Abstract

This document will summarise what my results are now that I have altered the code in an attempt to fix symmetry issues.

1 Noninteracting cases

The noninteracting cases now appear to be identical for the GPE code and the many-body code.

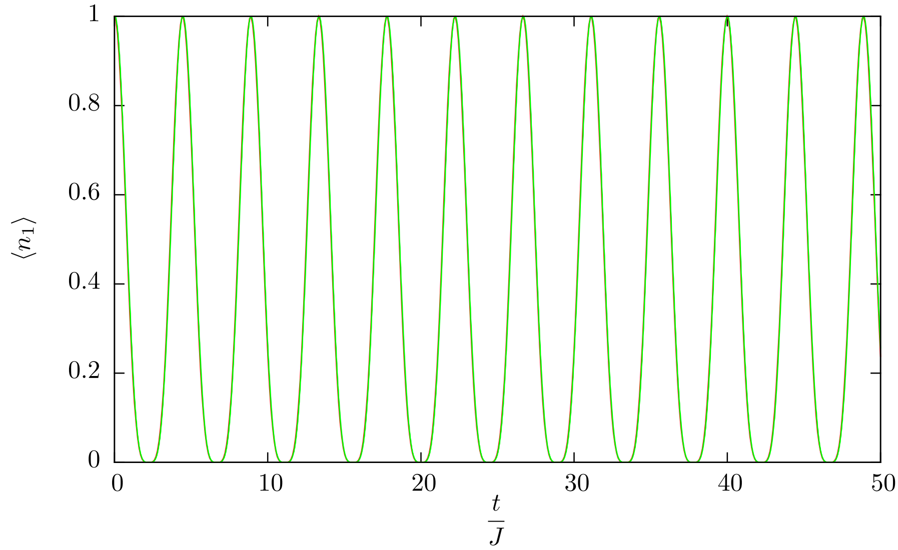

Figure 1: Similarity of output of many-body and GPE code for a 3×1 lattice with no interactions.

Note that the many-body graph no longer has “bumps” near its minima.

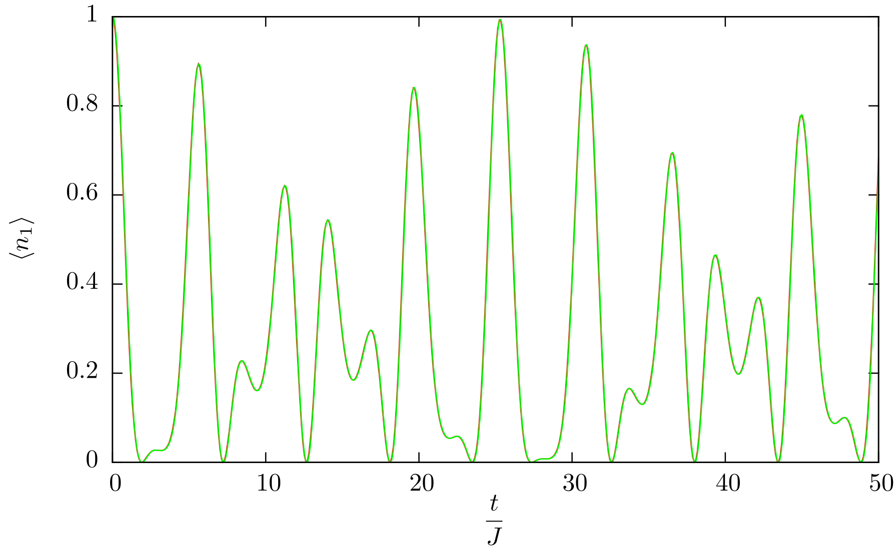

Figure 2: Similarity of output of many-body and GPE code for a 4×1 lattice with no interactions.

