NIS colloquium

"Advances in biomaterials: combining simulations and experiments"

Torino, 28-29 November 2013

A biophysical investigation of the interaction between fluorescent silica nanoparticles and neuronal cells

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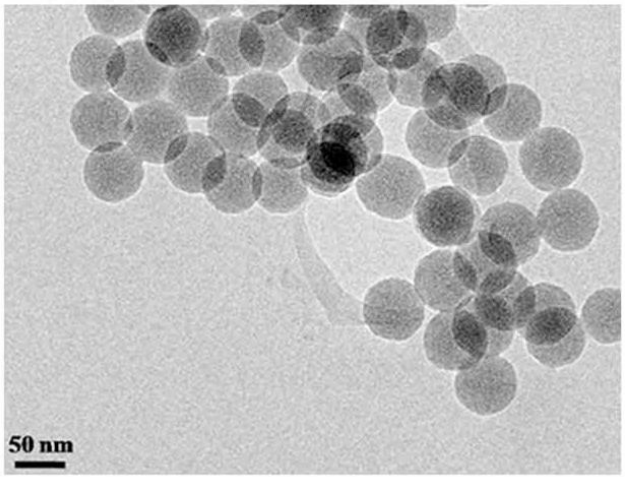
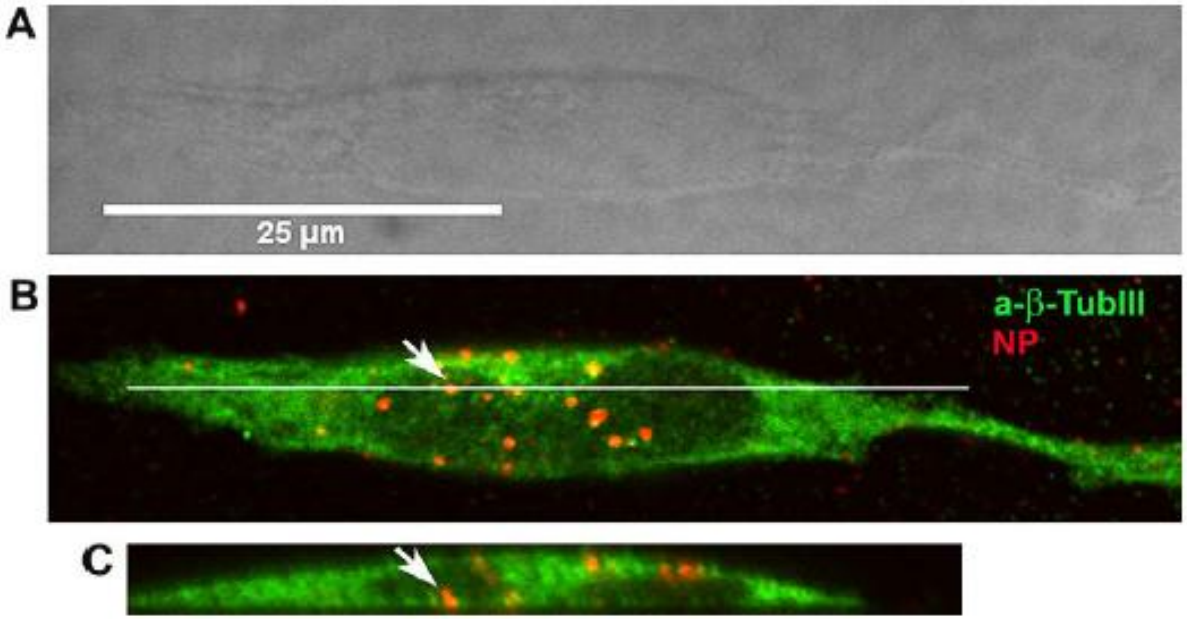
SiO_2 nanoparticles (50 nm)
high biocompatibility: great promise for their use as cellular trackers and markers

Mesenchimal stem cells:
Accommasso et al., Small 2012, 8, 3192-3200

Miletto et al., Dyes and Pigments 84:121, 2010



Neuronal cells



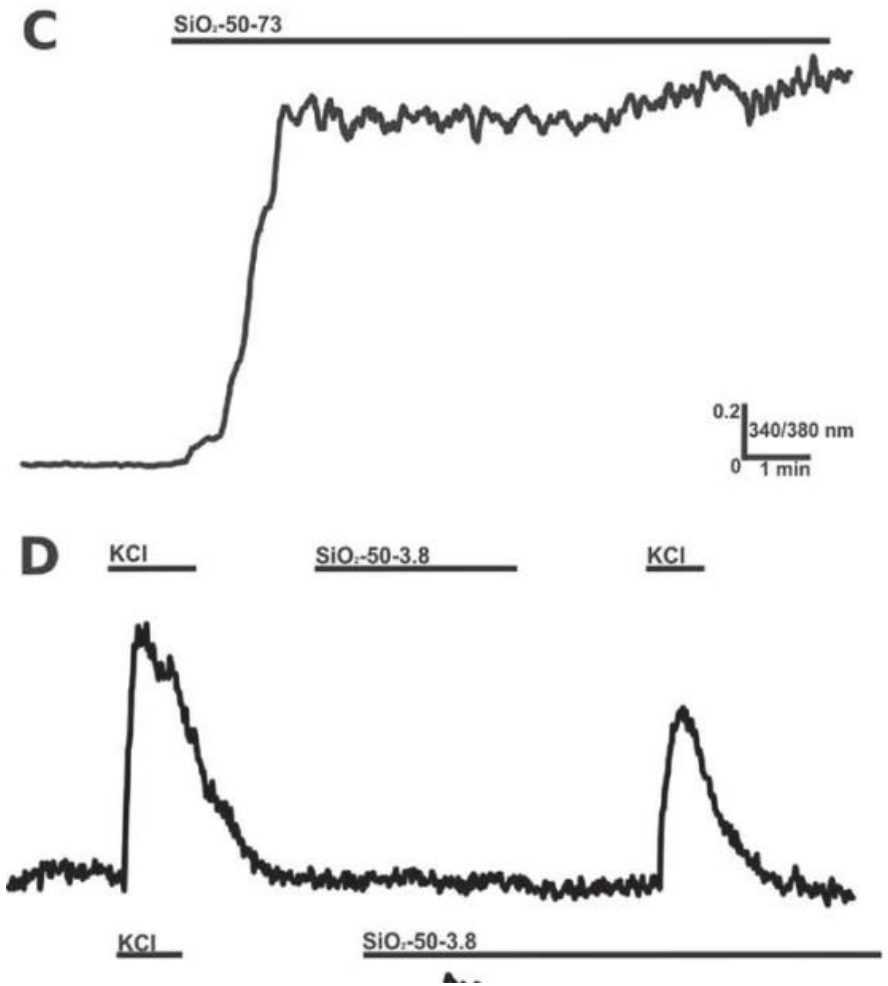
Phase contrast (A) and confocal images (B,C) of a GT1-7 cell loaded with the NPs (red). Culture time: 72 h. Internalization of the NP aggregates is shown in the section in C

