

OPTICAL TWEEZERS



Monitora:

Joana Teixeira

Alunos:

Noemi Carvalho

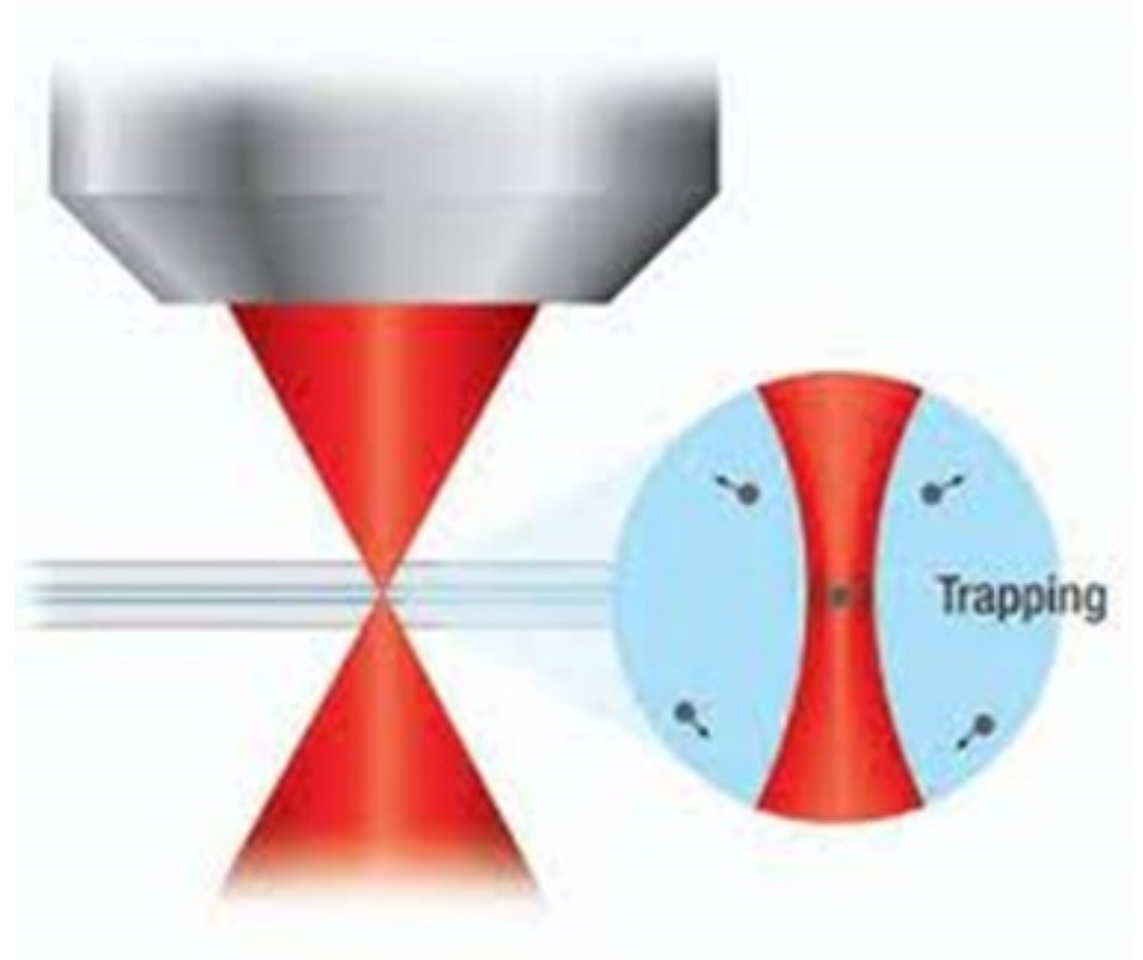
Pedro Oliveira

Rodrigo Freitas

Simone Pinto

O que são?

- Pinças óticas são uma técnica que permite manipular partículas microscópicas usando a força da luz;
- Permite-nos mover e manipular partículas tão pequenas quanto átomos e moléculas;
- Inicialmente desenvolvido em 1970, por Arthur Ashkin, que motivou o seu Prémio Nobel em 2018.



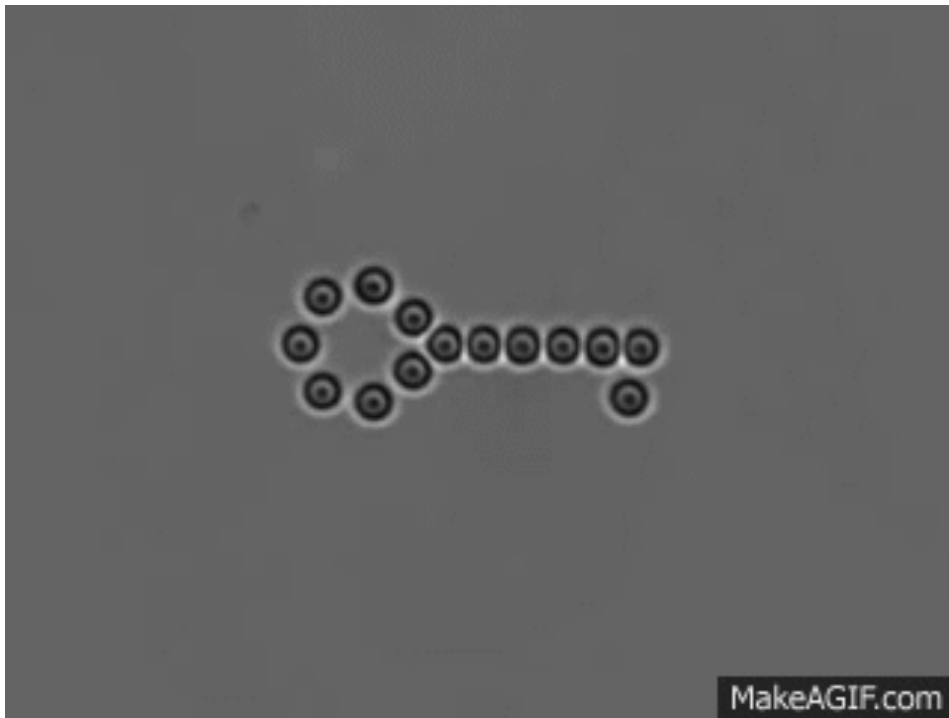
LASERs



- O *trapping* de partículas é feito com base num feixe *laser* altamente focado e na interação de duas forças óticamente induzidas – as forças de gradiente e de *scattering*;
- Emitem luz de um único comprimento de onda, com um feixe de luz estável e muito bem definido, face aos LEDs.

