Karol Łukanowski   QOT   *Centre of New Technologies, University of Warsaw*

Greedy receiver for photon-efficient optical communication

Improving communication with coherent states of light.

A novel optical receiver, in which incoming light-states are displaced in phase space according to a locally optimal rule, is presented for pulse-position-modulated data transmission, outperforming other state-of-the-art proposals in terms of readout error probability.
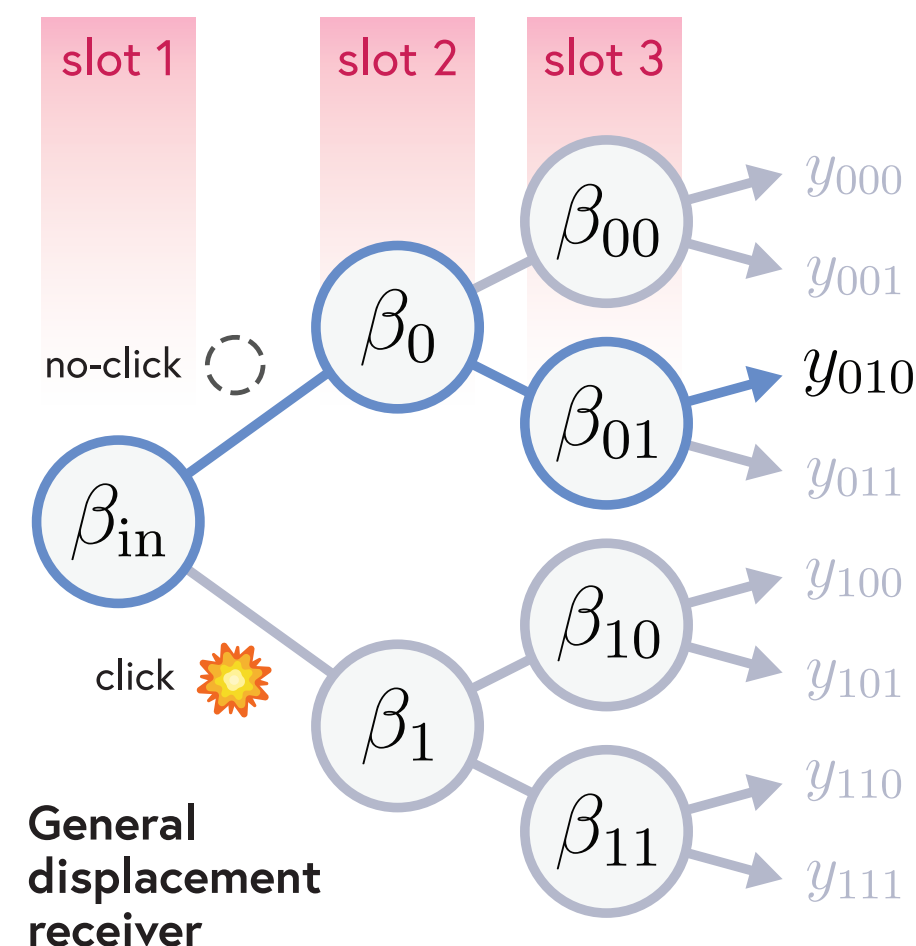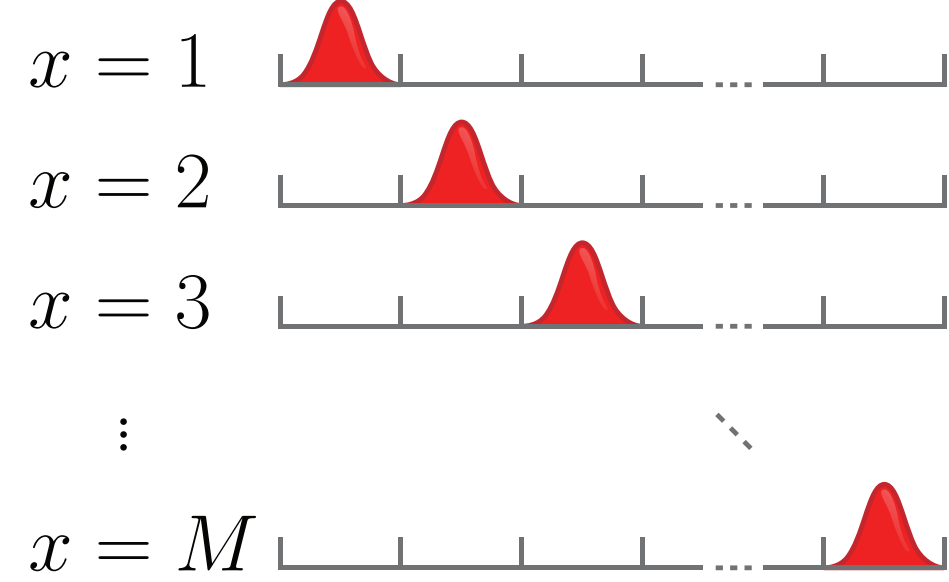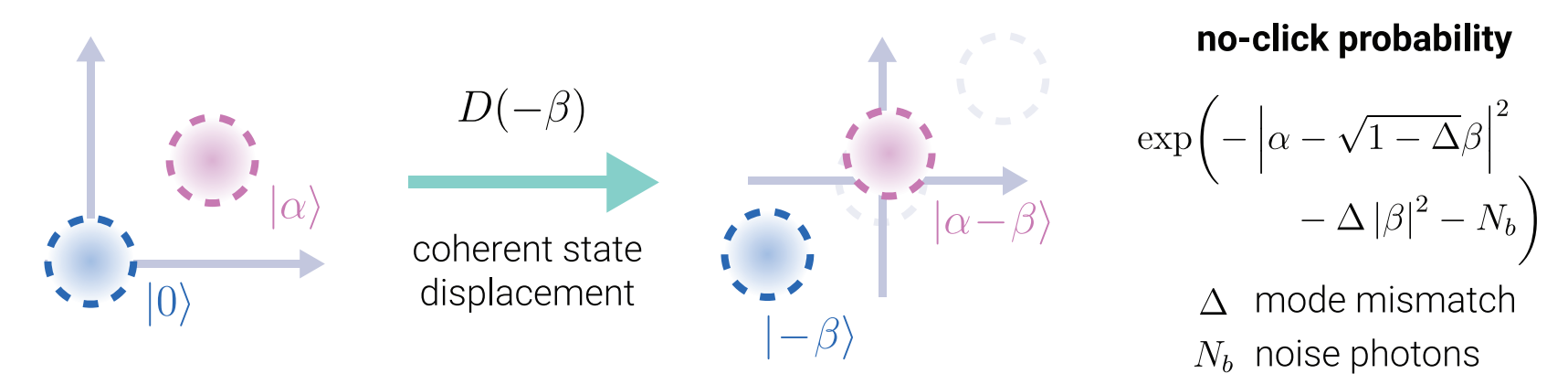
PPM: Information encoded in the pulse position.