On the other side:

complex perturbations in calcium homeostasis, size- and dose-dependent

Toxic [ ]

Non toxic [ ]

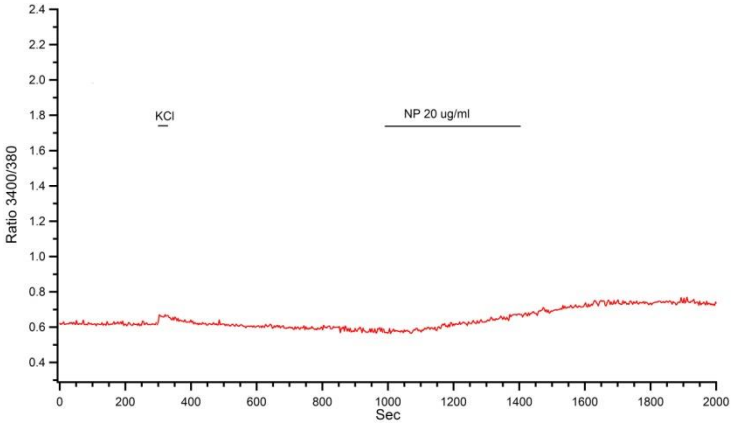


Ariano et al., Small, 2011, 7:766-74

Understanding the biophysical foundations of these effects

choice of a non-toxic dose: 20μg/ml

Calcium signalling



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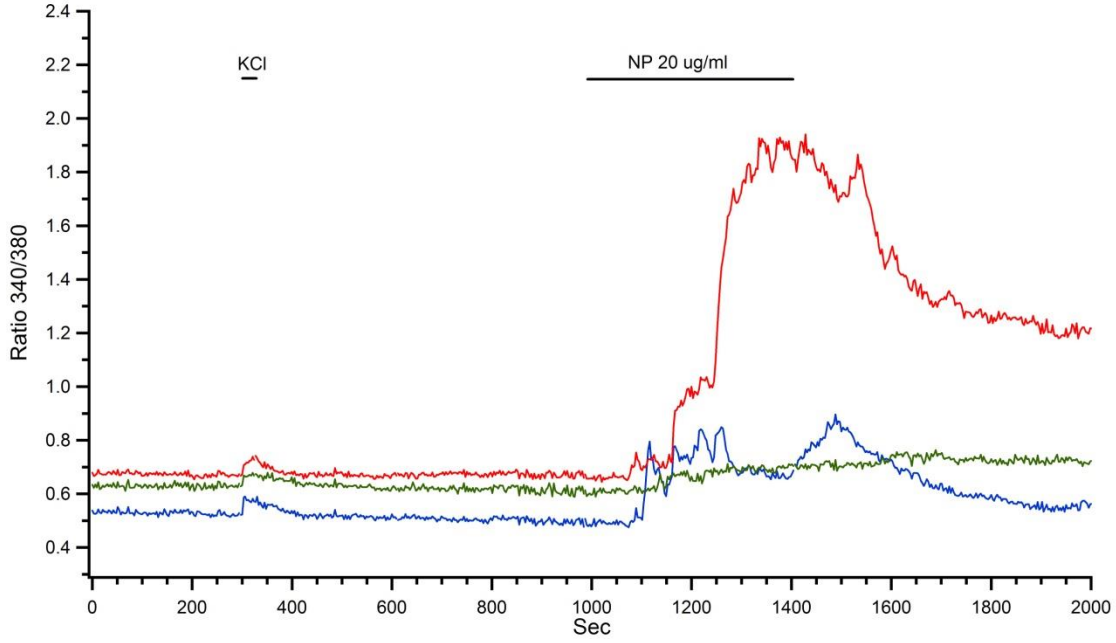
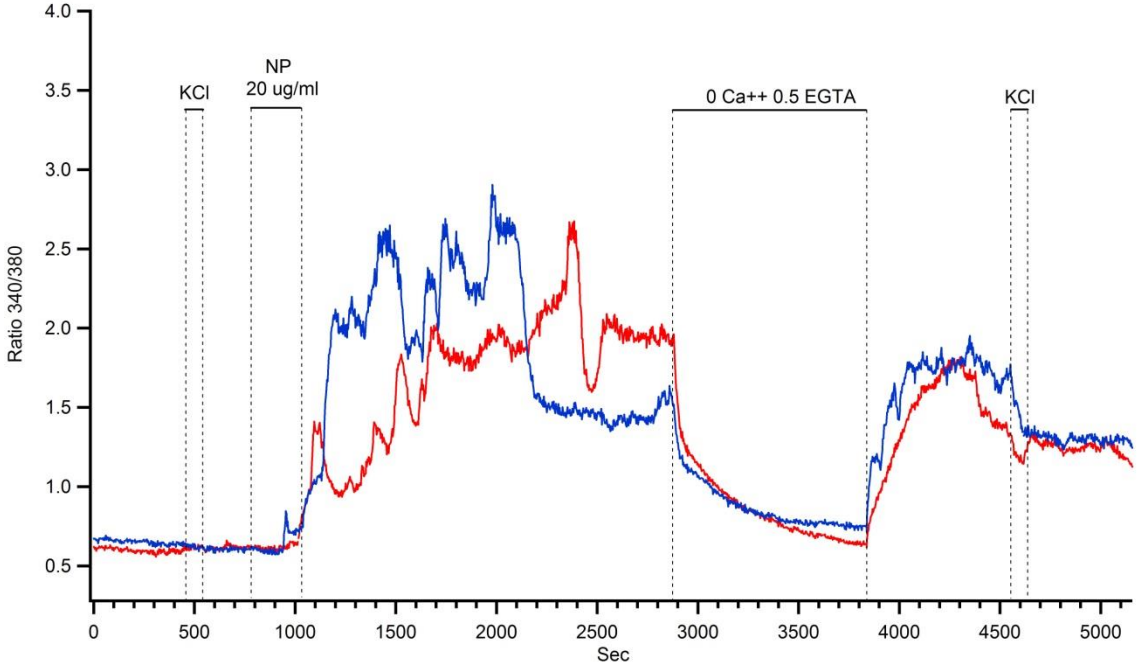


Influx or release?

