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PREPARATIONS FOR PELLET TRACKING SYSTEM

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Abstract

A Pellet Tracking System (PTS) for WASA at COSY is proposed in order to determine the interaction point (the primary interaction vertex) for each event between the COSY beam and the target pellets. The knowledge of this interaction vertex helps to reconstruct the paths of the different decay products and thus to improve the momentum resolution of the events. Furthermore, the PTS gives information about the position distribution of the pellets, thereby allowing the geometrical alignment of the system to be improved. Several measurements were done in order to test and optimize the equipment's capabilities.

1 Method

The main idea to determine the interaction point is to measure the x and z position of a pellet before and after the interaction point. That can be done by using a laser beam to light up the pellet and photographing it (using the scattered laser light from the pellet) by pairs of fast CCD line scan cameras, below and above the vertex point (see Fig. 1). The cameras are arranged at 90° relative to each other. Then the pellet trajectories can be tracked from the position information from each plane and the relative timing.

In previous work on the pellet tracker at Uppsala University a setup with one camera and one laser was used to study hair, wires as pellet simulator and pellets from a pellet test station. A one-dimensional distribution of the pellets was measured, and found to be consistent with the expectations from the geometry of the system [1–3].

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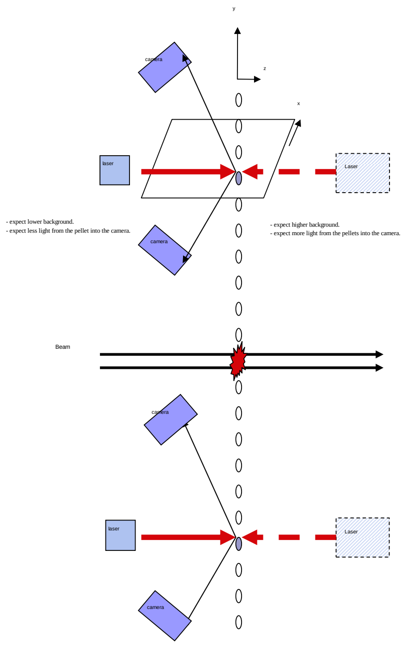

Figure 1: Proposed system to determine the x and z position of the individual pellets.

2 Results

2.1 Lens-target distance optimization

A strand of hair was photographed and its thickness (as FWHM) was measured at different distances between the lens of the camera and the hair. The relation between them is plotted in Fig. 2. The optimum measured distance was found to be D = 173 mm (while the calculated distance is 175 mm).

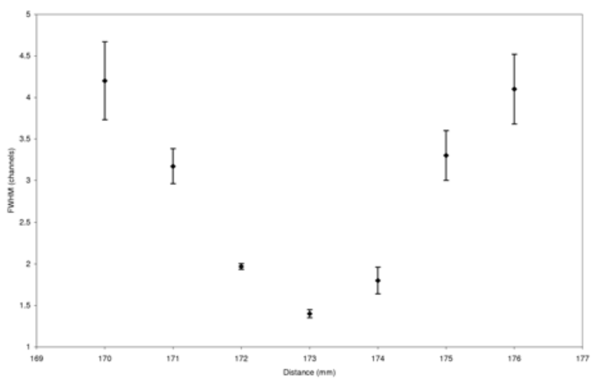

Figure 2: Measured width (FWHM) of the image of a hair as a function of the lens-target distance.

2.2 Pixel size calibration

At distance of 173 mm from the lens, an image of a grating with pitch (2.00±0.03)mm was taken, (see Fig. 3). For the camera operating parameters (512 pixels of 14 $\mu m \times 14$ μm, D = 173 mm and lens focal length l = 50 mm), the calculated magnification factor is M = (40 $\pm$ 3)%, in comparison to the measured magnification factor M = (39.2 ±1)% (i.e. 1 $pixel$ = (35±1.8) μm).

