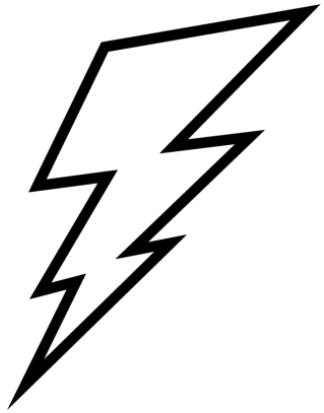
Karlsruhe Institute of Technology

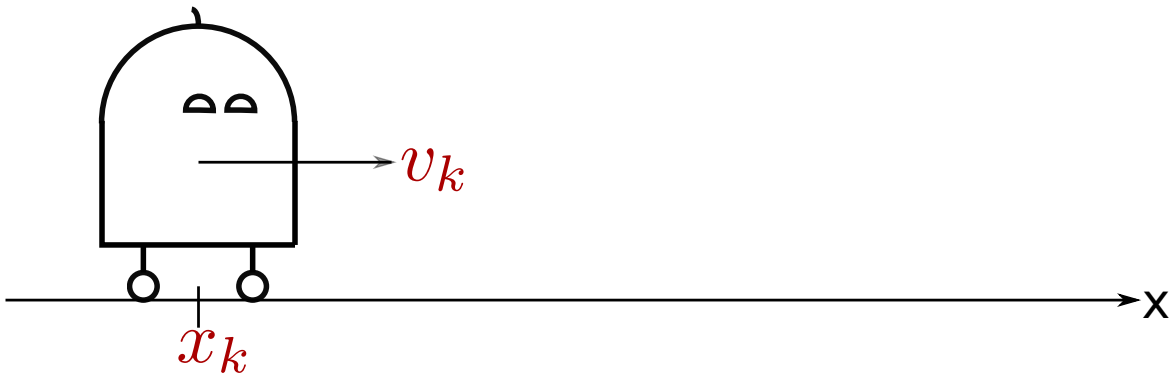


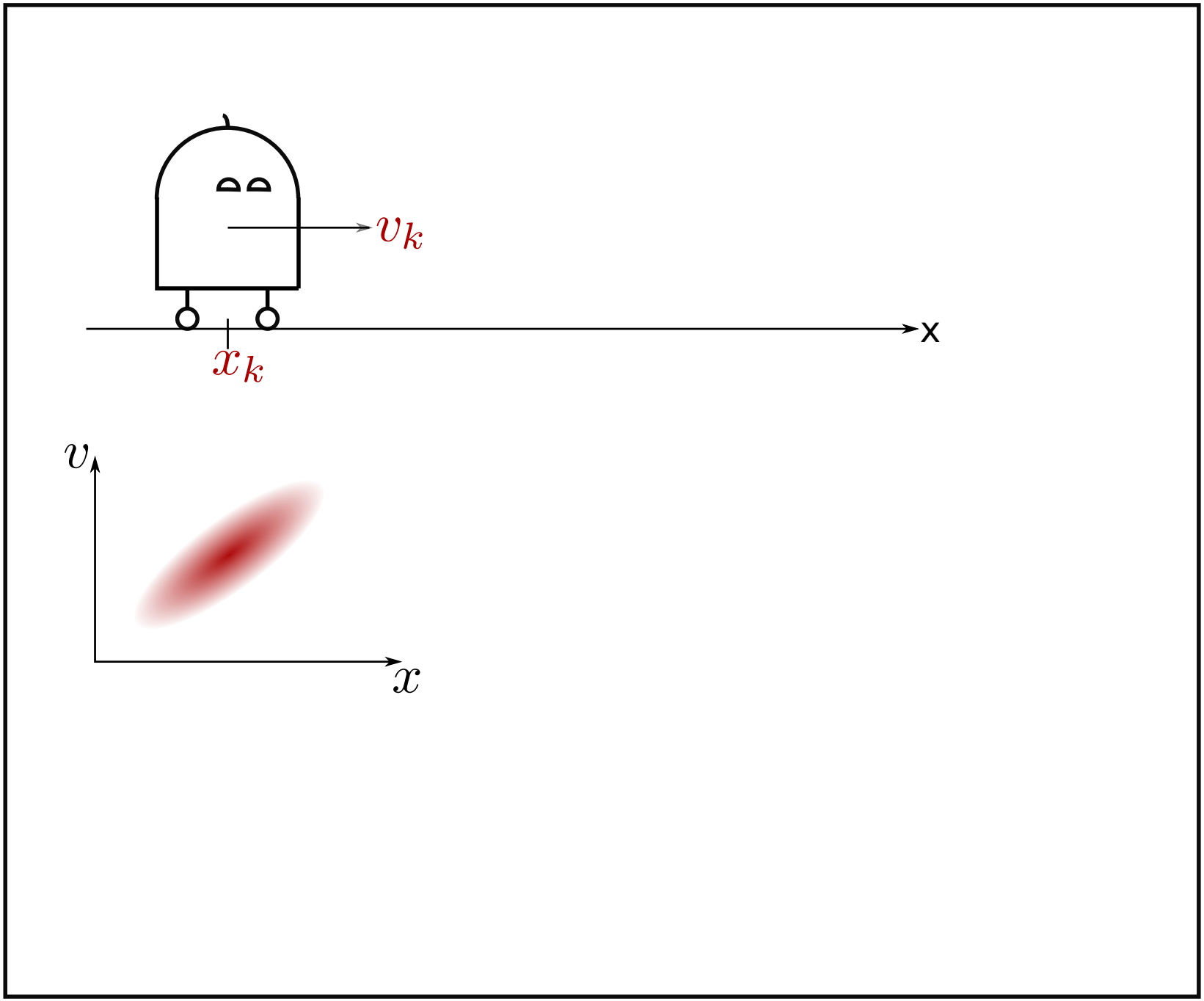
The Basic of the Kalman filter

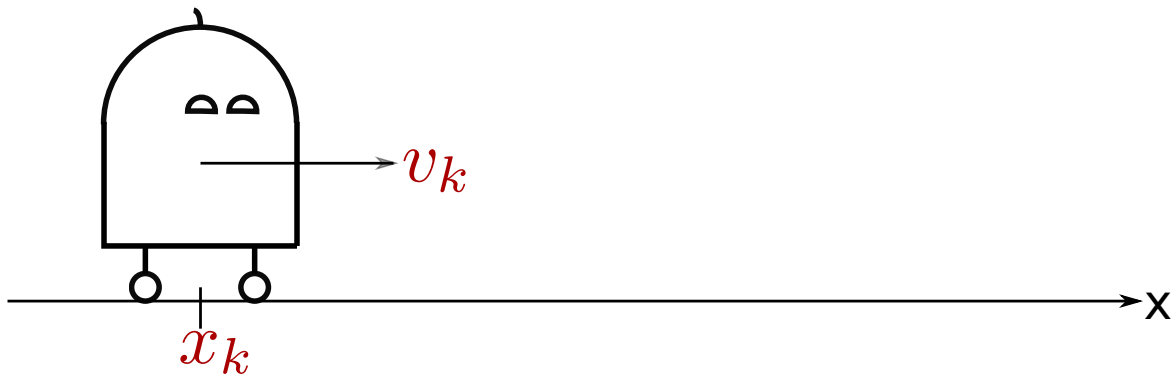
... or how you keep track of stuff

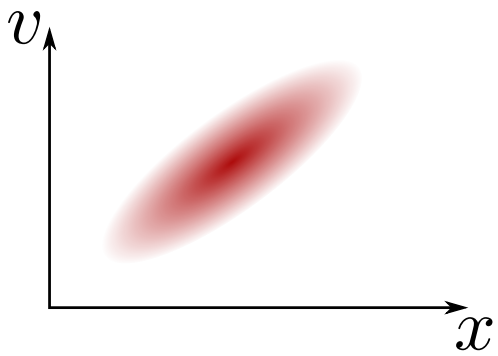
Markus Prim | 08.09.2016

INSTITUT OF EXPERIMENTAL NUCLEAR PHYSICS (IEKP)


