PROCEEDINGS OF SCIENCE

Overview about recent results from the A2 real photon facility at MAMI

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For the A2-Collaboration

The A2 Collaboration at the Mainz Microtron MAMI measures photon absorption cross sections using circularly and linearly polarized 'Bremsstrahlung' photons up to an energy of ~1.5GeV and a polarized Frozen Spin Target. We use a 4 π detection system with the 'Crystal Ball' as central part.
One important experimental topic is the investigation of the nucleons excitation spectrum. Measurements with both longitudinally and transversely polarized protons and deuterons are essential to disentangle the broad and overlapping resonances.

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1. Experimental Apparatus

1.1 The A2 Photon Beam

The MAMI accelerator with its source of polarised electrons, based on the photoeffect on a strained GaAs crystal, routinely delivers polarised beam with a maximum energy of 1604 MeV and a degree of polarisation of approximately 85%. The last accelerator stage, MAMI C, is realized as a Harmonic Double Sided Microtron (HDSM). . Main features of this new machine concept are the four 90° bending magnets and the two LINACs working on 2.45GHz and the first harmonic. Details of the machine can be found in reference [1].

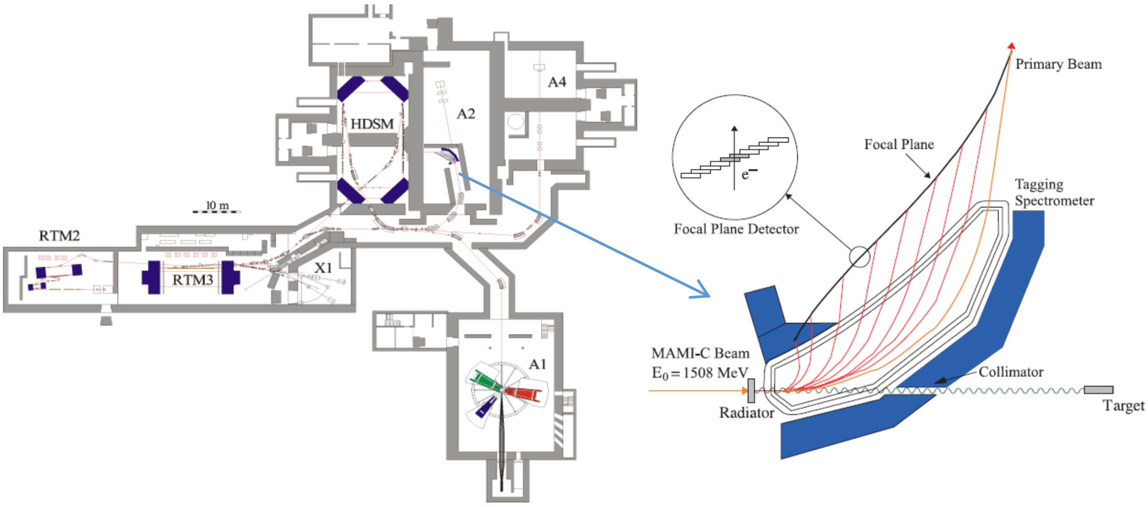

Figure 1. Floor plan (left side) of the MAMI accelerator with zoom in the Glasgow-Mainz tagging system (right side).

The A2-Glasgow-Mainz tagging facility [2] stands out due to its high photon intensity. The beam is derived from the production of Bremsstrahlung photons during the passage of the MAMI electron beam through a thin radiator. The resulting photons can be circularly polarised, with the application of a polarised electron beam, or linearly polarised, in the case of a crystalline radiator. The tagger focal plane is segmented into 352 scintillation detectors. Each counter can operate reliably to a rate of 1 MHz, giving a high photon flux photons. The photons can be tagged in the momentum range from 4.7 to 93.0% of E_0. At the moment we are upgrading the detector system to allow for an even higher photon flux.

1.2 The Crystal Ball detector setup

The central detector system consists of the Crystal Ball calorimeter combined with a barrel of scintillation counters for particle identification and two coaxial multiwire proportional counters for charged particle tracking. This central system provides position, energy and timing information for both charged and neutral particles in the region between 21^o and 159^o in the polar angle and over almost the full azimuthal range. At forward angles, less than 21^o, reaction products are detected in the TAPS forward wall. The full, almost hermetic, detector system is shown schematically in figure 2.
The full angular coverage of this detector system sets very rigorous condition for the construction of the polarized target.

