20.109
Synthetic Biology Module
Lecture #6

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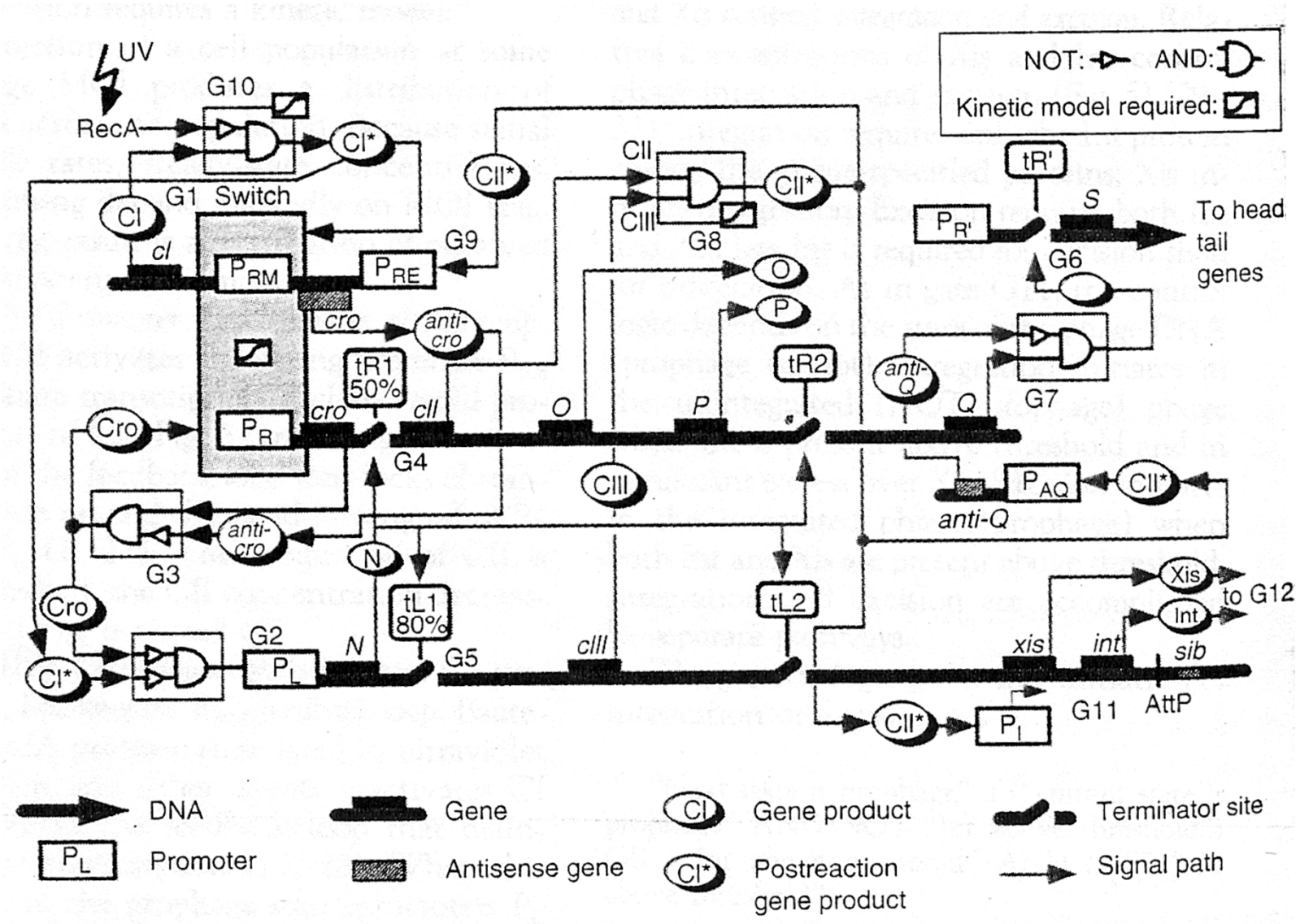
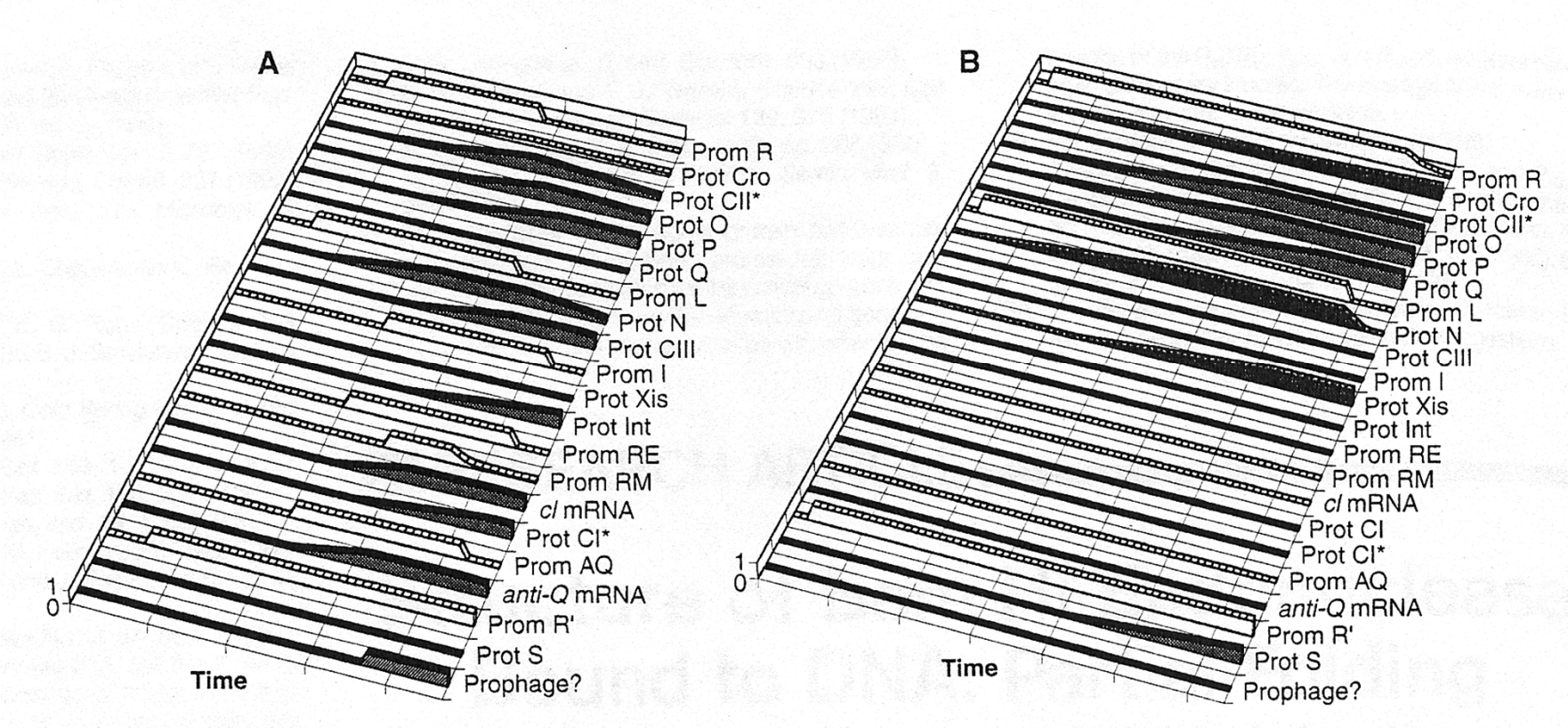
CSAIL

