Search for Bremsstrahlung radiation in the quasi-free p n → p n γ reaction

J. Przerwa[a] & P. Moskal[a,b] for the COSY-11 collaboration

[a] Institute of Physics, Jagellonian University

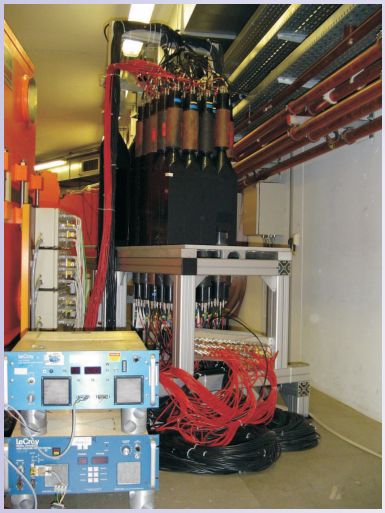
[b] Nuclear Physics Institute, Research Centre, Jülich

German Physical Society meeting, Cologne 2004

The installation of a neutron detector at the COSY-11 facility opens wide possibilities not only to investigate the isospin dependence of the meson production but also enables to measure the Bremsstrahlung radiation created in the collision of nucleons. The NN → NNγ reaction channel is sensitive to the NN potential and helps to investigate details of the NN interaction.

Gamma quanta produced in NN collisions are an excellent tool for the calibration of the neutron detector since their velocity is constant and the time-of-flight between the target and the hitted module depends on the path lenght of the γ's only.

DETECTOR FOR NEUTRAL PARTICLES



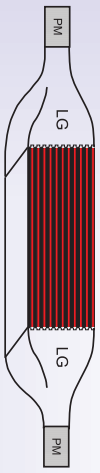
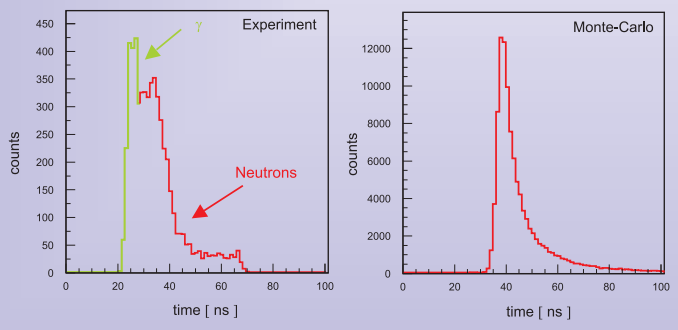


Photo of the detector for neutral particles consisting of 24 modules. The scheme of a scintillator/lead sandwich module is sketched in the right figure.

TIME-OF-FLIGHT DISTRIBUTION

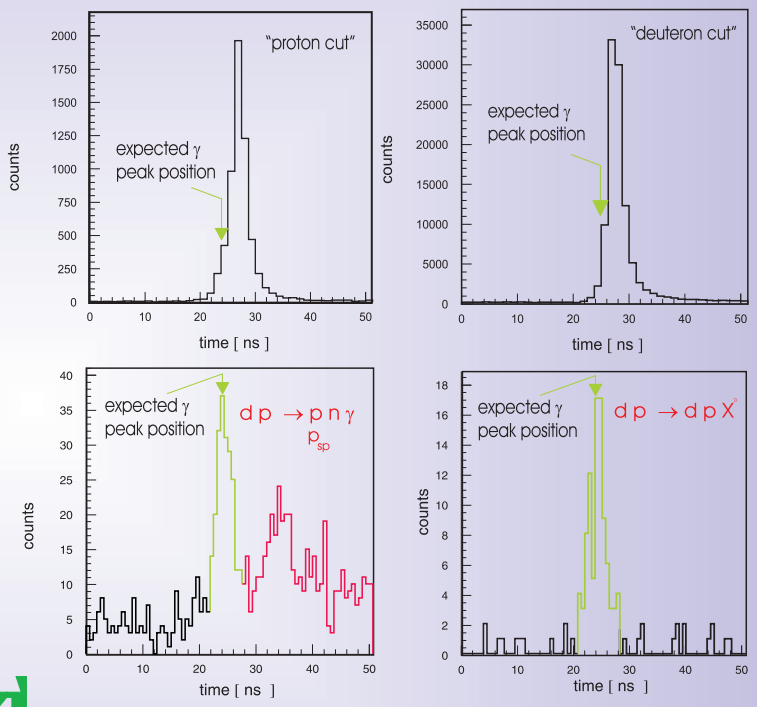
p d INDUCED REACTION



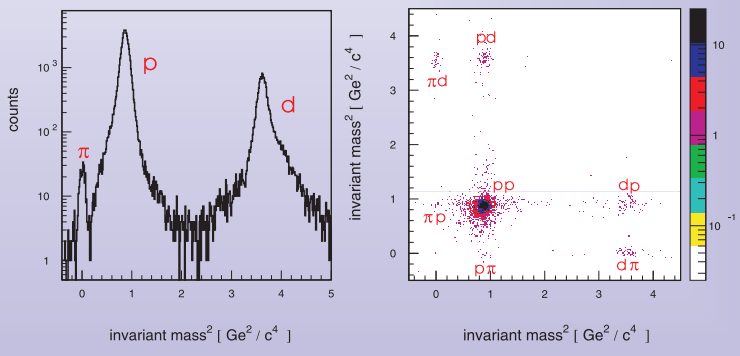
The time-of-flight spectrum - for neutral particles - measured between the target and the neutron detector. The data are from an experiment performed with a deuteron target and a proton beam with a momentum of 2.075 GeV/c (left figure). In addition to a broad distribution from neutrons (red) a sharp peak from γ rays is seen (green) at a value of about 25 ns. A Monte-Carlo simulation performed for the pn → pnη reaction, which is one of the possible processes contributing to the neutron time-of-flight distribution is shown in the right figure.

d p INDUCED REACTION

The figure below presents experimental distributions of the time-of-flight between target and neutral-particle-detector. The spectra were obtained with a proton target and deuteron beam acclerated to the momentum of 3.204 GeV/c. The upper panel shows the time-of-flight on the condition that in coincidence with neutral particle also a proton (letf) or deuteron (right) was indentified based on signals from drift chambers and scintillator hodoscopes. The γ quanta do not appear above an overwhelming quasi-free elastic (dp → ppn_spectator) and dp → dnπ reactions. However, when requiring the identification of two charged particles: two protons or proton and deuteron, a clear signal originating from free- (dp → dpγ) and quasi-free Bremsstrahlung (dp → pnγp_spectator) reactions is evidently seen (lower panel).



INVARIANT MASS DISTRIBUTION



The charged ejectiles are very well identified by the COSY-11 detection system as is shown in the invariant mass distribution.

BIBLIOGRAPHY

1. J. Greiff et al., Phys. Rev. C65 034009 (2002).
2. R. Bilger et al., Phys. Lett. B429 195-200 (1998.)
3. P. Moskal et al., e-Print Archive: nucl-ex/0311003 (2003).
4. R. Czyżykiewicz, Berichte des FZ-Jülich, JÜl-4017 (2002).
5. P. Moskal, e-Print Archive: nucl-ex/0110001 (2001)