Development of a target system at the baby cyclotron BC1710 for irradiation of solids and gases and the adaptation of existing target systems to the external beamline at the injector of COSY

B. Scholten, S. Spellerberg, W. Bolten, H. H. Coenen

Institute of Neurosciences and Medicine, INM-5: Nuclear Chemistry,
Forschungszentrum Jülich GmbH, 52425 Jülich, Germany

In former years most of our radionuclide development studies were done at the compact cyclotron CV 28 of the Forschungszentrum Jülich. Several dedicated target systems were constructed to irradiate solid and gaseous targets, either for cross section measurements or for production of radionuclides [1-16].

Due to the decommissioning of the compact cyclotron CV 28 in 2006 new target systems had to be developed at our baby cyclotron BC1710. This cyclotron is used to produce the light PET isotopes (^{18}F, ^{11}C, ^{13}N) in special gas chambers and in water targets. These specialized target systems are arranged in a target changing system with six positions. There was no target system at our BC1710 for the irradiation of solid targets and gas cells. So a beam line extension at the lowest position of the target changing system was constructed with a water cooled beam collimator and electrical insulation of the targets for beam current measurement. The front plate allows inserting different target holders close to the main end of the beam line. Target holders were constructed for the irradiation of foils and pellets in the stacked foil technique, which also allows irradiating powders in aluminum capsules. Furthermore, it is also possible to insert a slanting target for the production of radionuclides (i.e. ^{124}I, $^{120g+m}$I, ^{48}V) at higher currents. All target systems are water cooled. A special front plate was constructed for the external irradiation of gas cells. During the development of the target system several optimizations had to be done to collimate the beam and to increase the beam efficiency on the target.

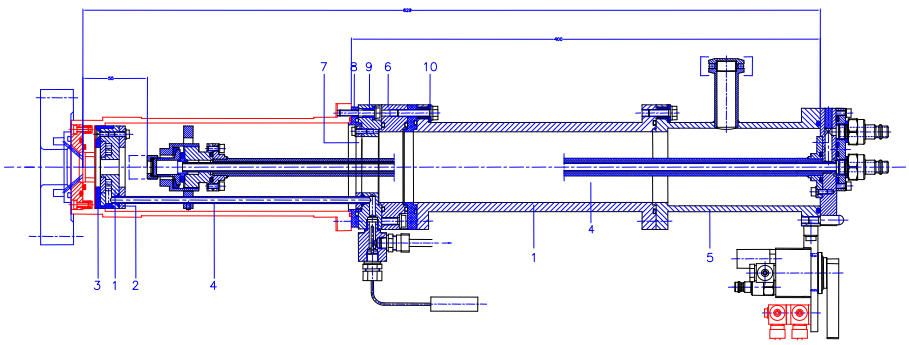

Fig. 1: Drawing of the beamtube extension at the BC 1710 with inserted stack foil holder.

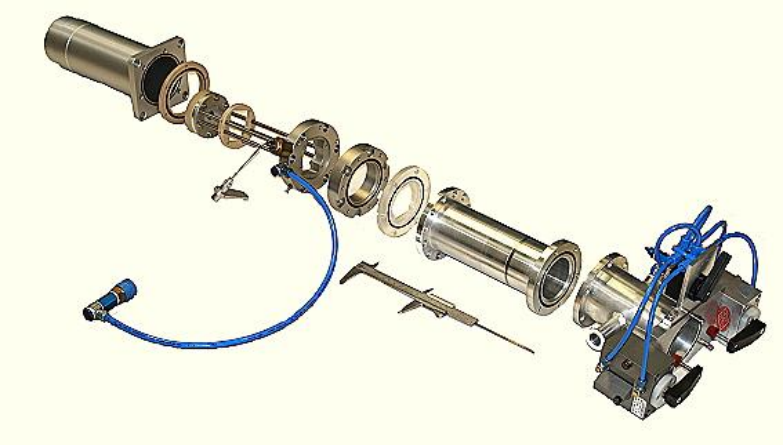

Fig. 2: Picture of the component parts of the BC1710 beamline extension before assembling.

At the injector of COSY an internal target system exists for the irradiation of targets in the stacked-foil mode using the just extracted beam of the cyclotron [17]. At this position there is a geometrical limitation for the target system and special care has to be taken that no contamination of the internal part of the cyclotron can happen. Intense water cooling of the targets is not possible there. Therefore an adaptation system at the end of an external beamline of the injector of COSY was developed which allows using all former target holder systems and dedicated targets developed earlier for the CV 28. In the adapter four adjustable water cooled sector absorbers are built in to collimate the beam. The beam windows are cooled by a helium gas stream. Manual remote control of the system is possible from outside the cyclotron vault and a PC based remote system is projected.

References:

[1] H. Michael et al., Int. J. Appl. Radiat. Isot., 32 (1981) 581 [2] G. Blessing et al., Int. J. Appl. Radiat. Isot., 33 (1982) 333 [3] K. Suzuki et al., Int. J. Appl. Radiat. Isot., 33 (1982) 1445 [4] S. M. Qaim and G. Stöcklin, Radiochim. Acta 34 (1983) 25 [5] G. Blessing and S. M. Qaim, Int. J. Appl. Radiat. Isot., 35 (1984) 927 [6] Z. Kovács et al., Int. J. Appl. Radiat. Isot., 36 (1985) 635 [7] S. M. Qaim, Progress in Radiopharmcy, Martinus Nijhoff Publishers, Dortrecht, The Nederlands (1986) 85 [8] G. Blessing et al., Int. J. Appl. Radiat. Isot., 37 (1986) 1135 [9] S. M. Qaim et al., Proc. 2nd Workshop on Targetry and Target Chemistry, Heidelberg 1987, DKFZ, Heidelberg (1988) 50 [10] S. M. Qaim, Proc. Second International Symposium on Advanced Nuclear Energy Research - Evolution by Accelerators, Mito, Japan1990, JAERI (1990) 98 [11] G. Blessing and S.M. Qaim, Appl. Radiat. Isot., 41 (1990) 1229 [12] G. Blessing et al., Appl. Radiat. Isot., 43 (1992) 455 [13] G. Blessing et al., Appl. Radiat. Isot., 48 (1997) 37 [14] S. Spellerberg et al., Appl. Radiat. Isot., 49 (1998) 1519 [15] E. Hess et al., Appl. Radiat. Isot., 52 (2000) 1431 [16] S. M. Qaim et al., Appl. Radiat. Isot., 58 (2003) 69 [17] G. Blessing et al., Appl. Radiat. Isot. 46 (1995) 955