BACTERIAL COPING MECHANISMS FOR AGING: USING AN INDIVIDUAL-BASED MODEL TO STUDY AGING IN BIOFILMS

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Microbiology Society 2019

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IMI INSTITUTE OF MICROBIOLOGY AND INFECTION

MIBTP Midlands Integrative Biosciences Training Partnership

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IS REPAIR BETTER THAN SEGREGATION OF DAMAGE FOR AGING CELLS IN A BIOFILM?

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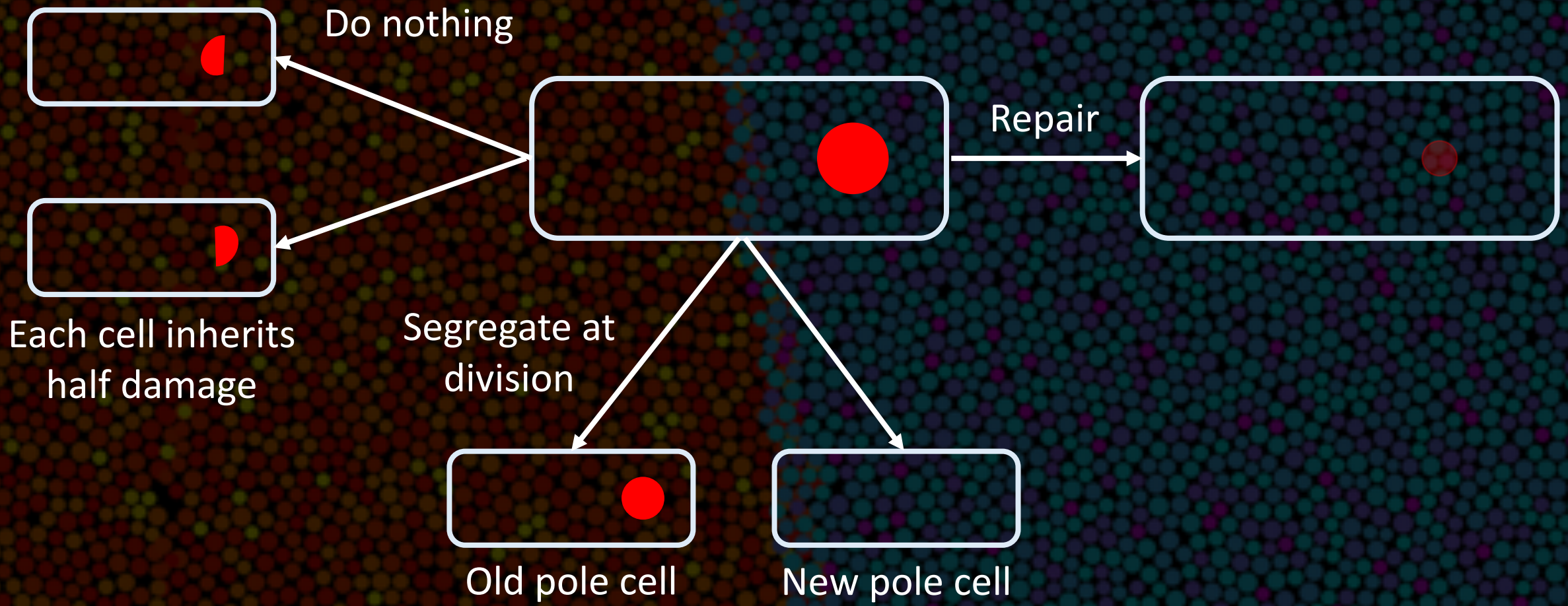
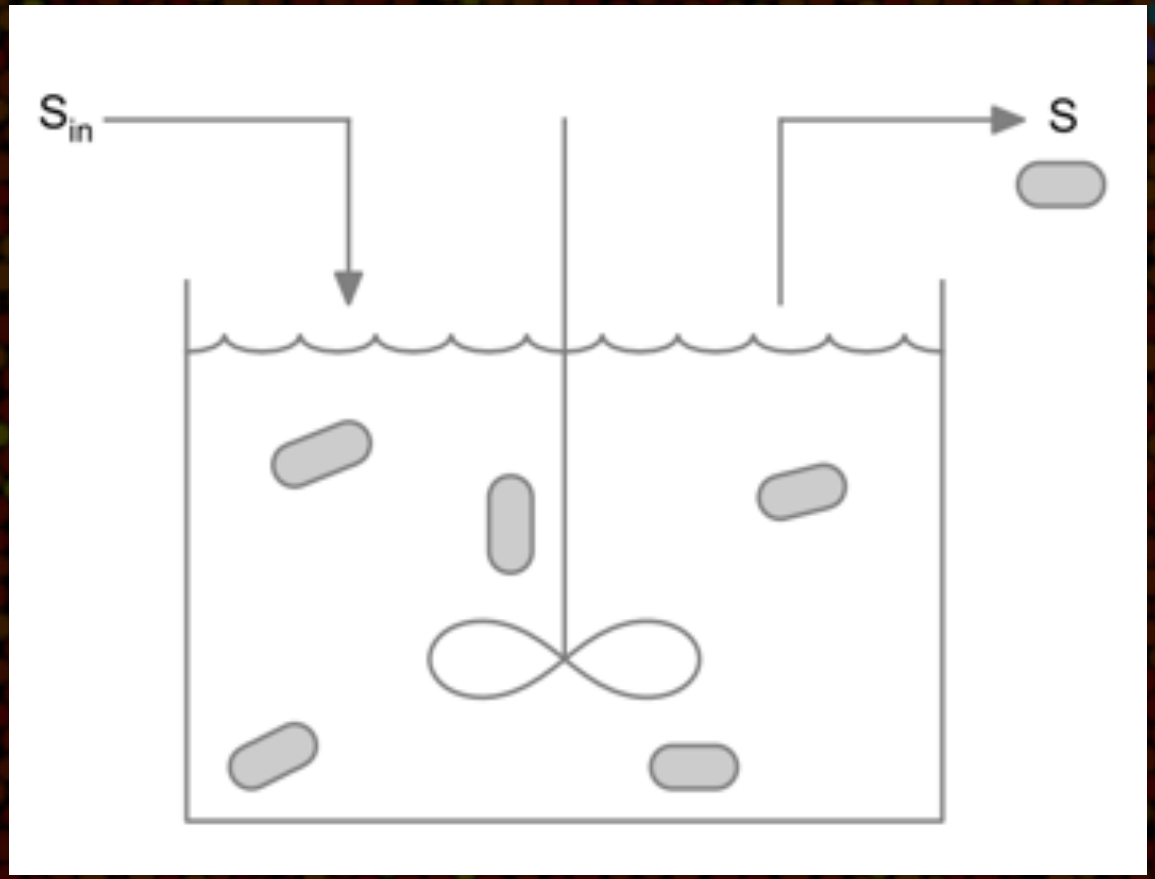
WHAT IS AGING?