Receiver goal: Determine the pulse position with a low probability of error. But how?

**1** **Standard idea:** Just detect each slot directly.

2 **Kennedy's idea ('70s):** Displace coherent states in phase space before measuring them. This can change photodetection statistics in favor of lower error probabilities.

$D(-\beta)$ — coherent state displacement — $|\alpha\rangle$, $|0\rangle$, $|\alpha-\beta\rangle$, $|-\beta\rangle$

no-click probability
$$\exp\left(-\left|\alpha-\sqrt{1-\Delta}\beta\right|^2 - \Delta\,|\beta|^2 - N_b\right)$$
Δ mode mismatch
N_b noise photons

3 **Dolinar ('80s):** An algorithm for displacements in each PPM slot: the conditional pulse nuller.

**Adaptive methods ('10s–'20s):** Numerically optimal displacement algorithms for low modulation orders M.

Greedy idea → Choose the next slot displacement *on the fly* to be *locally optimal*, yielding minimal error probability only after the next measurement.
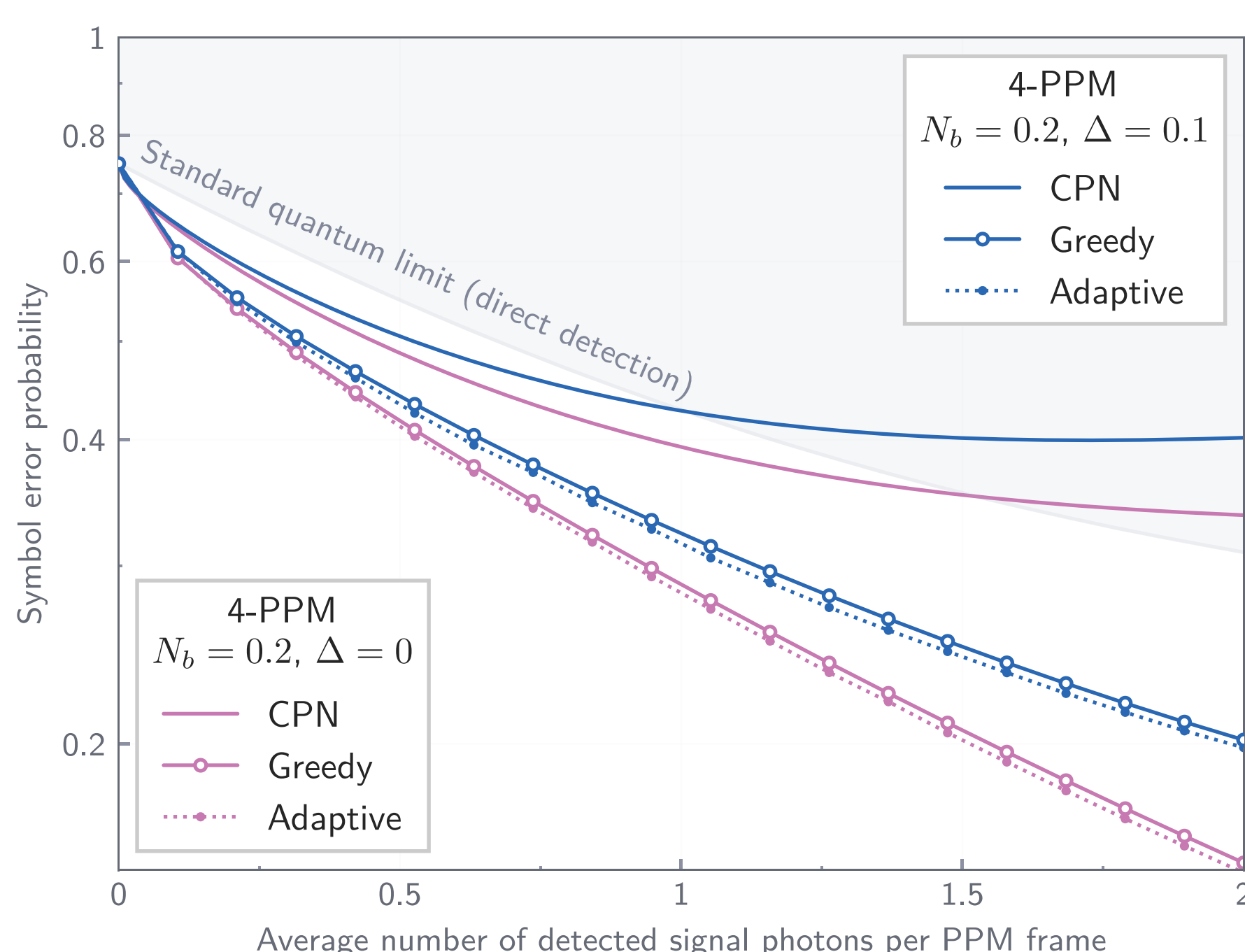
Greedy as good as adaptive at low orders

