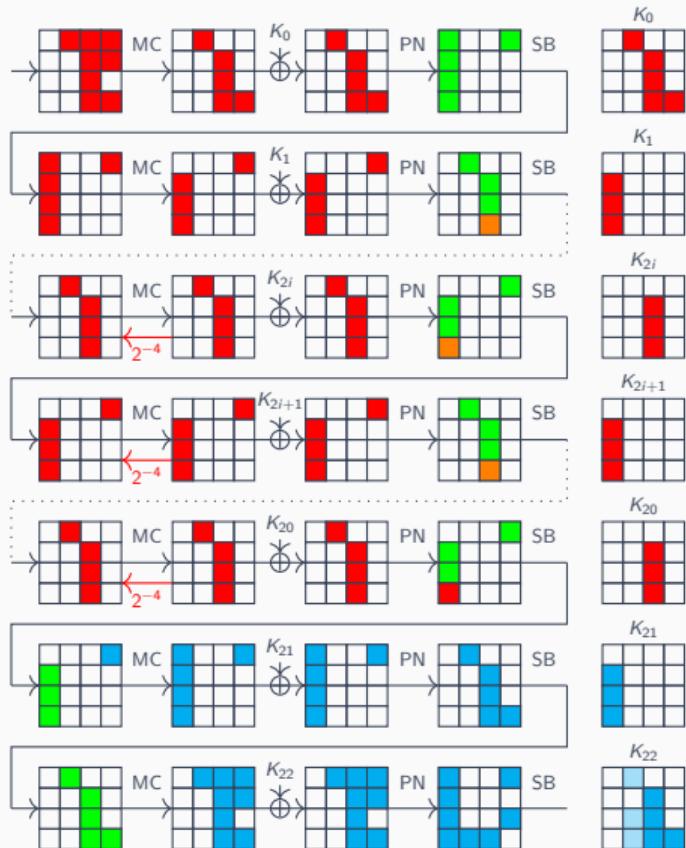
Probabilistic Key Recovery



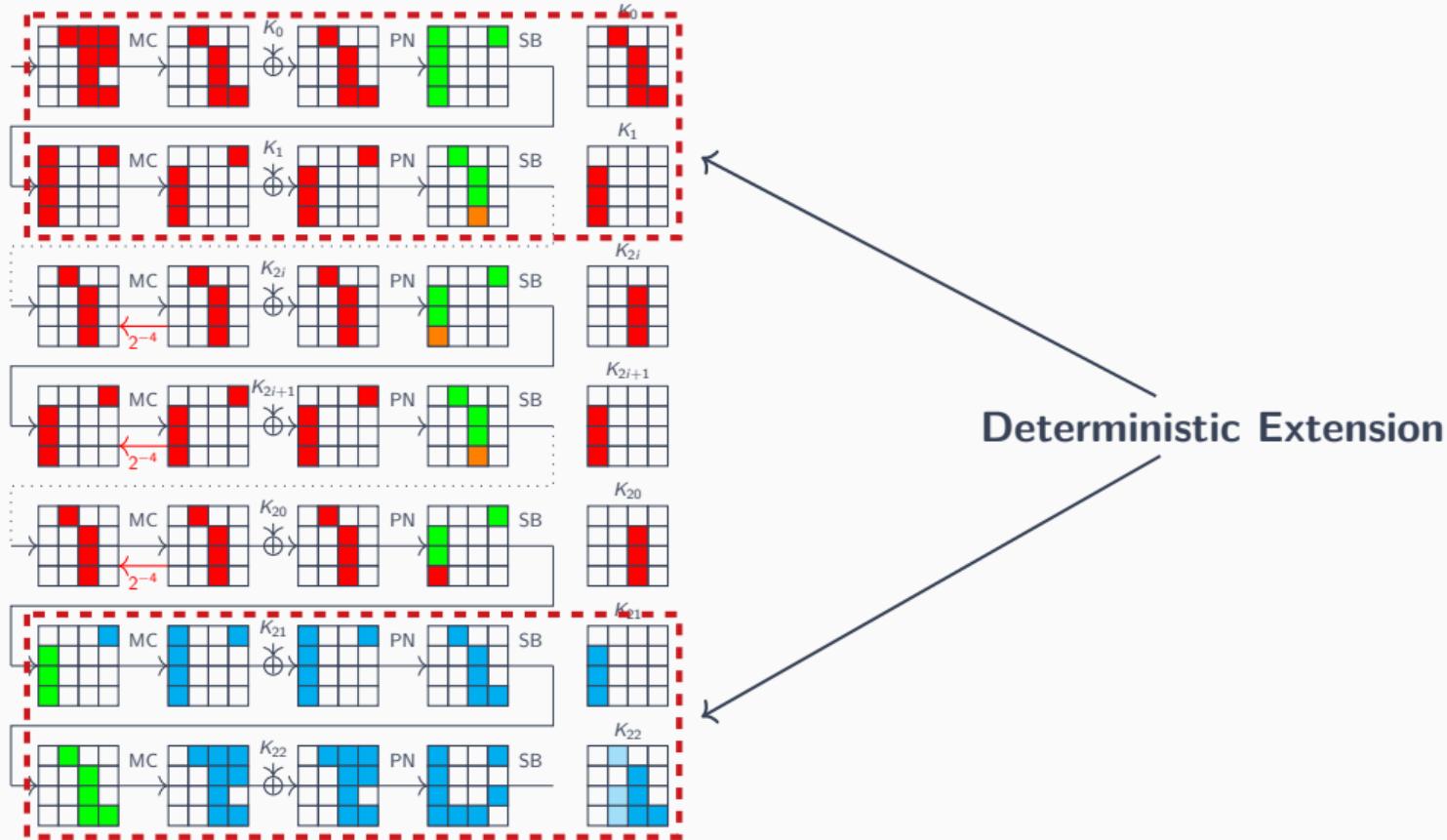
Truncated-Differential Characteristic



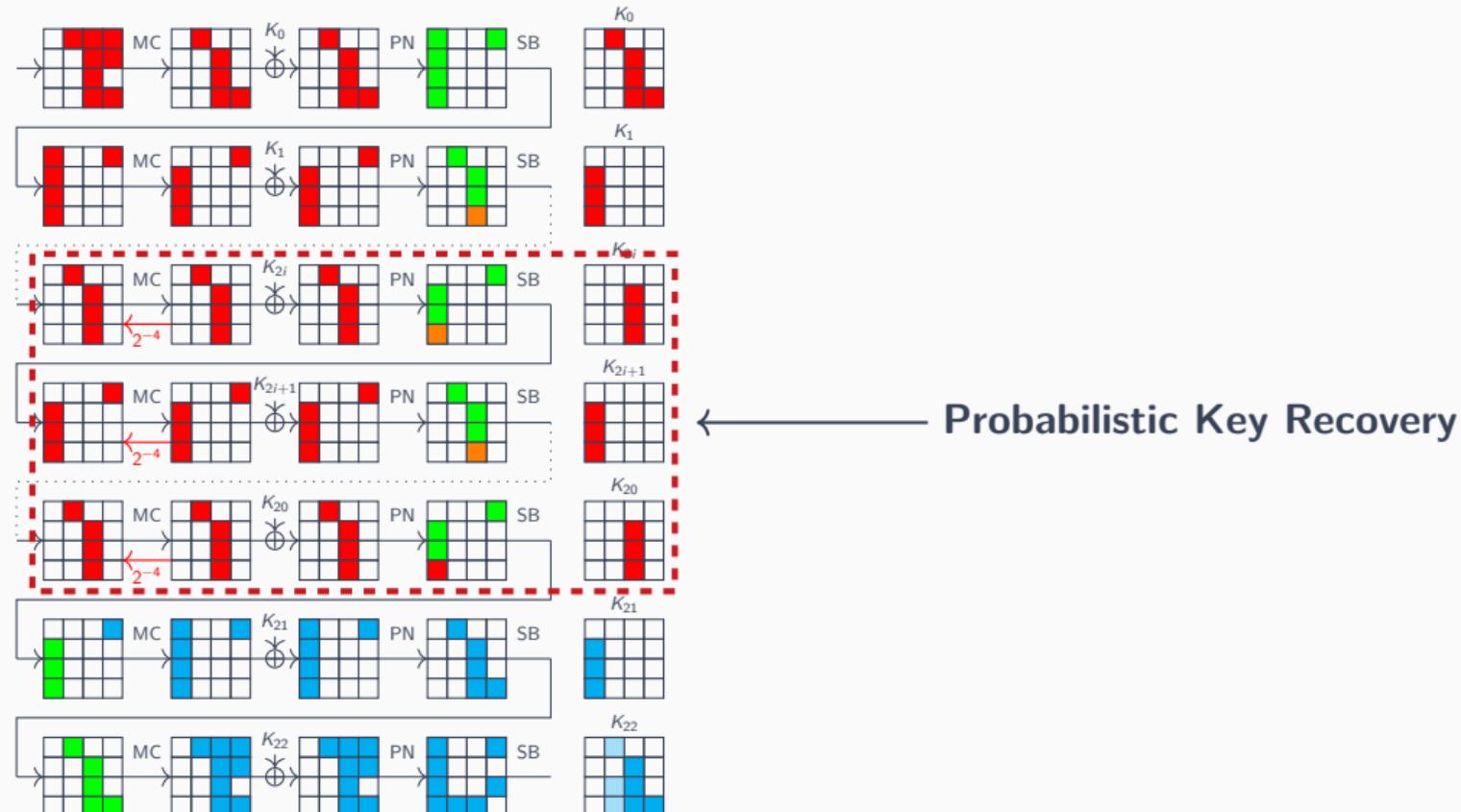
Our Attack



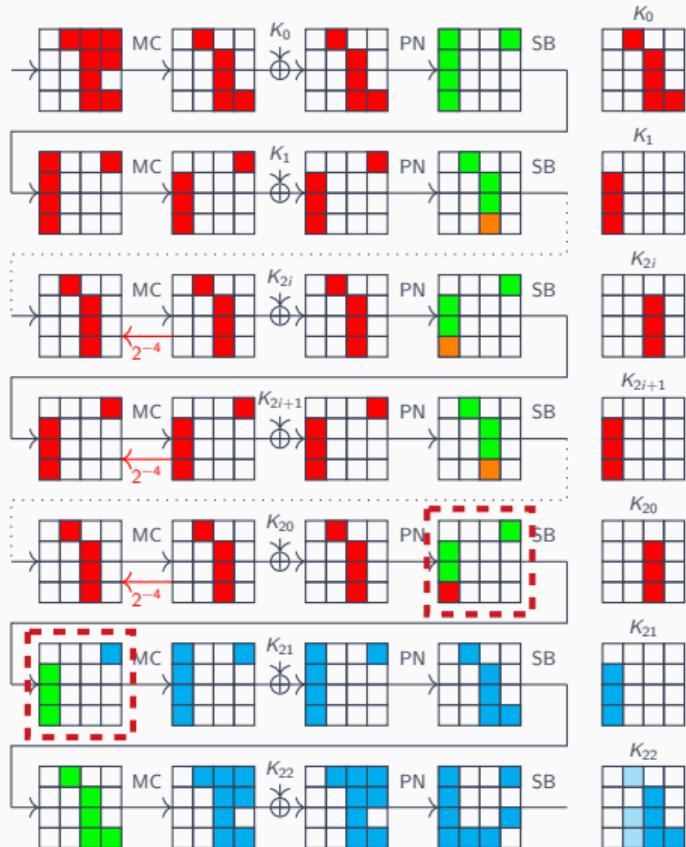
Our Attack



Our Attack

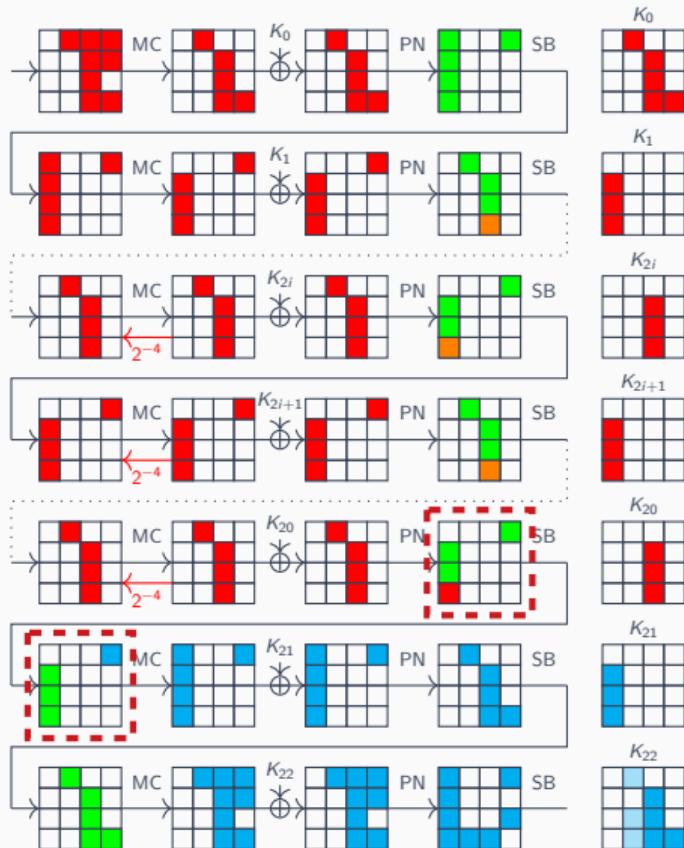


Our Attack



