

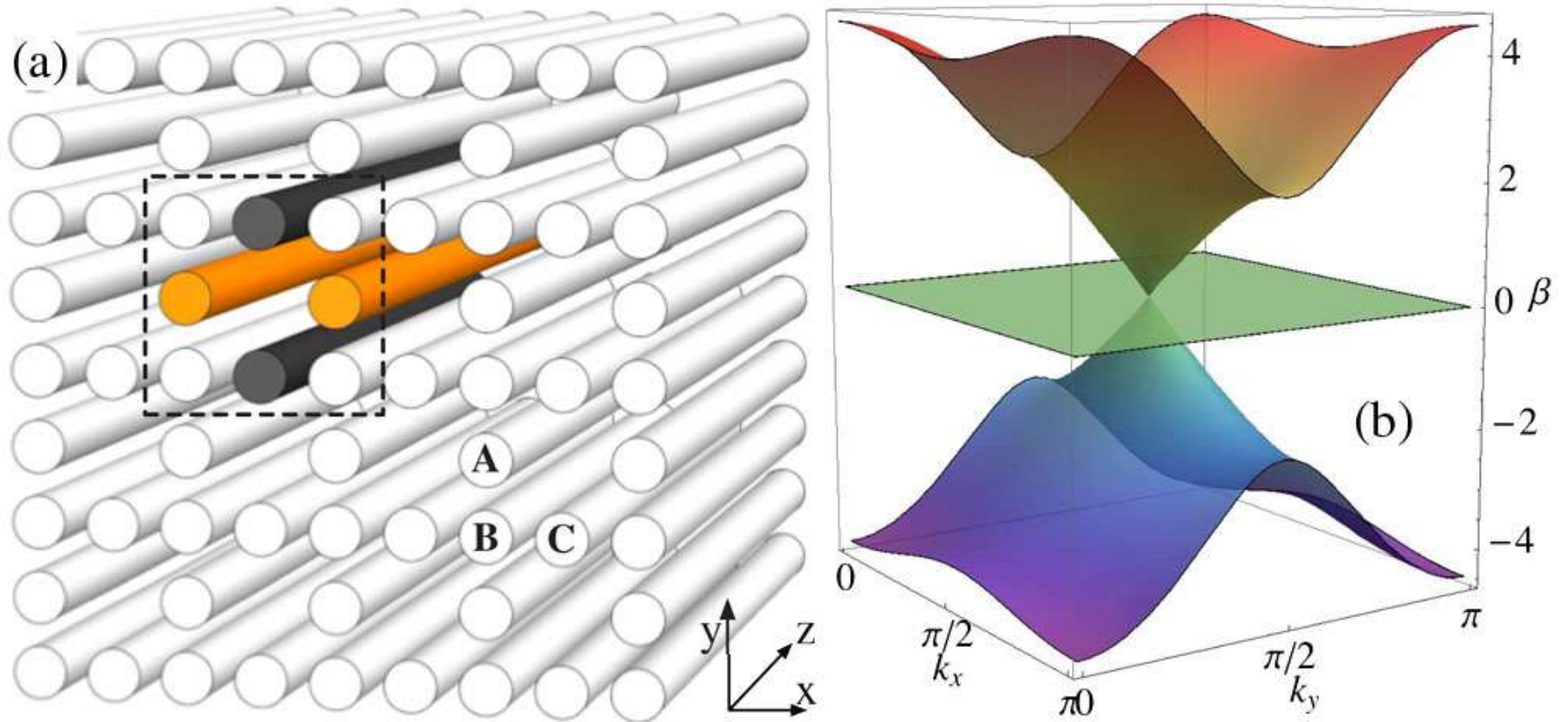
Quantum Network Transfer and Storage with Compact Localized States

