**Effect of concentration gradient on spiral wave dynamics
in the Belousov-Zhabotinsky reaction system**

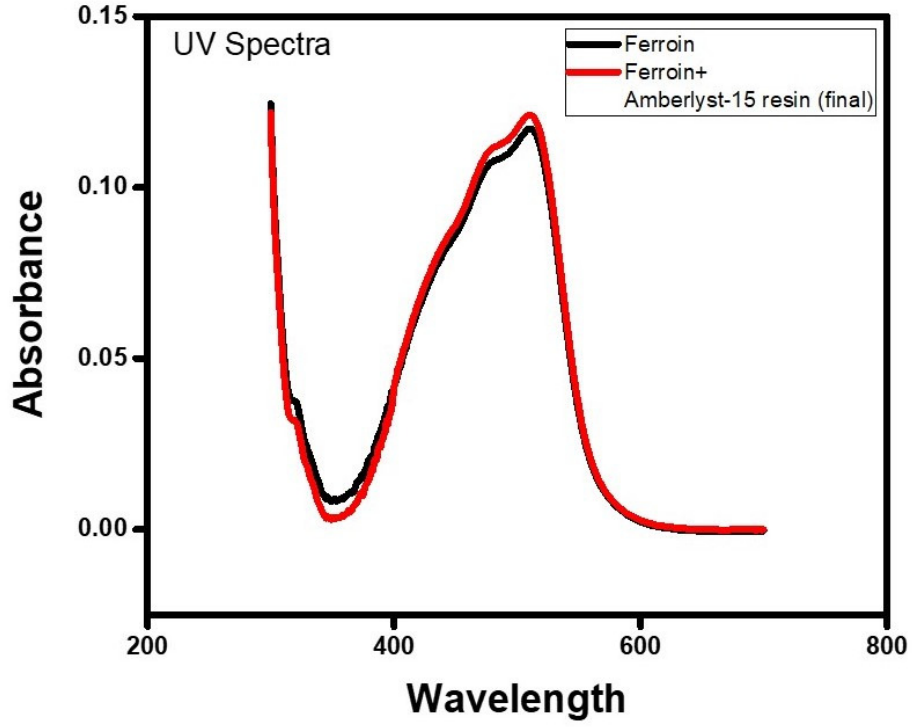Authors: Parvej Khan and Sumana Dutta

Supplemental materials

Figure S1: UV-vis spectrophotometric analysis of ferroin catalyst and resin beads. Black curve depicts the absorbance spectrum for a fresh ferroin solution. The decanted ferroin solution in which resin beads were soaked overnight gives the red curve, showing that the ferroin had not loaded in the resin matrix.
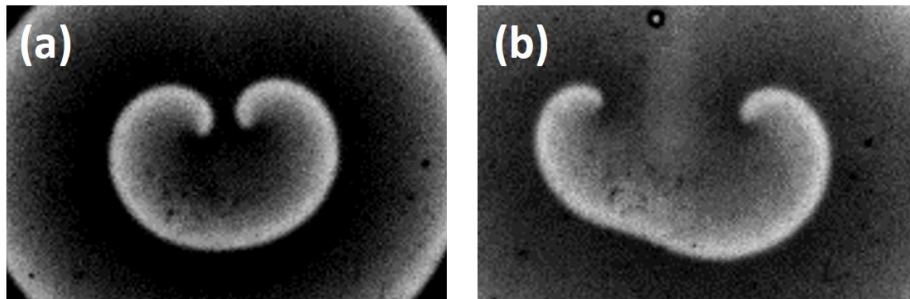

