

Espectrometrias de raios X: Ferramentas para explorar a localização e movimento de nutrientes em plantas

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GEFEN

GRUPO DE ESTUDO DE FERTILIZANTES
ESPECIAIS E NUTRIÇÃO



Synchrotron

Watch this video

<https://www.youtube.com/watch?v=l4NSF-gkKCU>



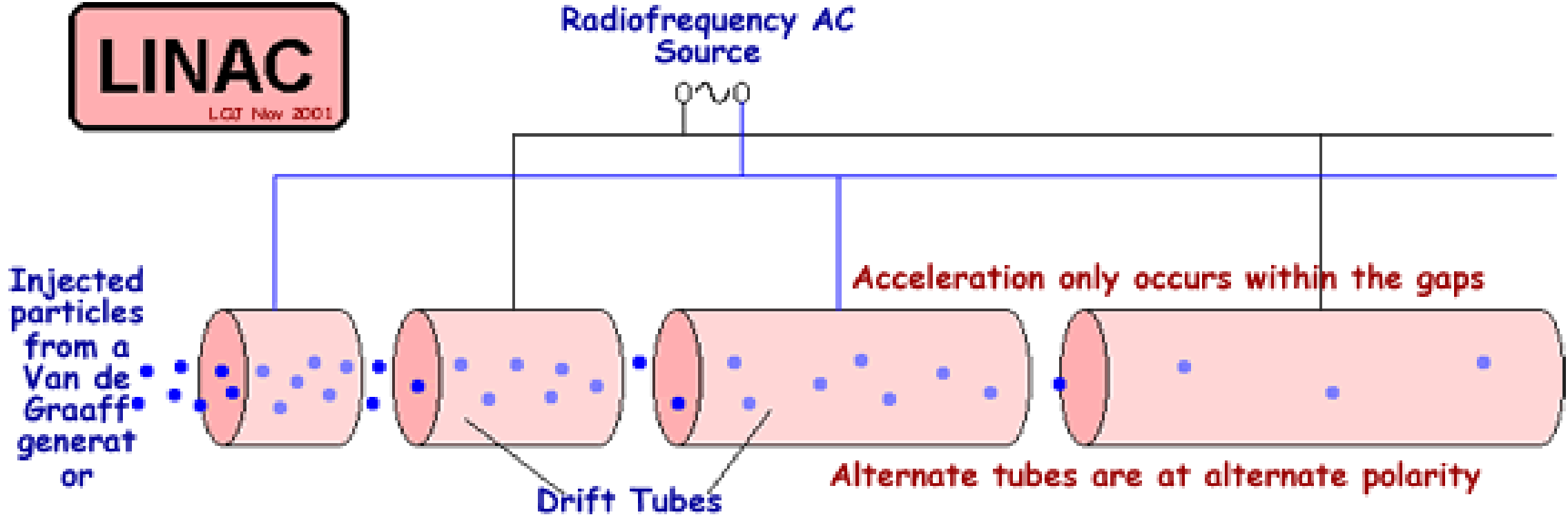
<https://revistagalileu.globo.com/Ciencia/noticia/2020/11/sirius-o-que-e-e-como-funciona-o-acelerador-de-particulas-brasileiro.html>

