



# ESPETROSCOPIA DE PLASMAS

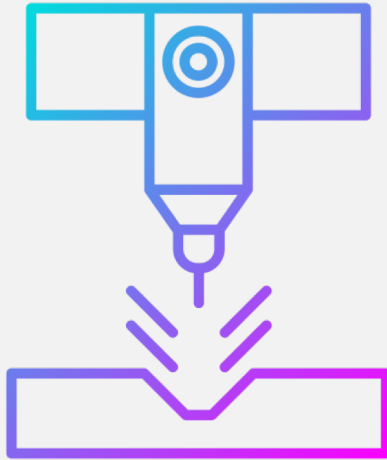
*LIBS*





# Plasma

- 4.º estado da matéria
- É o mais abundante no universo
- **Gás ionizado**



## Exemplos

- Relâmpagos
- Estrelas
- Chama

01

02

03

04

05

06

01

02

03

04

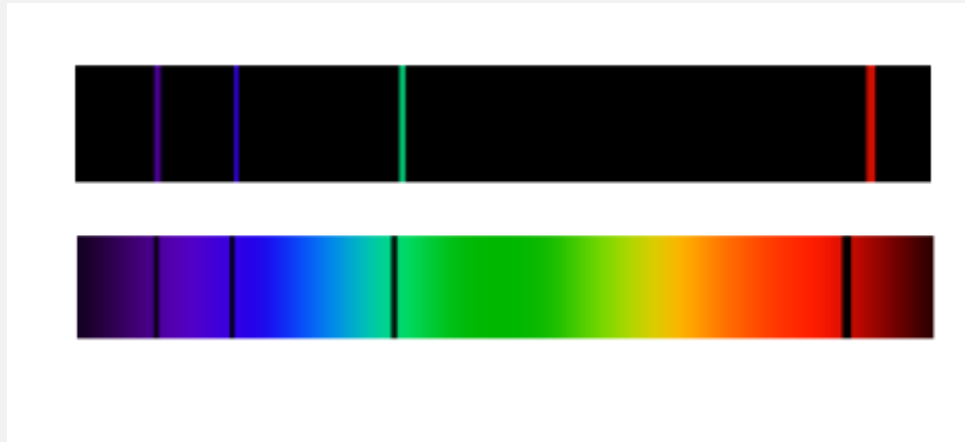
05

06



# Espetroscopia

*A espectroscopia é o estudo da interação entre a radiação eletromagnética e a matéria.*

