




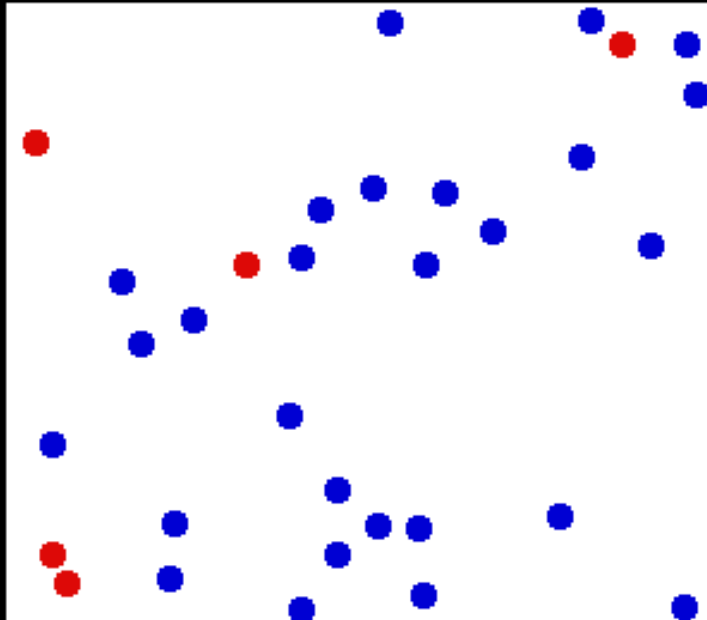
Krótki wstęp do teorii chaosu



A dark, stormy night scene with a lightning bolt striking the Eiffel Tower. The tower is silhouetted against a dark, cloudy sky. A bright lightning bolt strikes the top of the tower, with several smaller bolts visible in the background. The scene is framed by a jagged, white, starburst-like shape.