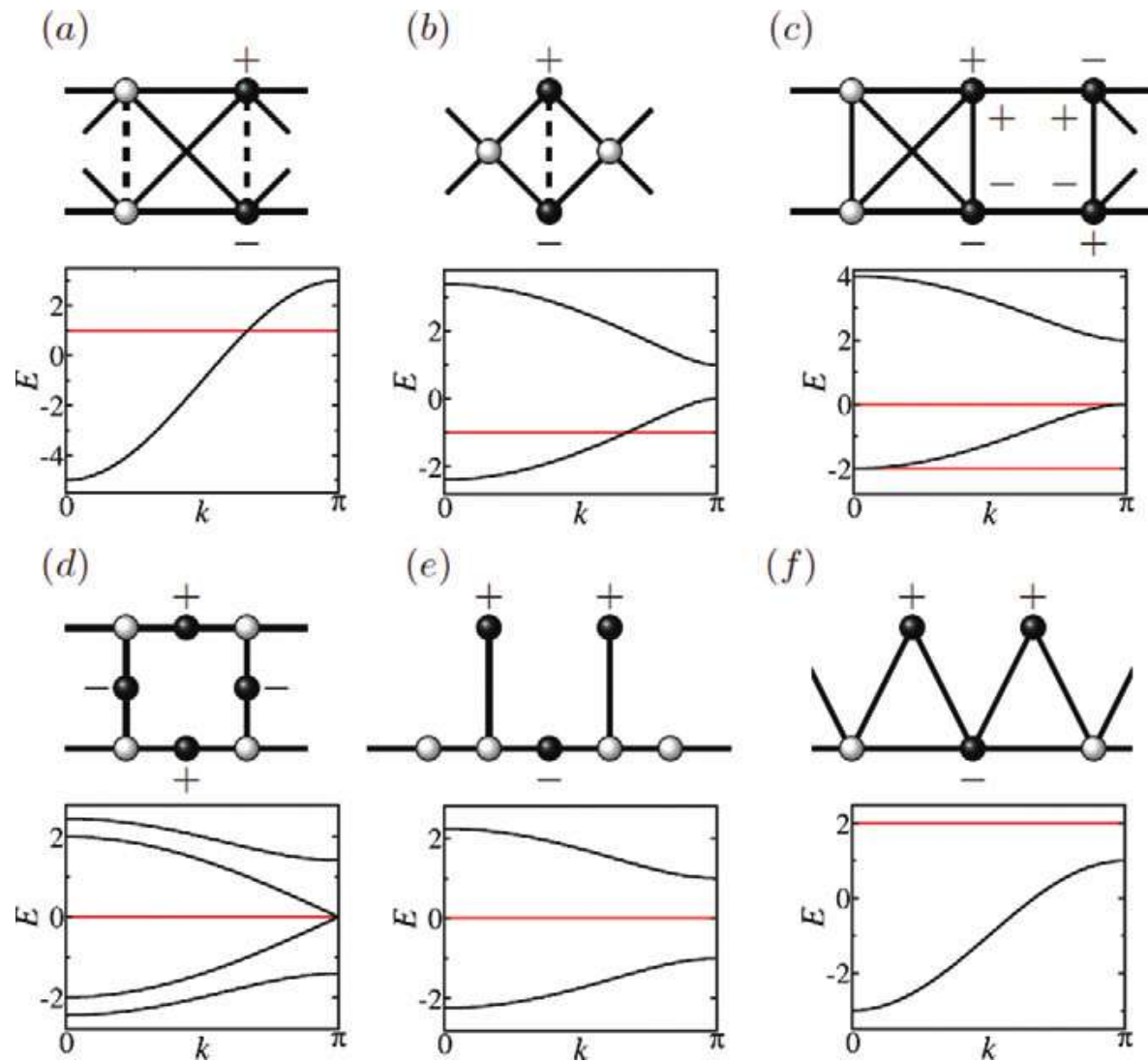
Christian Morfonios

Local Symmetry Workshop | Karystos 2019.09.05

M. Röntgen, C. V. Morfonios, I. Brouzos, F. K. Diakonou, P. Schmelcher, PRL **123** (2019) 080504

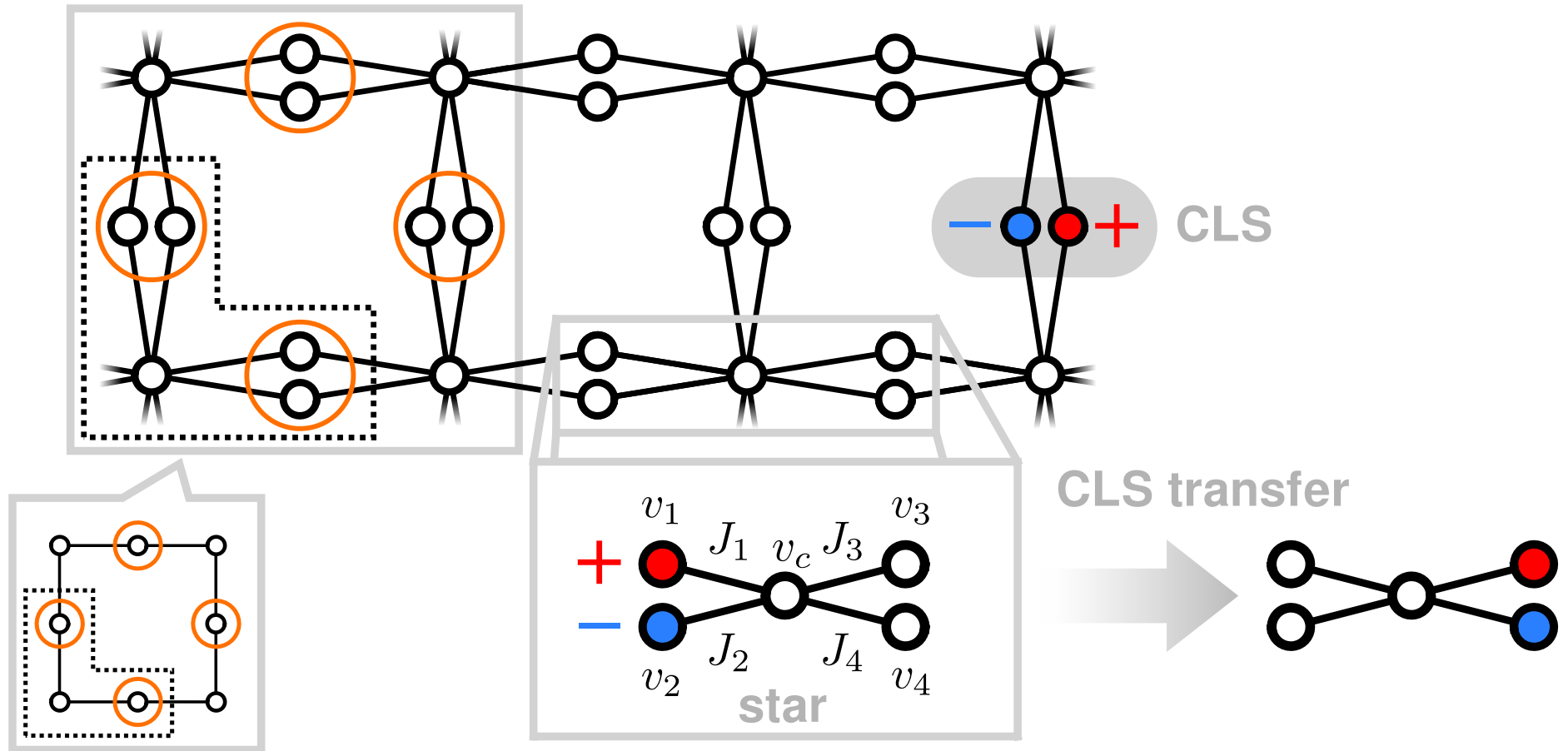
Compact localized states & Flat bands



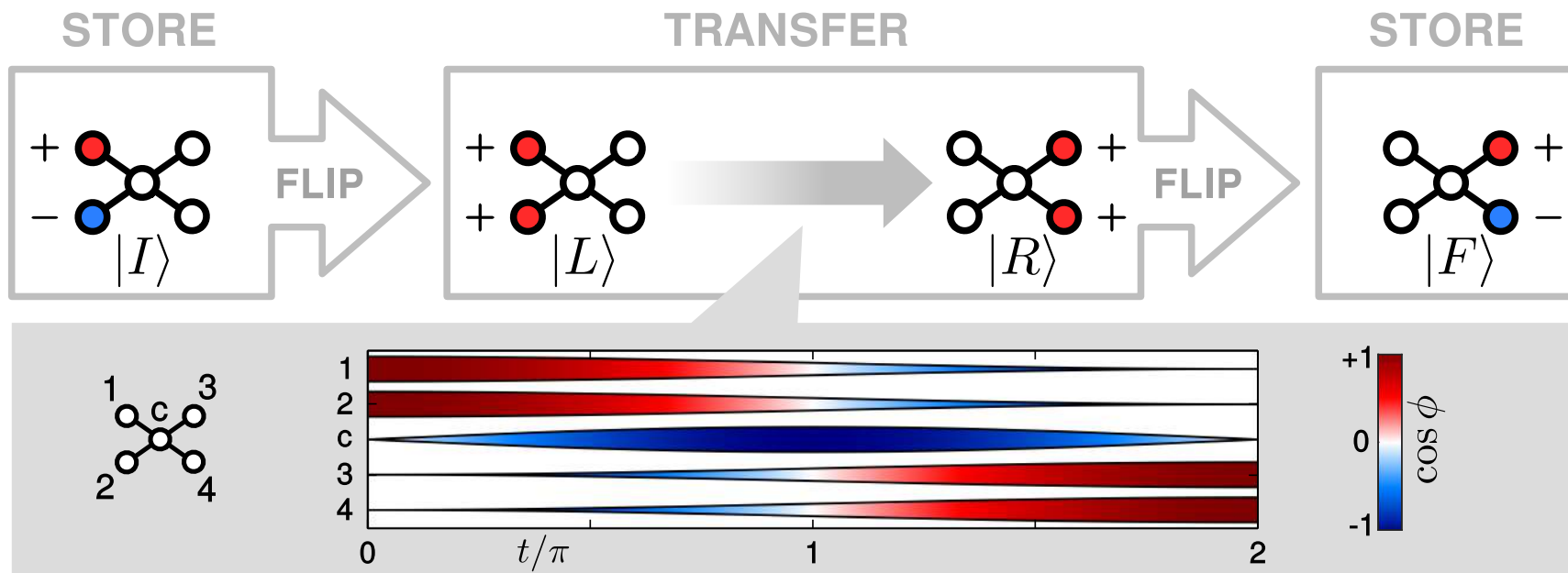


CLSs are ideal candidates for *storage* of a localized excitations (information), but what about their spatial *transfer*?