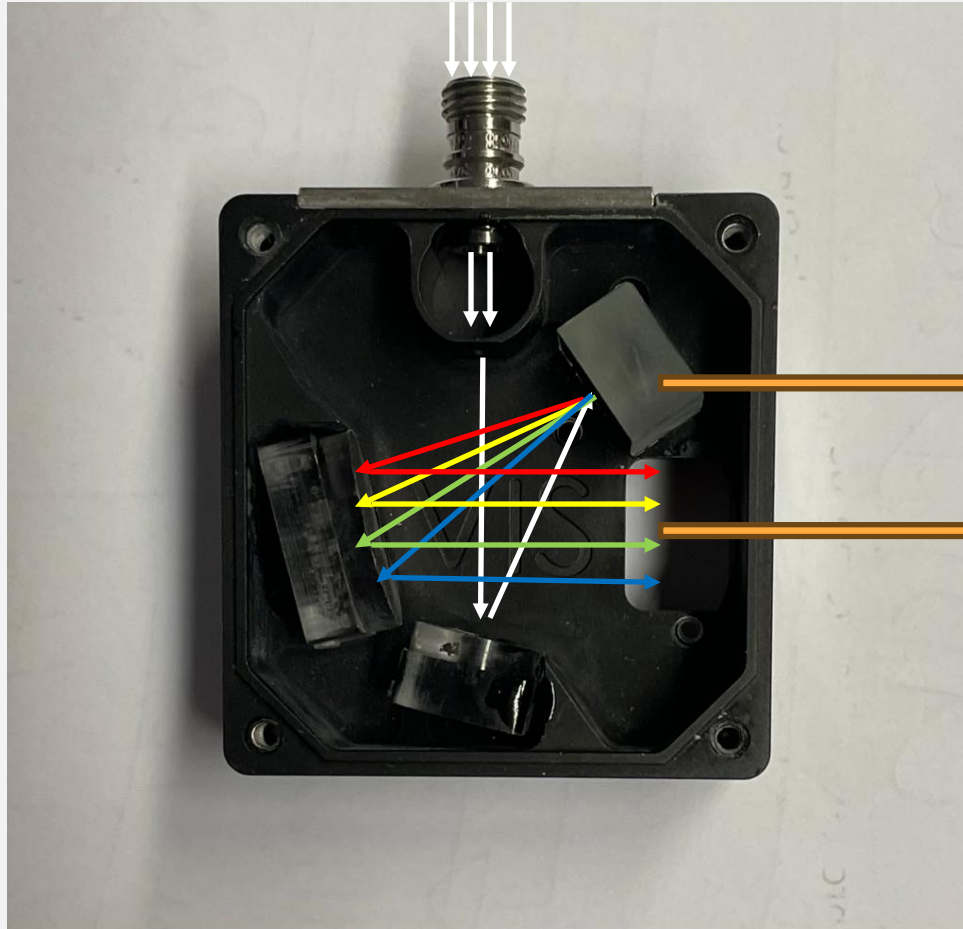


003-1040559

1250 003-77156.8

1760 0009-14563.7

73273

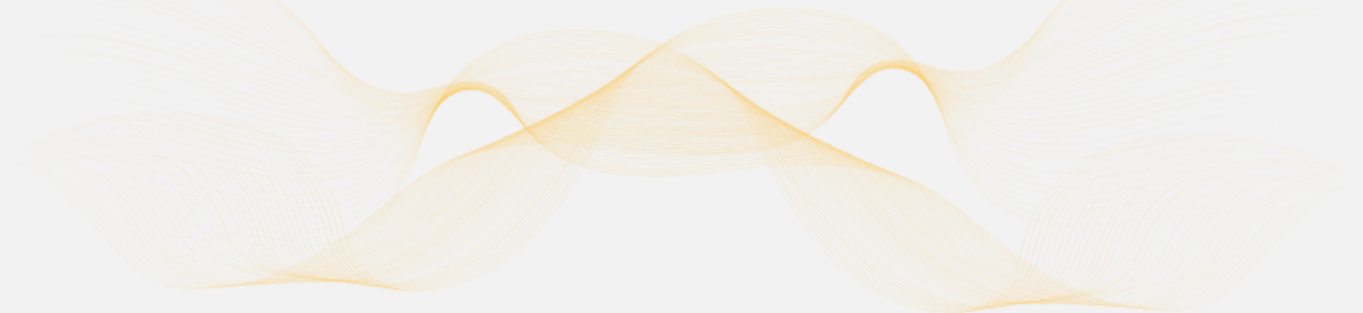


**Rede de Difração**

**Array de fotodetetores**







# LIBS

*Laser-induced Breakdown Spectroscopy*





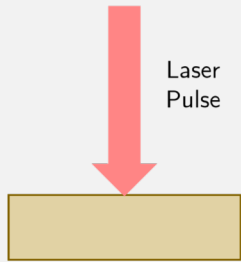
# Em que consiste a técnica LIBS?

Técnica de espectroscopia que utiliza um pulso laser de elevada intensidade para determinar a composição de