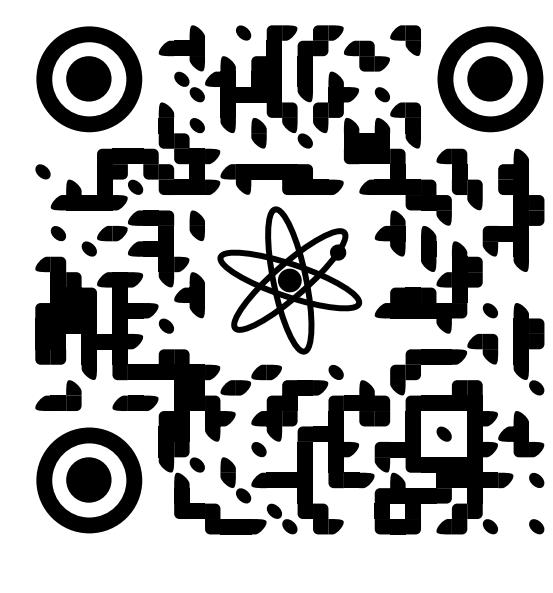


Towards atoms in a fibre

Modulating, multiplexing and memorising photons for quantum networks and computing



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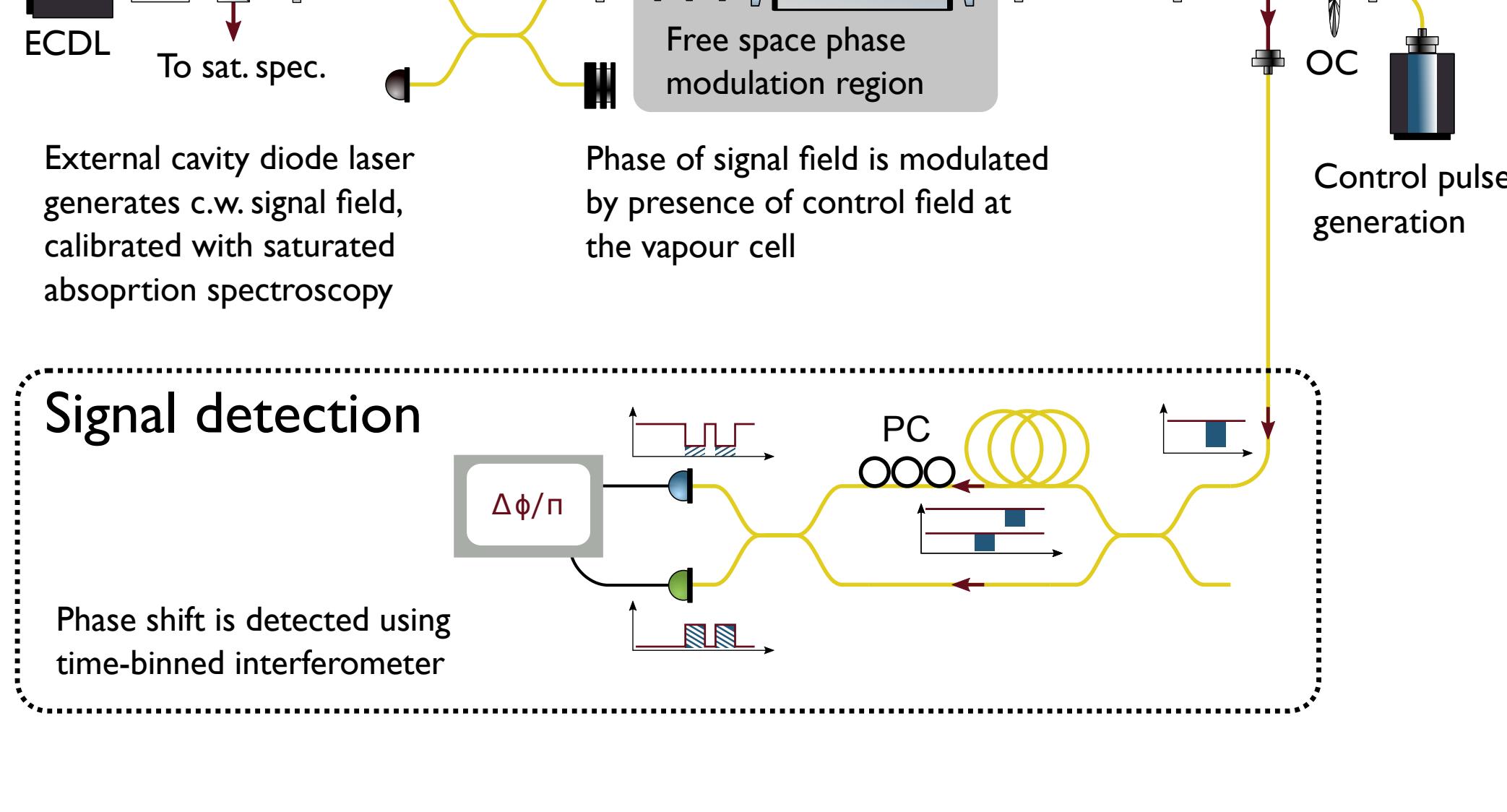
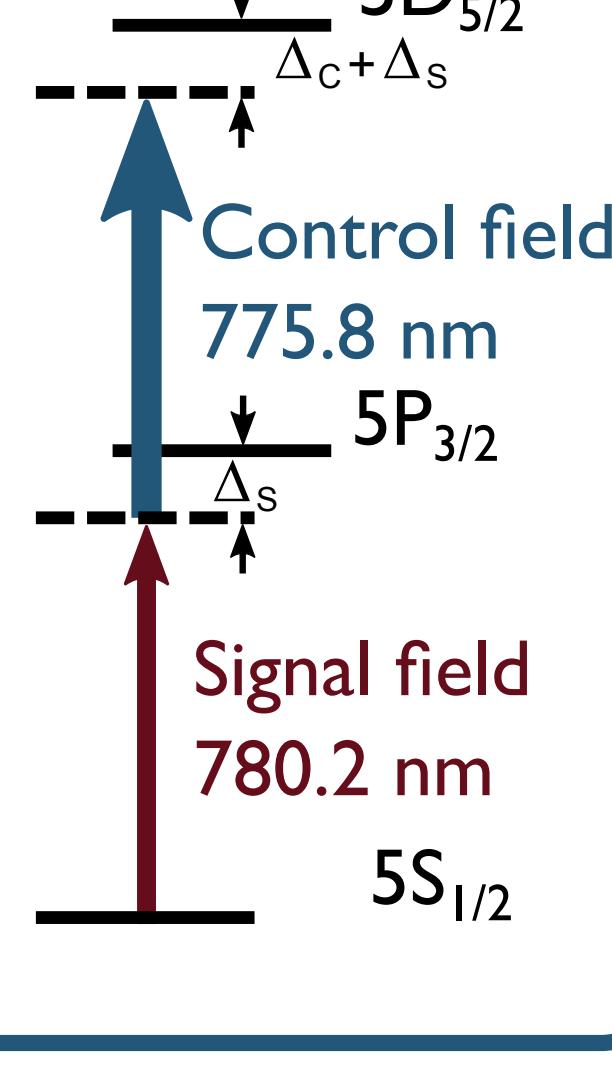
EQUS

