Improved Single-Key Attacks on 8-round AES

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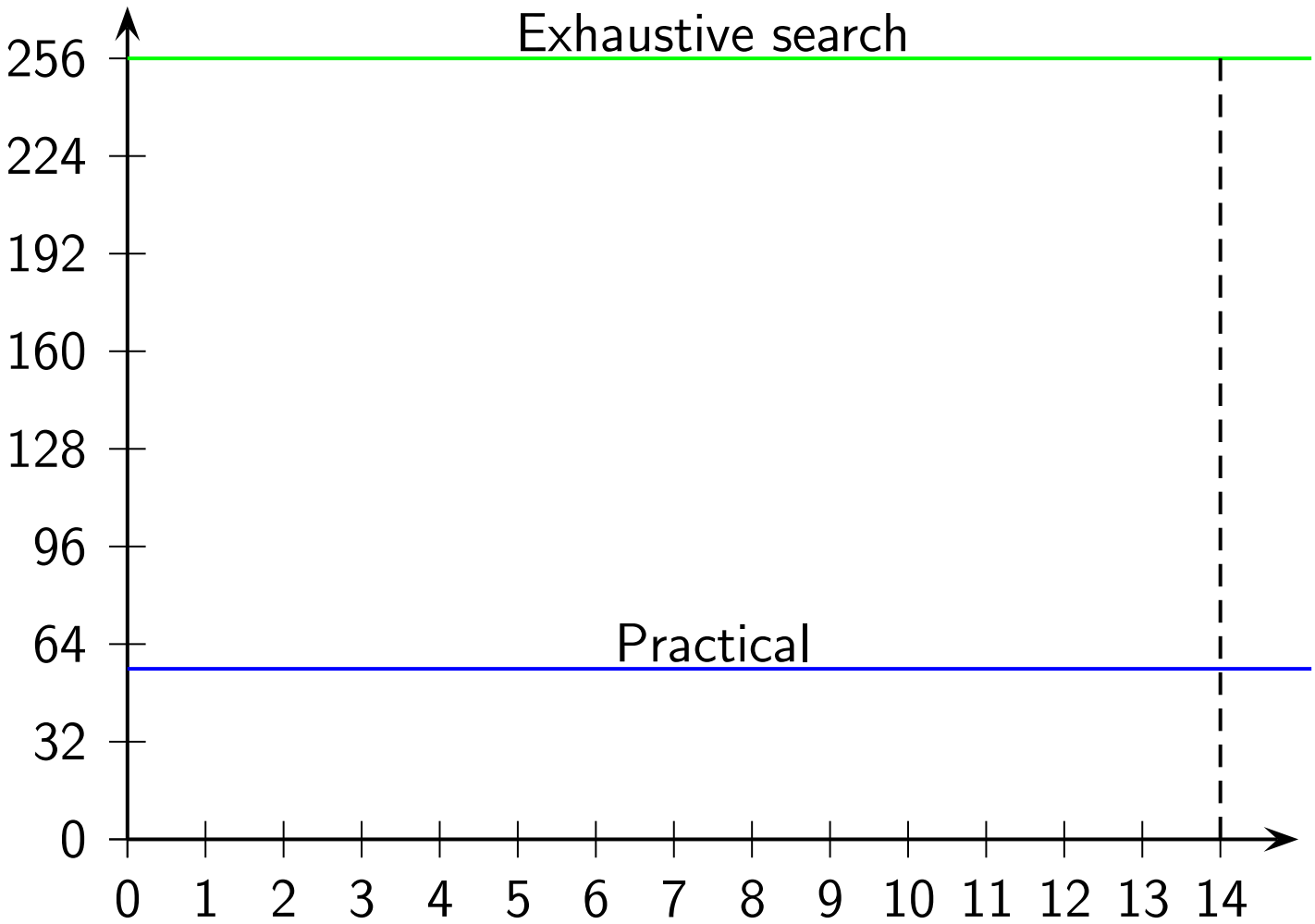
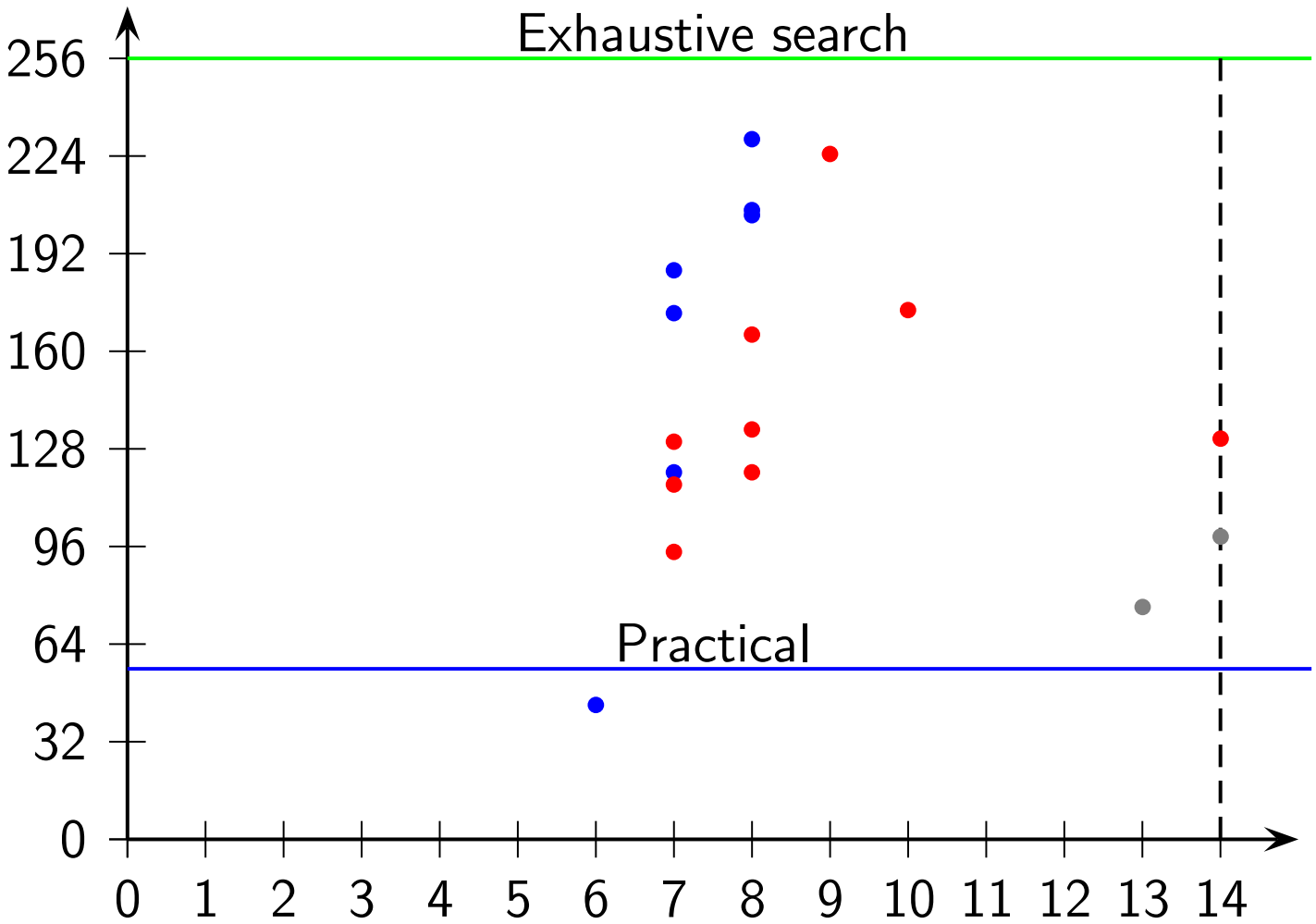
Attacks on AES-256