But works great at high orders too! Huge improvement for few-photon pulses

More resistant to mode mismatch than Dolinar's CPN
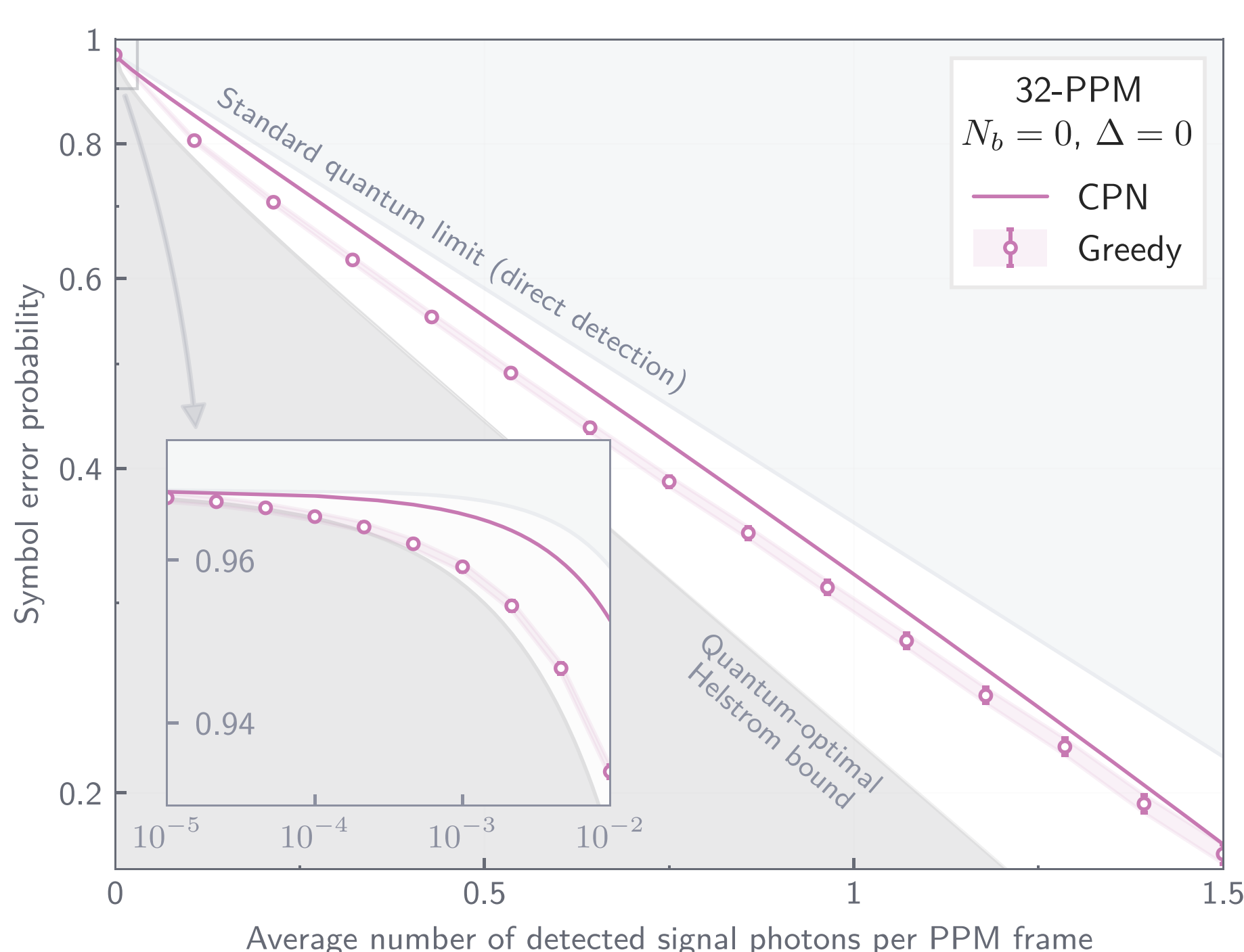