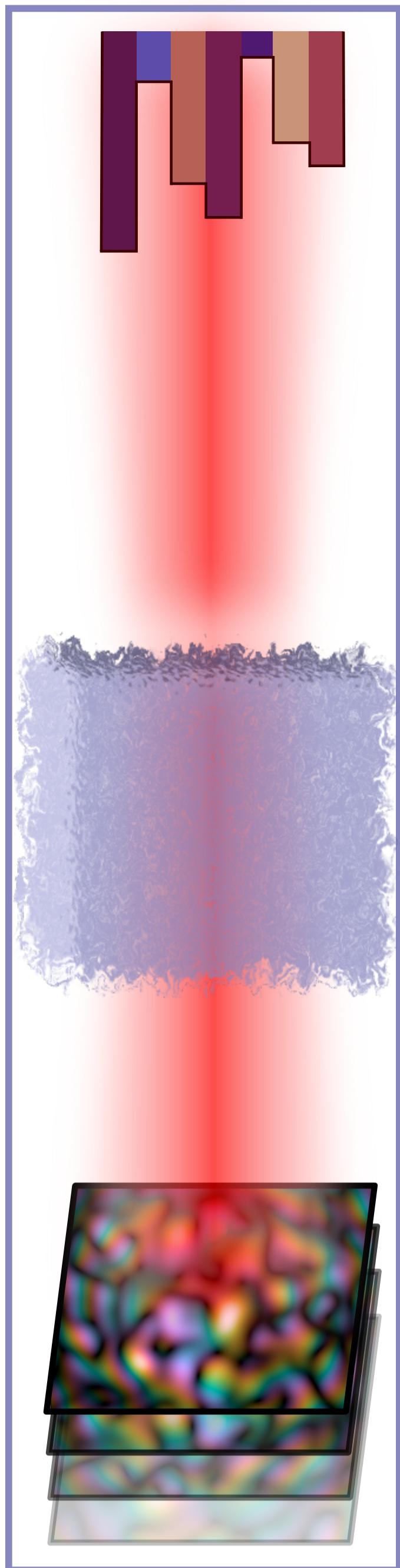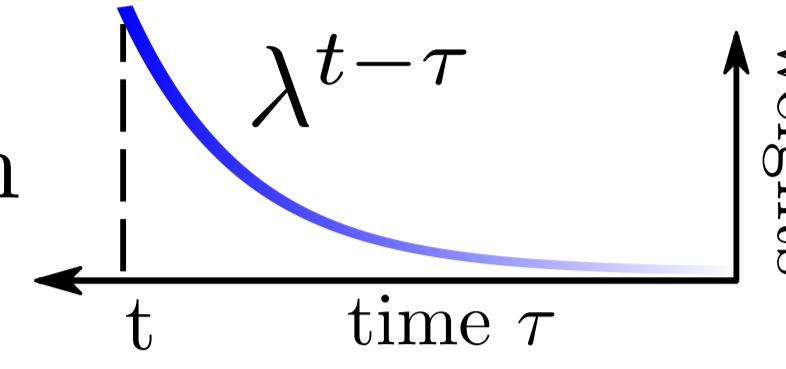**(a) Recursive least-squares estimation of the dynamic transfer matrix**