v_k
x
x_k

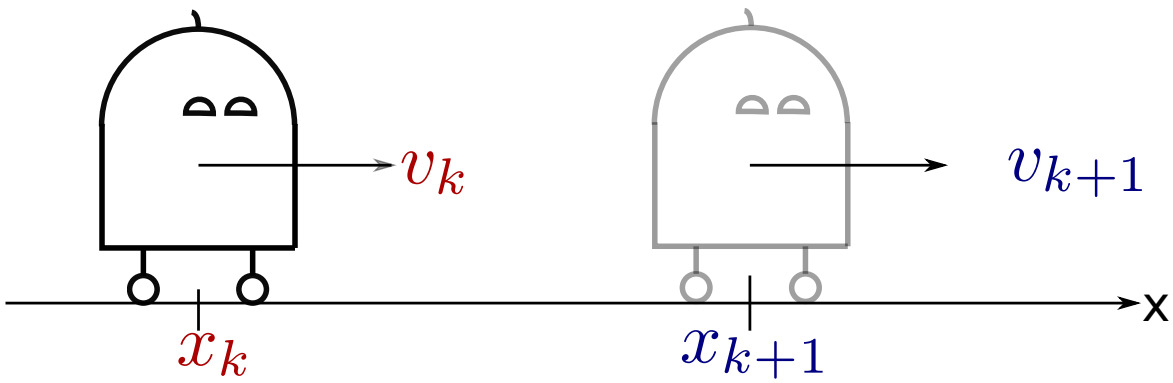

v_k
x
x_k
v
x

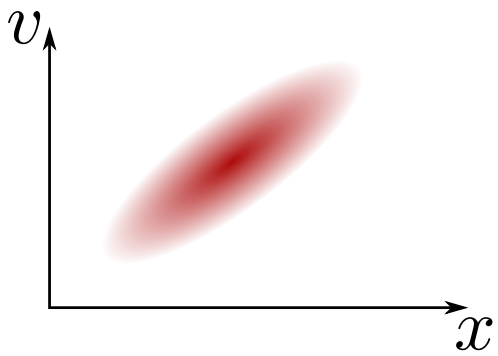




$$\vec{x} = (x, v)$$

$$P = \begin{pmatrix} \sigma_x^2 & \sigma_x \sigma_v \\ \sigma_x \sigma_v & \sigma_v^2 \end{pmatrix}$$





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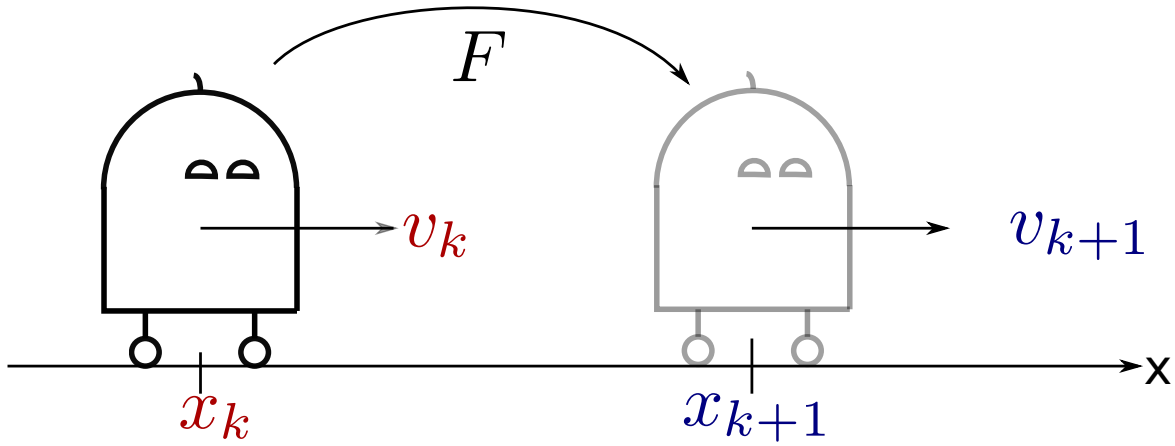

