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Cecilia Zaza (Lic)

Francisco Correa-Tedesco (Lic)

Martin Ruhle (Lic)

Hernán G Solari

Raúl Barriga (Doc)

Marcelo Javier Otero (Inv)

Ariel Chernomoretz

Santiago Videla (Postdoc)

Victoria Romeo Aznar (Postdoc)

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Ivan M. Lengyel (Doc)

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Sol Fernandez Arancibia (Lic)

Pedro Lagomarsino de Leon Roig (Lic)

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Santiago Boari (becario CONICET)

Alan Taitz (becario CONICET)

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Gonzalo Uribarri (Lic, Doc-2016)

Cecilia Herbert (Lic, Doc-2016)

Alan Bush (Posdoc-2016)

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Agustin Sanchez (Lic)

Silvina Ponce Dawson

Emiliano Perez Ipiña (Doc)

Lucia Lopez (Doc)

Estefania Piegari (Doc)

Cecilia Villarruel (Doc)

Marina Inchaussandague - Diana Skigin

Andrés Dolinko (Inv)

Christian D'Ambrosio (Lic)

Lía Pietrasanta

Lorena Siguat (Inv)

Catalina von Bilderling (Postdoc)

Juan Burdisso (Postdoc)

Micaela Bianchi (Doc)

Marina Cuenca (Estímulo)

Hernán Grecco

Bruno Moretti (Doctorado)

Agustin Corbat (Estímulo)

Pablo Balenzuela

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María Claudia Marchi

Silvio Ludueña

Natalio De Vincenzo

Lía Pietrasanta

MC

María Laura Ponce

Grupo de dinámica intracelular



Valeria Levi



Diana Wetzler



"Perpetuum mobile"
M.A.D.

Doctorado

PostDoc



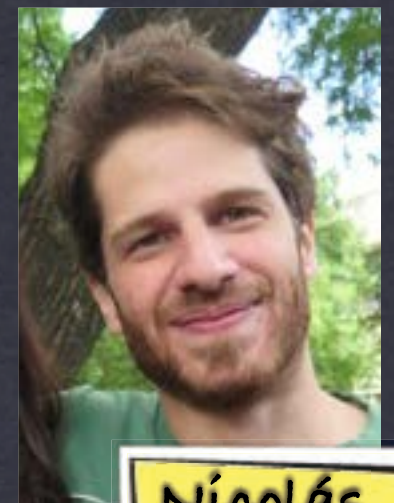
Cecilia
de Rossi



Carla
Pallavicini



Juan
Angiolini



Nicolás
Bardecí

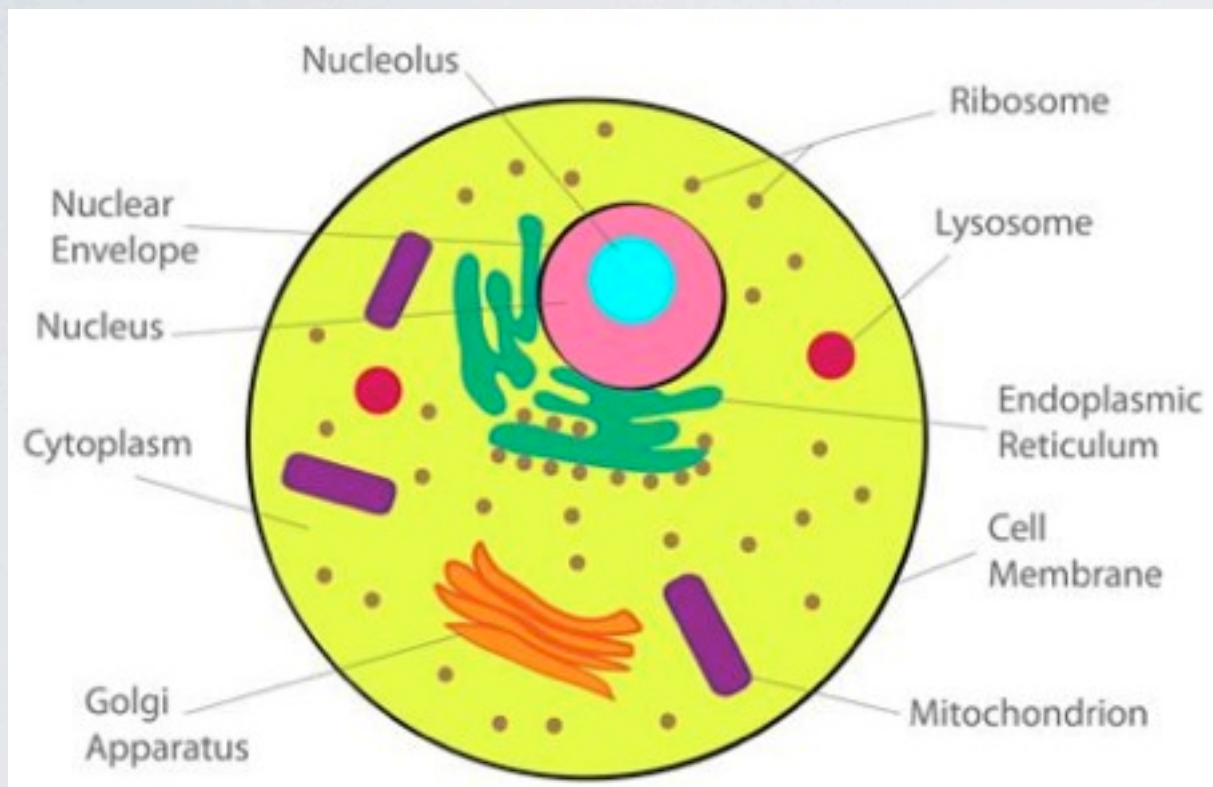
<http://www.gdti.df.uba.ar/>

Motores Moleculares y Citoesqueleto

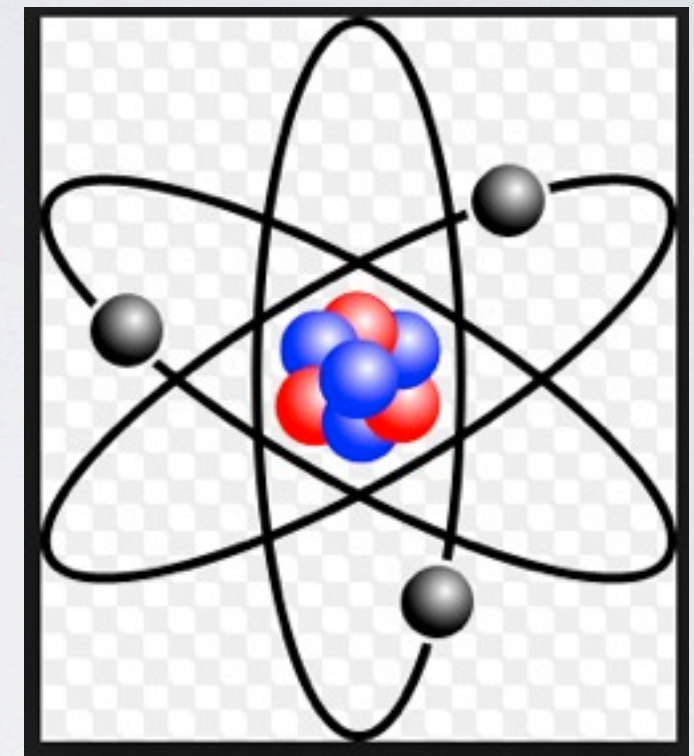
GRUPO DE DINAMICA INTRACELULAR

<http://www.gdti.df.uba.ar/>

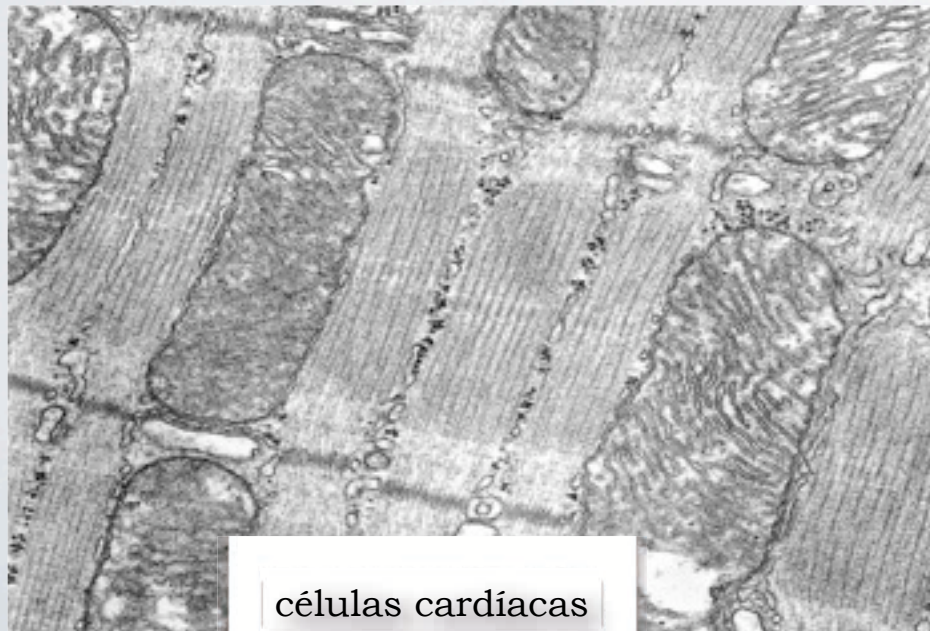
La célula



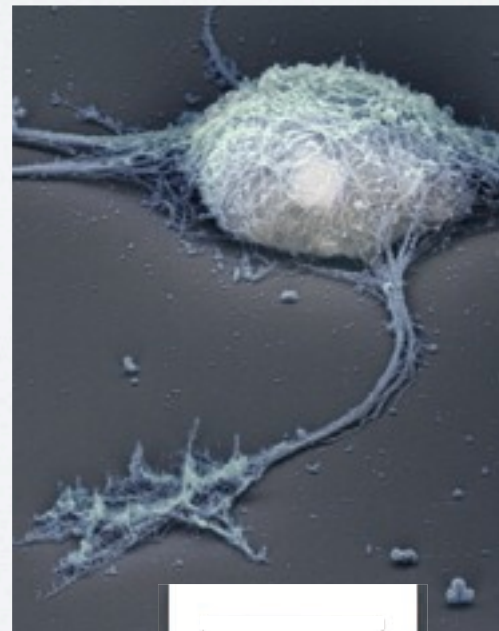
El átomo



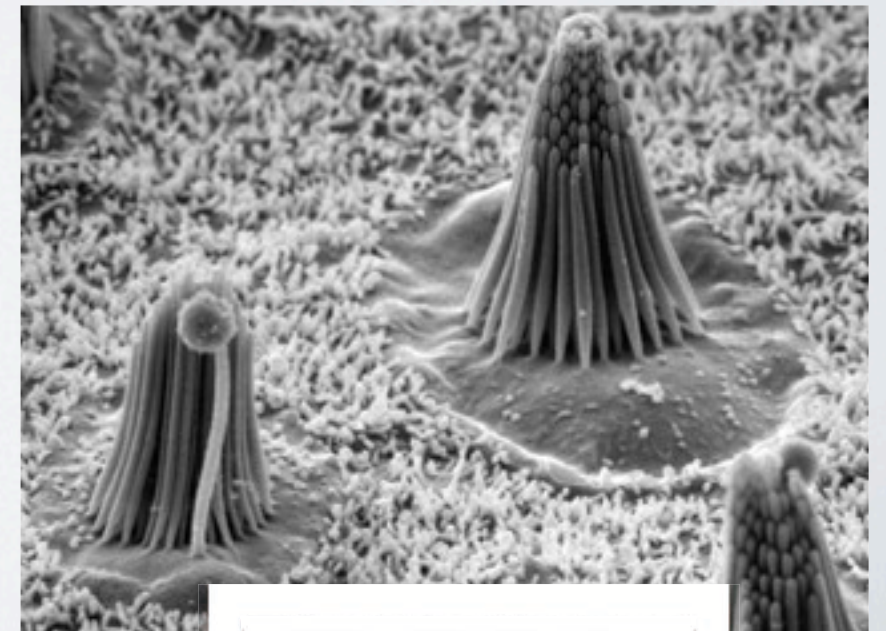
Organismos complejos: células diferenciadas



