Programmable cells: Interfacing natural and engineered gene networks

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Presentation

- Introduction to Cell Programming
- Cell Control and Transition States
- Discussion of Four Strains
  - A1
  - A2
  - B1
  - B2
- Conclusions
- Future Applications

Introduction to Cell Programming

- Biosensor detects signal and sends input
- Regulatory network follows rules to make input into output
- Output delivers response

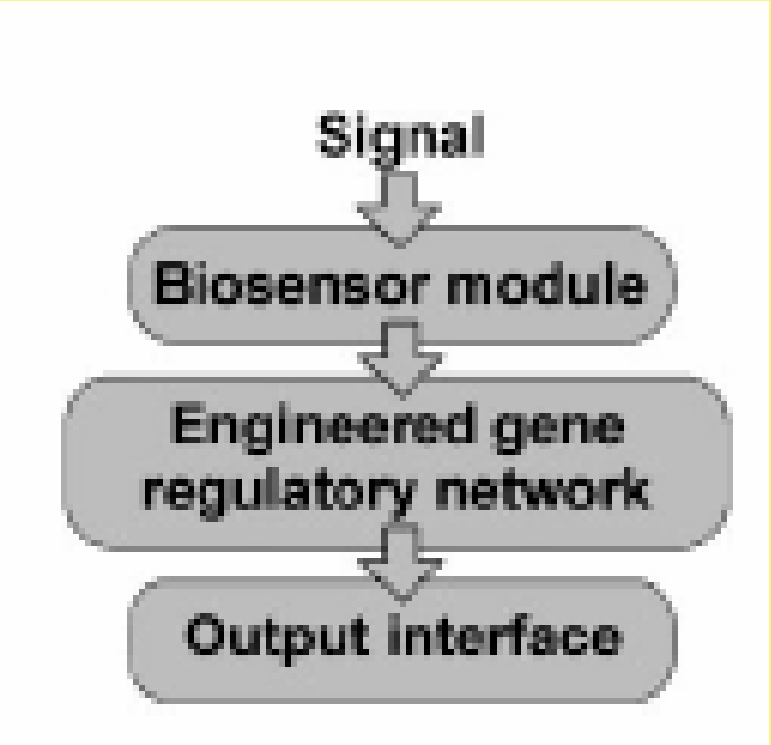


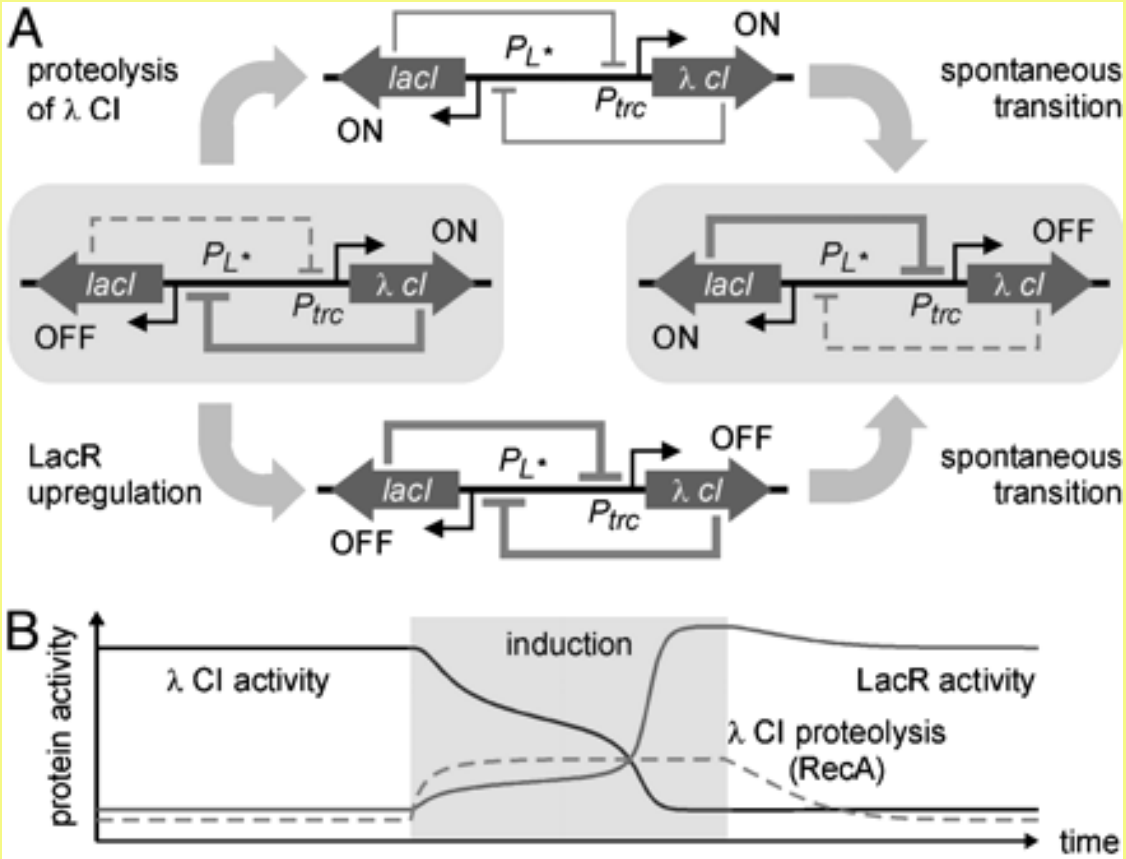
Figure from Programmable cells: Interfacing natural and engineered gene networks by Kobayashi et al

