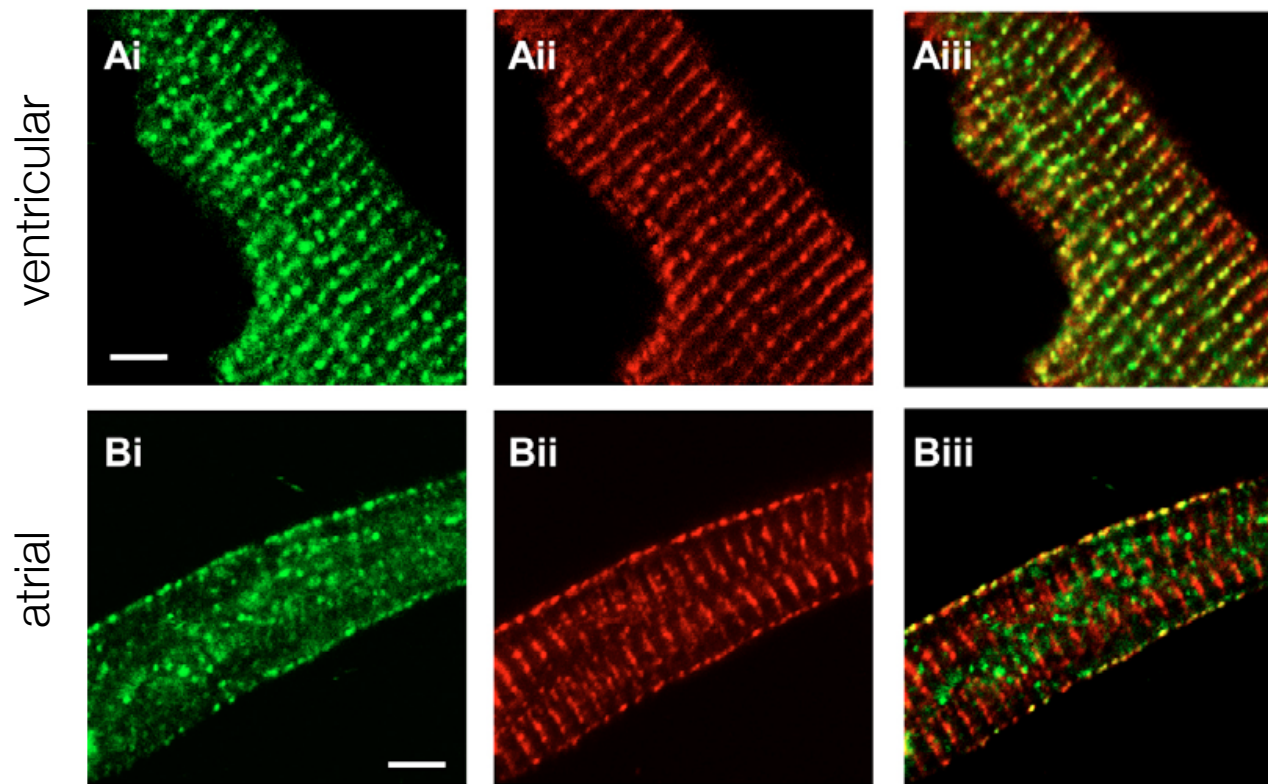


Firewalls in atrial myocytes

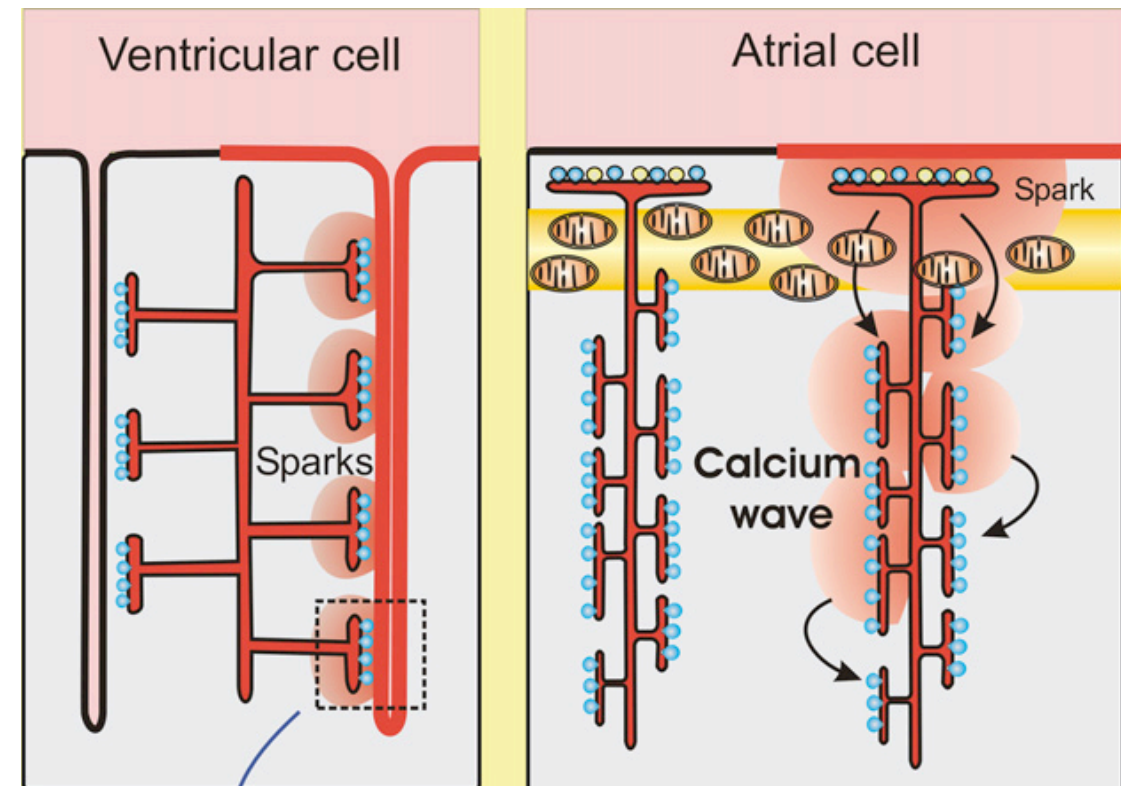
Rüdiger Thul and Stephen Coombes
University of Nottingham, UK

Martin D. Bootman