células cardíacas

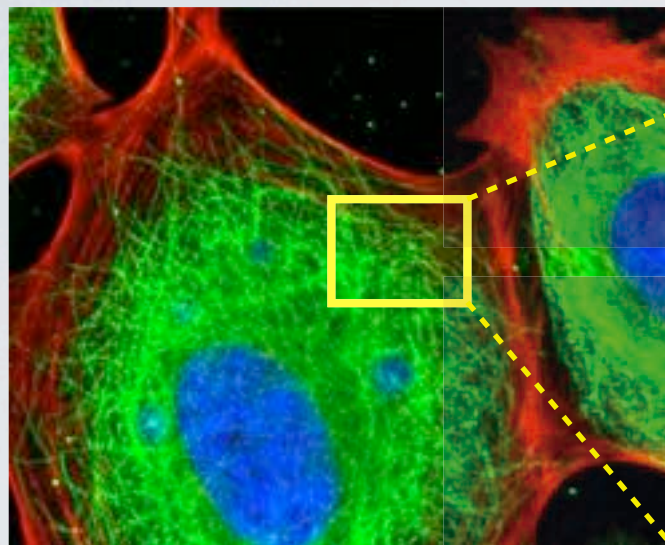


neurona



células del oído interno

EL CITOESQUELETO: estructura clave

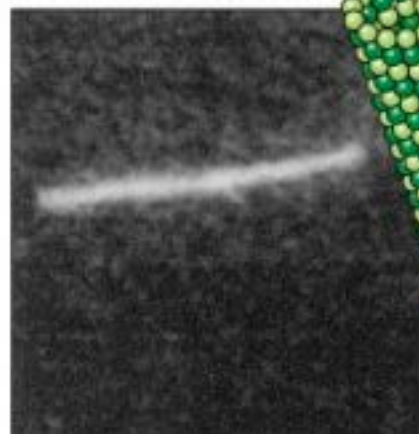


10 μm



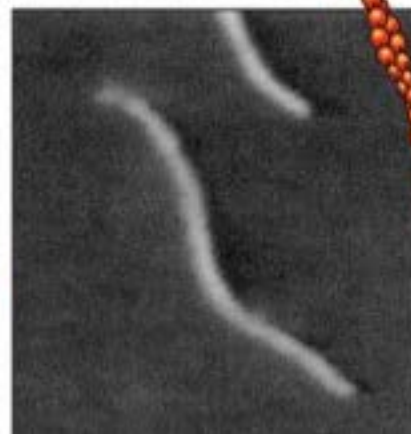
Microtúbulos

$\varnothing \approx 24 \text{ nm}$



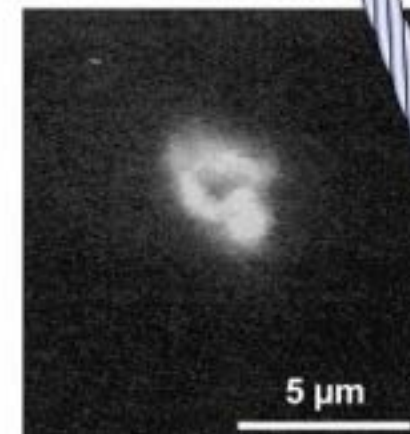
Filamentos de Actina

$\varnothing \approx 7-9 \text{ nm}$



Filamentos intermedios

$\varnothing \approx 10 \text{ nm}$

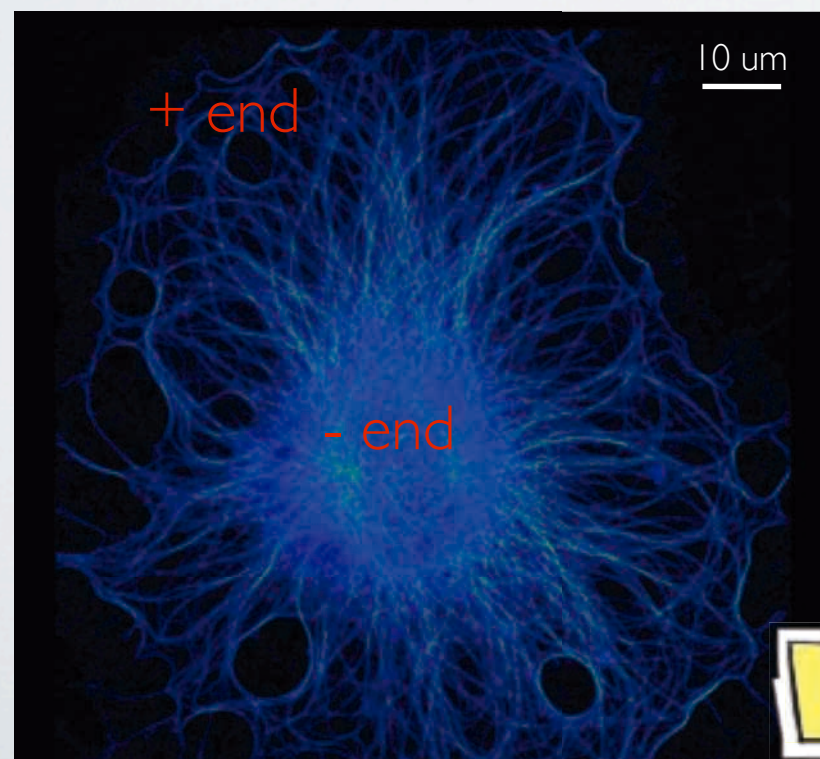
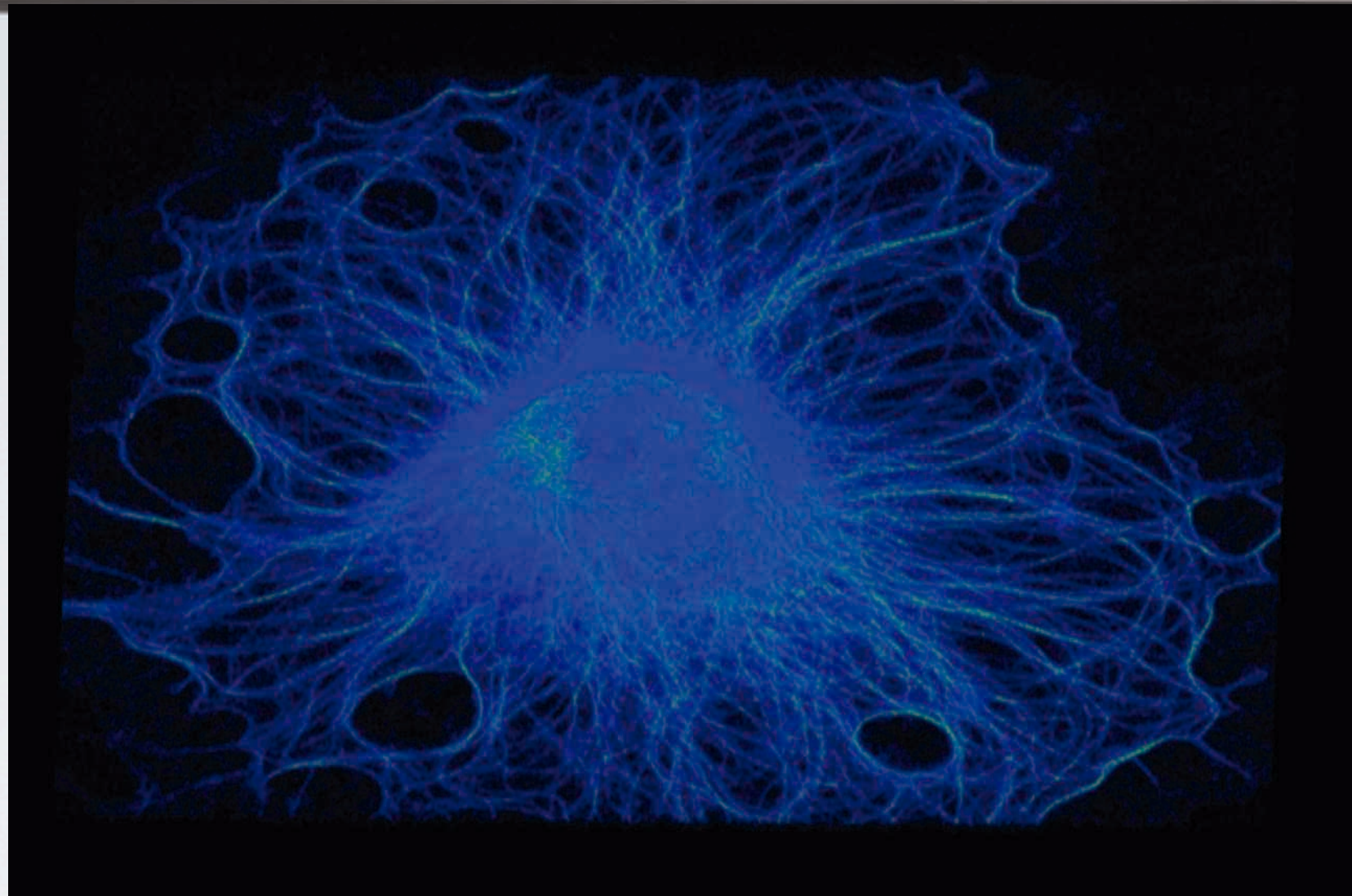


+ end

- end



Red de microtúbulos en una célula adherente



top view

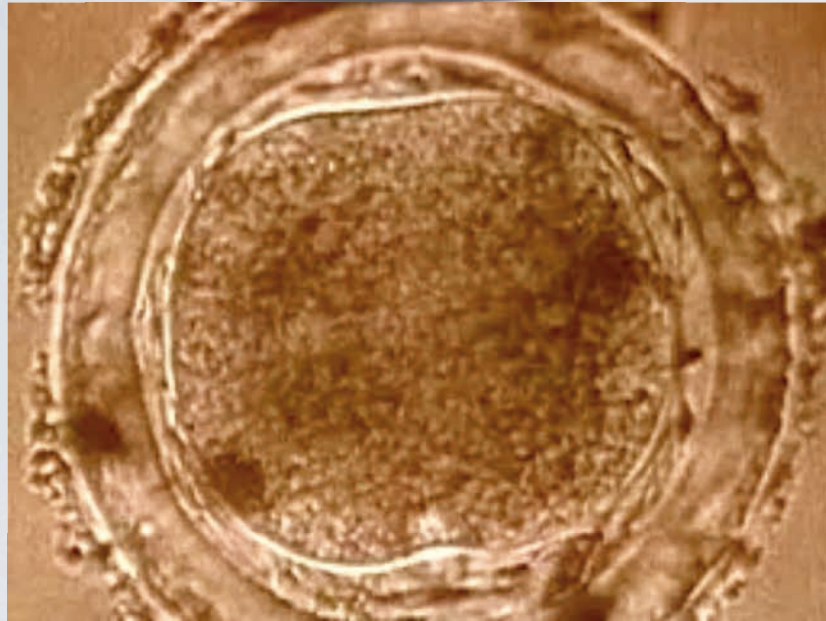


profile

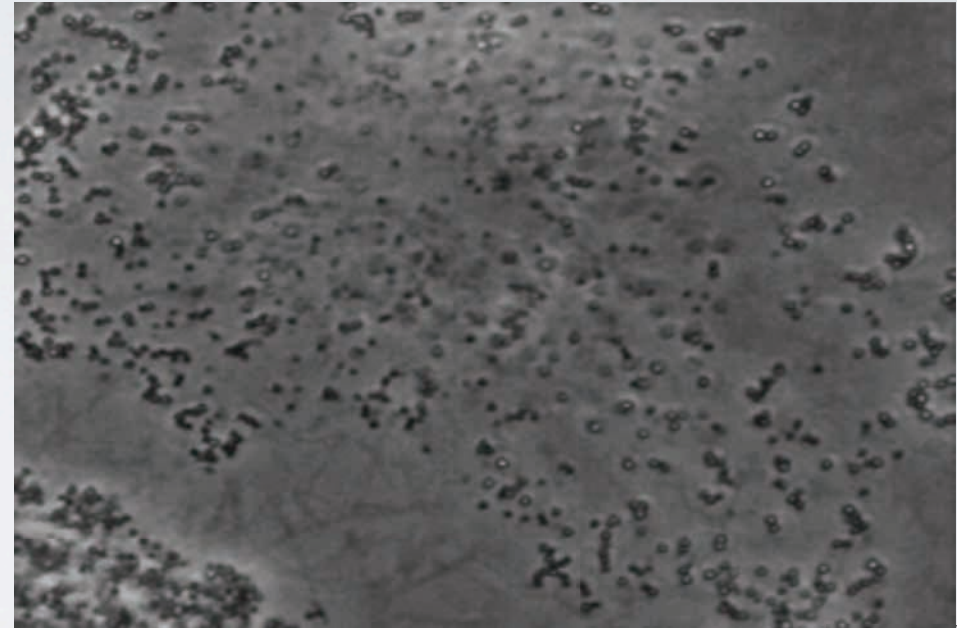
Reconstrucción 3D de la red de microtúbulos en una célula melanófora de *Xenopus Laevis*. Images: Carla Pallavicini & Juan Angiolini

algunos procesos celulares

División celular

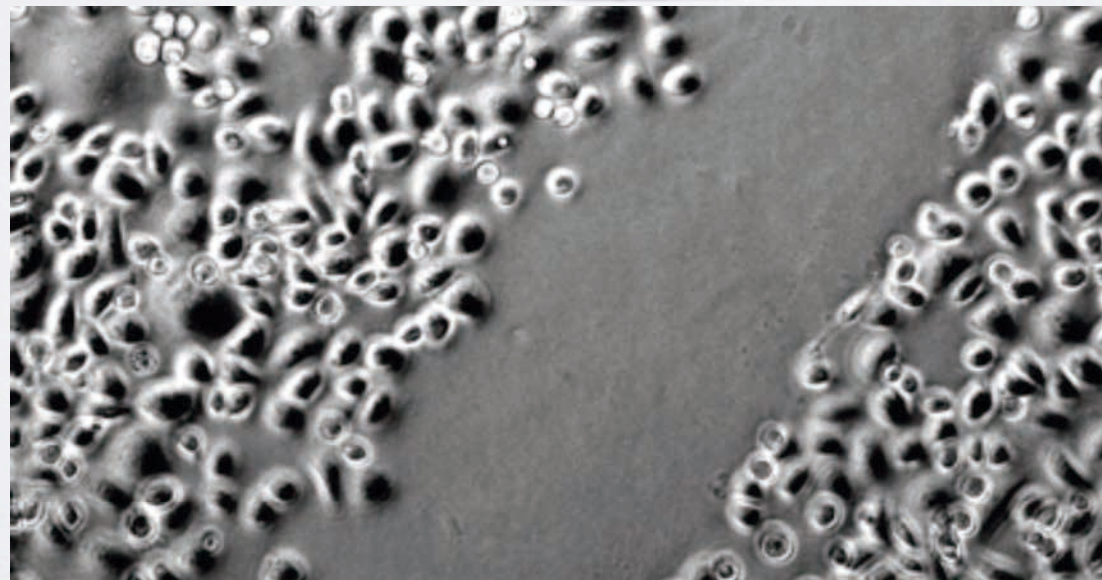


Transporte de organelas



Images: V. Gelfand

Migración celular



Images: Geraldine Guerón y col.

CITOESQUELETO
+
MOTORES MOLECULARES
=
Fuerzas mecánicas

Motores moleculares y Transporte

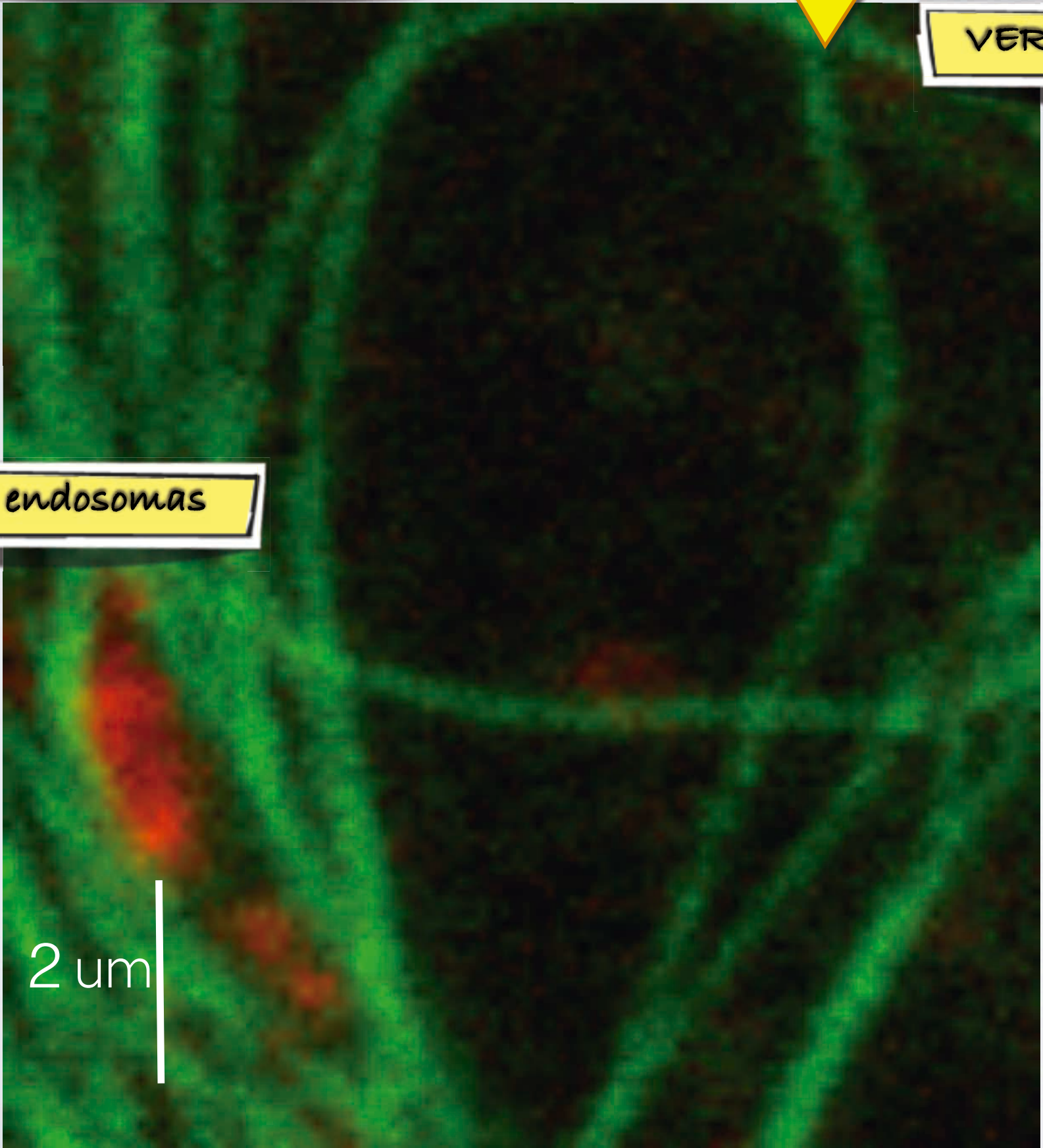


¿cómo los vemos?