Completely and reversibly abolished in 0 Cao



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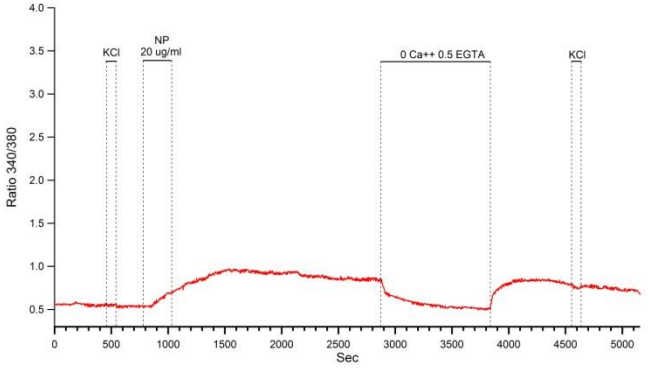
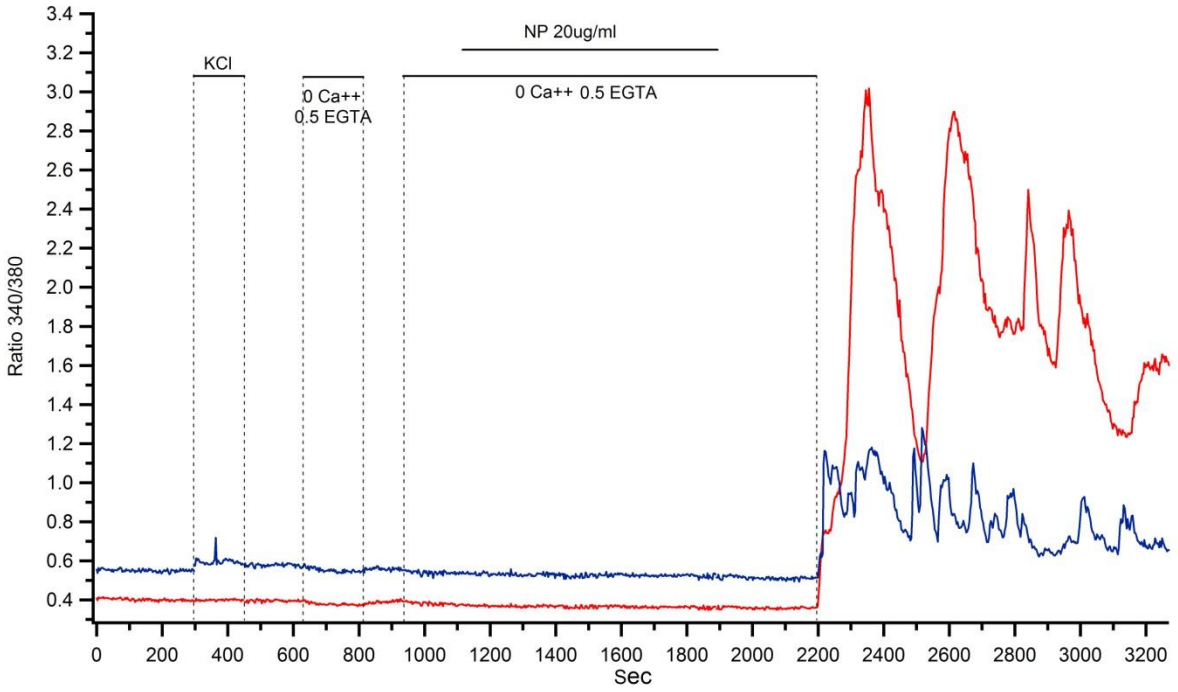
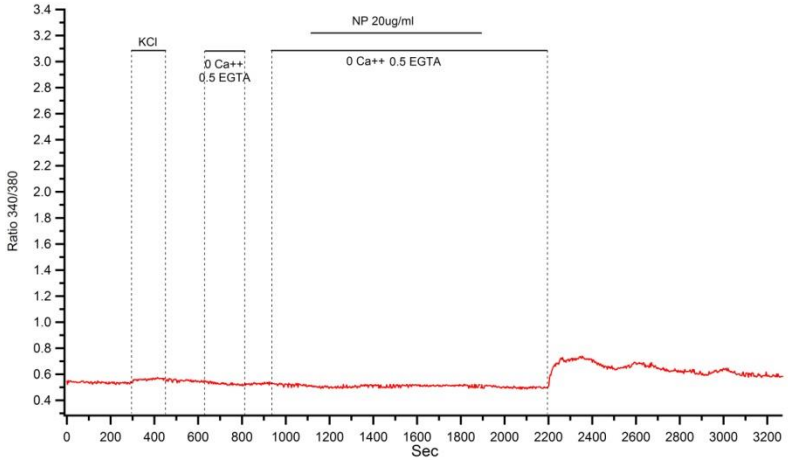


