

Setup
Model

Def-
i-
ni-
tion
To
cal-
cu-
late
mag-
netic
fric-
tional
forces
in
real
world,
we
use
square
lat-
tice
Ising
model
as

one
of
the
most
sim-
ple
ap-
prox-
i-
ma-
tion
of
mag-
netic
ma-
te-
ri-
als.
Hamil-
to-
nian
of
the
sys-
tem
is
given
by

$$\hat{H} := -J_{bulk} \sum_{(r,r') \in \text{b.c}} \hat{\sigma}_r \hat{\sigma}_{r'} - J_{b.c} \sum_{(r,r') \in \text{b.c}} \hat{\sigma}_r \hat{\sigma}_{r'} - J_{s.p} \sum_{(r,r'(t)) \in \text{s.p}} \hat{\sigma}_r \hat{\sigma}_{r'(t)}$$

where
 J_{bulk} ,
 $J_{b.c}$,
 $J_{s.p}$
de-
notes

the
in-
ten-
sity
of
spin
pair
in-
ter-
ac-
tions
on
b.c