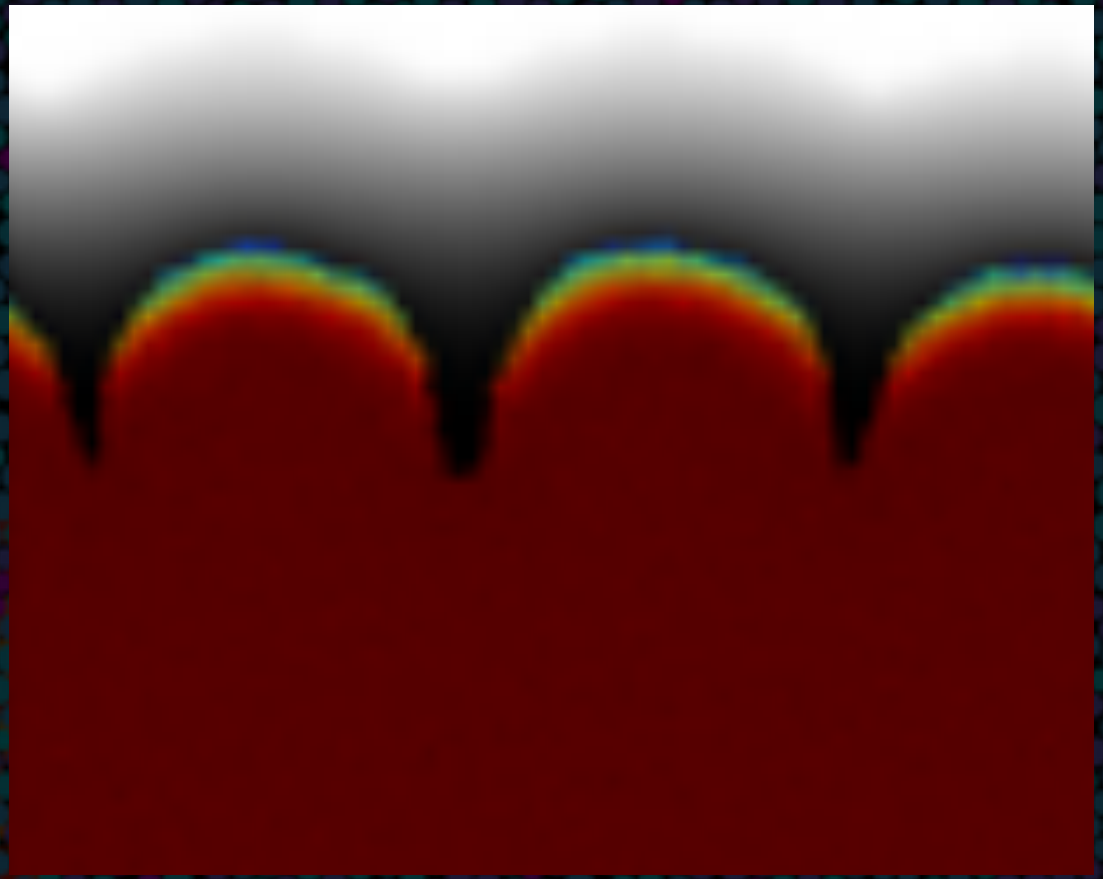
HOW CAN BACTERIA DEAL WITH AGING?



INTRODUCTION



Chemostat – optimal repair fitter than segregation of damage



Biofilm – ???

Clegg *et al.* (2014) *BMC Biology*

OBJECTIVES

1
Develop a strategy for adaptive repair

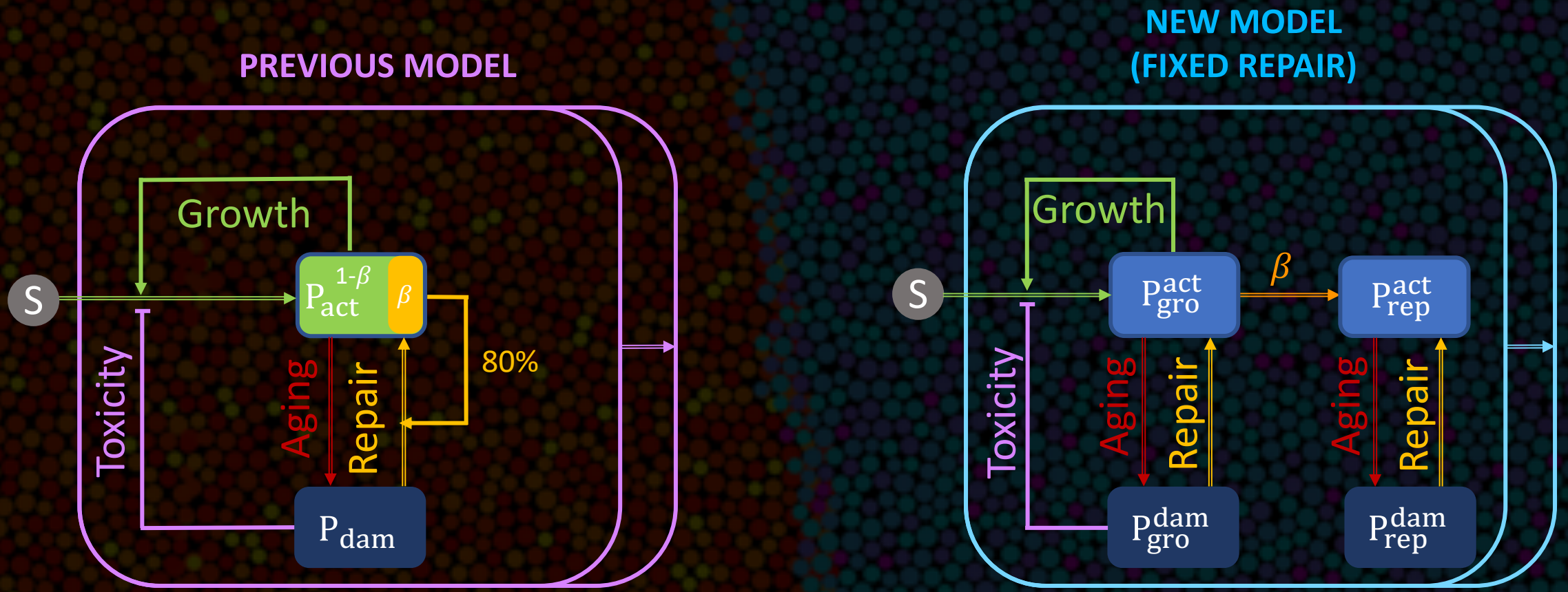
2
Compare adaptive repair with fixed repair

3
Apply this to growth in biofilms

4
Compare adaptive repair with damage segregation in biofilms

Is repair better than segregation of damage?