Absence of NP-induced release





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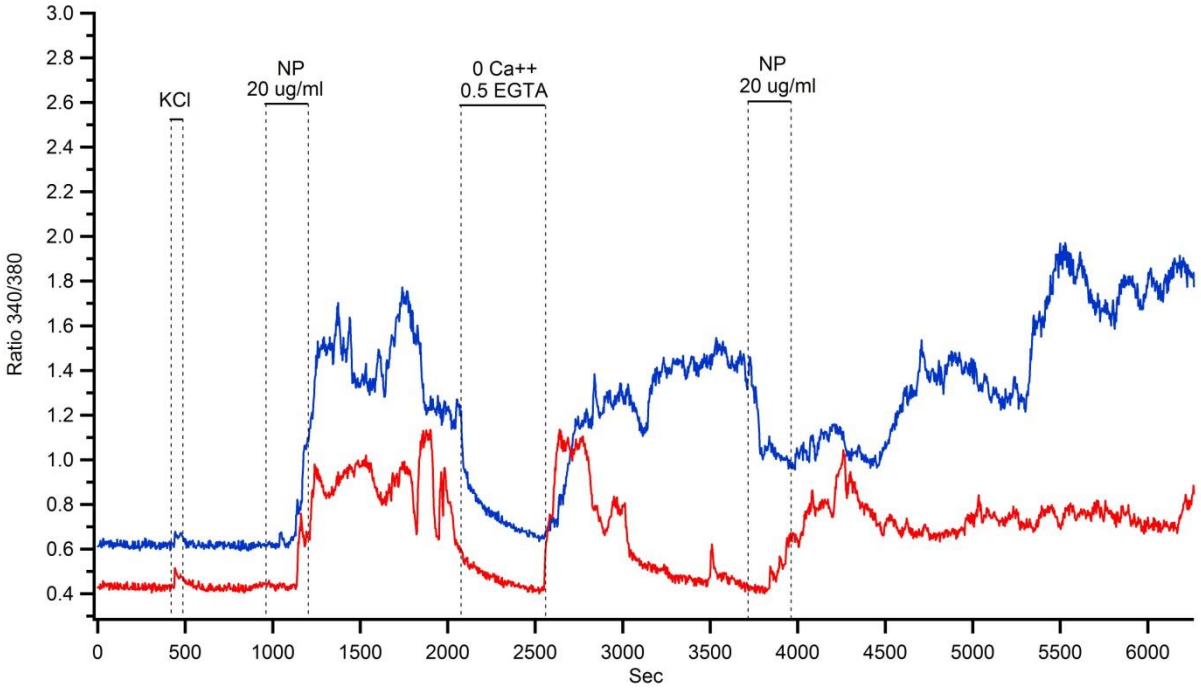
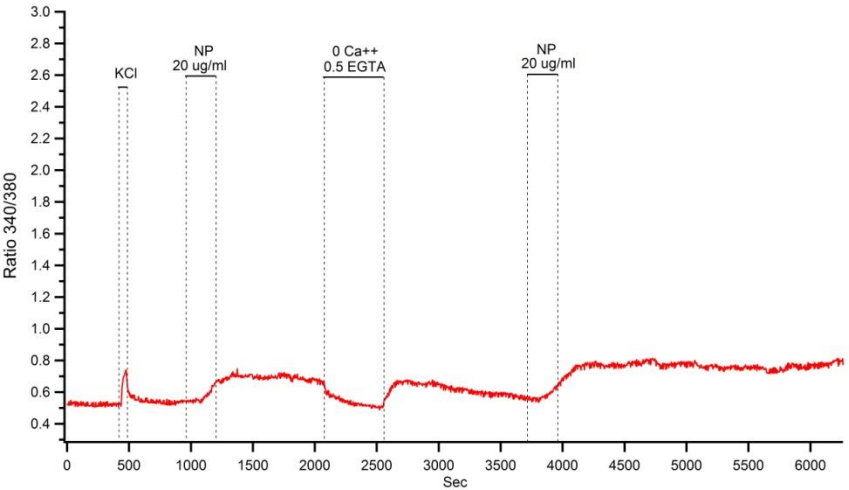
Reversibility 1

24 h preincubation
0.5% FCS





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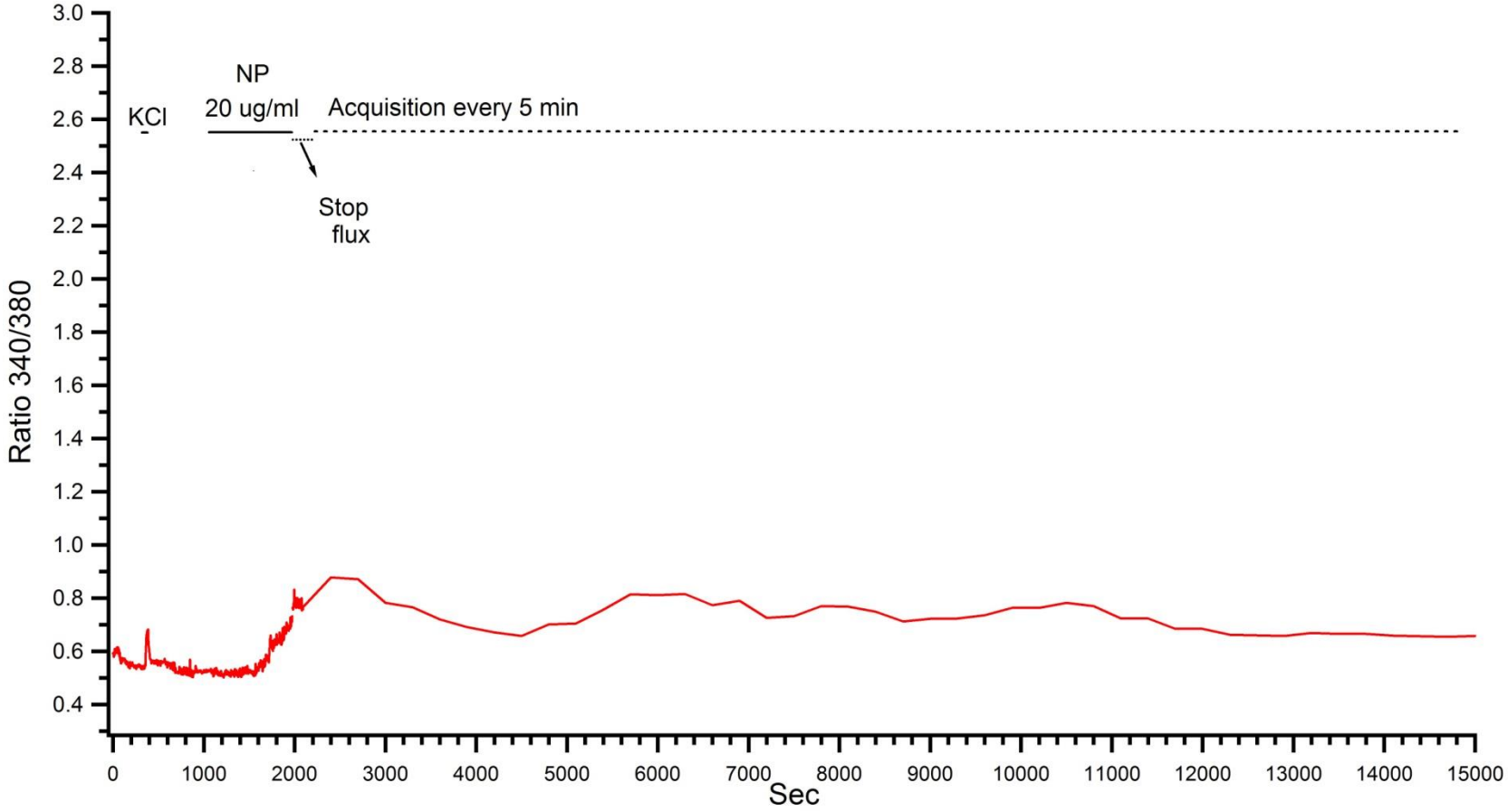
Reversibility 2

