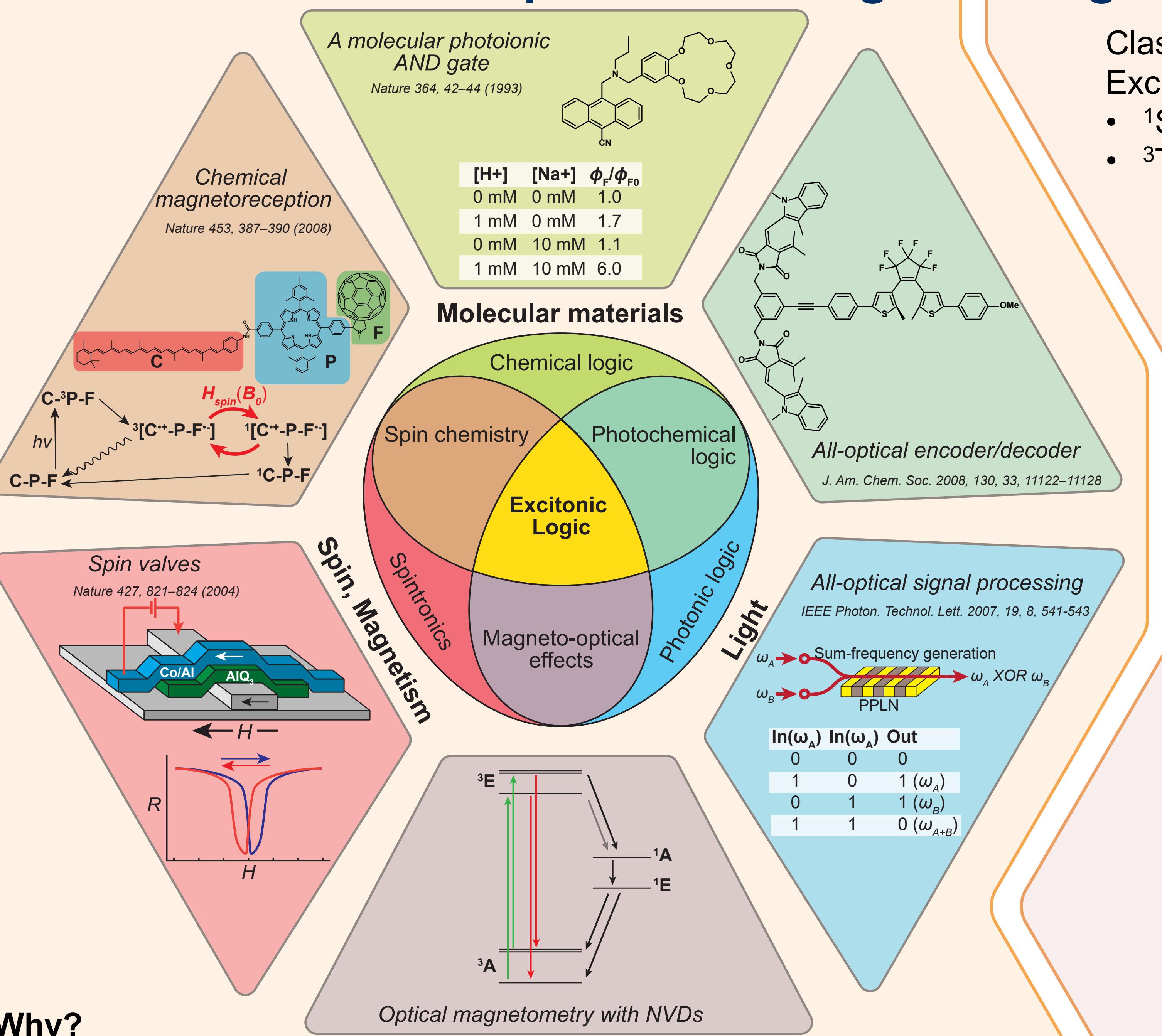




Exciton Logic

Thomas S. C. MacDonald, Rohan J. Hudson, Jared H. Cole, Dane R. McCamey

Excitons as a natural platform for logic



Why?