Blue — single key, Red — related-key, Gray — related-subkey

Attacks on AES-256



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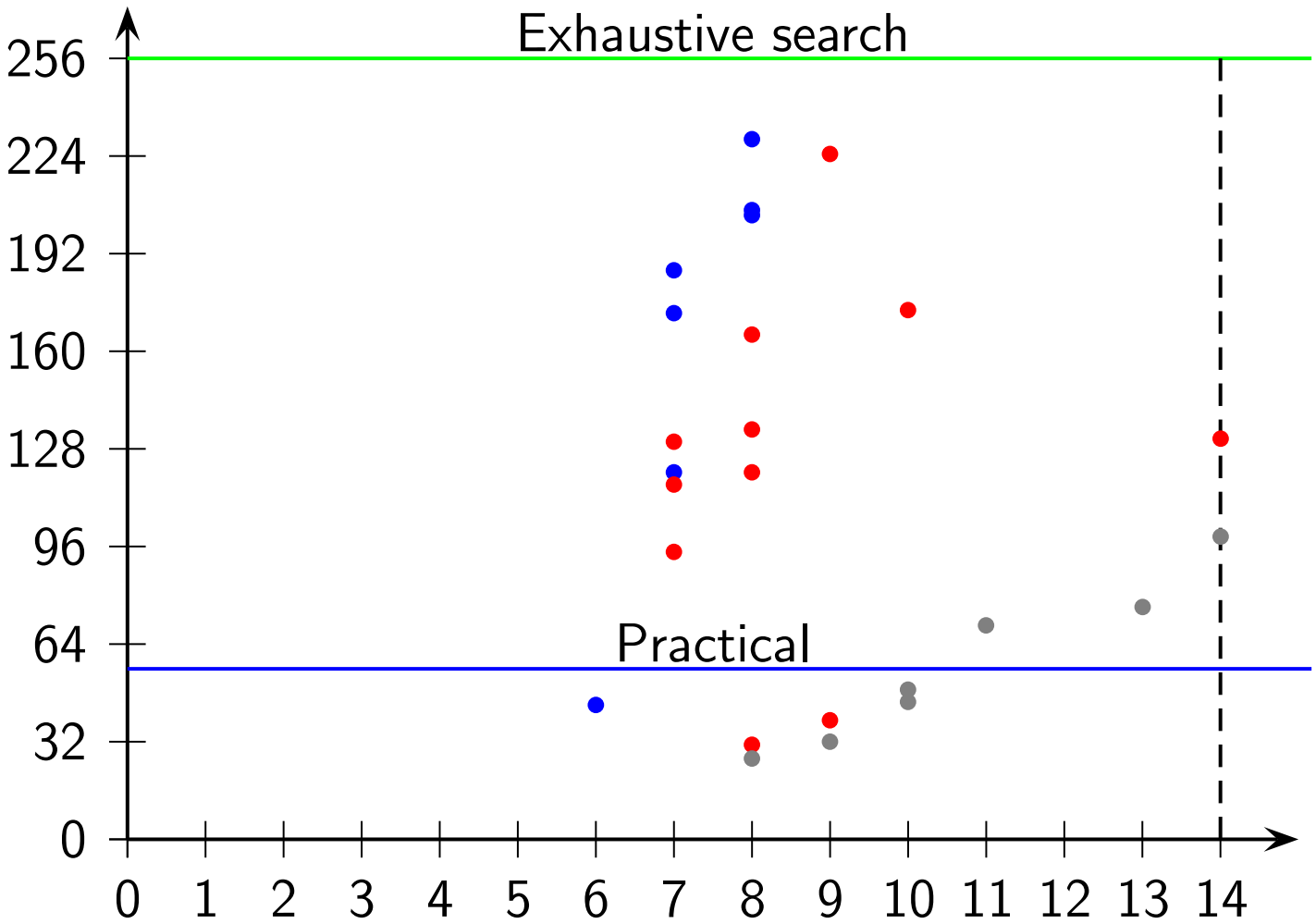

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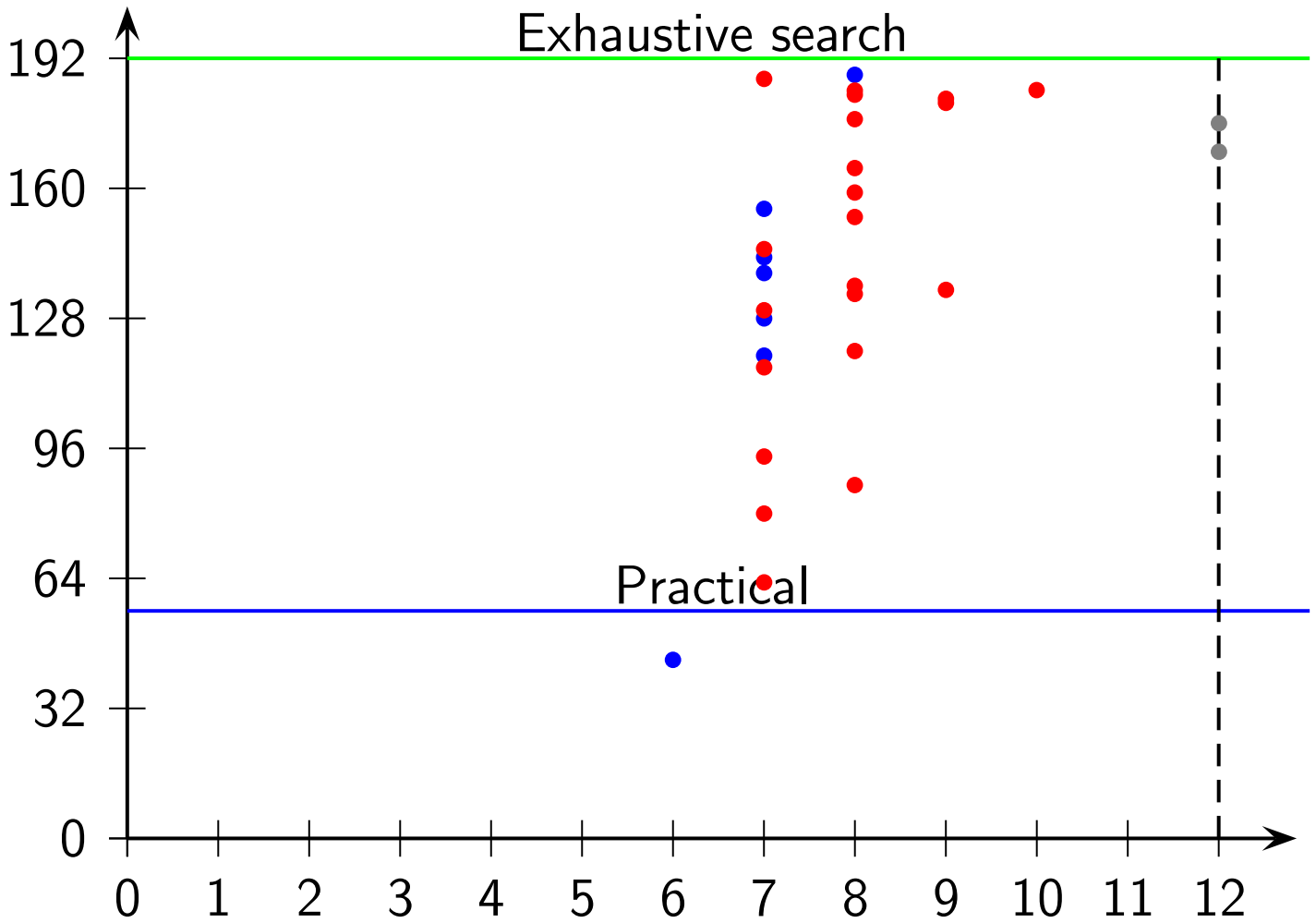
Attacks on AES-192