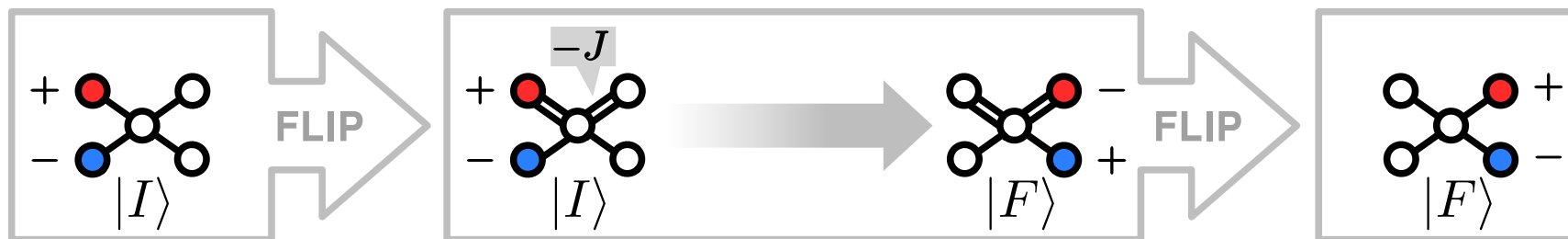
Dimerized Lieb lattice



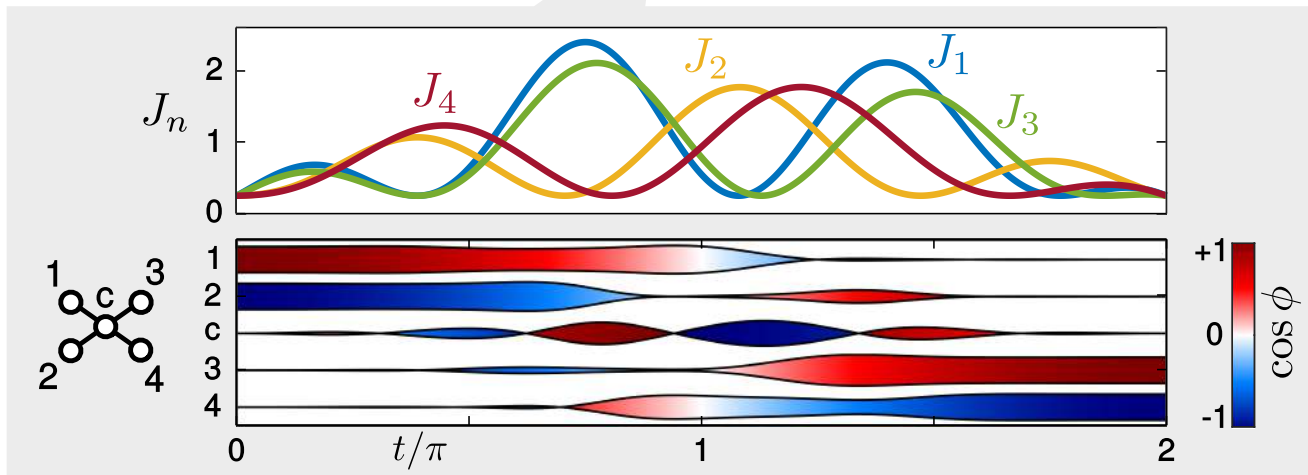
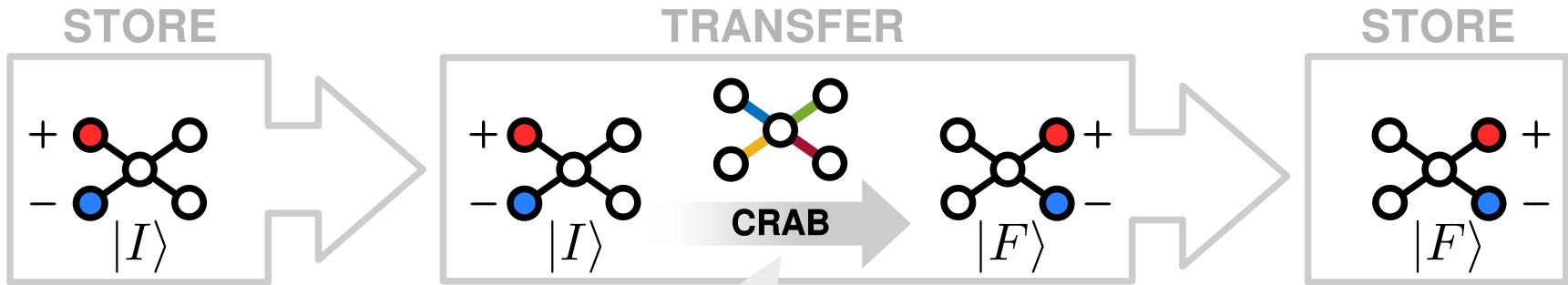
Dimer transfer upon amplitude flip



$$|\psi(t)\rangle = e^{-iHt}|I\rangle \quad H = v_c|c\rangle\langle c| + \sum_{n=1}^4 v_n|n\rangle\langle n| + J_n(|n\rangle\langle c| + |c\rangle\langle n|)$$



Transfer by optimal control



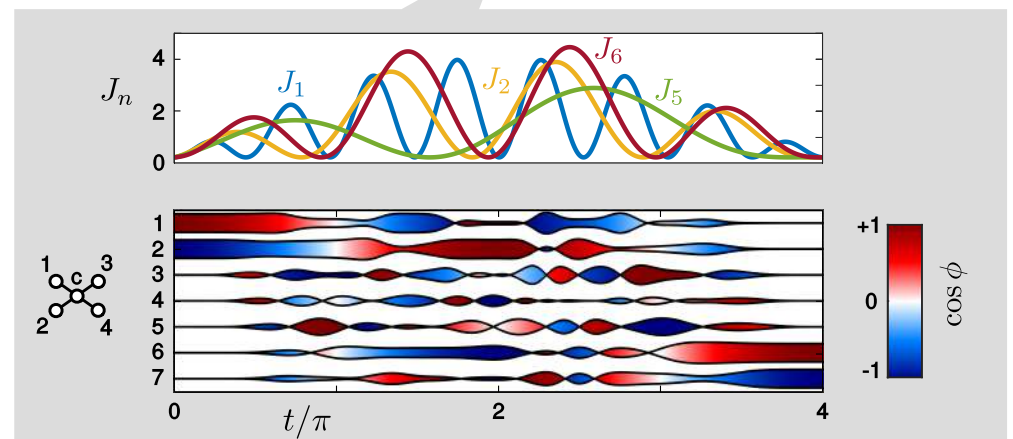
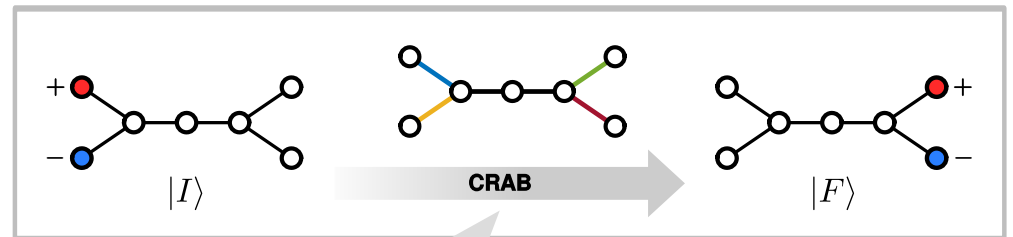
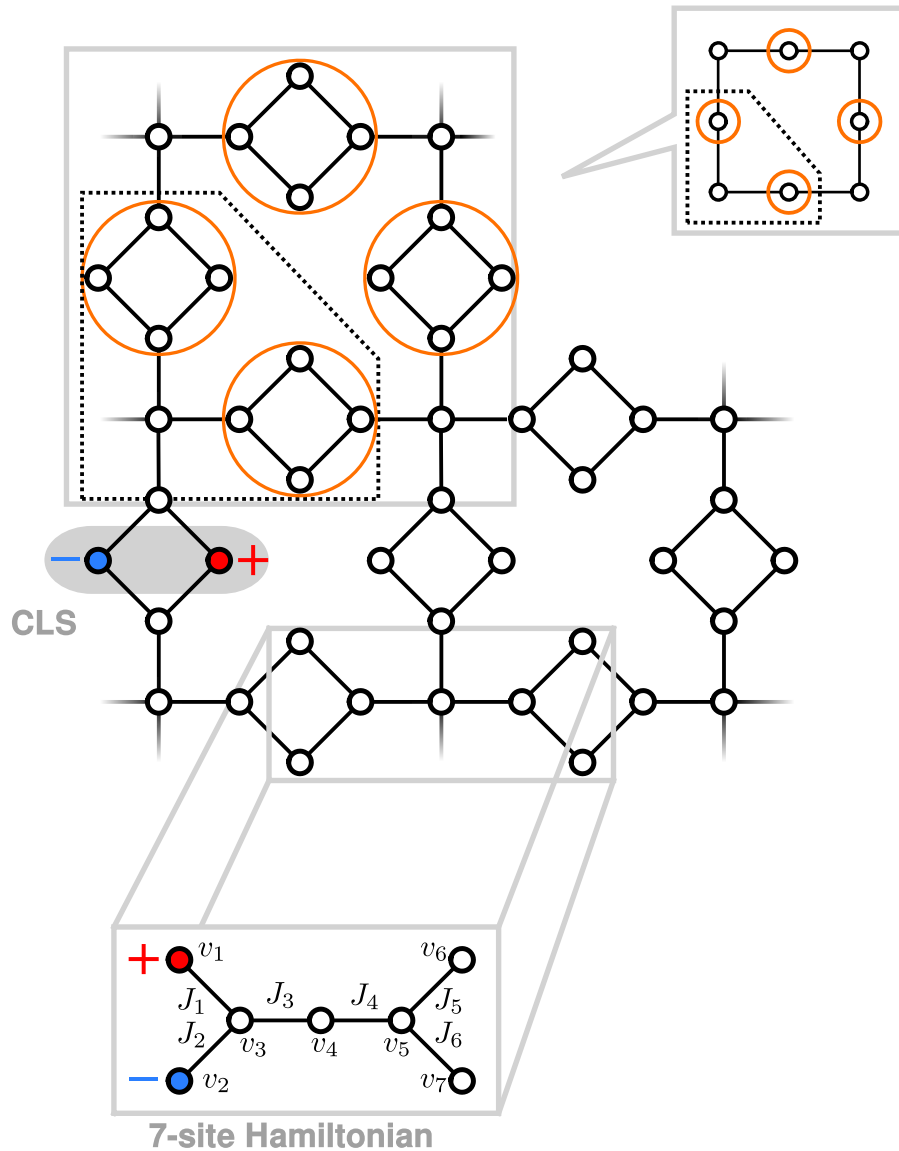
Chopped RANdom Basis
method for optimal control