Input fields a_t (modulated in amplitude and/or phase)
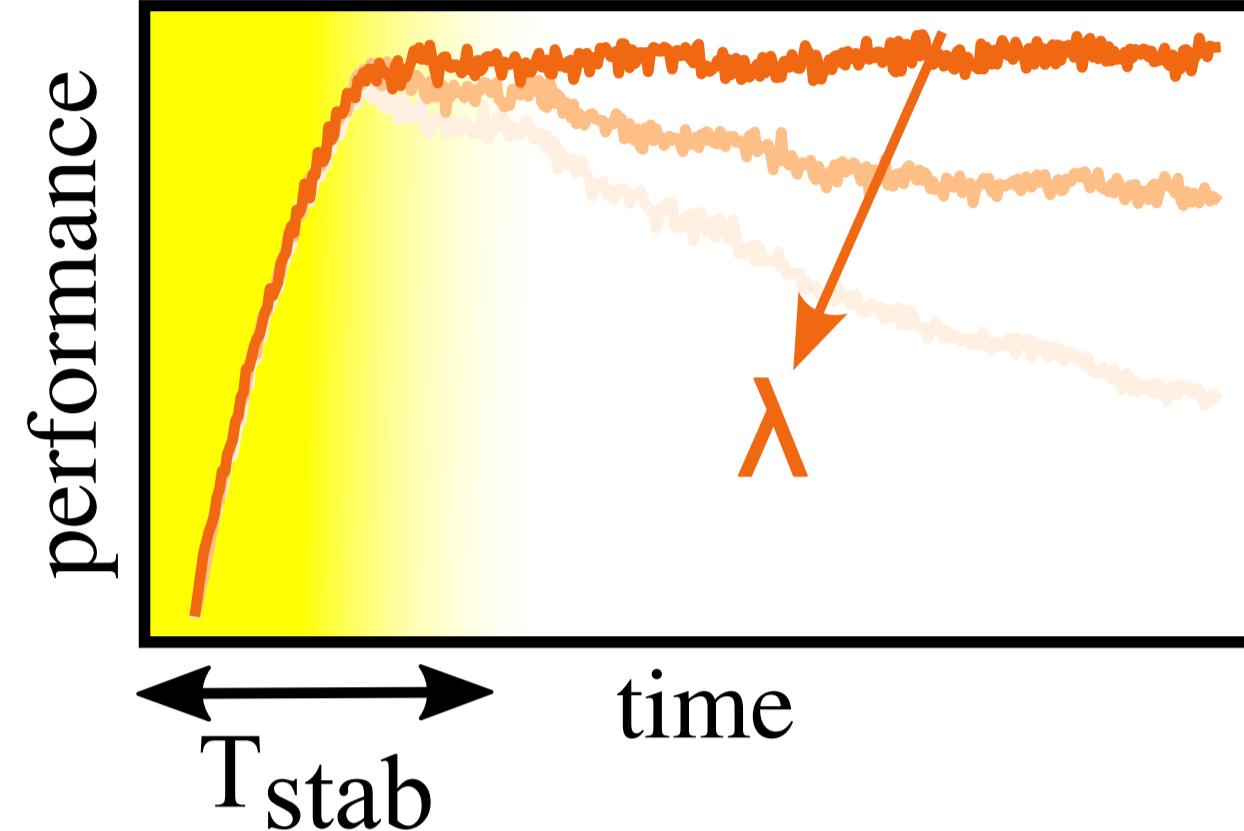
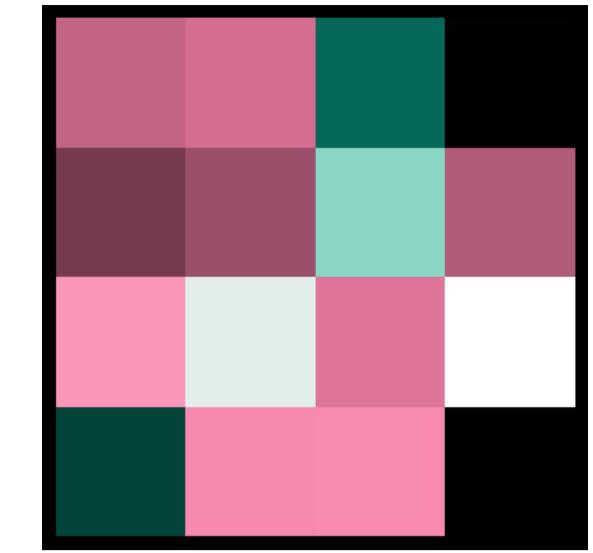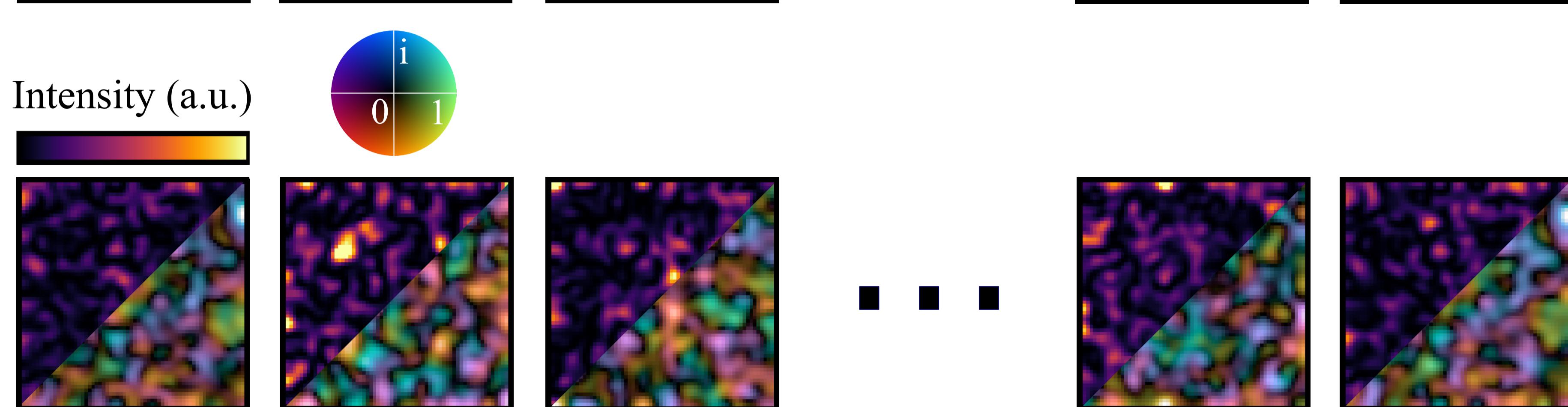**Recursively** solve $\min_{X_t} \sum_{\tau=1}^{t} \left(\lambda^{t-\tau} ||y_\tau - X_t a_\tau||^2 \right) + \delta \lambda^t ||X_t||_F^2$, with