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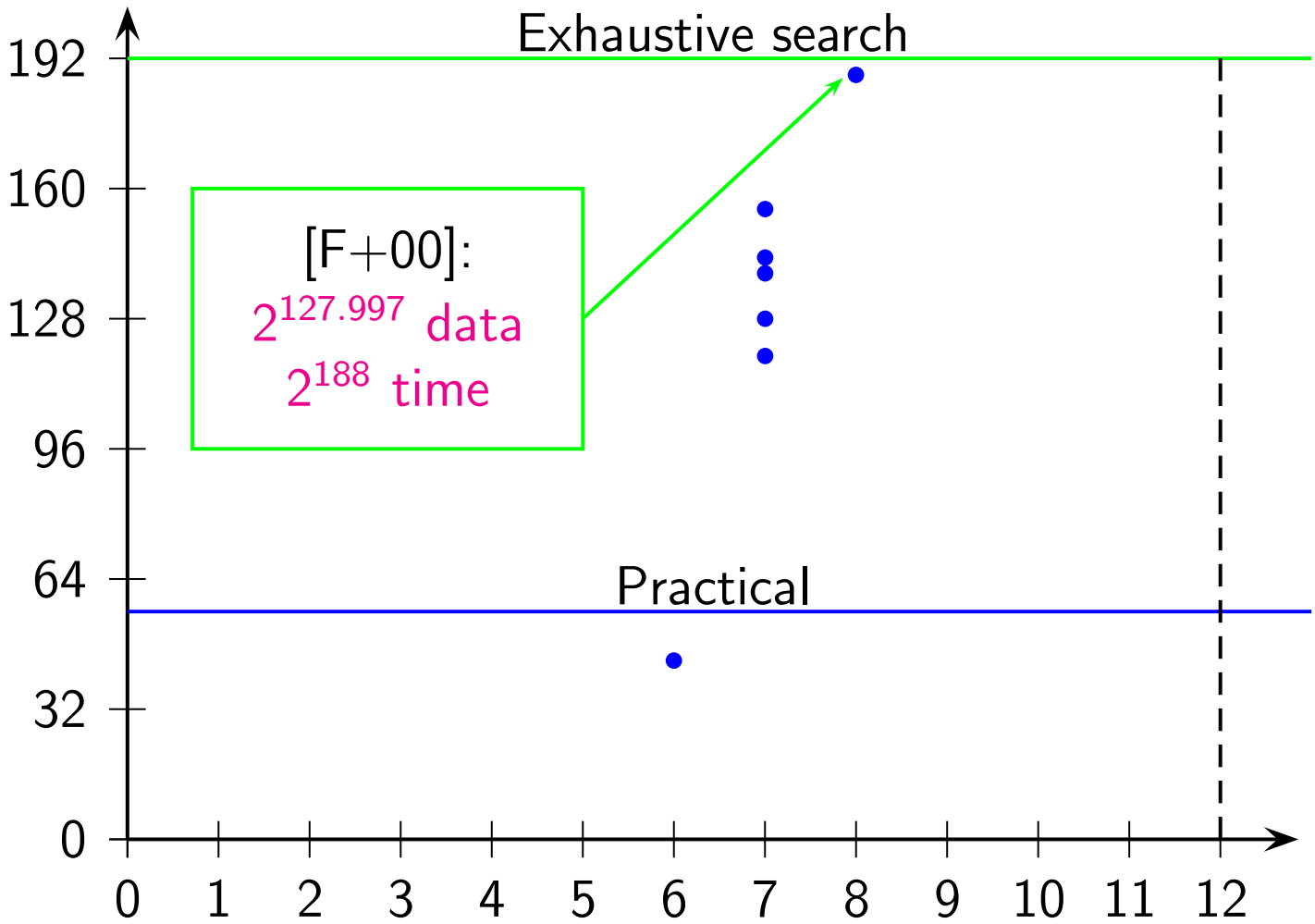

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The Belgian Defense

- The attacks are in the *Related-Subkey* model.
- The attacks have no meaning when dealing with encryption.
- The most successful attacks are in the adaptive chosen plaintext and ciphertext model.
- The practical attacks are not on the full cipher.

Back to the Basics

- Consider single key attacks.
- Best (in term of rounds) attacks:

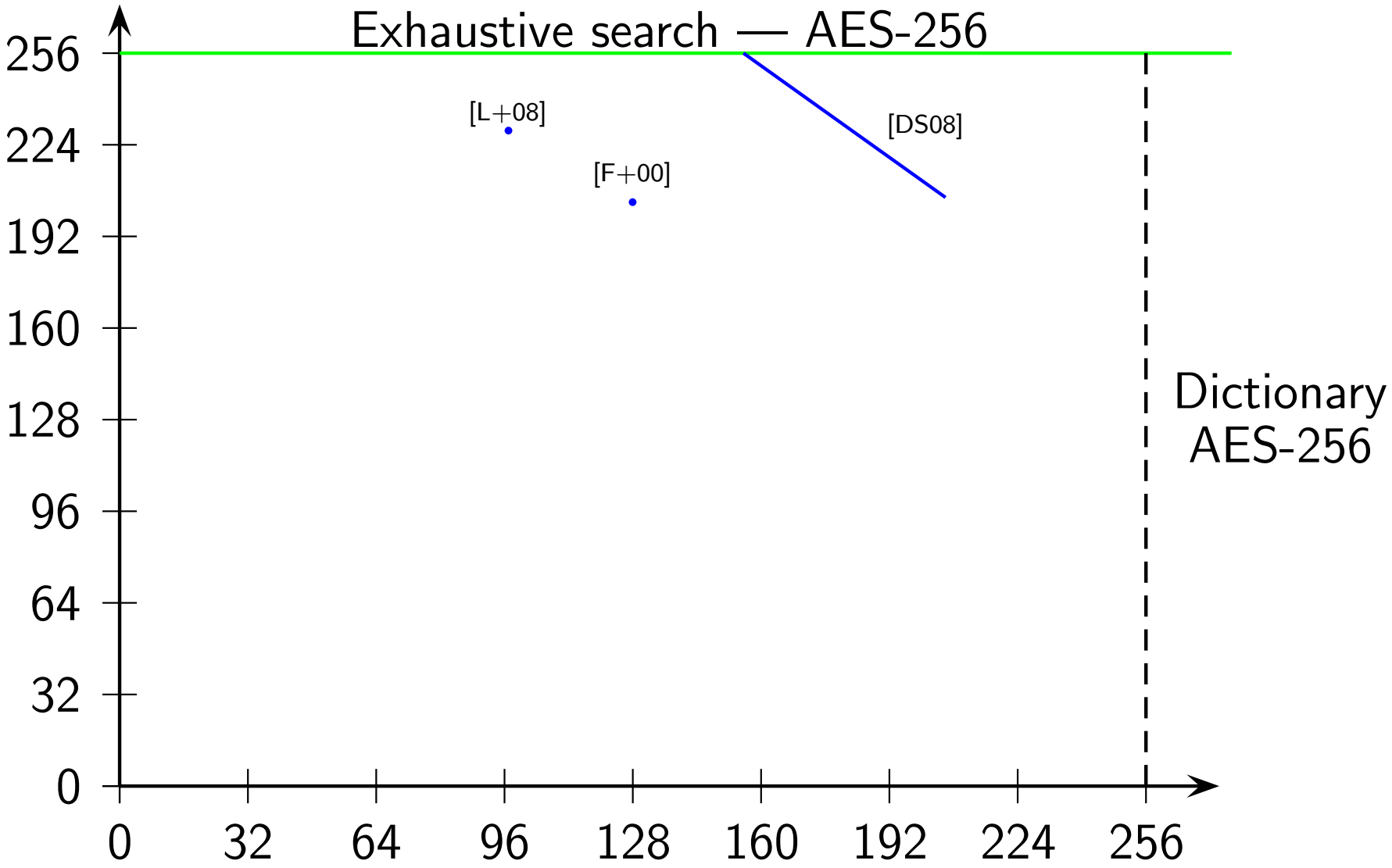
Version	Rounds	Data	Time	Memory	Ref.
AES-128	7	$2^{112.2}$	$2^{117.2}$	$2^{112.2}$	[L+08]
AES-192	8	$2^{127.997}$	2^{188}	2^{128}	[F+00]
AES-256	8	$2^{127.997}$	2^{204}	2^{128}	[F+00]