uma amostra pela geração de um plasma de elevada temperatura, seguido de espectroscopia temporal



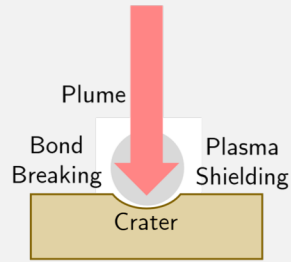


### Plasma Ignition



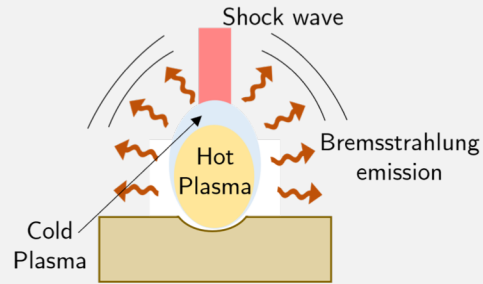
$T_0$

### Thermal Vaporization



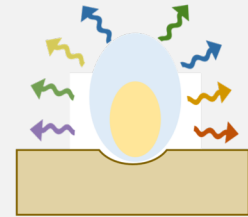
20 ps

### Plasma Expansion



20 ns

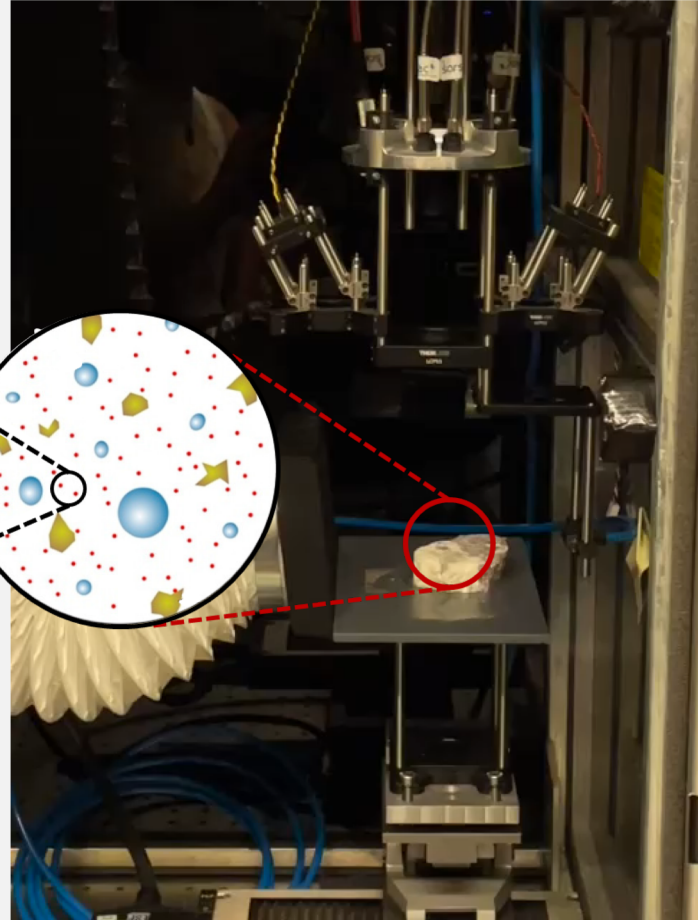
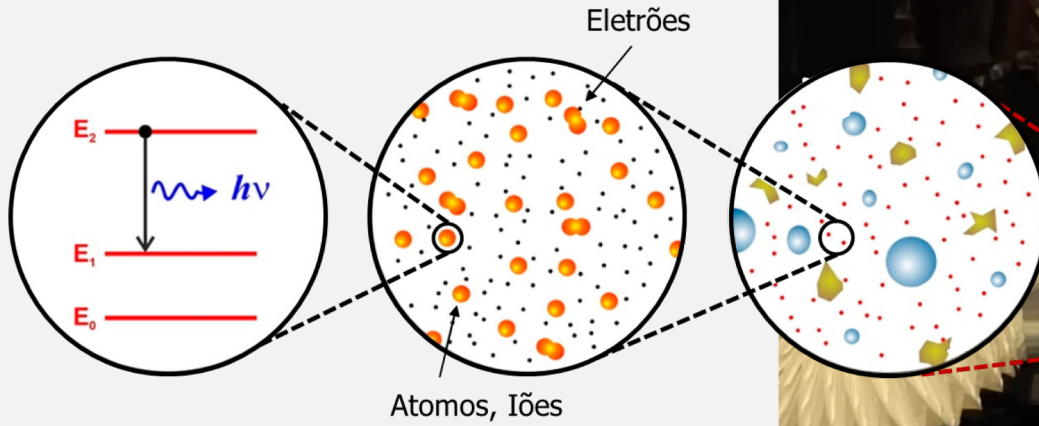
### Element Specific Emission