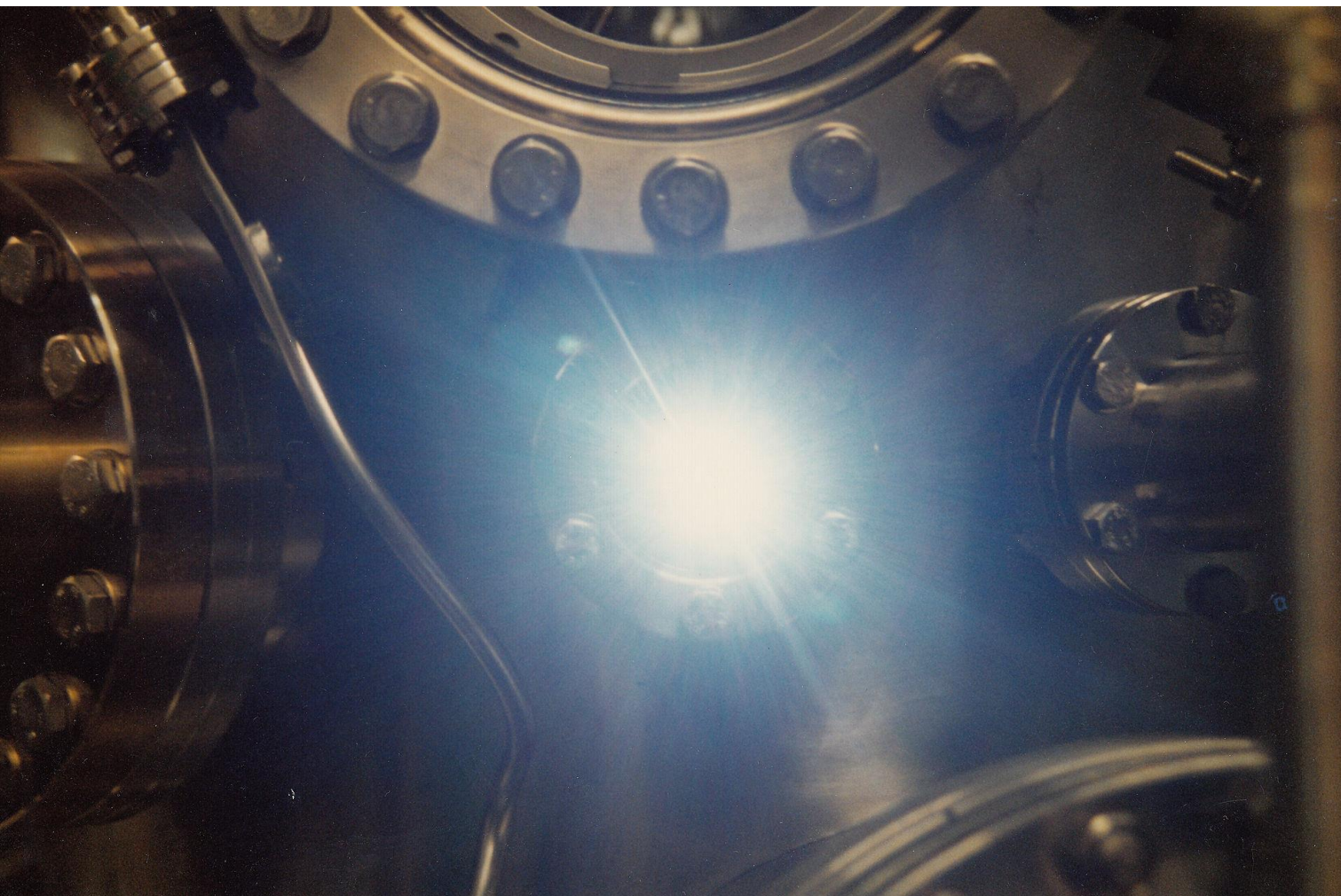


<https://www.reseau-canope.fr/docsciences/Galerie-Synchrotron.html>

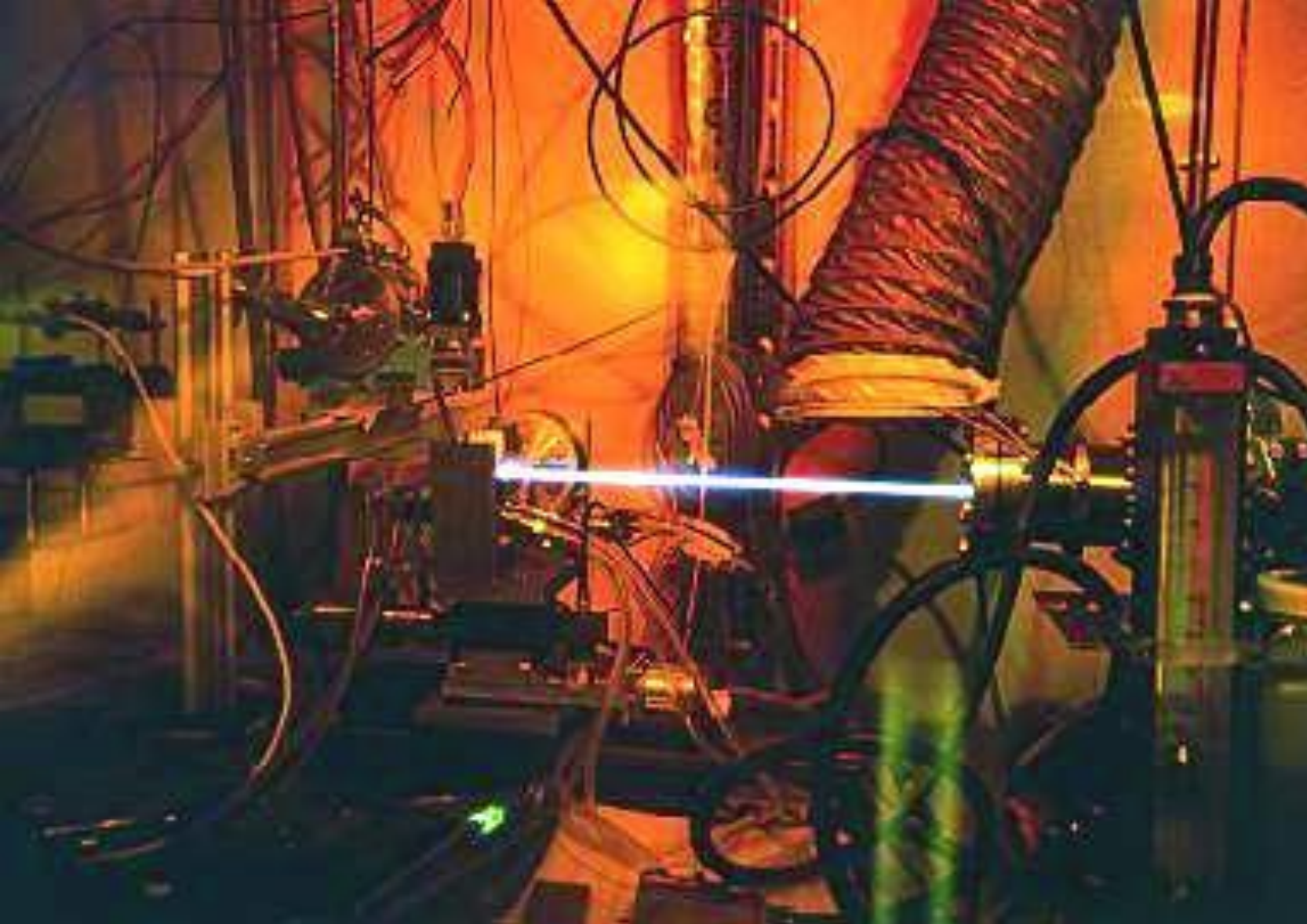
LINAC

LQJ Nov 2001





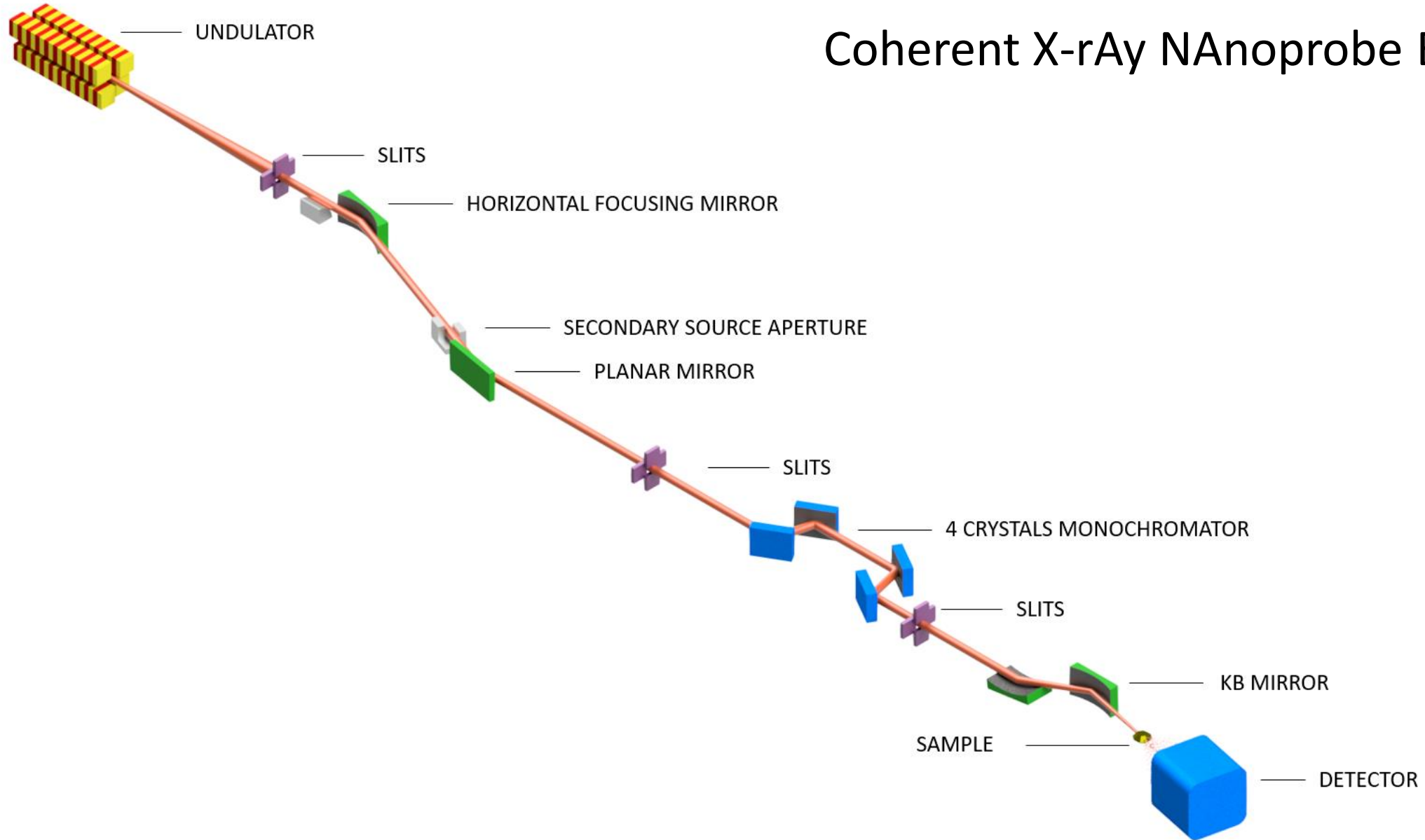
Synchrotron radiation reflecting from a [terbium](#) crystal at the Daresbury [Synchrotron Radiation Source](#), 1990



<https://www.cyberphysics.co.uk/topics/atomic/Accelerators/Synchrotron/synchrotron.htm>

CARNAUBA

Coherent X-ray Nanoprobe BeAmline

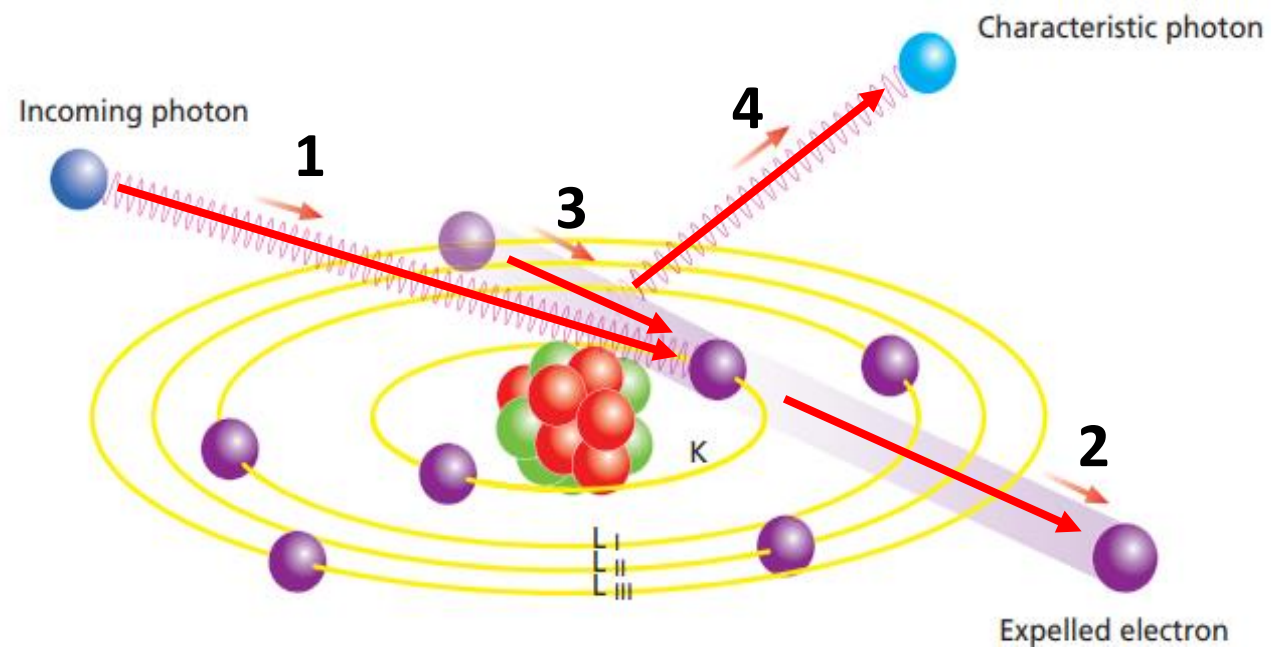
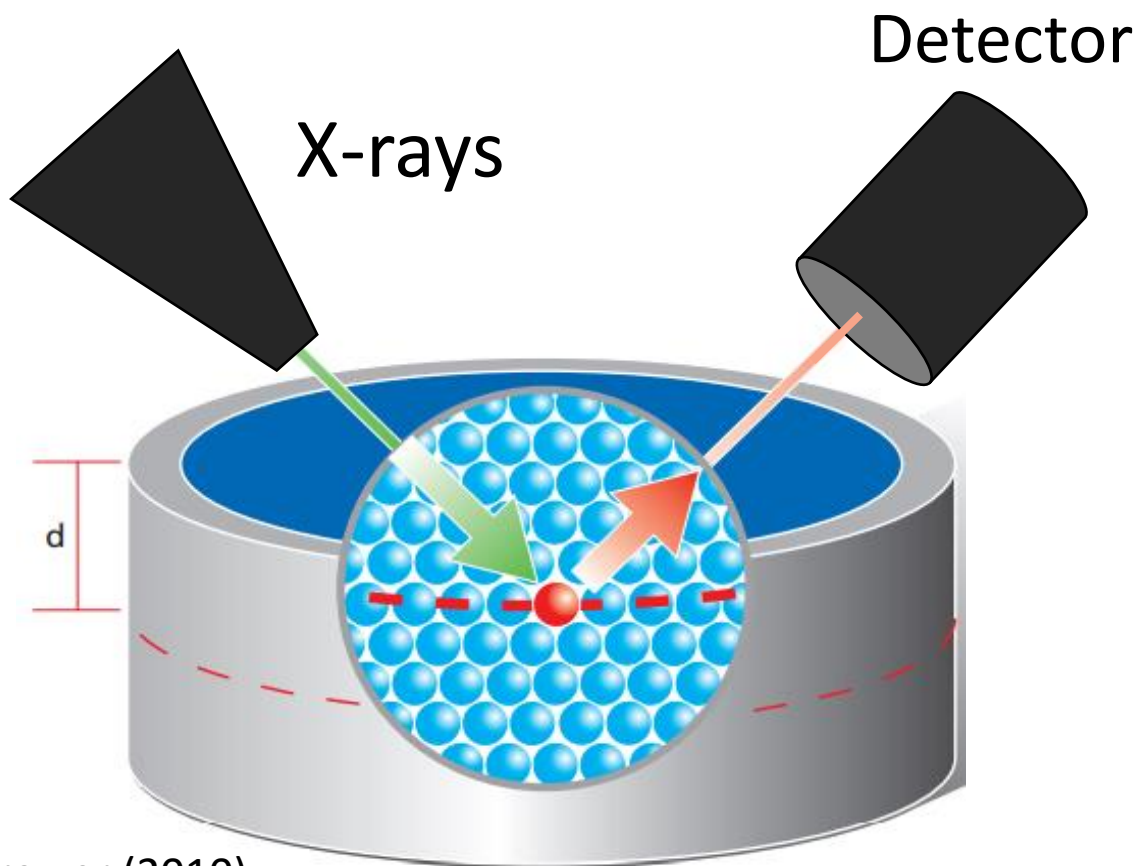