An Interesting Flavour of Attacks on AES

- Take Demirci-Selçuk's attack from FSE'08 (which in itself is based on Gilbert-Minier's attack from AES3)

Rounds	Data	Memory (Pre)	Time	MinMax	Ref.
7	2^{34+n}	2^{204-n}	2^{82+n}	2^{143}	[DS08]
8	2^{34+n}	2^{206-n}	$2^{205.6+n}$	$2^{205.8}$	[DS08]
8	$2^{34+\max(n-24,0)}$	2^{208-n}	2^{206+n} MA	2^{208}	[D+09]

8-Round Single-Key Attacks on AES



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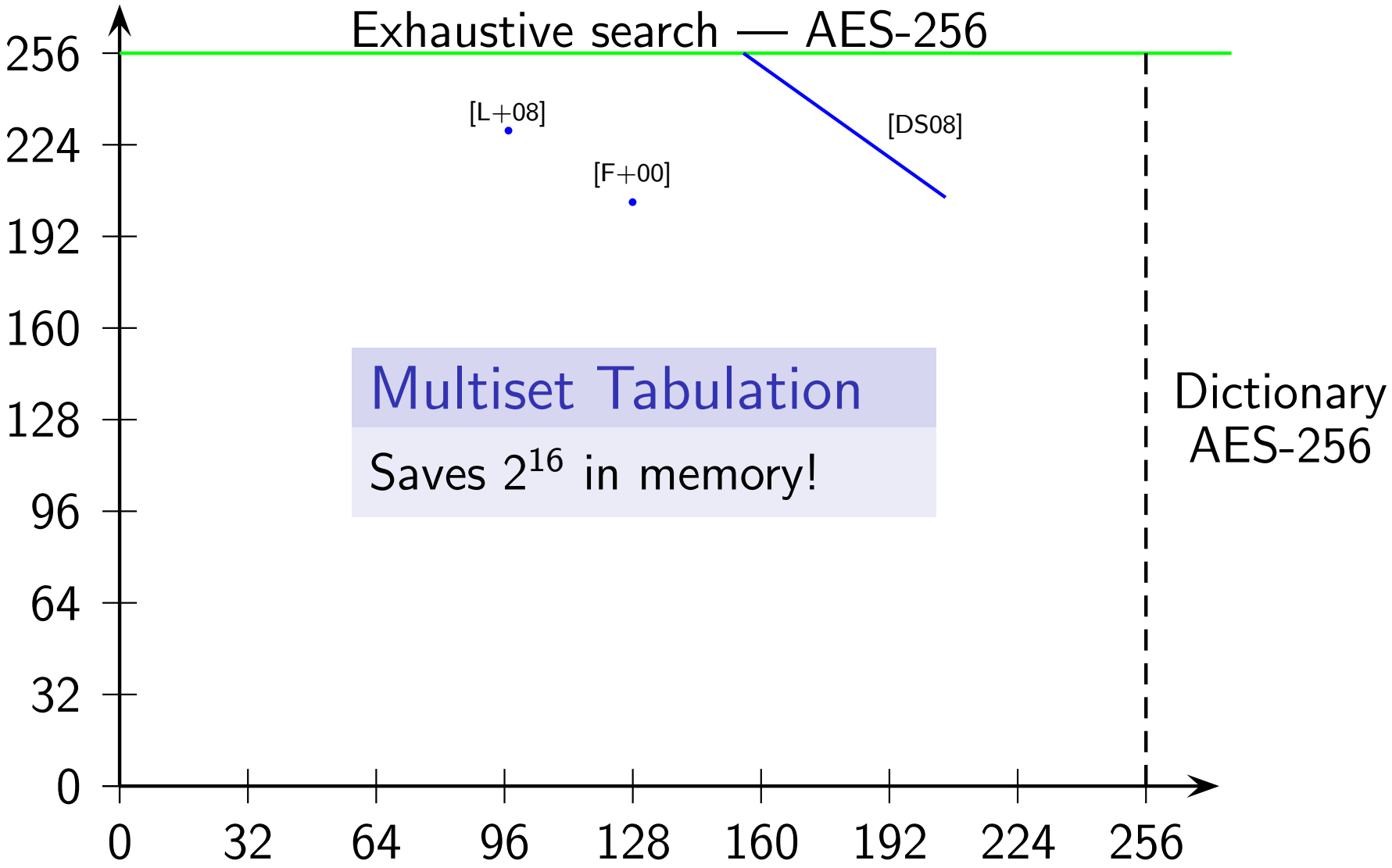

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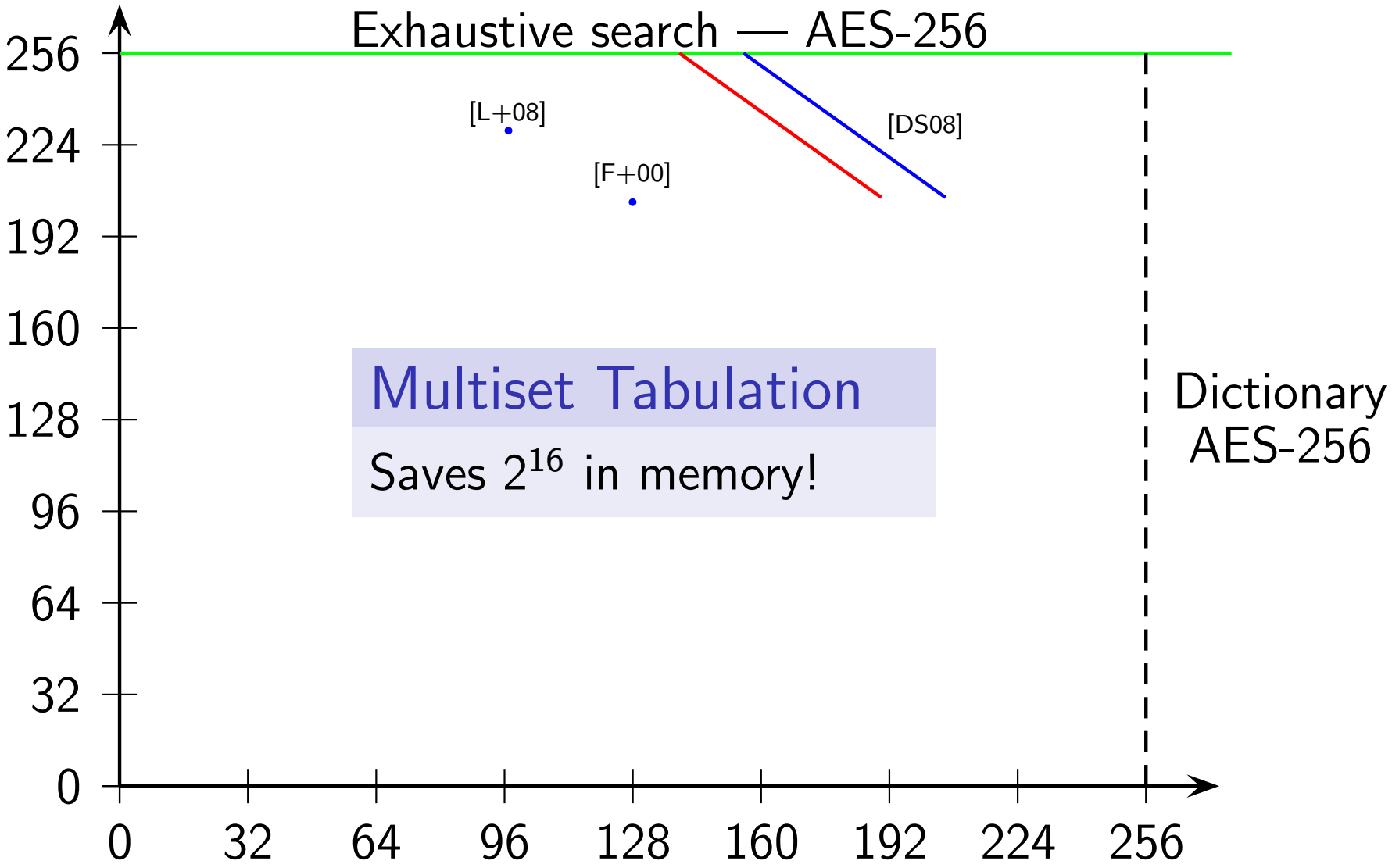