The similarity continues when we look at 2 dimensional noninteracting systems

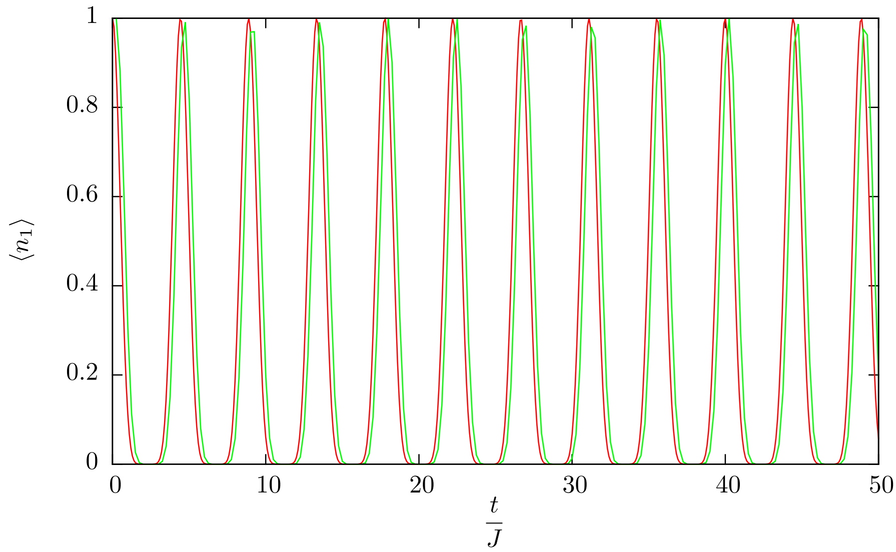

Figure 3: Similarity of output of many-body and GPE code for a 3×3 lattice with no interactions.

We also appear to have gotten rid of the problems with symmetry that we faced before (which were present even in the noninteracting case).

Lattice site positions			
Column number	Row 1	Row 2	Row 3
1	0.273	0.078	0.023
2	0.078	0.094	0.078
3	0.023	0.078	0.274

Table 1: Symmetry in long term averages for a 3×3 system with 1 particle and $U_0 = 0$ with many-body code.

The symmetry is also there in the GPE case.

2 Interacting cases

Initially, just looking at 3×3 lattices. More can be added as simulations finish.

For GPE, U=20 seems to agree with MB U=4 pretty well (they both keep the particles localised on the initial site).

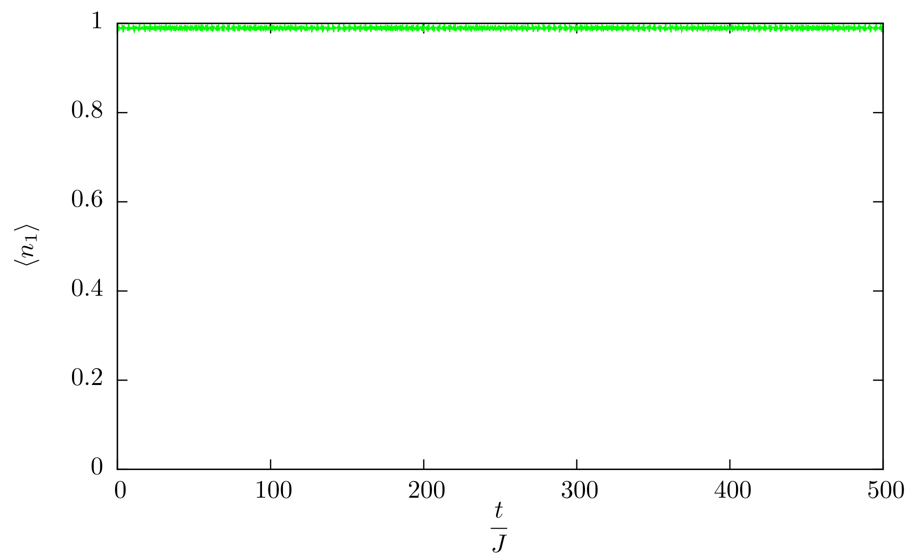

Figure 4: GPE simulation with U=20.

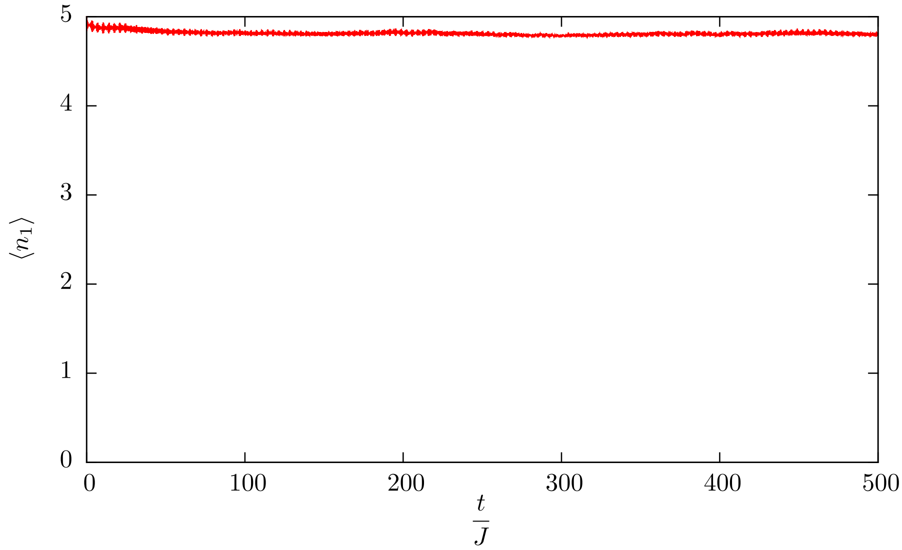

Figure 5: Many-body simulation with U=4.