1  $\mu$ s

Time



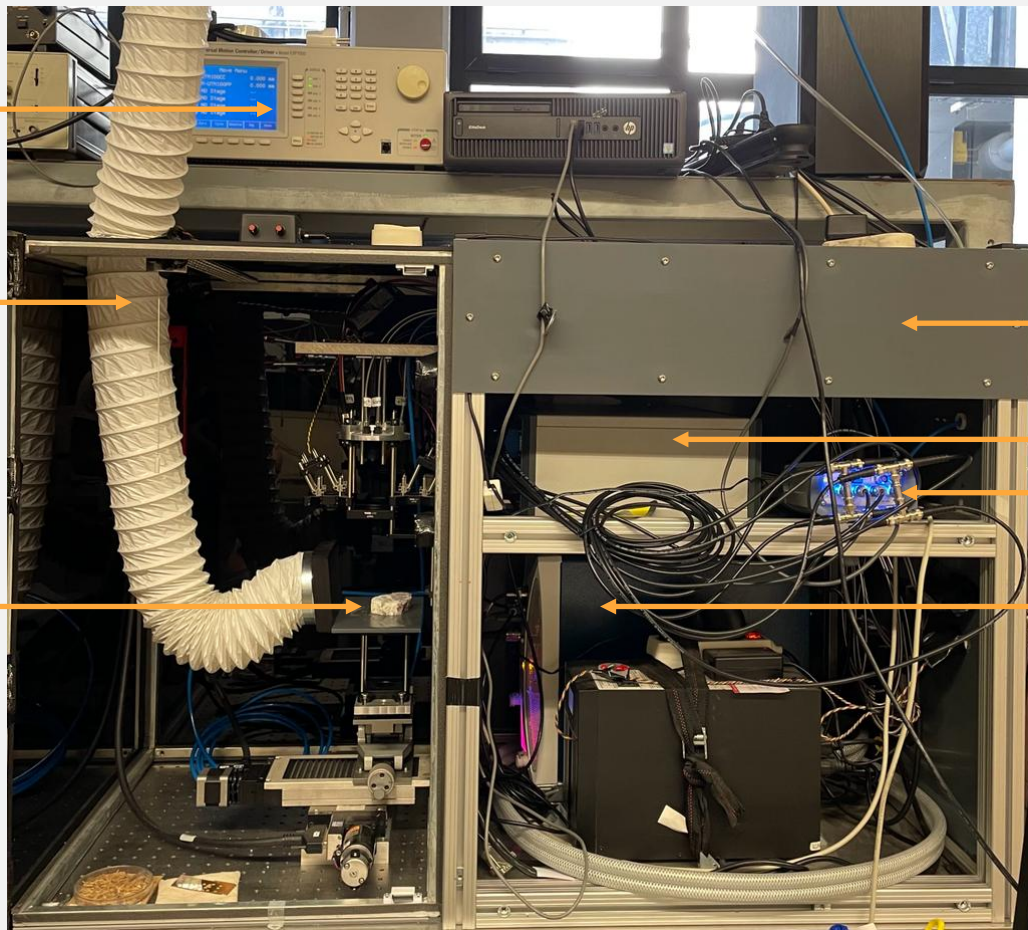




Motion controller

Tubo de extração

Amostra



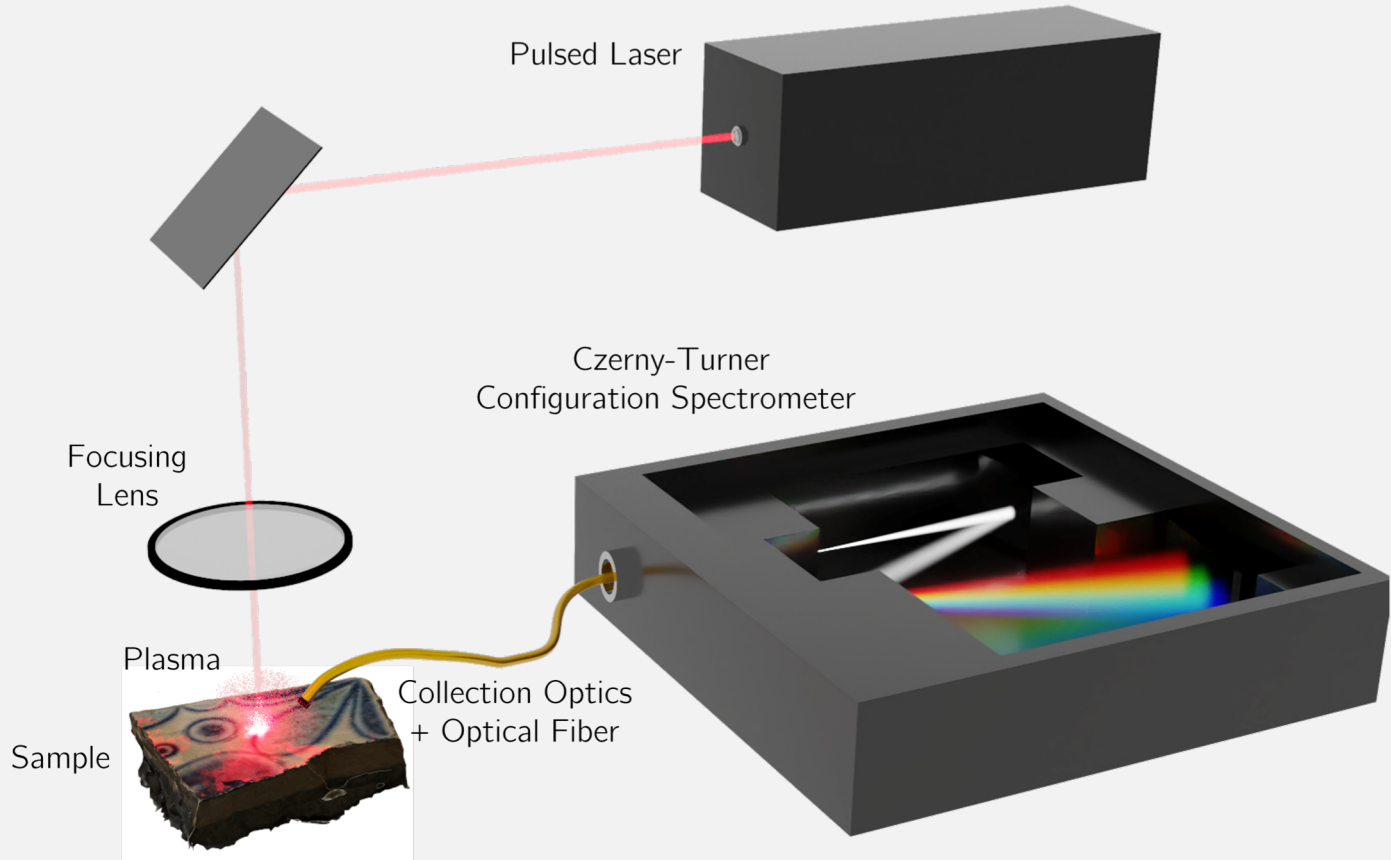
Laser

Espetrómetros

