

# Luminosity Determination for the Quasi-Free Nuclear Reaction in the WASA-at-COSY Experiment

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## Collaboration

WASA-at-COSY

## Abstract content

The scientific aim of our research is experimental confirmation of the existence of mesic-nucleus: a new exotic kind of nuclear matter consisting of nucleons and mesons. Already in 1986, Haider and Liu [1] postulated the hypothesis of a  $\eta$ -mesic nucleus. Since then, many tries have been undertaken to experimentally confirm its existence but without any conclusive result. The discovery of this new kind of an exotic nuclear matter would be very important as it might allow for a better understanding of the  $\eta$  meson structure and its interaction with nucleons [2,3].

Three experiments dedicated to the search of  $\eta$ -mesic helium has been performed by the WASA-at-COSY Collaboration at the Forschungszentrum Jülich (Germany). The measurements were carried out with high statistics and high acceptance with the WASA detection setup in deuteron-deuteron ( $^4\text{He}-\eta$ ) [4,5] and proton-deuteron ( $^3\text{He}-\eta$ ) [6] fusion reactions.

The measurements were performed using the ramped beam technique. During an acceleration cycle the luminosity could vary. In order to determine the luminosity dependence on the beam momentum we used the quasi-elastic proton-proton scattering, for which the cross sections were already experimentally established. In the proton-deuteron collisions, the protons from the beam scatter on the protons in the deuteron target. The neutrons from the deuterons play the role of spectators. The cross-sections for the elastic proton-proton scattering are taken from the SAID partial-wave analysis [7].

The poster will include a description of the simulation of the quasi-free  $pp \rightarrow pp$  reaction, the calculation of the integrated luminosity and the determination of the luminosity dependence of the excess energy.

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[3] S. D. Bass, A. W. Thomas, Acta Phys. Pol., 2010, B 41, 2239-2247.

[4] P. Adlarson, et al., Nucl. Phys. A 959, 102 (2017).

[5] P. Adlarson et al., Phys. Rev. C 87, 035204 (2013).

[6] M. Skurzok, W. Krzemien, O. Rundel and P. Moskal, Acta Phys. Polon., 2016, B 47, 503-508.

[7] <http://gwdac.phys.gwu.edu/>

**Primary author(s) :** KHREPTAK, Aleksander (Jagiellonian University)

**Co-author(s) :** SKURZOK, Magdalena (Jagiellonian University); RUNDEL, Oleksandr (IF Jagiellonian University); MOSKAL, Paweł (Jagiellonian University)

**Presenter(s) :** KHREPTAK, Aleksander (Jagiellonian University)

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