- Excitonic operations are **fast ($\sim 10^9 \text{ s}^{-1}$)**, **high-energy (eV)**
- Couple to **optical information** (via photoexcitation, emission)
- Couple to **molecular properties** with photophysics and photochemistry
- Couple to **magnetism via high-spin excitons**

Excitonic logic sits at the intersection of **molecular**, **spin**, and **optical** logic. Excitonic operations could translate information between these bases.

Scalable excitonic logic: the need for spin

We propose excitonic devices that use a long-lived **triplet excitons (red)** internally and **singlet excitons (blue)** for I/O via light.

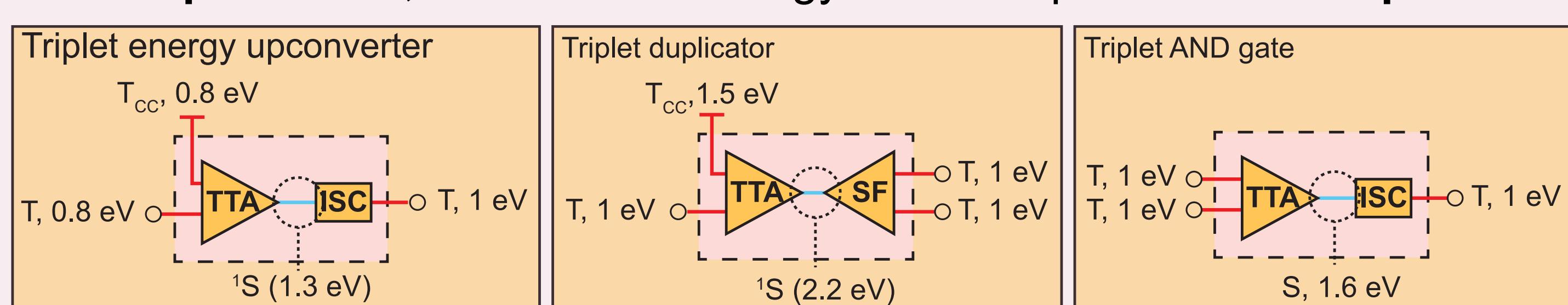
Excitonic components make up excitonic devices