VERDE: microtúbulos

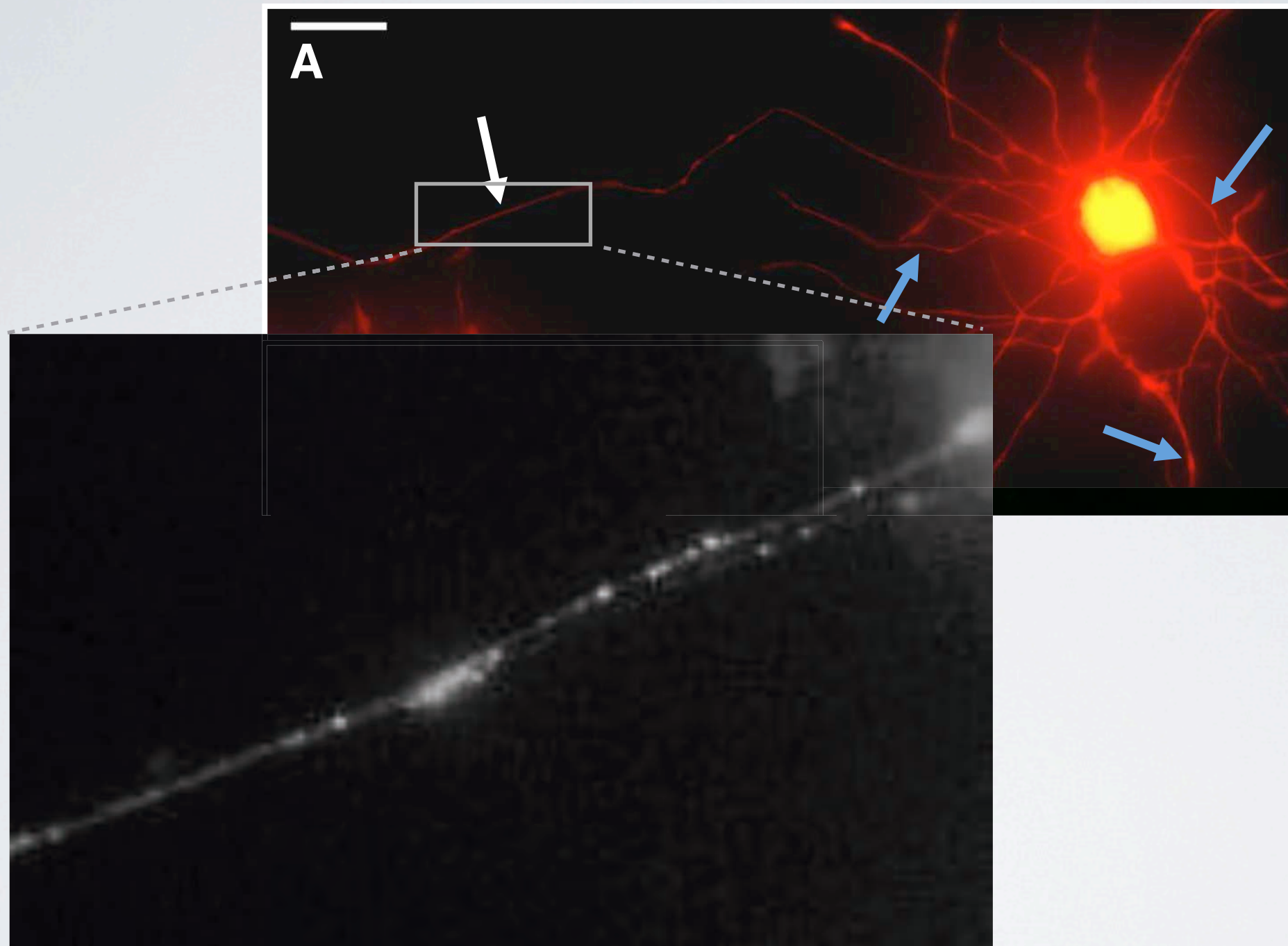
ROJO: endosomas



2 μm

XTP-labeled *Xenopus leavis* melanophore cells.
Duration 2.8 min
(Images: Diana Wetzler)

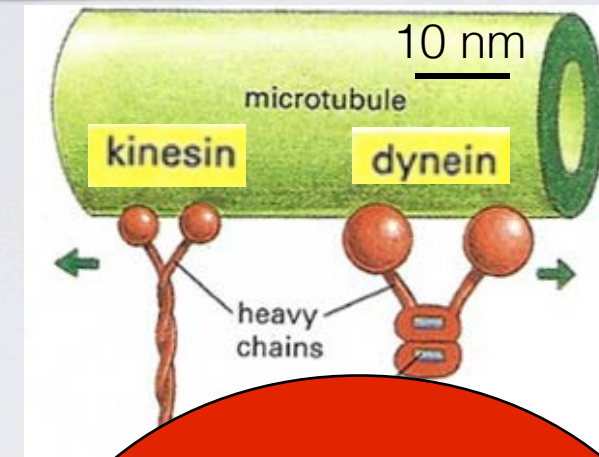
Transporte bidireccional



Axonal transport of synaptic vesicles labeled with YFP in mouse neurons.
(Images Matías Alloatti & Tomás Falzone)

Transporte bidireccional

+ end

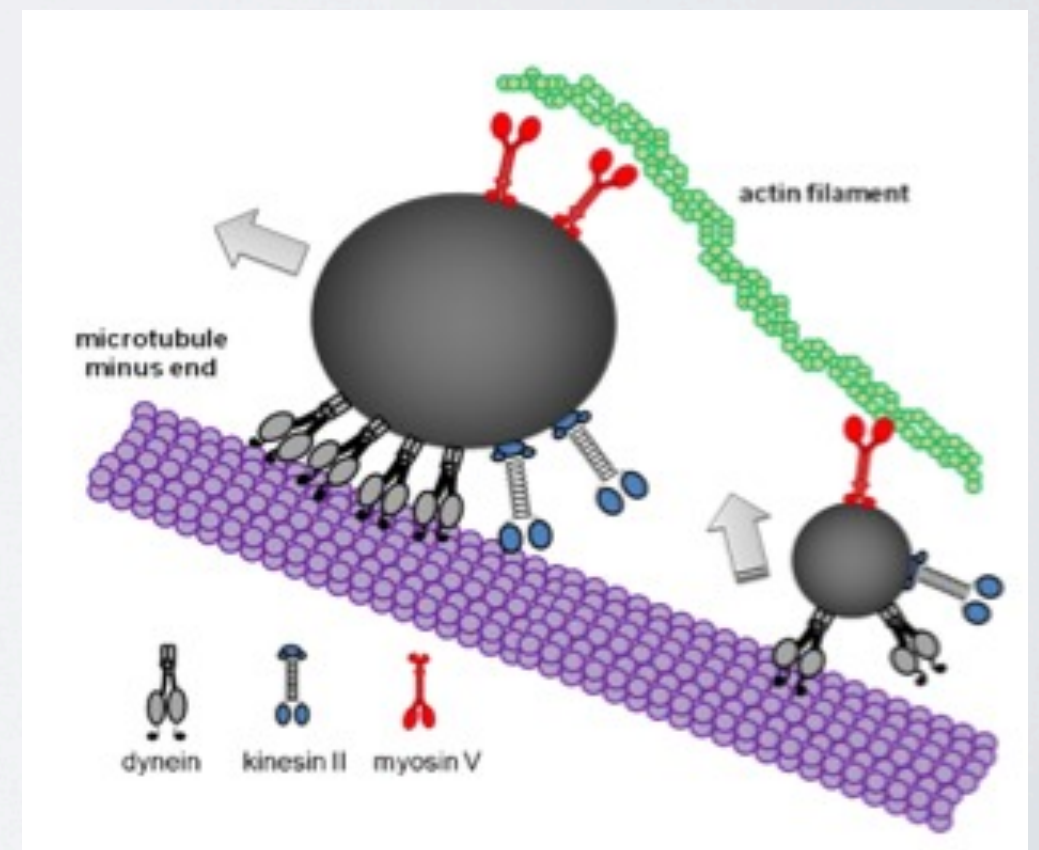
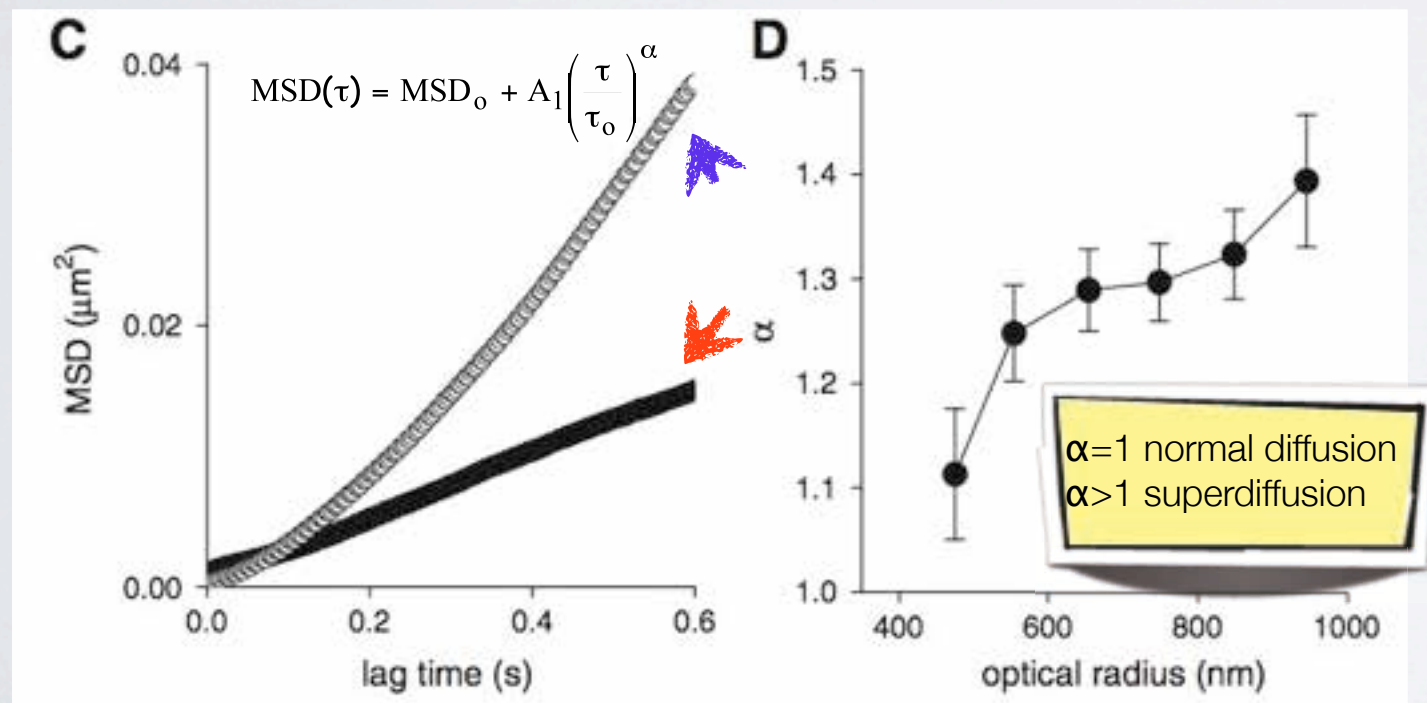
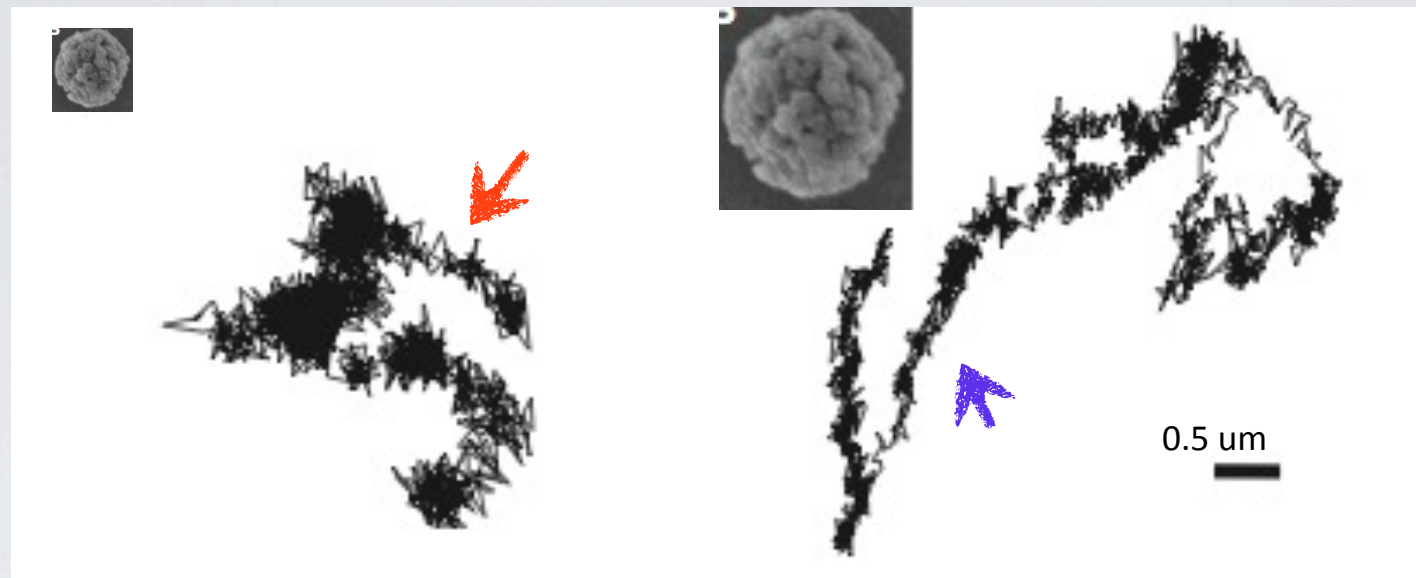


- end

¿Competencia vs coordinación?

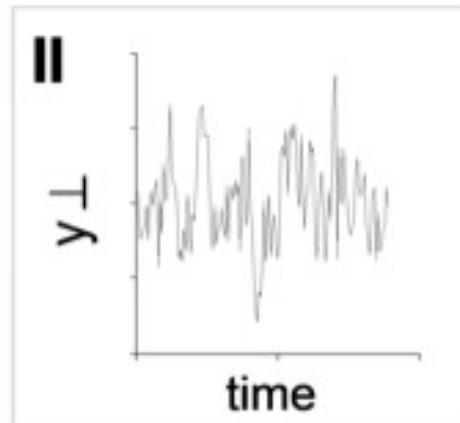
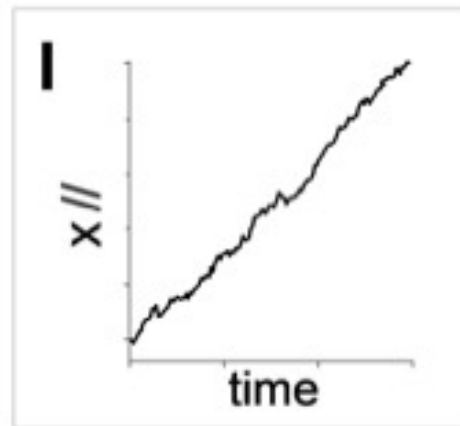
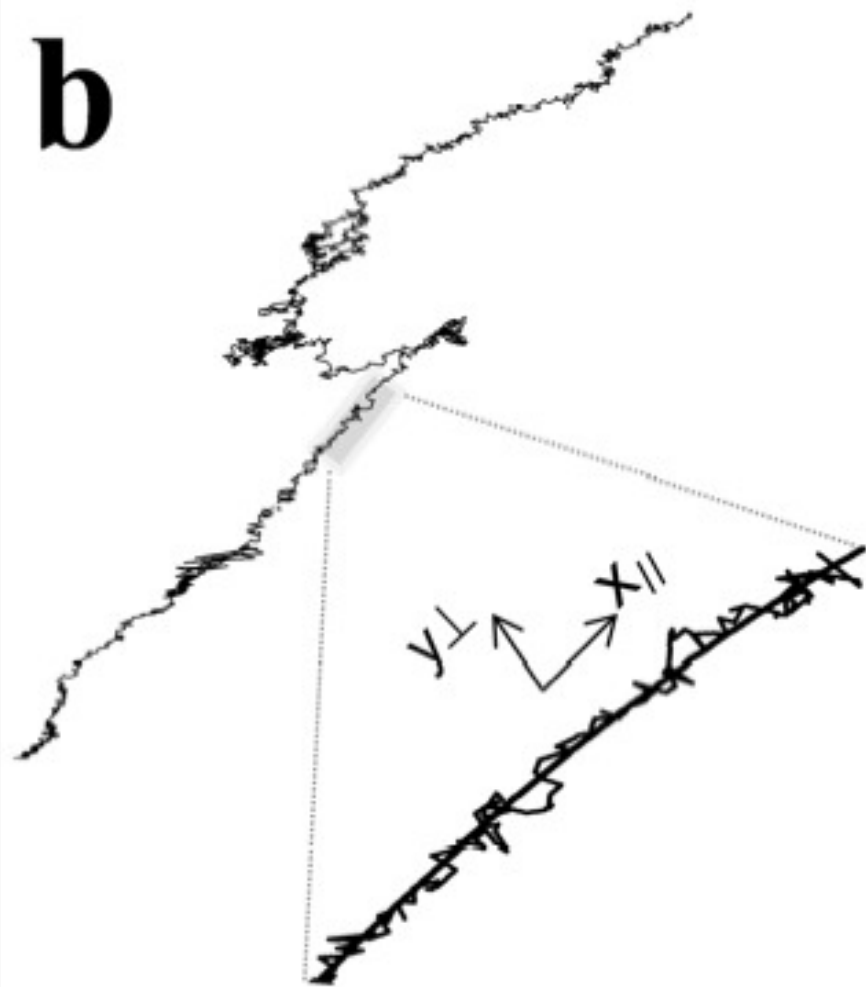


