Two-proton fragmentation of ^{20}Mg and ^{17}Ne studied by fragment tracking with micro-strip detectors at FRS*

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We report preliminary results for the fragmentation reactions ^{20}Mg→^{18}Ne+2p and ^{17}Ne→^{15}O+2p. The secondary ^{20}Mg and ^{17}Ne beams were produced by impinging a 591 A MeV ^{24}Mg primary beam with 5•10^9 ions/spill on a 4 g/cm^2 ^{9}Be target at the fragment separator FRS. The average intensities of the resulting 400 A MeV ^{20}Mg and ^{17}Ne secondary beams at the mid-plane of the FRS amounted to 400 and 800 ions/spill, respectively. Special ion-optical settings were applied: the first half of the FRS was tuned to an achromatic mode using a wedge-shaped degrader, while its second half was set for high acceptance in angle and momentum. A 6x6 cm^2 DSSD detector with 32x32 strips was used to track the secondary ions onto a 2 g/cm^2 ^{9}Be secondary target positioned at the mid-plane of the FRS.

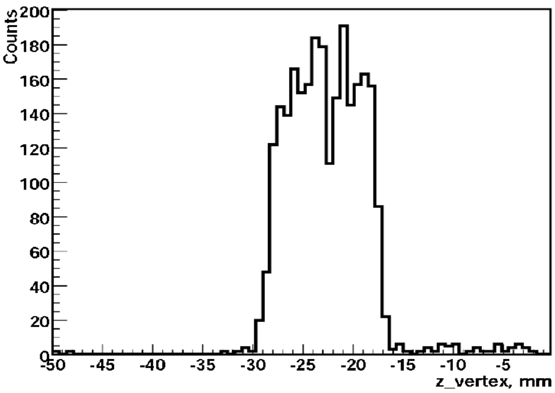

Figure 1: Profile of the ^{17}Ne→^{15}O+p+p fragmentation-vertex distribution along the beam direction as measured by the micro-strip detectors. The width of the intense bump matches the thickness of the secondary target.

Downstream from the reaction target, the break-up products of ^{20}Mg and ^{17}Ne were tracked by a newly developed detector array [1] consisting of four large-area (7x4 cm^2), 0.3 mm thick silicon micro-strip detectors with a pitch of 0.1 mm. The detector performance is reported in [2]. The detectors were used to measure energy loss and position of hits corresponding to the ejection of two protons and a heavy-ion residue, allowing the reconstruction of all fragment trajectories, their reaction vertices, angular distributions of the reaction products or proton-proton (p-p) correlations. This required careful relative alignment of the detectors with the help of reconstructed tracks; the achieved accuracy was 100 µm for protons and 15 µm for ^{15}O or ^{18}Ne.

The reaction vertices were reconstructed with an RMS uncertainty of 0.2 mm along the beam direction. Fig. 1 shows the profile obtained by demanding triple p+p+^{15}O events that correspond to fragmentation of ^{17}Ne in the 11 mm thick secondary target. Events outside this area are due to a background caused by events with delta electrons which mock up protons and thus lead to false triple-coincidence events.

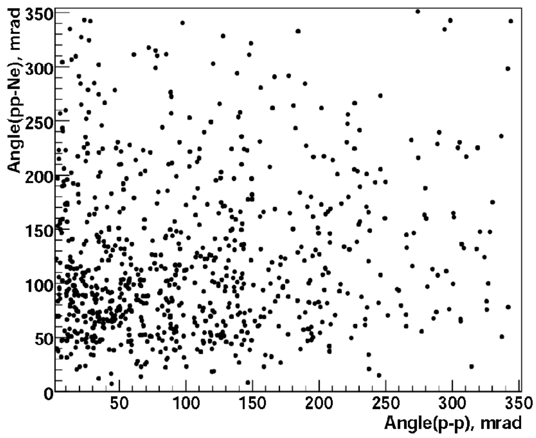

Figure 2: Proton-proton correlations observed for the ^{20}Mg→^{18}Ne+p+p reaction. The cluster of events at low p-p and intermediate pp-Ne relative angles reflects a strong p-p final-state interaction.

Fig. 2 displays the angular p-p correlations derived from the analysis of ^{20}Mg→^{18}Ne+p+p events. A strong p-p interaction corresponding to a 'di-proton' where two protons are emitted together with a relative orbital angular momentum of zero should manifest itself by small p-p and intermediate pp-Ne relative angles; the clustering of events in Fig. 2 indicates such an attraction. Similar behaviour is observed in the fragmentation ^{17}Ne→^{15}O+p+p which is in-line with the previous works [3,4].

References

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