Babraham Institute, Cambridge, UK

Excitation-contraction coupling



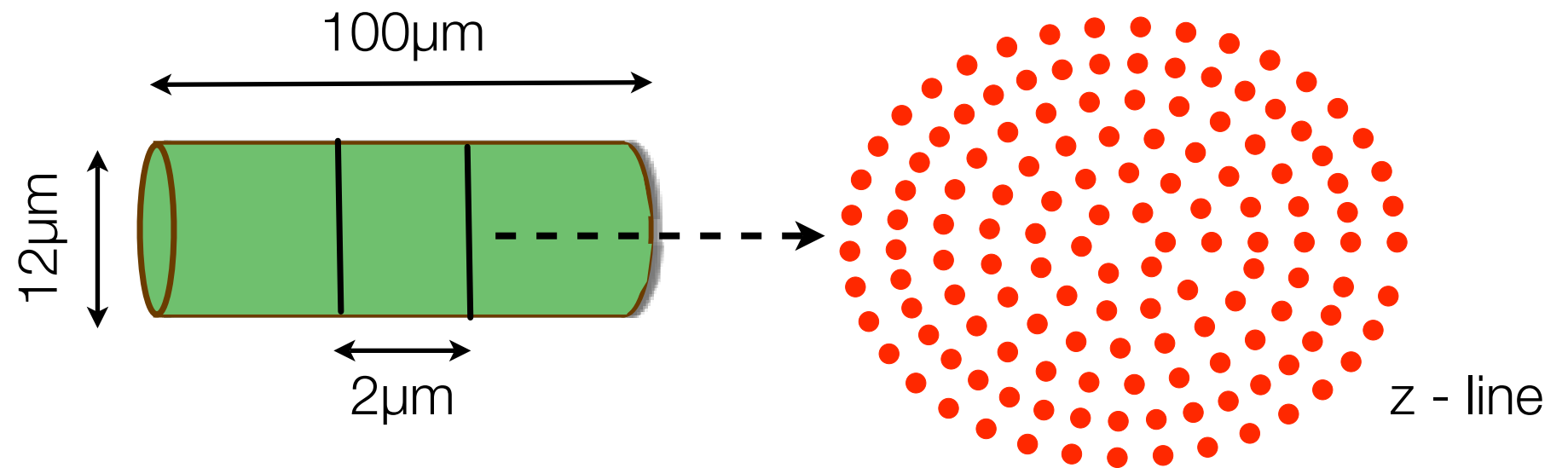
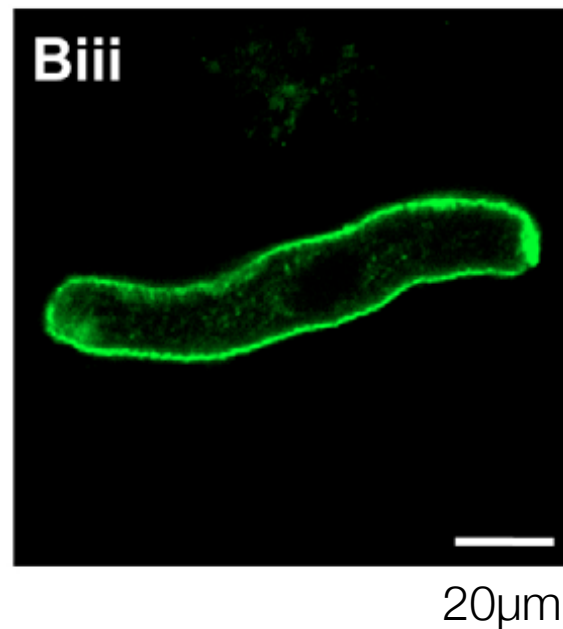
Bootman et. al, J. Cell Science (2006)



