INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI

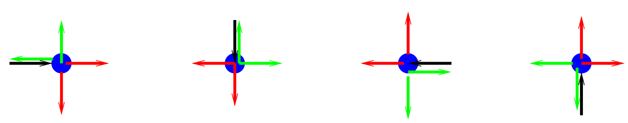
Department of Physics

PH415: Simulation Techniques in Physical Systems
MC-SSM: Test on Walks

Problem Consider a random walk of a (moving charged) particle on a 2d square lattice in the presence of a rotational bias B directed into the plane of the paper. In presence of such a field, the jump probability depends on the direction from which the random walker arrived the present site. With respect to the arrival direction, the jump probability p_a for two anti-clockwise directions and p_c for two clockwise directions are given by

$$p_a = \frac{1}{4}(1 - B) \quad \text{and} \quad p_c = \frac{1}{4}(1 + B)$$

where $2(p_a + p_c) = 1$ and the value of B can change from 0 to 1. The scheme of a rotational random walk is represented in the following figure. The arrival direction is shown by black, clockwise directions are shown by red and the ant-clockwise directions are shown by green. The value of B can be taken as $B = 0.5$, 0.75 and 1. Consider the starting point as the



origin, the central point of the lattice and take the step length equal to one. Generate the biased random walk of steps randomly chosen between $N = 40,000$ to $50,000$. The walks should be averaged over randomly chosen samples $N_s = 10,000$ to $20,000$. Plot the configurations of a single walk of $10,000$ steps for each B value (in the same scale). Calculate the the end-to-end distance $r_e = \sqrt{(y_0 - y_e)^2 + (x_0 - x_e)^2}$ of the walks for all three cases where (x_0, y_0) and (x_e, y_e) are the coordinates of the starting and end points respectively and plot the distributions of r_e. For all three B values, check how the average end to end square distance $\langle r_t^2 \rangle$ goes with t. Keep evaluating the local exponent ν_t. estimate the value of the exponent ν. Plot $\langle r_t^2 \rangle$ versus t in log-log scale (you may plot data at an interval of 100) and determine the exponent ν. Plot ν_t against $1/t$ and check where it is converging. Determine how the average number of sites visited (or covered) N_{cov} by the random walker with time t for each value of B.