PRA 84 (2011) 022326

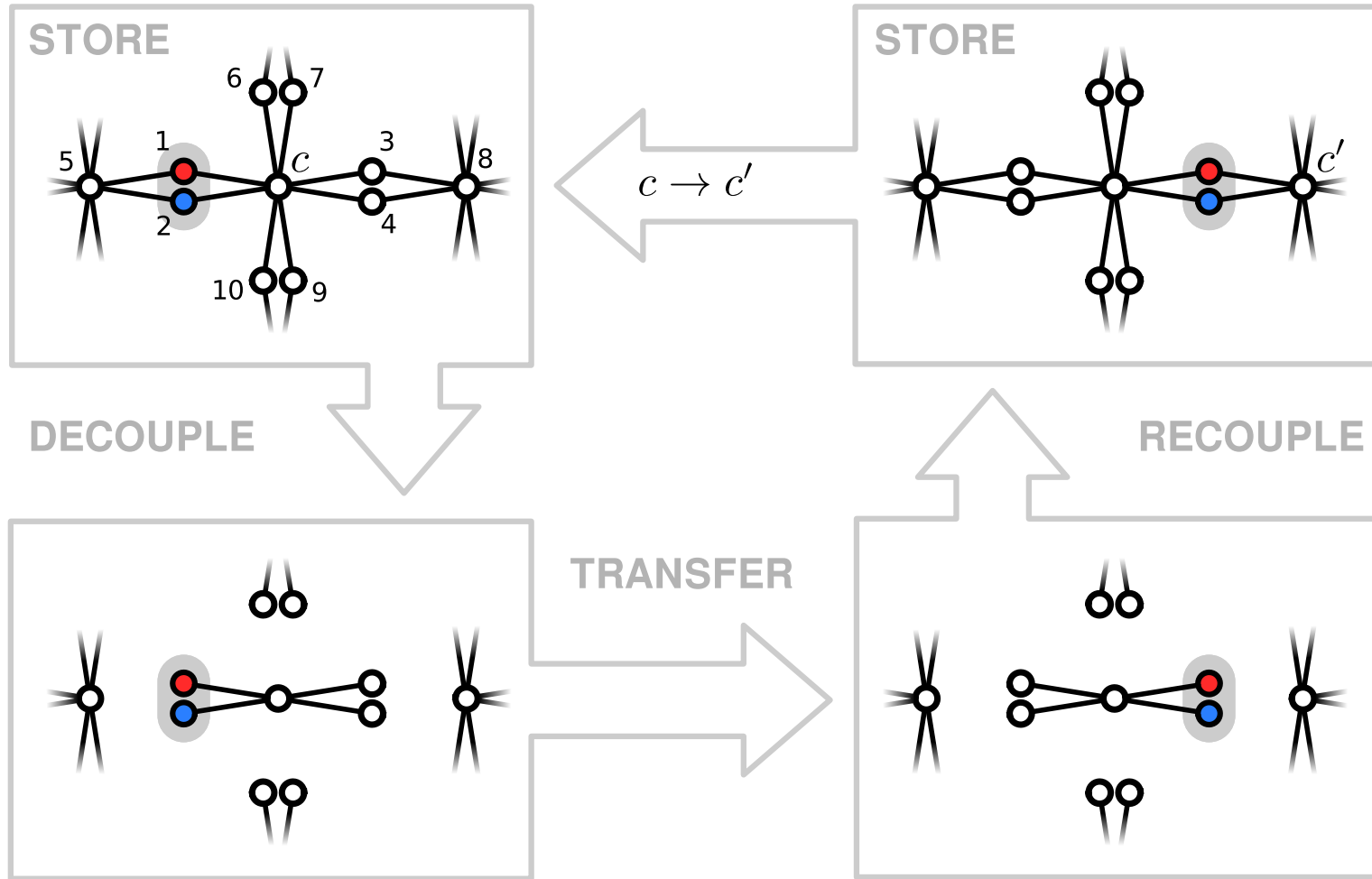
CRAB Ansatz:

$$J_n(t) = J \left(1 + \sin\left(\frac{t}{2}\right) [x_n \sin(\omega_n t) + x'_n \cos(\omega_n t)]^2 \right)$$