Berridge, Cell Calcium (2006)

Membrane depolarisation → Opening of voltage-gated Ca^{2+} channels
→ Activation of RyRs → More calcium → Contraction

Modelling framework



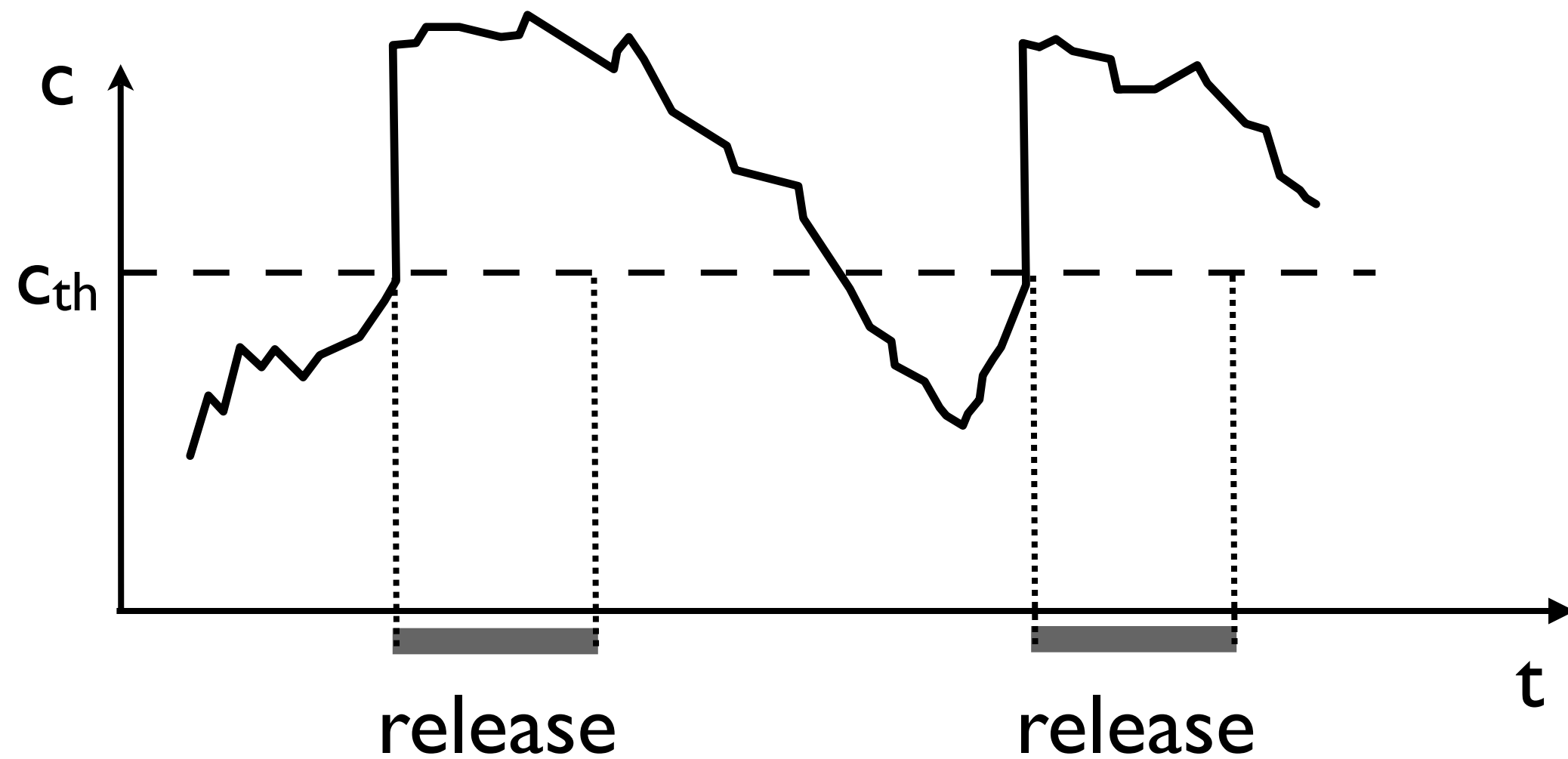
$$\frac{\partial c}{\partial t} = D \Delta c - \frac{c}{\tau} + J_{\text{rel}}$$