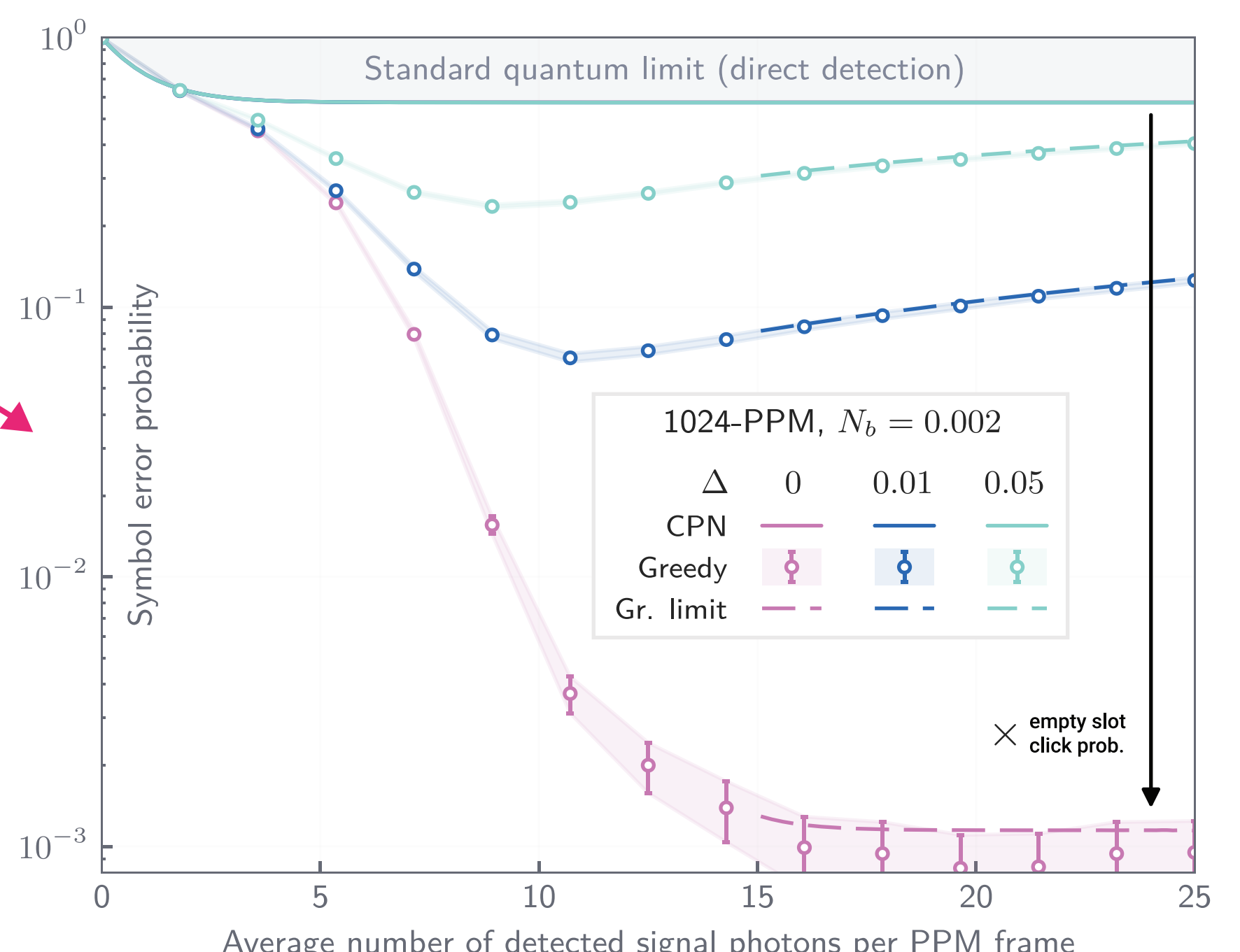
Greedy scales with the ultimate Helstrom bound, at low powers too

Would improve communication with today's deep space missions