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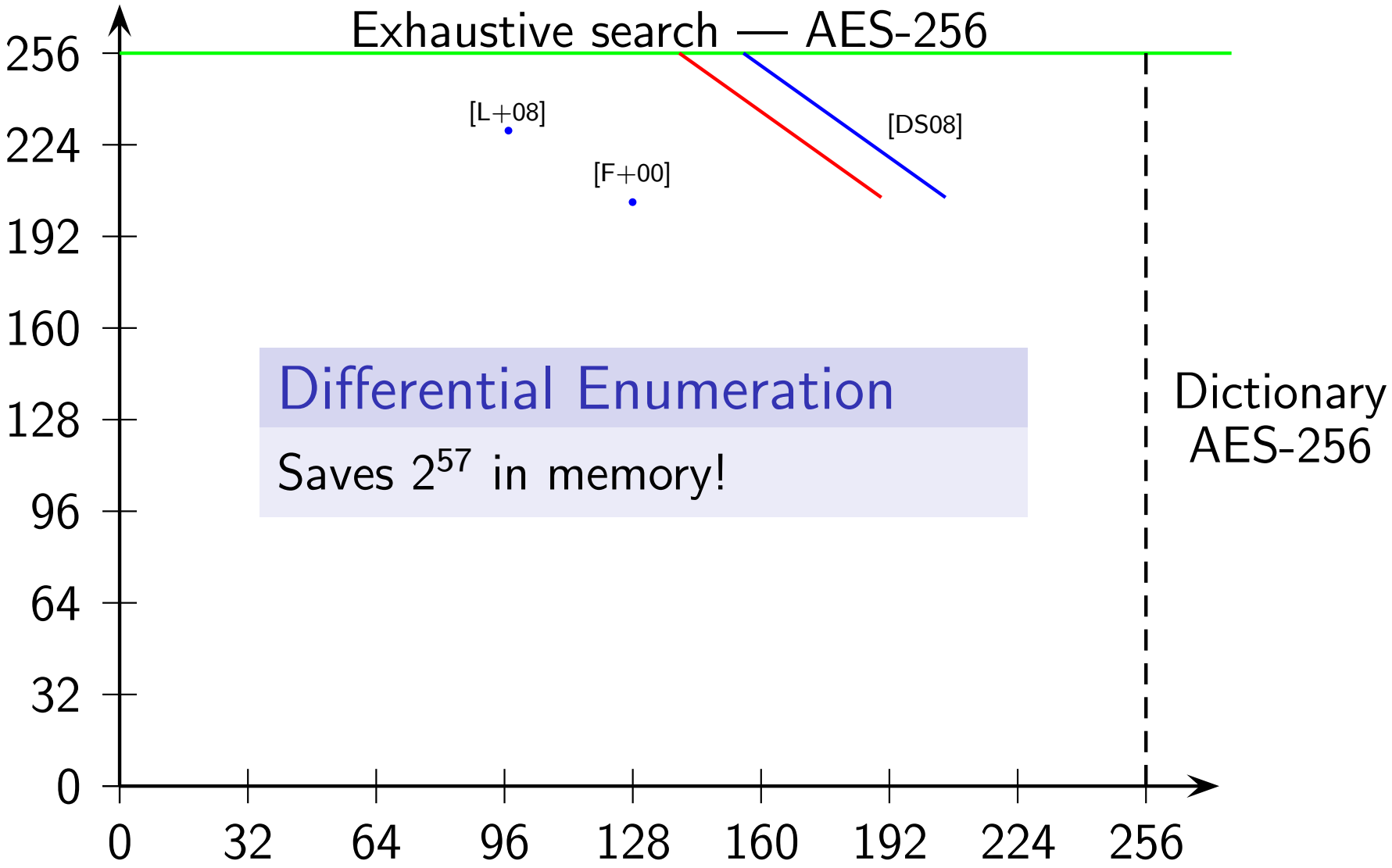

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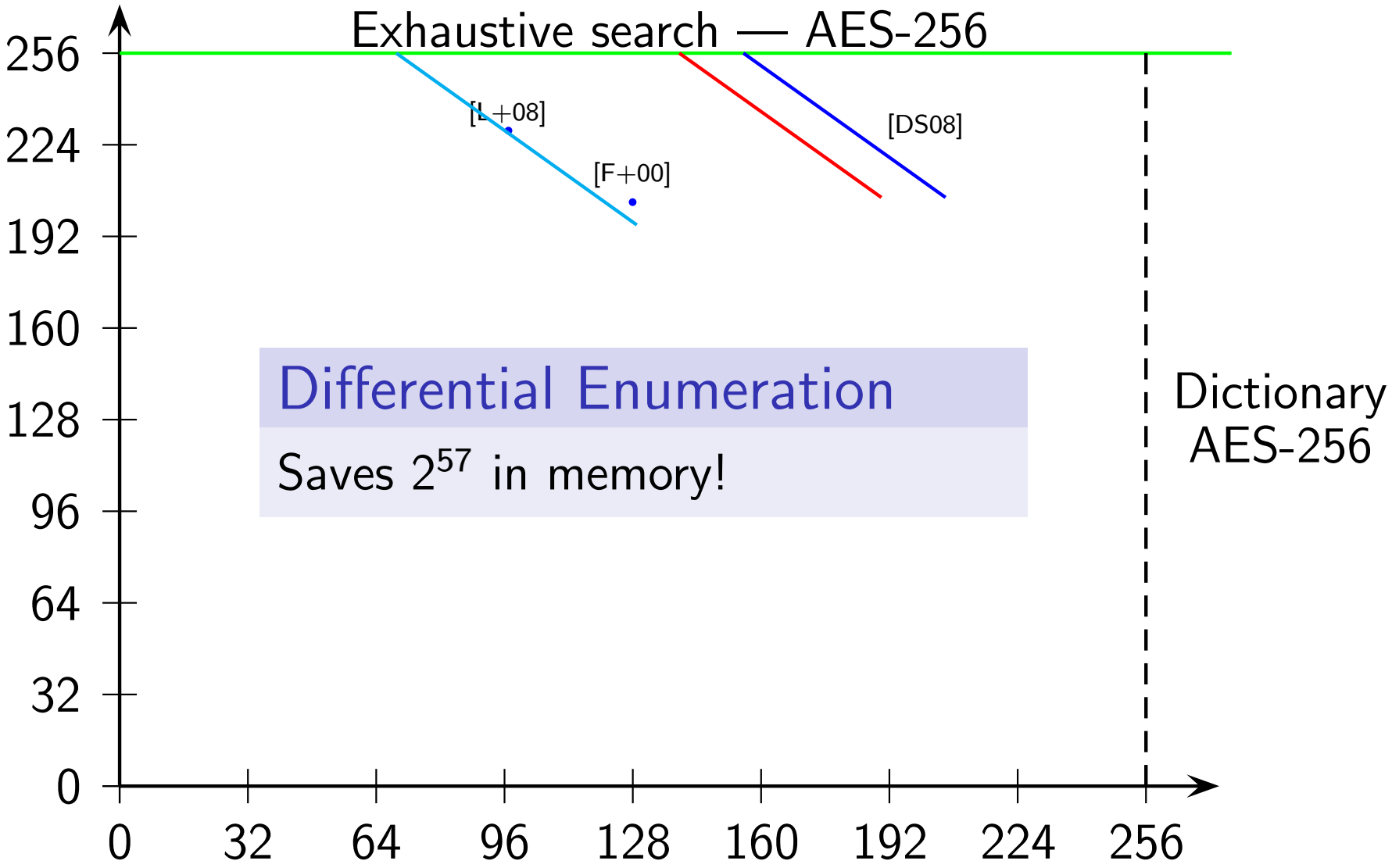