Australian Research Council
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Engineered Quantum Systems

We demonstrate all optical phase modulation mediated by a two-photon transition in warm atomic vapour, alongside a fibre-integrated vapour cell with low-loss interconnects.

Phase modulation

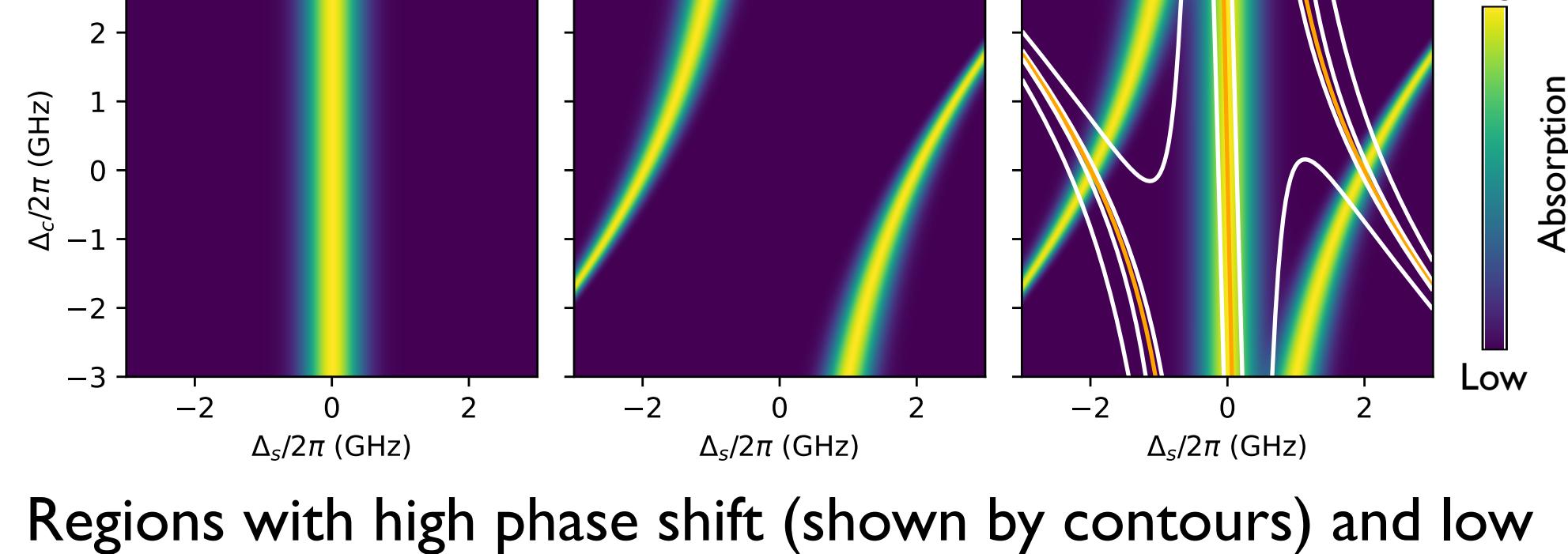
- * A weak **signal** field counter-propagates with a strong **control** pulse through a rubidium vapour cell.
- * The presence of the control pulse induces a change in susceptibility, resulting in a change to the phase of the signal.



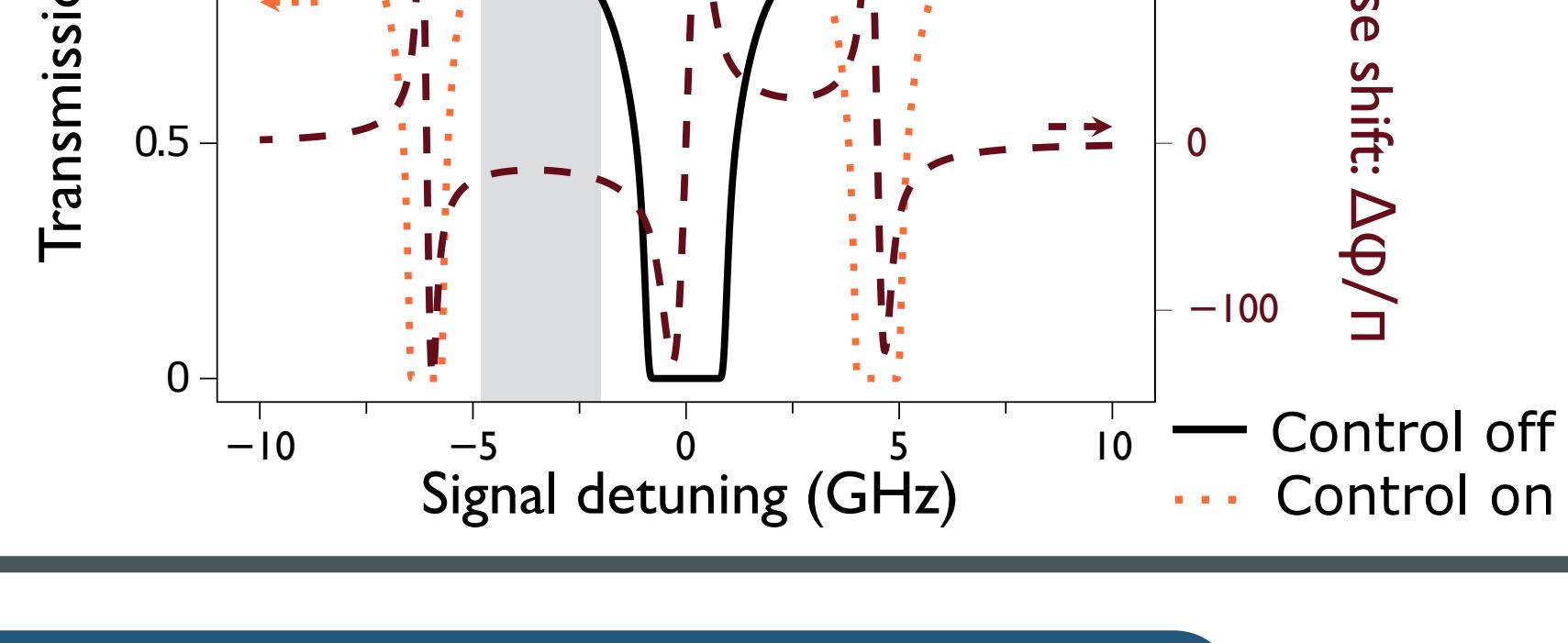
Applications:

- Fibre-integrated photonic quantum memories
- High speed (limited by control field modulation) and low-loss switching for heralded single photon sources
- Fast and efficient phase modulation of bright light

We model transmission and phase shift by solving the Maxwell-Bloch equations of motion.