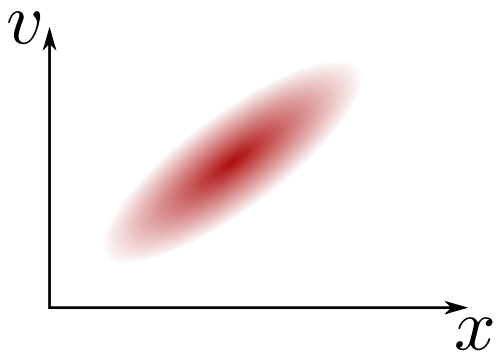

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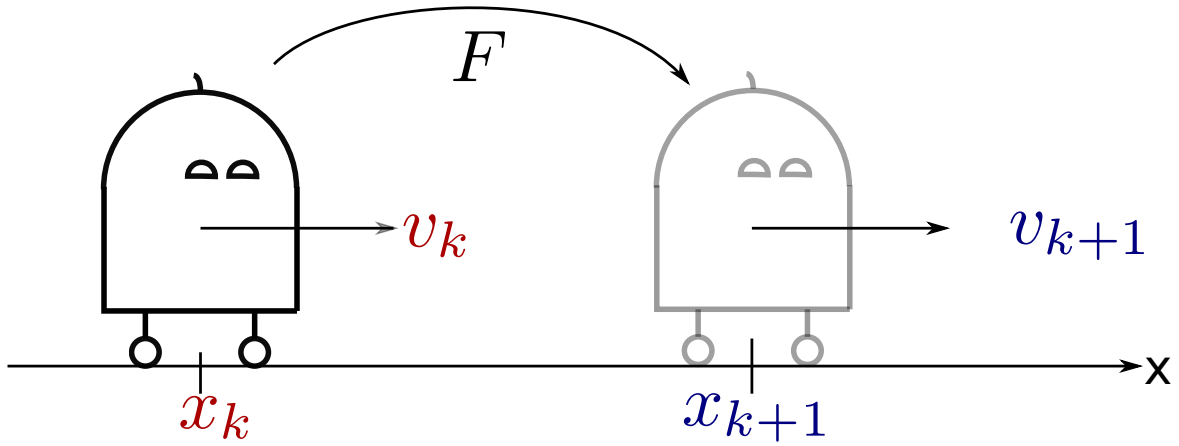

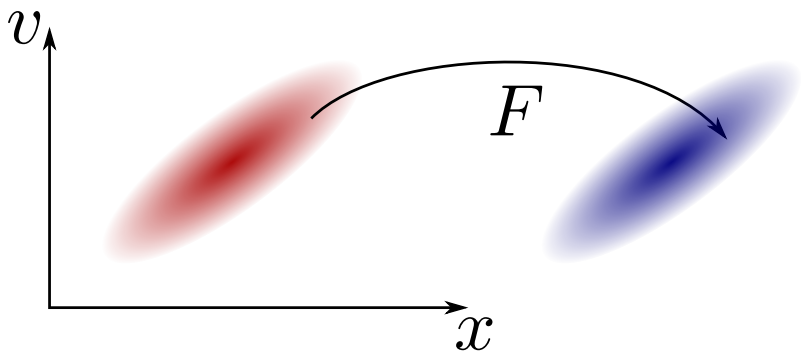

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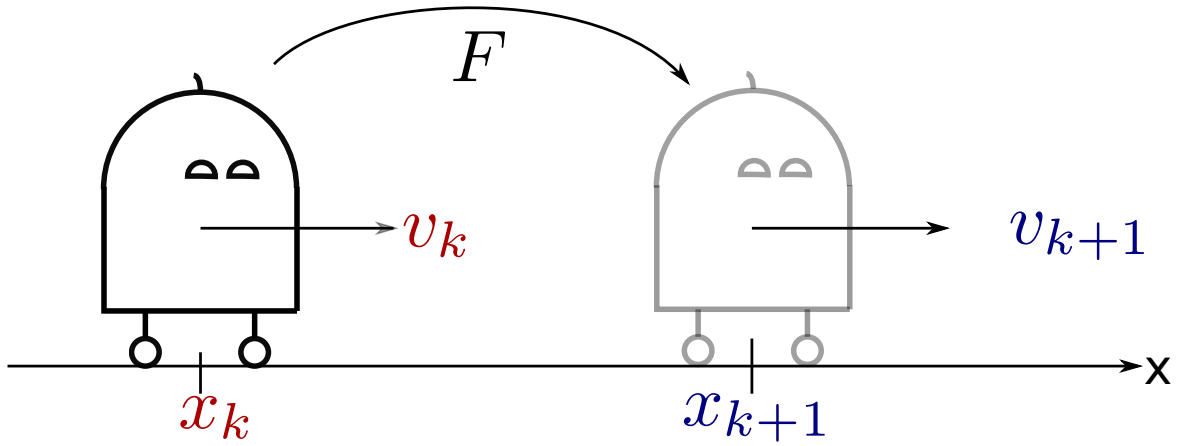
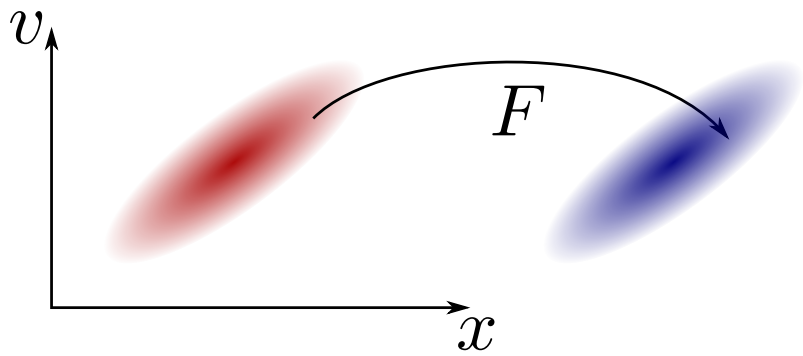




$x = v * t$

Our Model:

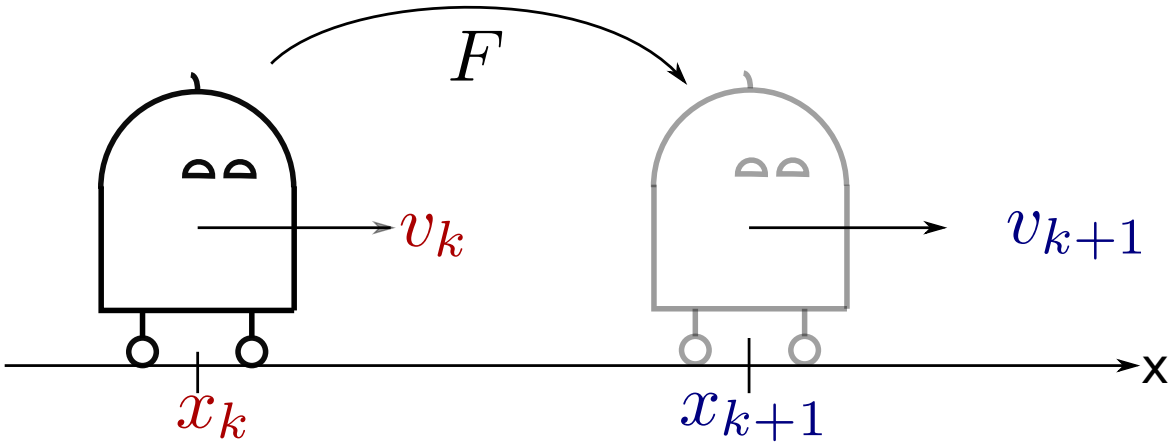
$$F = \begin{pmatrix} 1 & \Delta t \\ 0 & 1 \end{pmatrix}$$