Zero-Round Distinguisher

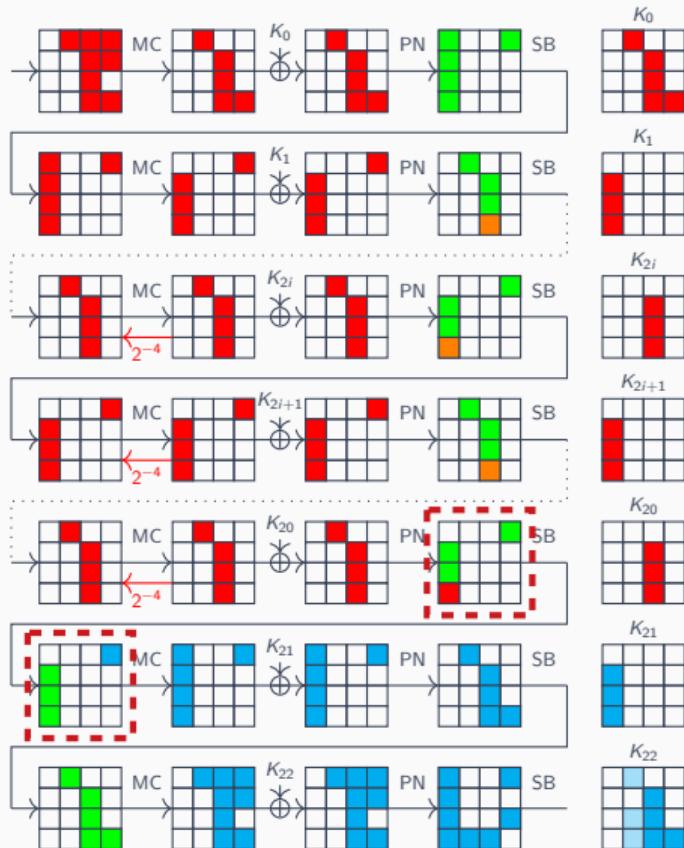
Our Attack



Zero-Round Distinguisher

Compute same cells from both sides

Our Attack

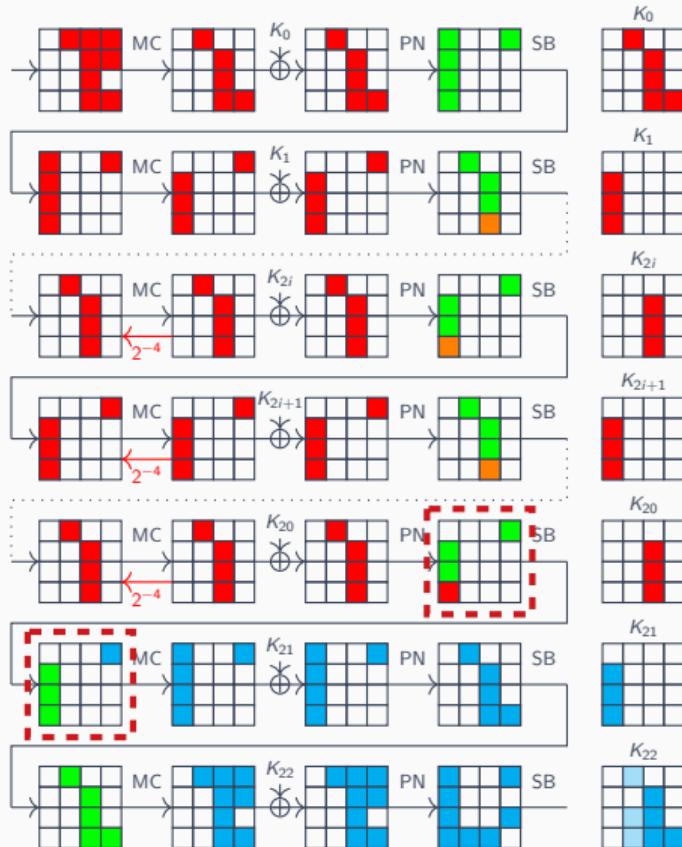


Zero-Round Distinguisher

Compute same cells from both sides

→ Use as additional filter

Our Attack



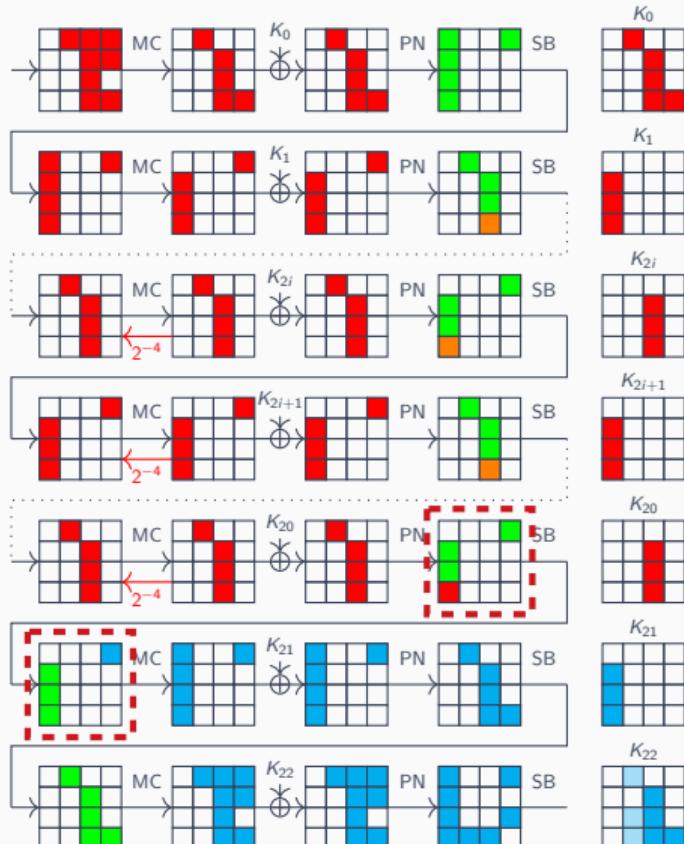