X-ray Fluorescence



X-ray spectrometry

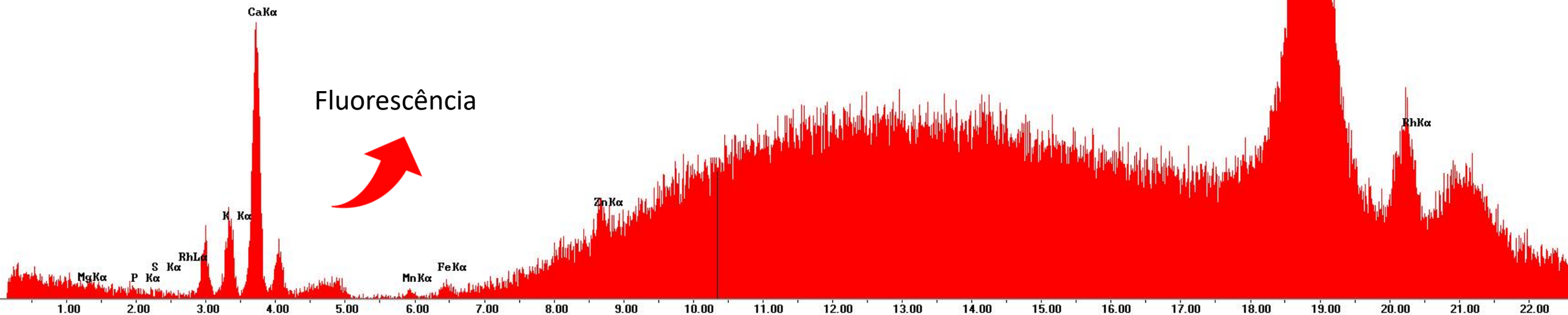
X-ray and matter interaction



Fluorescence

Spectrum

☐ You may recognize several elements



Spatial distribution pattern of elements in soybean seeds

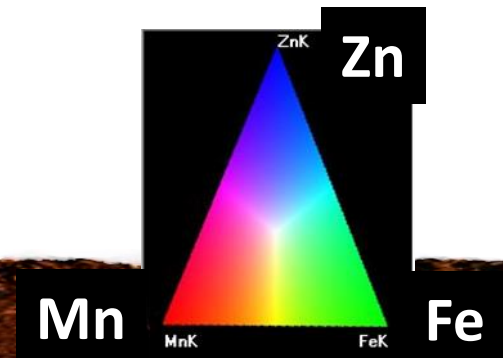
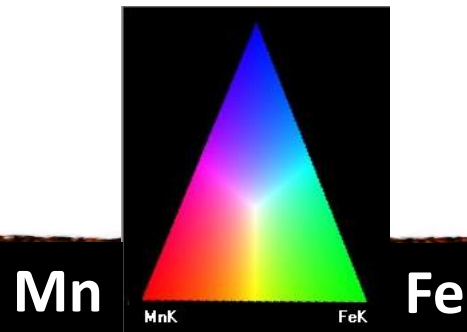
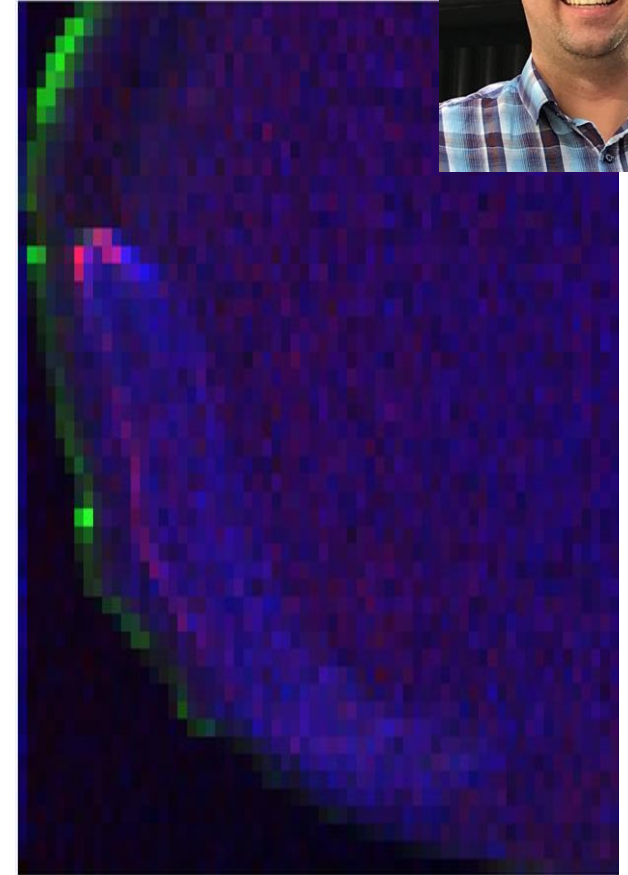
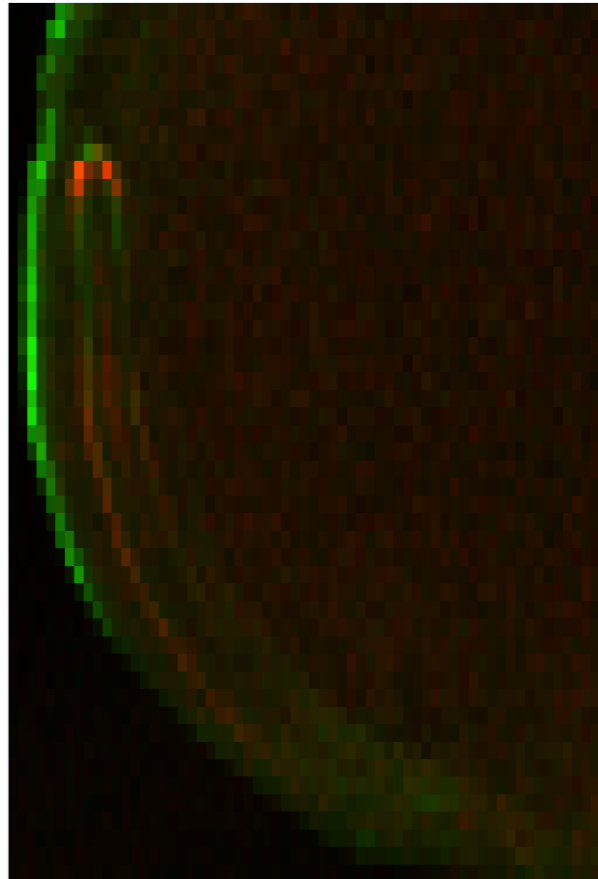
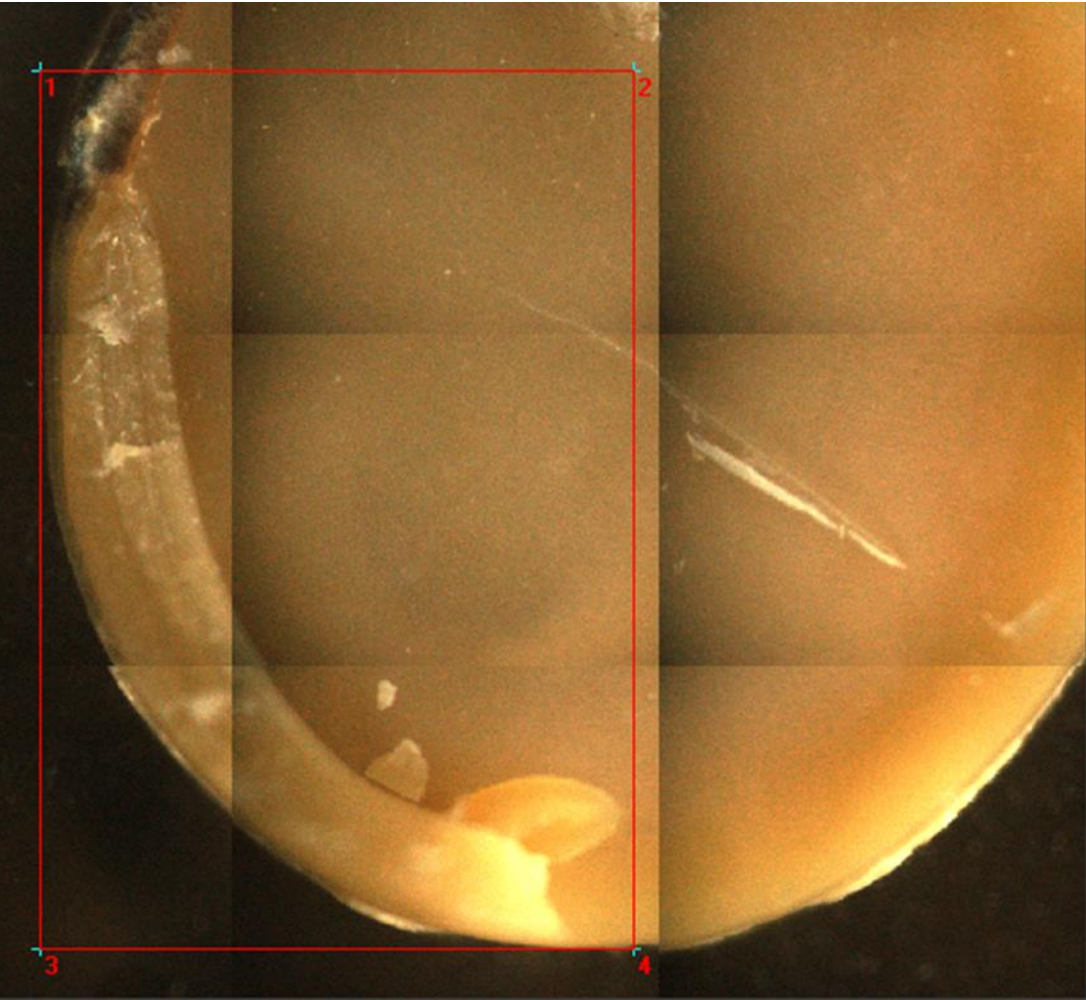