Sincronizador

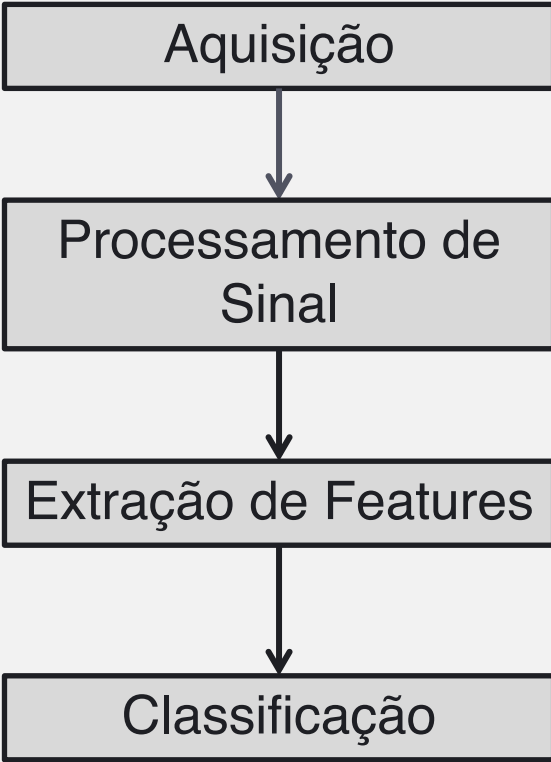
Refrigeração



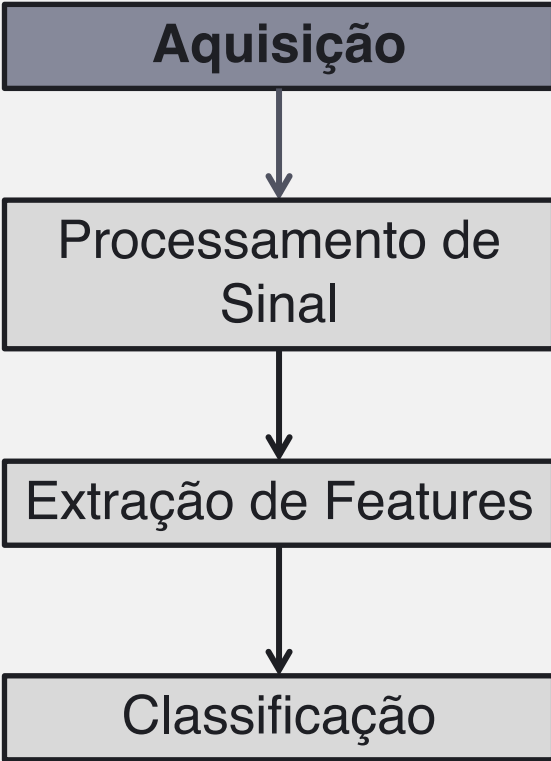


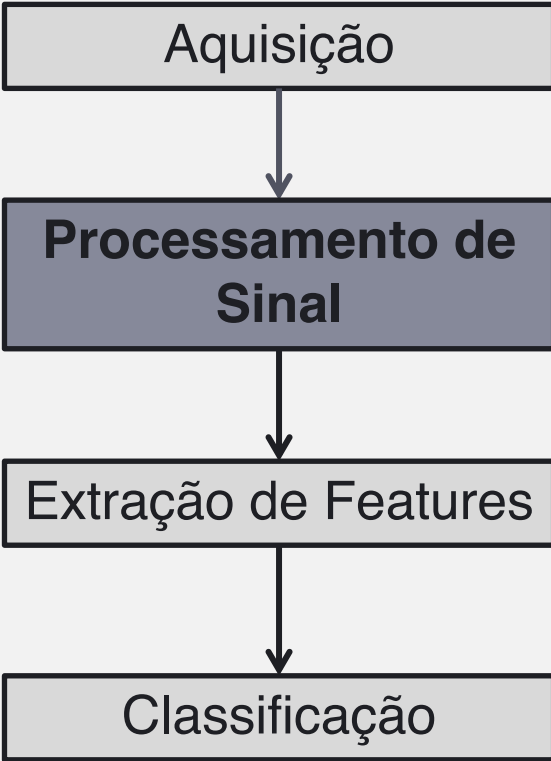