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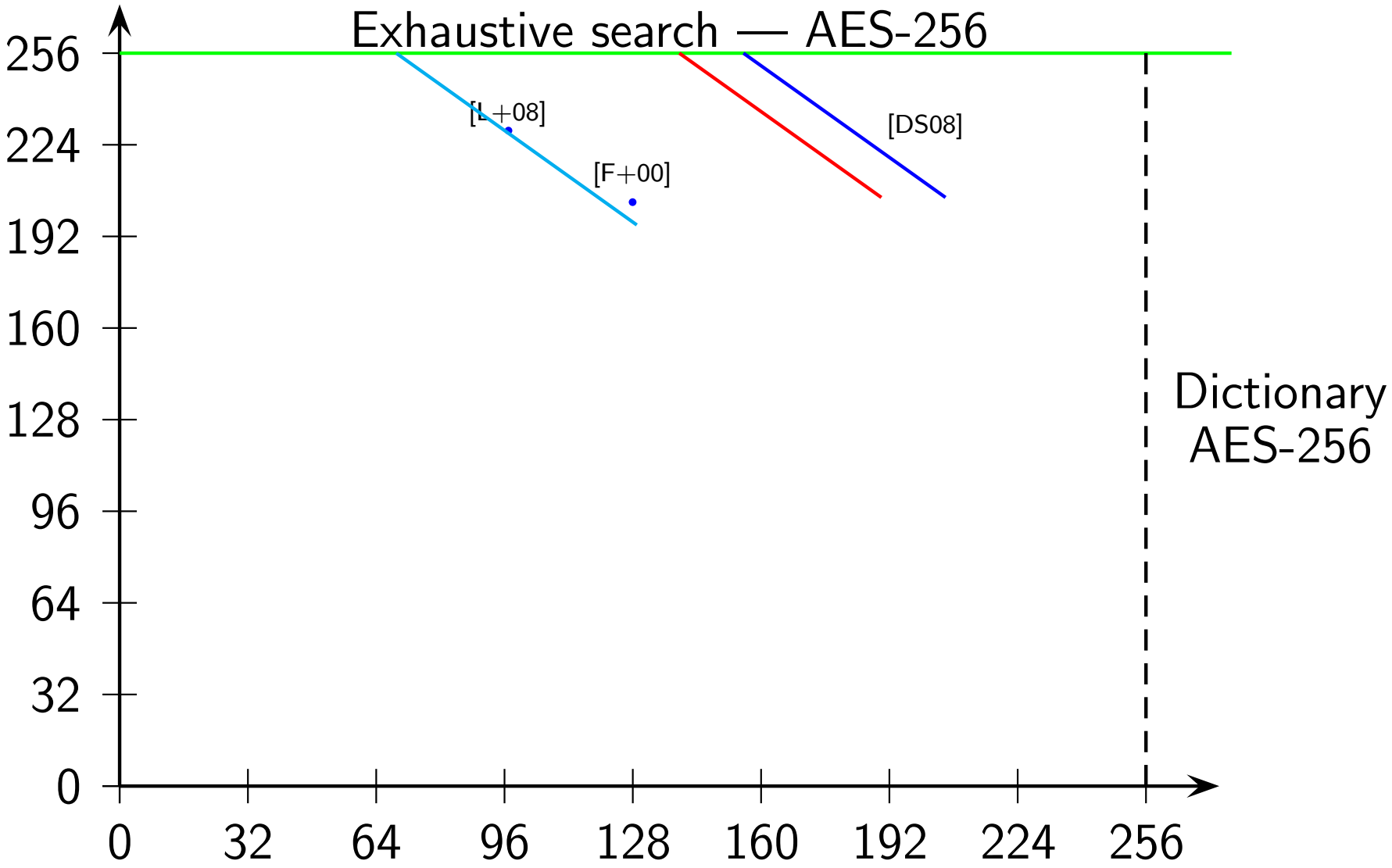

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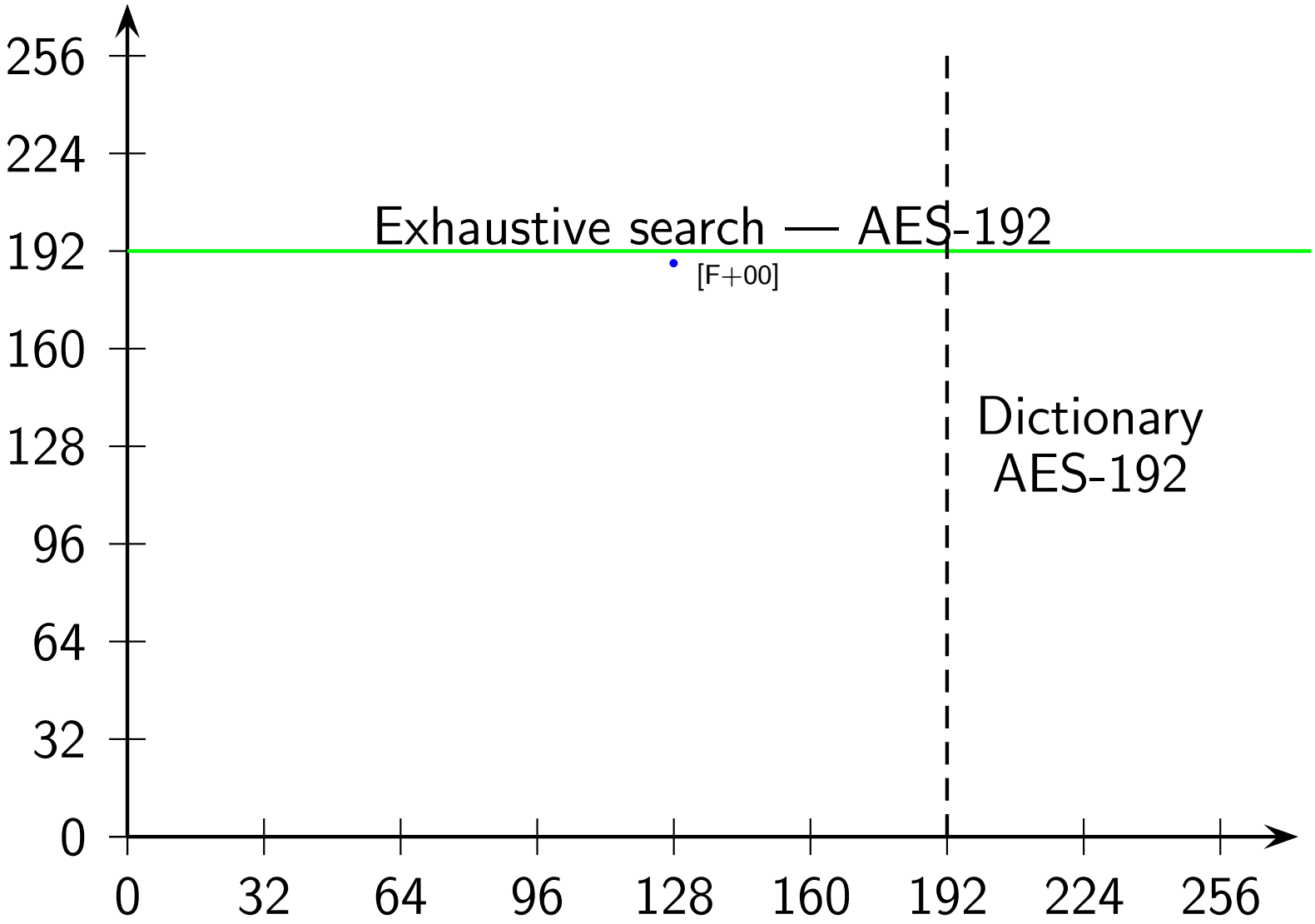