Long recordings



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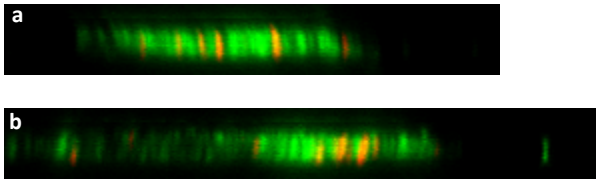
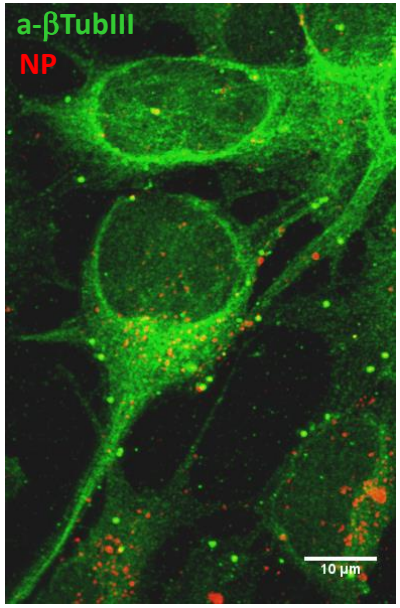
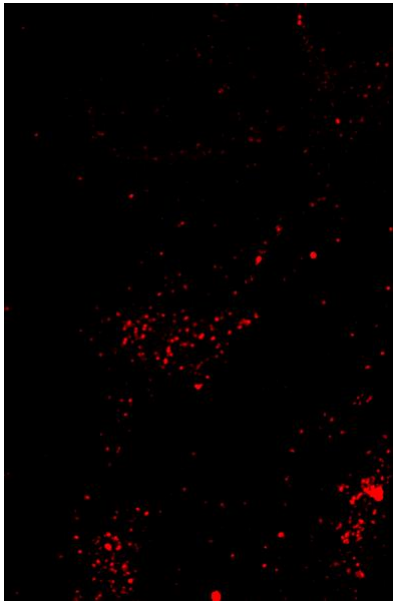
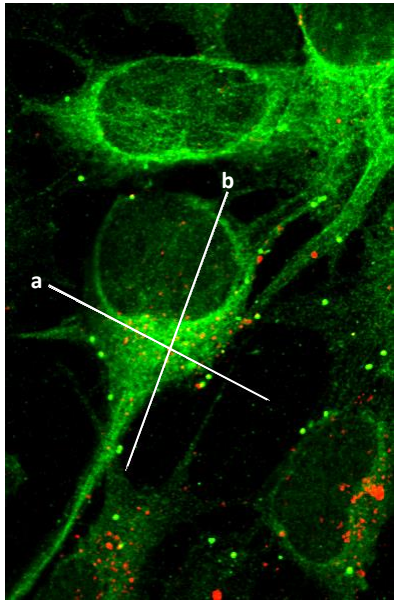
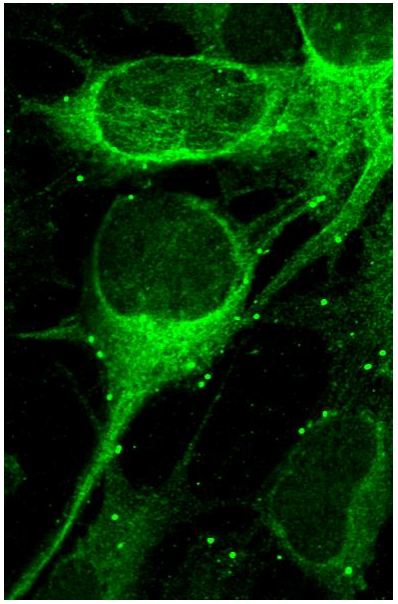
Incorporation at 4 h



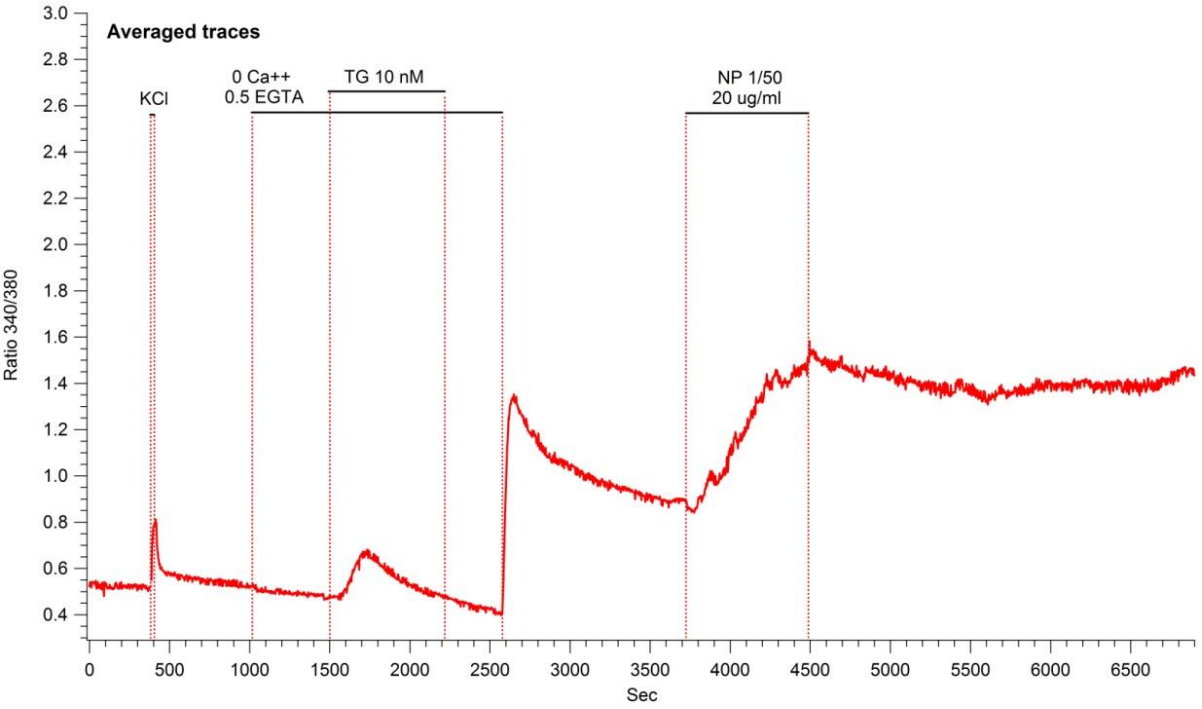








What kind of channels? 1 store-operated (SOCE)?



