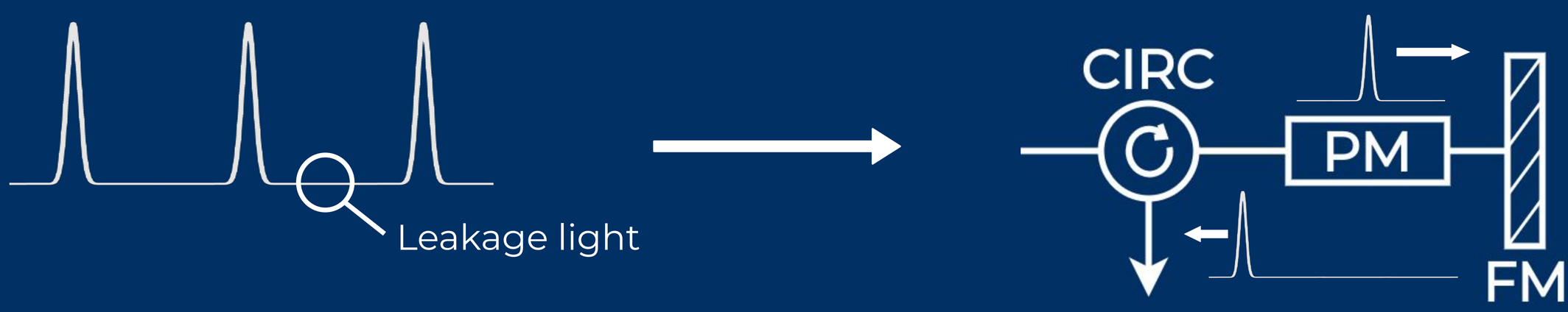
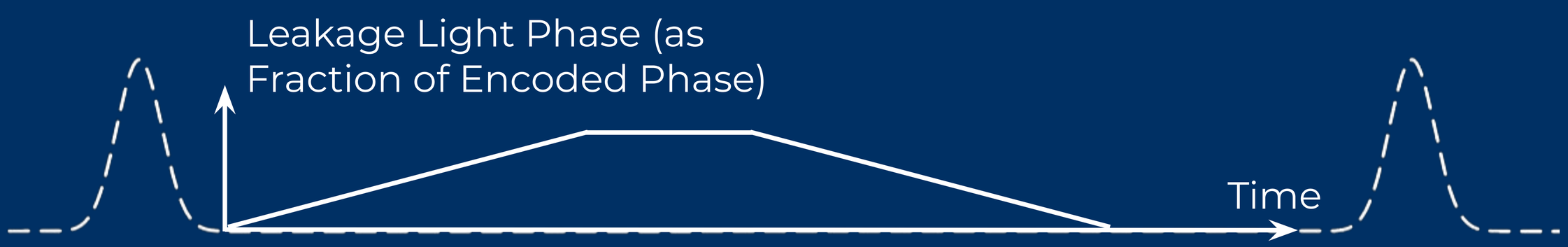
Incorporating passive time-dependent information leakage into QKD security proofs?

Although quantum key distribution (QKD) promises unconditional security [1], practical encoded signals from the source deviate from the theoretical requirements. Hence, these signals are often a source of passive information leakage. In practice, different experimental setups require different quantum optical models to describe this passive information leakage and how it varies in time (/frequency/etc.) across optical pulses. Previous work on side channels focused on active attacks by an adversary and specific models for passive side channels. [2] We demonstrate that a recently developed numerical security proof technique using semidefinite programming [4] can easily incorporate *any* arbitrary time varying model.

CASE EXAMPLE - NOVEL passive source side channel when using a Faraday mirror for stable bit (phase) modulation [5].



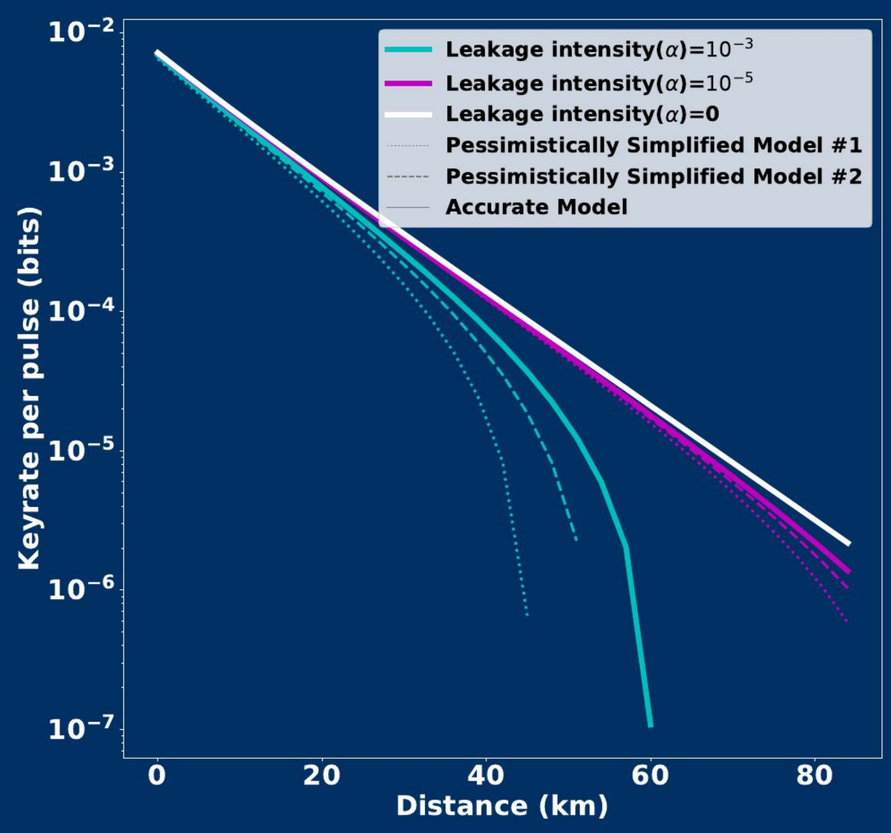
As an optical pulse experiences voltage induced bit/phase modulation, counter-propagating leakage light within the PM also gets modulated.



SECURITY ANALYSIS - Secure key rate improves noticeably when time dependence is fully incorporated (rather than making pessimistic simplifications)

Proof technique [4] (applied to decoy state MDI QKD):

- ➢ Express phase error rate in terms of inner products of Eve's states (unknowns)
- ➢ Constrain inner products of Eve's states by inner products of transmitted states (using unitary evolution postulate)
- ➢ Constrain inner products of Eve's states using decoy state detection statistics
- ➢ Perform a numerical optimization (semidefinite programming) with respect to inner products of Eve's states to obtain phase error rate



Key Rate Results when using Decoy State MDI QKD

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