Medidas em 06/2022



Mn, Fe, & Zn in soybean seed

J.P.R. Marques,
Postdoc, 2018-2020

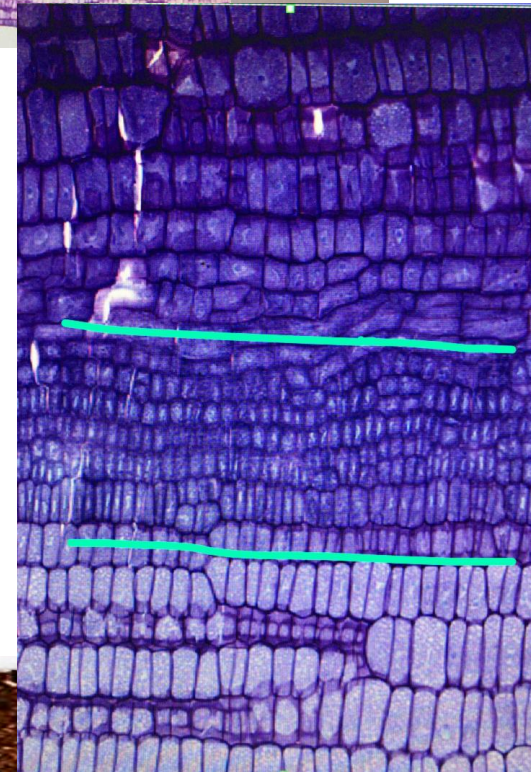
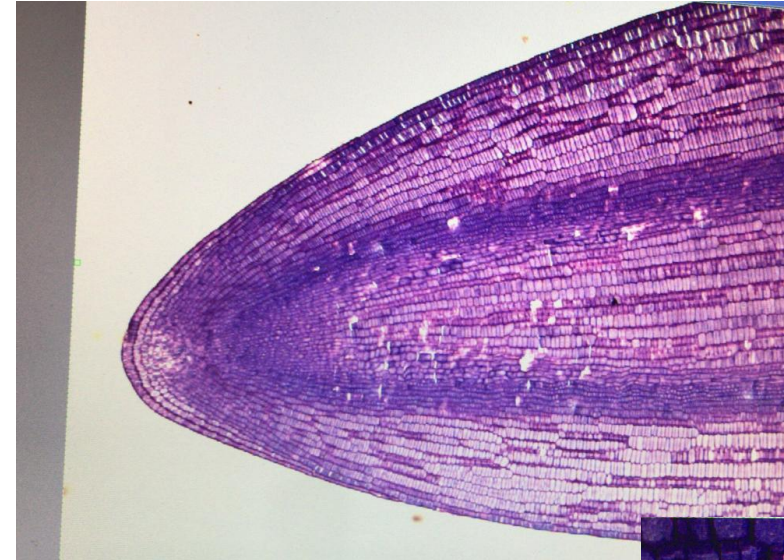
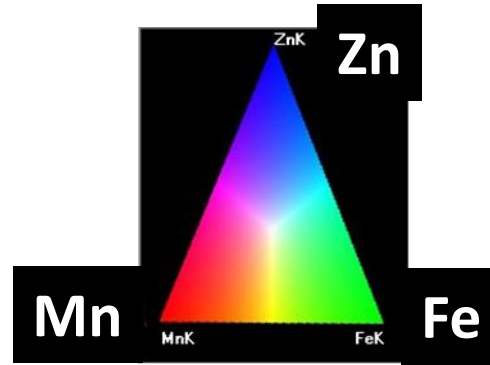
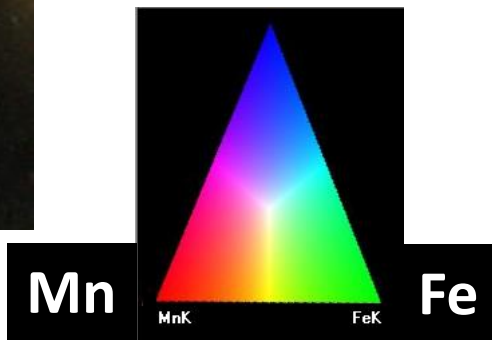
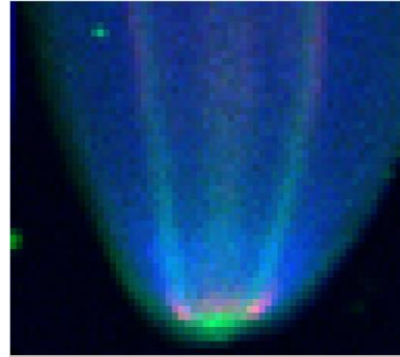
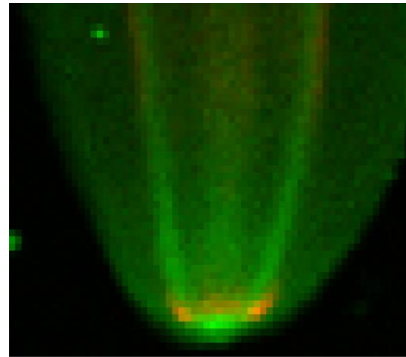


Longitudinal view on the embryo axis

J.P.R. Marques,
Postdoc, 2018-2020



□ Fe & Mn stripes



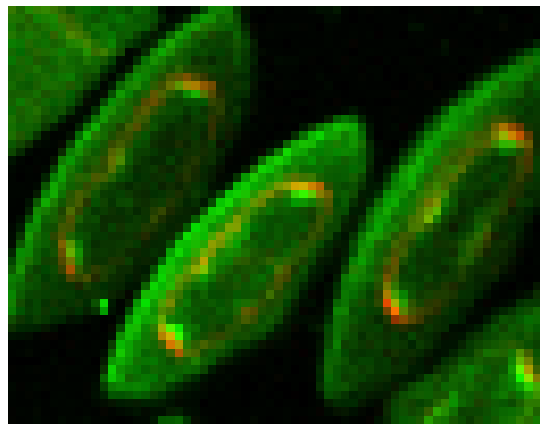
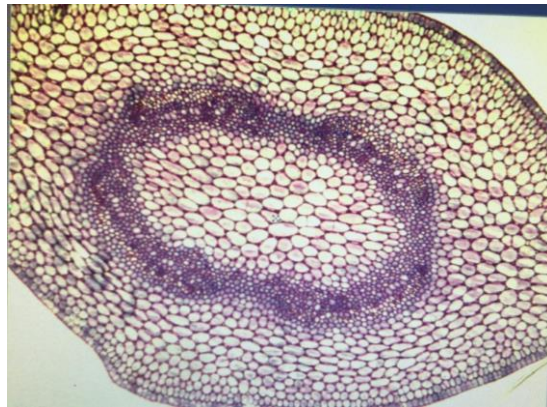
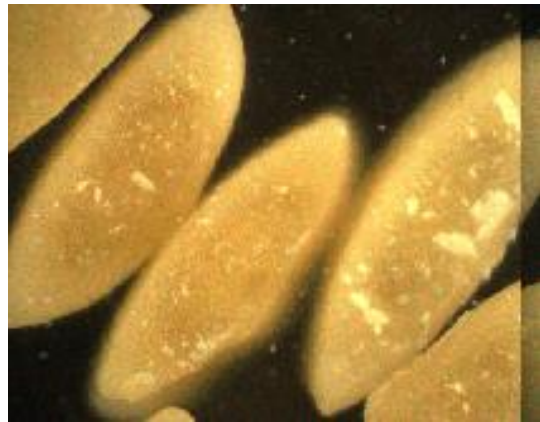
Transveral cut of the embryo axis

