

## Exploring Neutron stars EoS with coherent $\pi^0 \pi^0$ photoproduction at A2@MAMI

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Recent measurement of coherent  $\pi^0$  photoproduction on Pb lead to a most accurate determination of the neutron skin, constraining nuclear matter Equation of State (EoS) at around  $\rho \sim 1\rho_0$ . A natural next step is elucidating the nuclear EoS at higher densities to tune our understanding of the most violent process in the Universe - neutron star mergers. It was demonstrated that at densities above  $\sim 3\rho_0$ , dibaryonic degrees of freedom come into play [1]. The work presented in this talk aims to improve our knowledge of dibaryon behavior in dense nuclear matter by measuring coherent  $\pi^0 \pi^0$  photoproduction of Ca-40/48 nuclei. The experiment was performed at the A2@MAMI facility in Mainz (Germany). The goal of the analysis is to identify the first genuine hexaquark, the  $d^*(2380)$ , through photoproduction on nuclei. We are expecting to determine the medium modifications of the  $d^*(2380)$  in nuclear matter and constrain its couplings [2]. These new results will further improve our understanding of the neutron stars equation of state and allow precise determination of the maximum neutron star mass, as well as provide key ingredients for the calculation of the neutron star merger dynamics. Also, the interplay between the hexaquark, quark-gluon, and hyperon degrees of freedom in the EoS of dense nuclear matter will be discussed. The effective coupling constants obtained in this experiment can further constrain the possibility of hexaquark condensate dark matter [3].

[1] I. Vidana, M. Bashkanov, D.P. Watts, A. Pastore, Phys. Lett. B 781, 112-116 (2018)

[2] A. Mantziris, A. Pastore, I. Vidana, D.P. Watts, M. Bashkanov, A.M. Romero, Astronomy & Astrophysics A40, ISSN 0004-6361 (2020)

[3] M. Bashkanov, D.P. Watts 2020, J. Phys. G: Nucl. Part. Phys. 47 03LT01 (2020)

### Parallel Session

Hadron Spectroscopy

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