Multiple devices linked by singlet I/O via light or energy transfer

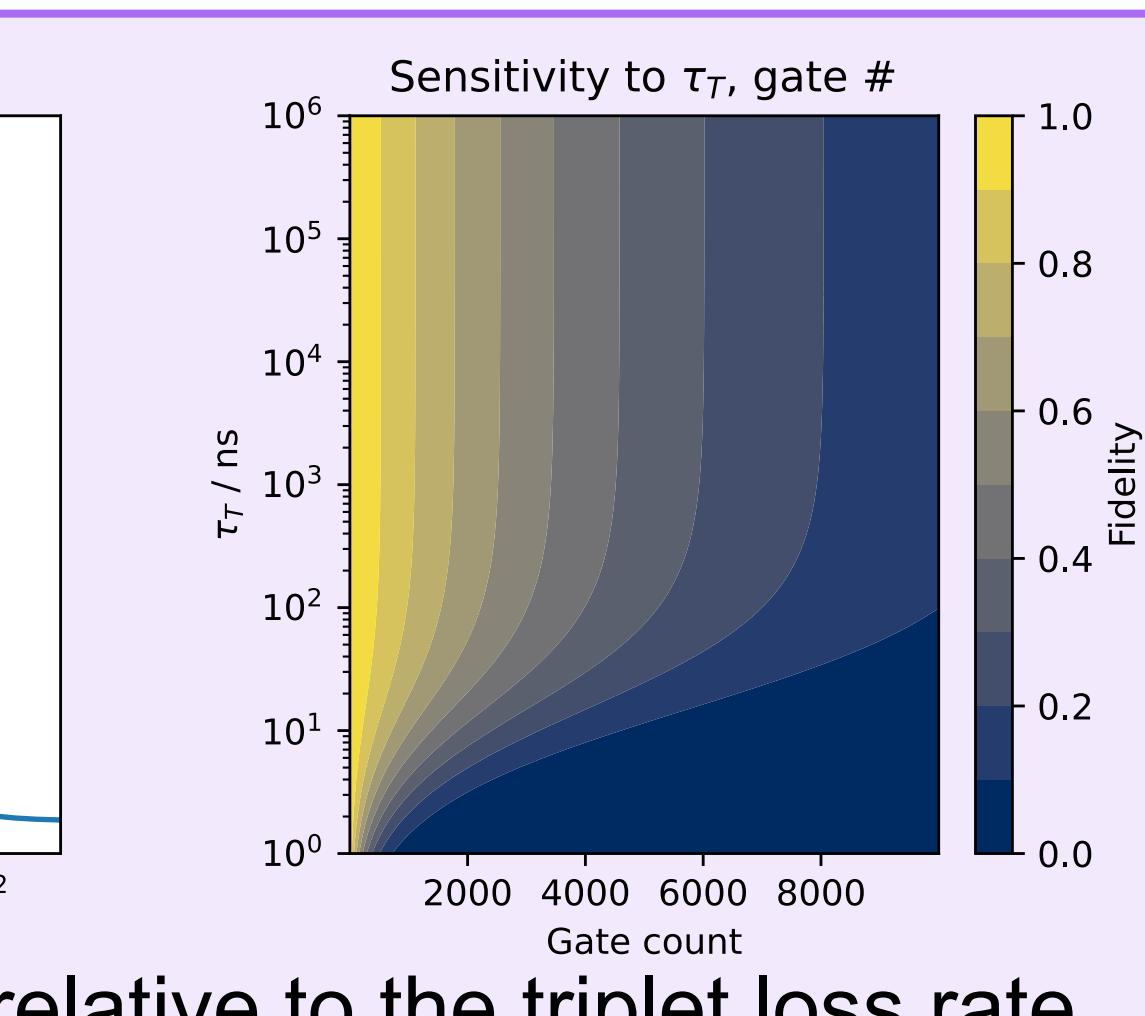
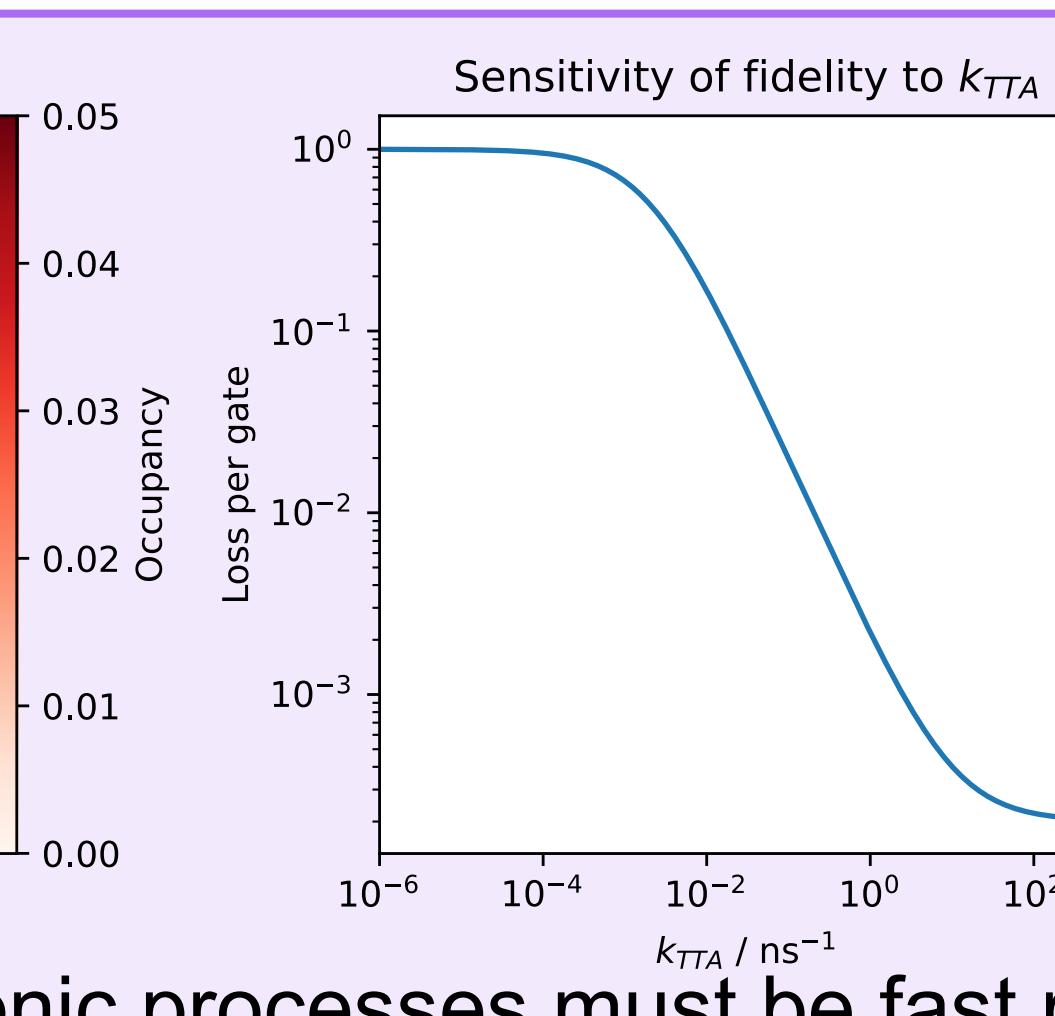
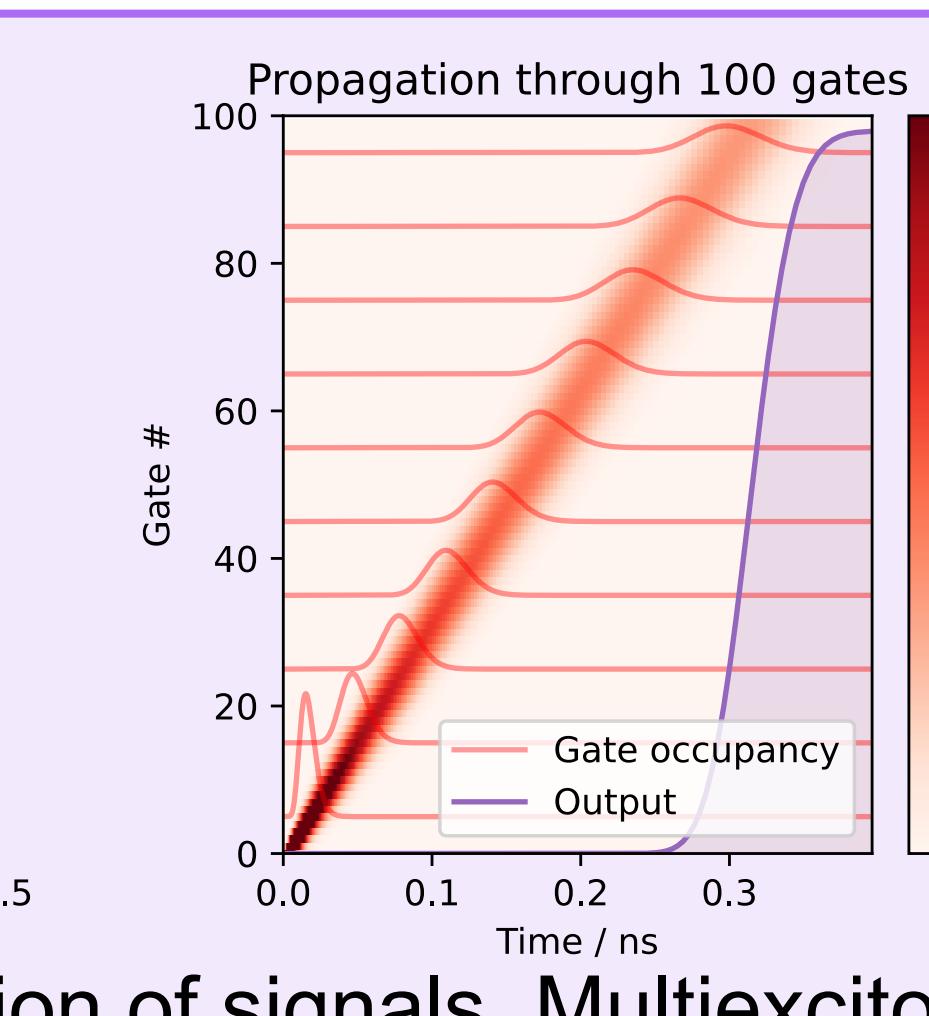