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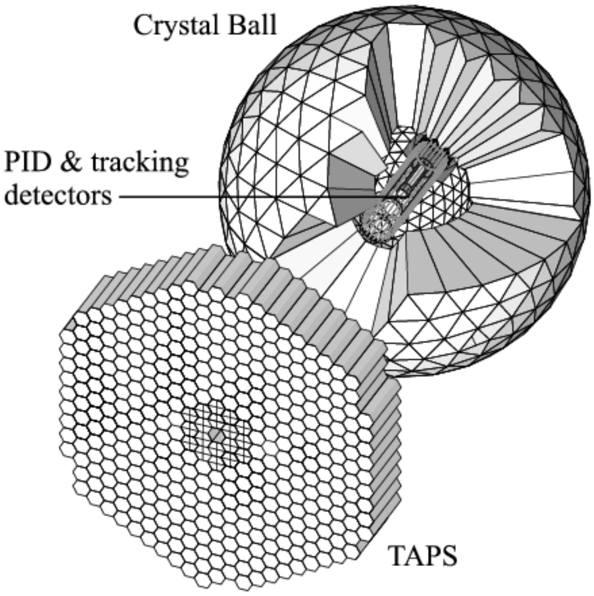

Figure 2. The Crystal Ball calorimeter, with cut-away section showing the inner detectors, and the TAPS forward wall.

1.3 The Polarized Target

The new frozen spin target was designed to retain the high angular acceptance of the detector system. The main boundary condition for the outer diameter of the frozen spin target cryostat was the most inner particle identification detector with a diameter of 104 mm. The internal holding coils had to be as thin as possible to allow particles to punch through.

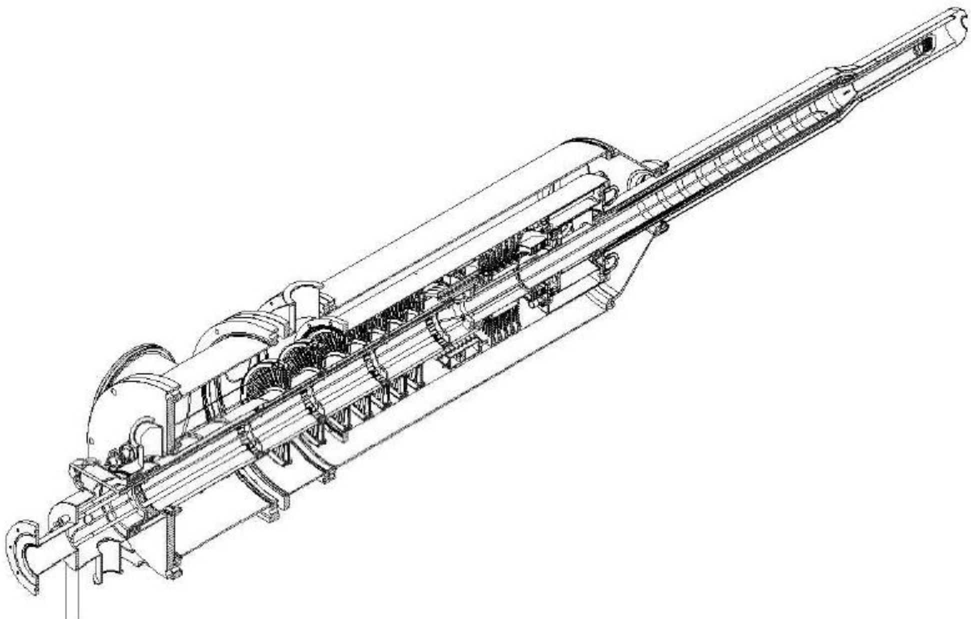

Figure 3. 3D- construction of the dilution refrigerator.

The core of the frozen spin target for the Crystal Ball detector is a specially designed, large horizontal $^3He/^4He$ dilution refrigerator (see figure 3) that was built in cooperation with the Joint Institute for Nuclear Research (JINR) Dubna.

2. Recent Results

Several papers have been published in the last years about our results concerning Baryon spectroscopy and meson photoproduction, in addition we have started an extended program to investigate unpolarized and polarized Compton scattering, see references [3-12].

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