The Entire λ Circuit



Simulating Lysis/Losogeny Decision



Lysogeny decision
at MOI of 10

Lysis decision
at MOI of 1

Deterministic Model

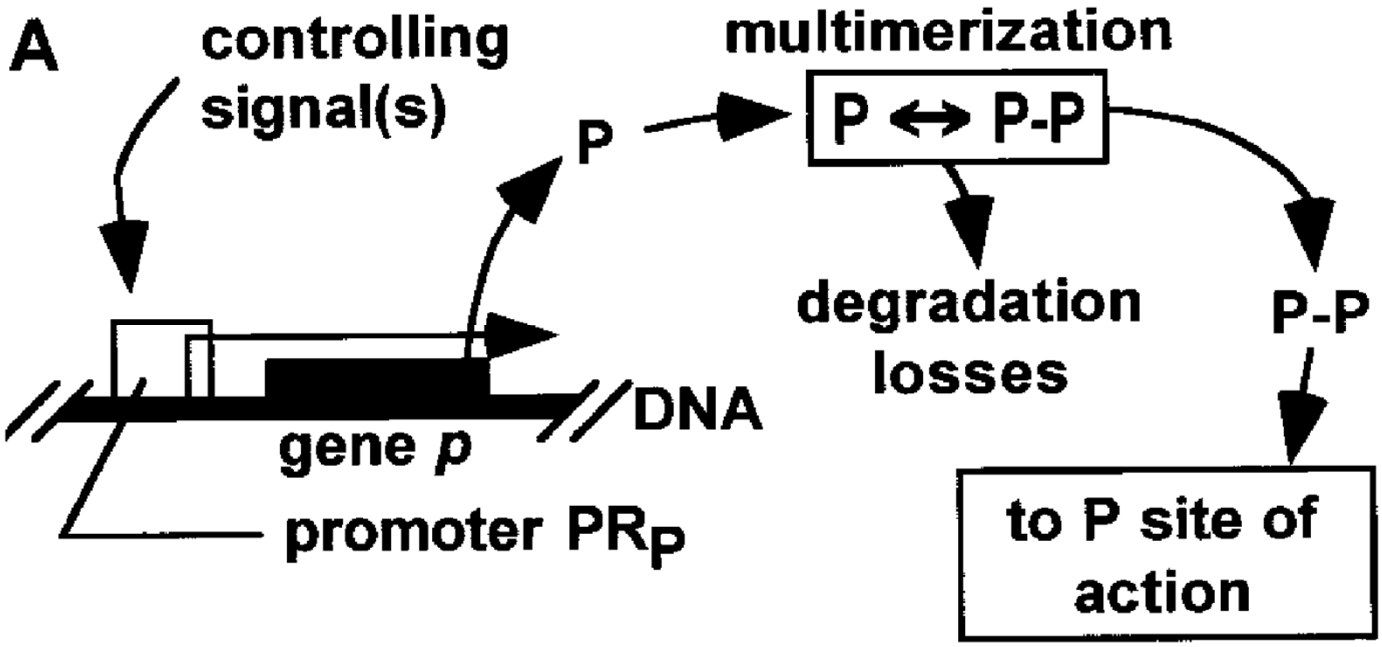
- Use ODEs to model the reactions
- Solve the coupled equations with given initial conditions
- Advantages:

- Drawbacks:

Stochastic model

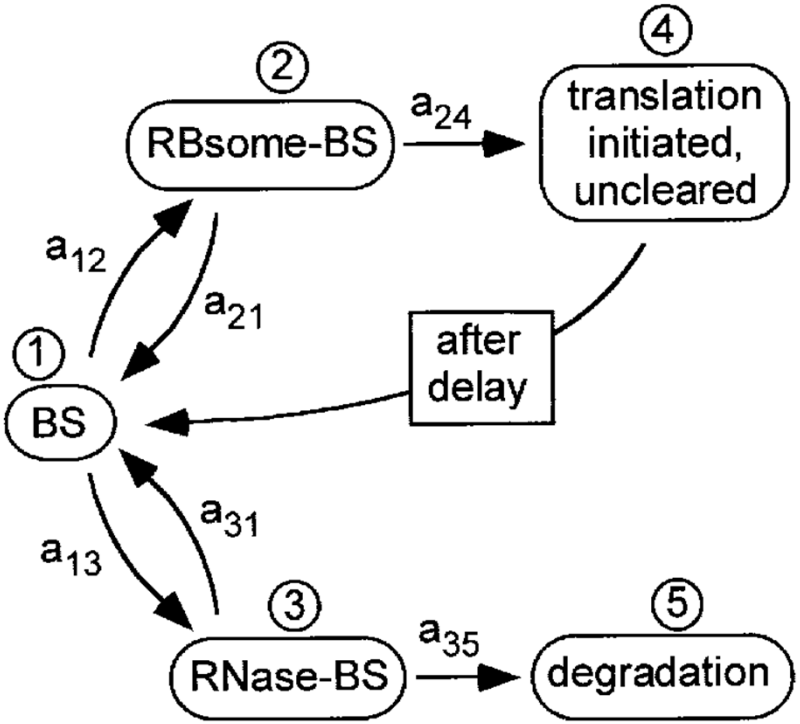
- ***Discrete*** and ***random*** processes
- Based on the probability of random collision between molecular species
- Use an algorithm to choose the next possible reaction and time of reaction
- Can study noise using this model

Simulating Transcription



Reaction Model: Translation

- Ribosomes and RNase E compete in binding
- After translation initiation, model ribosome movement



Translation reactions

$\text{Ribosome} + \text{RNA}_{\text{RBS}} \xrightarrow{k_{34}} \text{Ribosome·RNA}_{\text{RBS}}$	$k_{34} = 0.002\ (\text{nt sec})^{-1}$
$\text{Ribosome} + \text{RNA}_{n} \xrightarrow{k_{35}} \text{Ribosome·RNA}_{n+1}$	$k_{35} = 100\ \text{nt sec}^{-1}$
$\text{RNase} + \text{RNA}_{\text{RBS}} \xrightarrow{k_{36}} \text{RNase}$	$k_{36}\text{·RNase} = 0.2\ \text{sec}^{-1}$
Average number of proteins per transcript (all transcripts)	10

note: model an average of 10 transcripts per mRNA