Figure S2: Snapshots (1 cm ×1.5 cm) at interval of 3 hours for an experiment with $n=6$ and $d=1.5$ cm depict the increment of separation between the tips.
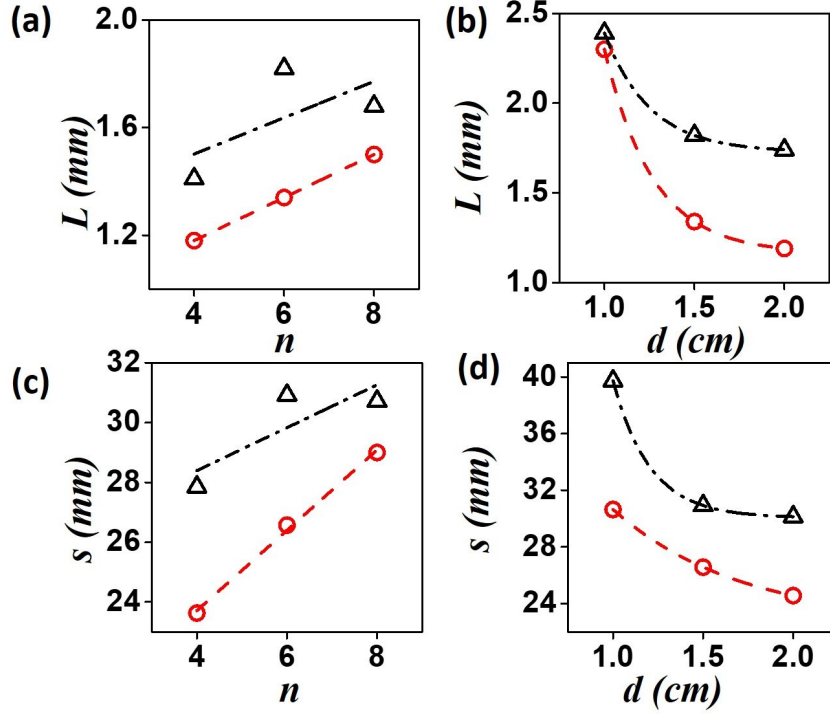
Figure S3: Comparison of movement of the two tips in experiments. Plots of (a,b) path length, (L), and (c,d) traversed length, (s), with respect to the number of beads, n (in (a) and (c)) and separation distance, d (in (b) and (d)). Red circles (dashed curve) denote values for left tip, and black triangles (dash-dotted curve) represent values for the right tip. In (a) and (c) $d = 1.5$ cm and in (b) and (d) $n = 6$.
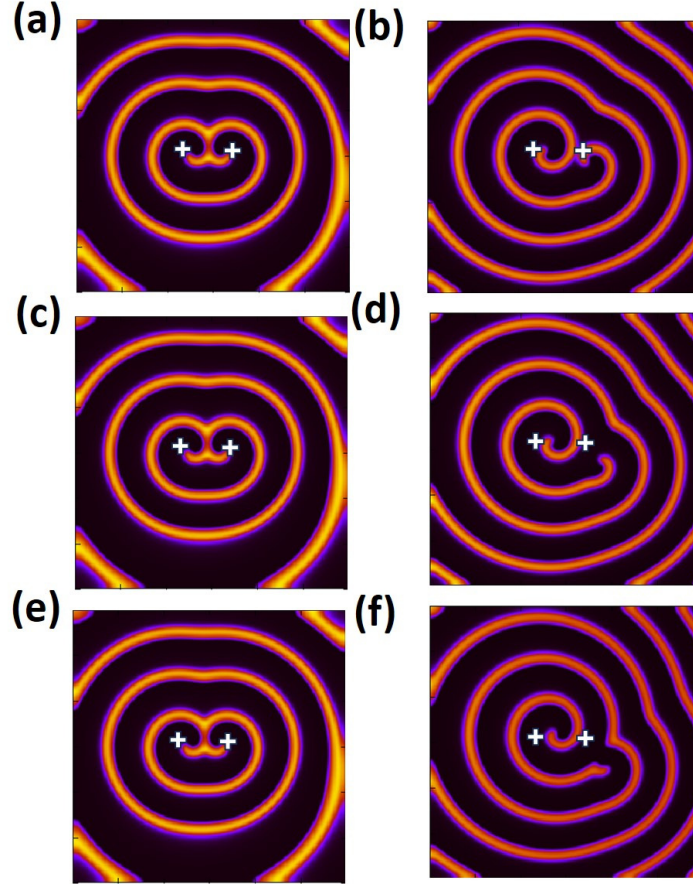
Figure S4: Snapshots (105 s.u × 105 s.u) from the numerical simulations for different gradient strengths with d=50.75 s.u. (a,c,e) show the initial position of the spiral tips (at 100 t.u.) and (b,d,f) show the tip positions at 900 t.u. for gradient strengths of (a-b) 0.04, (c-d) 0.06, (e-f) 0.08. '+' sign marks the initial position of the tips before the introduction of the gradient.
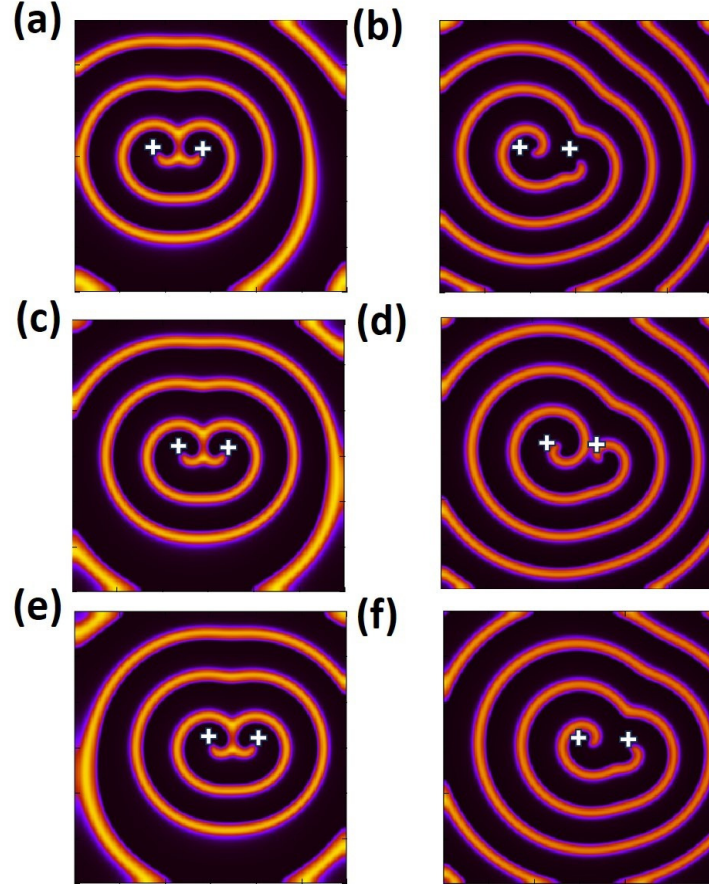