J.P.R. Marques,
Postdoc, 2018-2020

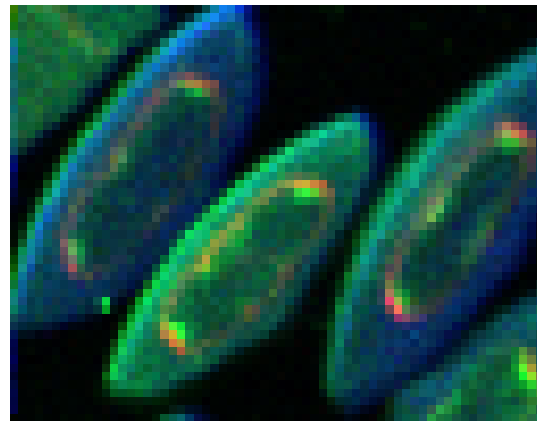


□ Fe & Mn rings & poles

4 mm above the root tip

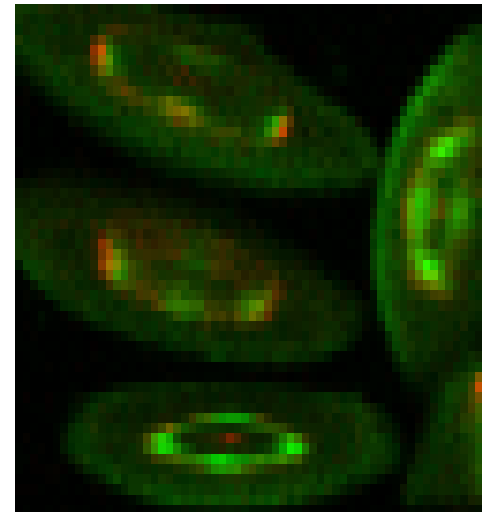


Mn(R) Fe(G)

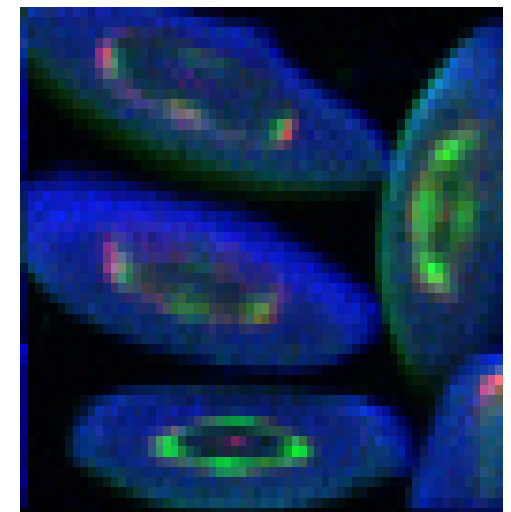


Mn(R) Fe(G) Ca(B)

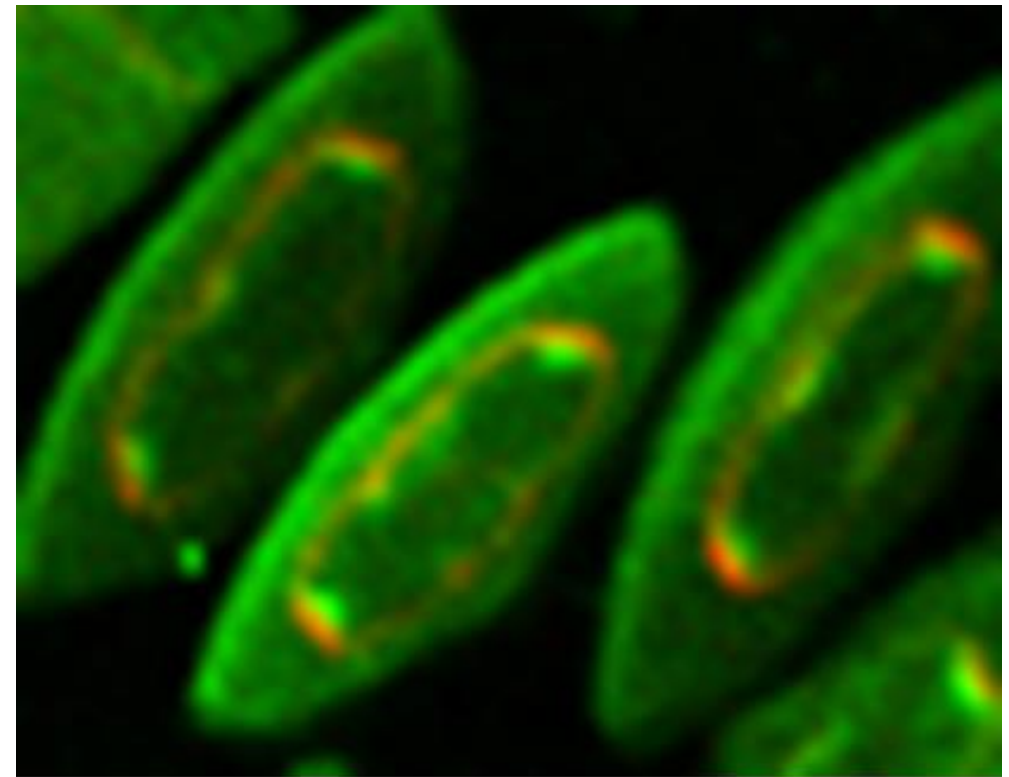
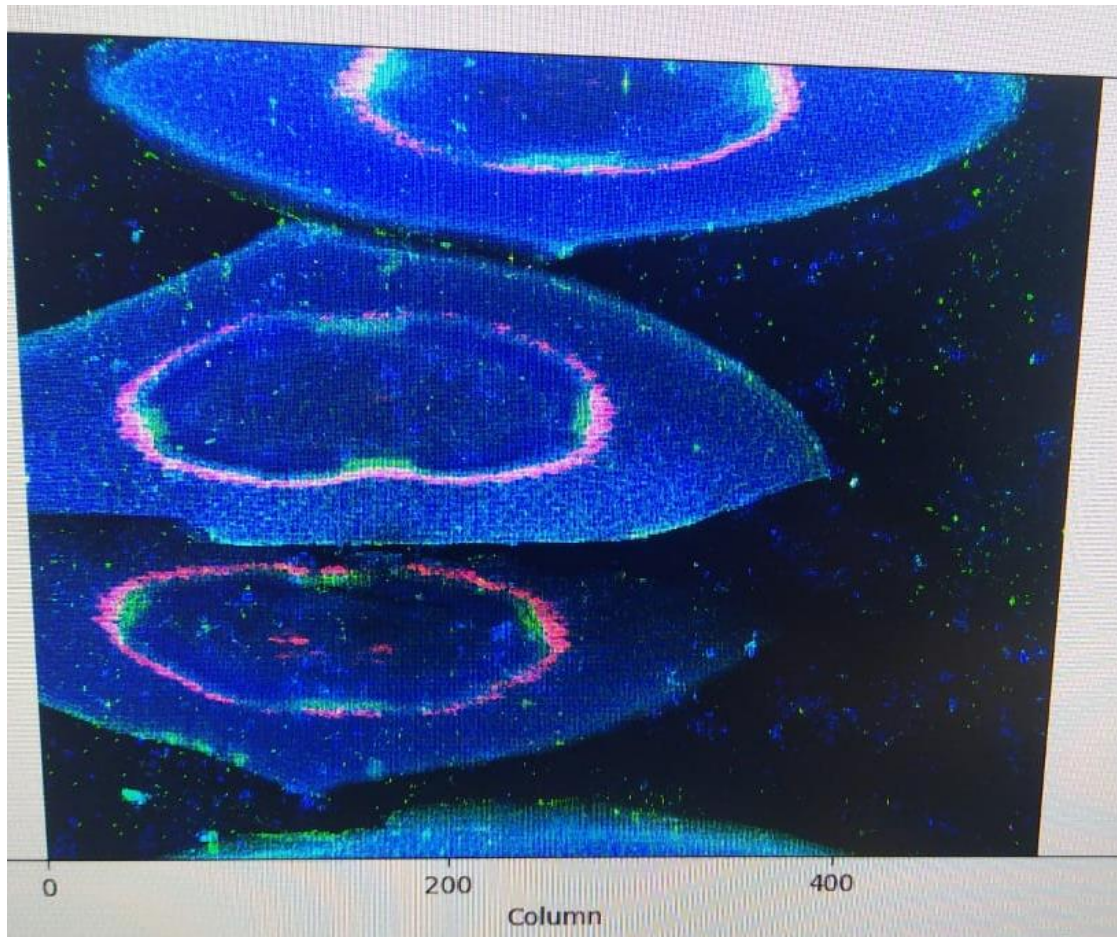
0.5 mm above the root tip