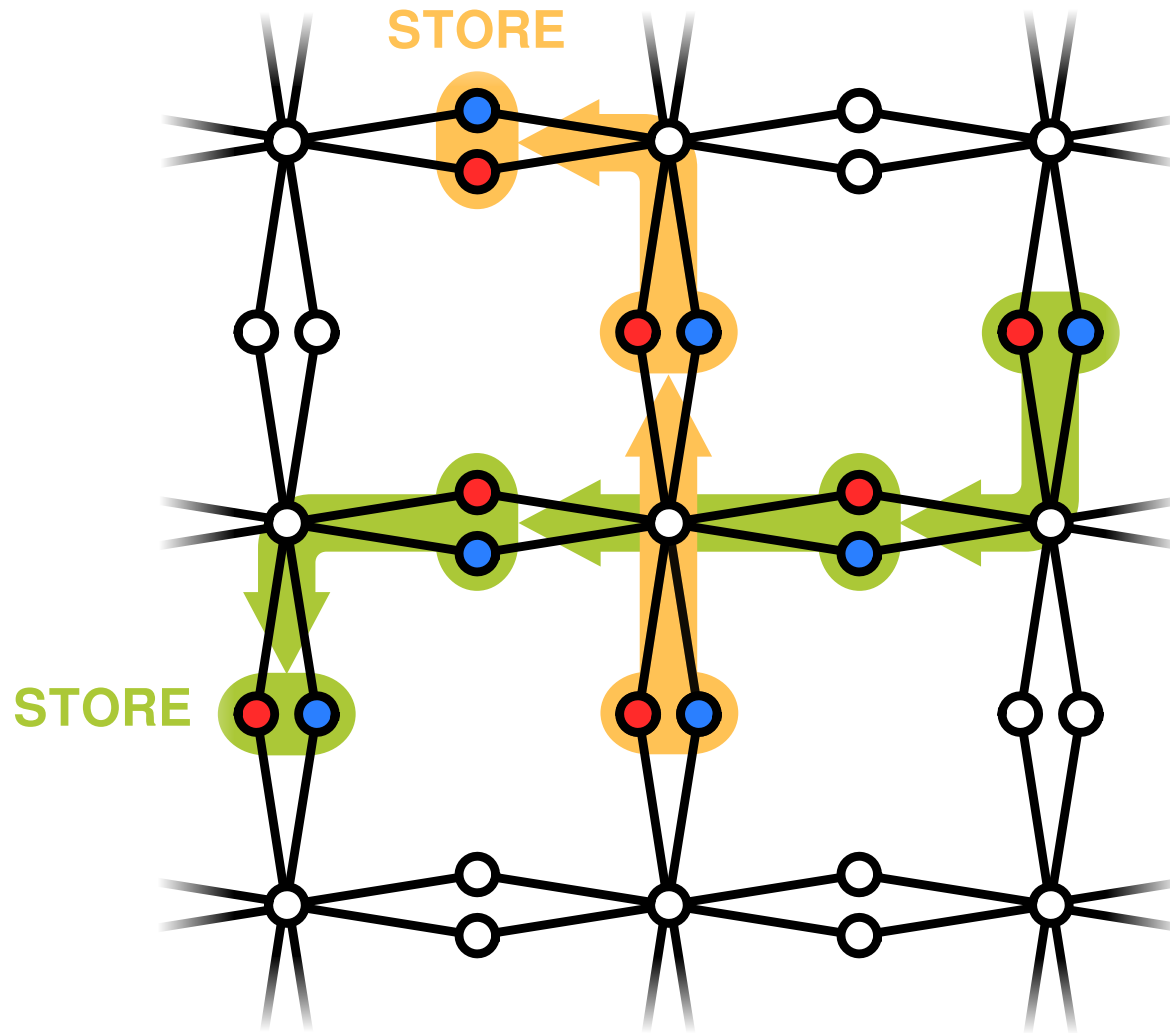
Diamond Lieb lattice



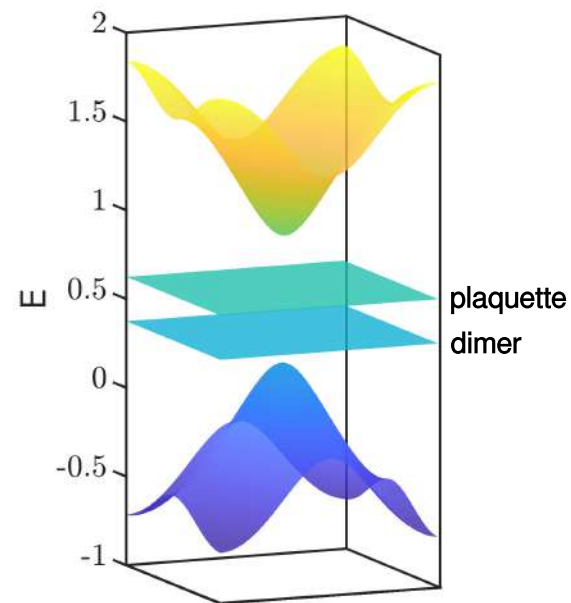
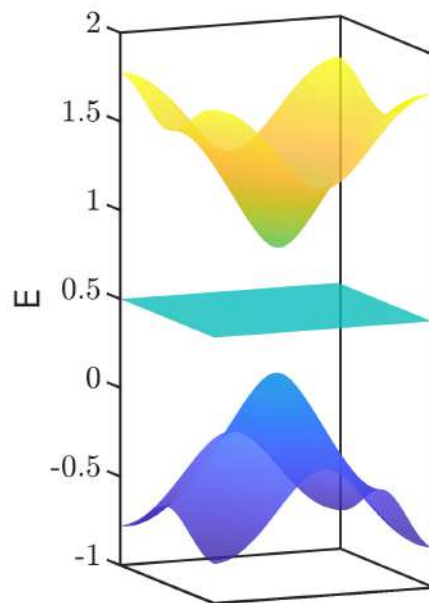
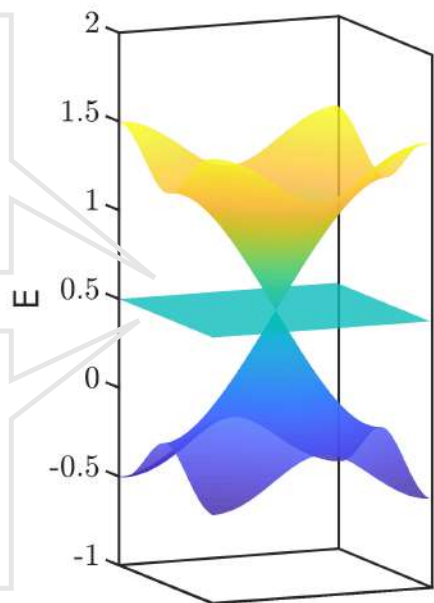
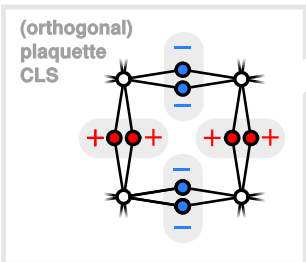
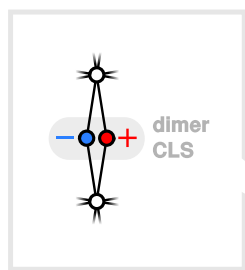
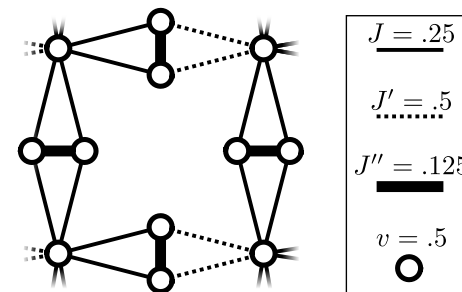
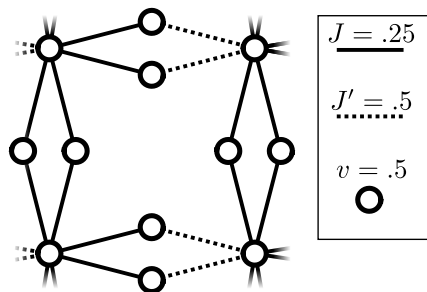
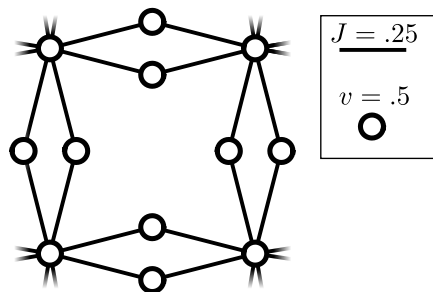
Network transfer



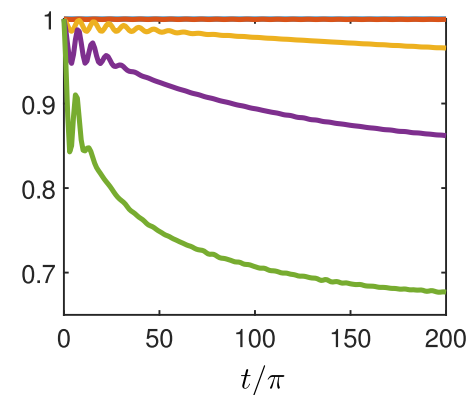
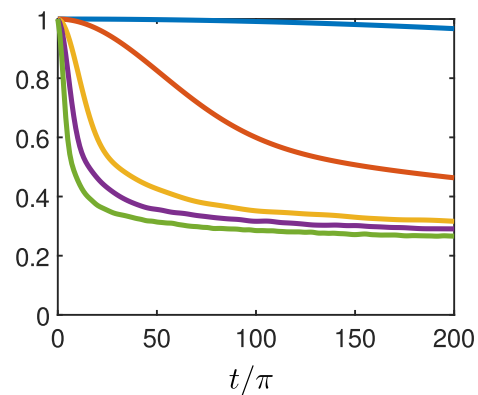
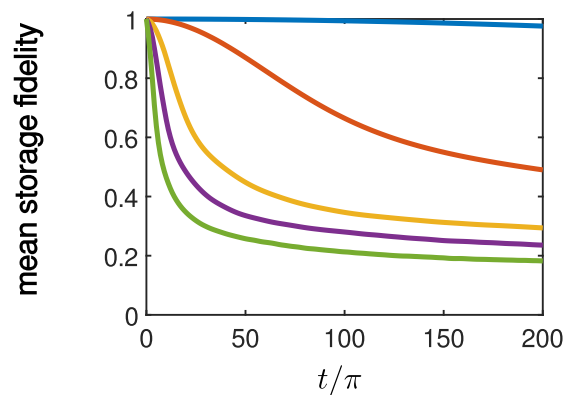
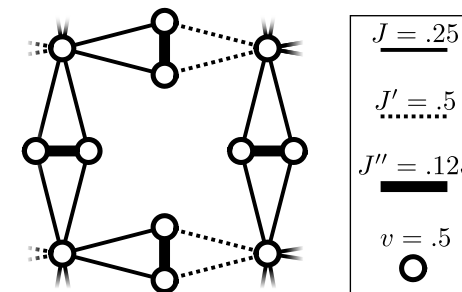
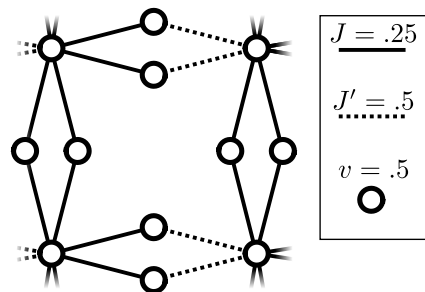
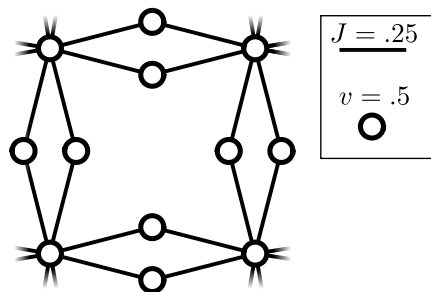
Network transfer