Aplicações práticas

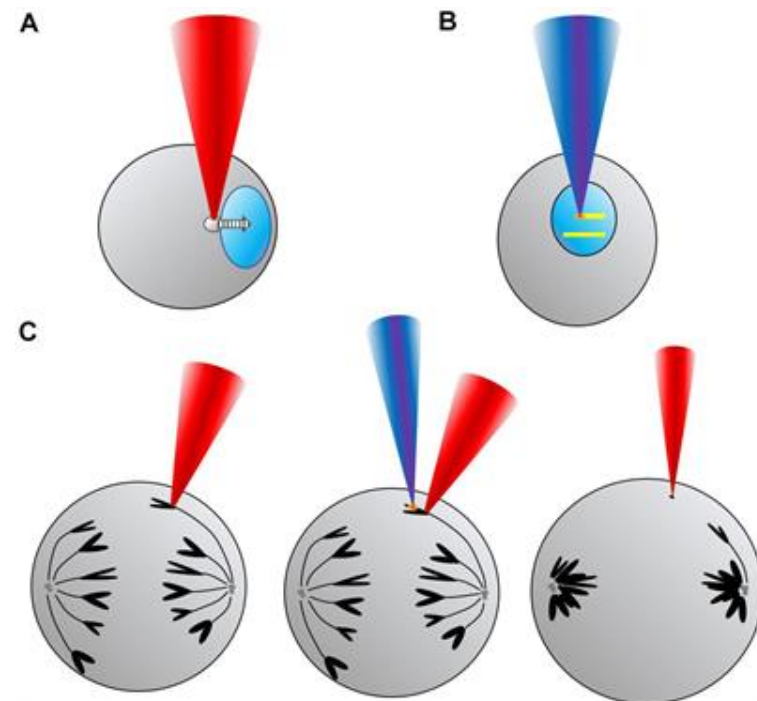
Manipulação de pequenas partículas



[HTML] Grasping and manipulation of a micro-particle using multiple optical traps

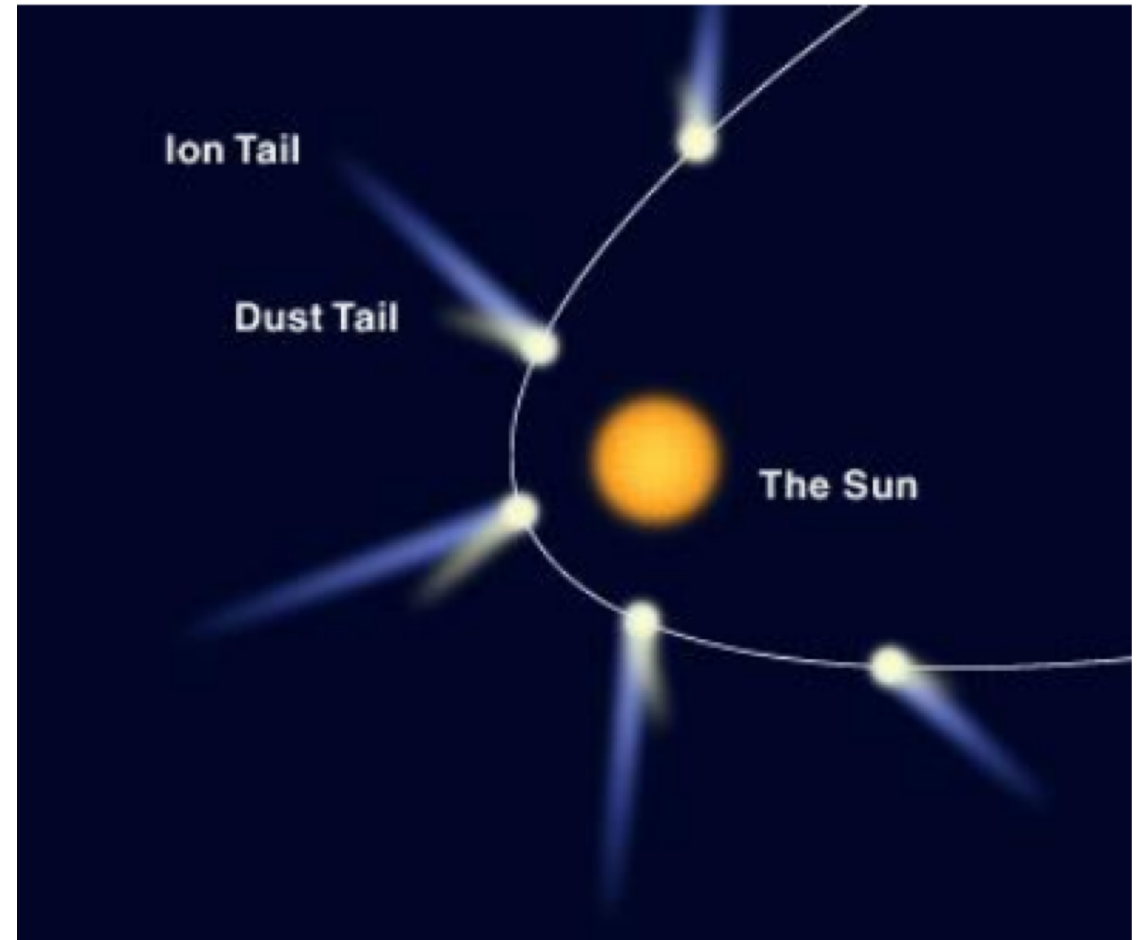
[CC Cheah, QM Ta, R Haghighi - Automatica, 2016 - Elsevier](#)

Manipulação genética

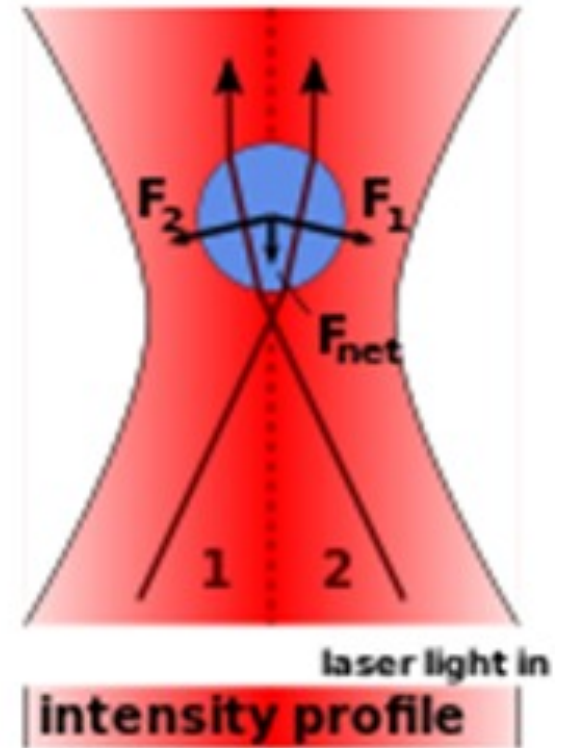
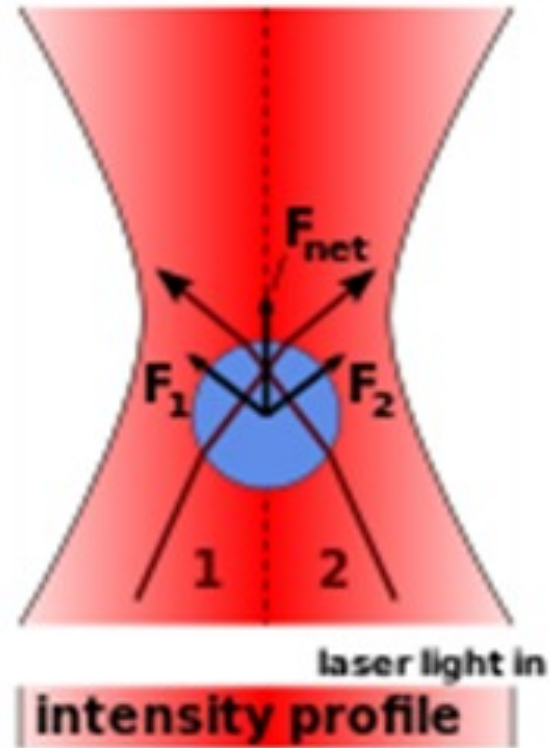
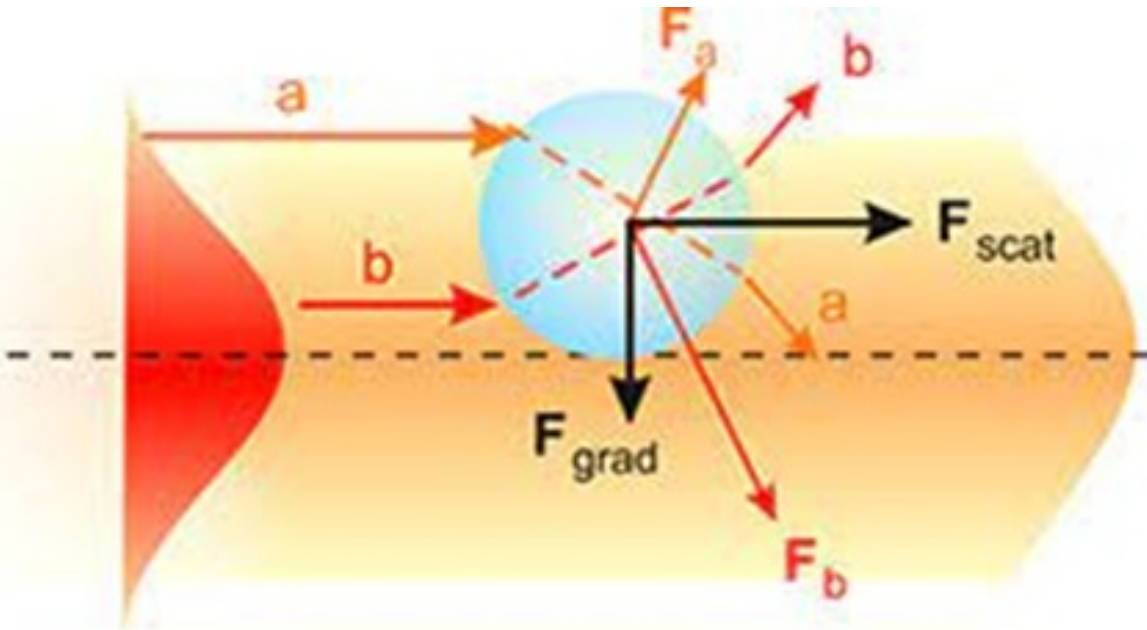