Zero-Round Distinguisher

Compute same cells from both sides

→ Use as additional filter

Two-Round Structure

Our Attack



Zero-Round Distinguisher

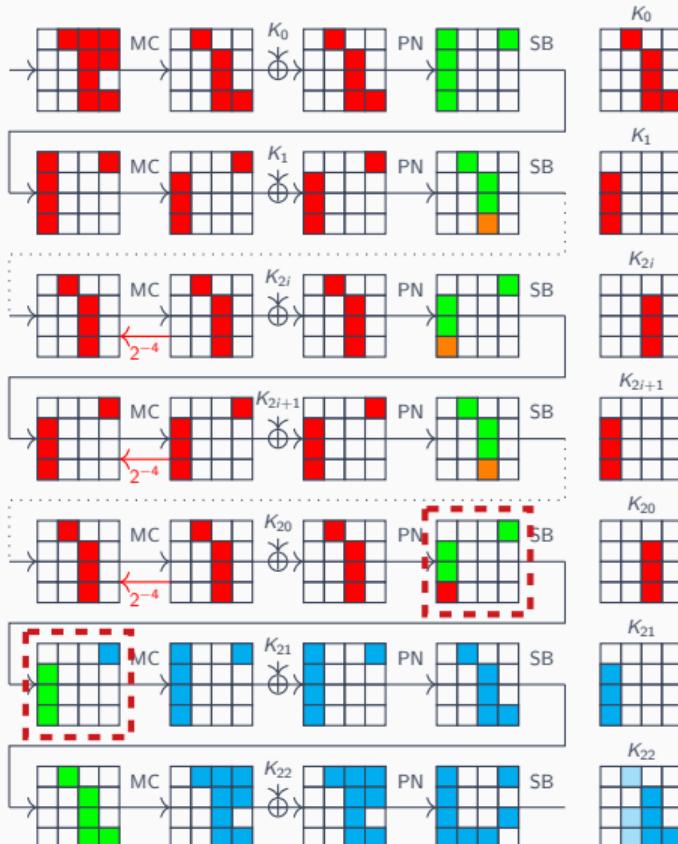
Compute same cells from both sides

→ Use as additional filter

Two-Round Structure

One-round structure in [AKMMNP24]

Our Attack



Zero-Round Distinguisher

Compute same cells from both sides

→ Use as additional filter

Two-Round Structure

One-round structure in [AKMMNP24]

Details in the paper

Comparison with Prior Work

Cipher	Rounds	Time	Memory	Data	Attack	Ref.
CRAFT	23	2^{125}	2^{101}	2^{60}	TD-MitM	[AKMMNP24]
		$2^{111.46}$	2^{120}	$2^{60.99}$	D	[SYCHW24]
		2^{109}	2^{36}	2^{58}	TD-MitM	This Work
	24	2^{110}	2^{34}	2^{60}	TD-MitM	This Work
	25	$2^{117.58}$	2^{48}	2^{60}	TD-MitM	This Work
	26	2^{118}	2^{34}	2^{64}	TD-MitM	This Work

D: Differential

TD-MitM: Truncated Differential MitM

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Thank you for your attention!