UNIVERSITY OF CAMBRIDGE

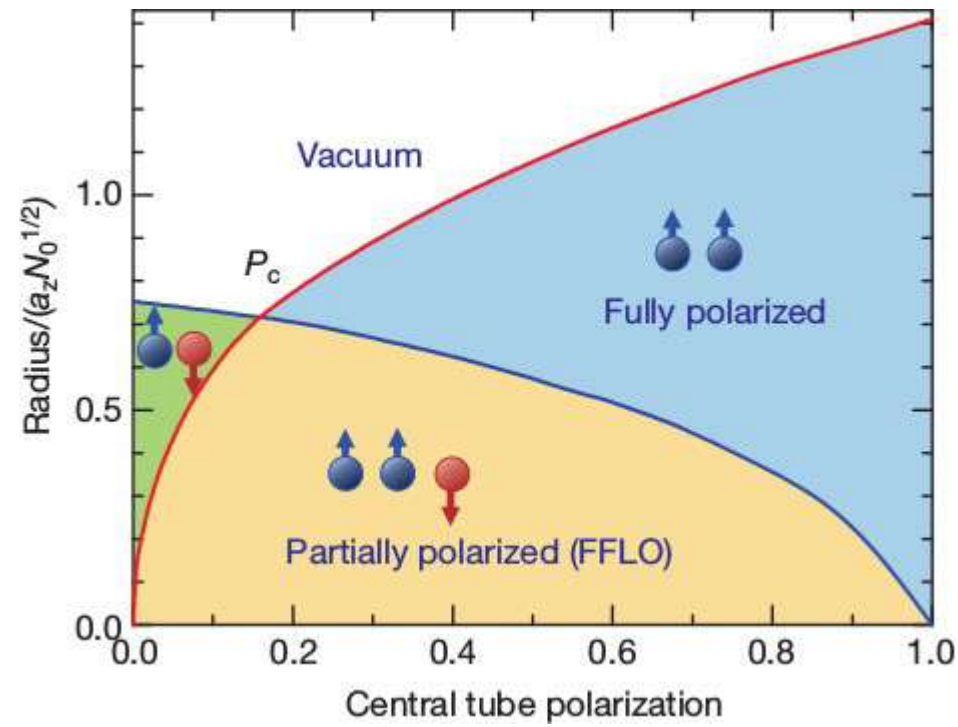# Three particle Cooper pair

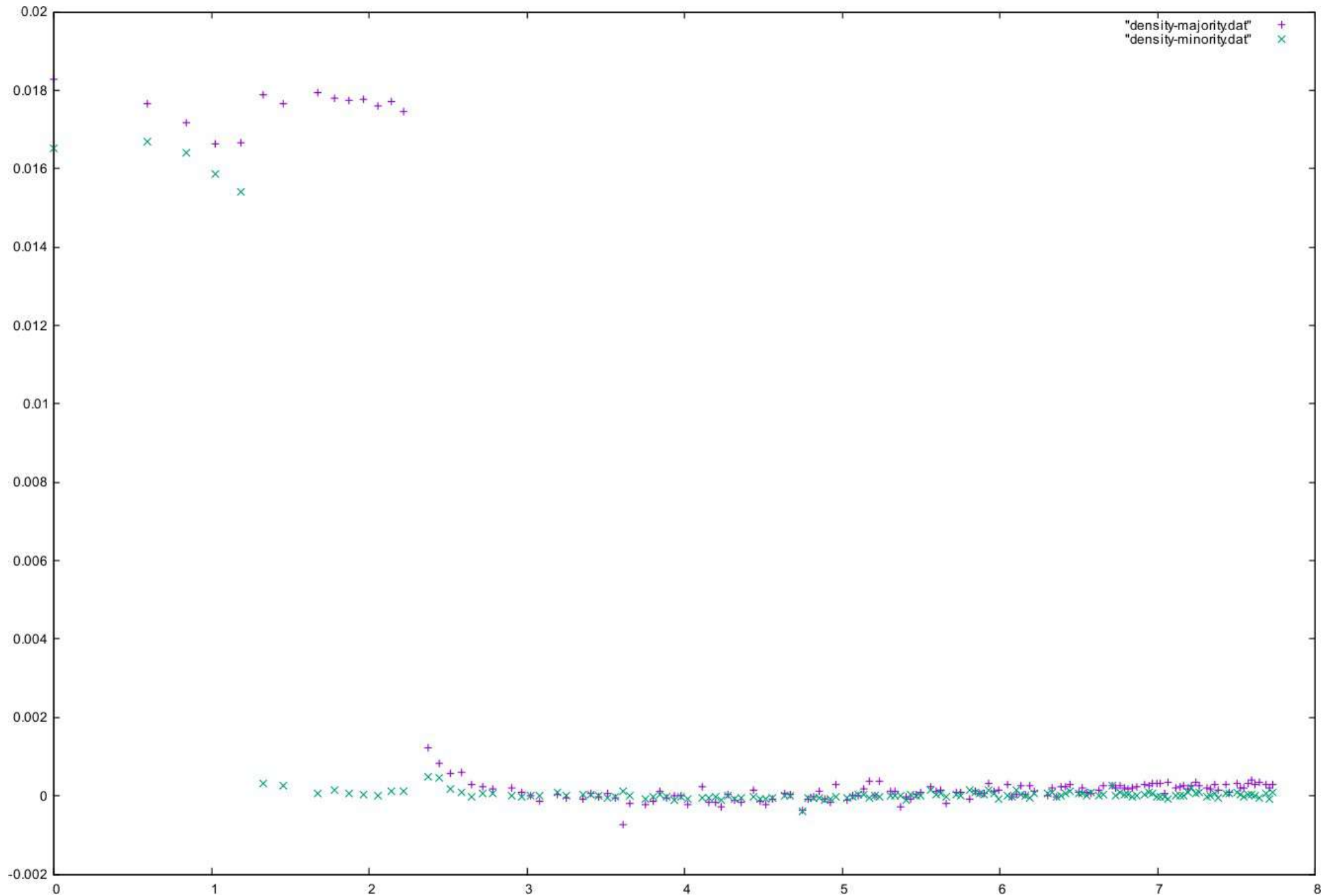Gareth Conduit
Pablo López Ríos
Lars Schonenberg