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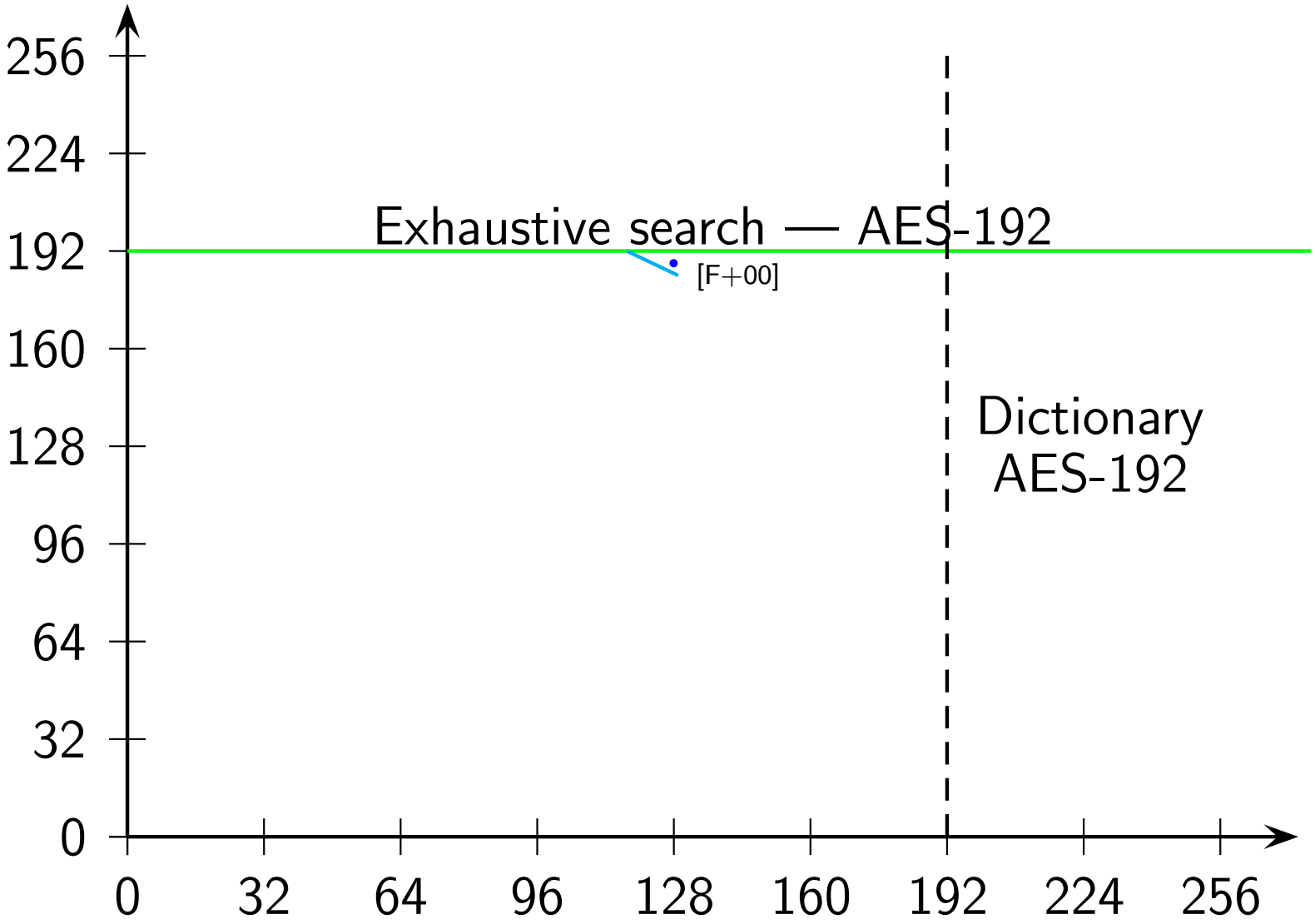

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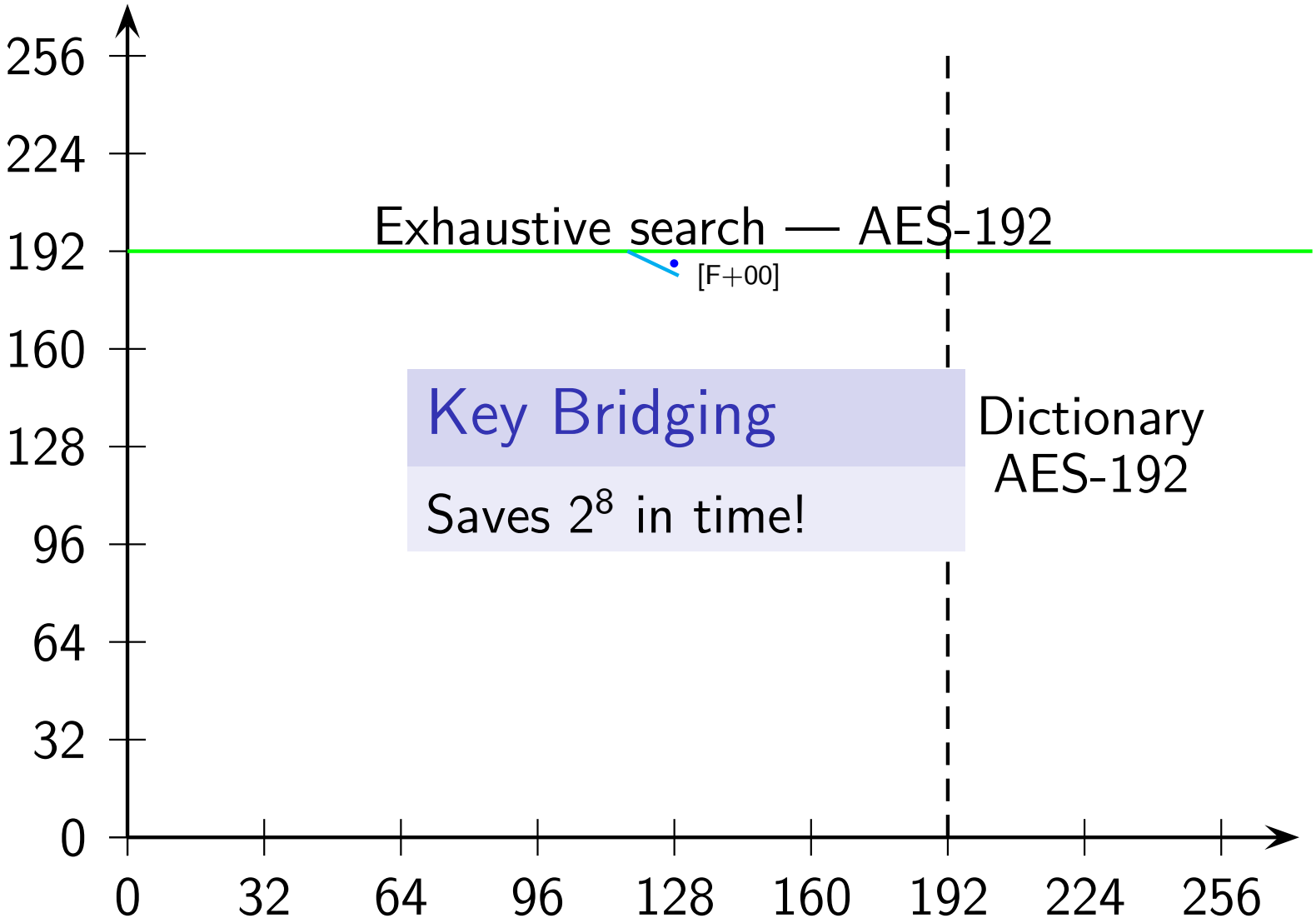