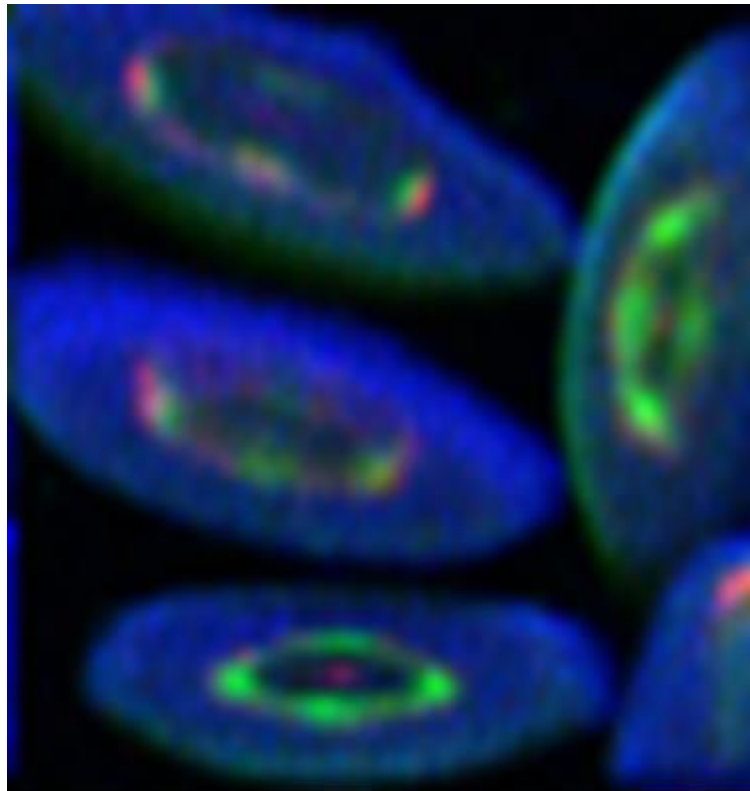
Mn(R) Fe(G)



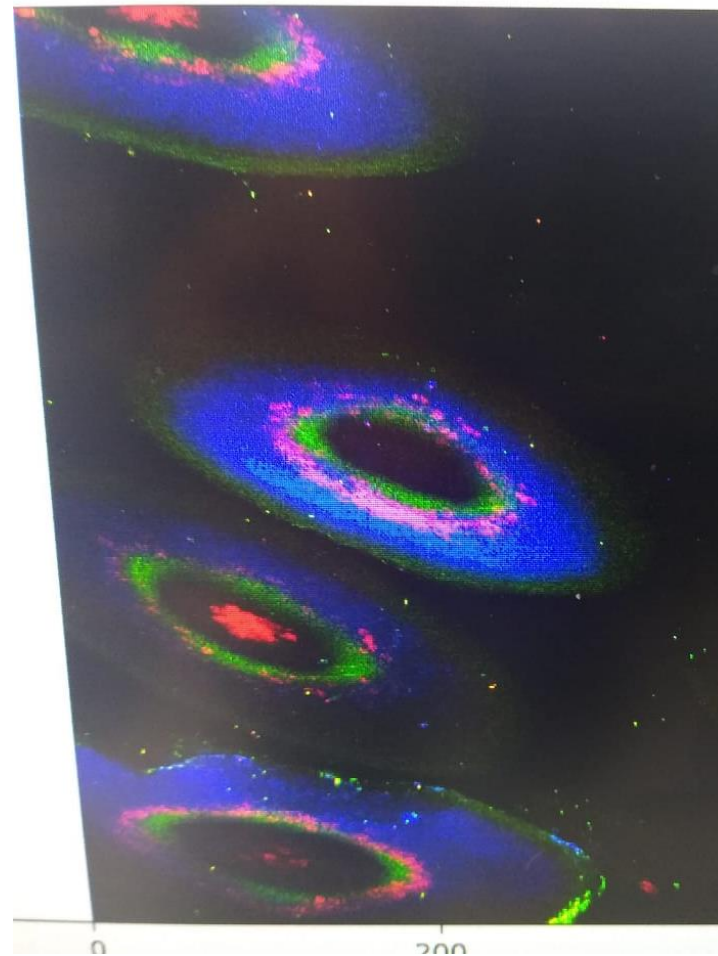
Mn(R) Fe(G) Ca(B)



Mn(R) Fe(G)



Mn(R) Fe(G) Ca(B)



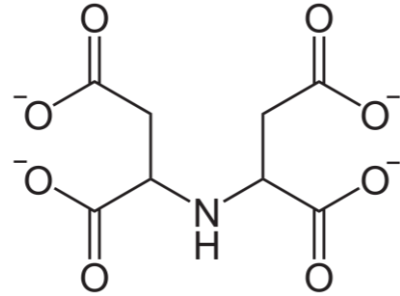
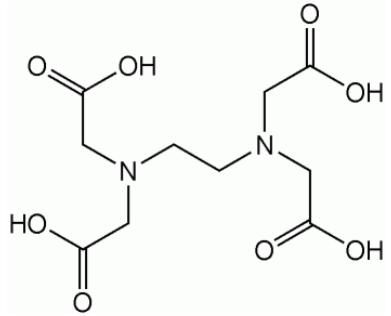
Spatial distribution of zinc and manganese fertilizers in coffee leaves