Pressão de radiação

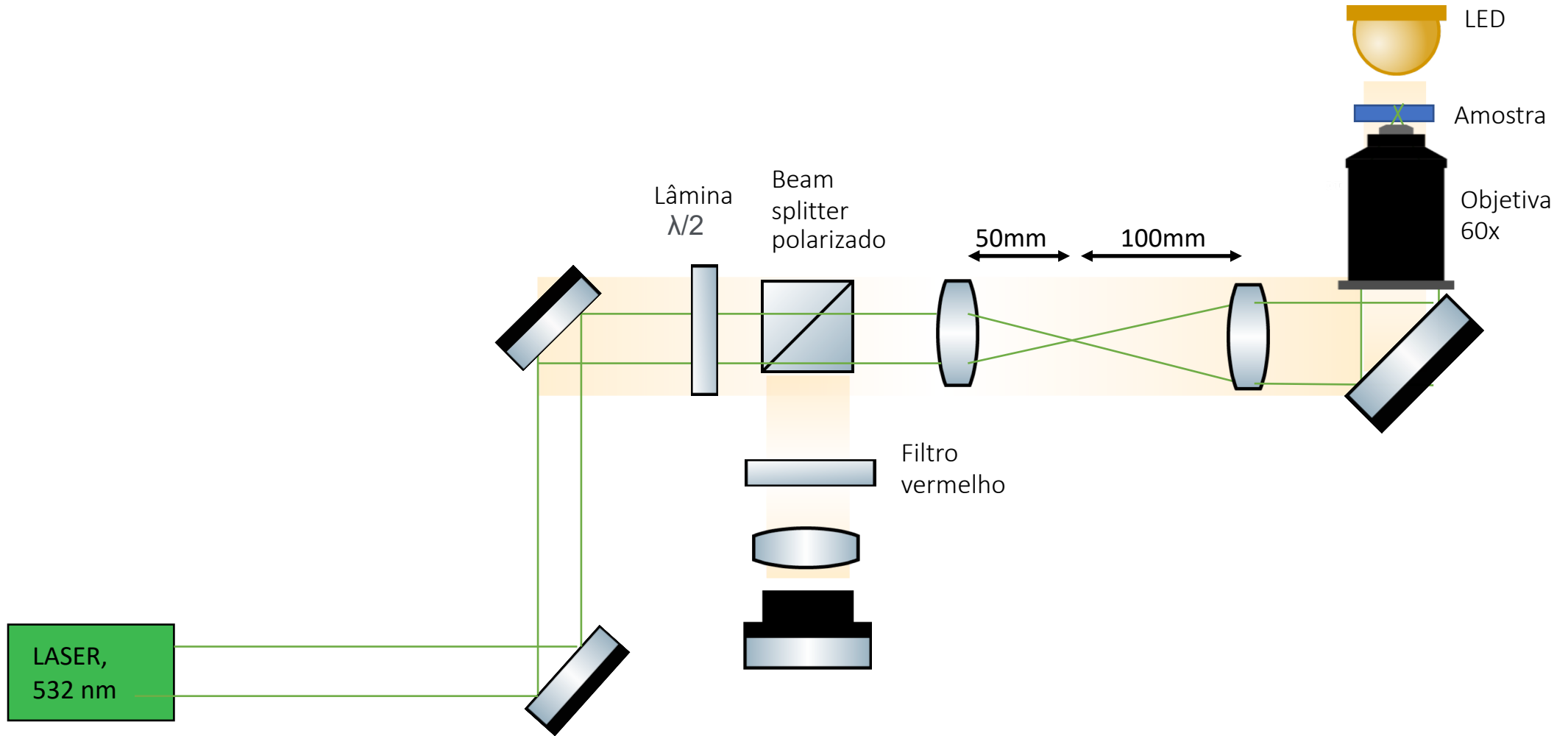
- A pressão de radiação é a pressão exercida sobre uma certa superfície devido à incidência de uma onda eletromagnética. Isto ocorre pois, apesar de uma onda eletromagnética possuir massa de repouso igual a zero, esta também possui momento linear.

