

## METHODS AND MATERIALS

### 1. Multi-slit collimator (MSC)

Figure 1 shows a simple diagram of the MSC. As illustrated, the open and closed septa of the proposed MSC are placed in equi-angular interval on a circular track of the sagittal plane. In this design, image acquisition is accomplished in two gantry rotations. In the first rotation, the MSC position relative to the source is fixed in one position and only the half of necessary data set is obtained. Then the MSC is rotated on its circular track of the sagittal plane by the amount of the equi-angle interval and another half of the data set is acquired in the second gantry rotation.

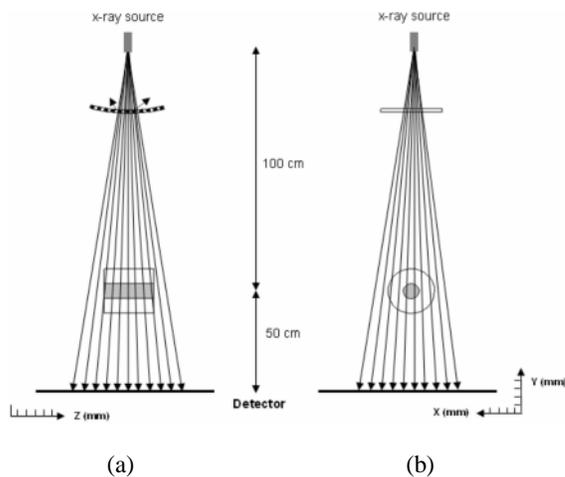


Fig. 1. MC geometry of the multiple-slit system

### 2. Monte Carlo Simulation and Imaging System

An MC software, MCNPX (v2.5d3, Los Alamos National Laboratory, Los Alamos, NM) program with the standard library of MCPLIB04 was used to build the imaging geometry of the MSC and obtain 2D projection images. The MCNPX radiography tallies (PI, TIR, and TIC), which were based on point detector, were used to evaluate the effect of scatter reduction in projection images. We used a F5 TIR radiography tally associated to flux image radiography on a planar image surface. The F5 TIR tally was also used to obtain both the scatter only radiation and primary + scatter radiation separately. The energy of x-ray beam was mono-energetic and 40 keV. The distance between the source and the center of an imaging object was 100 cm and the source-to-detector distance was 150 cm as shown in Figure 1 (a). Various widths of slits ranging from 10 mm to 50 mm in 10 mm increment were considered. The thickness of the slits was 10 mm. The imaging object phantom consisted of two parts, a PMMA ( $1.19 \text{ g/cm}^3$ ) outer cylinder of 15 cm diameter and a paraffin wax ( $0.93 \text{ g/cm}^3$ ) inner cylinder of 5 cm diameter as shown in Figure 1 (b). The length of the imaging object was 15 cm. The size of detector

panel was 30 cm×30 cm and a pixel size was 2.34×2.34 mm (128× 128 pixels).

### 3. Scatter Reduction Procedure

We approximate signals under the closed septa as scatter contributions, then subtract them from signals obtained with the open septa. Figure 2 illustrates the scatter reduction scheme by showing how a final projection image corresponding to a given angle (i.e., gantry angle) is obtained. Figure 2 (a) shows a raw projection image (with a profile of it) obtained during the first gantry rotation. Figure 2 (b) does it acquired during second gantry rotation. As can be seen in each raw projection, signals are small under the closed septa but not zero and these are considered due to scattered radiation contribution. Now, we assume scatter signals in areas under the open septa can be approximated by interpolating (and/or extrapolating) scatter signals under the closed septa. These scatter signals are subtracted from the raw signals [see Figure 2 (c) and (d)]. Finally, both scatter eliminated projection signals are added to get the final projection image [Figure 2 (e)]

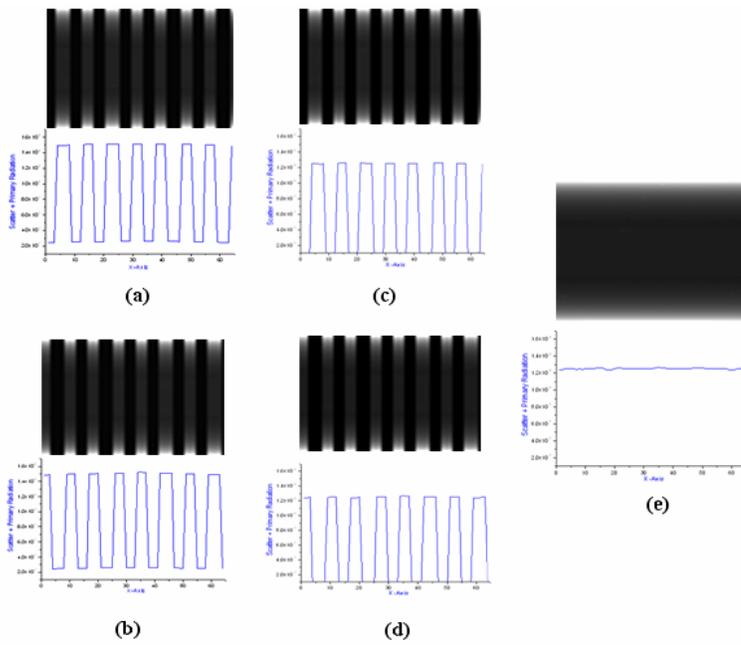


Fig. 2. Scatter reduction scheme