# Análise de dados

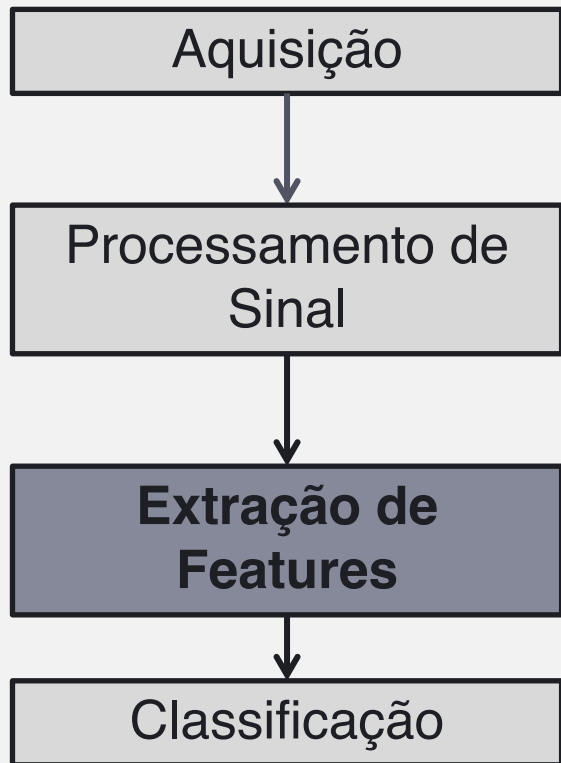




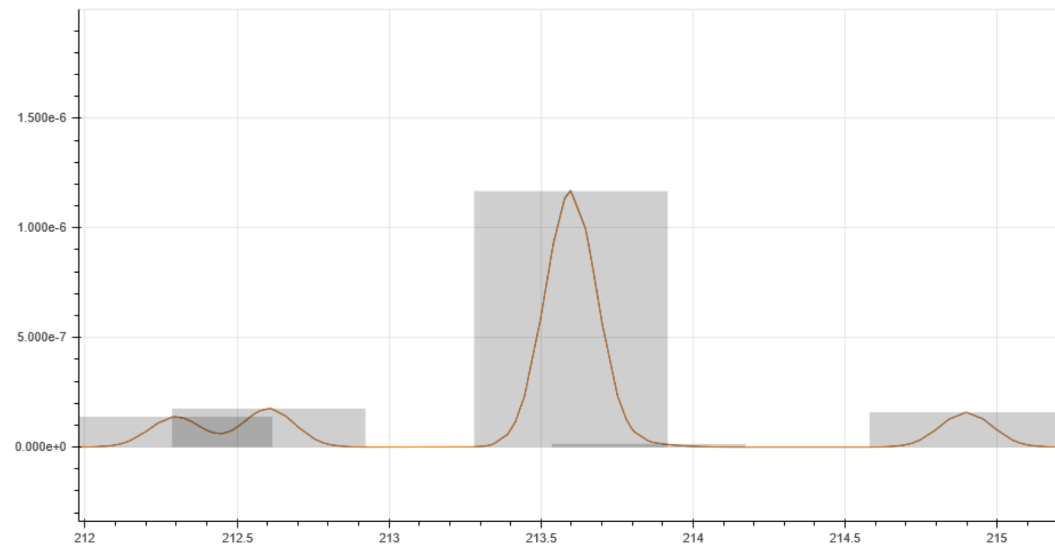


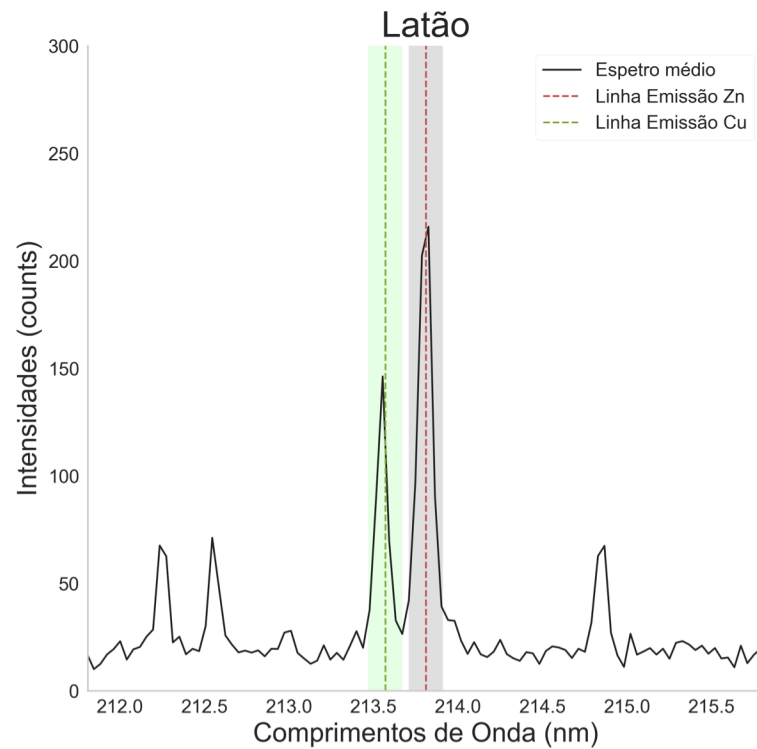
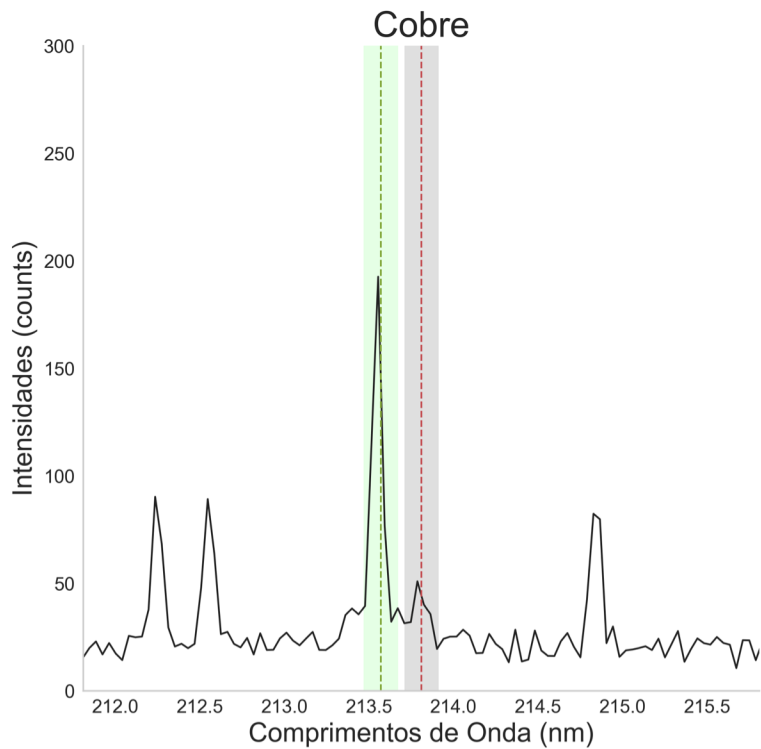