Chaotyczne

Procesy stochastyczne



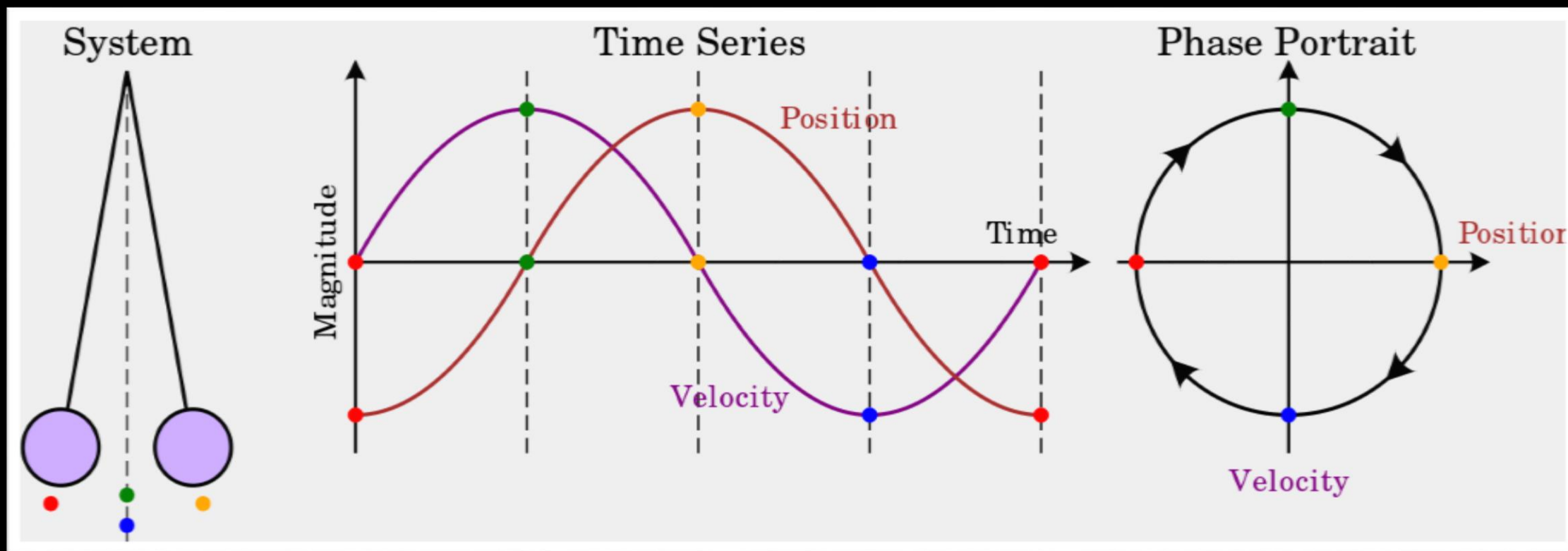
Ruchy Browna

Procesy chaotyczne

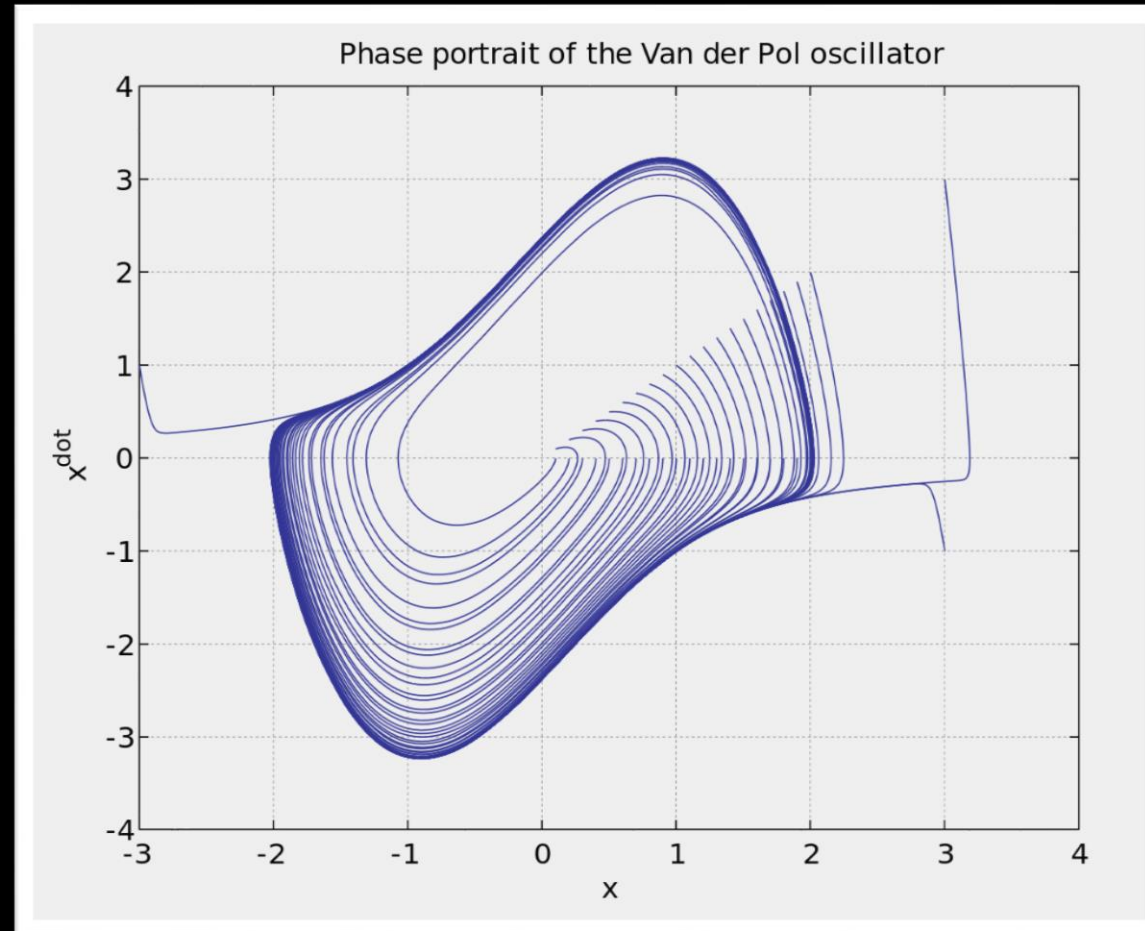


Podwójne wahadło

Przestrzeń fazowa

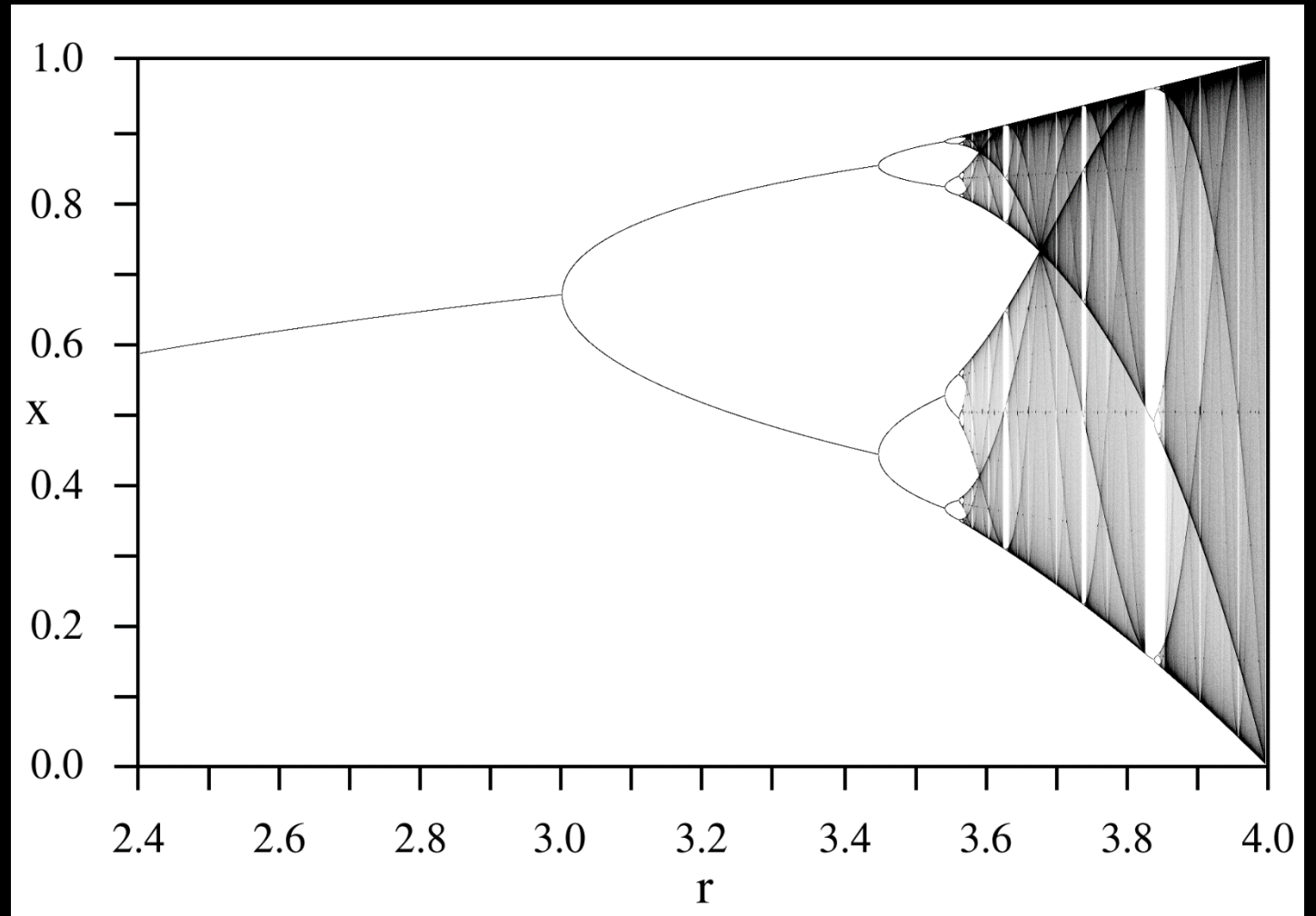


Atraktory



Odzworowanie logistyczne i Bifurkacje

$$x_{n+1} = r \cdot x_n(1 - x_n)$$
$$r \in]0,4[$$



Wykładnik Ljapunowa (Ляпунов)

$$|\delta Z(t)| \approx e^{\lambda t} |\delta Z_0|$$

$$\lambda = \lim_{t \rightarrow \infty} \lim_{\delta Z_0 \rightarrow 0} \frac{1}{t} \ln \frac{|\delta Z(t)|}{|\delta Z_0|}$$