Trayectorias individuales



velocidad y Elasticidad del linker MT-cargo

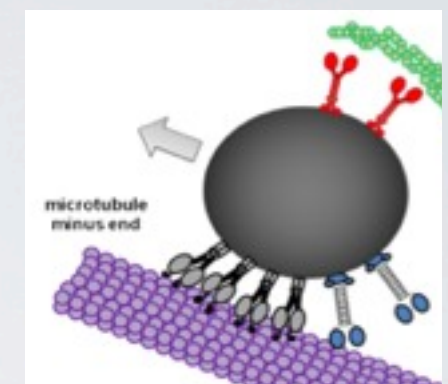
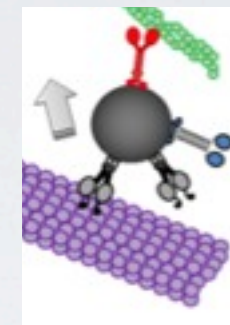
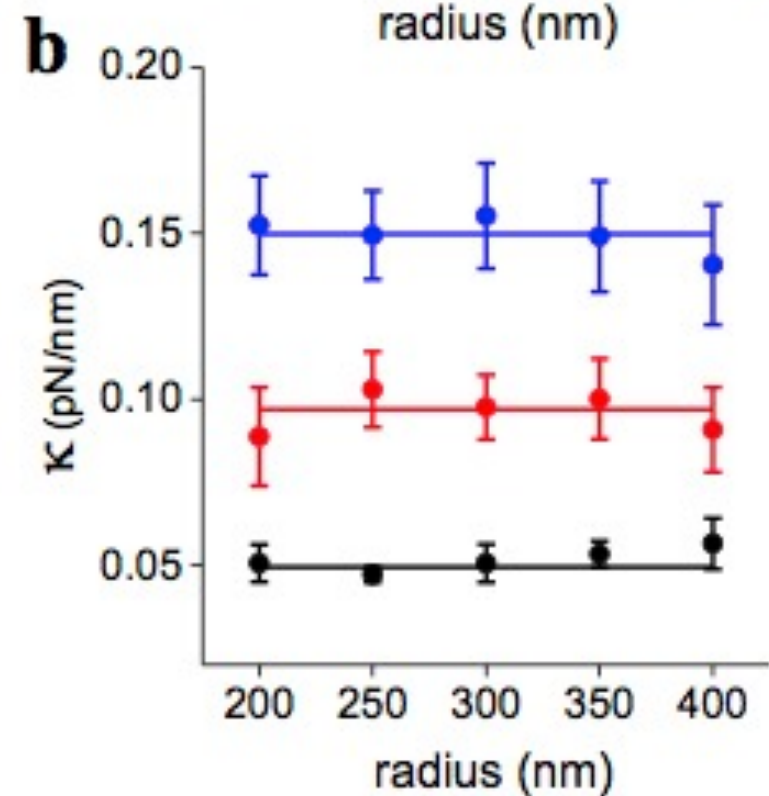
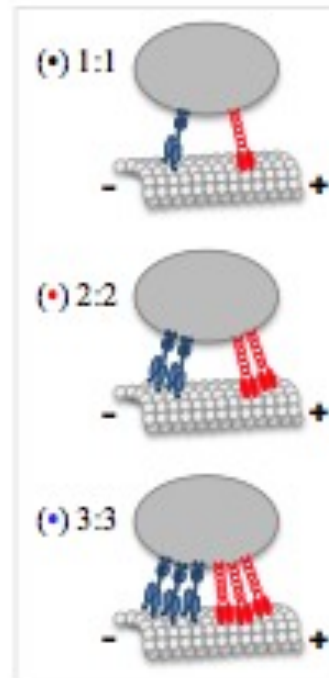
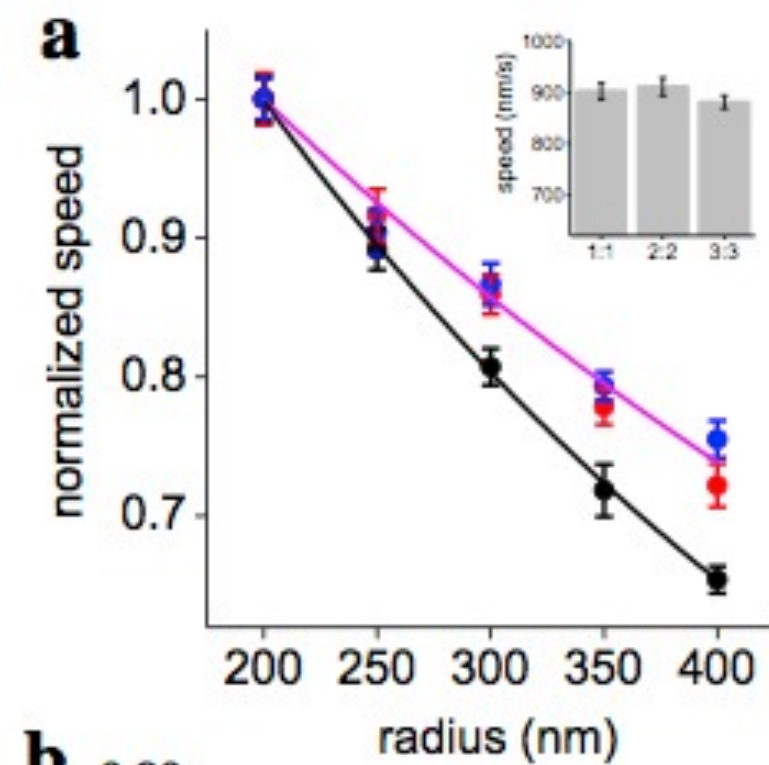
b



→ velocidad media

→ K : cte elástica

Simulaciones numéricas

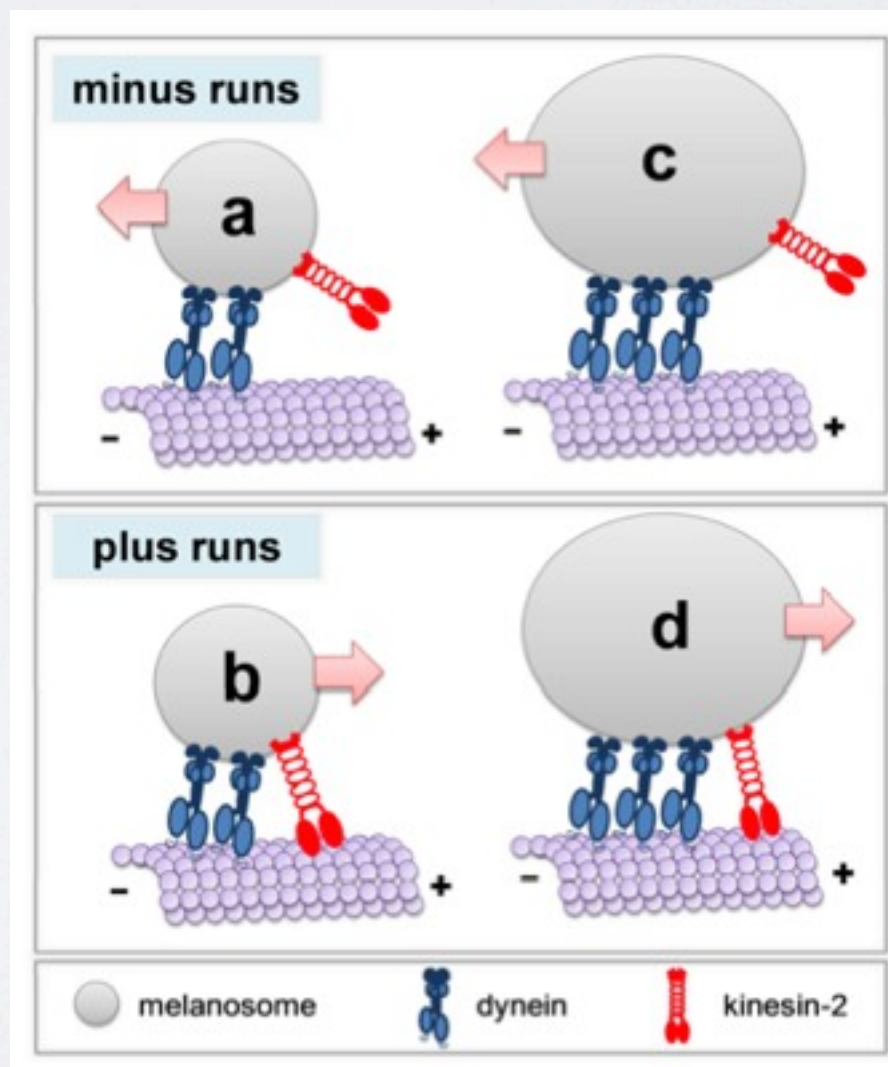
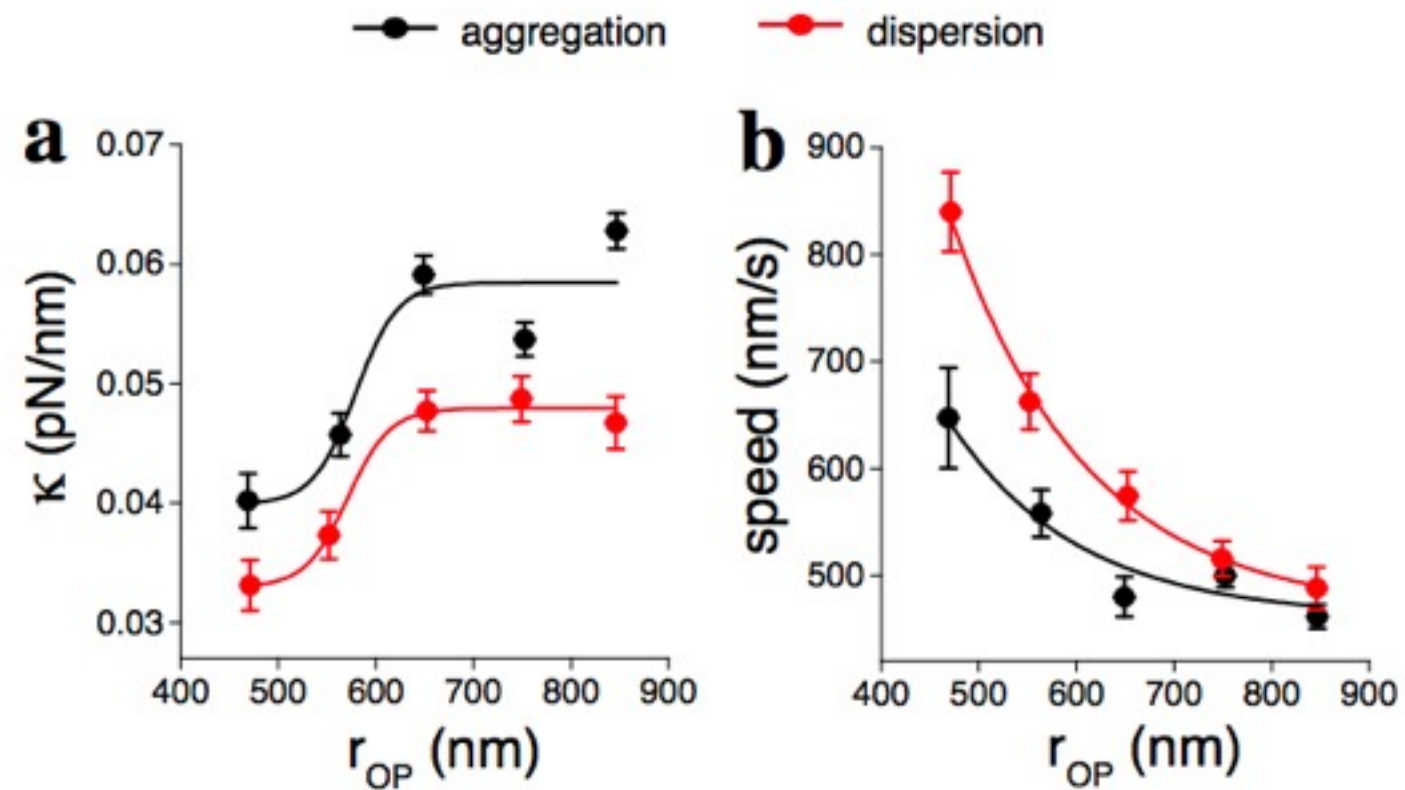