Spectral decoupling



Storage robustness

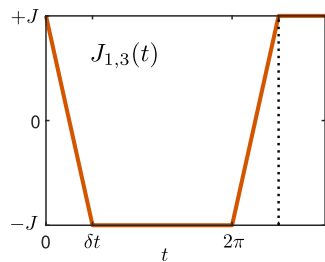
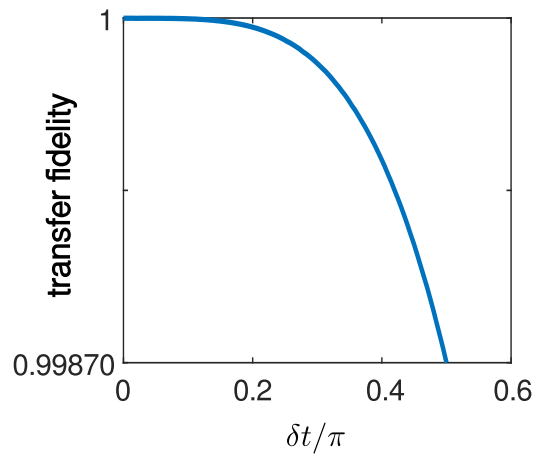


normally distributed hopping perturbation

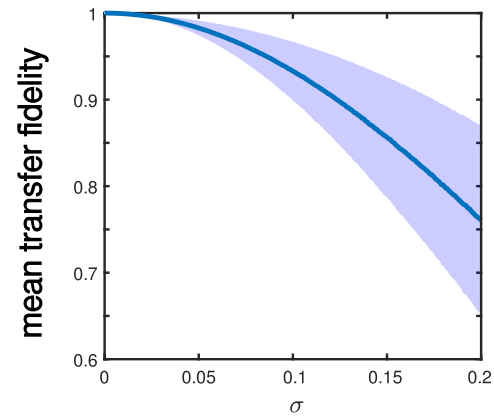
$\sigma = 0.001$
 $\sigma = 0.01$
 $\sigma = 0.05$
 $\sigma = 0.1$
 $\sigma = 0.2$