THE PREVIOUS MODEL

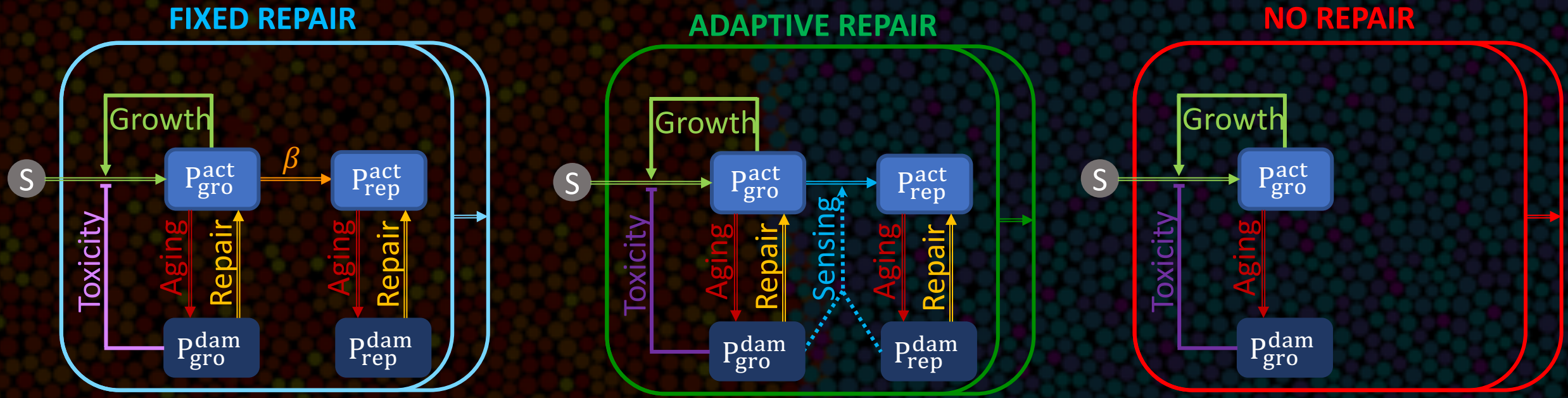


iDynoMiCS

iDynoMiCS - individual-based Dynamics of Microbial Communities Simulator

Clegg *et al.* (2014) *BMC Biology*

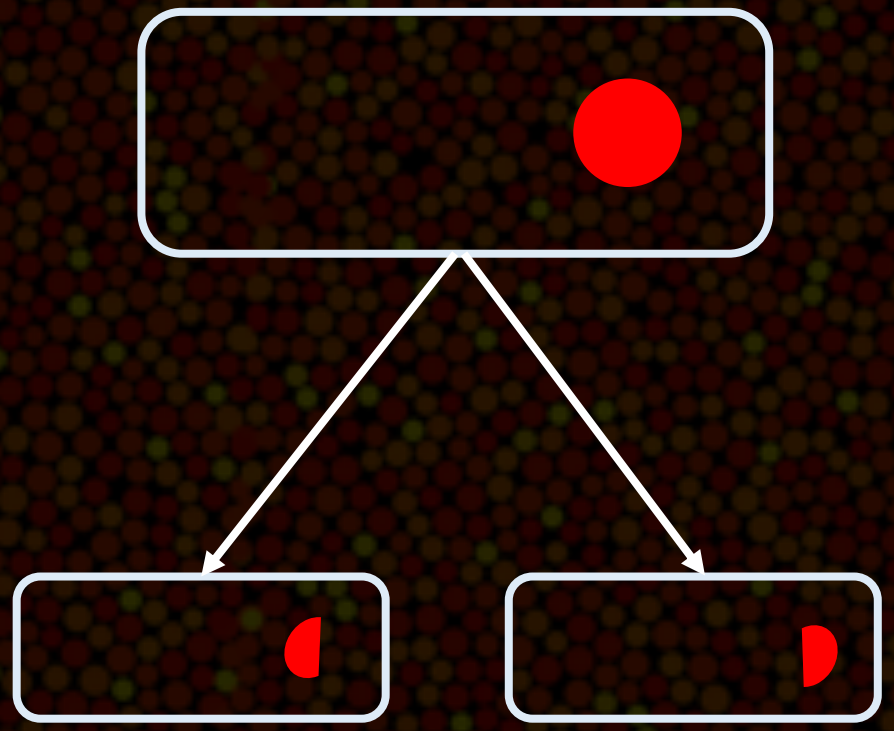
THE MODEL: REPAIR STRATEGIES



At optimal rate

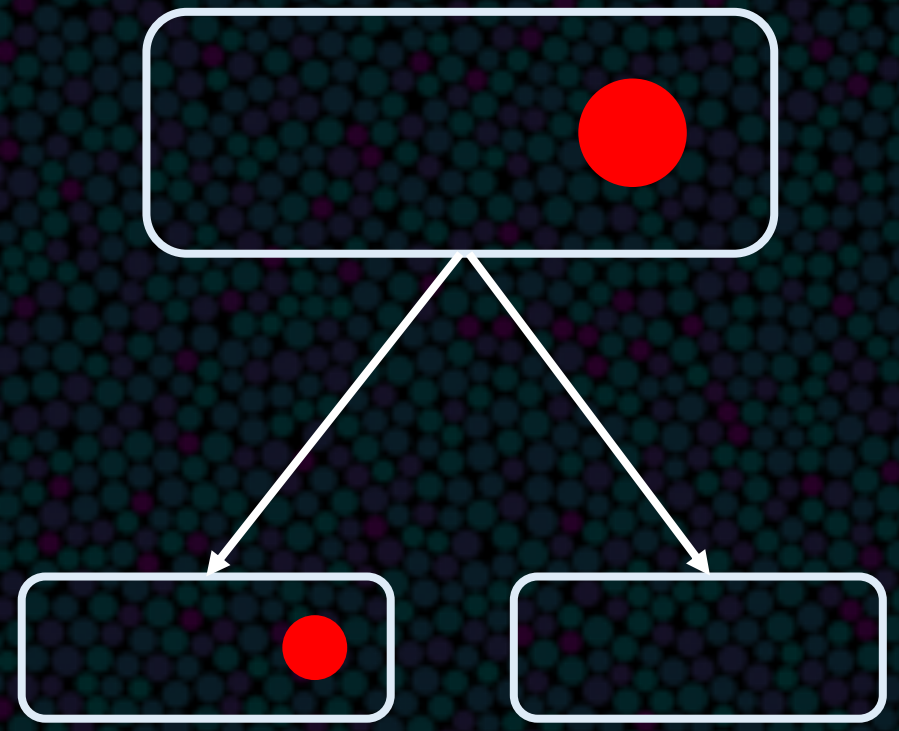
THE MODEL: DIVISION STRATEGIES

Symmetric division



Each cell inherits half damage

Asymmetric division

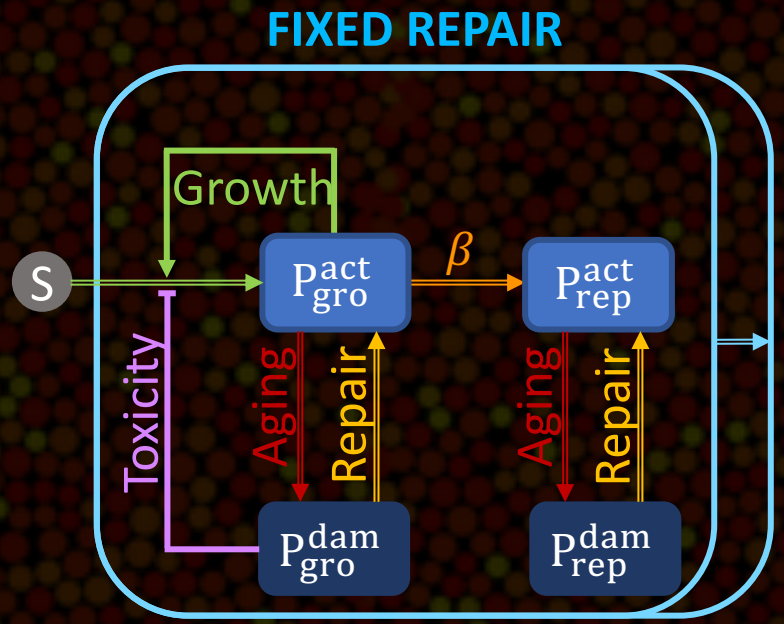


