MAMBO

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1 Introduction

MAMBO groups together two complementary INFN activities in Germany, both aimed at studying the excited spectrum of the nucleon: the experimental program A2 with the MAMI-C microtron in Mainz and the BGOOD experiment at Bonn-ELSA. LNF are involved in the latter activitiy.

2 BGOOD experiment

The BGOOD esperiment is performed in collaboration between INFN sections of Roma2, LNF, Pavia, ISS-Roma1 and Torino, the University of Messina, the University of Bonn, Physikalisches Institut, ELSA department, the University of Bonn, Helmholtz Institut für Strahlen- und Kernphysik, the University of Edinburgh, the National Science Center Kharkov Institute of Physics and Technology, the University of Moscow, the Petersburg Nuclear Physics Institute (PNPI), Gatchina, the Lamar University and the University of Basel. More that 70 physicists participate to this experimental program foreseen to last until 2020 with possible extention.

The INFN instrumental contribution consist in the *Rugby Ball* calorimeter and associated detectors previously used at GrAAL, the target system, the cylindrical tracking chambers and the MRPC detector. In the collaboration managment, LNF expresses the co-spokesperson and one of the experiments to be performed as advised by the joint MAMI-ELSA PAC is leaded by LNF as well (η' photoproduction near threshold).

3 Activity in 2020

The pandemic from SARS-COV-2 has stopped all the experimental activities at ELSA apart from the activities that could be performed by local personnel. The klystron that failed at the end of 2018 was subsituted and there is now the possibility of having again beam in the experimental hall. Due to travel restrictions there was no production period during 2020 and the collaboration focused on data analysis.

Results were obtained for $K^+\Lambda$ and $K^+\Sigma^0$ with forward going kaon. These results are now stable and ready for publication. In Fig. 1 the results for $K^+\Lambda$ are shown. BGOOD (black dots) is the now the more precise experiment for this reaction, with the best angular resolution (Fig. 2)

Also the reaction $\gamma + p \rightarrow K^+\Sigma^0$ was investigated in the same angular region of small momentum transfer t. The results are shown in Fig. 3 where a cusp-like structure appears the more pronounced at the smallest angles indicating a clear change in the dynamics of the reaction, maybe linked to the threshold of $K^+\Lambda(1405)$ channel at center-of-mass energy W=1900 MeV.

Tha calibration procedure of the BGO calorimeter by using ^{22}Na sources was completely revisited and implemented. The signal to background ratio in the invariant mass spectrum for two photons in the final state was improved.

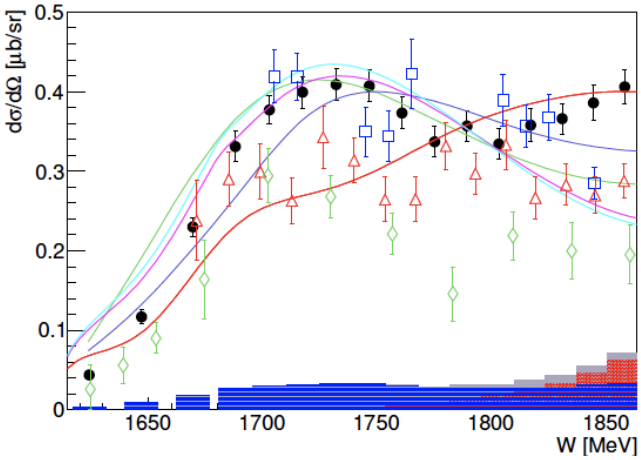

Figure 1: *Cross section for* $\gamma + p \rightarrow K^+\Lambda$ *for forward going kaons. Black dots: BGOOD data compared to existing measurements and with Bonn-Gatchina partial waves analysis.*

Finally a technical paper describing the the experiment (beam and apparatus) was published in EPJA on the cover (Fig. 4)

4 Planned activity in 2021

ELSA is expected to resume the beam delivery to the experiments by summer 2021. No particular hardware or upgrade interventions are foreseen for the rest of the year. The collaboration is waiting to resume normal production periods to collect data on D2 target (Kaon and η photoproduction off the neutron) and on H2 target to complete the necessary statistics for η' photoproduction at threshold. Data analysis will continue on the π^0 and η photoproduction channels both off the proton and off the neutron bound on deuteron. As a side product of these analyses, the detection efficiency in BGO for neutrons is being studied and PID techniques are implemented.

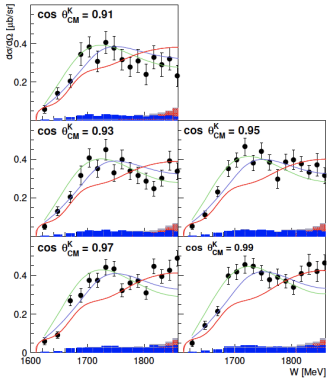

Figure 2: *Differential cross section for $\gamma + p \rightarrow K^+\Lambda$ for forward going kaons. BGOOD data compared to different PWA models.*

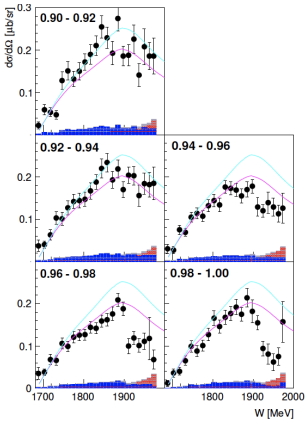

Figure 3: *Differential cross section for $\gamma + p \rightarrow K^+\Sigma^0$ for forward going kaons. Data at very forward angles show a change in the dynamics of the process around W=1900 MeV.*

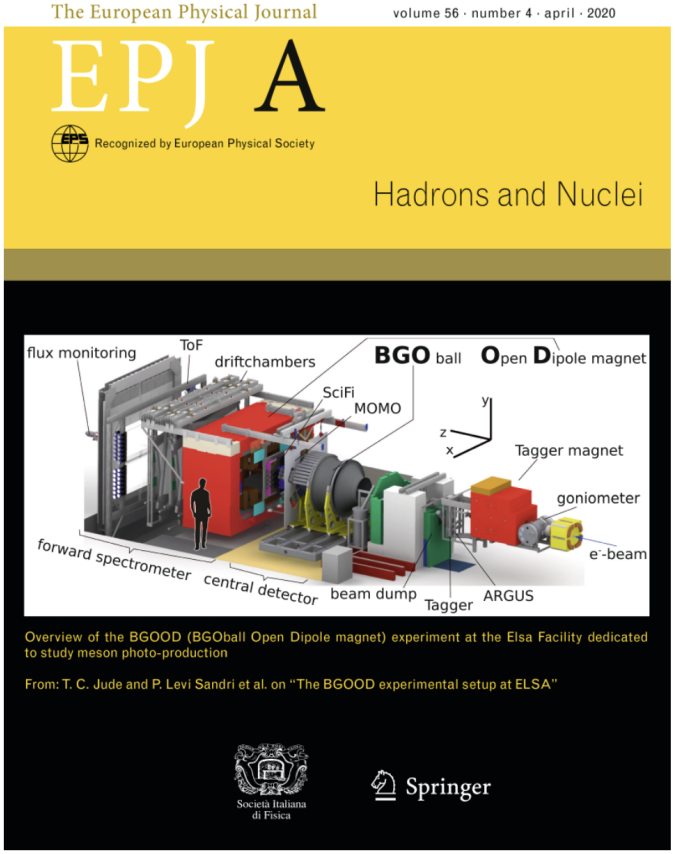

Figure 4: *2020 April issue of EPJA with BGOOD on the cover*