Perturbed star transfer

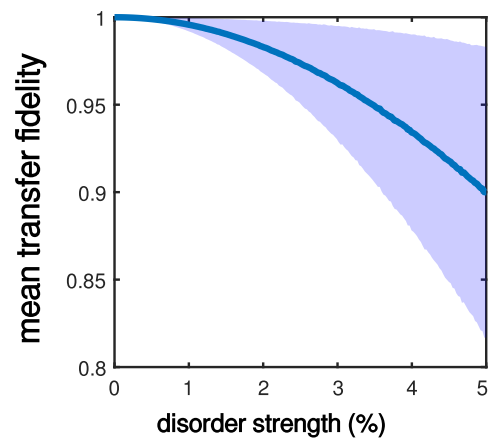
Finite duration hopping flip



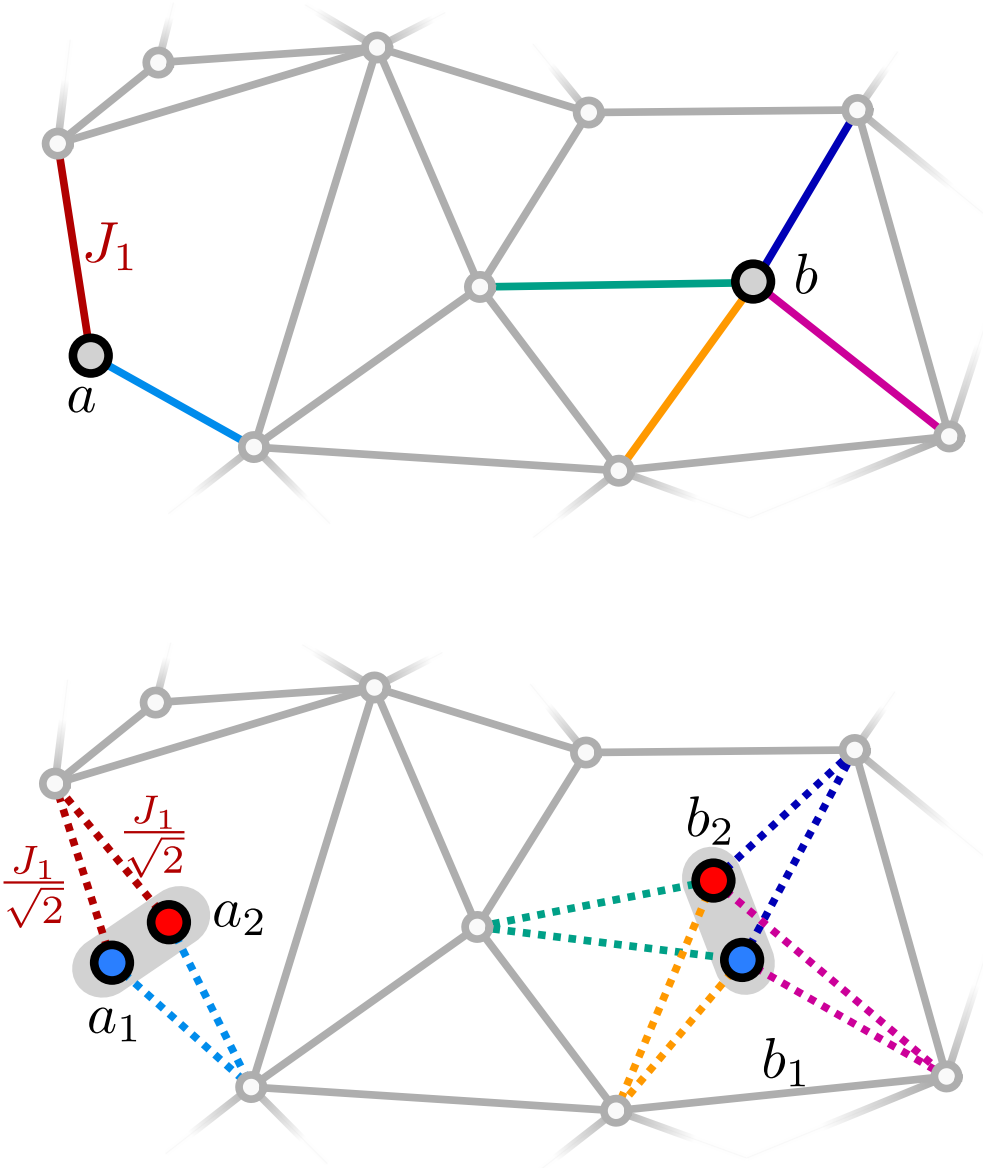
Perturbed static J_n, v_n



Perturbed CRAB parameters



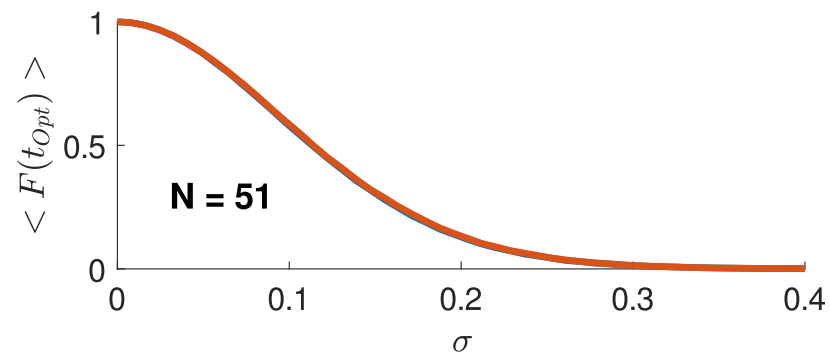
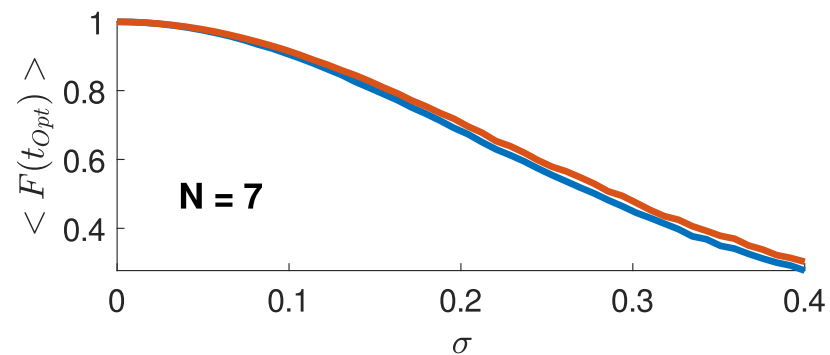
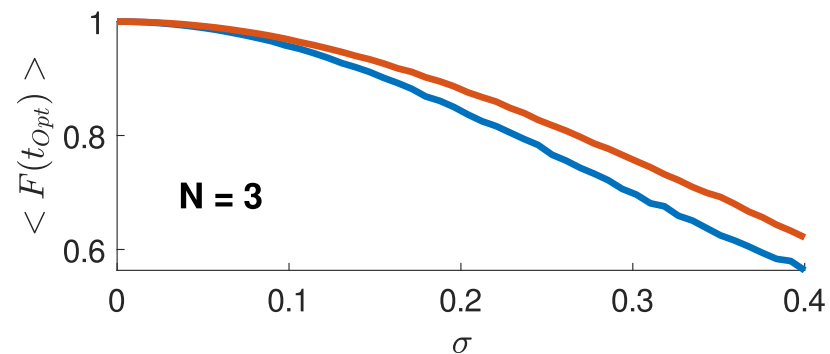
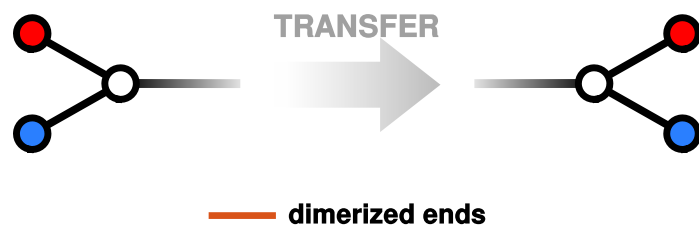
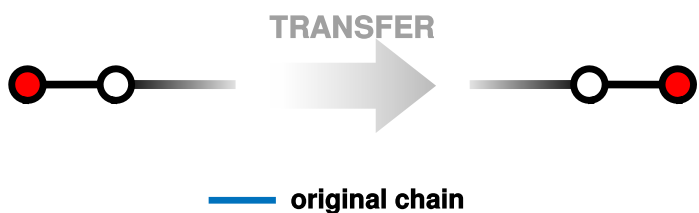
Static PST equipped with CLS storage