Old pole cell

New pole cell

One cell inherits all damage

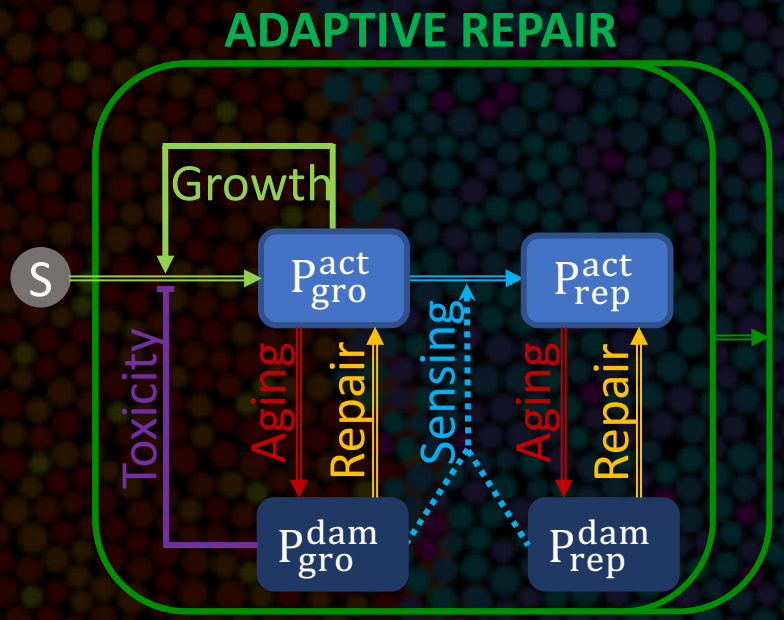
THE MODEL: REPAIR STRATEGIES



At optimal rate

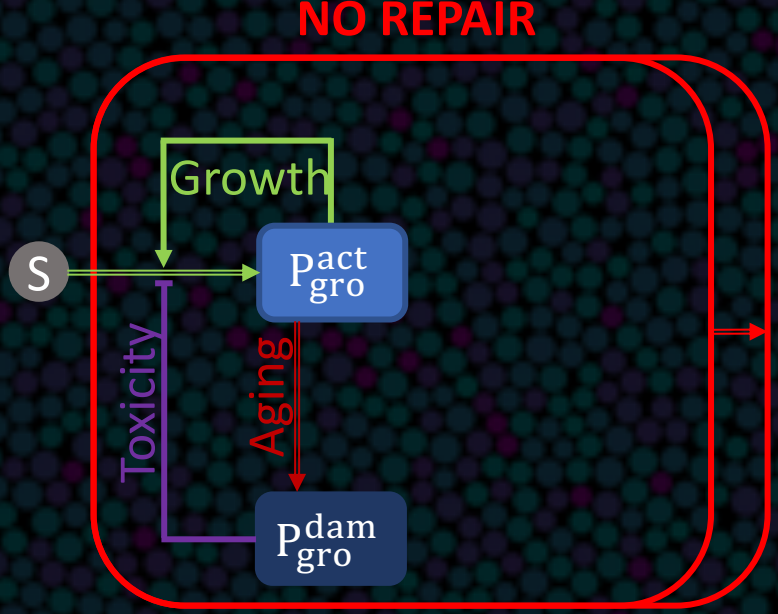
SYMMETRIC DIVISION

FIXED REPAIR



SYMMETRIC DIVISION

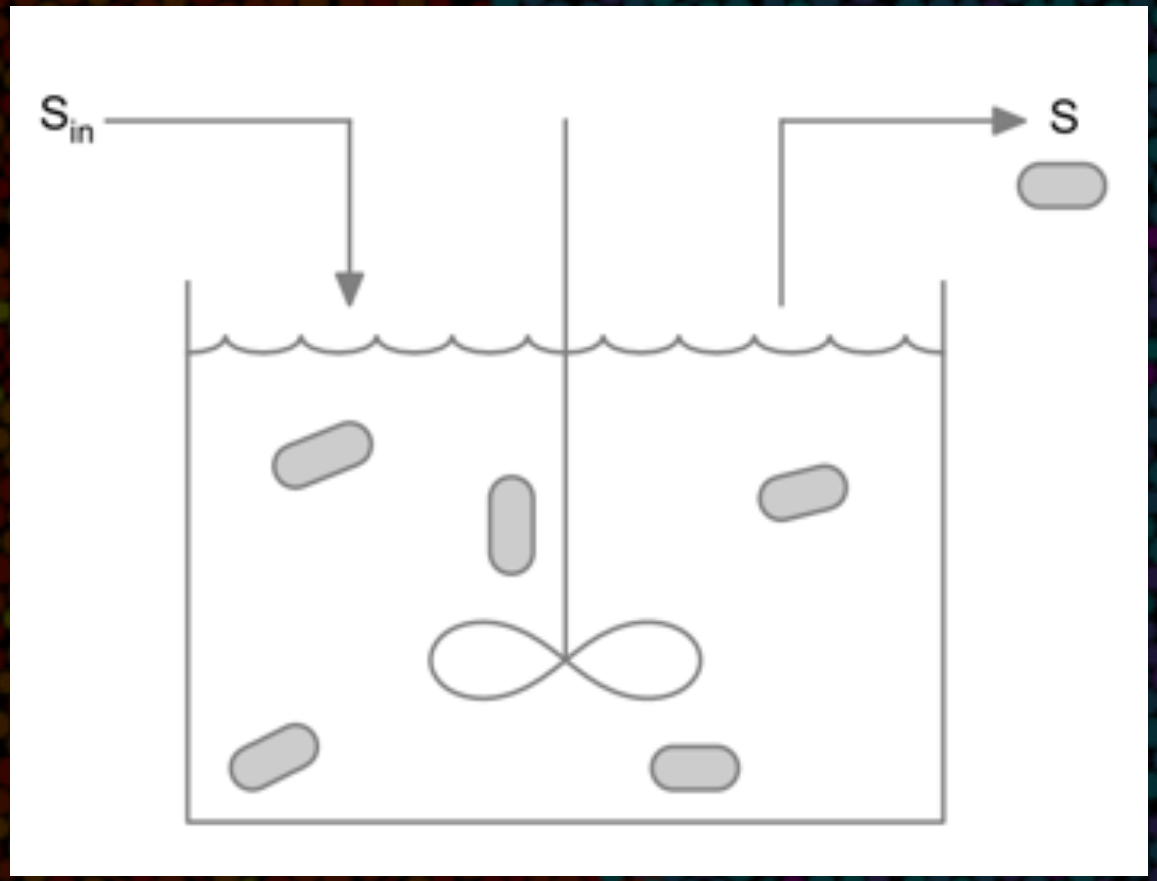
ADAPTIVE REPAIR



ASYMMETRIC DIVISION

DAMAGE SEGREGATION

CHEMOSTATS



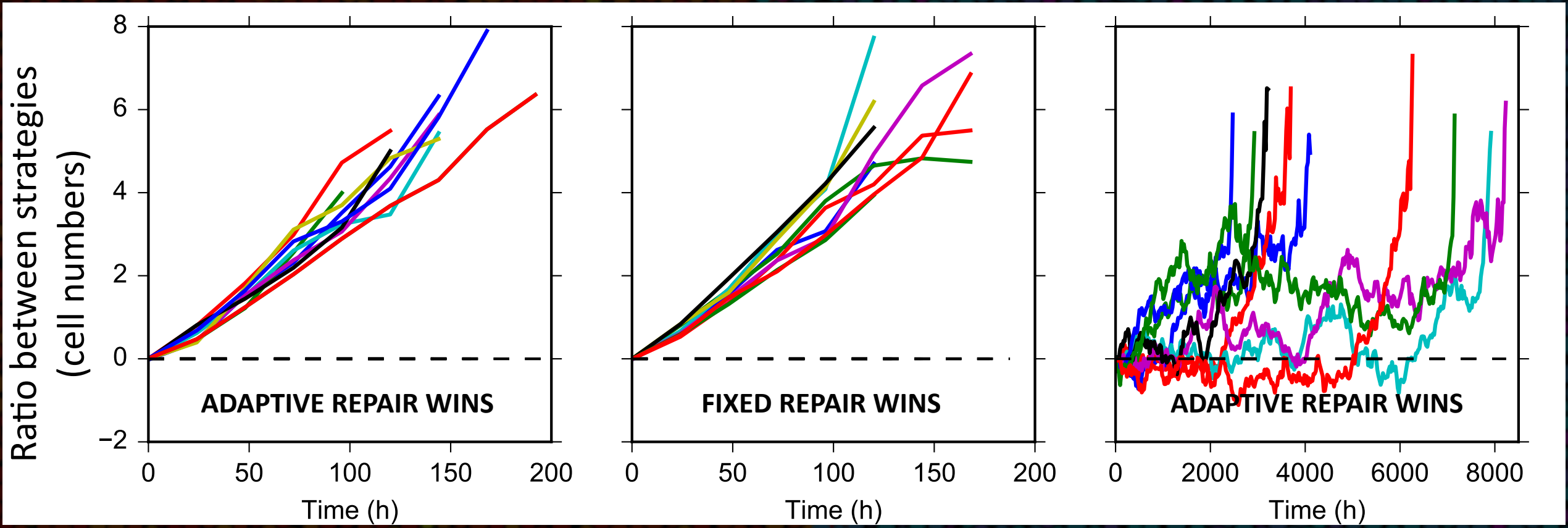
Compare new adaptive repair with previous strategies