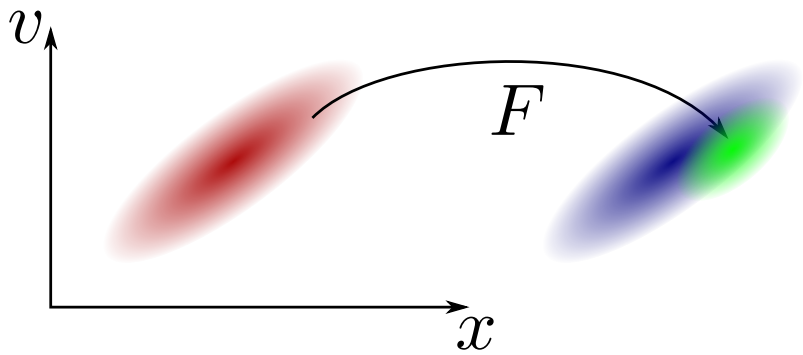
$$\vec{x} = (x, v)$$

$$P = \begin{pmatrix} \sigma_x^2 & \sigma_x\sigma_v \\ \sigma_x\sigma_v & \sigma_v^2 \end{pmatrix}$$

$$x_{k+1} = Fx_k$$

$$P_{k+1} = FP_kF^{-1}$$





Our Model:

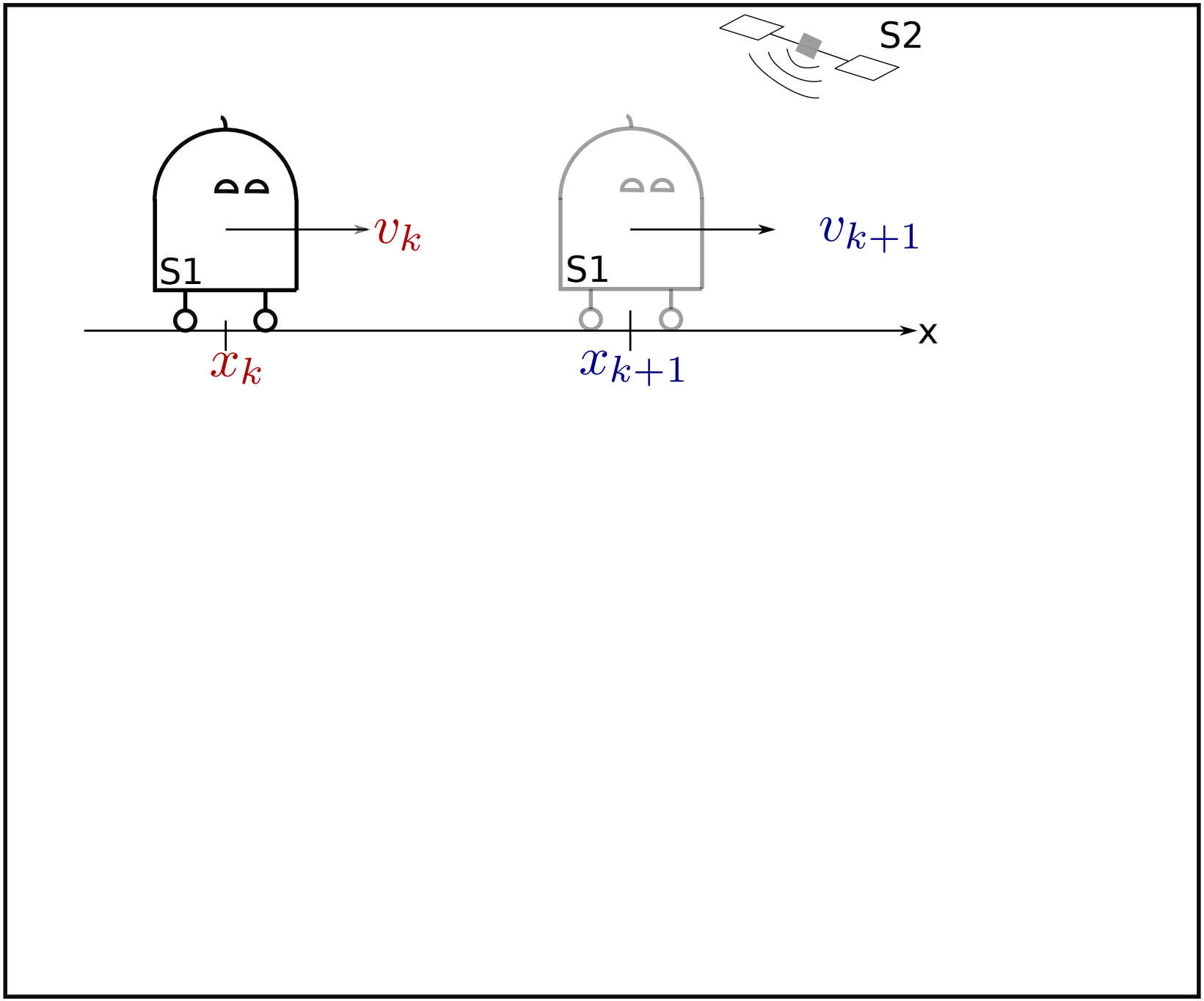
$$F = \begin{pmatrix} 1 & \Delta t \\ 0 & 1 \end{pmatrix}$$

