

Names: \_\_\_\_\_

Class: \_\_\_\_\_ Date: \_\_\_\_\_

In the table below, please record  $\theta_x$  and  $\theta_y$  for red and green dots. The colors indicate opposite directions from the collision point.

**Table 1:  $\theta_x$** 

Event Number	$\theta_x$ ( $\mu\text{rad}$ , red dot)	$\theta_x$ ( $\mu\text{rad}$ , green dot)

**Table 2:  $\theta_y$** 

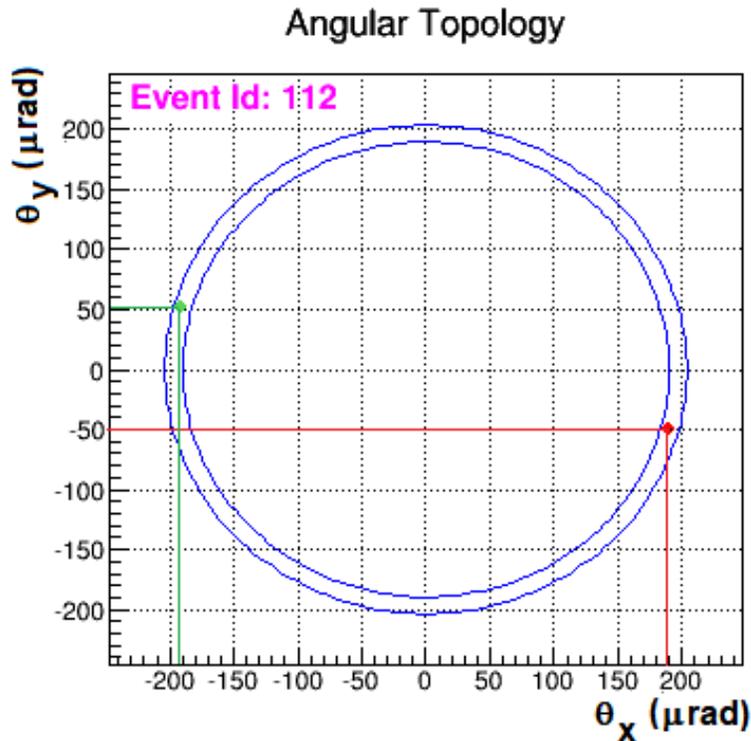
Event Number	$\theta_y$ ( $\mu\text{rad}$ , red dot)	$\theta_y$ ( $\mu\text{rad}$ , green dot)

Please check to be sure values have been transcribed properly and that the event numbers in each table are identical and in the same order. Use an additional sheet if you need more space.

An example of how to read the events is on the reverse side.

Sample TOTEM Event:

The event display shows a planar view, with the beam occupying an area in the middle; there is a gap in the detector there. The TOTEM detectors are embedded at the edges of the LHC beam pipe. Each records a “hit” where a scattered proton strikes. The red and green dots represent these hits.



This sample event shows the main features. The Event ID is 112.

We can measure  $\theta_x$  and  $\theta_y$  of each dot (red or green) found between the two blue rings by dropping perpendiculars, shown here as red and green lines, to the  $\theta_x$  and  $\theta_y$  axes. Be careful to correctly read the gradations on the axes: they are in units of 10  $\mu\text{rad}$  for some events, 20  $\mu\text{rad}$  for others. Here,  $\theta_x = +189 \mu\text{rad}$  and  $\theta_y = -50 \mu\text{rad}$  for the red dot and  $\theta_x = -192 \mu\text{rad}$  and  $\theta_y = +50 \mu\text{rad}$  for the green dot. The details of each event will vary.

The diameter of a dot can be estimated from the gradations and used to find the

approximate uncertainty in measurement. Looking at the width of the red dot, its  $\theta_x$  value could stretch from -187 to -214  $\mu\text{rad}$ , so we can take the uncertainty as  $\Delta\theta_x/2 = \pm(214-187 \mu\text{rad})/2 = \pm 3.5 \mu\text{rad}$ . Round to  $\pm 4 \mu\text{rad}$ . We can use the uncertainty on one axis on one dot as a stand-in for the whole event.

Thus we would enter this event as:

**Table 1:  $\theta_x$** 

Event Number	$\theta_x$ ( $\mu\text{rad}$ , red dot)	$\theta_x$ ( $\mu\text{rad}$ , green dot)
112	+189	-192

and

**Table 2:  $\theta_y$** 

Event Number	$\theta_y$ ( $\mu\text{rad}$ , red dot)	$\theta_y$ ( $\mu\text{rad}$ , green dot)
112	-50	+50