

Contents

1	Motivation	1
2	Introduction	3
2.1	The formation of stars and protoplanetary discs	3
2.2	Observations and properties of protoplanetary discs	4
2.3	The evolution of protoplanetary discs	7
3	Smoothed Particle Hydrodynamics	13
3.1	A basic SPH formulation	14
3.2	Improvements to the basic formulation	18
3.3	A resolution requirement	22
4	The tree-code PEPC	25
4.1	Tree-codes in general	25
4.2	Parallel tree code - PEPC	28
4.3	The tree-walk in detail	35
5	PEPC with SPH	39
5.1	Smoothed Particle Hydrodynamics equations	39
5.2	Implementation details	40
5.3	The neighbour search	41
6	Testing the new code	55
6.1	1D sound wave	56
6.2	1D sound wave in 2D volume	57
6.3	1D shock-tubes	58
6.4	Sphere collapse	62
6.5	A protoplanetary disc	65
7	Conclusion	71
8	Prospect	73