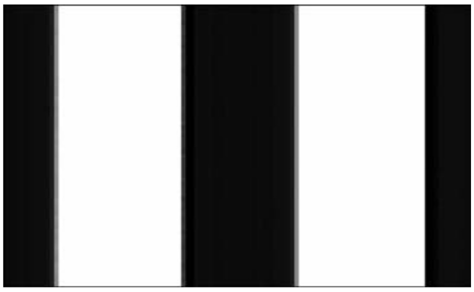

Figure 3: Pixel image for a grating of 2 mm pitch.

2.3 Hair thickness measurement

A strand of hair was fixed at the optimum distance D = 173mm from the lens. At this distance the lens has a magnification factor of (40 ± 3)%. As shown in Fig. 4a,b. The FWHM of the measured light distribution was found to be (1.8 ± 0.06) channels . Using the pixel size of 14 μm [4] and the magnification factor M = (39.2 ± 1)%, the calculated thickness of the hair is found to be (63.3 ± 2)μm, in agreement with the value (70 ± 5)μm measured directly with a micrometer.

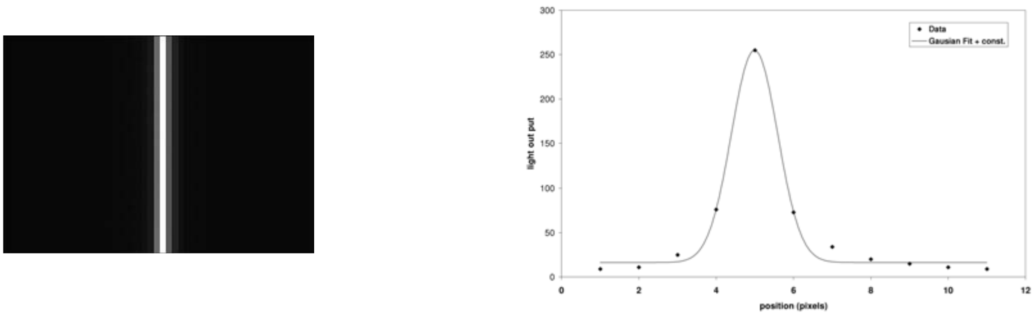

Figure 4: (a)(upper) Pixel image of the hair, (b)(lower) Gauss fit of the measured light intensity in the camera to the scattered light from a hair

2.4 Time calibration

By taking 70000 line pictures of a rotating object with (138 ± 3) kHz, using 1 μs integration time, the line rate frequency is measured to be (97.8 ± 1.7) kHz, corresponding to a time resolution of 10.2 μs (Fig. 5).

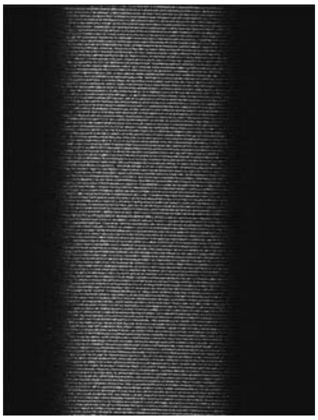

Figure 5: 70000 line pictures of a rotating source.

3 Conclusion

The optimum distance between the lens and the object measured and found to be D = 173 mm. At this distance the magnification factor is $M = (39.2 \pm 1)\%$, (i.e., 1 pixel = 35 μm, which is in the range of the pellet size $(25 - 40\ \mu\text{m})$). With this magnification and at this distance the thickness of a hair was measured and found to be consistent with the directly measured thickness. The maximum line rate frequency of the line scan camera found to be (97.8 ± 1.7)kHz.

References

[1] Ö. Nordhage *et al.*, *Nucl. Instrum. Meth.* **A 568**, 561 (2006).

[2] Jonas Lith, *Development of a Tracking System for Hydrogen Pellet Targets Utilizing a Line-Scan Camera*, Master thesis, Uppsala University (2006).

[3] Matthias Schult, *Development of a Pellet Tracking System. Project work*, Master thesis, Uppsala University (2005).

[4] ATMEL. AVIIVA^{TM} M2 Cl Cameralink^{TM} Line Scan Camera, (2006), Data sheet.