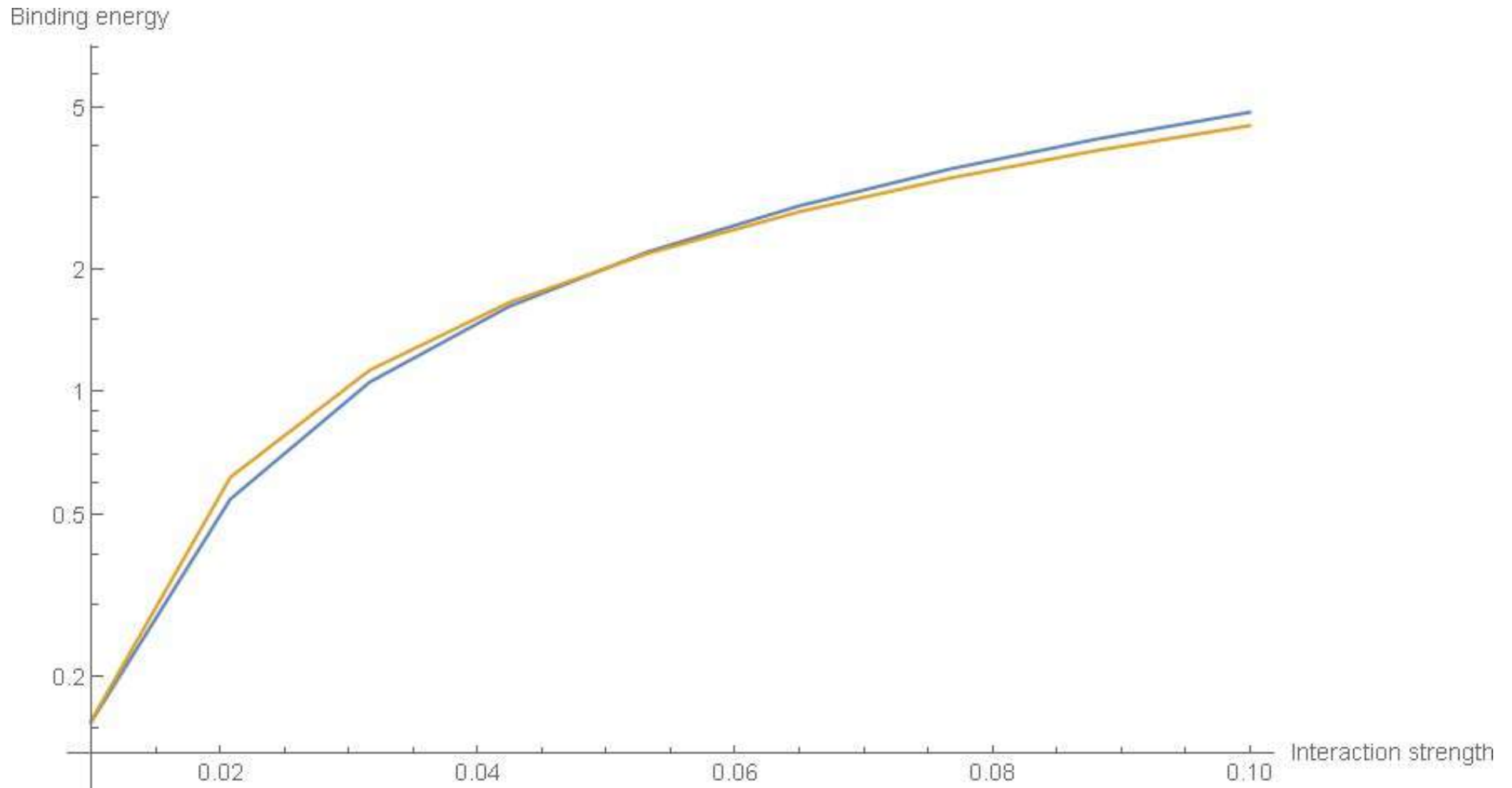TCM Group, Department of Physics

Breached pair state

```
0.188162    0.245639    1.    0.02
0.257229    0.244568    1.    0.04
0.286999    0.242802    1.    0.06
0.288334    0.240374    1.    0.08
0.273644    0.237321    1.    0.1
0.236609    0.233694    1.    0.12
0.172004    0.229548    1.    0.14
0.0779483   0.160078    1.02  0.16
0.131135    0.170288    1.02  0.02
0.205012    0.169773    1.02  0.04
0.235996    0.16892     1.02  0.06
0.24262     0.167741    1.02  0.08
0.226579    0.166249    1.02  0.1
0.193183    0.164461    1.02  0.12
0.133594    0.162397    1.02  0.14
0.0673702   0.123701    1.04  0.16
0.0887715   0.129711    1.04  0.02
0.130948    0.129411    1.04  0.04
0.169979    0.128916    1.04  0.06
0.179009    0.128228    1.04  0.08
0.167166    0.127354    1.04  0.1
0.131087    0.126302    1.04  0.12
0.102953    0.125081    1.04  0.14
0.0591038   0.100435    1.06  0.16
0.0682539   0.10436     1.06  0.02
0.0895421   0.104166    1.06  0.04
0.109027    0.103845    1.06  0.06
0.12638     0.103398    1.06  0.08
0.113257    0.102829    1.06  0.1
0.100729    0.102142    1.06  0.12
0.0804051   0.101342    1.06  0.14