κ



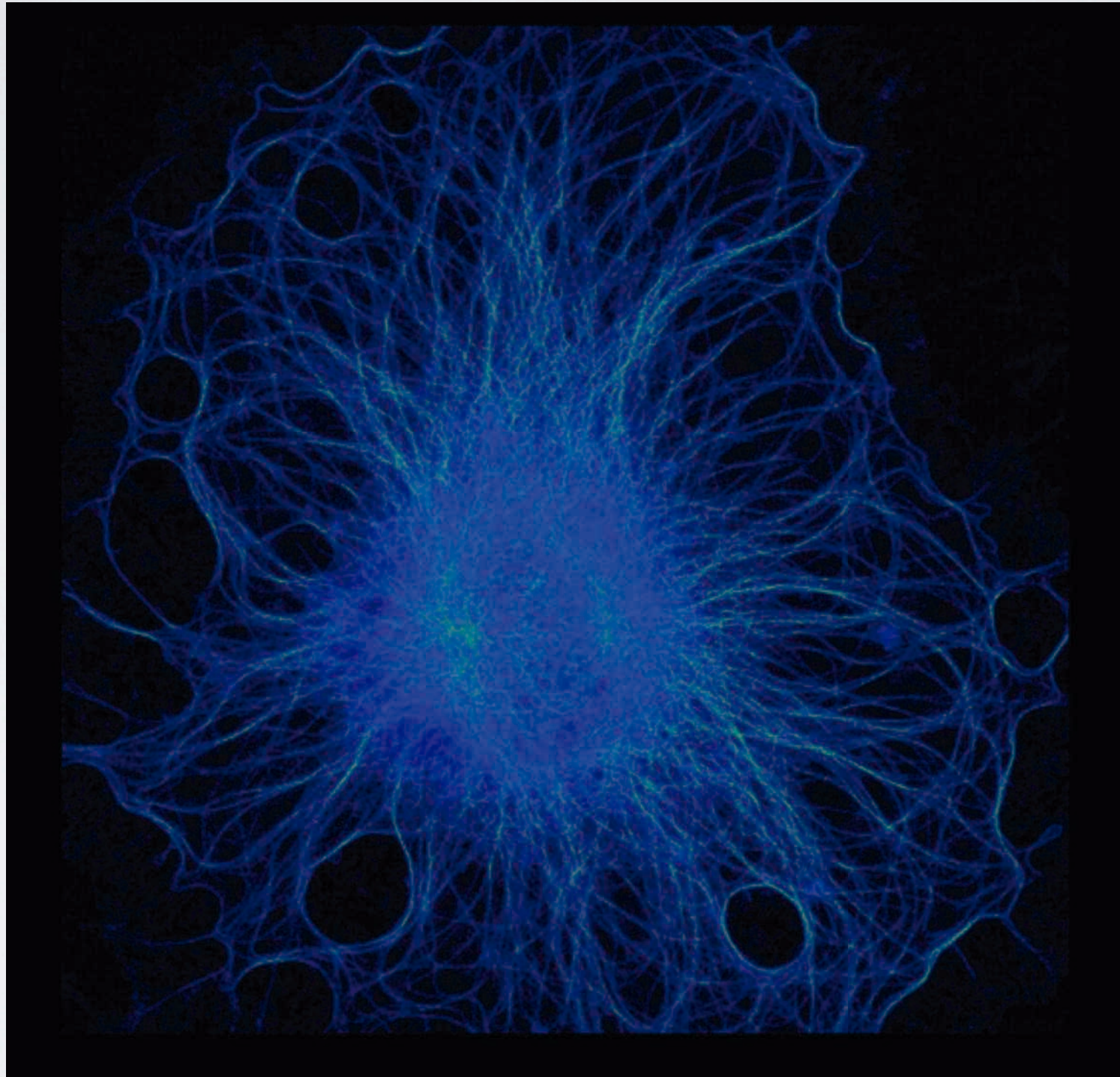
v





competencia
~~vs y~~
 coordinación

Red de microtúbulos en una célula adherente

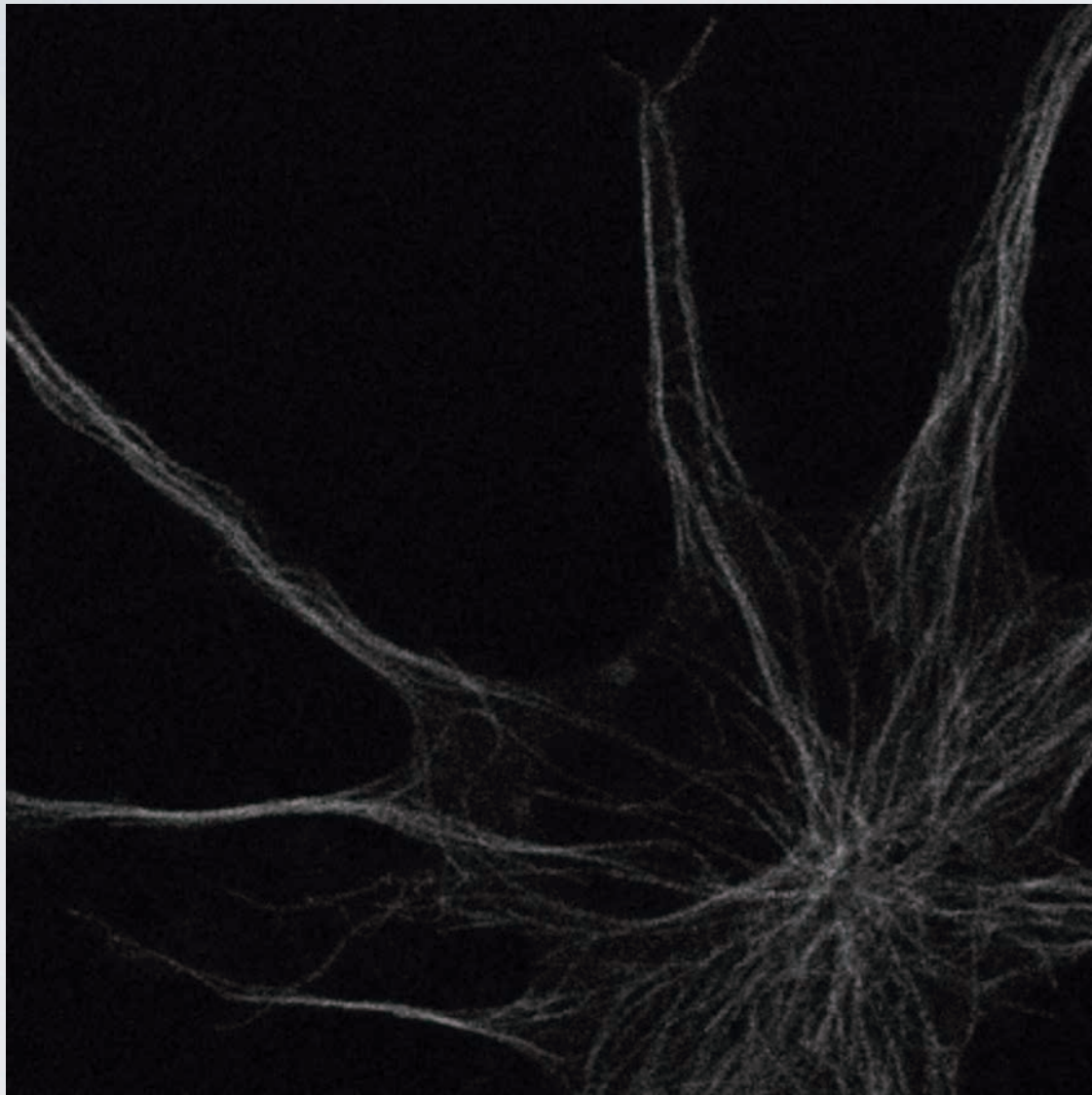


La RED es dinámica y activa



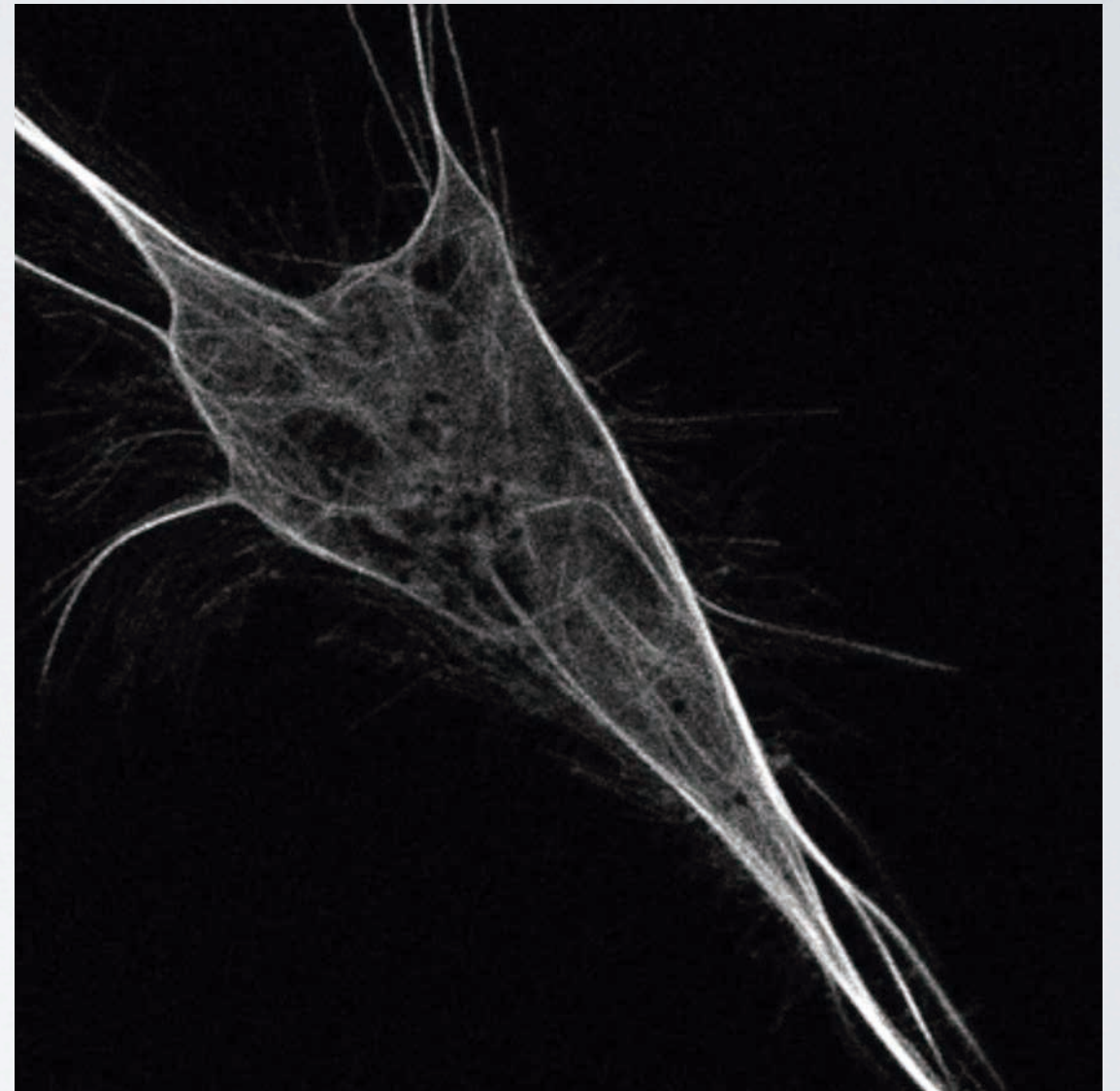
¿qué es un proceso activo?

Célula línea estable XTP-GFP



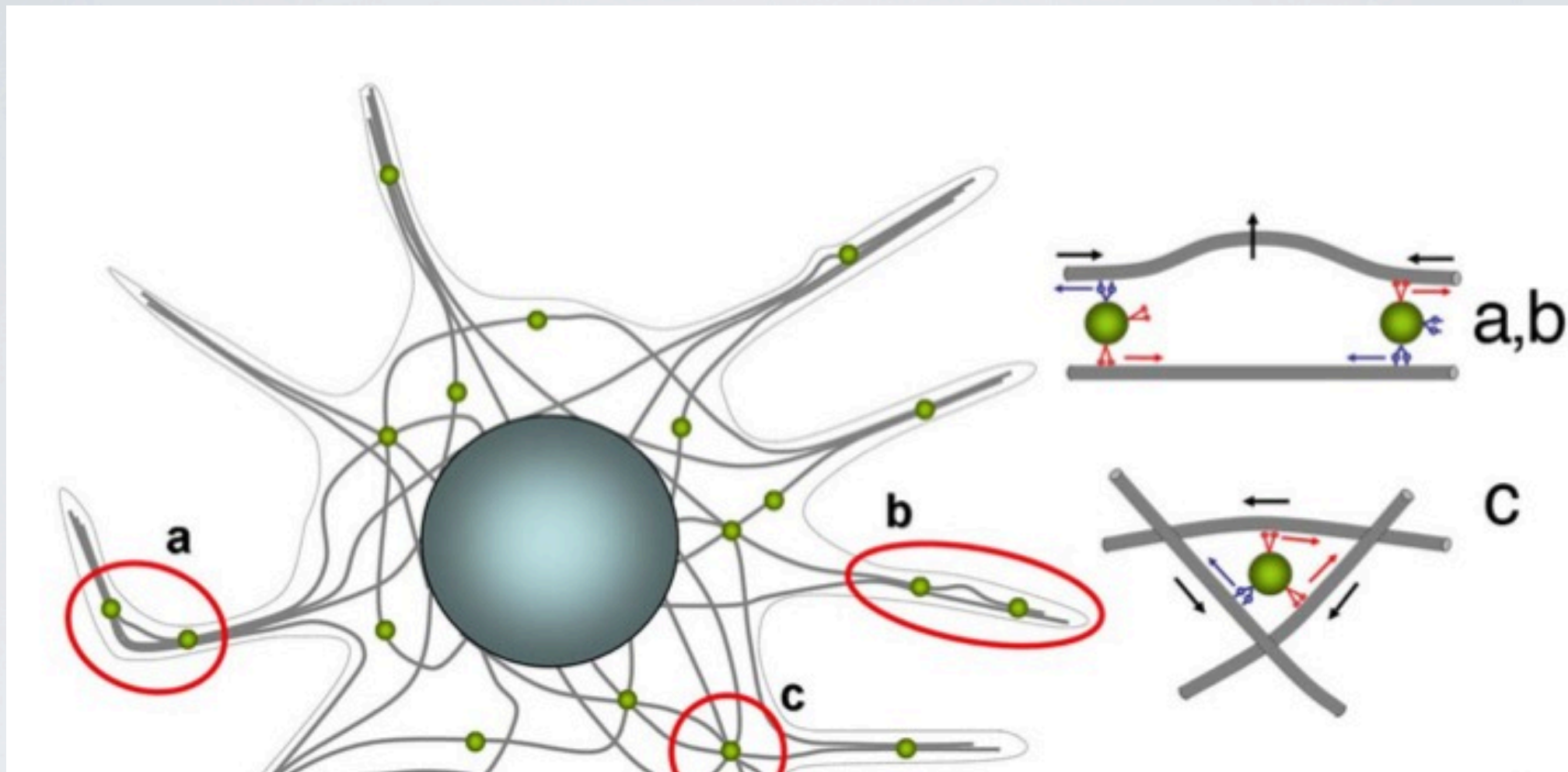
10 um

Tratada con Azida:
inhibidor de la producción de ATP

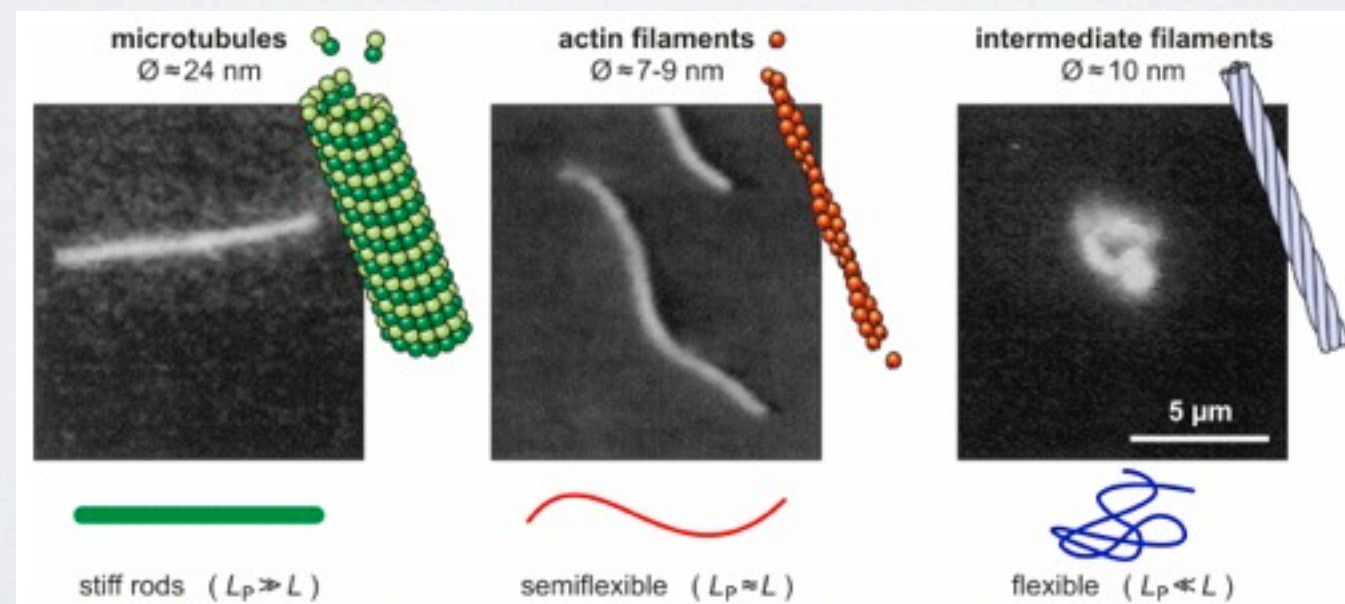


Cell line of melanophores stably expressing EGFP-tagged XTP, a Xenopus homologue of tau protein which bind to microtubules (0.103um/pixel, 1s/frame). Duration ~2min (Images: Diana Wetzler, Carla Pallavicini & Bruno Moretti (H. Grecco))

Fuerzas activas y microtúbulos



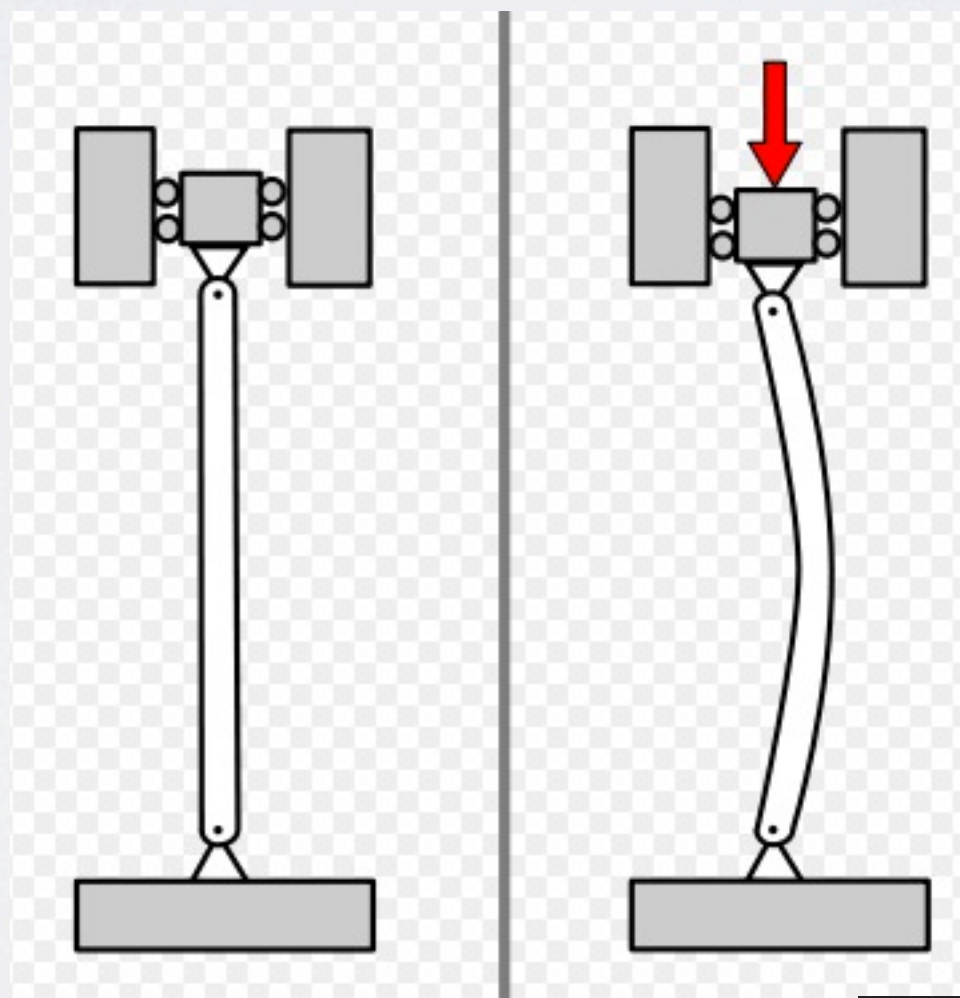
Kulic et al, PNAS, 2008



Fuerzas de compresión y "buckling"