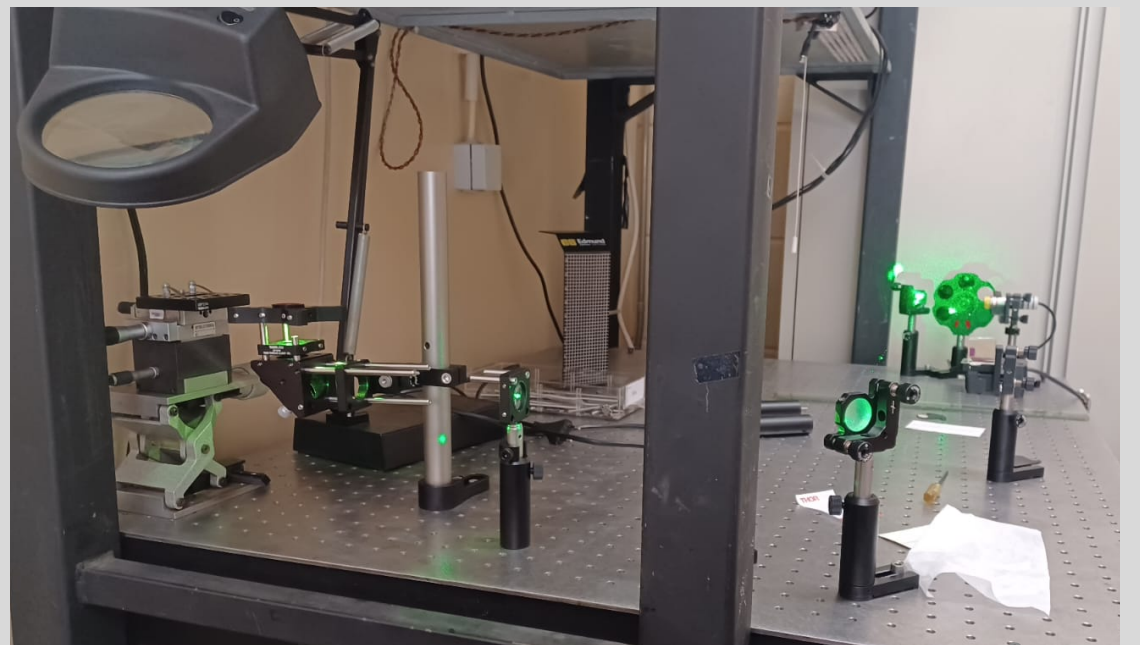
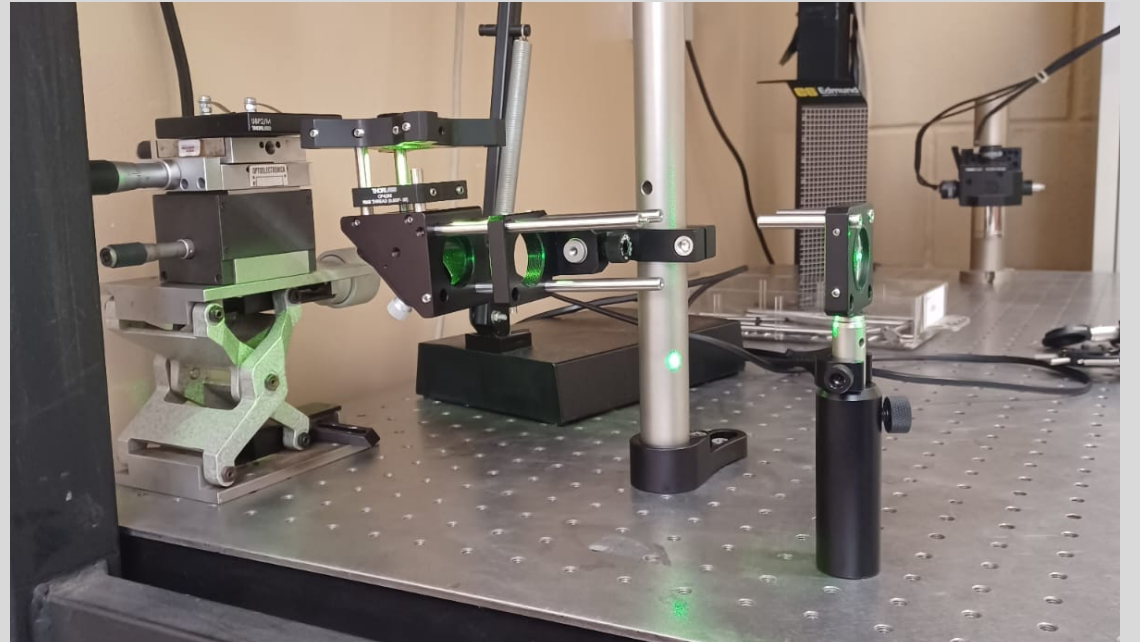
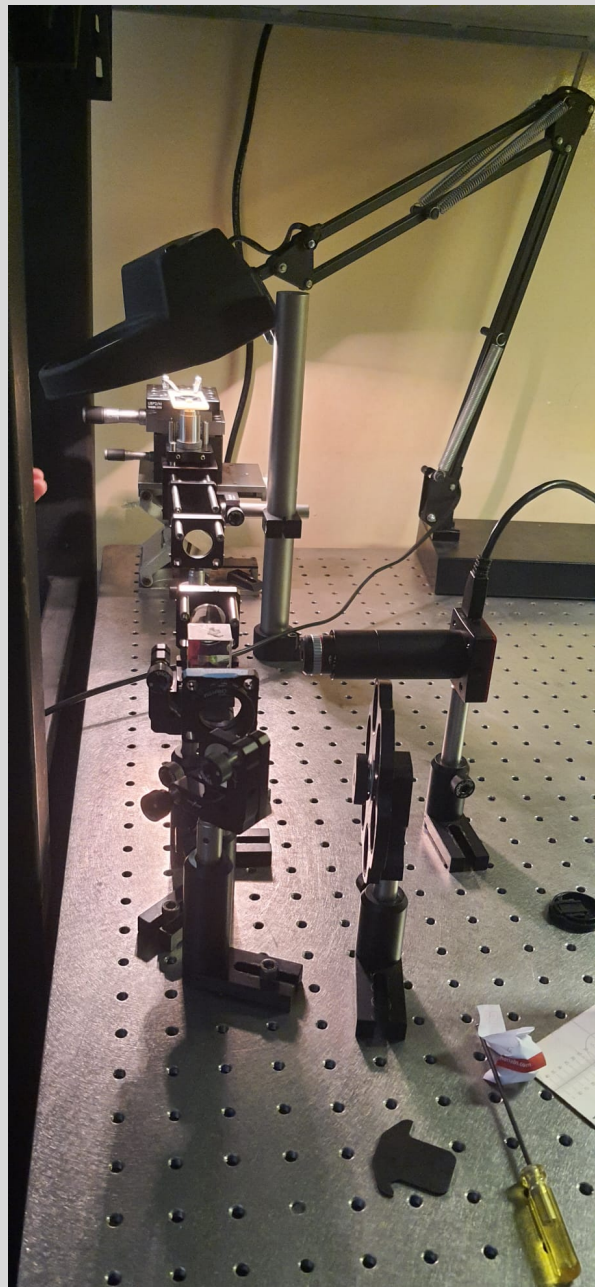
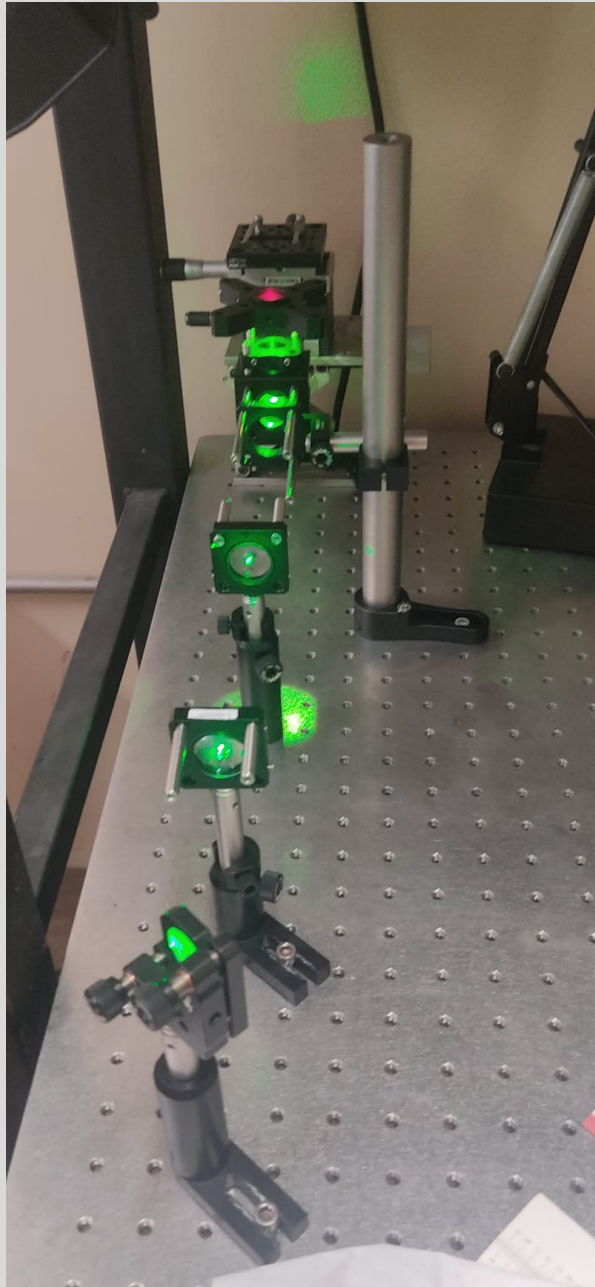