LIBS Info: Cu Analysis







Aquisição



Processamento de Sinal



**Extração de Features**



**Linhas de Emissão de Zinco e Cobre**





Aquisição



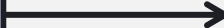
Processamento de Sinal



Extração de Features

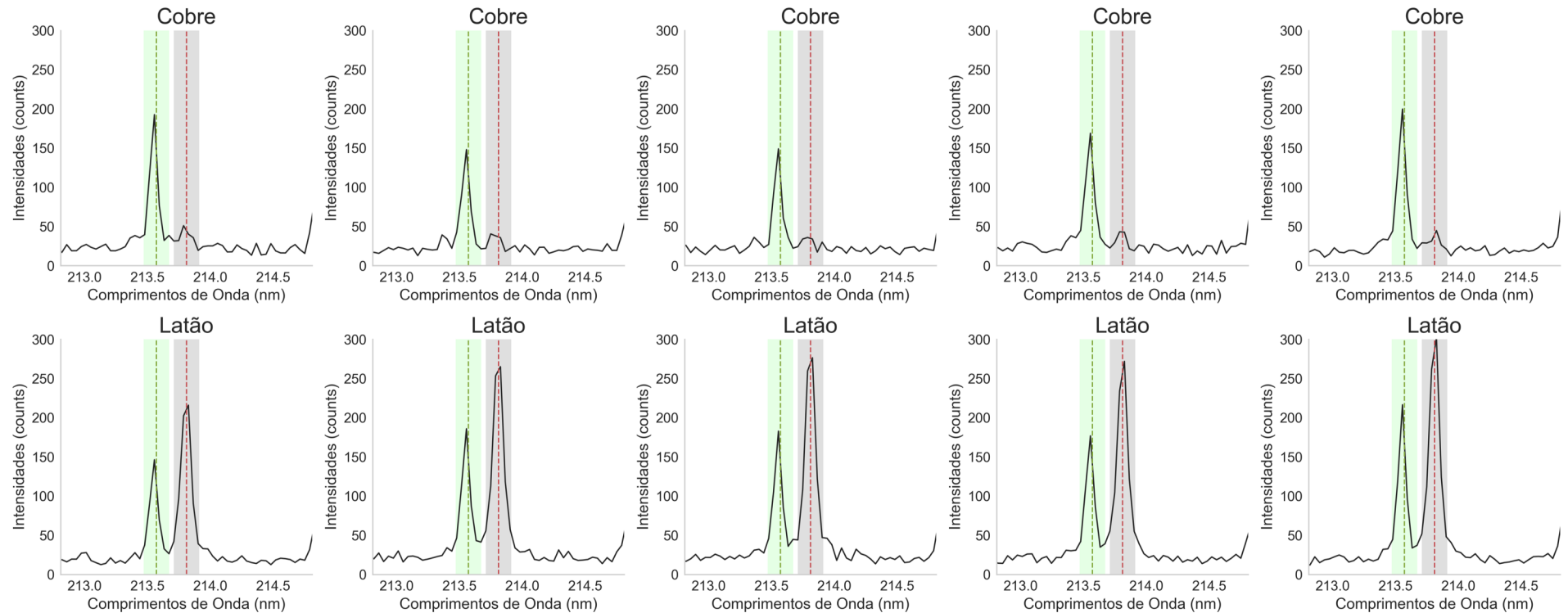


**Classificação**

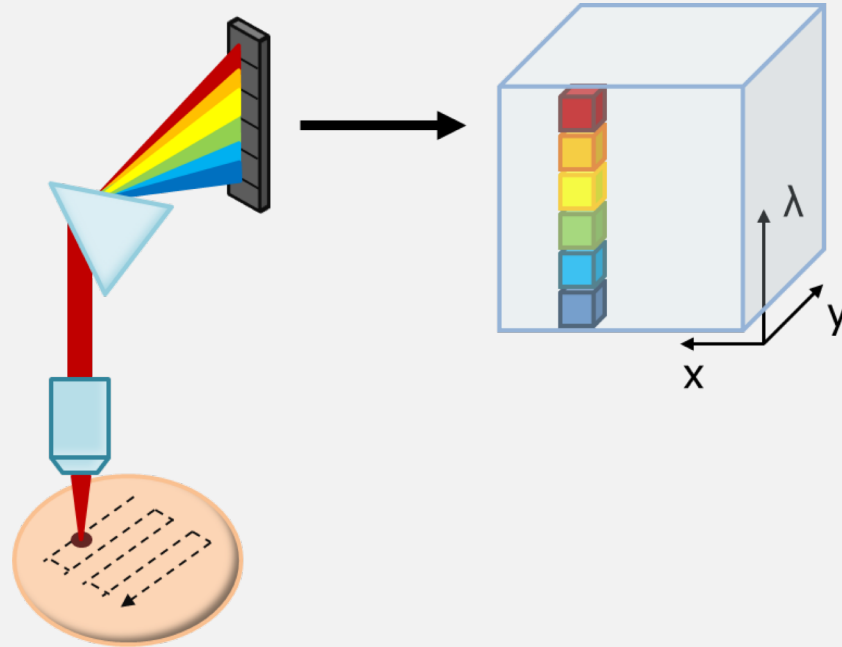