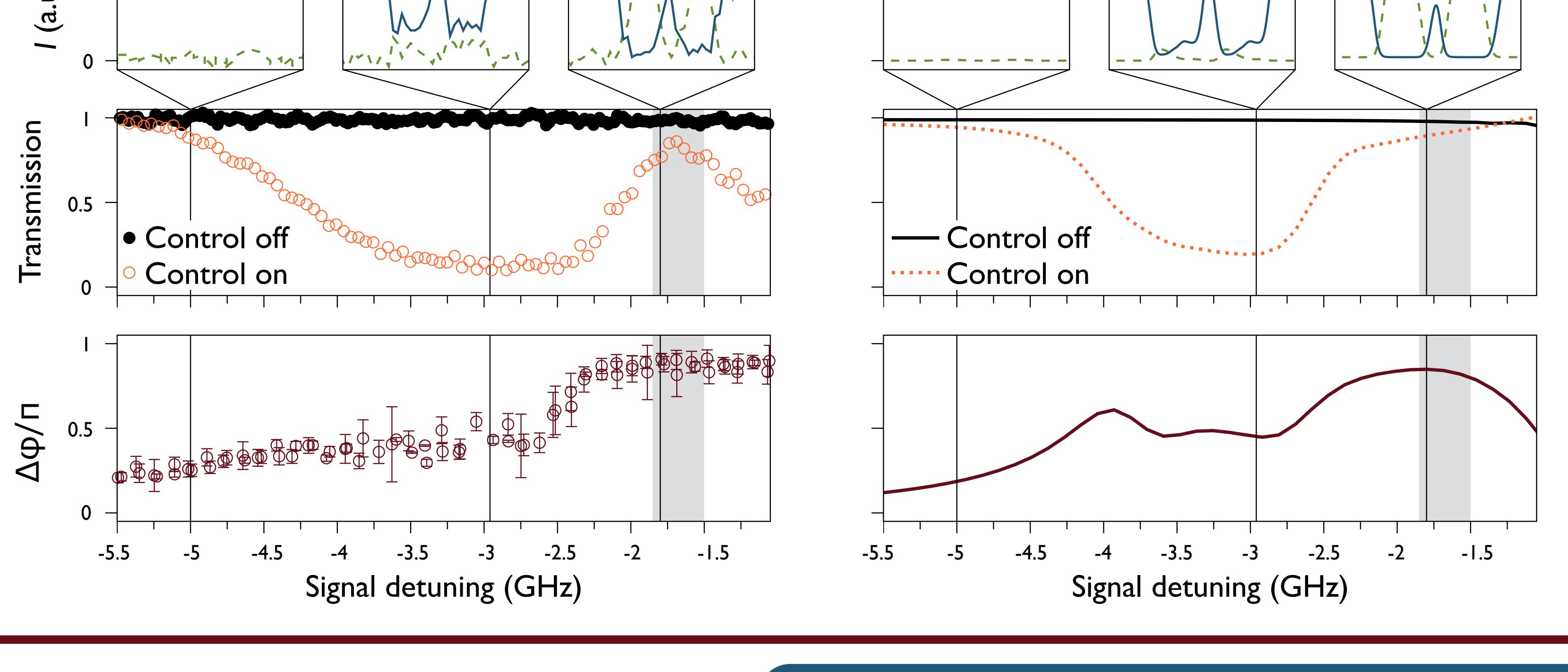


Regions with high phase shift (shown by contours) and low absorption (shown in colour) are suitable for the scheme. For example, below in the shaded region with $\Delta_c = -1.6$ GHz



High phase shift with low loss: $\Delta\phi/\Pi = 0.90(5)$; $T = 83(2)\%$

Experiment



Theory

Low insertion loss: 0.6(2) dB at 780nm

- * We have fabricated a cell for realising phase modulation and memories within optical fibre.

- * Low-loss interconnects to hollow core fibre (HCF) are achieved by lensing in graded index fibre (GIF) into custom-designed HCF.