$\lambda^{t-\tau}$ weights   time τ t

Dynamic transfer matrix X_t

Intensity (a.u.)   0   1   i
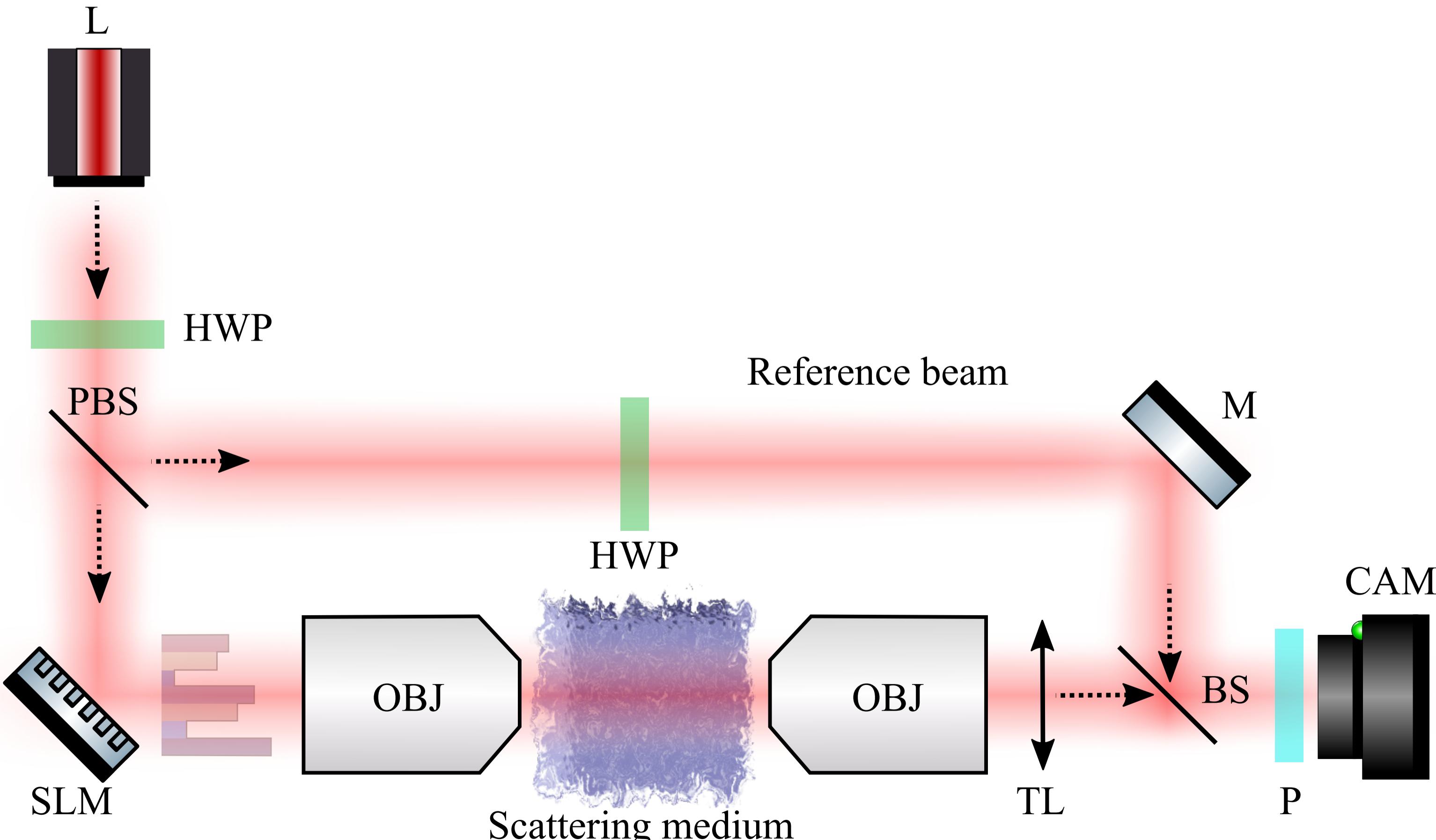
Output patterns y_t (complex or intensity-only)

(b) Arbitrary light control

performance   time λ T$_{stab}$

(c) Experimental implementations

Transmission mode

L   HWP   PBS   Reference beam   M   HWP   SLM   OBJ   Scattering medium   OBJ   TL   BS   P   CAM

OCT-like mode

L   HWP   PBS   M   HWP   Delay line   M   M   M   Reference pulse   M   M   TL   BS   SLM   BS   OBJ   Scattering medium   M   Delay   P   CAM