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Development of vacuum chambers for J-PET experiments

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Vacuum chambers are necessary for the physics experiments, planned to be carried out with the use the J-PET detector. Several chambers, with particular purposes listed below, were manufactured and tested at various stages of development of the detector.

The chambers used for particular runs of J-PET experiments had generally cylindrical shapes, while the radioactive source was placed in the center of each chamber. Such orientation ensures the axially symmetrical response of J-PET scintillators and allows to carry out correct calibration. Variation of the material used for manufacturing of the chambers (aluminum/ plastic), allows to observe the detector response with various absorption and scattering of gamma quanta. Such determination is necessary for proper analysis of multi-gamma annihilation, which will be needed for planned experiments.

Additionally, individual chambers vary in sizes and the spatial orientation of the porous material, used as a target in which positrons/ positronium atoms annihilate. In two chambers the investigated sample, was placed in the immediate vicinity of the source, while in the biggest one, the target material was evenly distributed on the internal surface of the chamber wall. Such orientation allowed to investigate the exact position of annihilation event. The replacement of porous material with metal one allowed to observe the difference of the detector efficiency for 2 gamma and 3 gamma detection.

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