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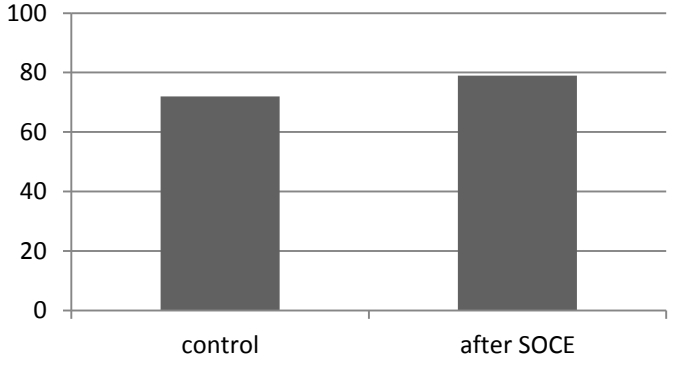
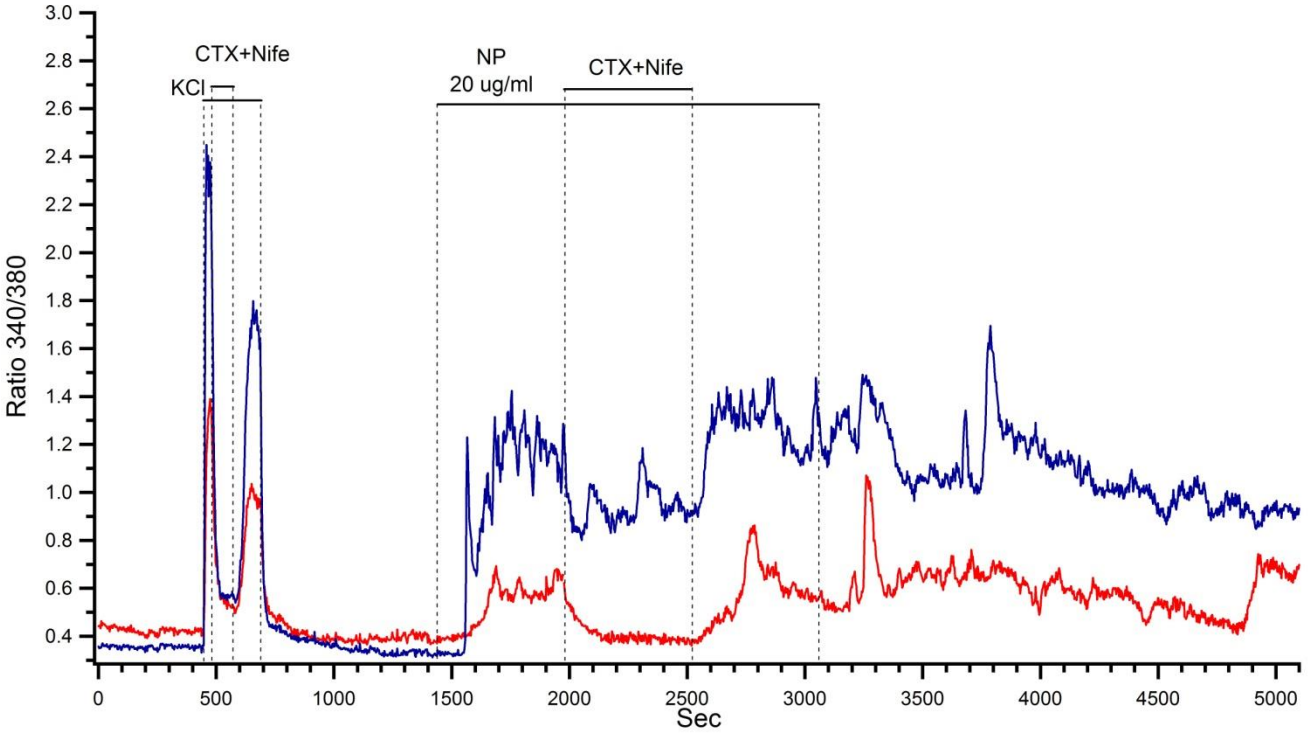
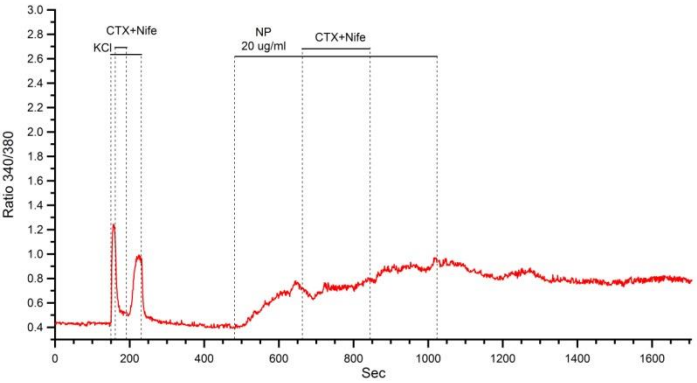
Following full activation of SOCE, NPs did elicit a strong calcium signal in high % of cells