Components

- Sensors
  - SOS pathway detects DNA strand damage
  - AHL plasmid pAHLa is quorum sensing
- Network
  - Toggle switch to regulate CI and lacI network
- Outputs
  - GFP expression
  - Biofilm production

Cell Control and Transitions

- Integration of cI and lacI system



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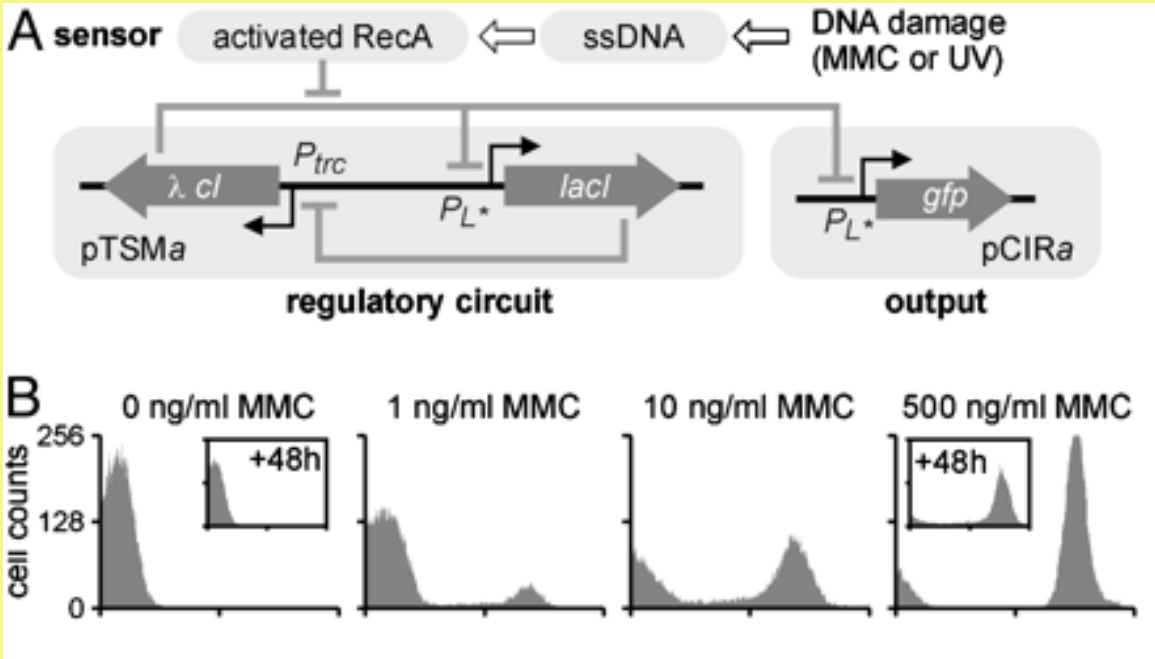
Strain A1

- Sensor: SOS pathway
- Regulator: toggle switch pTSMa
- Output: GFP plasmid
- DNA damage activates RecA, increasing lacI and GFP



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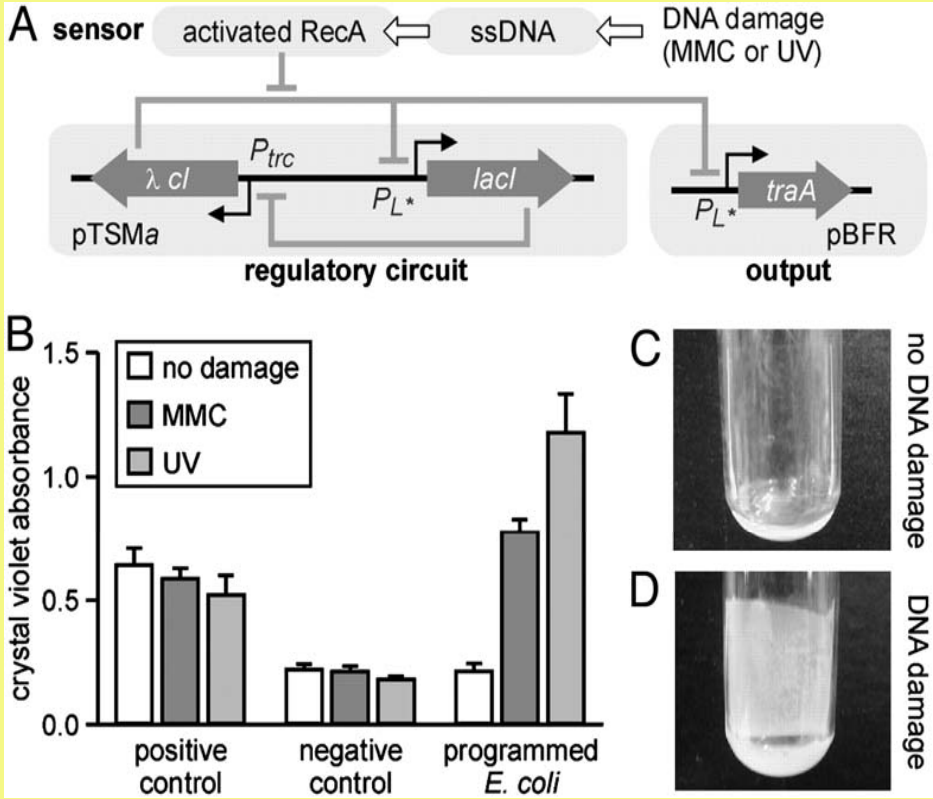
Strain A2