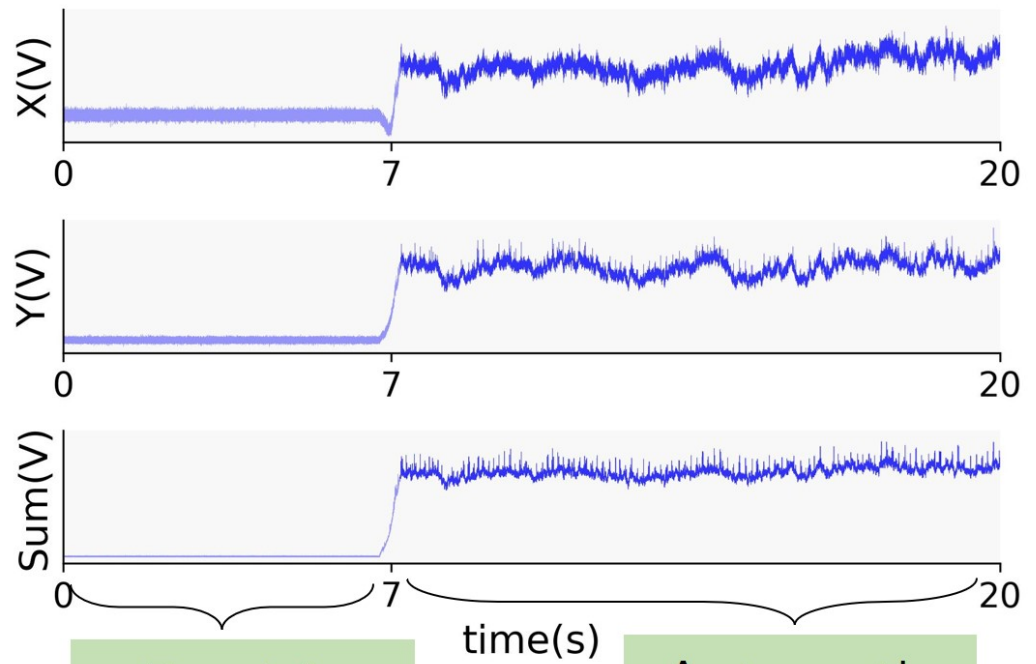
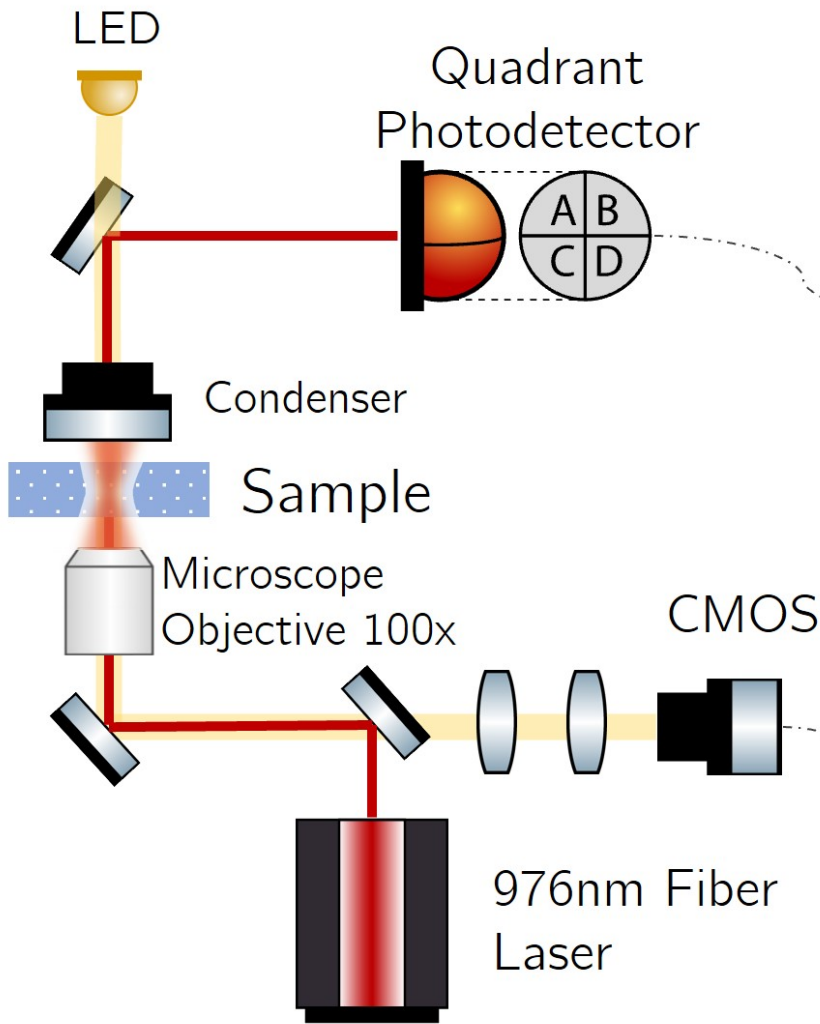
Como funciona?



Montagem do sistema

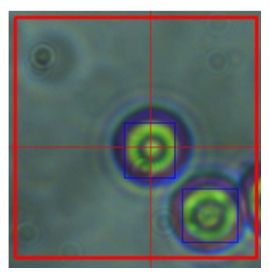
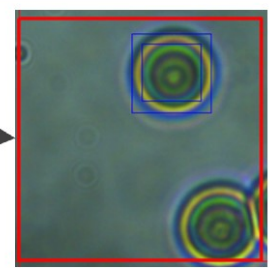