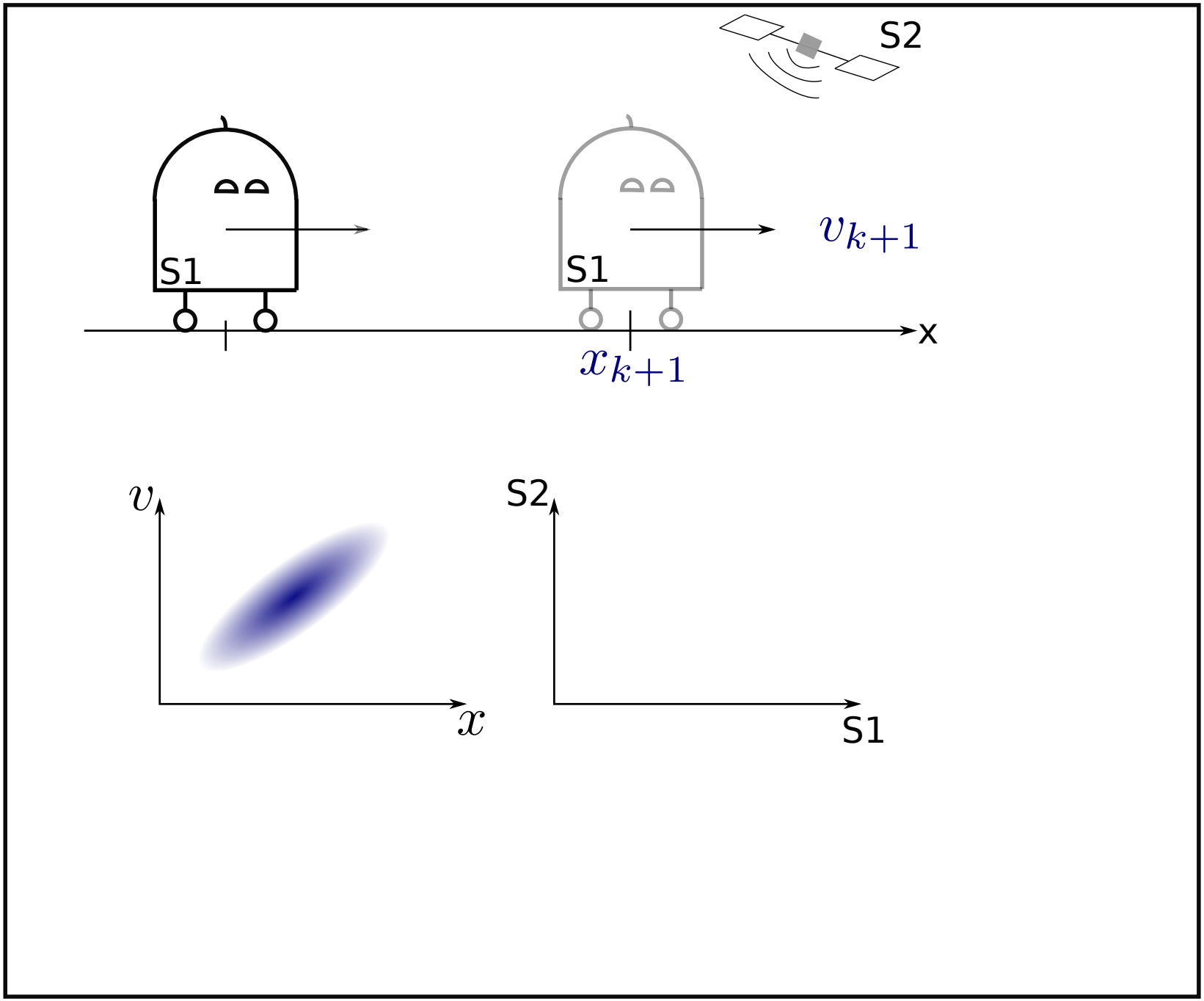
$$\vec{x} = (x, v)$$

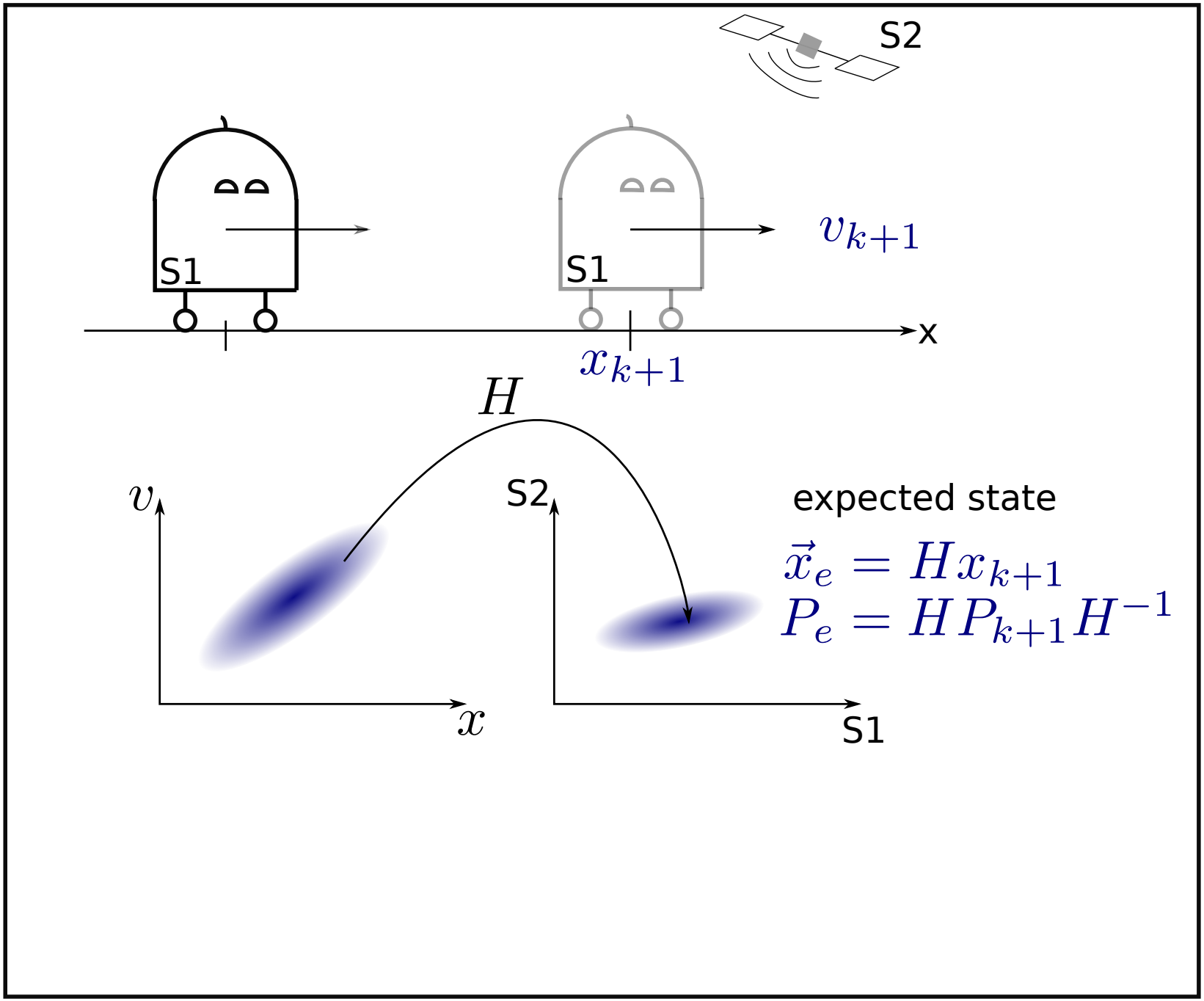
$$P = \begin{pmatrix} \sigma_x^2 & \sigma_x\sigma_v \\ \sigma_x\sigma_v & \sigma_v^2 \end{pmatrix}$$