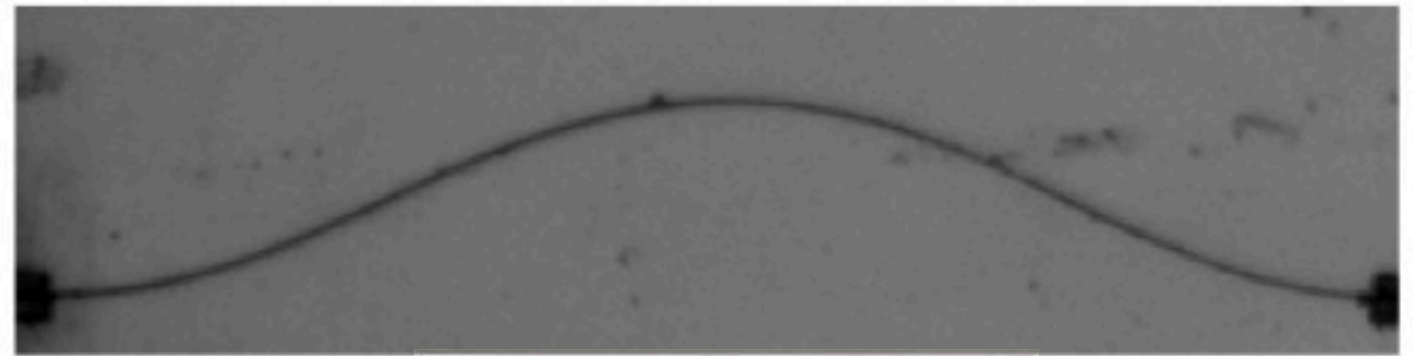
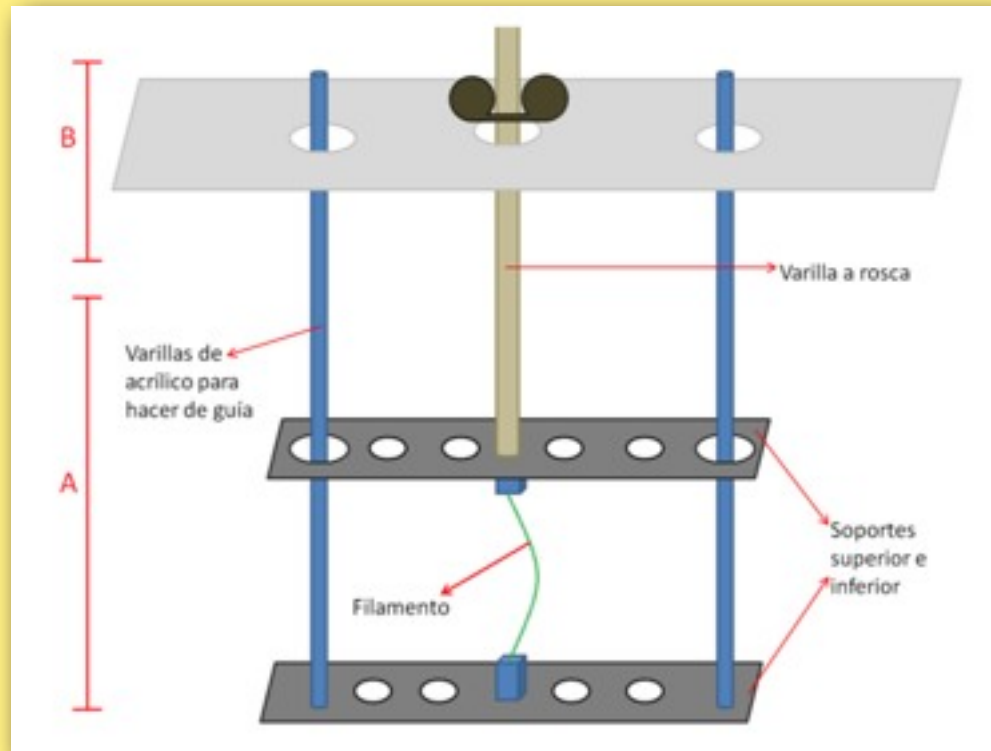
- When a slender rod is under compression it will bend if the applied force is larger than a critical force: the Euler force

$$F_c = (\pi/L)^2 K$$

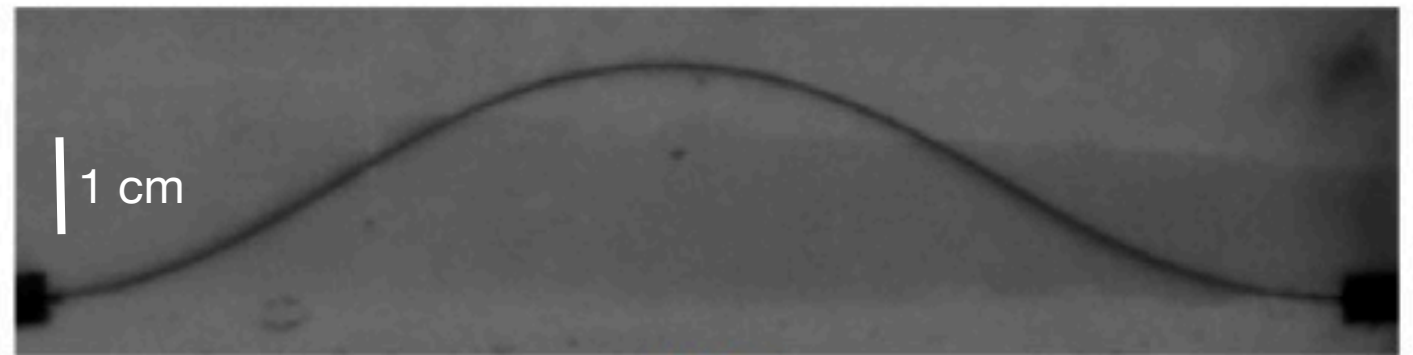


en.wikipedia.org

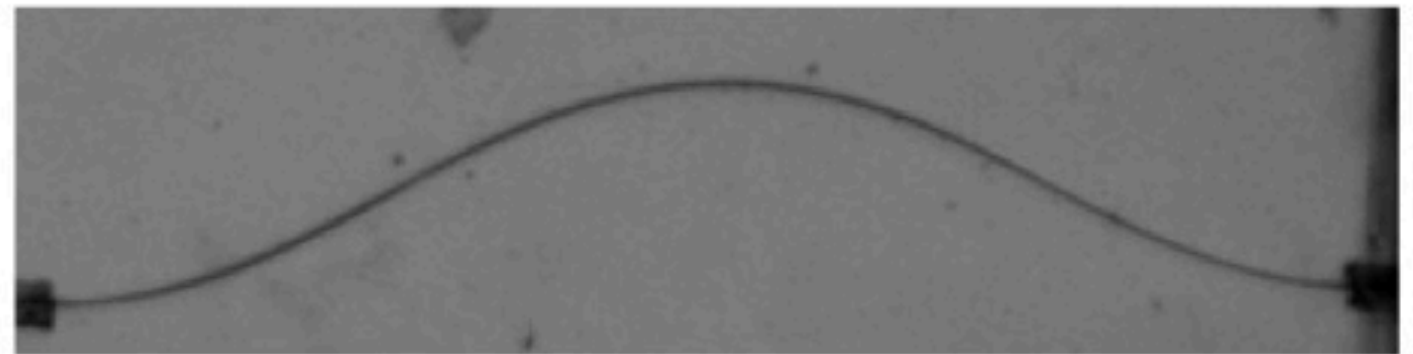
► Filamentos macroscópicos



Agua



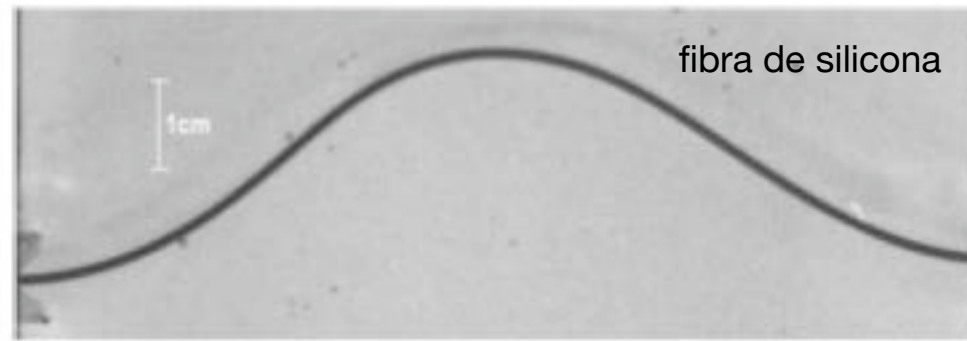
Aire



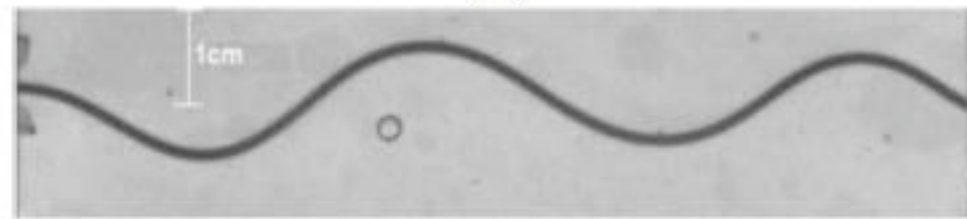
Glicerol

(Carolina Gómez, Labo 6y7, 2014, con Vero D'Angelo)

Buckling en medios viscoelásticos



(a)



(b)

Glicerol

Gel de
Poliacrilamida

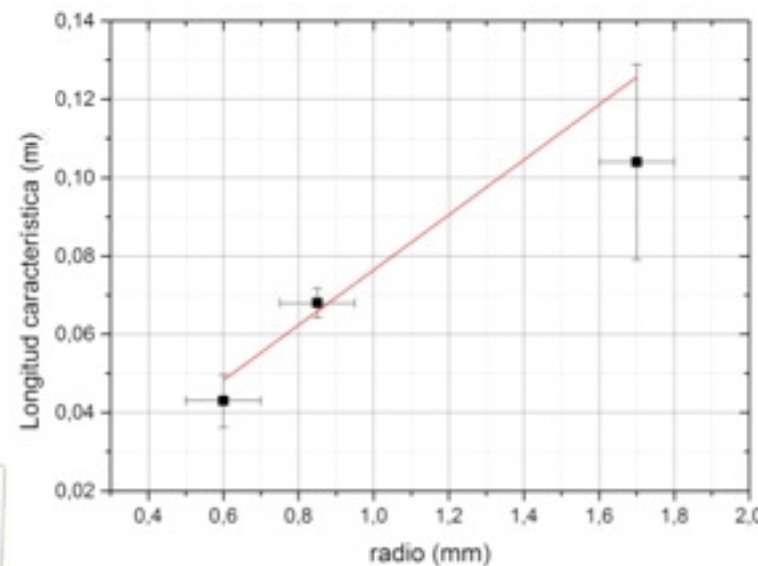
Elasticidad del filamento

$$\lambda \propto \left(\frac{EI}{G}\right)^{1/4}$$

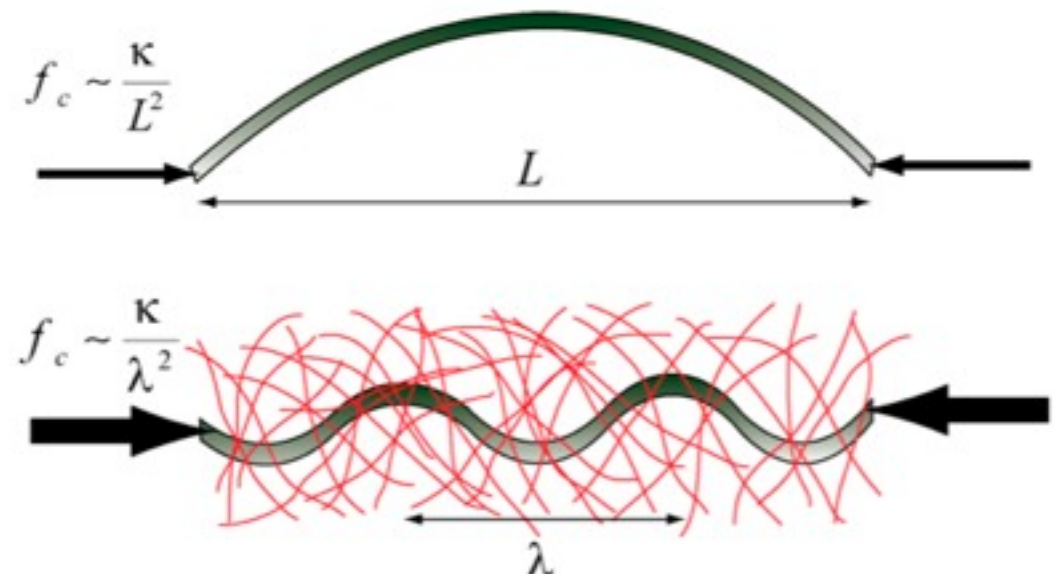
Elasticidad del medio

$E = 1.6 \text{ MPa}$

$G \sim 4 \text{ kPa}$



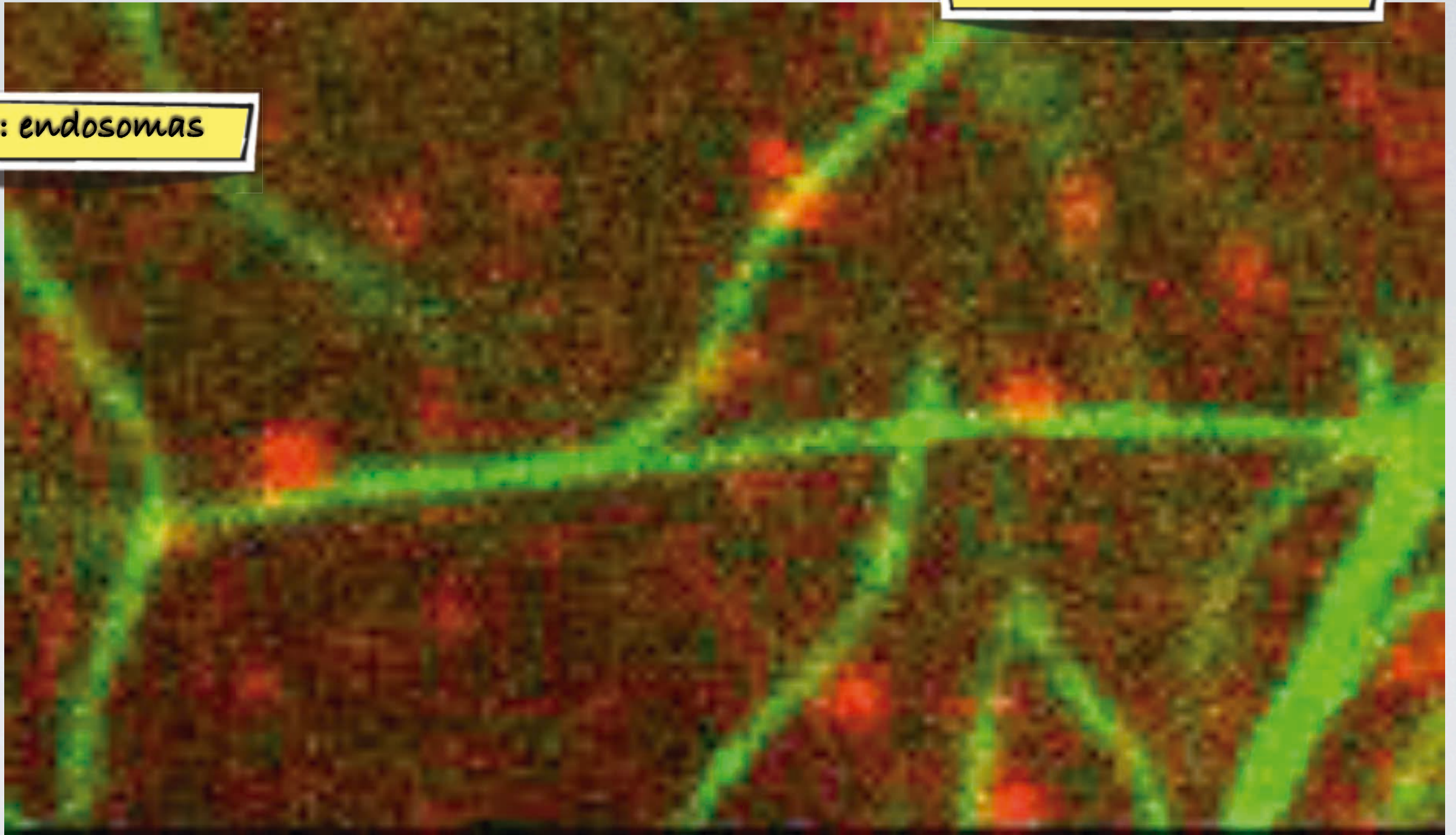
Fuerza crítica



Fuerzas activas y microtúbulos

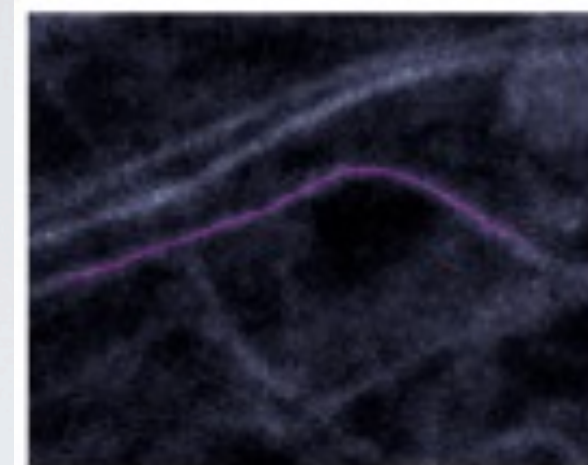
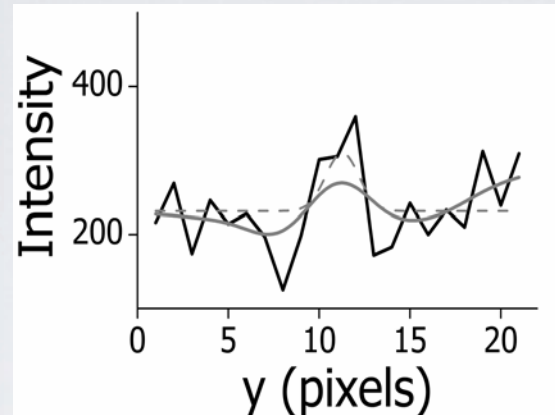
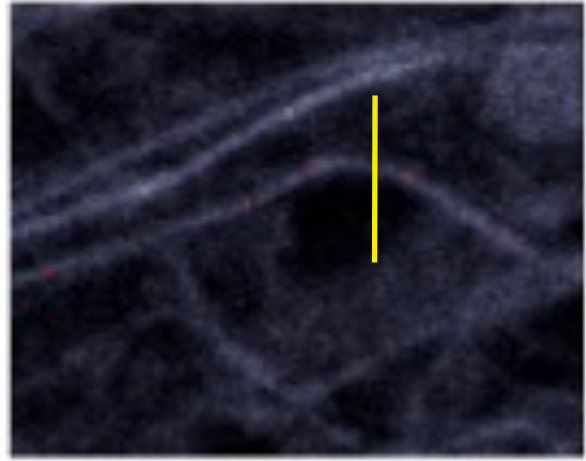
VERDE: microtúbulos

ROJO: endosomas



XTP-labeled *Xenopus leavis* melanophore cells.
Image size: 7 x 8 μm^2
Time resolution 350 ms/frame
(Images Carla Pallavicini)

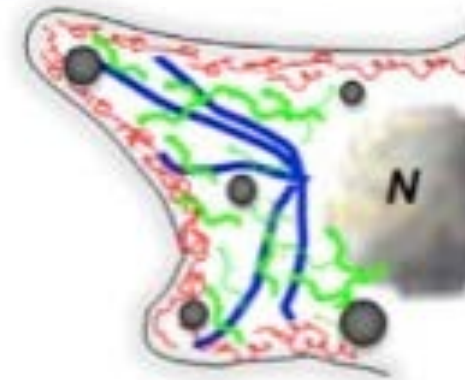
Tracking de microtúbulos individuales



Para estudiar la influencia del entorno citoplasmático...