Medidas em 04/2022

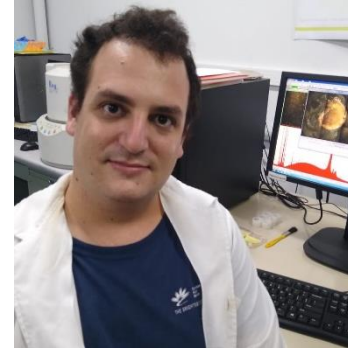


Uptake of fertilizers by coffee leaves

□ Zn-EDTA *versus* Zn-IDHA



Laboratório Nacional
de Luz Síncrotron

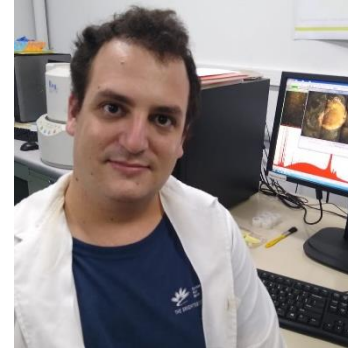


Gabriel Montanha,
Doctoral candidate,
2020-present

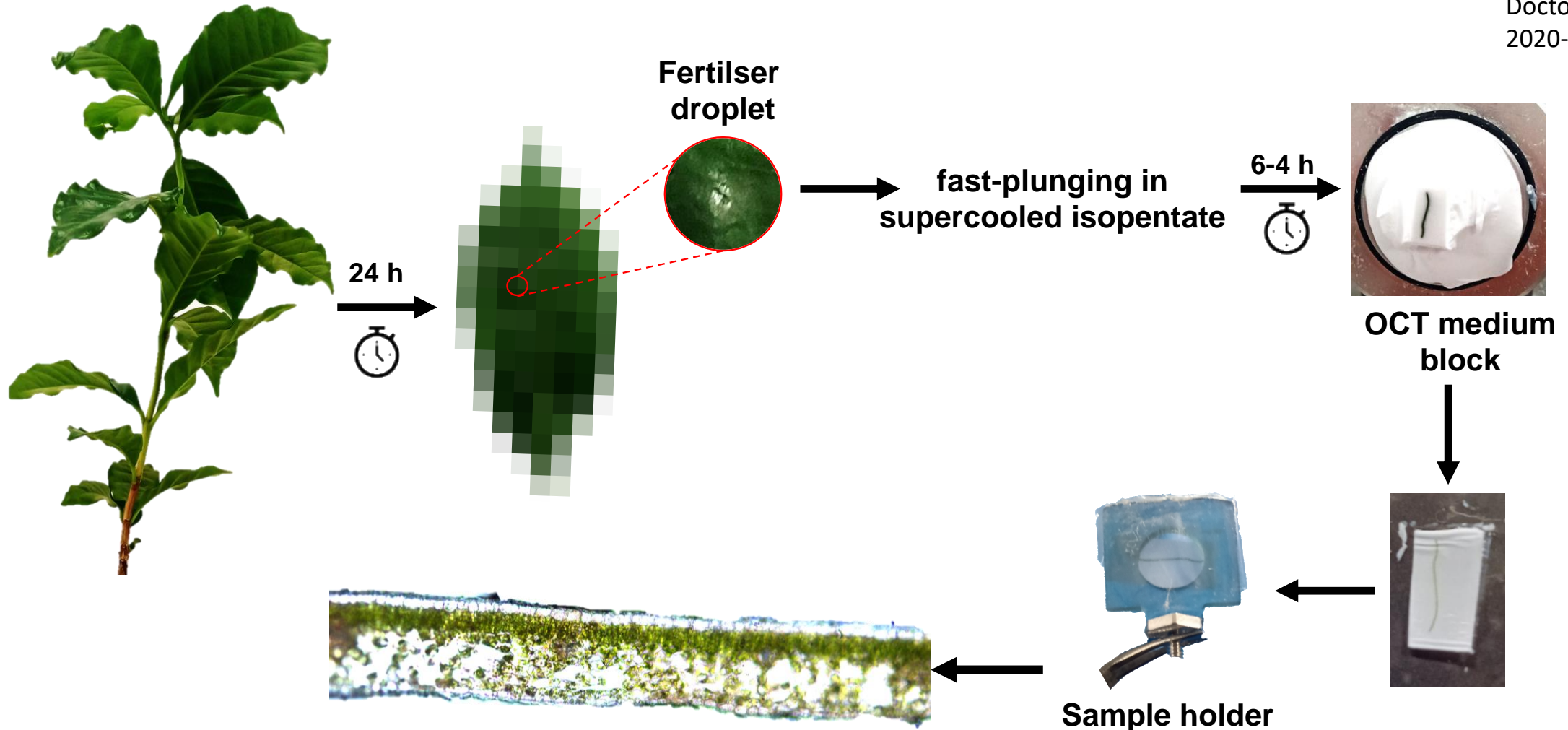


Uptake of fertilizers by coffee leaves

□ Sample Preparation Strategy



Gabriel Montanha,
Doctoral candidate,
2020-present

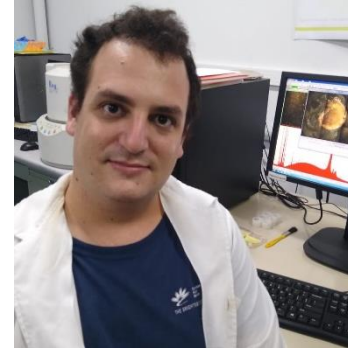
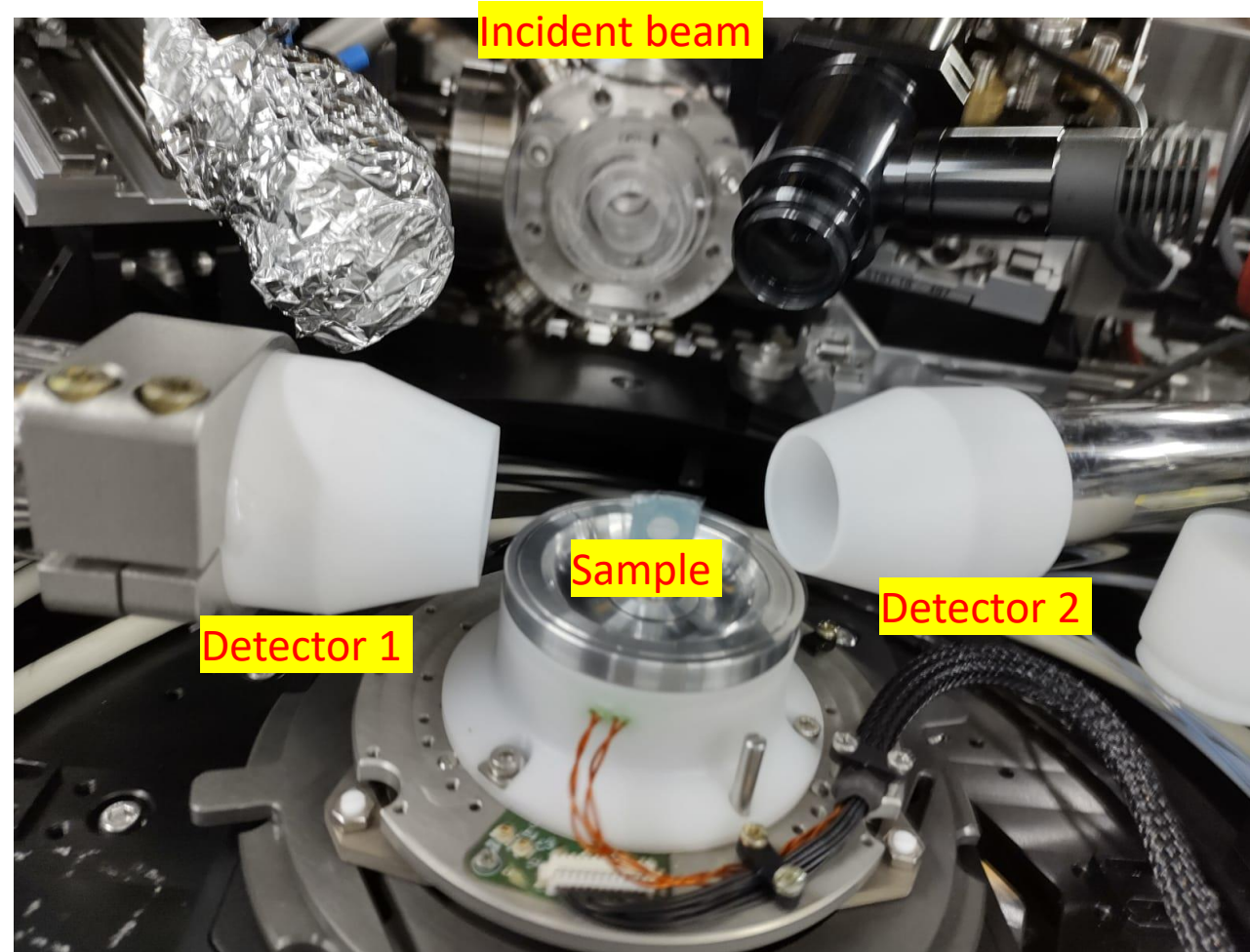


Uptake of fertilizers by coffee leaves

□ Measurement

CARNAÚBA (Coherent X-ray NANoprobe BeAmline) beamline

TARUMÃ (Tender-to-hard X-ray for sub-micro analysis) endstation



Gabriel Montanha,
Doctoral candidate,
2020-present

Zn/Mn-IDHA

Zn/Mn-EDTA

fertiliser droplet

ep
pp
sp
ep

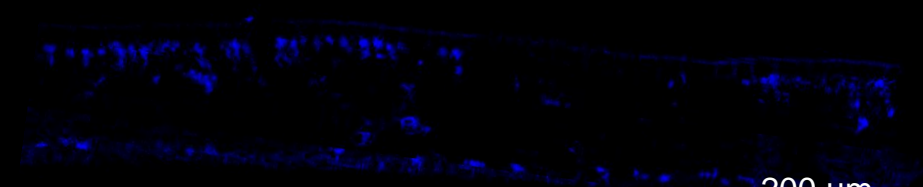
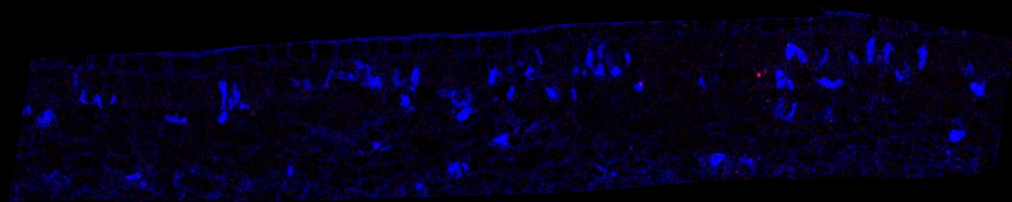
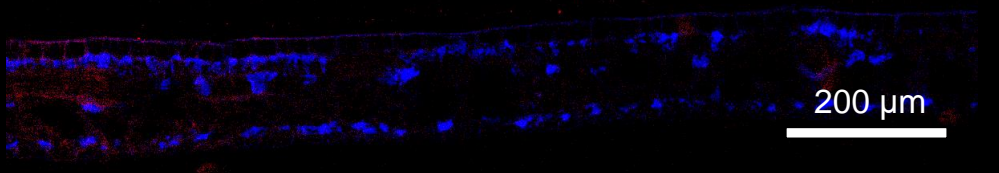
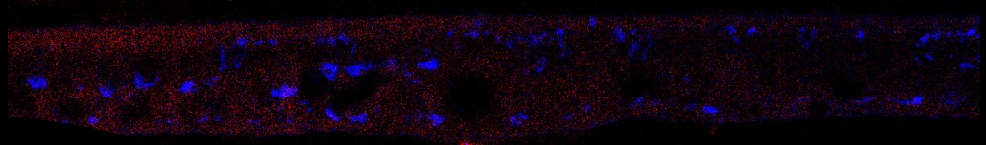
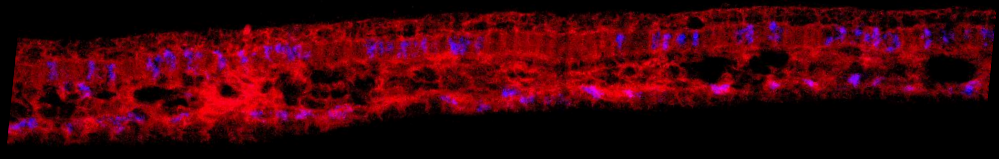
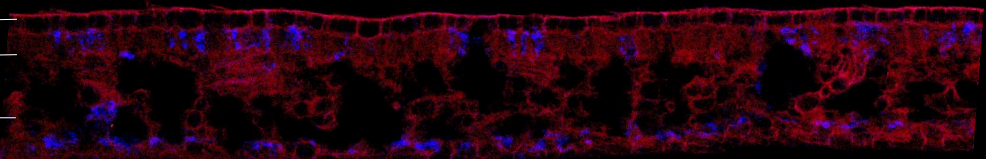
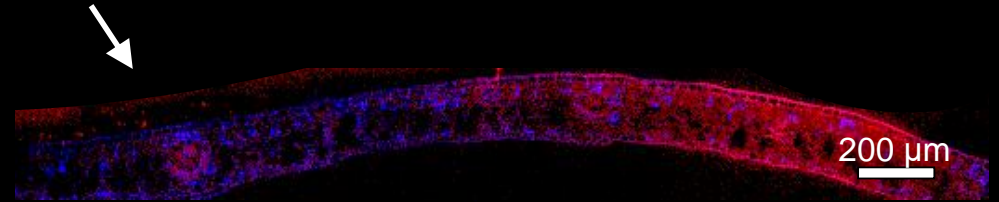
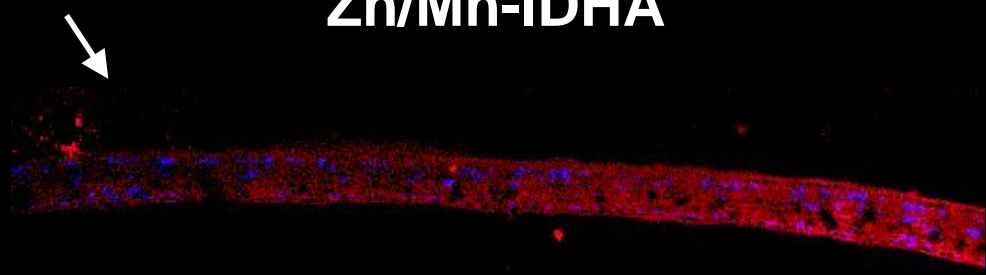
200 μ m

