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"""
Created by Ye Cheng (Lewis) Chen and Jesko Sirker
The disordered XXZ model
Calculation for Loschmidt echo using SPH and formula |det(1-C+C*exp(-iHt))|^2
"""
import numpy as np
import argparse
from bisect import bisect_left as findIndex

# parameters for entanglement calculations
parser = argparse.ArgumentParser(description=
'Calculation of Loschmidt echo for disordered fermions')
parser.add_argument('-L', type=int, default=4,
                    help='# system length L')
parser.add_argument('-V', type=float, default=1.0,
                    help='V interaction term')
parser.add_argument('-W', type=float, default=0.0,
                    help='width box potential disorder')
parser.add_argument('-tint', type=float, default=0,
                    help='# initial time')
parser.add_argument('-tmax', type=float, default=50,
                    help='# maximum time range')
parser.add_argument('-dt', type=float, default=0.005,
                    help='# discrete time interval')
parser.add_argument('-sample', type=int, default=1,
                    help='# samples')
parser.add_argument('-openbc', type=int, default=1,
                    help='OBC = 1, PBC = 0')
args=parser.parse_args()

# State function configurations in spinless fermions
def manyPsi(particle,site):
    a=np.arange(2**site)
    bitcount=np.array([bin(x).count("1") for x in a])
    b=a.compress(bitcount==particle).tolist()[::-1]
    aList=[]
    for item in b:
        a=bin(int(item))[2:].zfill(site)
        aList.append(a)
    return aList

# C+C fermionic operators on Neel configurations
def cpc(l,j,Psi):
    Psi2=Psi.copy()
    for item in Psi2:
        k = Psi2.index(item)
        if item[j-1]=='0':
            Psi2[k]=list(item)
            Psi2[k][j-1]='1'
            Psi2[k]="".join(Psi2[k])
        if item[j-1]=='1':
            Psi2[k]=list(item)
            Psi2[k][j-1]='0'
            Psi2[k]="".join(Psi2[k])
    for item in Psi2:
        k = Psi2.index(item)
        if item[l-1]=='0':
```