Static PST equipped with CLS storage

Prototype case:
Kac chain

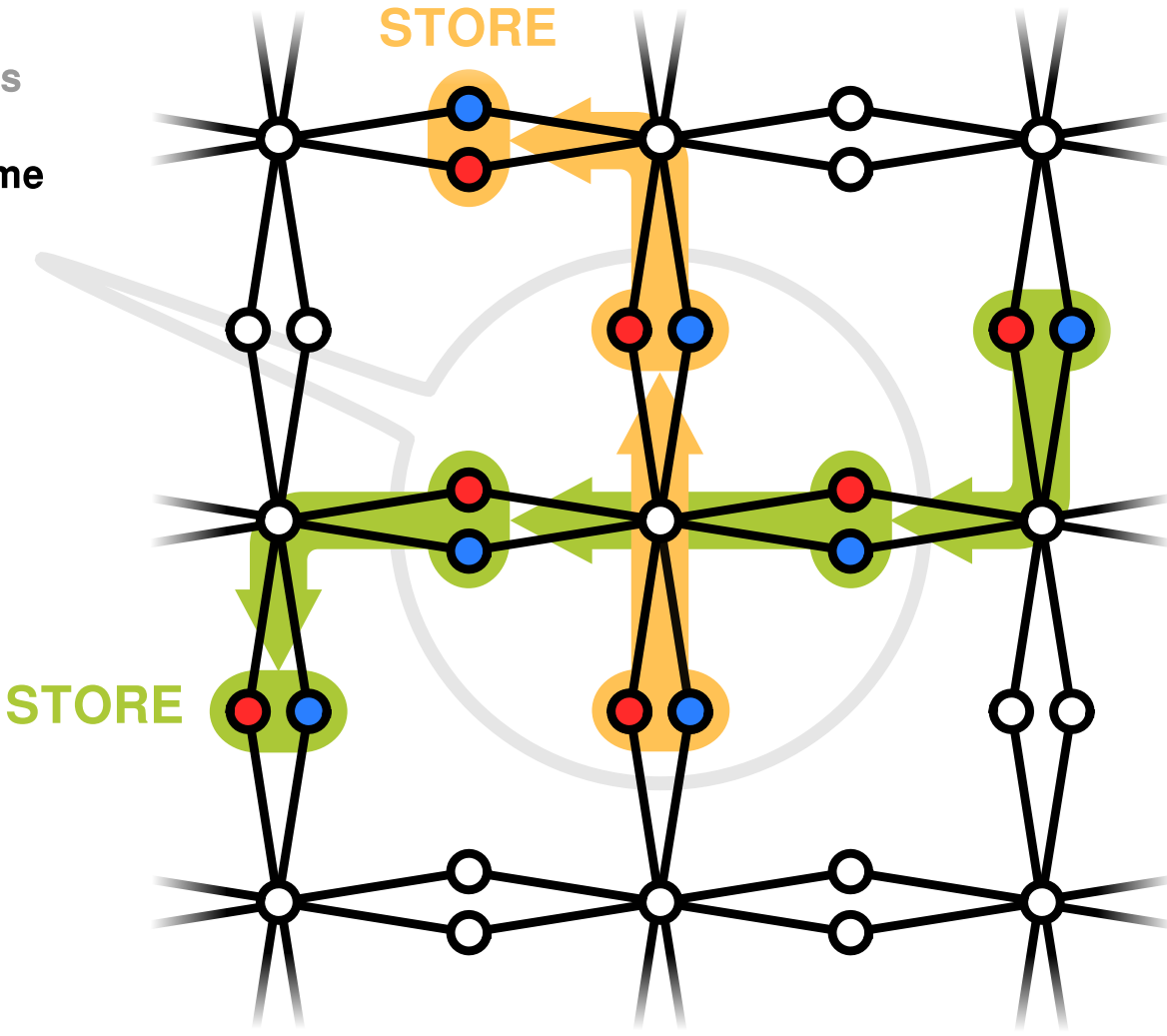
$$J_n = \sqrt{n(N-n)}$$



OUTLOOK

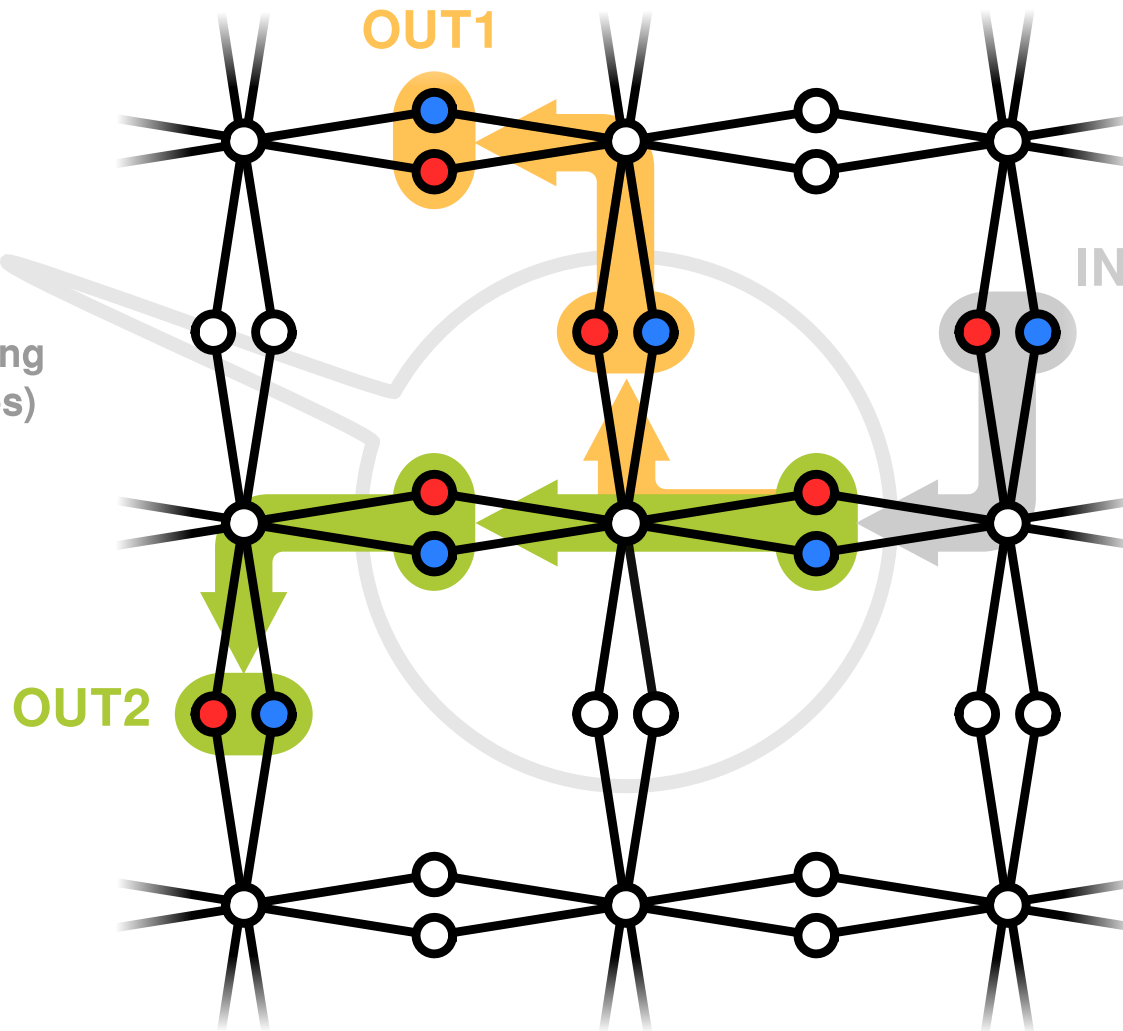
CLS transfer along crossing paths

transfer paths
crossing in
space and time
under single
modulation
protocol

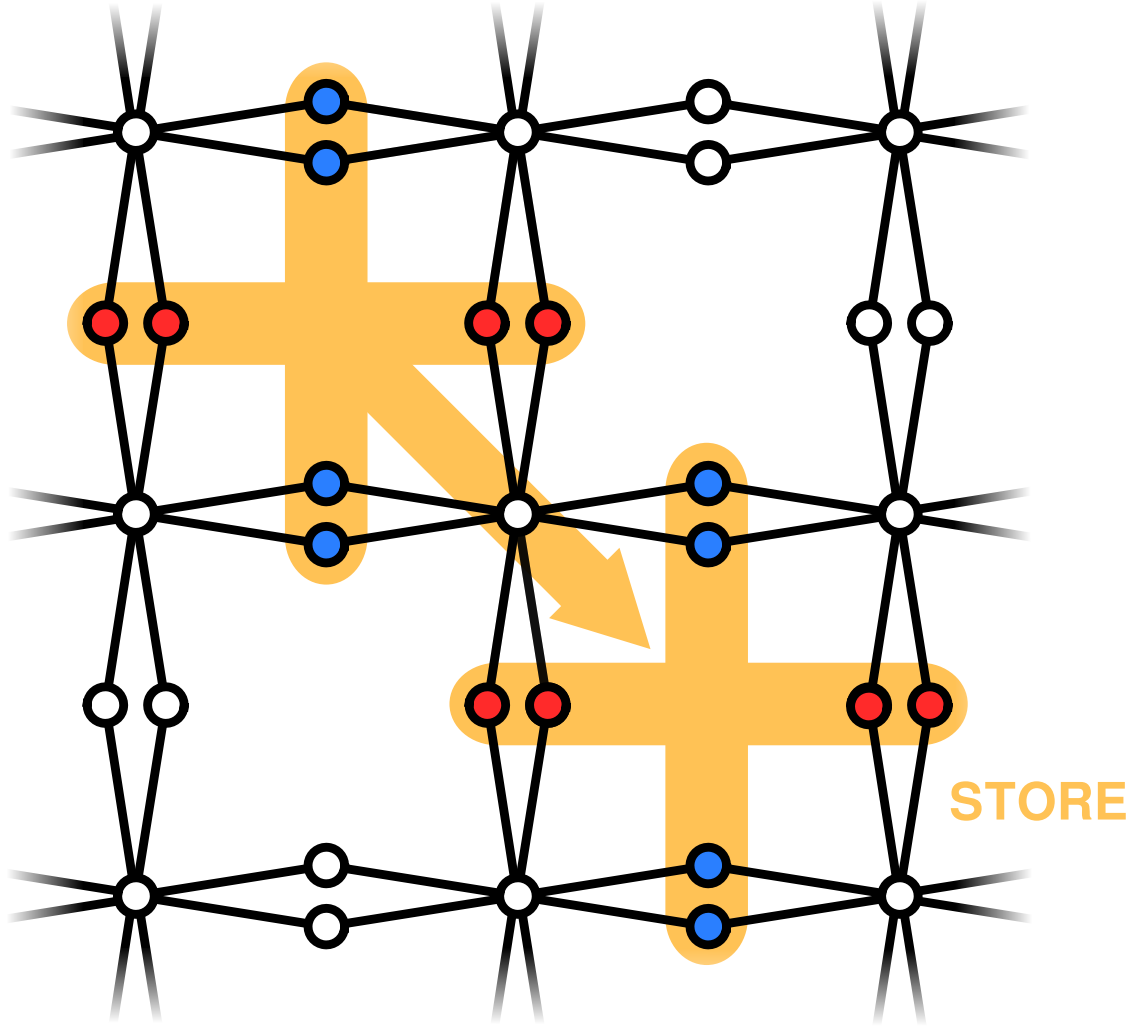


Directional CLS transfer switch

local directional junction based on switching one or more network elements (including geometry changes)



Transfer of extended CLSs



Conversion between CLSs and extended states