Алекса́ндр Миха́йлович Ляпуно́в

Twierdzenie Poincaré–Bendixsona

- Na tablicy + dowód

Twierdzenie Poincaré–Bendixsona

- Żartowałem

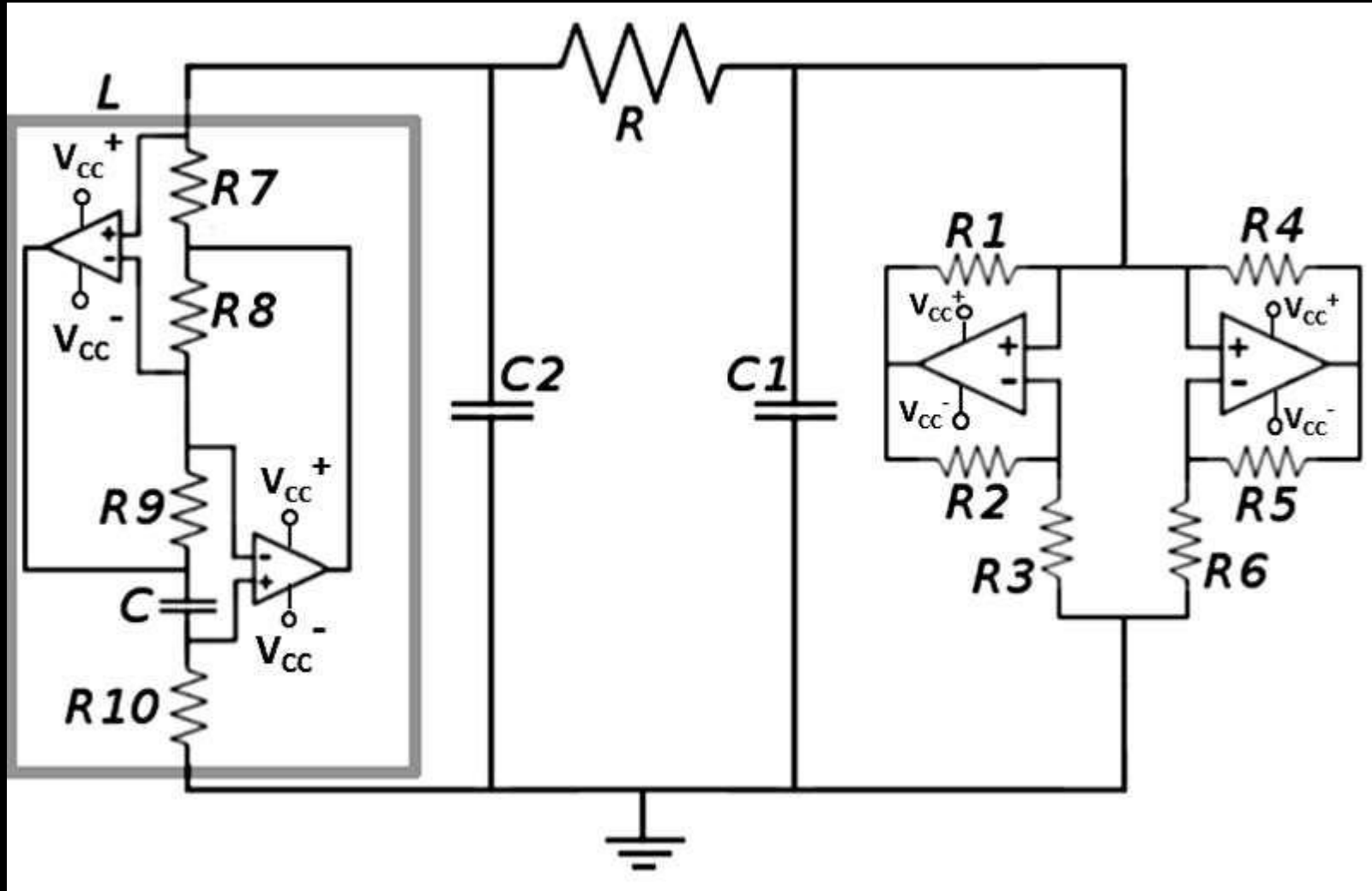