**Automatização do processo de classificação**

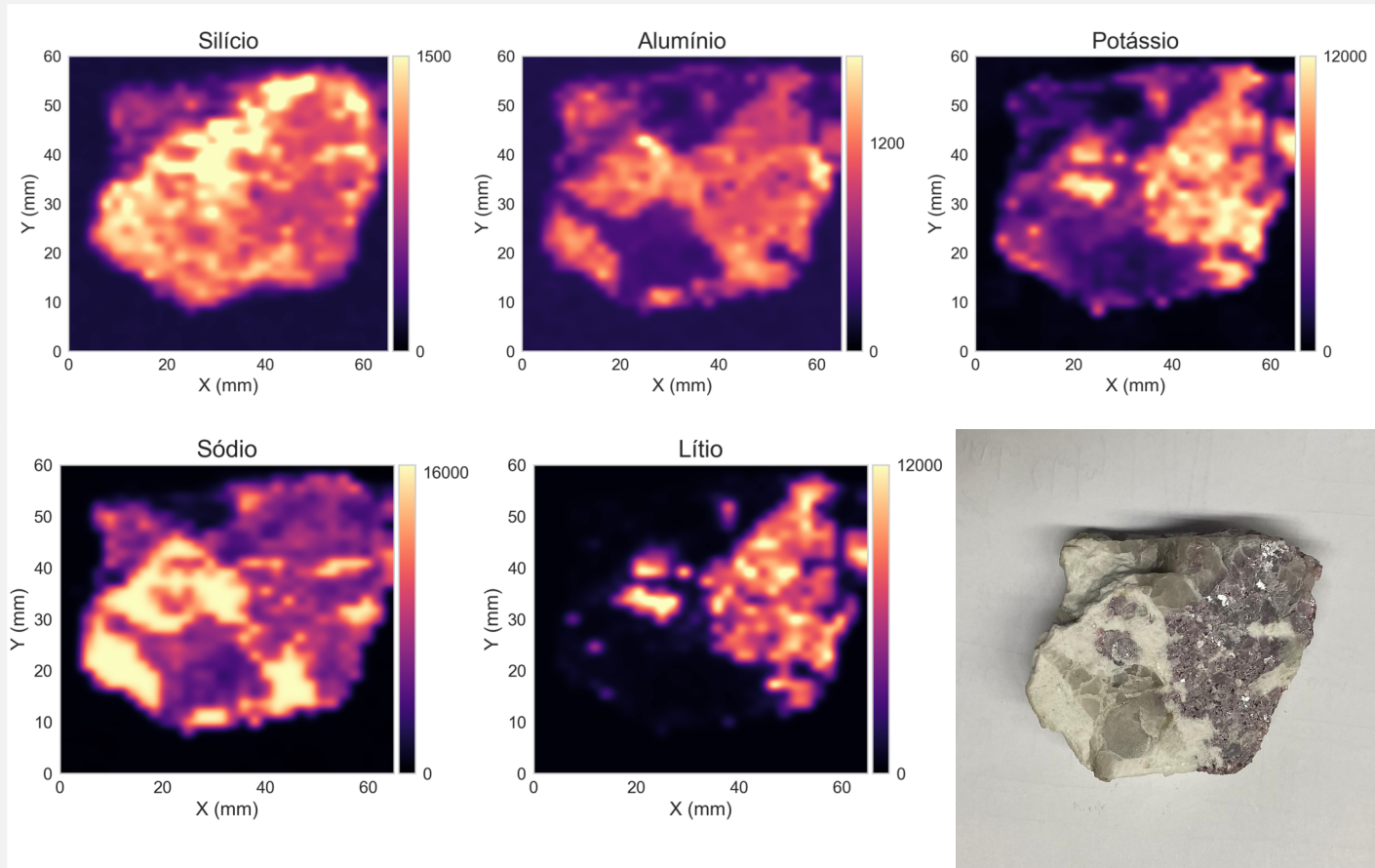


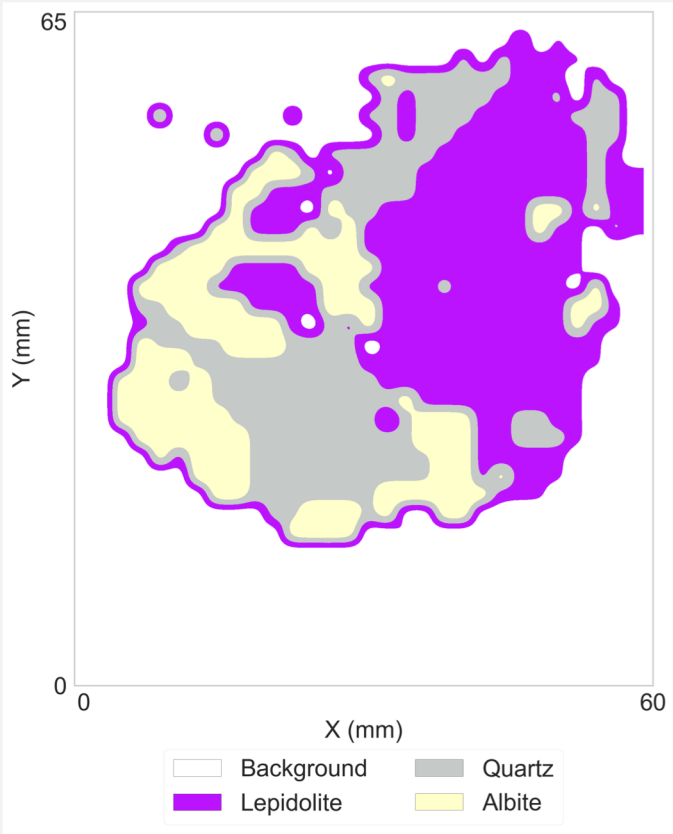


# LIBS imaging











## Vantagens

Não é necessário a preparação das amostras

Elevadas taxas de aquisição

Versatilidade e portabilidade

## Desvantagens



Necessidade de contextualização da amostra

Inconsistências no plasma





**Obrigado! 😊**