CHEMOSTAT ENVIRONMENT COMPETITIONS

Adaptive repair *vs* damage segregation

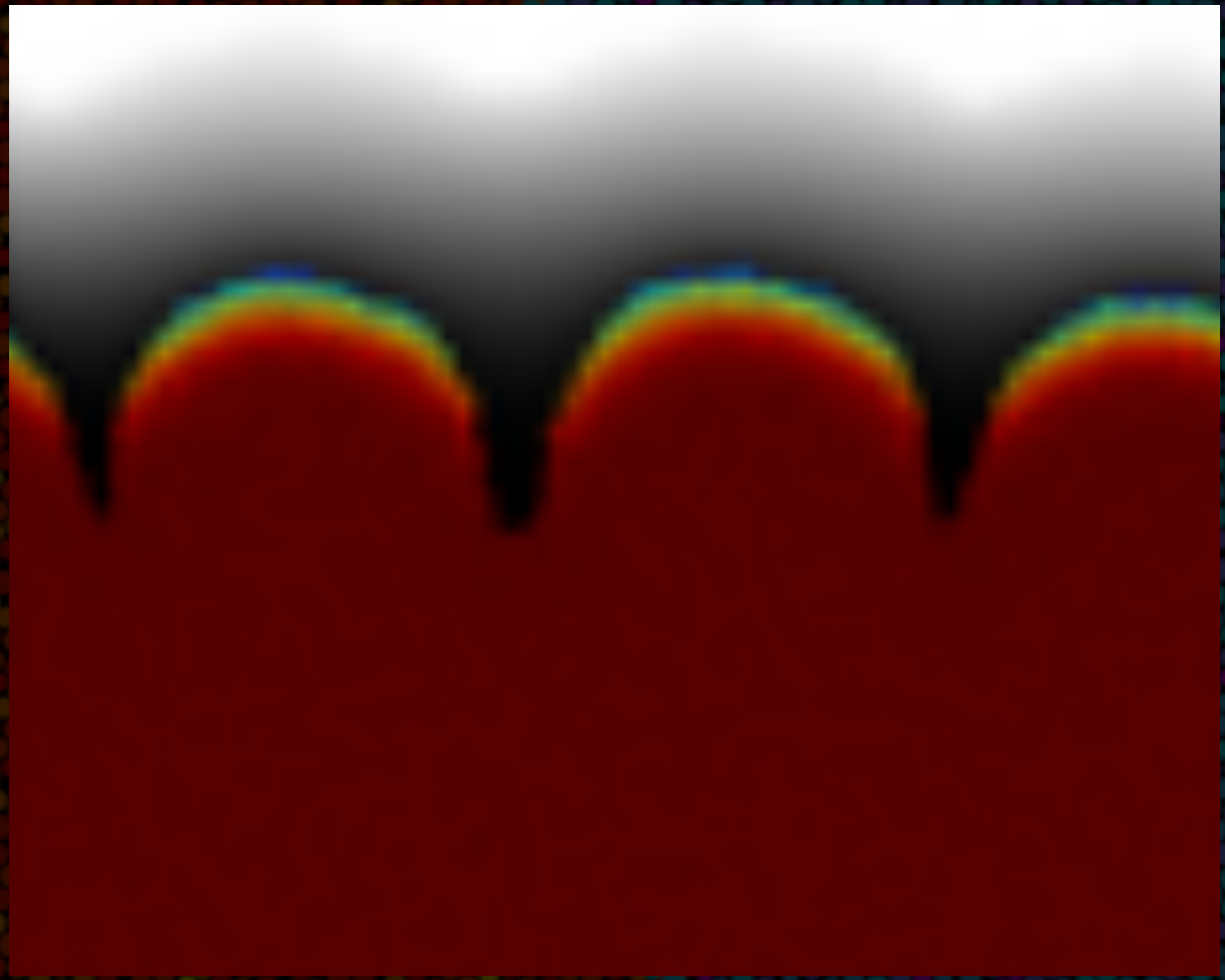
Fixed repair *vs* damage segregation

Adaptive repair *vs* Fixed repair

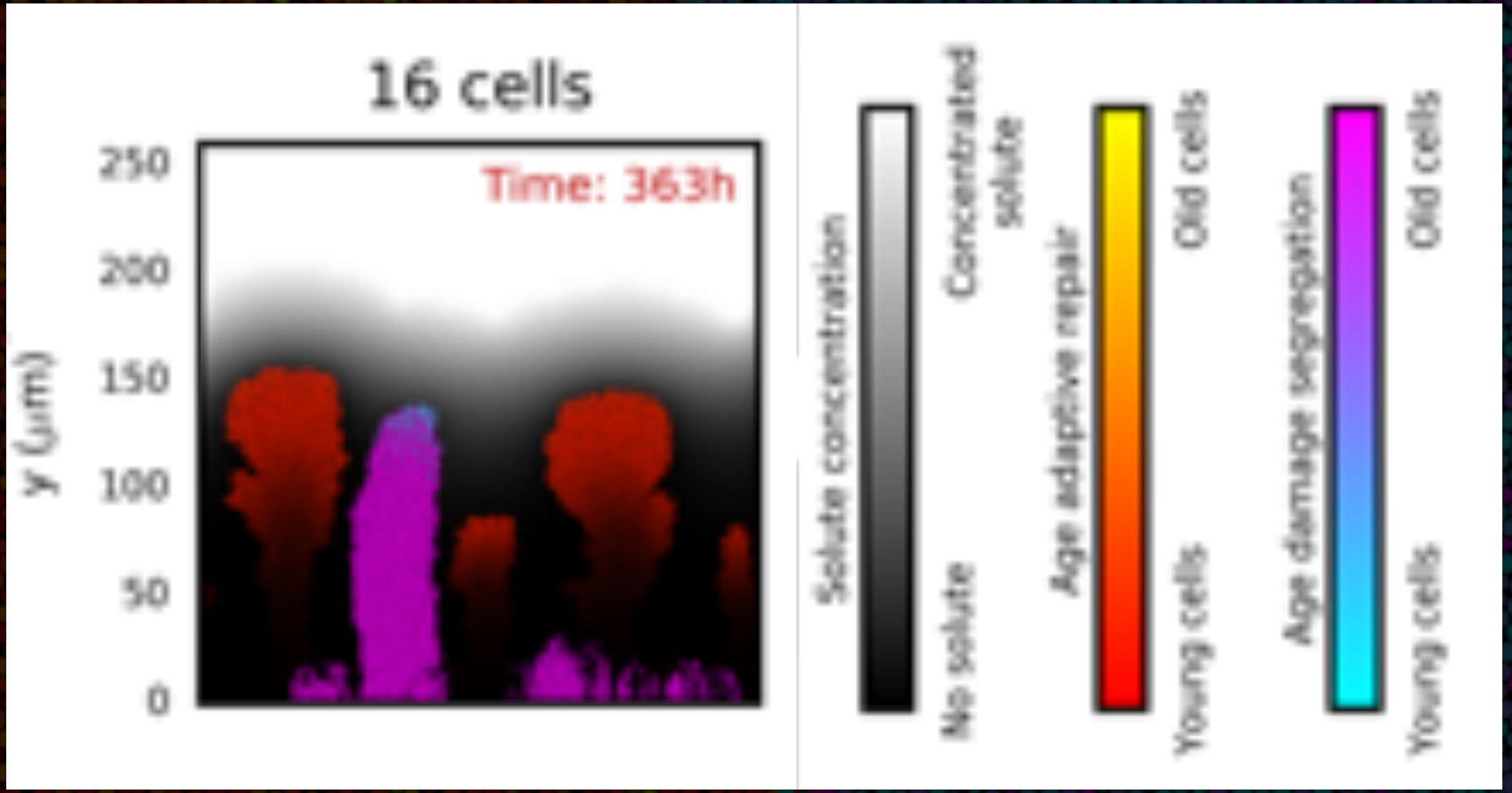


WINNER = ONLY ONE REMAINING IN CHEMOSTAT

WHAT ABOUT IN BIOFILMS?



BIOFILM ENVIRONMENT (adaptive repair *vs* damage segregation)



