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SUPPLEMENTARY INFORMATION

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Exciton-polariton spin switches

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Switching propagation

In this section we provide further insights on the role of the momentum of the pump polaritons in the propagation of the switched signal. Figure S1 shows real space images of a σ^+ cw pumped region in the absence (a) and in the presence (b-d) of a σ^+ cw probe, arriving at the left edge (b), centre (c) and right edge (d) of the pump spot. In these images polaritons are pumped with an angle of incidence of 3.8º, corresponding to an in-plane momentum k_p =0.49 µm^{-1}. This momentum corresponds to polaritons moving from left to right in Fig. S1. According to the propagation model described in the main text, polaritons moving out of the region initially switched on by the probe will also induce the switching on of the pumped area to which they have moved (transition from point I to point II in the density curve plotted in Fig. 1a). Polaritons are created with a momentum which goes from left to right, they move in the same direction, and only the regions of the pump spot to the right of the probe arrival spot will be switched on by the propagation mechanism. Indeed this is what we observe in Fig. S1 (b-d). If we place the probe spot on the left edge of the pump spot (a) we will induce the switching of the whole pump spot. If the probe is placed on the centre only the right part of the spot will switch on (c), while if it is placed on the right edge, no switching will take place.

Pump momentum

The momentum of the pump polaritons is given unambiguously by the angle of incidence φ_p of the excitation laser with respect to the normal of the sample's surface:

$$k_p = (\omega_p / c)\sin(\varphi_p)\,, \tag{S1}$$

where ω_p is the polariton emission frequency and c is the speed of light. The excited polaritons keep a momentum equal to kp while they propagate in the sample, and are emitted out of the sample at an angle φ_{emiss} with respect to the normal to the sample's surface given by the reciprocal of Eq. (S1):

$$\varphi_{emiss} = \arcsin\left(ck_p / \omega_p\right), \tag{S2}$$

Figure S1 shows the far field image of the emitted polaritons in transmission configuration in the conditions of Fig. S1b. Let us note that the angle of emission is the same as the angle of incidence of the pump polaritons: emitted polaritons keep the same direction as those of the pump.

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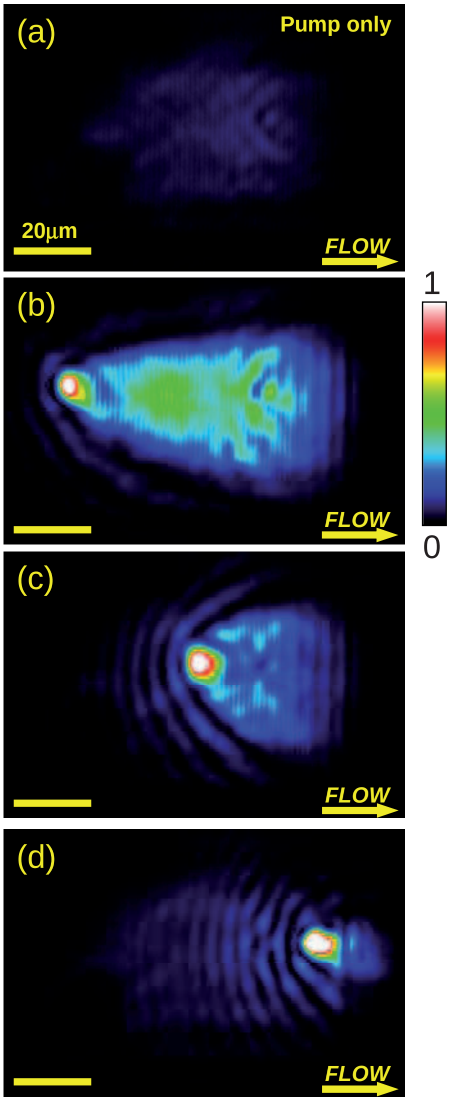

Fig. S1. Real space images of the transmitted σ^+ cw pump alone (a), and in the presence of a σ^+ cw probe placed on the left edge (b), centre (c) and right edge (d) of the pump spot. The polarization of detection is σ^+. As the pump polaritons are injected with a momentum which goes from left to right, only the area of the pump spot situated to the right of the probe arrival region is switched on.

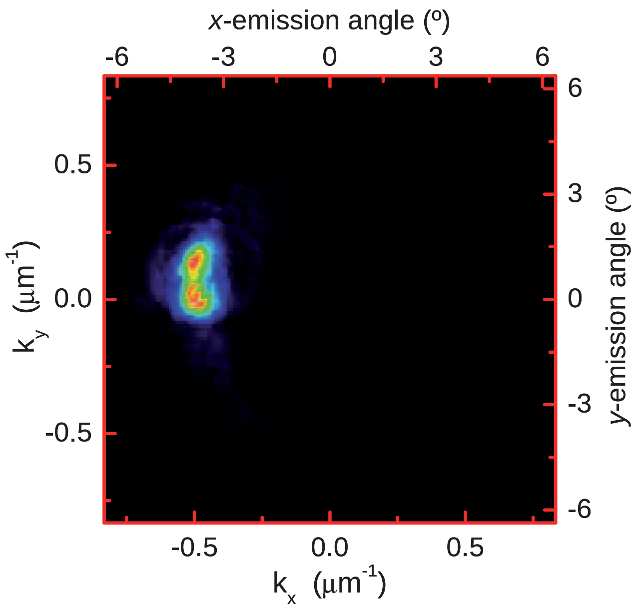

Fig. S2. Momentum space image of the transmitted pump and probe corresponding to Fig. S1b. The angle of emission, in the *x* direction, is of 3.8º, the same as the angle of incidence of the pump polaritons. The angles are measured with respect to the direction normal to the sample's surface.