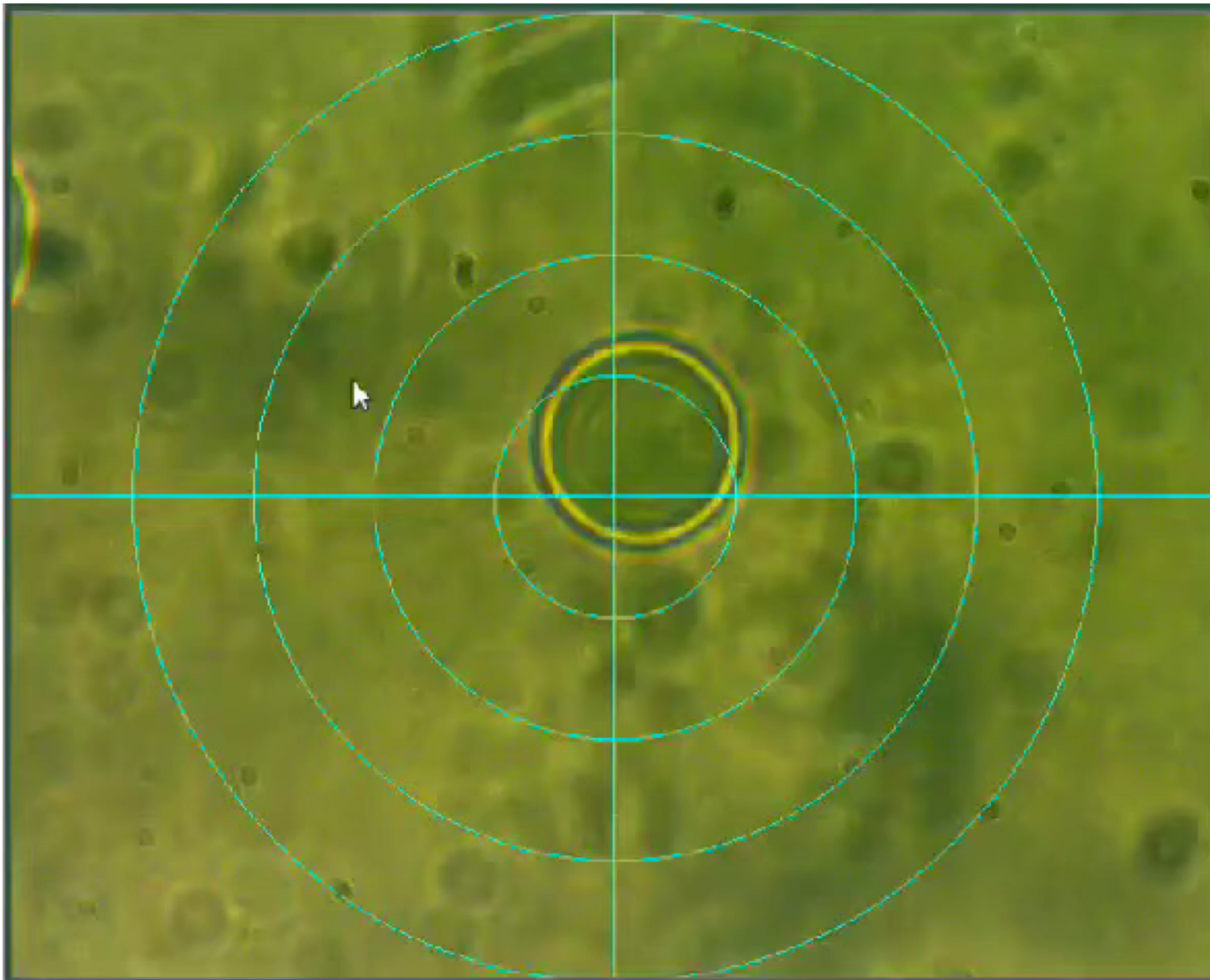




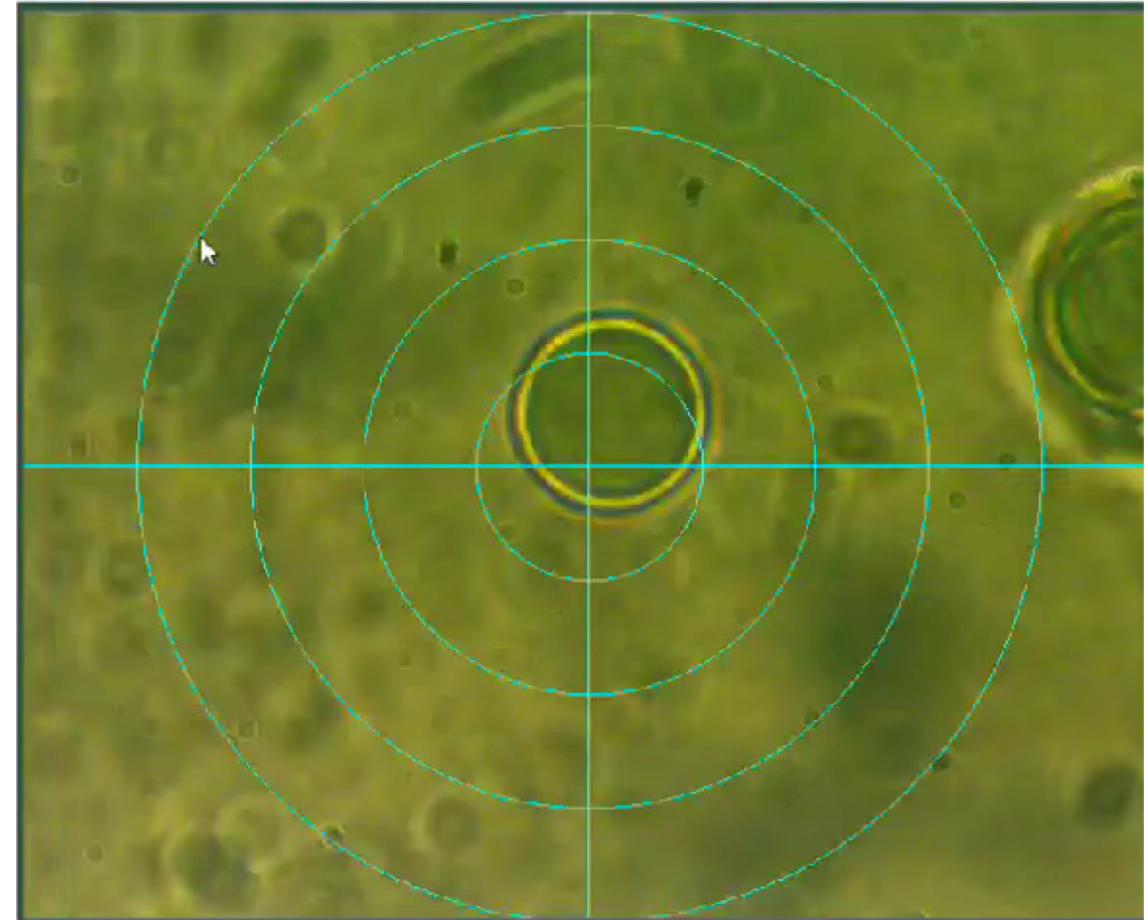
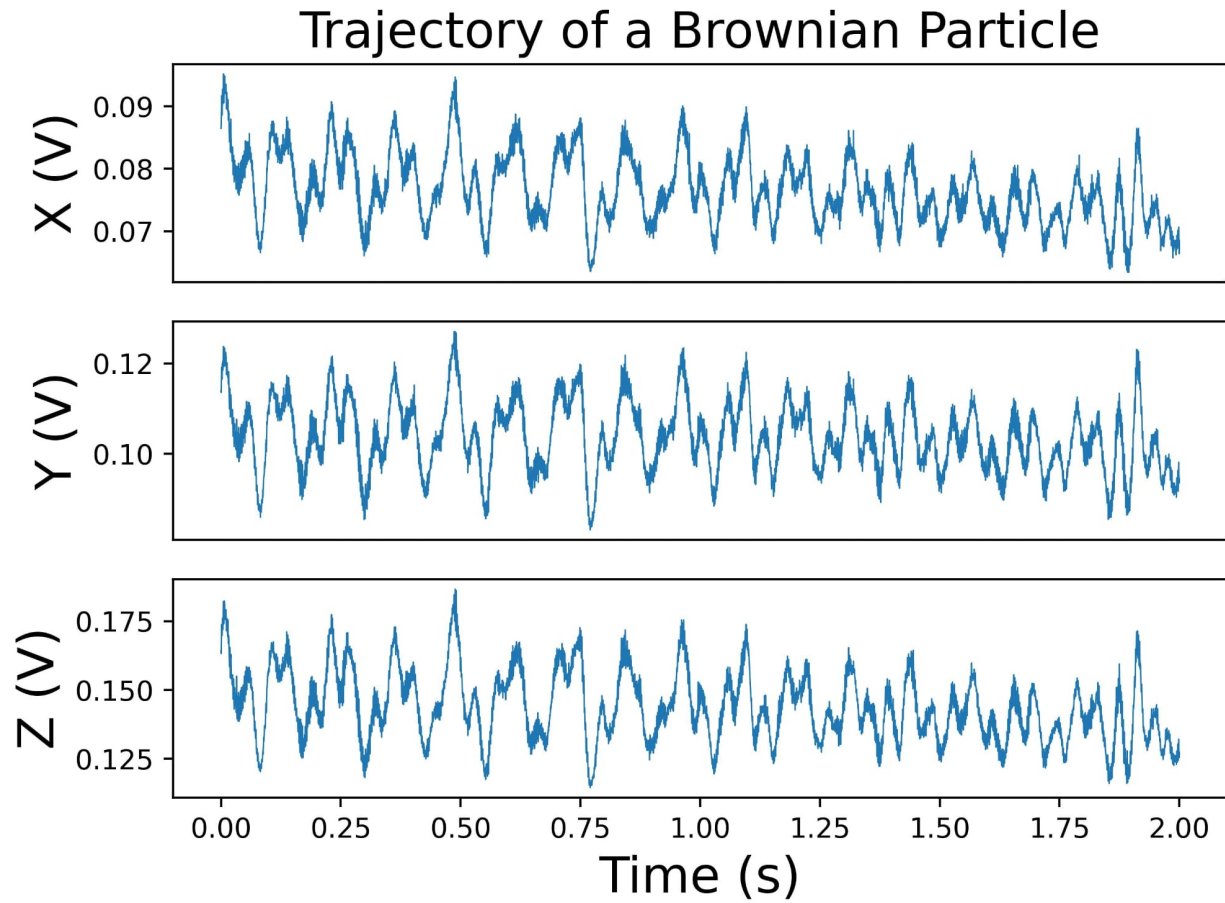
Particle Detection