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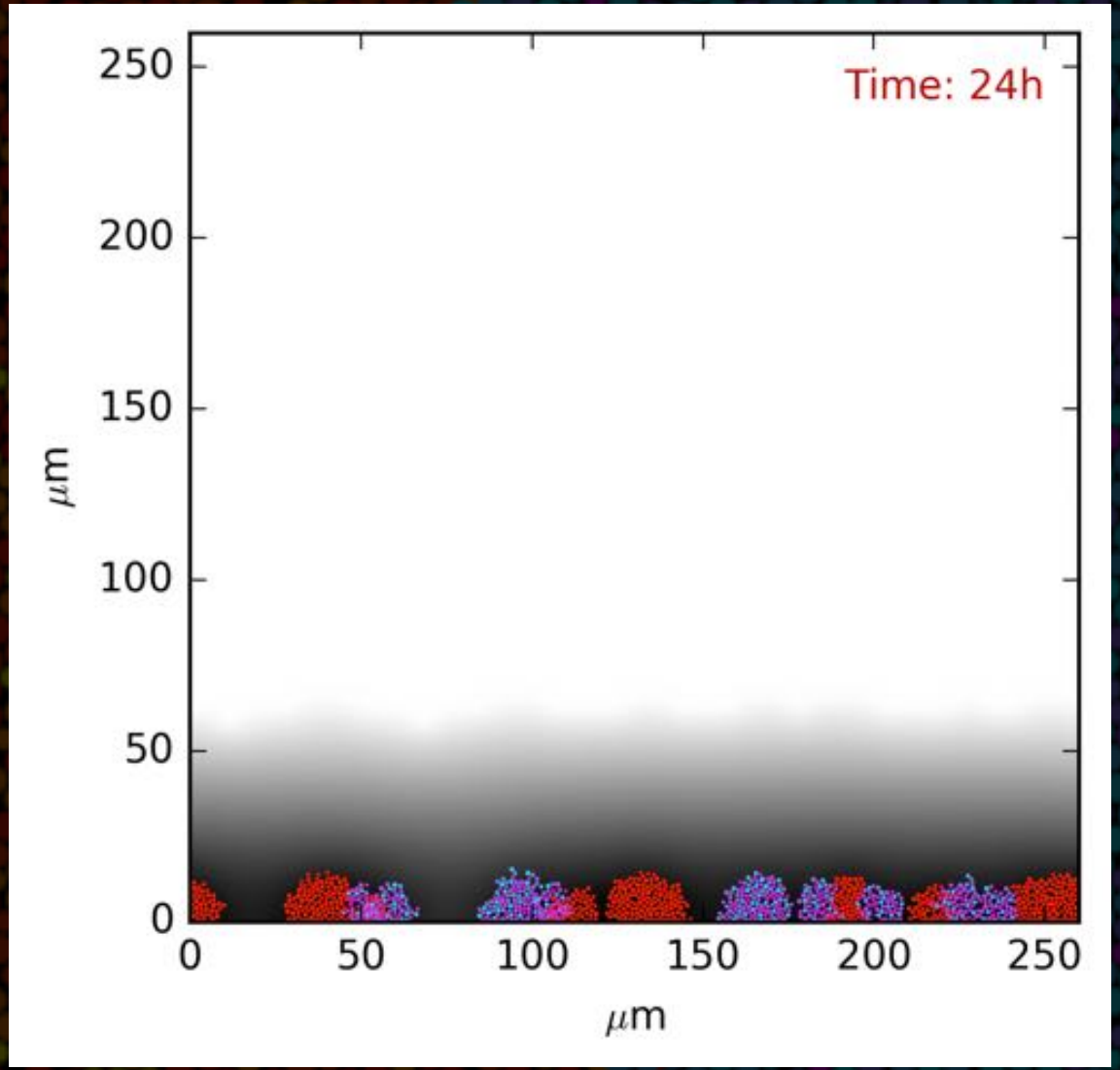
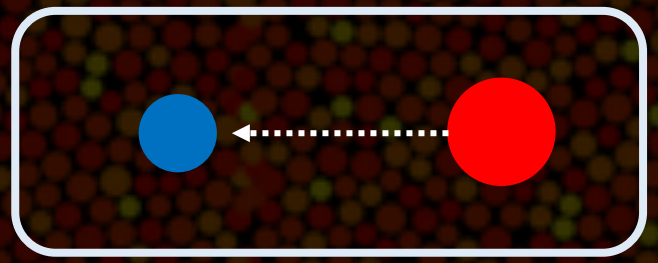
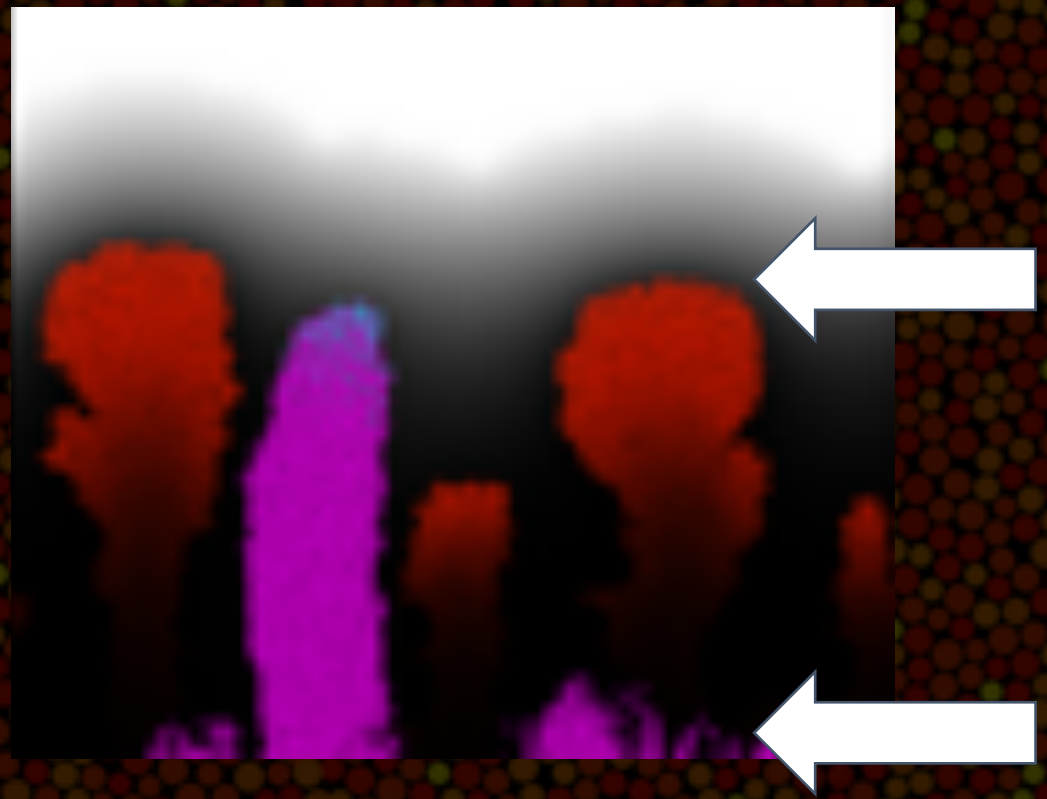