Figure S5: Snapshots (105 s.u × 105 s.u) from the numerical simulations for different $d-$values at a gradient strength of 0.04. (a,c,e) are the initial snapshots at 100 t.u. for d=40.25, 50.75, 61.25 s.u., respectively. (b,d,f) represents the same at 900 t.u. '+' signs in (a-f) depicts the initial position of the tips before the introduction of the gradient.
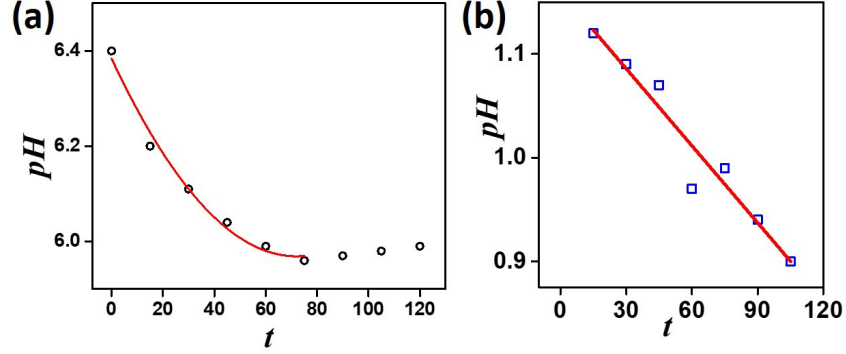
Figure S6: Change of pH with time in the presence of the resin beads. (a) for a stirred homogeneous unreactive system. (b) for a homogeneously stirred BZ-reaction system.
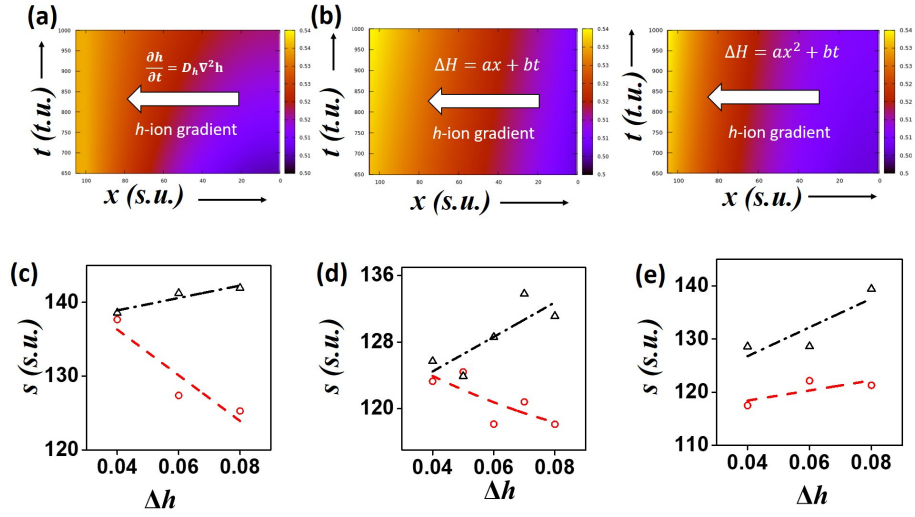

Figure S7: Results for different forms of $h-$gradient. (a-c) Variation of hydrogen ion concentration in space and time for (a) only diffusion of h, (b) an introduced linear gradient of h with space and time, (c) a quadratic variation in h with space, and linear variation with time. White arrows show the direction of the gradient. (d-f) Traversed length of spiral tips for the three cases shown in the panel above. Black triangles denote right tip and red circles denote the positions of left tip in each panel.