BC: finite flux, e.g. $\frac{\partial c}{\partial r} + hc = 0$

$$G(r, \phi, z, r', \phi', z', t) = \frac{2}{\pi a^2} \sum_{n=-\infty}^{\infty} \cos n(\phi - \phi') \sum_{\beta} \frac{\beta^2 J_n(\beta r) J_n(\beta r') e^{-\beta^2 D t}}{(h^2 + \beta^2 - n^2/a^2) J_n^2(\beta a)} \\ \sum_{\alpha} \frac{(\alpha \cos \alpha z + h_0 \sin \alpha z)(\alpha \cos \alpha z' + h_0 \sin \alpha z') e^{-\alpha^2 D t}}{l(\alpha^2 + h_0^2) + 2h_0}$$

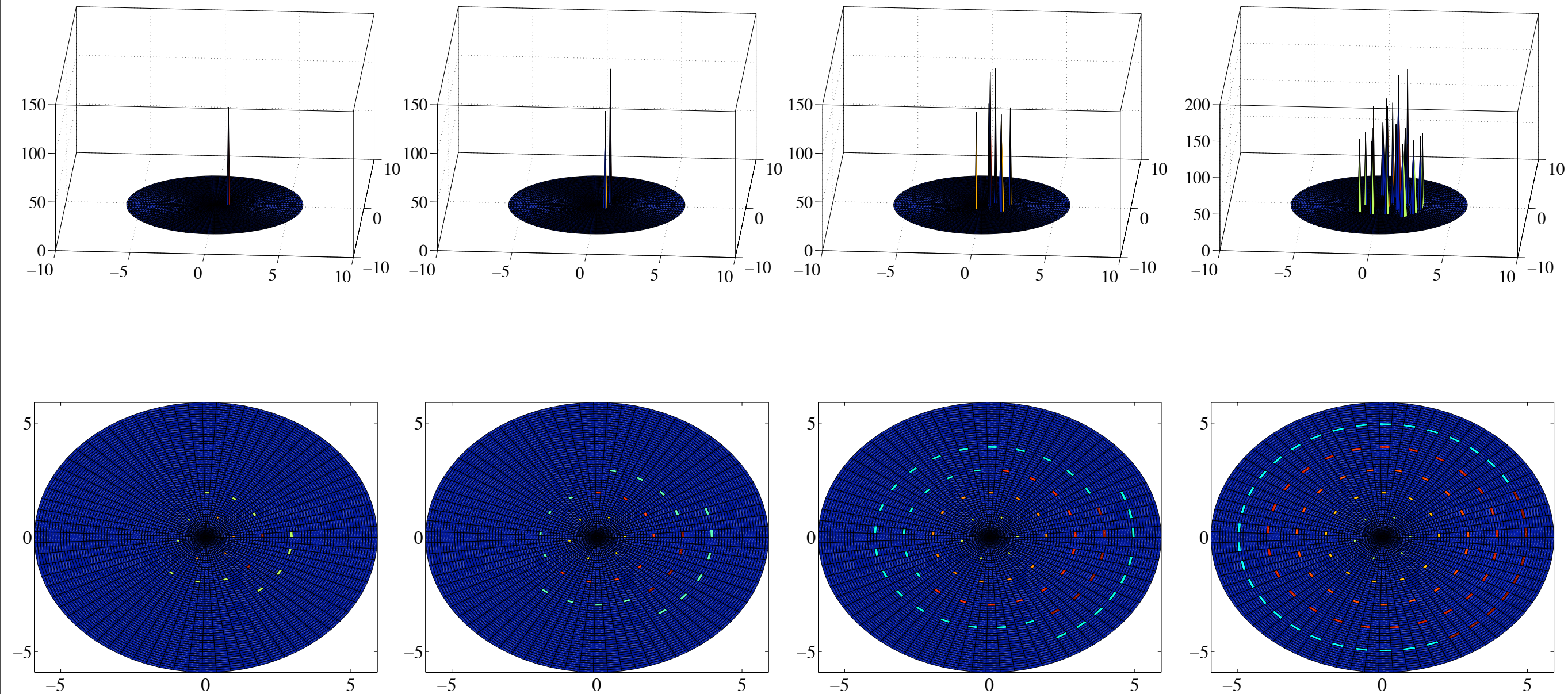
Eigenvalues: $(\alpha^2 - h_0 h_l) \tan(\alpha l) = \alpha(h_0 + h_l) \quad \beta J'_n(\beta a) + h J_n(\beta a) = 0$

A threshold model for release



Fire-Diffuse-Fire approach of Joel Keizer

Calcium wave



Conclusion

- Calcium waves in atrial myocytes are a geometrically determined process
- Realisation of a computationally efficient model in the fire-diffuse-fire framework



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