OLD MODEL

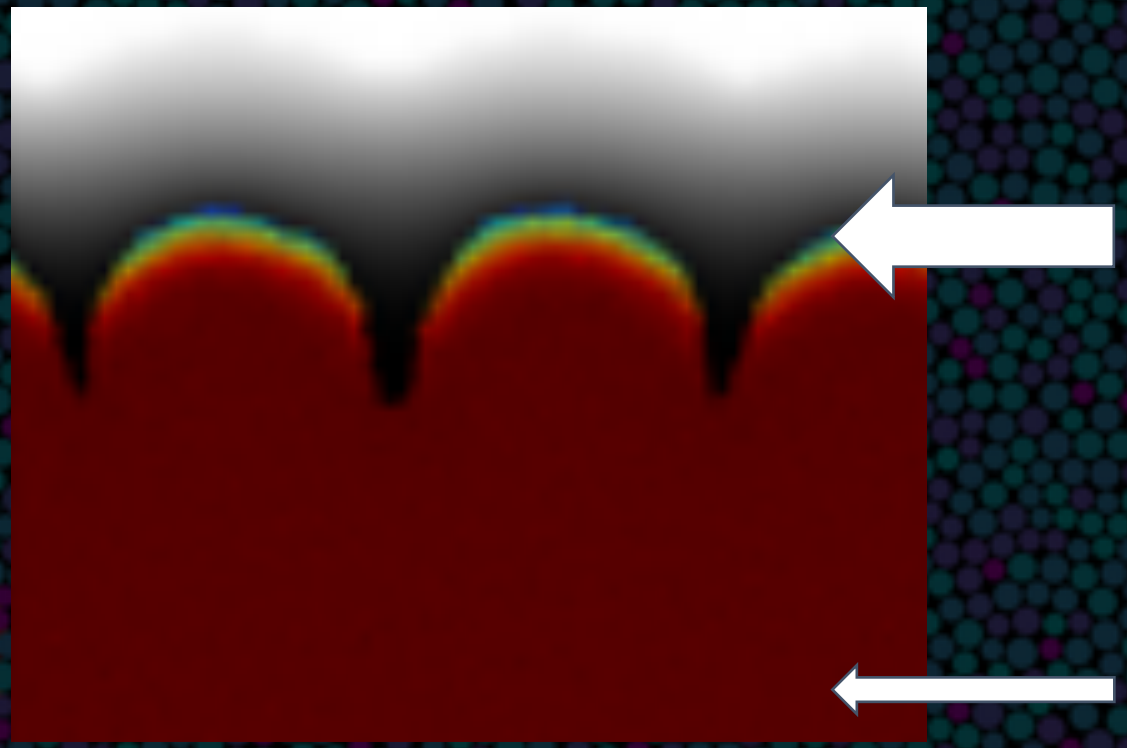


Only 80% efficient

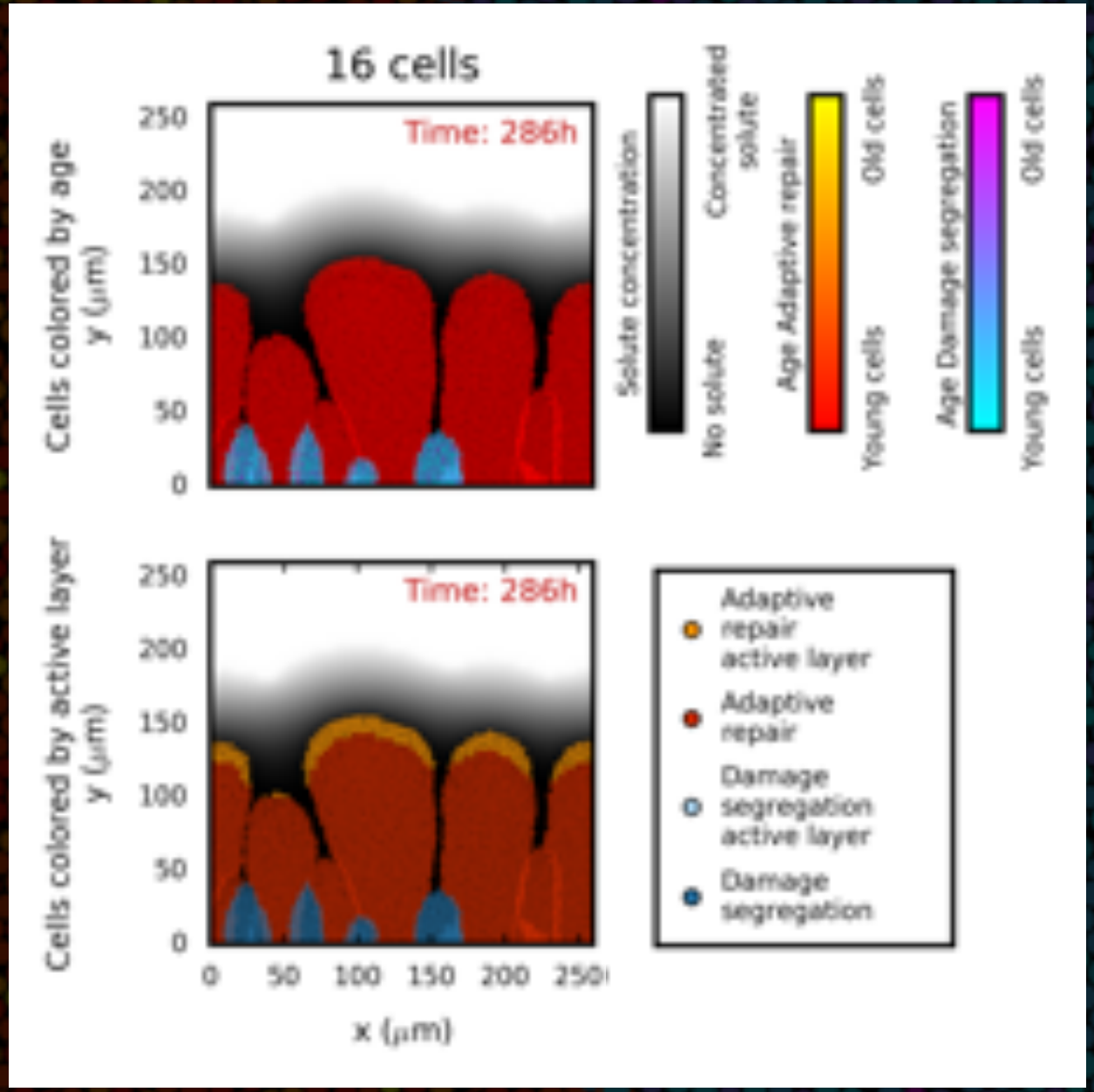


NEW MODEL

Damage proportional to growth rate



PROPORTIONAL AGING (adaptive repair *vs* damage segregation)



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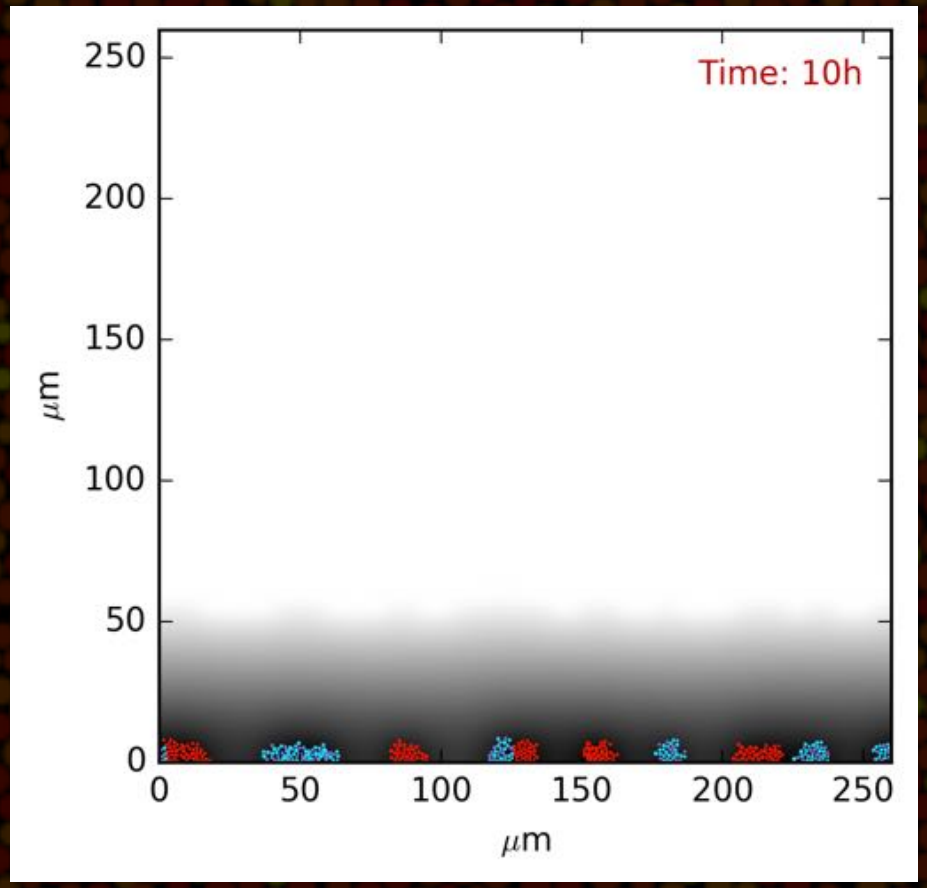

