Explosive transitions in coupled Lorenz oscillators

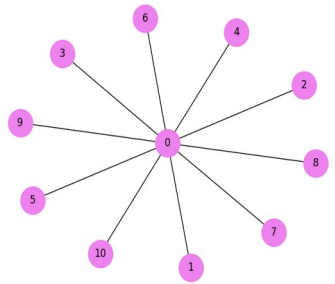
Yusra Ahmed

The equations of motion for the dynamics on the nodes is given by:

$$\dot{x}_i = \alpha_n[\rho y_i - \rho x_i]$$

$$\dot{y}_i = \alpha_n[\gamma_n x_i - y_i - x_i z_i + \varepsilon_y (y_h - y_i)]$$

$$\dot{z}_i = \alpha_n[x_i y_i - \beta z_i + \varepsilon_z (z_h - z_i)]$$



The dynamics on the hub is given by:

$$\dot{x}_h = \alpha_h[\rho y_h - \rho x_h]$$

$$\dot{y}_h = \alpha_h[\gamma_h x_h - y_h - x_h z_h + \frac{\varepsilon_y}{(N-1)} \sum_{i=1}^{N-1} (y_i - y_h)]$$

$$\dot{z}_h = \alpha_h[x_h y_h - \beta z_h + \frac{\varepsilon_z}{(N-1)} \sum_{i=1}^{N-1} (z_i - z_h)]$$

$$\rho = 10, \beta = 8/3, \gamma_n = 28, \gamma_h = 30, \alpha_n = 2, \alpha_h = 20, N = 500$$

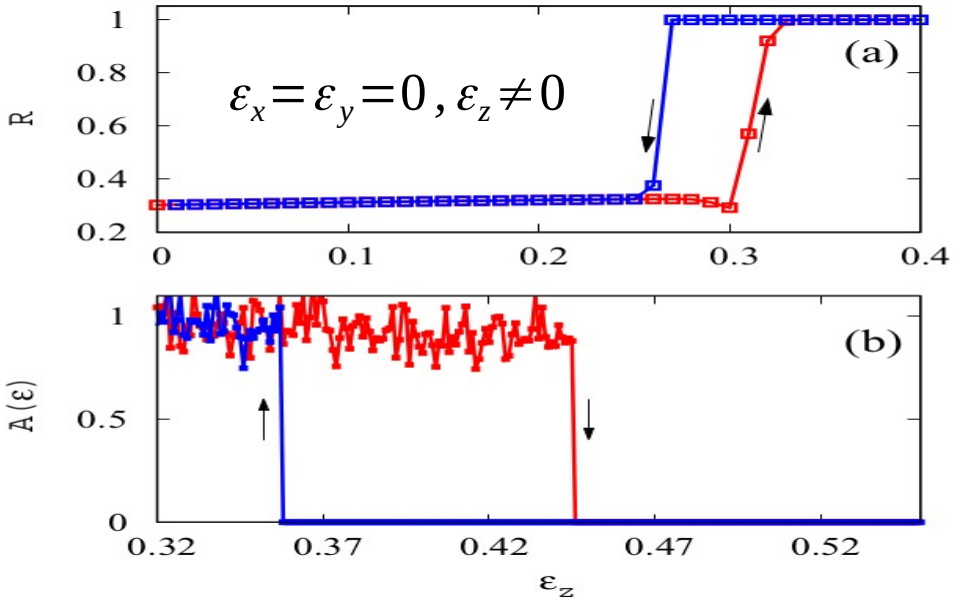
Phase order Parameter

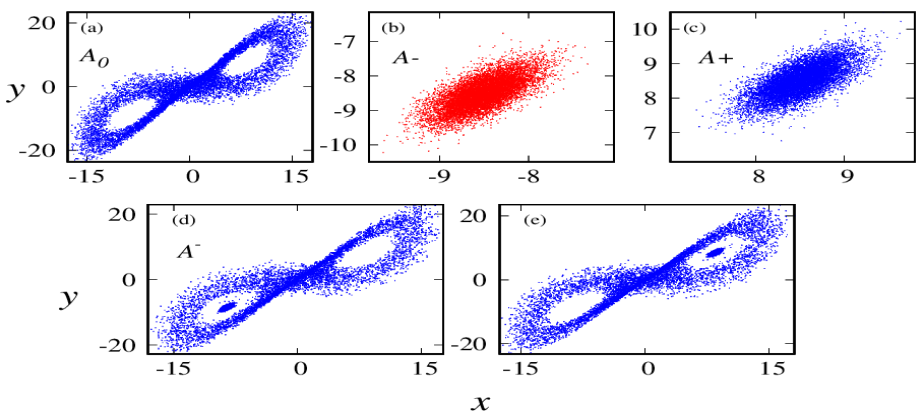
$$R = \langle | \frac{1}{N} \sum_{j=1}^{N} e^{i\Phi_j(t)} | \rangle$$