- Sensor: SOS pathway
- Regulator: toggle switch pTSMa
- Output: biofilm plasmid pBFR
- DNA damage activates RecA increasing lacI and pBFR



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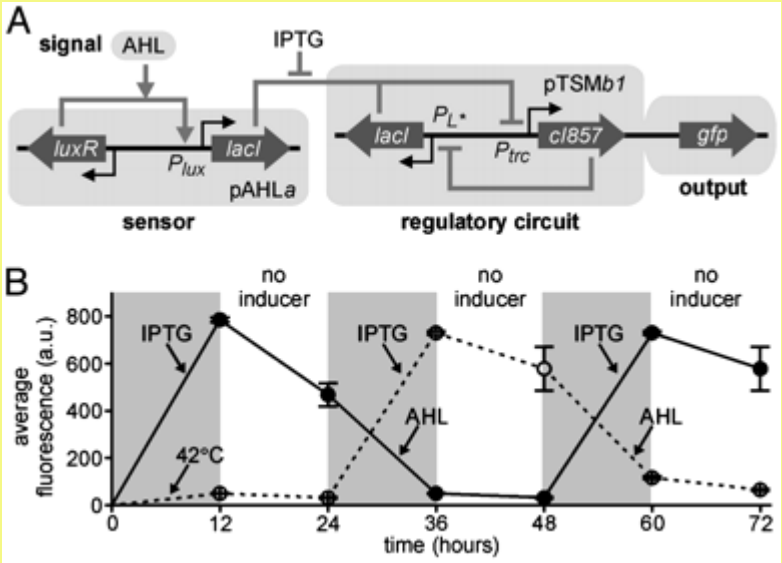
Strain B1

- Sensor: AHL inducible pAHLa
- Regulator: toggle switch pTSMb1
- Output: GFP
- GFP expression with low LacR and high CI



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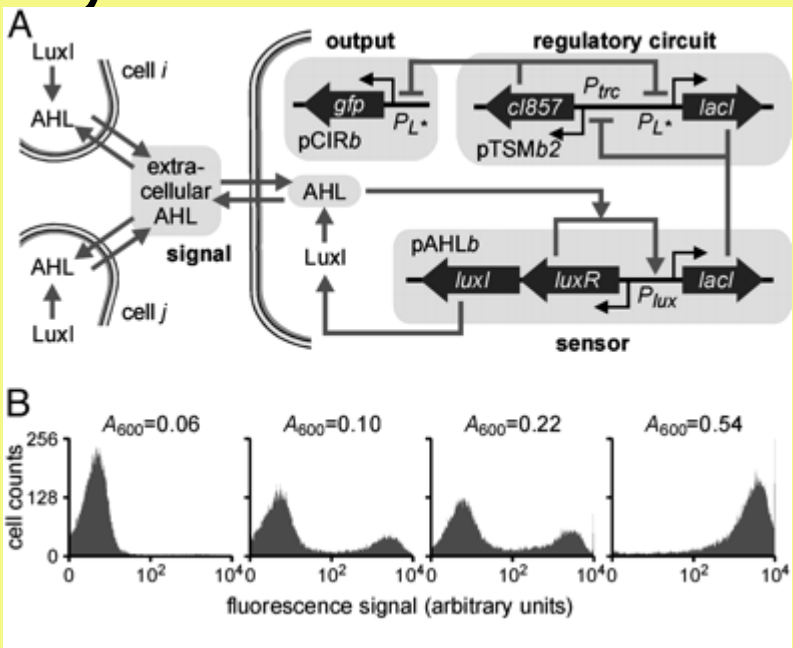
Slide B2

- Sensor: AHL plasmid pAHLb
- Regulator: toggle switch pTSMb2
- Output: GFP plasmid pCIRb
- Lux R activation and lacI expression when cell density increases



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Conclusions

- Programmable cells can be constructed by coupling sensors to cell regulatory mechanisms
- Binary response, around threshold get some bimodal response due to differences in individual cells
- Memory capable- changes are stored and passed on to future generations

Future Applications

- Evaluate further interactions of programming and basal cell functions
- Look at directed evolution for optimizing system instead of individual responses
- Examine more complex networks for counting and integration

Questions?