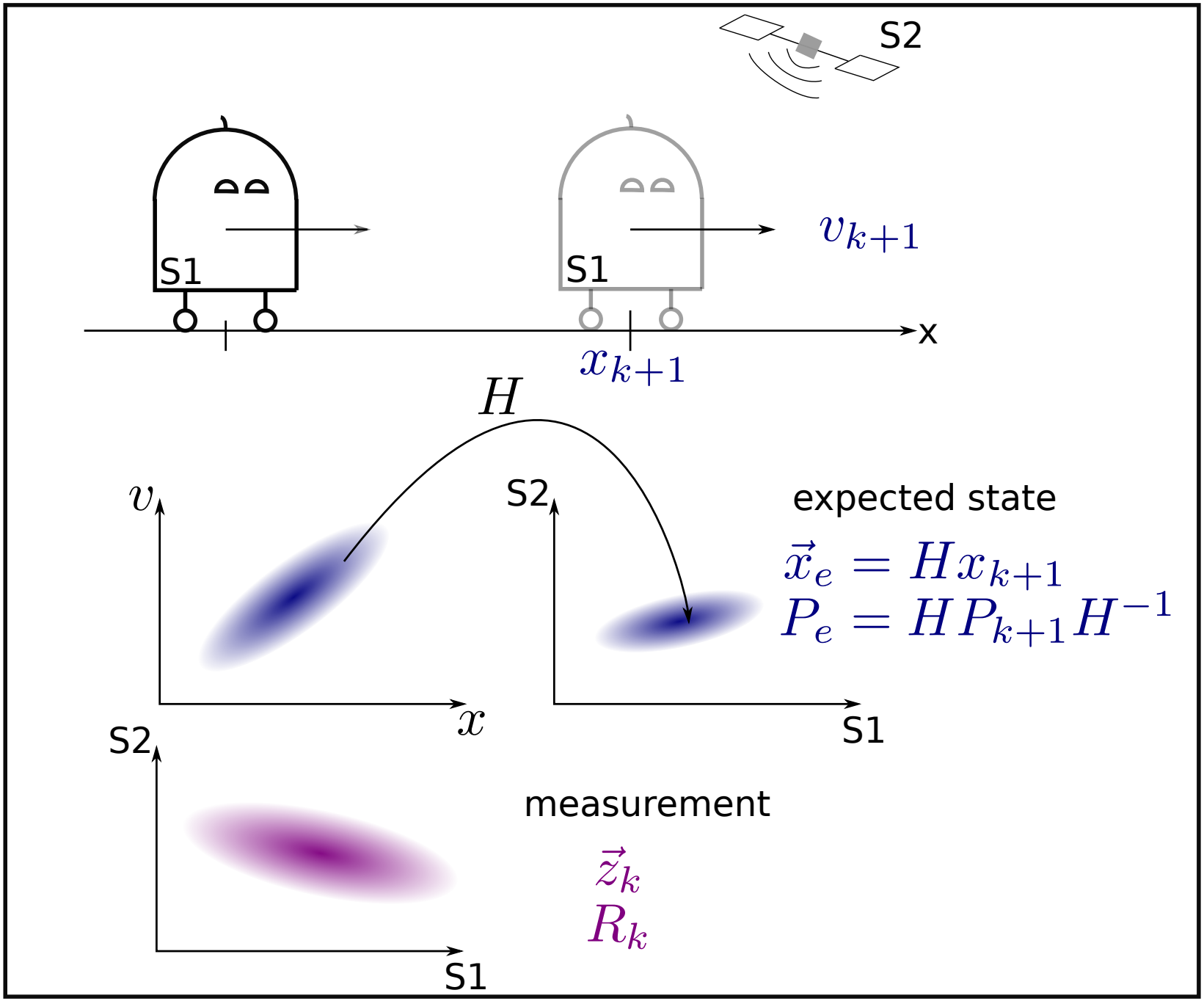
$$x_{k+1} = F x_k$$

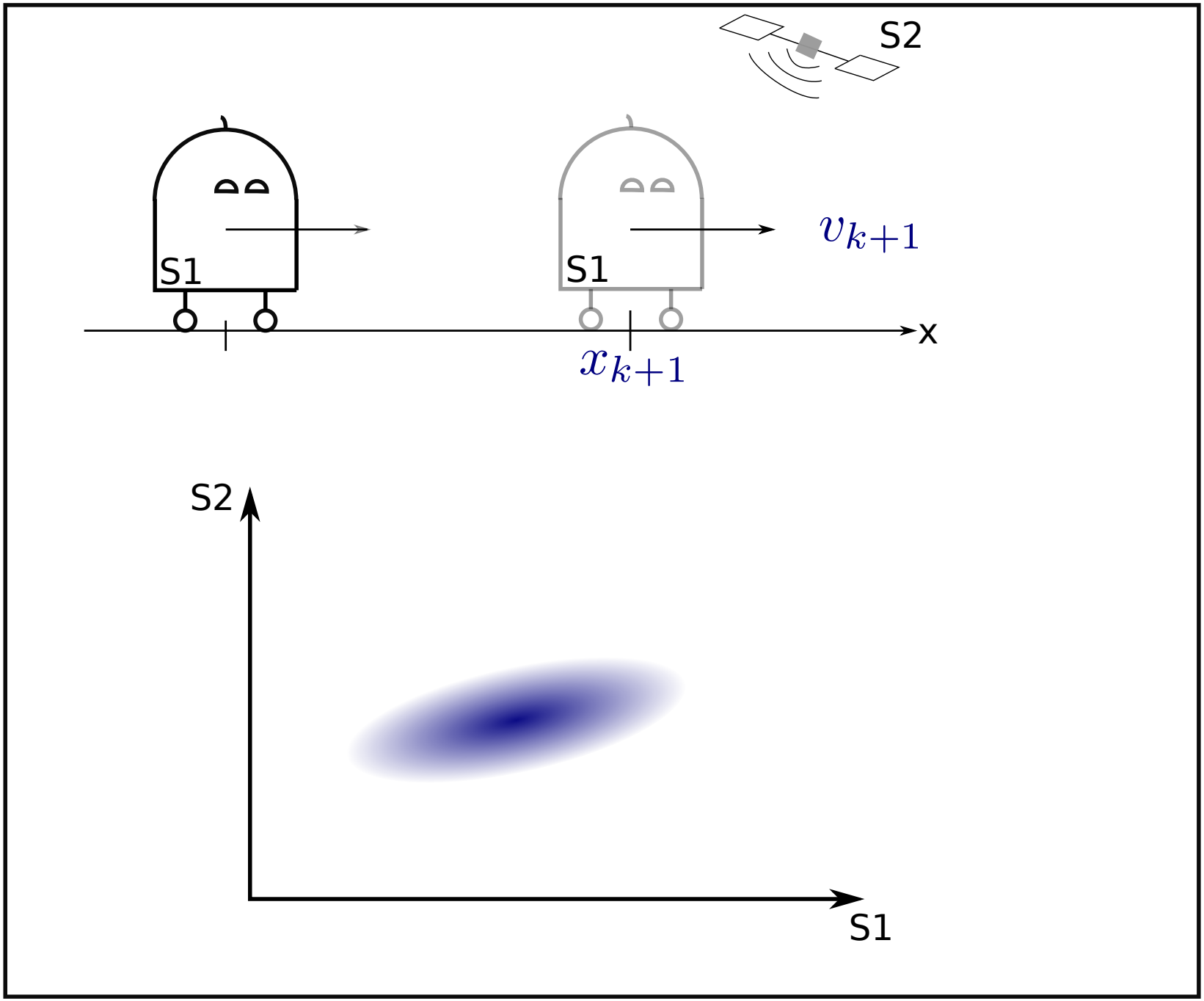
$$P_{k+1} = F P_k F^{-1} + Q_k$$

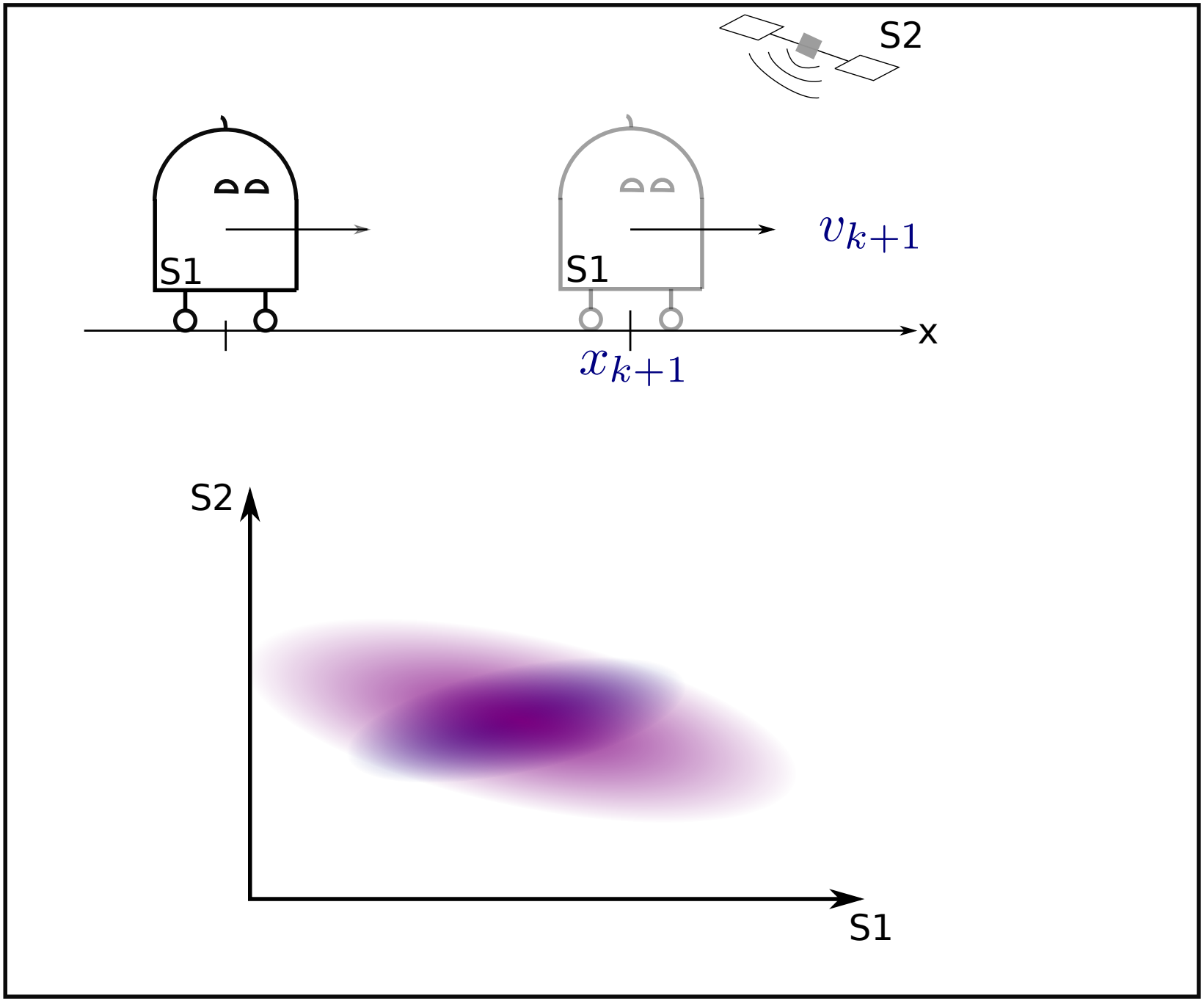

S2
S1
v_k
S1
v_{k+1}
x
x_k
x_{k+1}

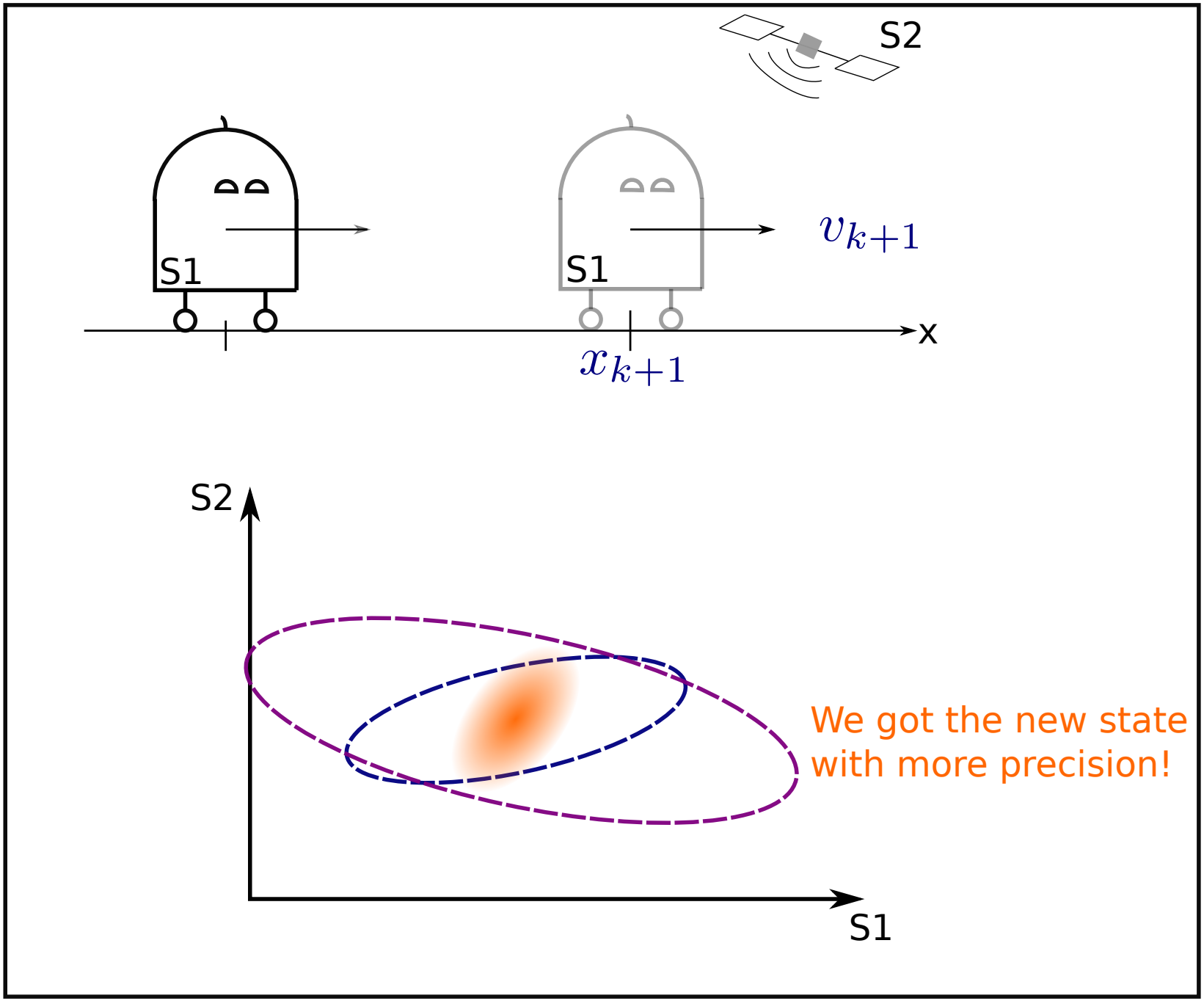

S2
S1
S1
v_{k+1}
x
x_{k+1}
v
x
S2
S1