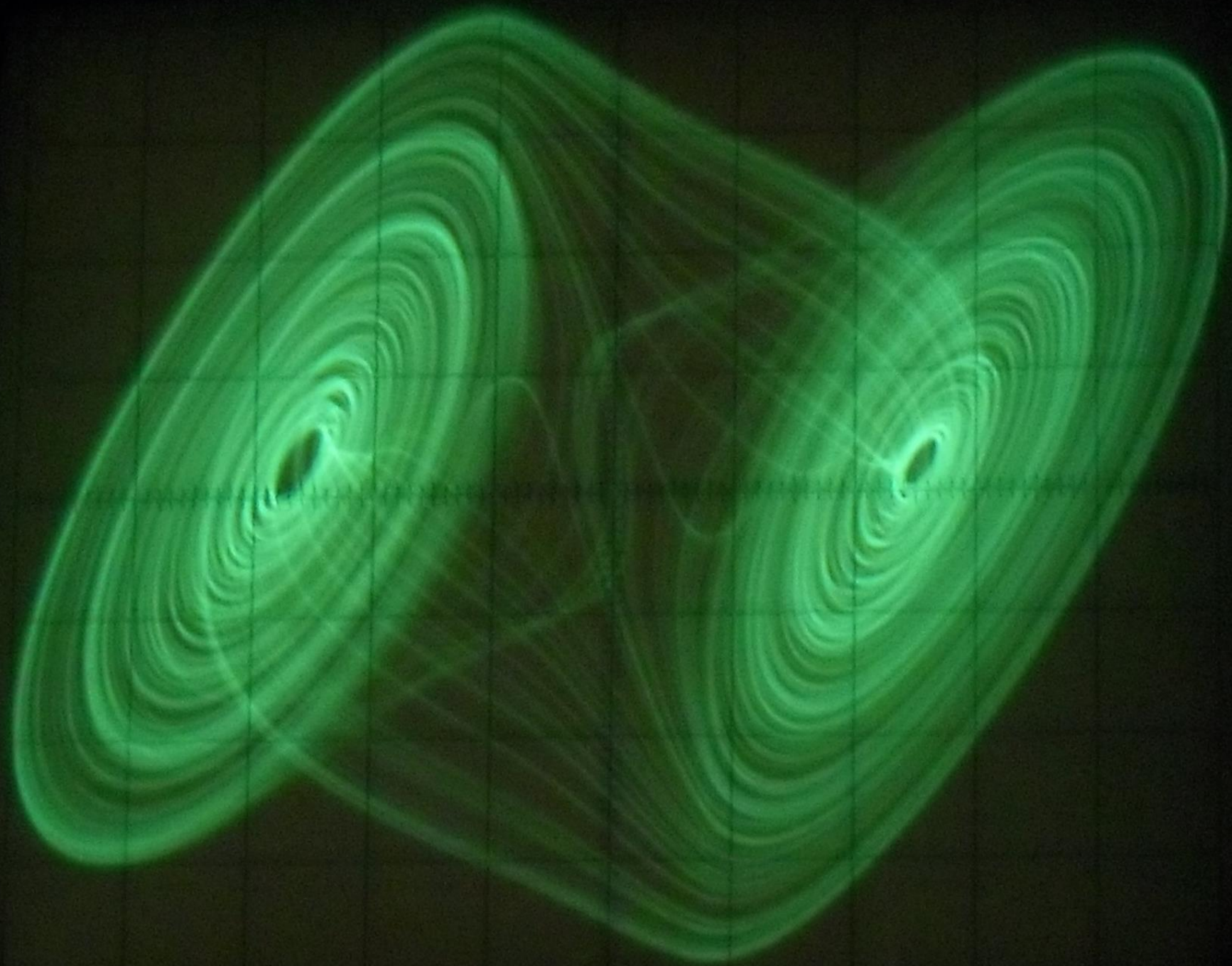
Edward Norton Lorenz

$$\begin{cases} \dot{x} = \sigma(y - x) \\ \dot{y} = x(\rho - z) - y \\ \dot{z} = xy - \beta z \end{cases}$$