0.0527754   0.0842806   1.08  0.16
0.0569342   0.0870278   1.08  0.02
0.0656794   0.0868929   1.08  0.04
0.0697555   0.086669    1.08  0.06
0.0686633   0.0863575   1.08  0.08
0.0801465   0.0859603   1.08  0.1
0.0757836   0.0854798   1.08  0.12
0.0671058   0.0849188   1.08  0.14
0.0482548   0.0724155   1.1   0.16
0.0463163   0.0744343   1.1   0.02
0.0480616   0.0743357   1.1   0.04
0.0391414   0.0741718   1.1   0.06
0.0400082   0.0739435   1.1   0.08
0.044544    0.0736521   1.1   0.1
0.0553683   0.0732991   1.1   0.12
0.0549547   0.0728862   1.1   0.14
0.0415789   0.0633355   1.12  0.16
0.0356762   0.0648744   1.12  0.02
0.027849    0.0647994   1.12  0.04
0.0257409   0.0646748   1.12  0.06
0.0228645   0.0645012   1.12  0.08
0.0243083   0.0642794   1.12  0.1
0.0310461   0.0640103   1.12  0.12
0.0422406   0.0636952   1.12  0.14
0.0328051   0.056166    1.14  0.16
0.020052    0.057373    1.14  0.02
0.0185554   0.0573143   1.14  0.04
0.0148977   0.0572168   1.14  0.06
0.0136299   0.0570809   1.14  0.08
0.0136241   0.0569071   1.14  0.1
0.0164185   0.0566961   1.14  0.12
0.0231284   0.0564488   1.14  0.14
0.0176339   0.050364    1.16  0.16
```

