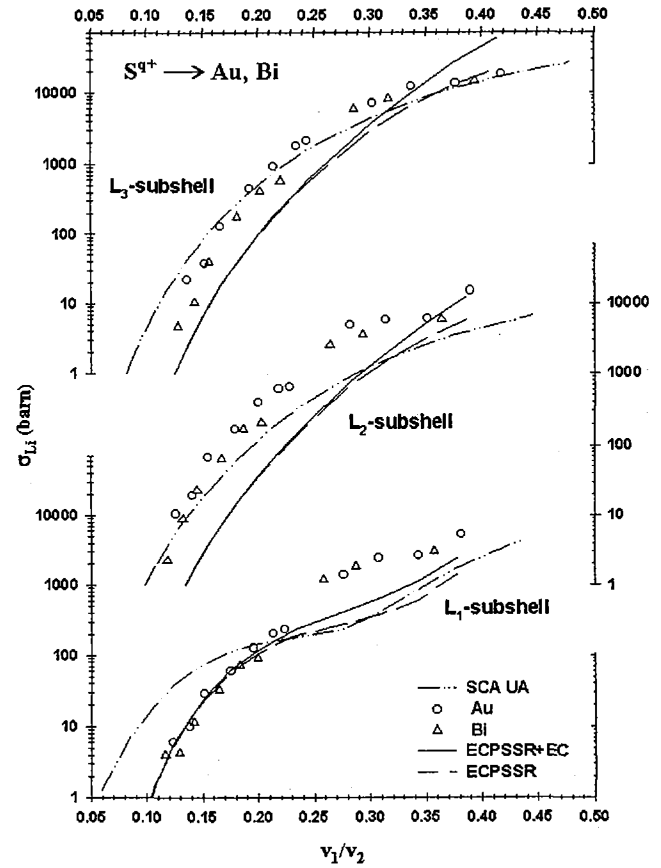

Fig. 2 Measured ionisation cross sections for L_1, L_2 and L_3 subshells of Au, and Bi bombarded by S-ions plotted versus relative projectile to electron velocity v_1/v_1, compared to the SCA-UA [3], ECPSSR [4], and ECPSSR + EC results of calculations.

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10. Charged particle veto detector (CUP)

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A highly efficient scintillator particle detector has been constructed. The detector, named CUP, is designed to work as a proton and α-particle veto device in γ-ray spectroscopy fusion-evaporation experiments. It should generate a signal when at least one charged particle is detected and thus should facilitate observation of γ rays from nuclei produced without the emission of charged particles. No attempt is made to distinguish between protons and α particles nor to determine the number of interacting particles. The main intended application of the new device was a large scale experiment with the EUROBALL[1] detector array, in which excited states of the ^{100}In nucleus were studied. In this experiment, which has recently been performed (March 2003), excited states in ^{100}In were populated in the ^{45}Sc(^{58}Ni,3n)^{100}In reaction, and CUP, together with the Neutron Wall[2], was used for selecting very rare events in which only 3 neutrons were emitted. The evaluation of the data collected in this experiment is in progress.

The basic active element of the detector is a cylindrical scintillator "cup" open at one end. It has a diameter of 62 mm, length 85 mm and the scintillator thickness 1 or 0.5 mm (see Fig. 1). The scintillator is placed in the vacuum chamber. The bottom of the scintillator cup is permanently glued to a transparent window. A photomultiplier is connected to the other side of this window. The scintillator thickness was chosen so that sufficient mechanical stability of the cup is assured, an interacting maximum energy proton (30 MeV) generates a large enough signal in the scintillator, and the probability of γ-ray interactions is small.