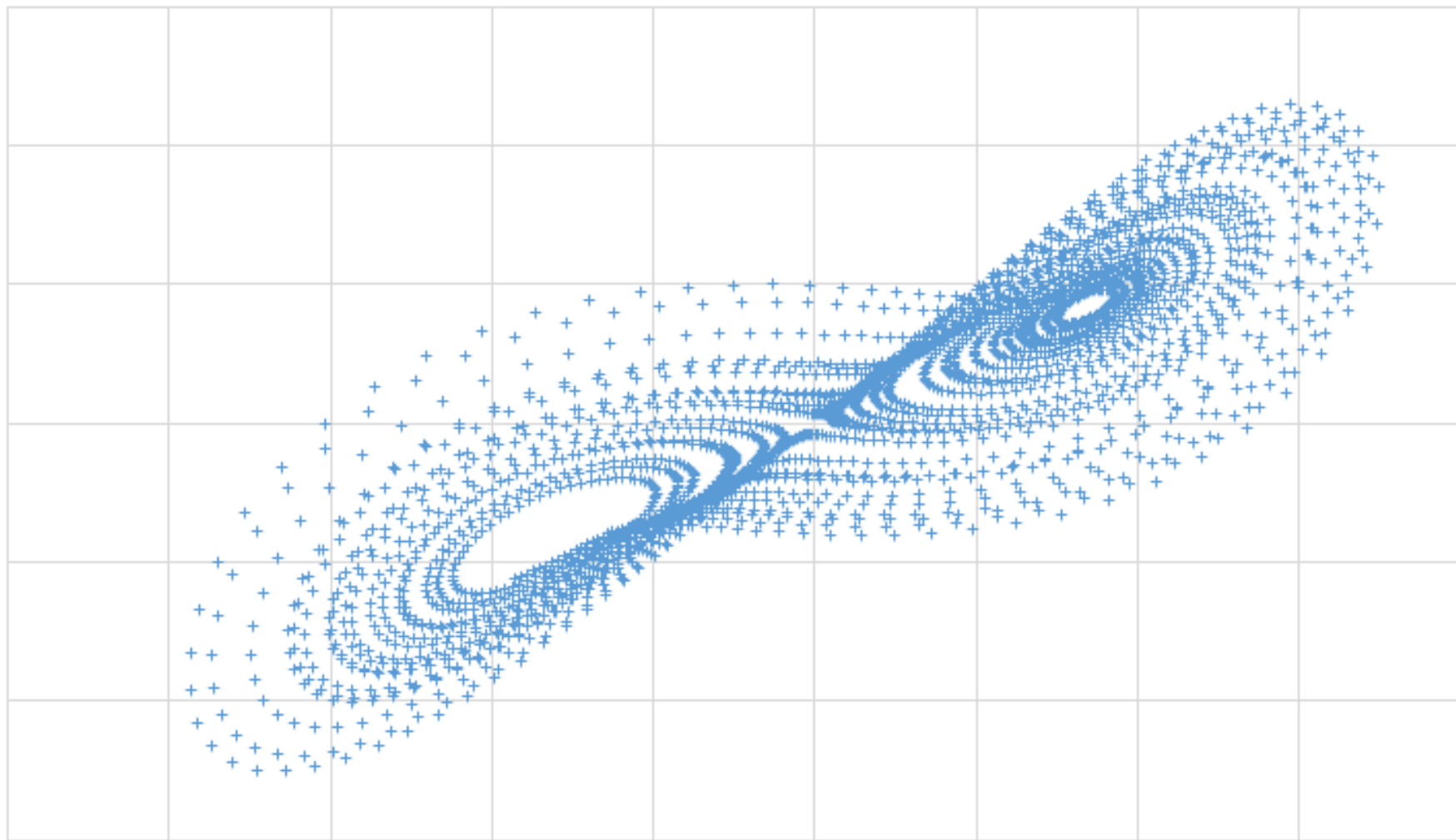


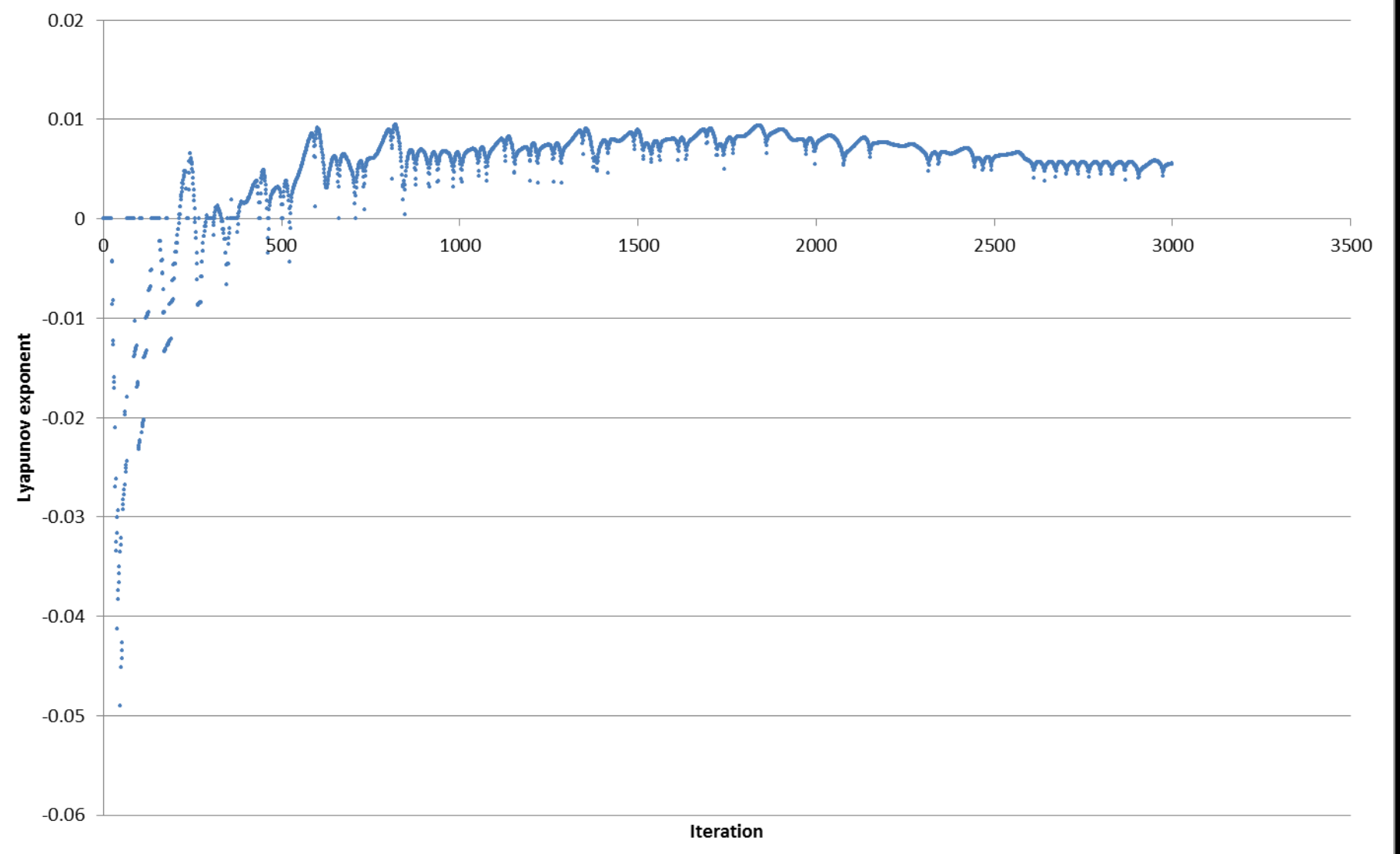