57-33 system momentum density

kx	ky	kz	n up	e up	n dn	e dn	type
0	0	0	1.030	0.009	1.012	0.007	up dn
1	0	0	1.036	0.006	1.000	0.005	up dn
-1	0	0	1.036	0.006	1.000	0.005	up dn
0	0	-1	1.030	0.006	1.005	0.005	up dn
0	0	1	1.030	0.006	1.005	0.005	up dn
0	1	0	1.025	0.006	0.997	0.005	up dn
0	-1	0	1.025	0.006	0.997	0.005	up dn
-1	0	-1	1.027	0.006	0.995	0.005	up dn
1	0	1	1.027	0.006	0.995	0.005	up dn
1	1	0	1.022	0.006	0.989	0.005	up dn
-1	-1	0	1.022	0.006	0.989	0.005	up dn
-1	1	0	1.026	0.006	0.993	0.005	up dn
1	-1	0	1.026	0.006	0.993	0.005	up dn
-1	0	1	1.024	0.006	0.995	0.005	up dn
1	0	-1	1.024	0.006	0.995	0.005	up dn
0	-1	-1	1.023	0.006	0.994	0.005	up dn
0	1	1	1.023	0.006	0.994	0.005	up dn
0	-1	1	1.020	0.006	0.987	0.005	up dn
0	1	-1	1.020	0.006	0.987	0.005	up dn
1	-1	-1	1.028	0.006	0.986	0.005	up dn
-1	1	1	1.028	0.006	0.986	0.005	up dn
1	1	-1	1.020	0.006	0.983	0.005	up dn
-1	-1	1	1.020	0.006	0.983	0.005	up dn
-1	-1	-1	1.029	0.006	0.985	0.005	up dn
1	1	1	1.029	0.006	0.985	0.005	up dn
-1	1	-1	1.020	0.006	0.985	0.005	up dn
1	-1	1	1.020	0.006	0.985	0.005	up dn
-2	0	0	1.020	0.006	0.981	0.005	up dn
2	0	0	1.020	0.006	0.981	0.005	up dn
0	2	0	1.010	0.006	0.977	0.005	up dn
0	-2	0	1.010	0.006	0.977	0.005	up dn
0	0	2	1.017	0.006	0.976	0.005	up dn
0	0	-2	1.017	0.006	0.976	0.005	up dn
-2	-1	0	1.021	0.006	0.022	0.005	up
2	1	0	1.021	0.006	0.022	0.005	up
2	-1	0	1.021	0.006	0.024	0.005	up
-2	1	0	1.021	0.006	0.024	0.005	up
2	0	-1	1.020	0.006	0.028	0.005	up
-2	0	1	1.020	0.006	0.028	0.005	up
2	0	1	1.022	0.006	0.025	0.005	up
-2	0	-1	1.022	0.006	0.025	0.005	up
1	0	-2	1.012	0.006	0.017	0.005	up
-1	0	2	1.012	0.006	0.017	0.005	up
1	2	0	1.014	0.006	0.018	0.005	up
-1	-2	0	1.014	0.006	0.018	0.005	up
1	0	2	1.013	0.006	0.018	0.005	up
-1	0	-2	1.013	0.006	0.018	0.005	up
1	-2	0	1.014	0.006	0.021	0.005	up
-1	2	0	1.014	0.006	0.021	0.005	up
0	-1	-2	1.018	0.006	0.019	0.005	up
0	1	2	1.018	0.006	0.019	0.005	up
0	2	1	1.019	0.006	0.025	0.005	up
0	-2	-1	1.019	0.006	0.025	0.005	up
0	1	-2	1.011	0.006	0.018	0.005	up
0	-1	2	1.011	0.006	0.018	0.005	up
0	2	-1	1.006	0.006	0.012	0.005	up
0	-2	1	1.006	0.006	0.012	0.005	up
2	-1	-1	0.023	0.006	0.023	0.005	none
-2	1	1	0.023	0.006	0.023	0.005	none
-2	-1	-1	0.025	0.006	0.018	0.005	none
2	1	1	0.025	0.006	0.018	0.005	none
-2	1	-1	0.024	0.006	0.017	0.005	none
2	-1	1	0.024	0.006	0.017	0.005	none
2	1	-1	0.018	0.006	0.017	0.005	none
-2	-1	1	0.018	0.006	0.017	0.005	none
1	-1	-2	0.019	0.006	0.018	0.005	none