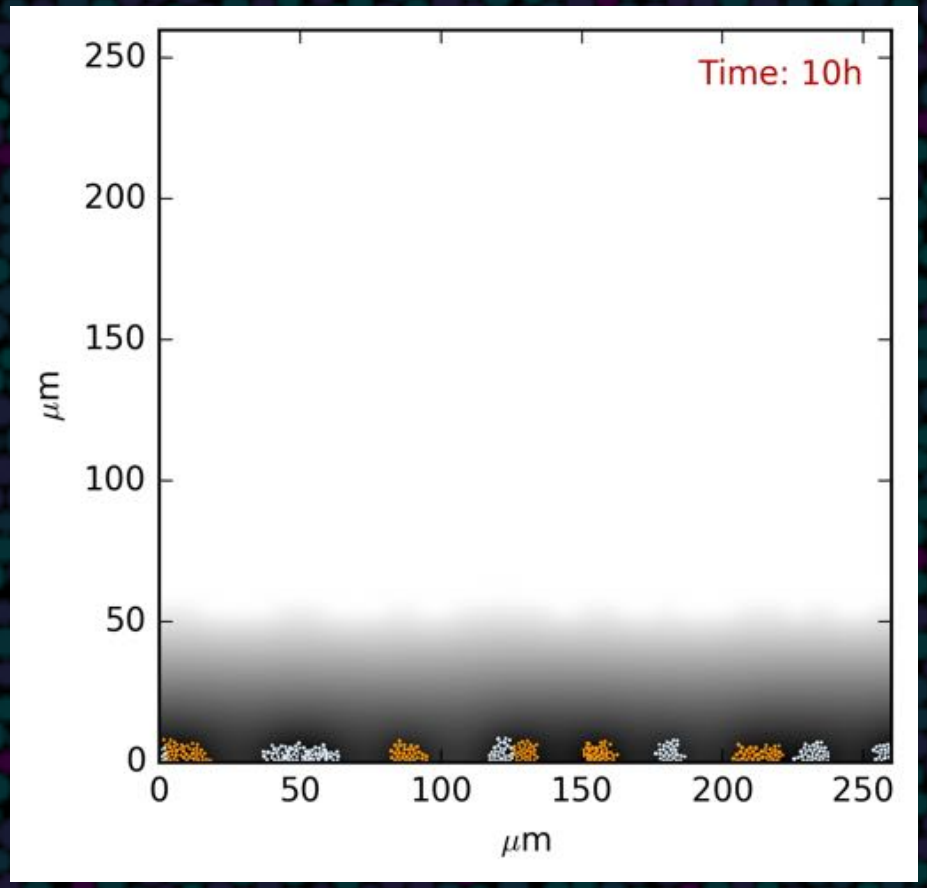

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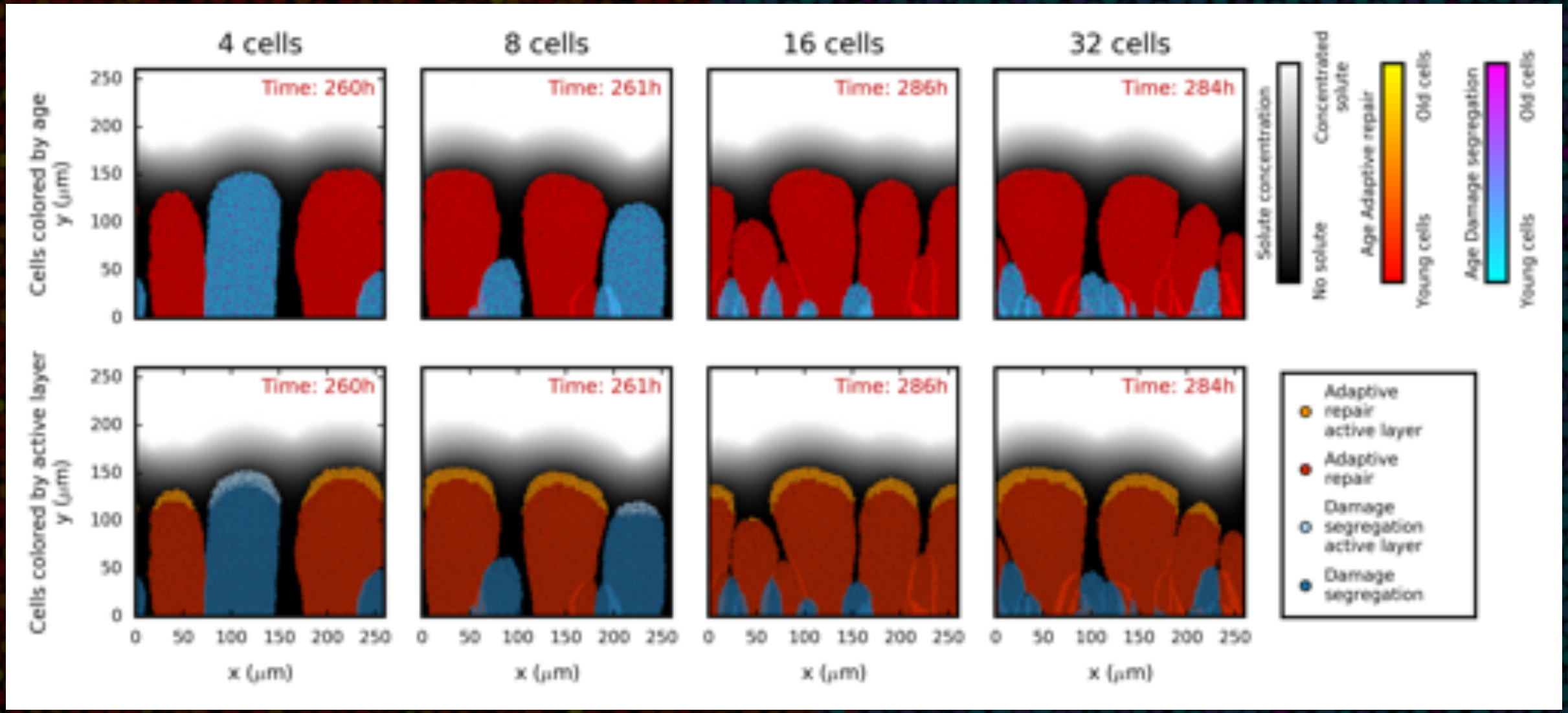
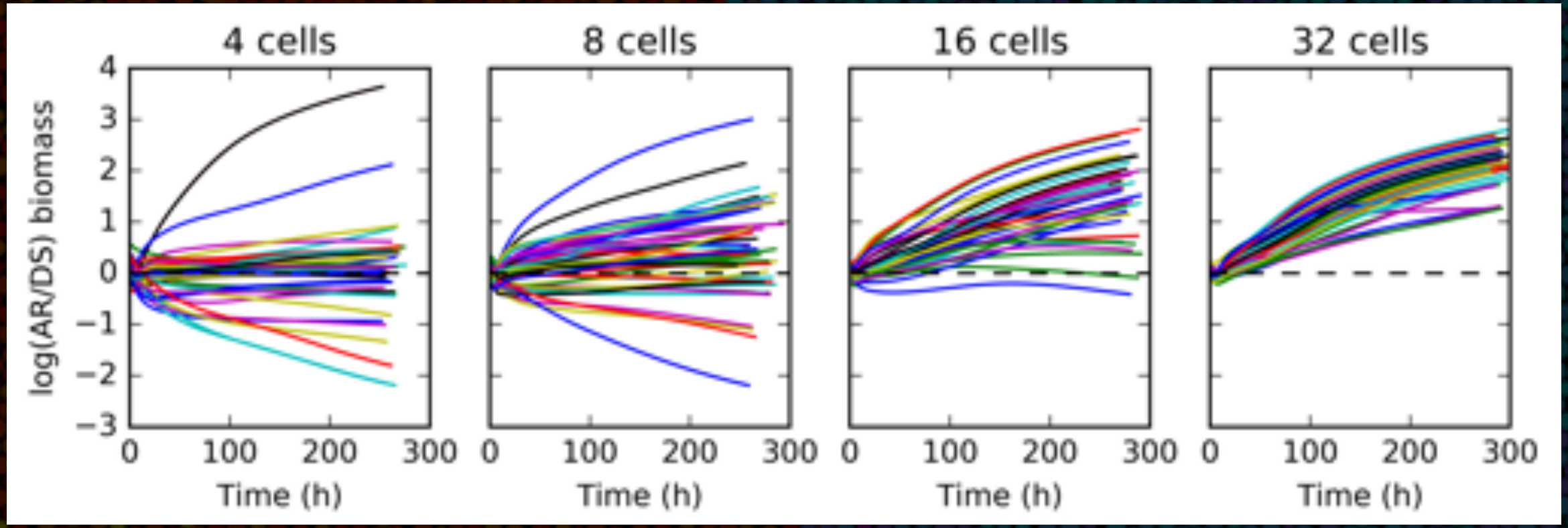


Initial cell density

PROPORTIONAL AGING (adaptive repair *vs* damage segregation)



Initial cell density

CONCLUSIONS

Repair better than segregation (in biofilms and chemostats)

Repair more beneficial when competition is strong

Looking at fitness of individual cells incredibly difficult

As is tracking cells over multiple generations

Models can be used to direct laboratory experiments

ACKNOWLEDGEMENTS

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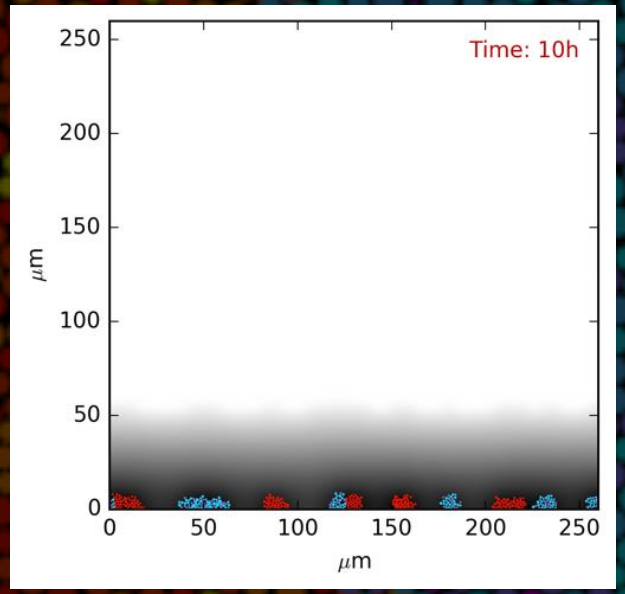
THANKS FOR LISTENING!
QUESTIONS?



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