Leon Ong Chua

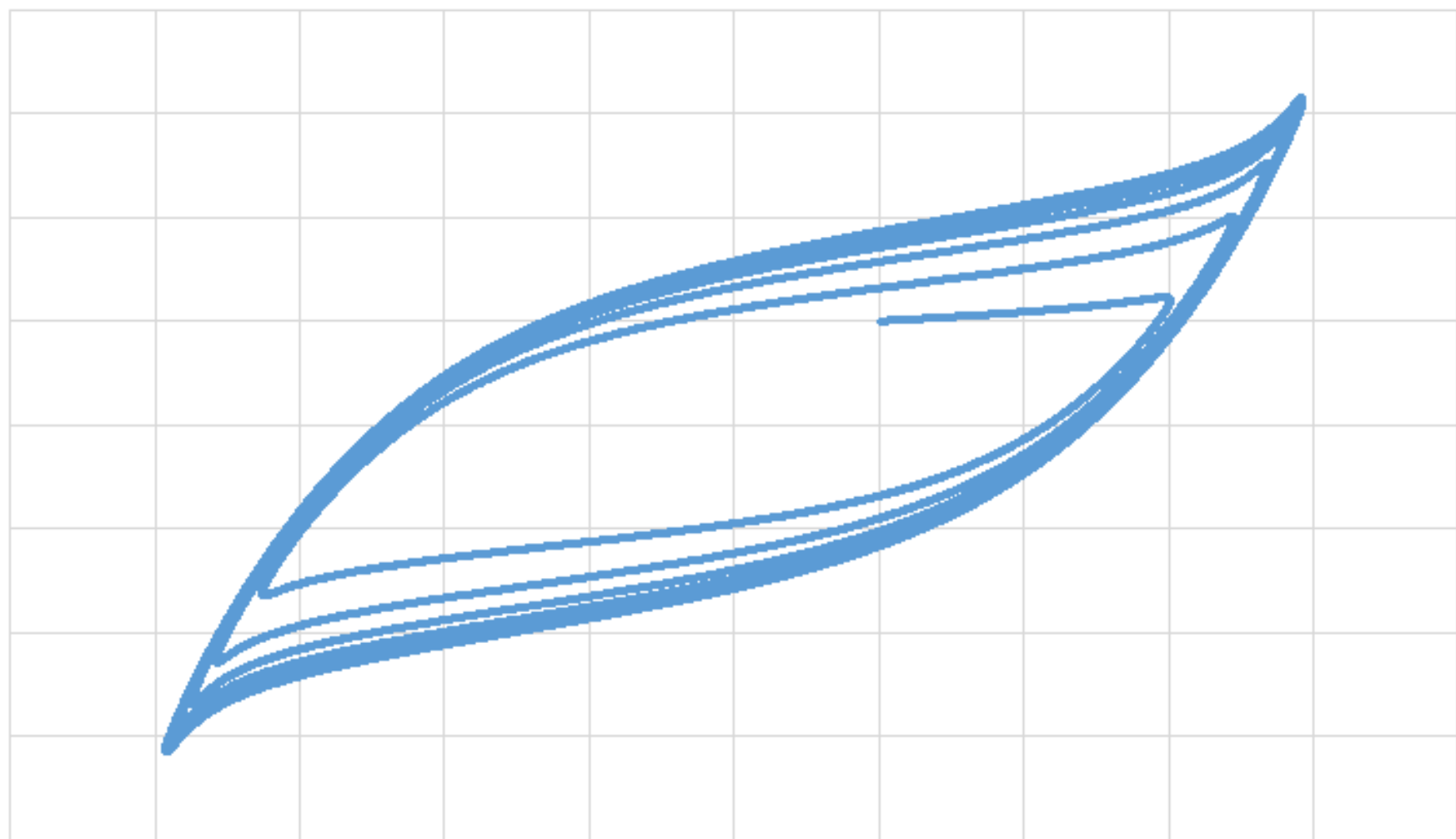


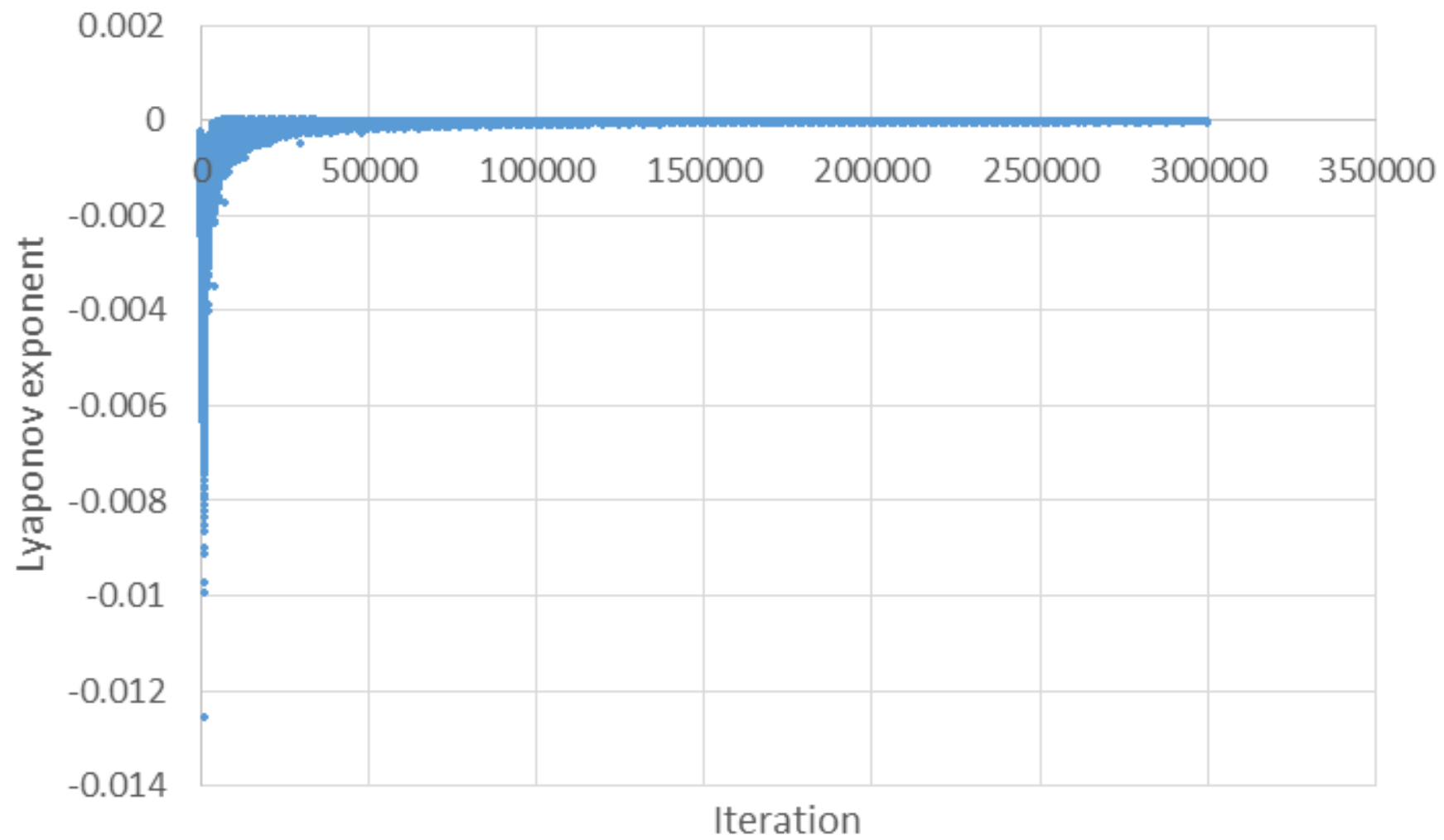


Matematyka eksperymentalna











Był to: krótki wstęp do teorii
chaosu