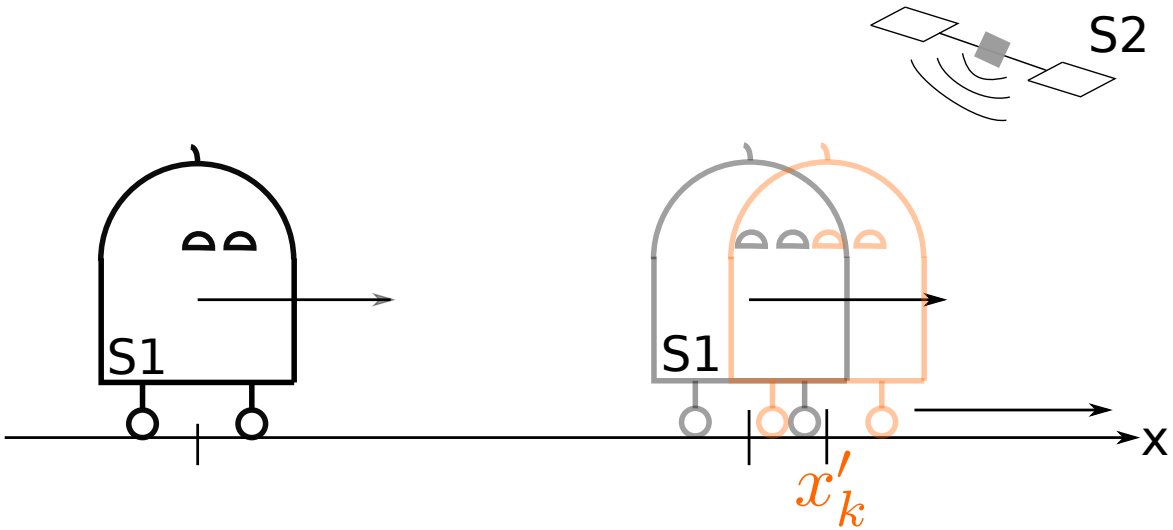

S2
S1
S1
v_{k+1}
x
x_{k+1}
H
v
x
S2
S1
expected state
$\vec{x}_e = H x_{k+1}$
$P_e = H P_{k+1} H^{-1}$

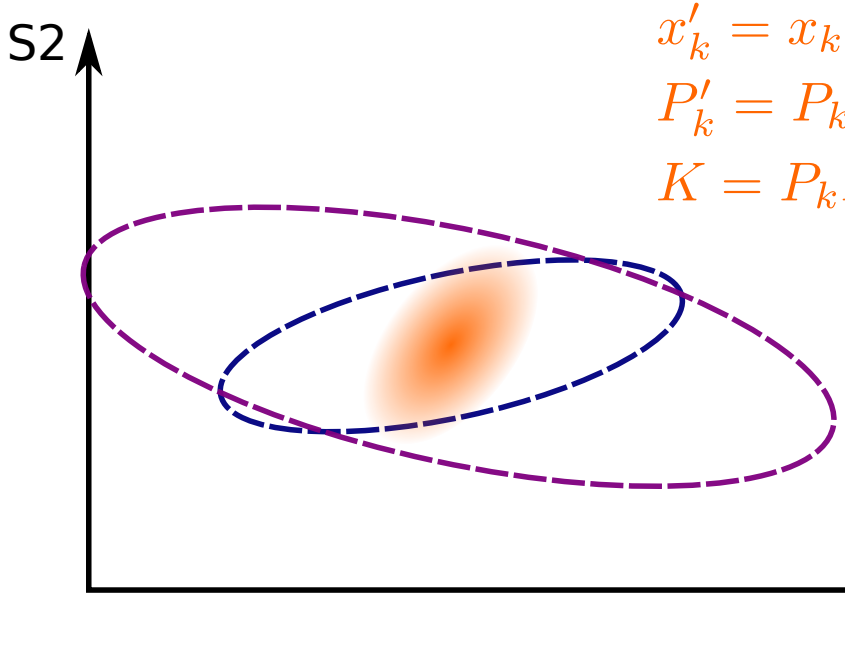

S2
S1
S1
v_{k+1}
x
x_{k+1}
H
v
x
S2
S1
expected state
$\vec{x}_e = H x_{k+1}$
$P_e = H P_{k+1} H^{-1}$
S2
S1
measurement
$\vec{z}_k$
R_k


S2
S1
S1
v_{k+1}
x
x_{k+1}
S2
S1


S2
S1
S1
v_{k+1}
x
x_{k+1}
S2
S1


S2
S1
S1
v_{k+1}
x
x_{k+1}
S2
S1
We got the new state
with more precision!





$$x'_k = x_k + K(z_k - Hx_k)$$
$$P'_k = P_k - KHP_k$$
$$K = P_k H^T (HP_k H^T + R_k)^{-1}$$

We got the new state with more precision!