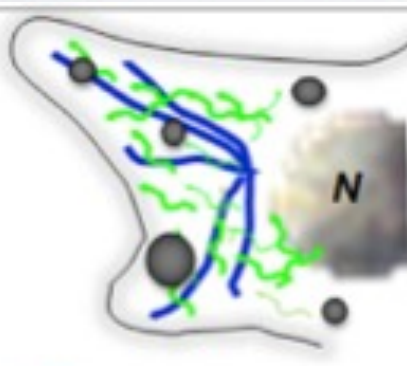
— microtubule
— vimentin
— actin
N nucleus
 melanosome

■ WT

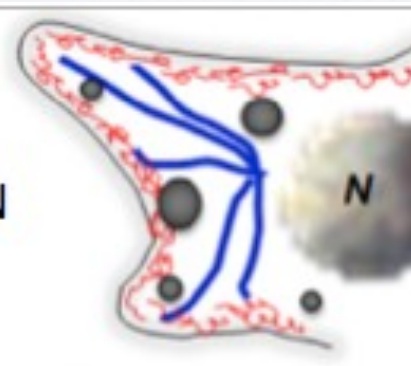


...Podemos depolimerizar las distintas redes del CSK de manera selectiva

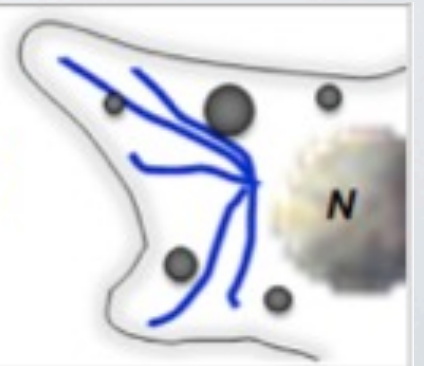
● NO ACTIN



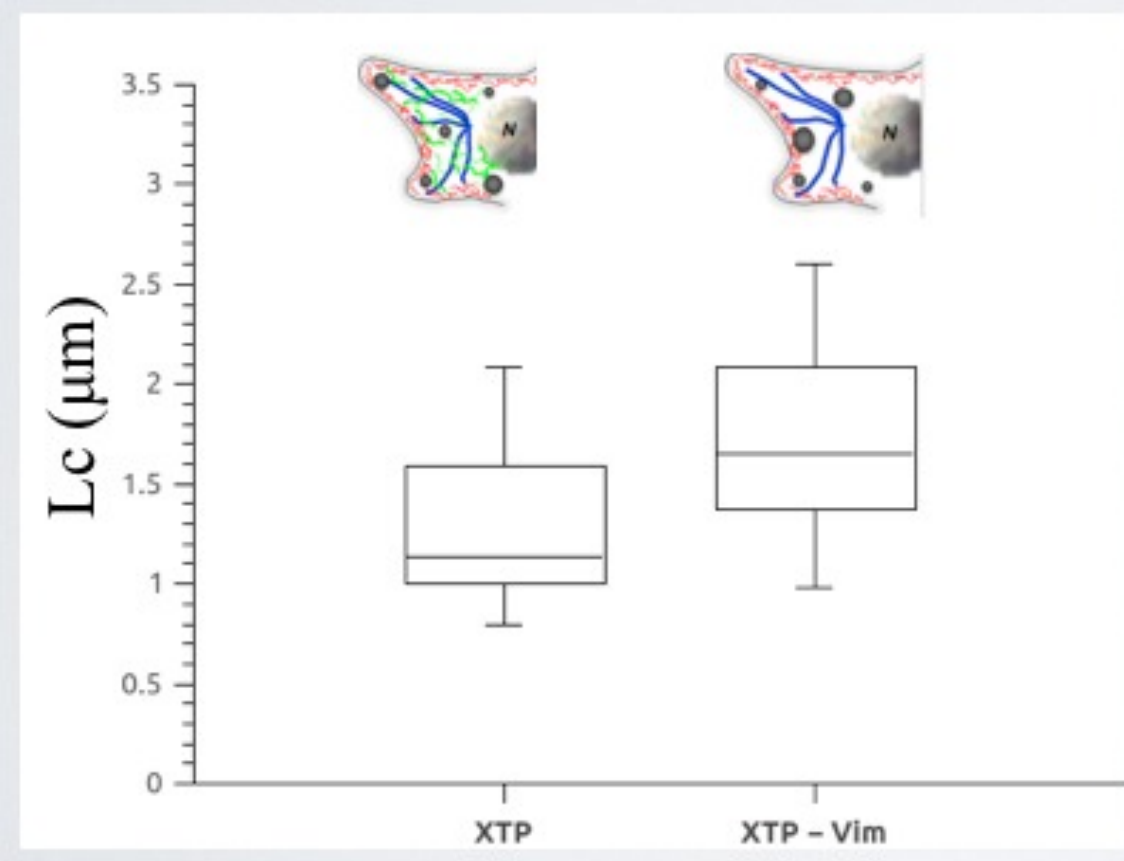
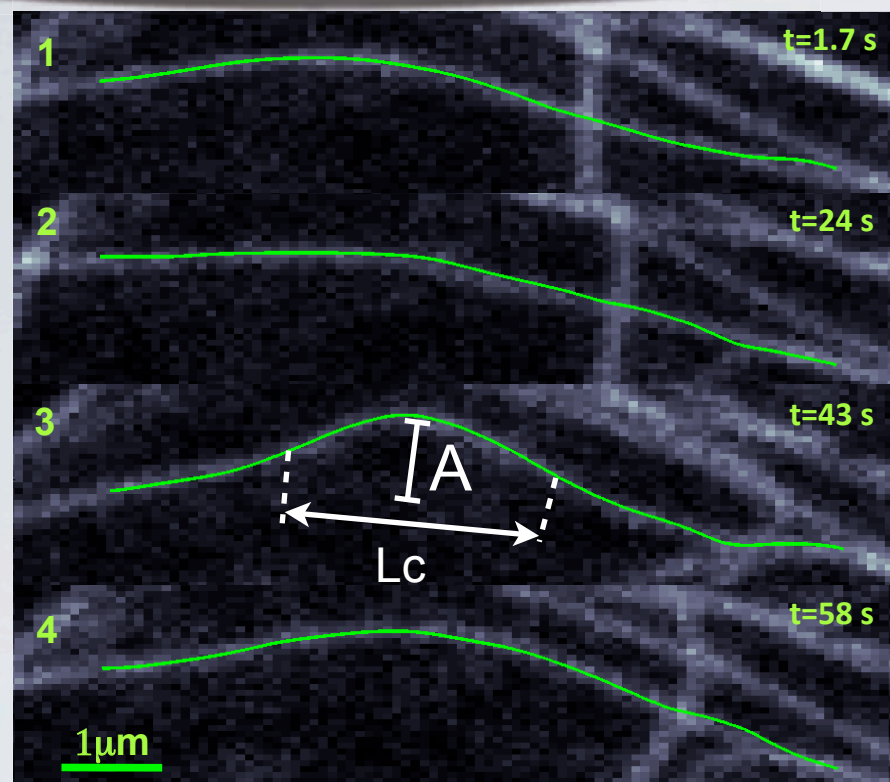
▲ NO VIMENTIN



▼ NO VIMENTIN
& NO ACTIN



Buckling y fuerzas



N = 13-23
from 7-15 cells

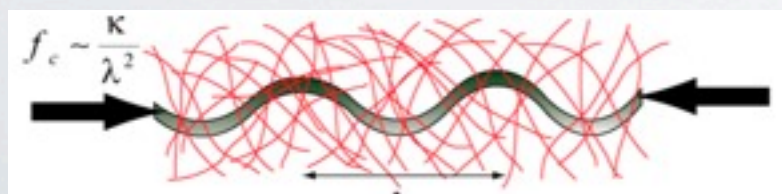
$$\lambda \propto \left(\frac{EI}{G}\right)^{1/4}$$



$$G_{\text{vim}} \approx 1/4 G_{\text{WT}}$$

$$EI \approx 2 \times 10^{-23} \text{ Nm}^2$$

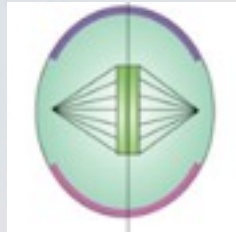
$$G \approx 1 \text{ kPa}$$



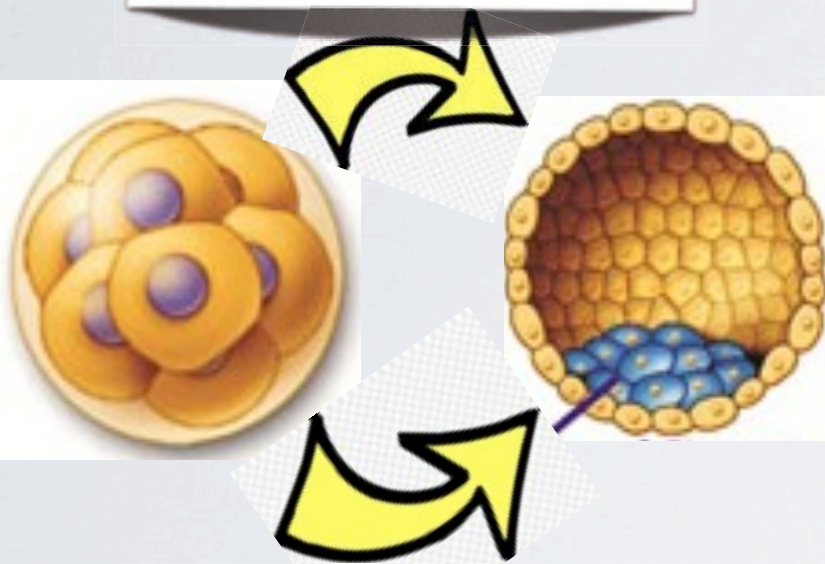
$$F_c \approx 100 \text{ pN}$$

Fuerzas activas y microtúbulos.

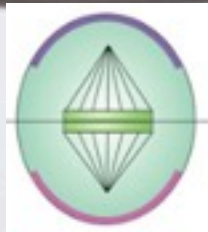
Posicionamiento del núcleo en embriones tempranos de ratón



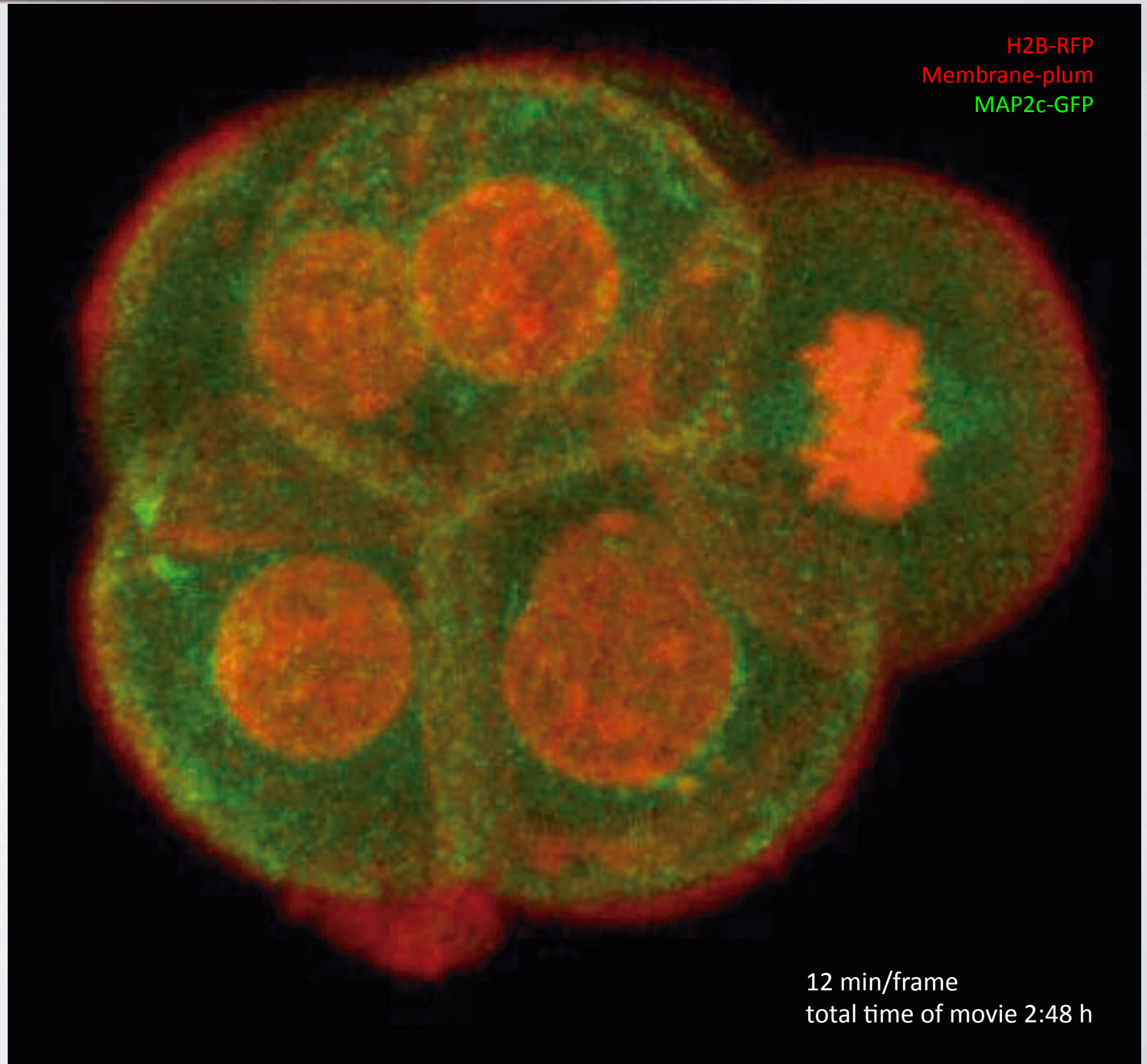
Divisiones simétricas:
extra-embrión (placenta)



Divisiones asimétricas:
embrión



6-cells mouse embryo
(Images Jenny Zenker & Nicolás Platcha)