% of cells responding to NPs



What kind of channels? 2
VOCs blockers





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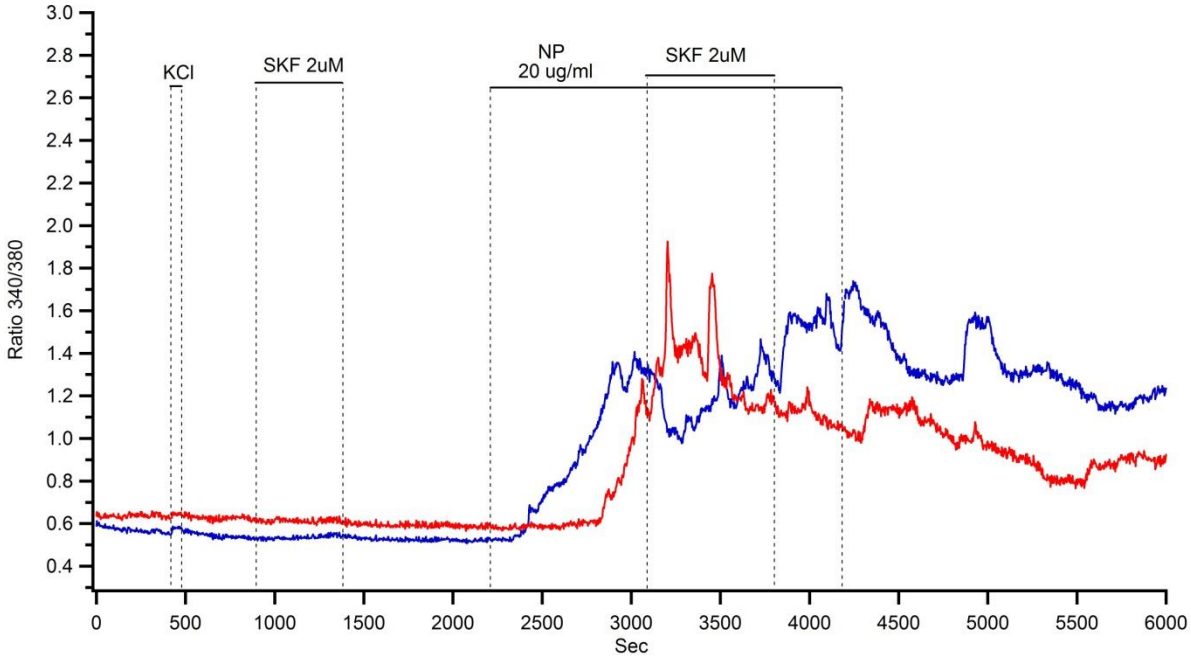
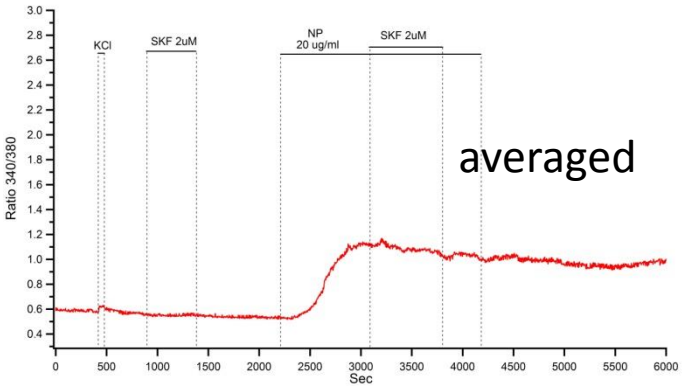
What kind of channels? 2
TRPC blockers





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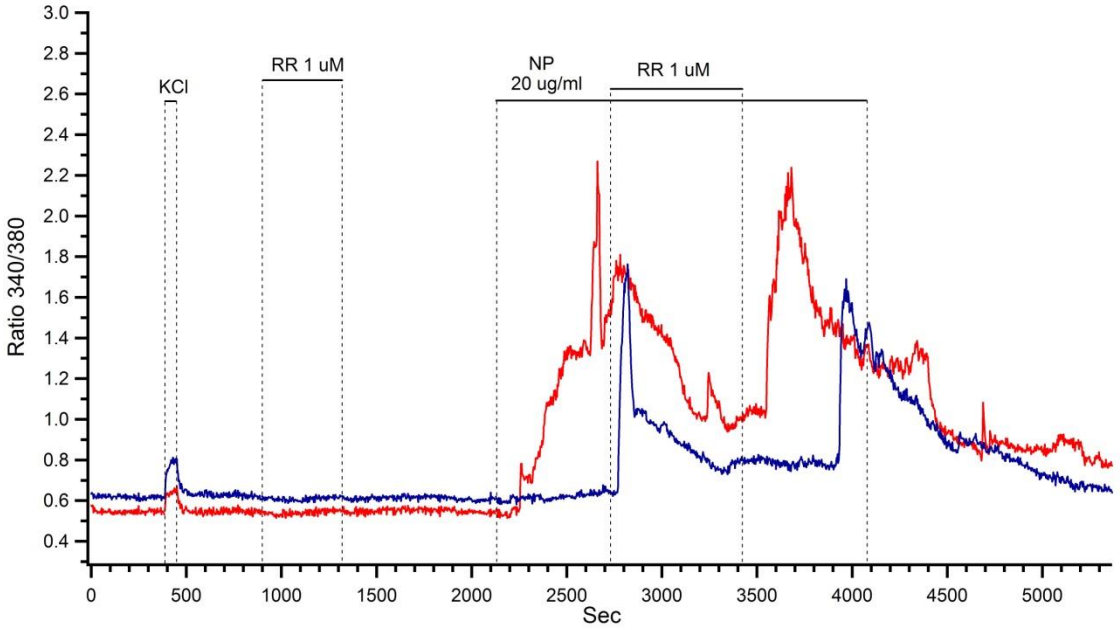
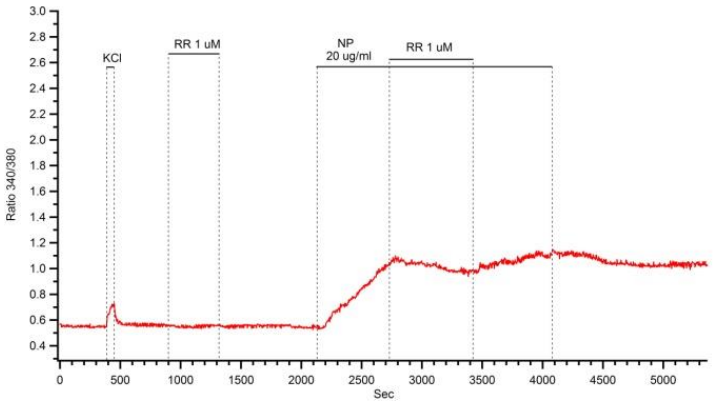
Complex and subtle changes.. spectral analysis needed (wavelets)