57-33 system condensate fraction

kx	ky	kz	c/e	Type
0	0	0	0.0	BCS/breach
1	0	0	-1.6	FFLO
-1	0	0	-1.6	FFLO
0	0	-1	1.0	FFLO
0	0	1	1.0	FFLO
0	1	0	-1.0	FFLO
0	-1	0	-1.0	FFLO
-1	0	-1	-0.6	
1	0	1	-0.6	
1	1	0	2.2	
-1	-1	0	2.2	
-1	1	0	-0.1	
1	-1	0	-0.1	
-1	0	1	0.2	
1	0	-1	0.2	
0	-1	-1	1.9	
0	1	1	1.9	
0	-1	1	-0.7	
0	1	-1	-0.7	
1	-1	-1	-0.9	
-1	1	1	-0.9	
1	1	-1	-0.2	
-1	-1	1	-0.2	
-1	-1	-1	-0.2	
1	1	1	-0.2	
-1	1	-1	1.4	
1	-1	1	1.4	

kx	ky	kz	c/e	Type
-2	0	0	1.1	
2	0	0	1.1	
0	2	0	1.1	
0	-2	0	1.1	
0	0	2	-0.1	
0	0	-2	-0.1	
-2	-1	0	0.7	Triple
2	1	0	0.7	Triple
2	-1	0	0.2	Triple
-2	1	0	0.2	Triple
2	0	-1	-0.3	Triple
-2	0	1	-0.3	Triple
2	0	1	-2.3	Triple
-2	0	-1	-2.3	Triple
1	0	-2	-0.2	Triple
-1	0	2	-0.2	Triple
1	2	0	1.6	Triple
-1	-2	0	1.6	Triple
1	0	2	-0.2	Triple
-1	0	-2	-0.2	Triple
1	-2	0	0.0	Triple
-1	2	0	0.0	Triple
0	-1	-2	1.2	Triple
0	1	2	1.2	Triple
0	2	1	1.4	Triple
0	-2	-1	1.4	Triple
0	1	-2	-1.9	Triple
0	-1	2	-1.9	Triple
0	2	-1	2.7	Triple
0	-2	1	2.7	Triple