GPE U=0.1 disagrees quite dramatically with MB U=0.02, with the many body version converging to a uniform spread but the GPE one staying very localised, as it was previously.

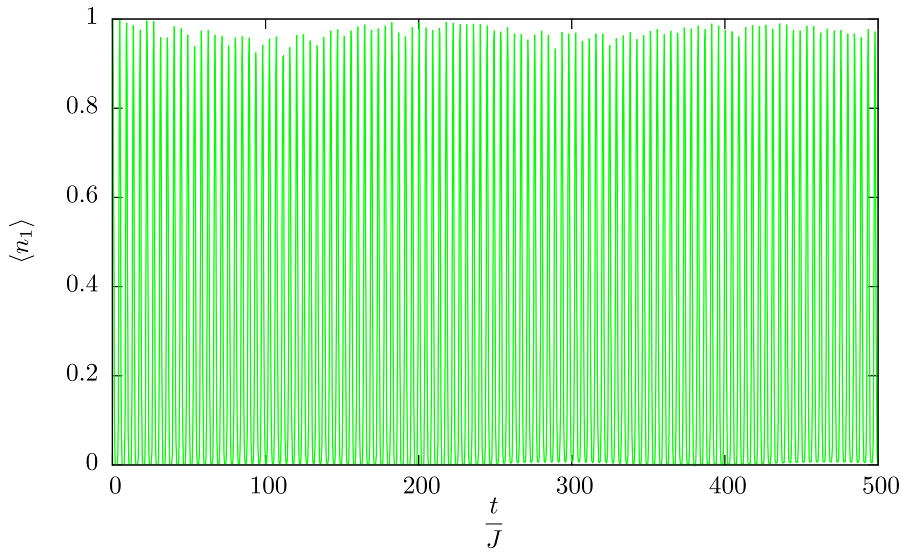

Figure 6: GPE simulation with U=0.1.

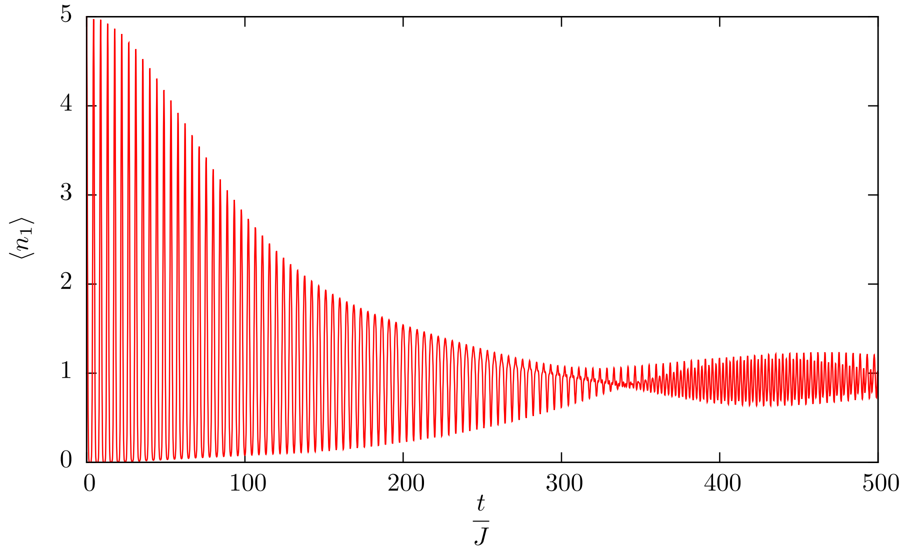

Figure 7: Many-body simulation with U=0.02.

Symmetry is also not a problem with these simulations (averages not shown here, but they're always perfectly or almost-perfectly symmetric).

3 Next steps

- See what the properties we find for systems larger than 3x3 (especially for the weakly interacting GPE).
- Investigate the transition values of U again with the new code.
- Once fixed Fourier Transform code is completed, look at comparing momentum distributions.