200 μ m

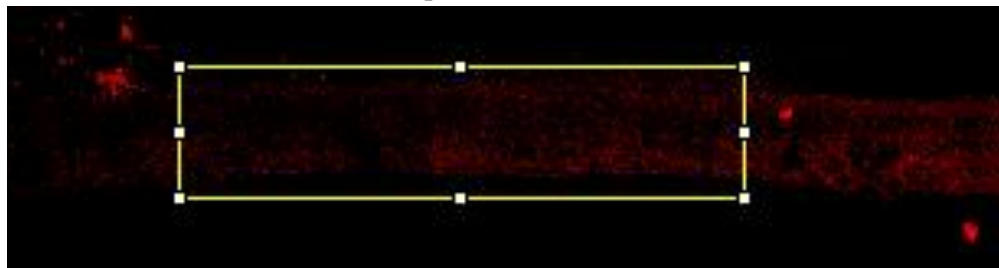
Control

200 μ m

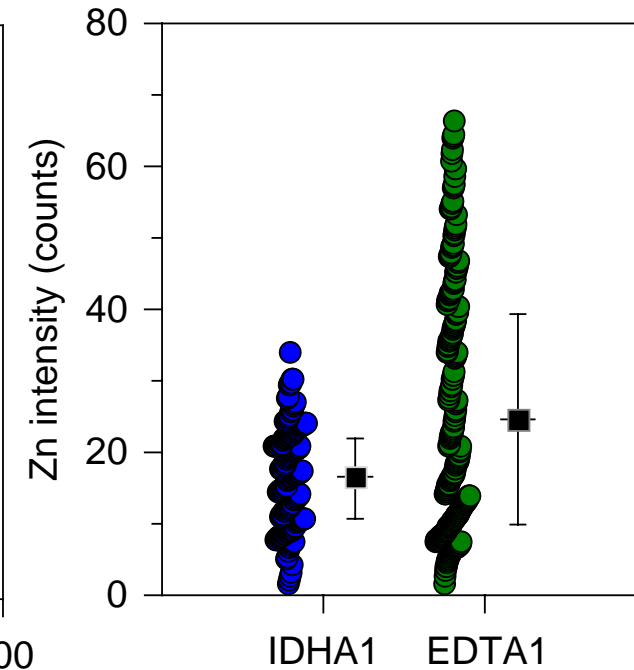
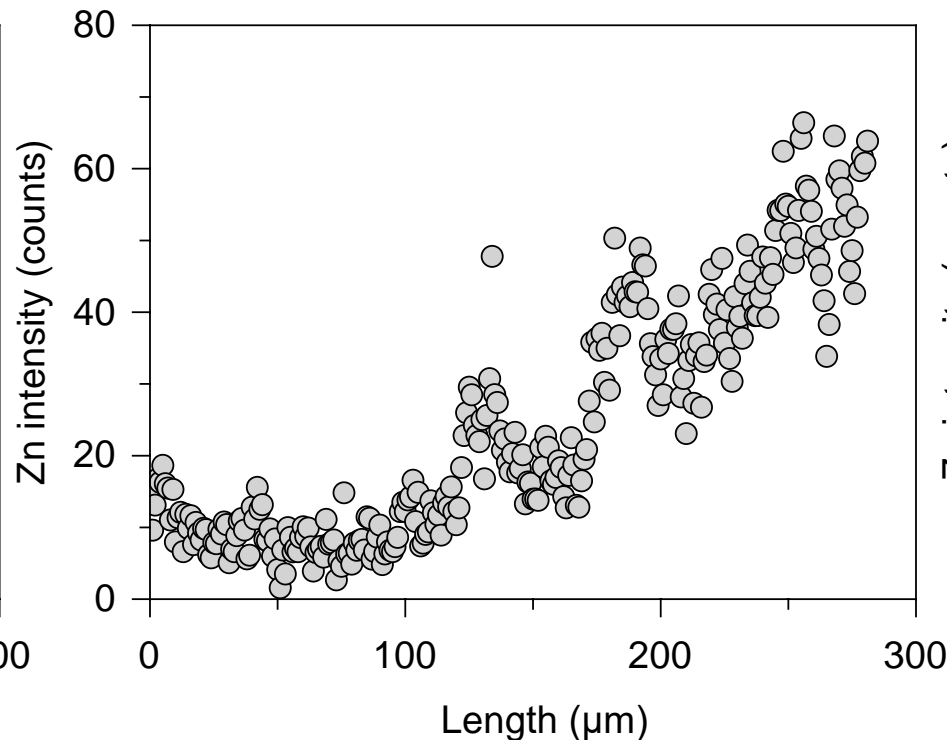
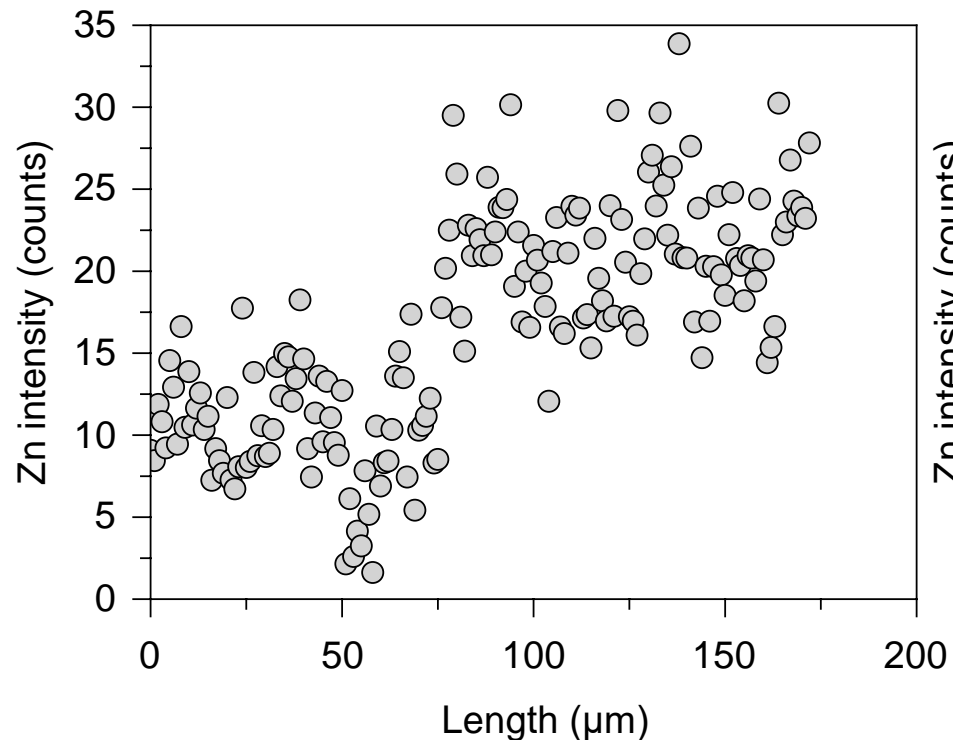
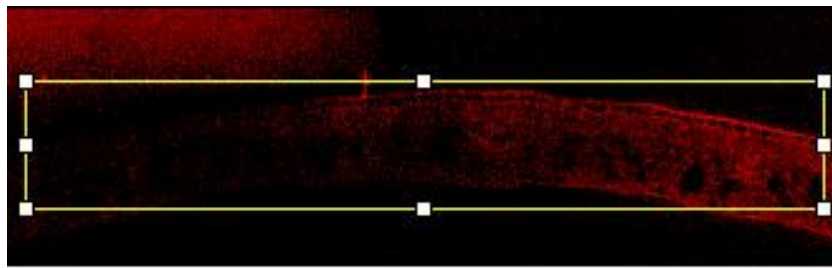
Zn  Ca



Zn/Mn-IDHA



Zn/Mn-EDTA



Zn/Mn-IDHA

Zn/Mn-EDTA

ep
pp
sp
ep

200 μ m

200 μ m

Zn  Ca

APOLASTIC PATHWAY?