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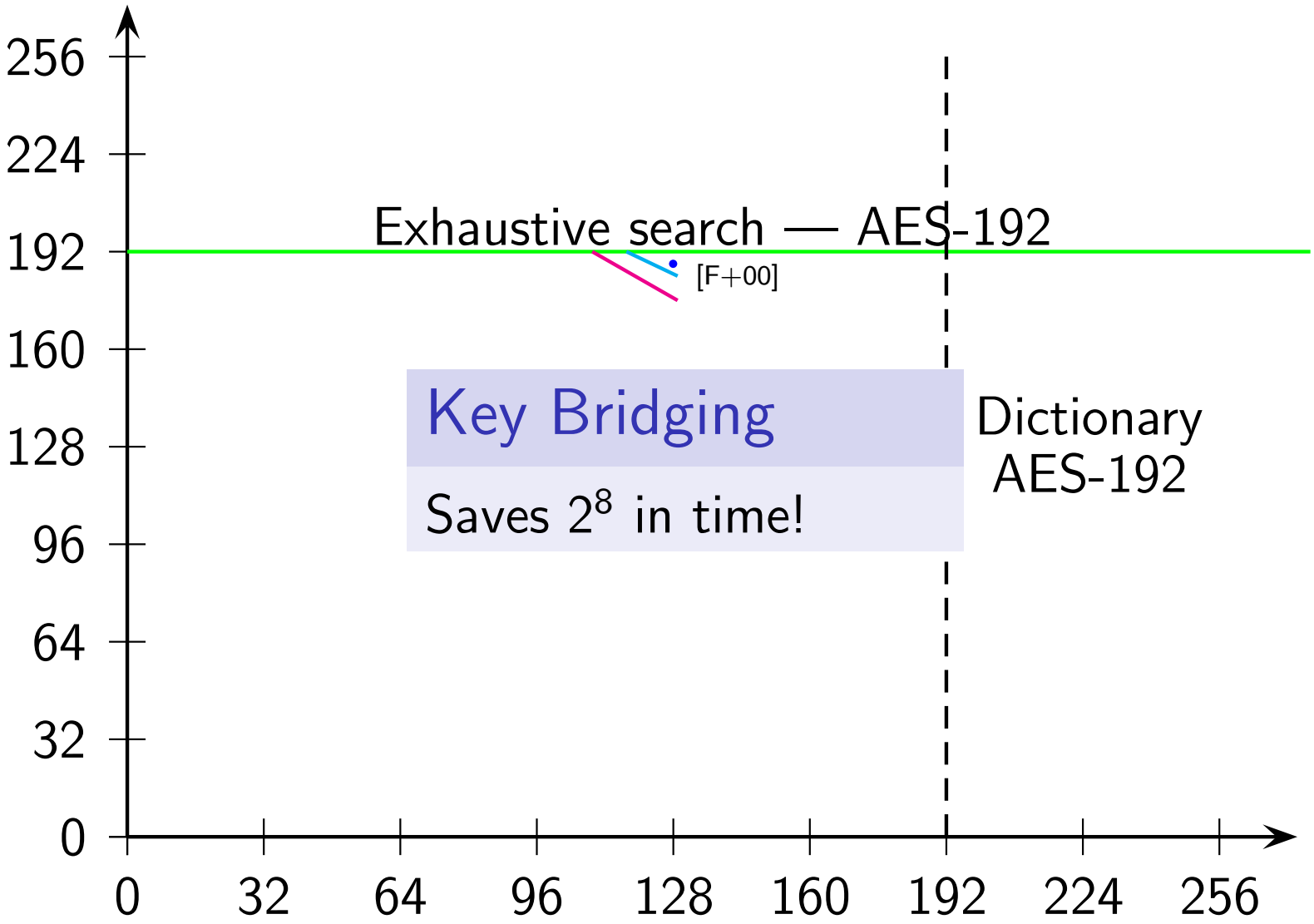

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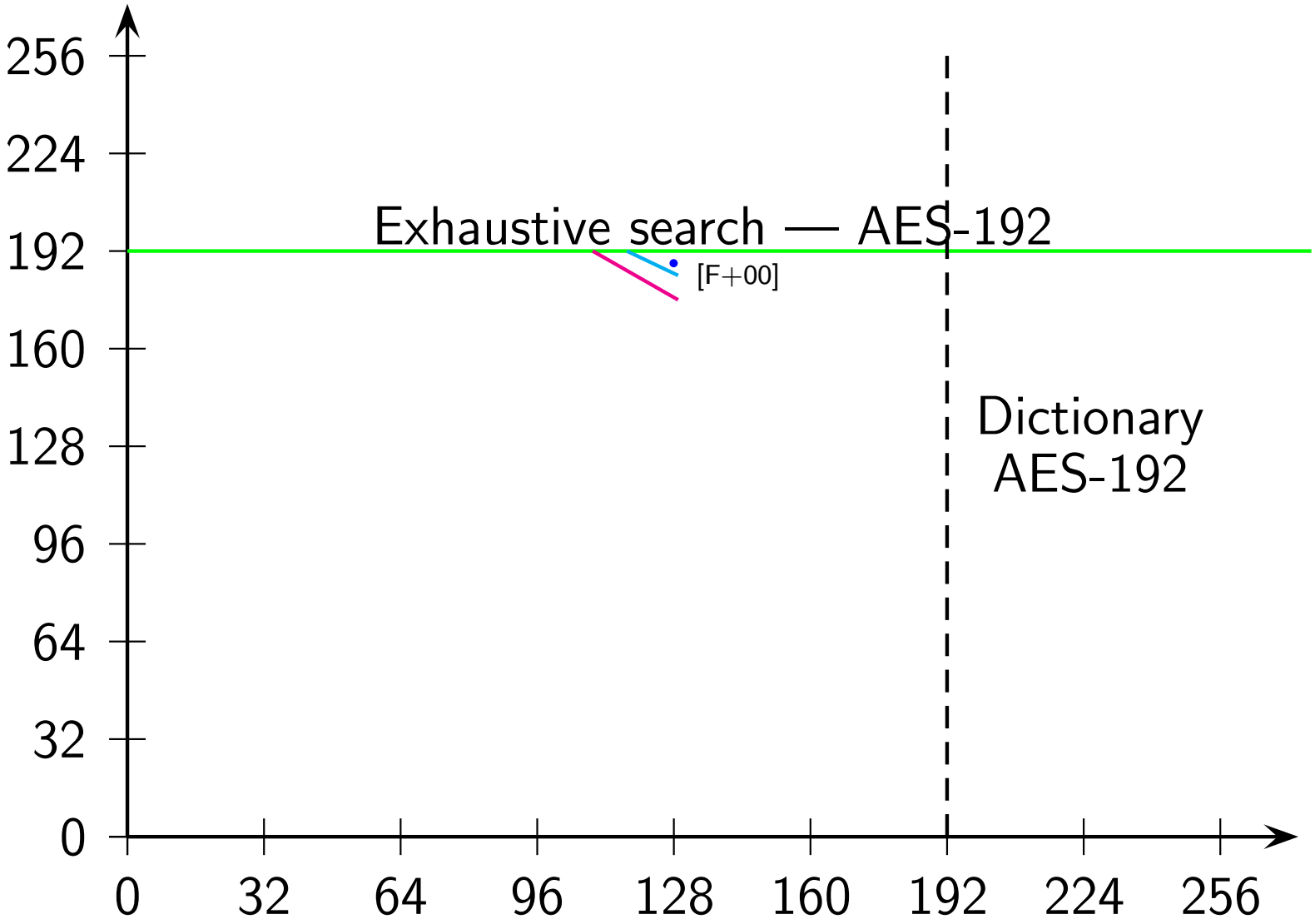

Outcome?

- First **non-marginal** attack on 8-round AES-192, even if precomputation time is counted.
- Best known result on 8-round AES-256 (single key!).
- Improved other attacks with the key bridging.

Version	Rounds	Data	Memory (Pre)	Time	MinMax
All	7	$\mathbf{2}^{103+n}$	$\mathbf{2}^{129-n}$	$\mathbf{2}^{103+n}$	2^{116}
AES-192	8	$\mathbf{2}^{113+n}$	$\mathbf{2}^{129-n}$	$\mathbf{2}^{172+n}$	$\mathbf{2}^{172}$
AES-256	8	$\mathbf{2}^{113+n}$	$\mathbf{2}^{129-n}$	$\mathbf{2}^{196+n}$	$\mathbf{2}^{196}$

Questions?

Thank you for your attention.

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