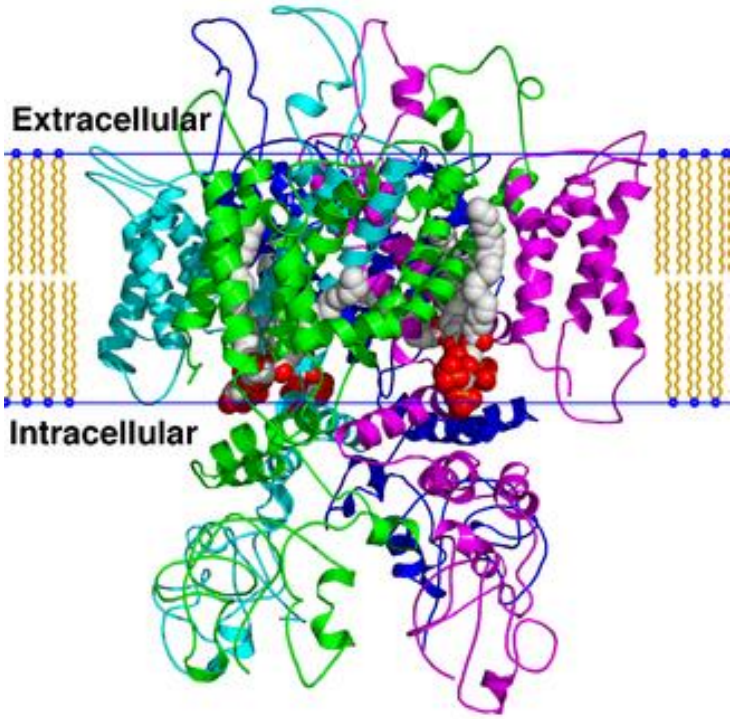
What kind of channels? 3 TRPV blockers

RR



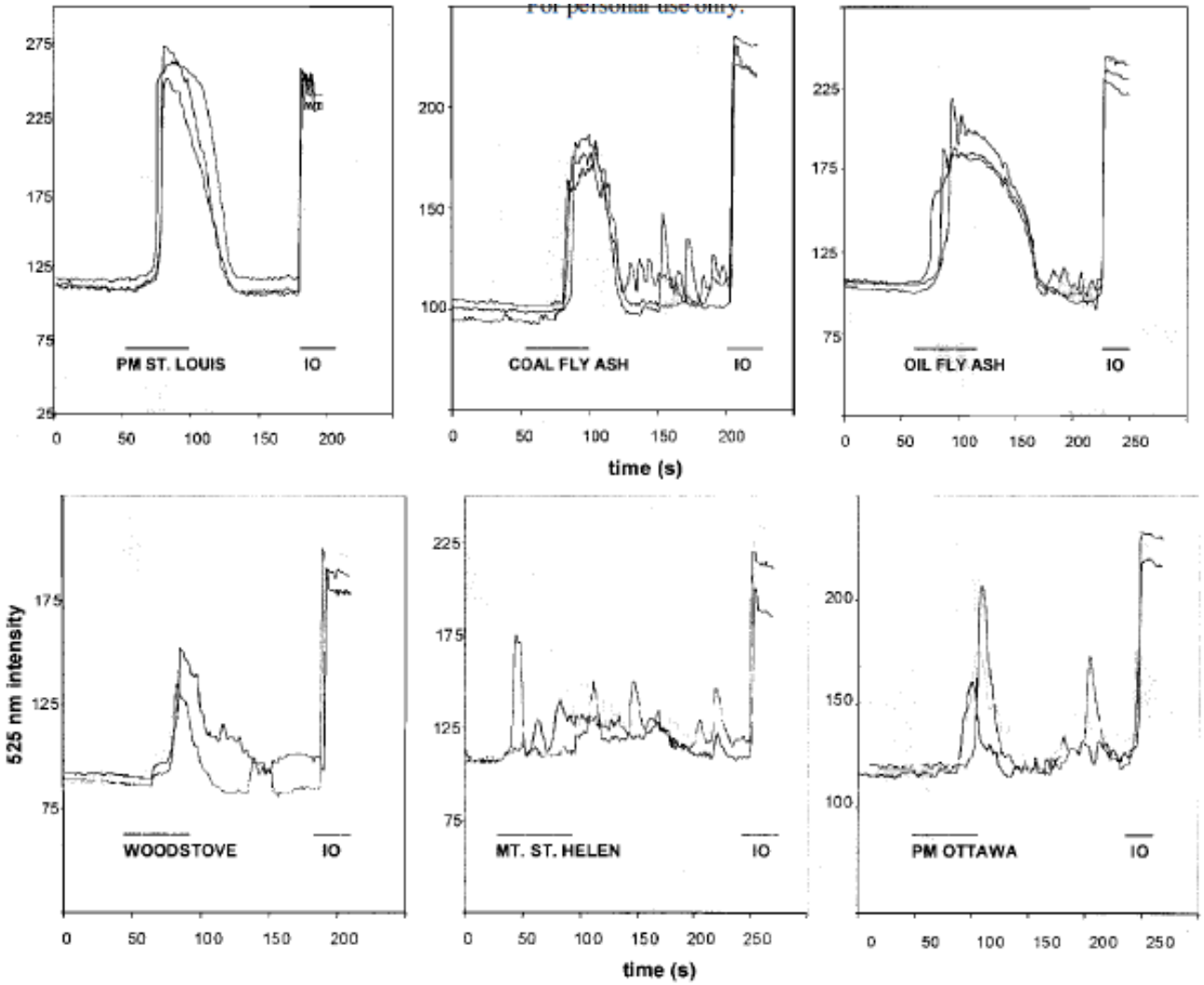


TRPVs:
“hot” channels!



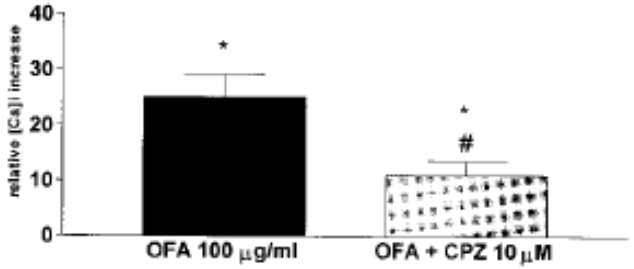
But, of greater relevance:
molecular integrators of multiple stimuli:
thermal, chemical, noxious…

and:
targets for particulate matter



Airway epithelial cells

Veronesi et al., Inhal Toxicol. 2002, 14:159-83



A two-faced perspective:

- *A quite useful tool for marking specific neuronal populations (functionalization with Abs…) and for tracking vescicle traffic*

- *Engineered cell lines with TRPV overexpression as easily manageable and efficient detectors of environmental NPs….*

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