33-27 system momentum density

kx	ky	kz	n up	e up	n dn	e dn	type
0	0	0	1.015	0.002	1.007	0.002	up dn
0	1	0	0.997	0.001	0.989	0.001	up dn
0	-1	0	0.997	0.001	0.989	0.001	up dn
0	0	1	0.998	0.001	0.989	0.001	up dn
0	0	-1	0.998	0.001	0.989	0.001	up dn
1	0	0	0.997	0.001	0.986	0.001	up dn
-1	0	0	0.997	0.001	0.986	0.001	up dn
0	-1	-1	0.991	0.001	0.982	0.001	up dn
0	1	1	0.991	0.001	0.982	0.001	up dn
0	-1	1	0.993	0.001	0.982	0.001	up dn
0	1	-1	0.993	0.001	0.982	0.001	up dn
-1	0	-1	0.991	0.001	0.980	0.001	up dn
1	0	1	0.991	0.001	0.980	0.001	up dn
1	0	-1	0.992	0.001	0.981	0.001	up dn
-1	0	1	0.992	0.001	0.981	0.001	up dn
-1	1	0	0.991	0.001	0.979	0.001	up dn
1	-1	0	0.991	0.001	0.979	0.001	up dn
-1	-1	0	0.992	0.001	0.981	0.001	up dn
1	1	0	0.992	0.001	0.981	0.001	up dn
1	-1	-1	0.987	0.001	0.975	0.001	up dn
-1	1	1	0.987	0.001	0.975	0.001	up dn
1	1	-1	0.987	0.001	0.976	0.001	up dn
-1	-1	1	0.987	0.001	0.976	0.001	up dn
-1	-1	-1	0.987	0.001	0.976	0.001	up dn
1	1	1	0.987	0.001	0.976	0.001	up dn
-1	1	-1	0.986	0.001	0.976	0.001	up dn
1	-1	1	0.986	0.001	0.976	0.001	up dn
0	-2	0	1.002	0.001	0.015	0.001	up
0	2	0	1.002	0.001	0.015	0.001	up
0	0	-2	1.000	0.001	0.014	0.001	up
0	0	2	1.000	0.001	0.014	0.001	up
-2	0	0	0.998	0.001	0.013	0.001	up
2	0	0	0.998	0.001	0.013	0.001	up

33-27 system condensate fraction

kx	ky	kz	c/e	Type
0	0	0	8.1	BCS/breach
0	1	0	1.0	
0	-1	0	1.0	
0	0	1	-0.6	
0	0	-1	-0.6	
1	0	0	0.5	
-1	0	0	0.5	
0	-1	-1	-2.0	Triple
0	1	1	-2.0	Triple
0	-1	1	0.6	Triple
0	1	-1	0.6	Triple
-1	0	-1	-0.7	Triple
1	0	1	-0.7	Triple
1	0	-1	0.9	Triple
-1	0	1	0.9	Triple
-1	1	0	0.7	Triple
1	-1	0	0.7	Triple
-1	-1	0	1.7	Triple
1	1	0	1.7	Triple
1	-1	-1	1.0	FFLO, triple
-1	1	1	1.0	FFLO, triple
1	1	-1	0.7	FFLO, triple
-1	-1	1	0.7	FFLO, triple
-1	-1	-1	-0.7	FFLO, triple
1	1	1	-0.7	FFLO, triple
-1	1	-1	-1.0	FFLO, triple
1	-1	1	-1.0	FFLO, triple
0	-2	0	1.3	
0	2	0	1.3	
0	0	-2	-1.1	
0	0	2	-1.1	
-2	0	0	0.1	
2	0	0	0.1	

What expectation values will discriminate between different sorts of superfluid order?

Is the three-particle order an analogue of FFLO?

What are the experimental signatures?

What would be a good form for a many-body trial wavefunction?