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(* The  $\sigma_{\mu\nu}^k$  matrix of Molmer's paper: transition operator for atom k *)
 $\sigma_{\mu\nu}[\text{Num\_}, k_, \mu_, \nu_] := \text{Table}[$ 
  If[
    i[[k]] ==  $\mu$  (* initial state *)
    &&
    j[[k]] ==  $\nu$  (* final state *)
    &&
    Drop[i, {k}] == Drop[j, {k}] (* the other atoms does not change *)
    , 1, 0], {i, AvailableStates[Num]}, {j, AvailableStates[Num]}}];

(*Atom-field hamiltonian, without detuning*)
H[Num_] :=
  Sum[ $\Omega_1$  / 2 * ( $\sigma_{\mu\nu}[\text{Num}, i, "1", "2"] + \sigma_{\mu\nu}[\text{Num}, i, "2", "1"]$ ) +
     $\Omega_2$  / 2 * ( $\sigma_{\mu\nu}[\text{Num}, i, "2", "3"] + \sigma_{\mu\nu}[\text{Num}, i, "3", "2"]$ ) , {i, Num}];
```