Automatic Trapping



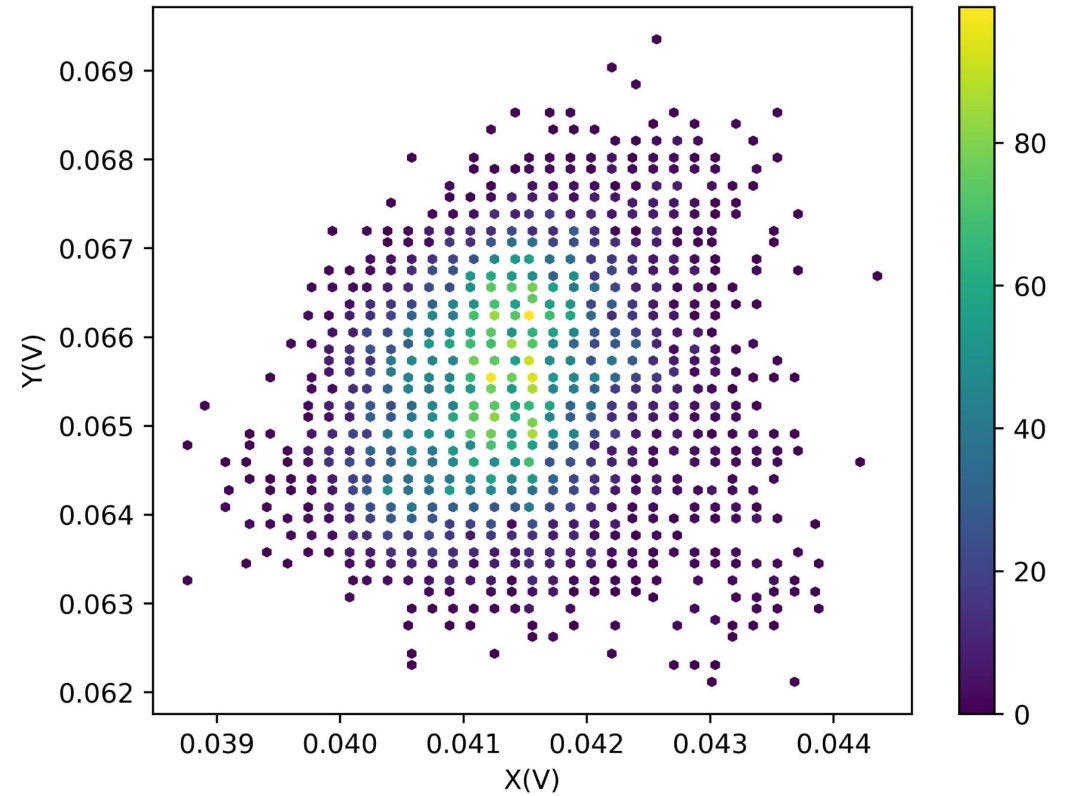
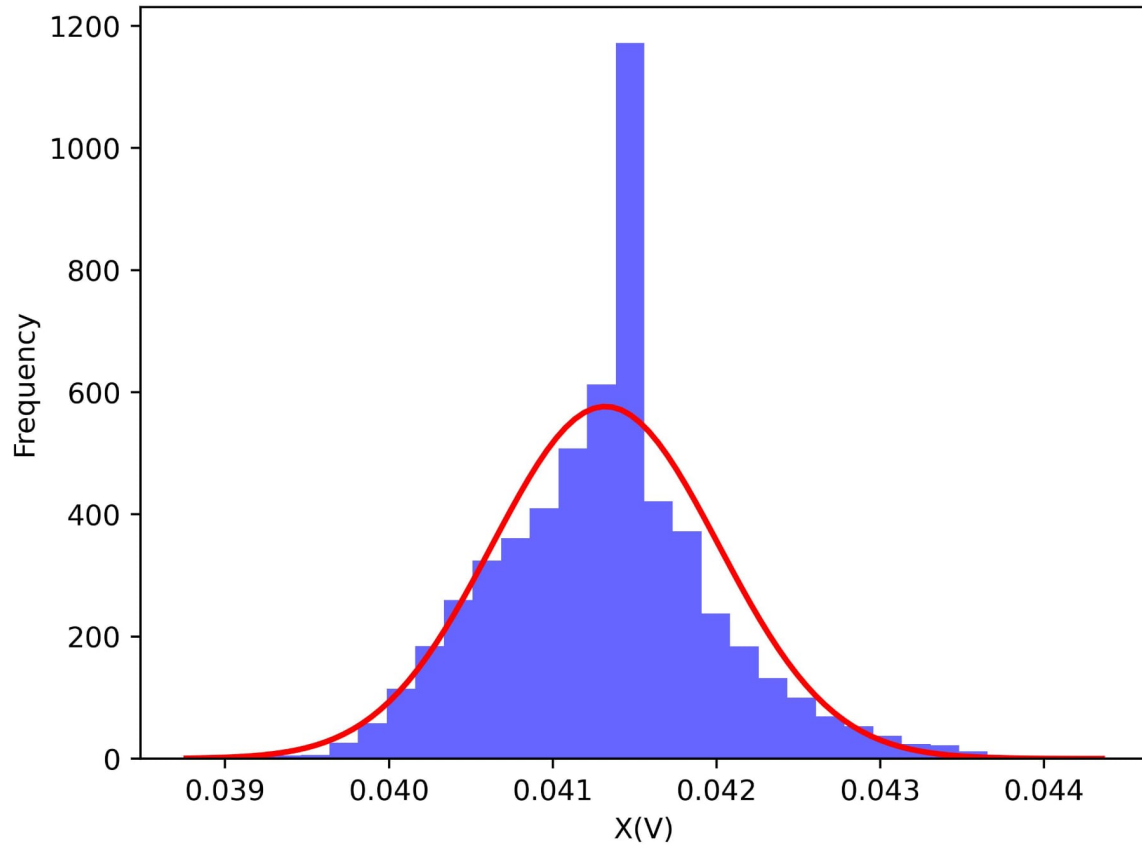


