

PLENARY LECTURE - ART WINFREE PRIZE, Friday, July 1, 11:00

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Temporal Organization of the Cell Cycle

In his classic book on the Geometry of Biological Time, Art Winfree introduced the notions of a simple 'clock' (a periodic sequence of events) and a 'checkpoint' (a ratchet-like device). These ideas are central to understanding the logic of progression through the eukaryotic cell cycle (growth, DNA replication and cell division). Now that we know the molecular complexities of the cell cycle control system (cyclin-dependent kinases, regulated protein synthesis and degradation, etc.), we can build a realistic mathematical model of cell cycle progression. The model embodies, in terms of positive and negative feedbacks, exactly the 'clock + checkpoints' organization envisioned by Winfree. The model accounts for the fundamental physiological properties of mitotic cell divisions and provides new ways of thinking about crucial issues of the robustness and irreversibility of cell cycle transitions.

REFERENCES

- [1] Novak et al. (2007) Irreversible cell-cycle transitions are due to systems-level feedback. *Nat Cell Biol* 9:724.
- [2] Tyson & Novak (2008) Temporal organization of the cell cycle. *Curr Biol* 18:R759.
- [3] Barik et al. (2010) A model of yeast cell-cycle regulation based on multisite phosphorylation. *Mol Syst Biol* 6:405