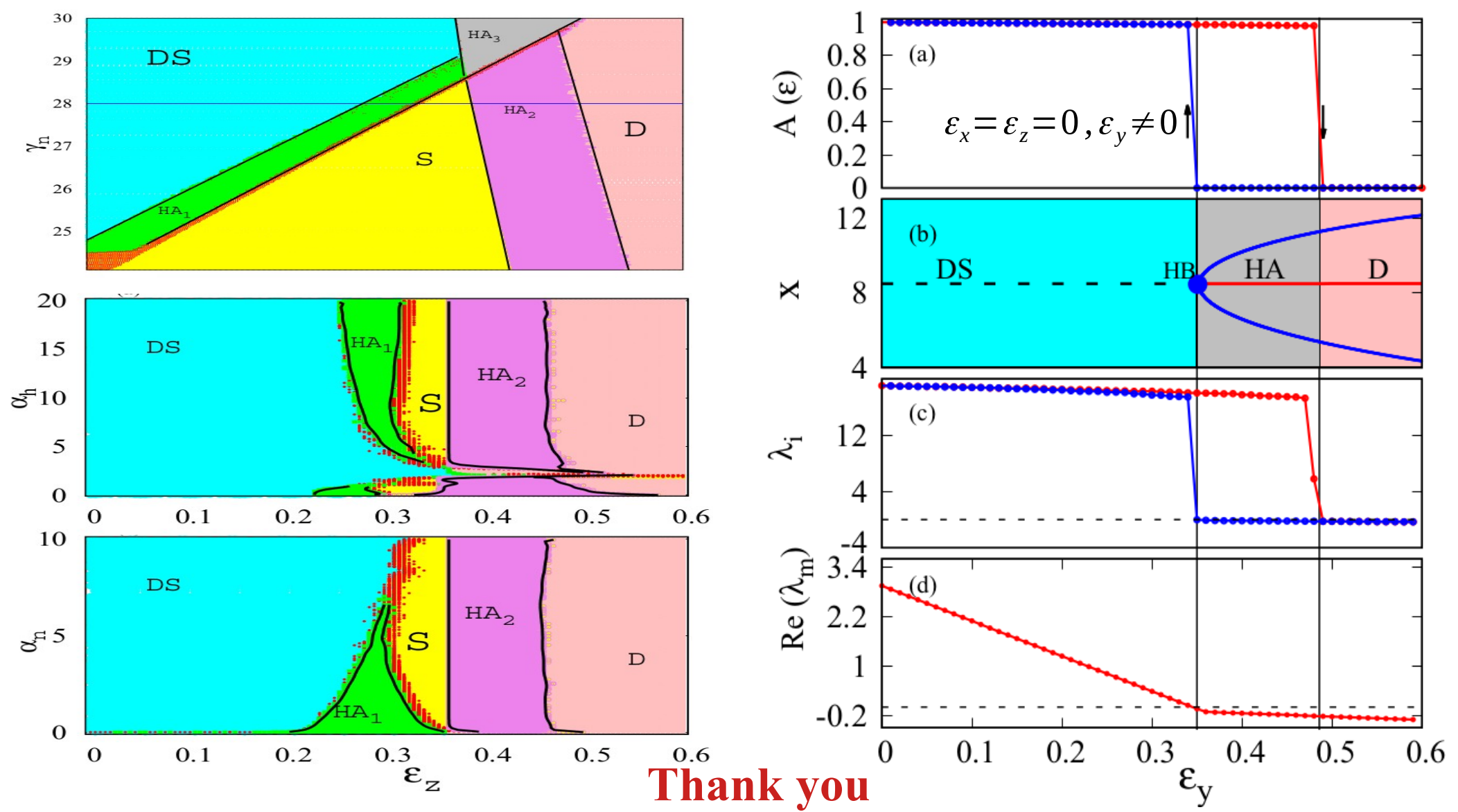
Amplitude order Parameter

$$a(\varepsilon) = \frac{1}{N} \sum_{i=1}^{N} [\langle x_{i,max} \rangle - \langle x_{i,min} \rangle]$$

$$A(\varepsilon) = \frac{a(\epsilon)}{a(0)}$$






DS
HA3
HA2
HA1
S
D
γn
αh
αn
εz
A (ε)
(a)
εx = εz = 0 , εy ≠ 0
(b)
DS
HB
HA
D
x
(c)
λi
(d)
Re (λm)
εy

Thank you