Trajectoria de uma partícula browniana

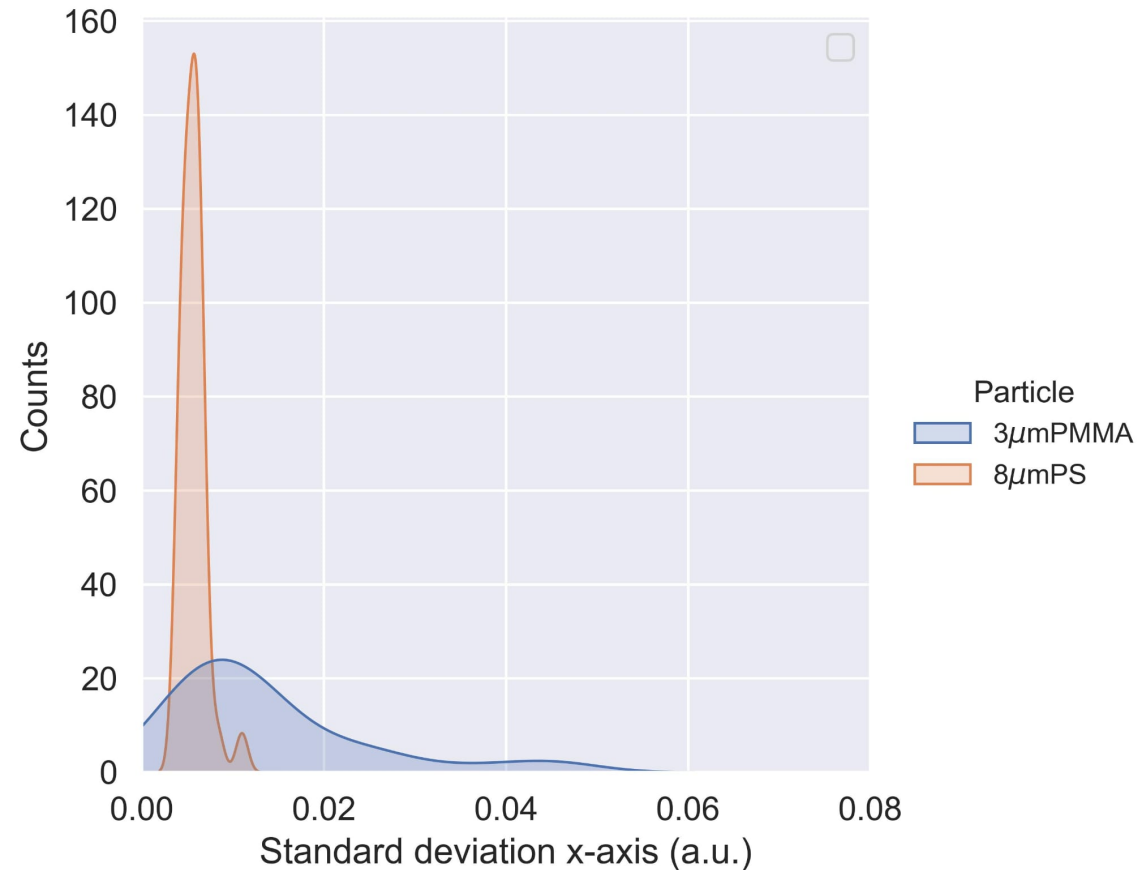


Distribuição Gaussiana

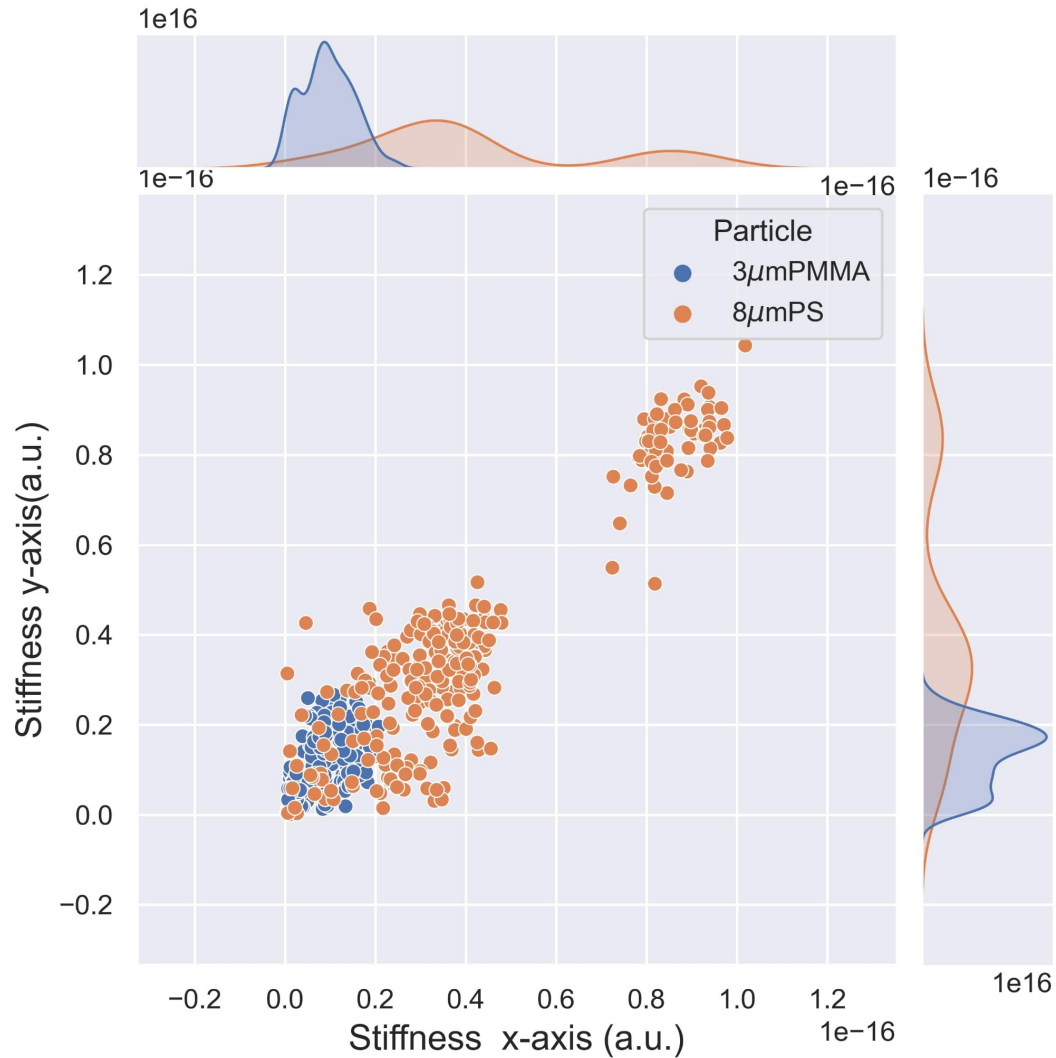
Histogram with Gaussian Distribution



Desvio padrão da posição das partículas



Teorema da Equipartição



$$\langle U(x) \rangle = \frac{1}{2} \kappa_x \langle (x - x_{\text{eq}})^2 \rangle = \frac{1}{2} k_B T$$

T Temperatura

k_B Constante de Boltzmann

Conclusão

