

# Charge Symmetry Breaking in $dd \rightarrow {}^4\text{He}\pi^0$ with WASA-at-COSY

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## Collaboration

WASA-at-COSY

## Abstract content

Symmetries and symmetry breaking patterns in the non-perturbative regime of QCD is a key issue of the physics program of WASA-at-COSY. One objective is the determination of possible  $p$ -wave contributions to the charge symmetry breaking amplitude in the reaction  $dd \rightarrow {}^4\text{He}\pi^0$  at 1.2 GeV/c beam momentum (corresponding to an excess energy of  $Q = 60$  MeV). Charge symmetry is a subgroup of isospin symmetry being broken by the different masses of the up and down quarks as well as electromagnetic interaction [1]. In order to get access to quark mass effects on hadron level it is favorable to look at charge symmetry breaking (CSB) observables as the relative pion mass difference, which is of electromagnetic origin, does not contribute. The reaction  $dd \rightarrow {}^4\text{He}\pi^0$  is forbidden by charge symmetry and, thus, the cross section is directly proportional to the square of the CSB amplitude. While the reaction has been measured close to threshold at IUCF [2] resulting in a cross section compatible with  $s$ -wave, data at higher excess energies sensitive to higher partial waves are missing. Such data are, however, crucial for ChPT calculations currently under way. These calculations are a major theoretical effort and recent developments in this direction are reported in Ref. [3,4]. This presentation will discuss the results of the initial measurements completed in 2007 and 2008 as well as the status of the recent high statistics run in spring 2014.

[1] G.A. Miller et al., Phys. Rept. 194 (1990) 1. [2] E.J. Stephenson et al., Phys. Rev. Lett. 91, 142302 (2003). [3] A. Gårdestig et al. Phys. Rev. C 69, 044606 (2004). [4] A.C. Fonseca, R. Machleidt and G.A. Miller, Phys. Rev. C 80, 027001 (2009).

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