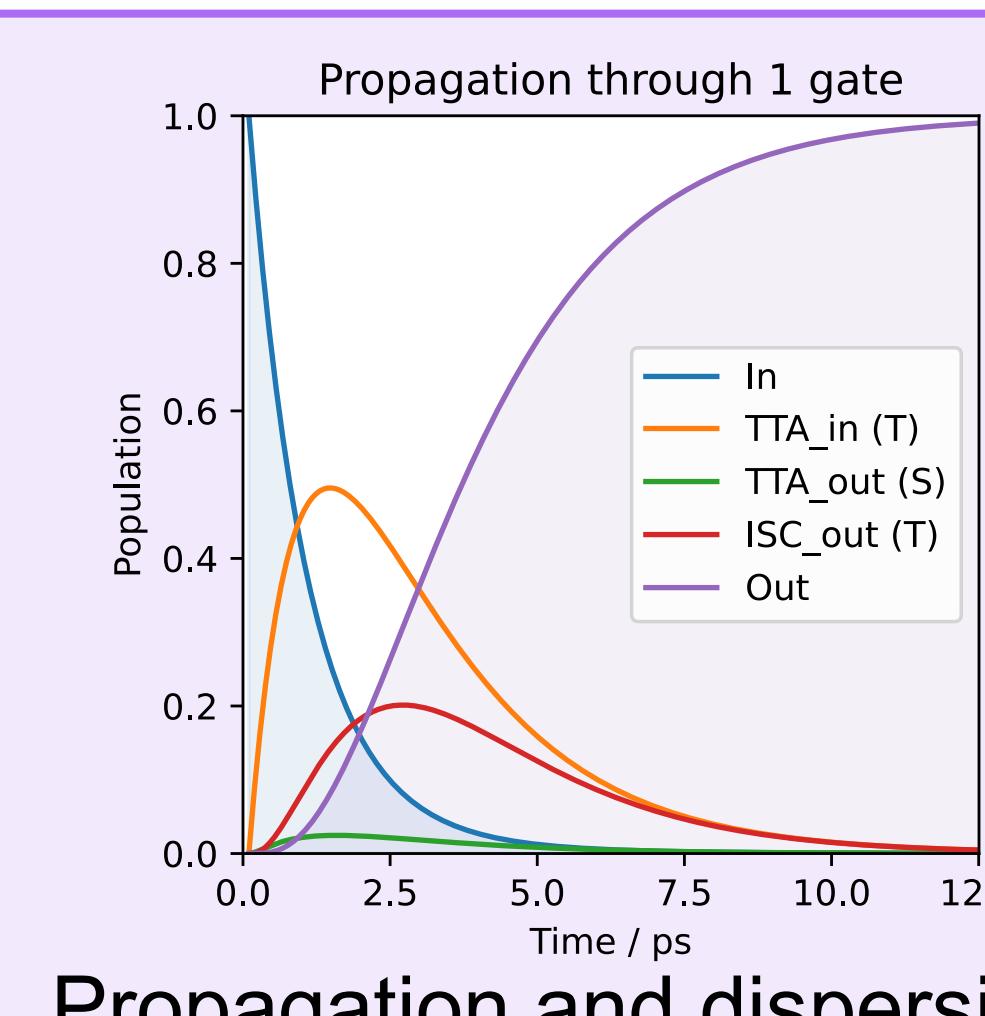
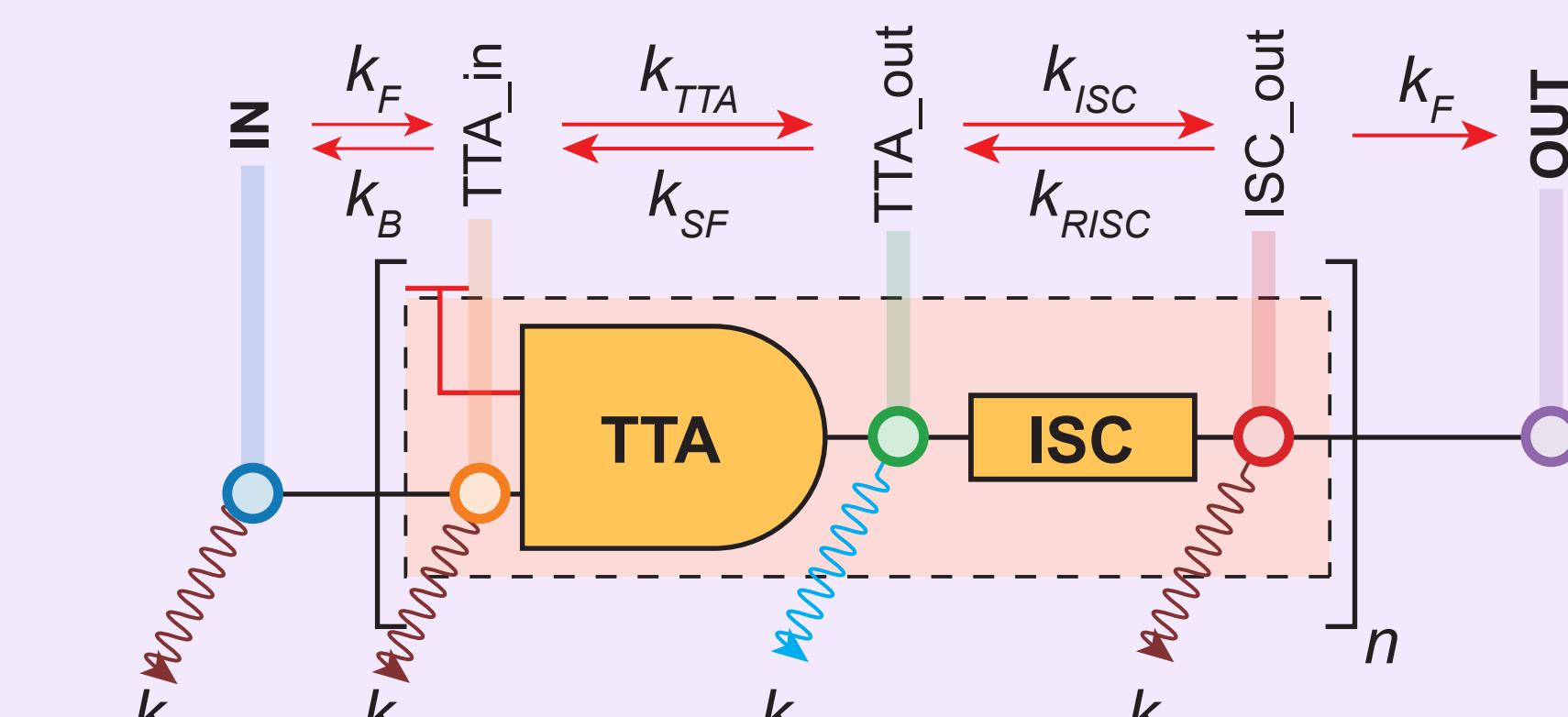
Effective logic needs:

- Input-output homogeneity: outputs and inputs with same basis, same energy.
- Fan-out: one output can drive multiple inputs.

Need **amplification**, which draws energy. Drive amplifiers with a **triplet rail**:



Fidelity of excitonic devices



Propagation and dispersion of signals. Multiexcitonic processes must be fast relative to the triplet loss rate ($k_T = 0.5 \text{ ns}^{-1}$ here) for good fidelity over multiple gate operations.

Acknowledgements

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