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Unexpected Formation Modes of the First Hard Binary in Core Collapse

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(Submitted on 20 Jul 2011)

The conventional wisdom for the formation of the first hard binary in core collapse is that three-body interactions of single stars form many soft binaries, most of which are quickly destroyed, but eventually one of them survives. We report on direct N-body simulations to test these ideas, for the first time. We find that both assumptions are often incorrect: 1) quite a few three-body interactions produce a hard binary from scratch; 2) and in many cases there are more than three bodies directly and simultaneously involved in the production of the first binary. The main reason for the discrepancies is that the core of a star cluster, at the first deep collapse, contains typically only five or so stars. Therefore, the homogeneous background assumption, which still would be reasonable for, say, 25 stars, utterly breaks down. There have been some speculations in this direction, but we demonstrate this result here explicitly, for the first time.

Comments:	15 pages, 11 figures, 1 table, submitted to New Astronomy
Subjects:	**Galaxy Astrophysics (astro-ph.GA)**
Cite as:	**arXiv:1107.3866 [astro-ph.GA]**
	(or **arXiv:1107.3866v1 [astro-ph.GA]** for this version)

Submission history

From: Ataru Tanikawa [view email]

[v1] Wed, 20 Jul 2011 00:17:46 GMT (696kb)

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