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# 2 + 2 MOULTON CONFIGURATION

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**Abstract.** We pose a new problem of collinear central configurations in Newtonian $n$-body problem. It is known that the configuration of two bodies moving along the Newtonian force is always a collinear central configuration. Can we add new two bodies on the straight line of initial two bodies without changing the move of the initial two bodies and the configuration of the four bodies is central, too? We call it 2+2 Moulton configuration.

We find three special solutions to this problem and find each mass of new two bodies is zero.

*MSC*: 70F10
*Keywords*: Celestial mechanics, collinear central configuration, four-body problem, inverse problem

## 1. Introduction

Euler found solutions of three-body problem on a line, collinear three problem [2], $(n, d) = (3, 1)$, for the first time in history. In general solutions of n-body problem on a line, called a collinear n-body-problem, become *collinear central configuration*, that is, the ratios of the distances of the bodies from the center of mass are constants [5]. F. Moulton [5] proved that for a fixed mass vector $\mathbf{m} = (m_1, \dots, m_n)$ and a fixed ordering of the bodies along the line, there exists a unique collinear central configuration $\mathbf{q} = (q_1, \dots, q_n)$ with mass $\mathbf{m} = (m_1, \dots, m_n)$ (up to translation and scaling). The configuration is called a *Moulton Configuration*, which will be abbreviated as M.C.

Many papers about M.C. were published by many authors since then. For example, Albouy and Moeckel [1] consider the inverse problem: given a fixed collinear configuration $(q_1, \dots, q_n)$ of n bodies, the problems to find masses $m_1, m_2, \dots, m_n$ which make $(q_1, \dots, q_n)$ with $(m_1, \dots, m_n)$ central. They proved that for $n \leq 6$, each configuration $(q_1, \dots, q_n)$ determines a one-parameter family of masses $(m_1, \dots, m_n)$ which makes $(q_1, \dots, q_n)$ with $(m_1, \dots, m_n)$ central.

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