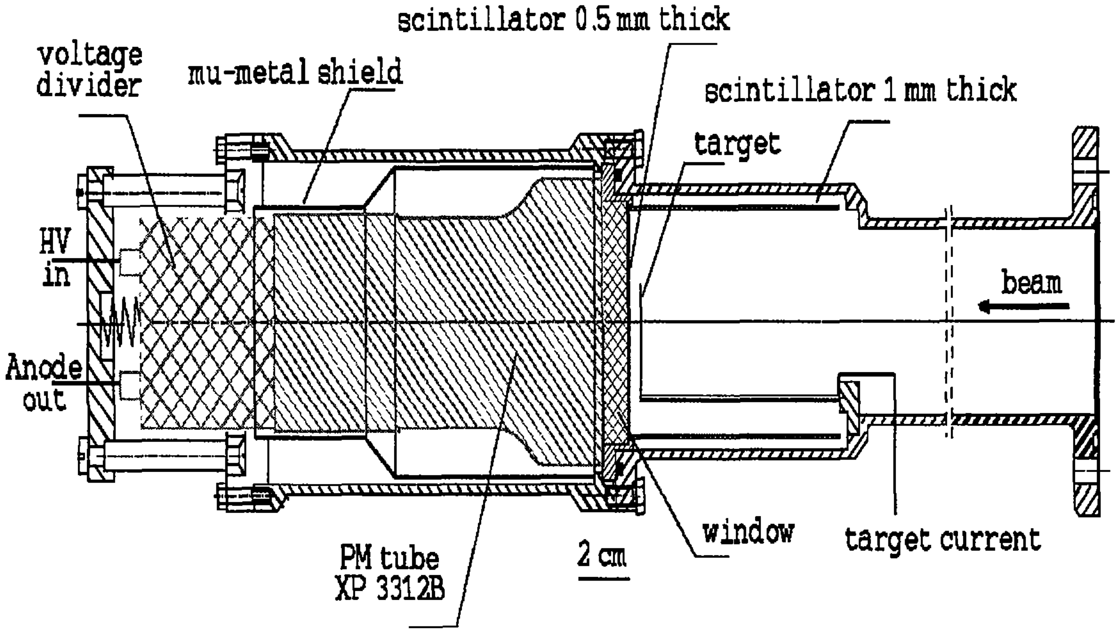

Fig.1 The CUP detector.

The target is situated about 3 mm from the bottom of the cup and is mounted at the end of a rod parallel to the walls of the cup. A specially designed target frame has to be used in order to minimize the number of particles stopped in the frame. The beam has to be stopped in the target. This is the only way to avoid scattering of beam particles into the scintillator, which would be a very significant source of false signals. The device is especially suitable for studying inverse kinematics, or symmetric, reactions. In case of reactions with the beam lighter than the target, backscattered beam particles will interact in the scintillator, again producing false signals. Such backscattered beam particles will have to be stopped by using absorber foils, which can be done at varying efficiency cost, depending on the particular reaction and foils used.

Two in-beam tests of the CUP have been performed at HIL in 2002, and one at IReS, Strasbourg. The performance of the detector determined in the tests done at HIL, for four different fusion-evaporation reactions, is summarized in Table 1.

Tab.1 Proton (e_p) and α-particle (e_α) detection efficiency of the CUP detector. The e_α values in case of reactions 3. and 4. were not determined due to too low statistics collected in these tests.

	Reaction	measured		simulated	
		e_p	e_α	e_p	e_α
1.	^{32}S (160 MeV)+^{124}Sn (23 mg/cm^2)	0.82±0.03	0.62±0.03	0.86	0.37
2.	^{32}S (160 MeV)+^{27}Al (19.4 mg/cm^2)	0.6±0.1	0.63±0.05	0.67	0.38
3.	^{32}S (160 MeV)+^{27}Al (19.4 mg/cm^2)	0.88±0.05		0.83	0.67
4.	^{40}Ar (120 MeV)+^{62}Ni (12.5 mg/cm^2)	0.75±0.05		0.88	0.57

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11. Beam tests of the monolithic silicon E-ΔE telescope produced by the Quasi-Selective Epitaxy

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The monolithic, silicon E-ΔE telescope with 20 μm thick ΔE detector followed by 70 μm thick E detector based on the n-p$^+$-n structure was produced using a new developed process named Quasi-Selective Epitaxy [1]. The measurements were performed using the electronic set-up consisting of two preamplifiers followed by active filter amplifiers with time shaping τ= 3 μs. The ADC's analysing E-ΔE signals were gated by 12 μs long logic pulse generated by TFA connected to the E detector preamplifier output. In Fig. 1 the E-ΔE scatter plot is presented after irradiation of the monolithic detector by the α-particles from the thorium calibration source emitting α-particles with energies ^{212}Bi: 6.05 MeV, 6.09 MeV and ^{212}Po: 8.78 MeV (upper left frame). Using such scatter plot the E-ΔE telescope energy resolution (FWHM) was estimated at about 300 keV. The response of the monolithic telescope to the continuous α-particle spectra is measured using the reaction ^{9}Be(^{40}Ar, α) with the beam energy E=184 MeV. For lower energy α-particles registered at the laboratory angle ϑ=75° (right upper frame) the E-ΔE hyperbola is produced. The α-particles of greater energy were registered at the laboratory angle ϑ=75° (left down frame). High energy α-particles have crossed the E detector and the hyperbola has been bent at energy about 10 MeV, which corresponds to the thickness E detector depletion layer about 70 μm. Response of the monolithic E-ΔE telescope to heavy ions was investigated using the reaction ^{12}C(^{14}N, X) with the nitrogenous energy of 82.6 MeV at the laboratory angle ϑ=20°. Results are shown in Fig. 2. The following nuclei have been detected with the telescope: He, Li, B, N, O, F, Ne. The ^{7}Be and ^{9}Be stable isotopes are visible in the beryllium banana. The three peaks at the E-ΔE nitrogen hyperbola (at E energies: 44, 50, 56 MeV) correspond to the two lowest excited states and the ground state in the carbon.