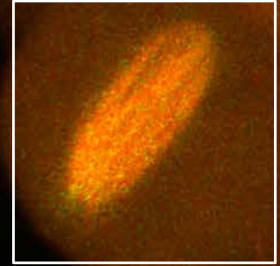


H2B-RFP
Membrane-plum
MAP2c-GFP

12 min/frame
total time of movie 2:48 h

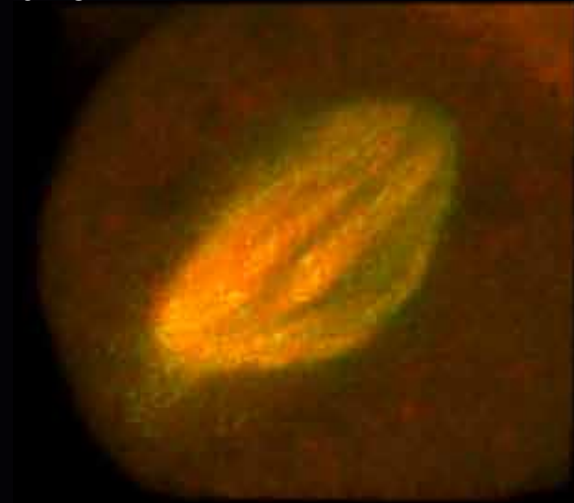
whole embryo at $t = 0$

MAP2c-RFP
EB1-GFP

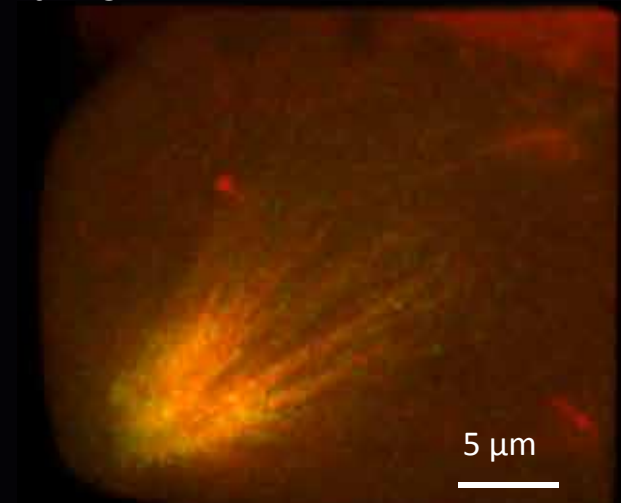


10 μm

$t = 0$

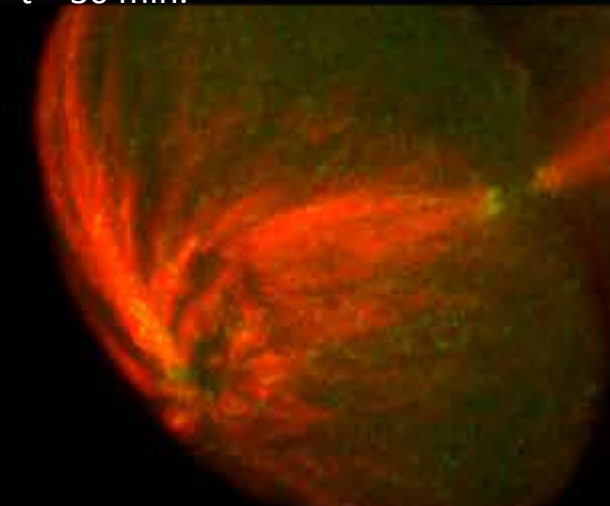


$t = 15 \text{ min.}$

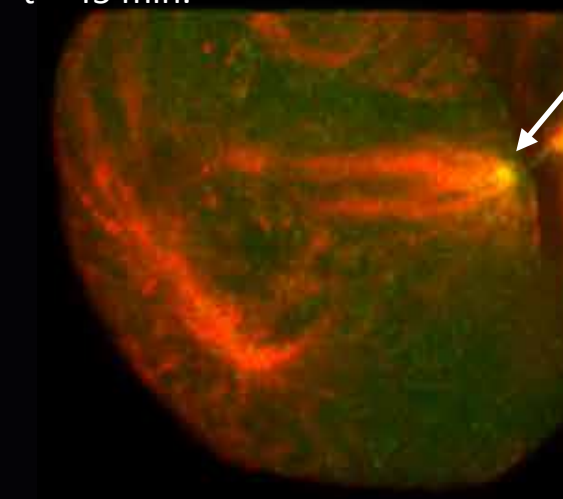


5 μm

$t = 30 \text{ min.}$

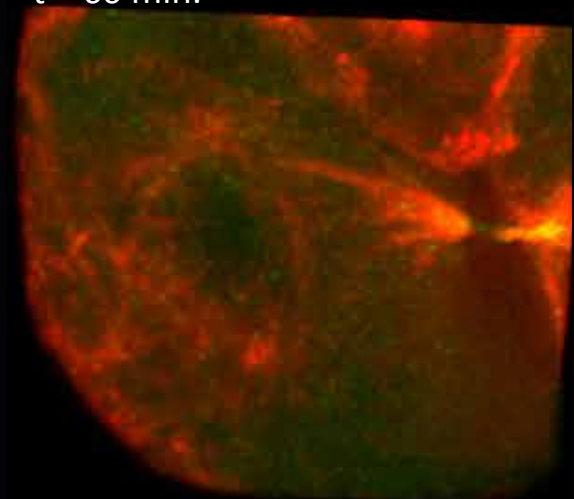


$t = 45 \text{ min.}$



EB1-GFP

$t = 60 \text{ min.}$



(Images Jenny Zenker & Nicolás Platcha)

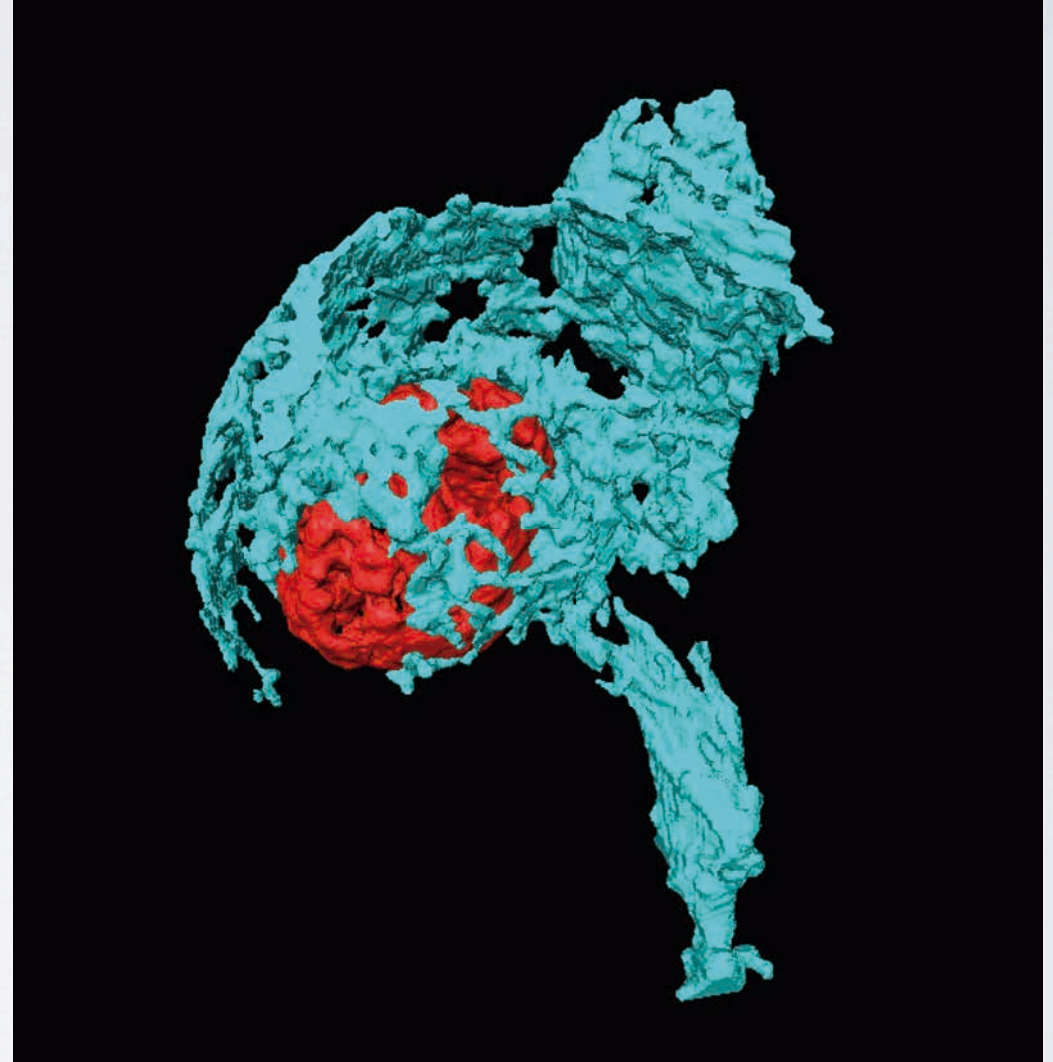
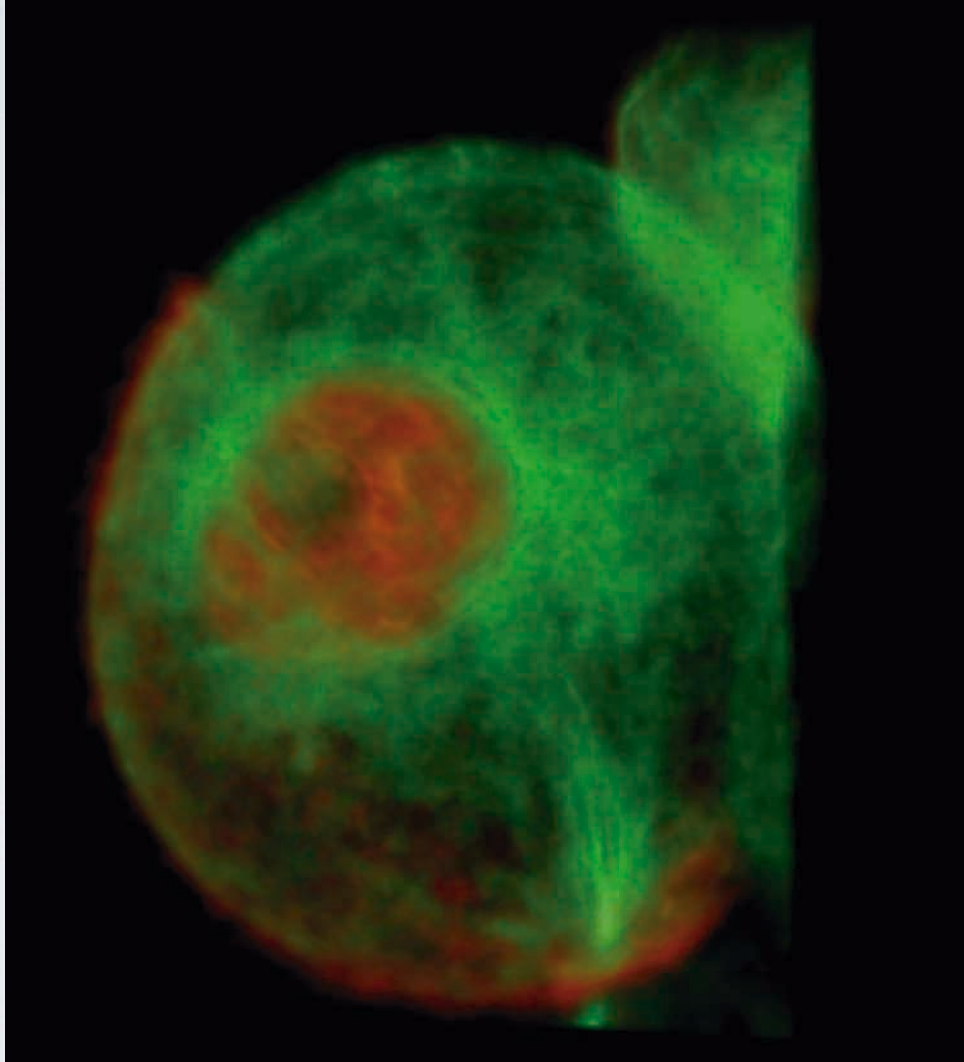
Pull

or

Push ?



Estructura 3D



(Images Jenny Zenker, Nicolás Platcha & Juan Angiolini)

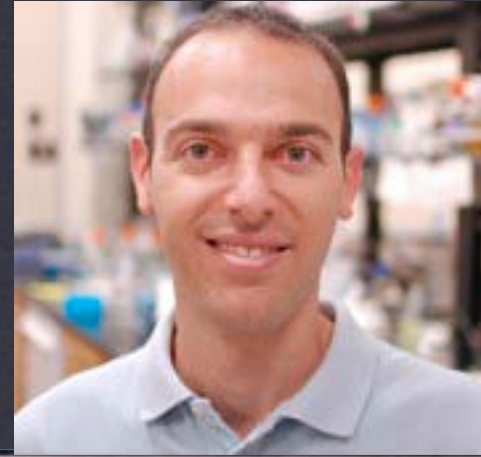
Colaboradores



Geraldine Querón
Grupo de Inflamación y
Cáncer- FCEN



Tomás Falzone
FMED-UBA



Nicolás Platcha
EMBL-Singapur



Verónica D'Angelo
FIUBA



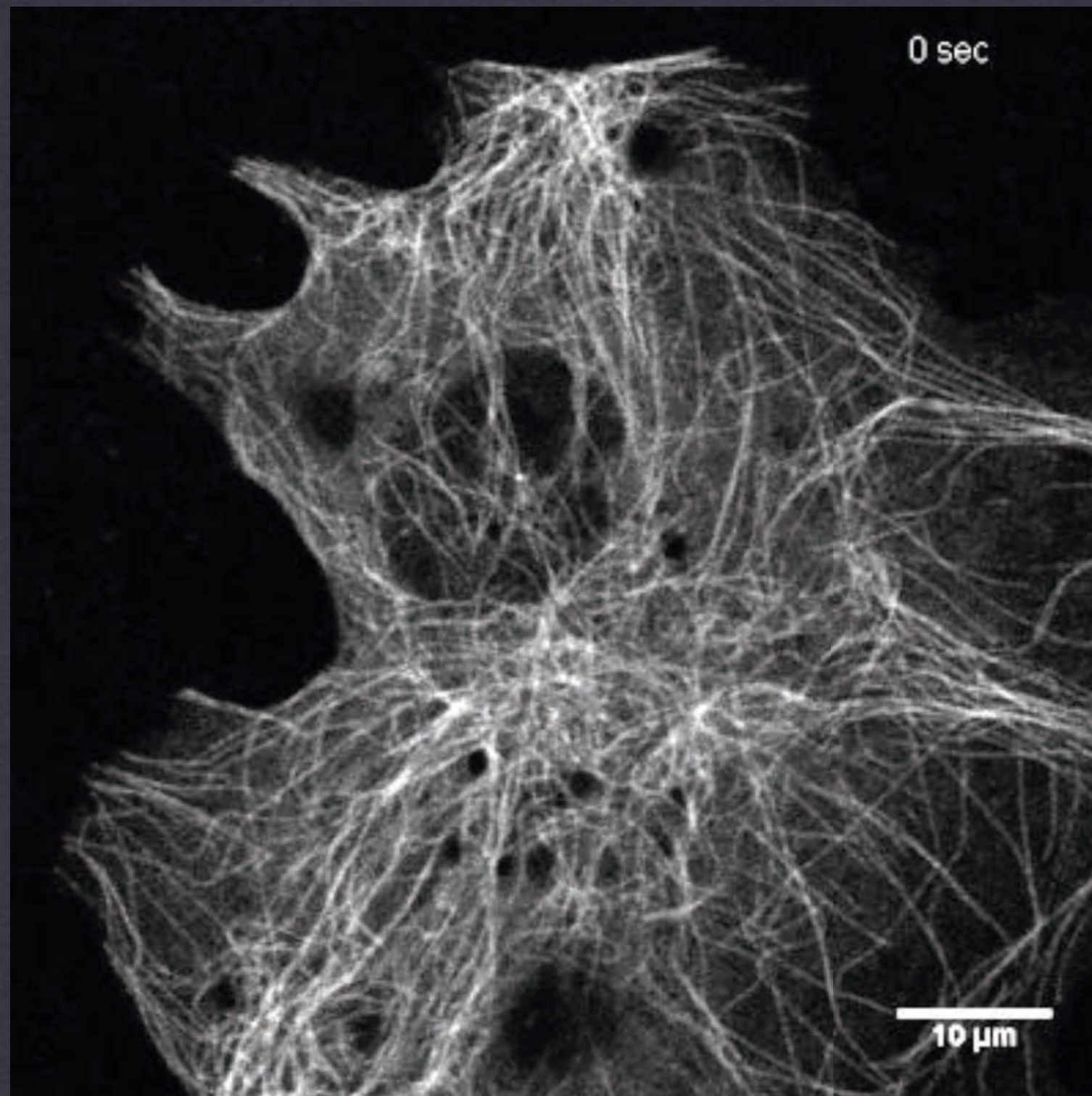
Mariela Sued y Daniela Rodríguez
IC - FCEN



Enrique Cerda
Universidad de
Santiago de Chile



Esteban Moscoso
DC-FCEN



Thank you!

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