



Plate-forme de Calcul pour les Sciences du Vivant

COMPUTING PLATFORM FOR LIFE SCIENCES

E. coli evolution in low radioactivity conditions

Pierre Micheau, Alexandre Taravaud, Thomas Hindré, Lydia Maigne,
Michel Zampaolo, Fabrice Piquemal, Vincent Breton



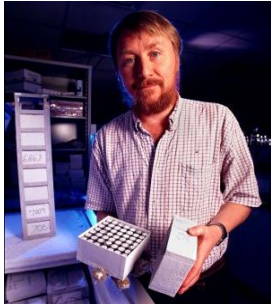


Study of long term evolution and evolution pathways

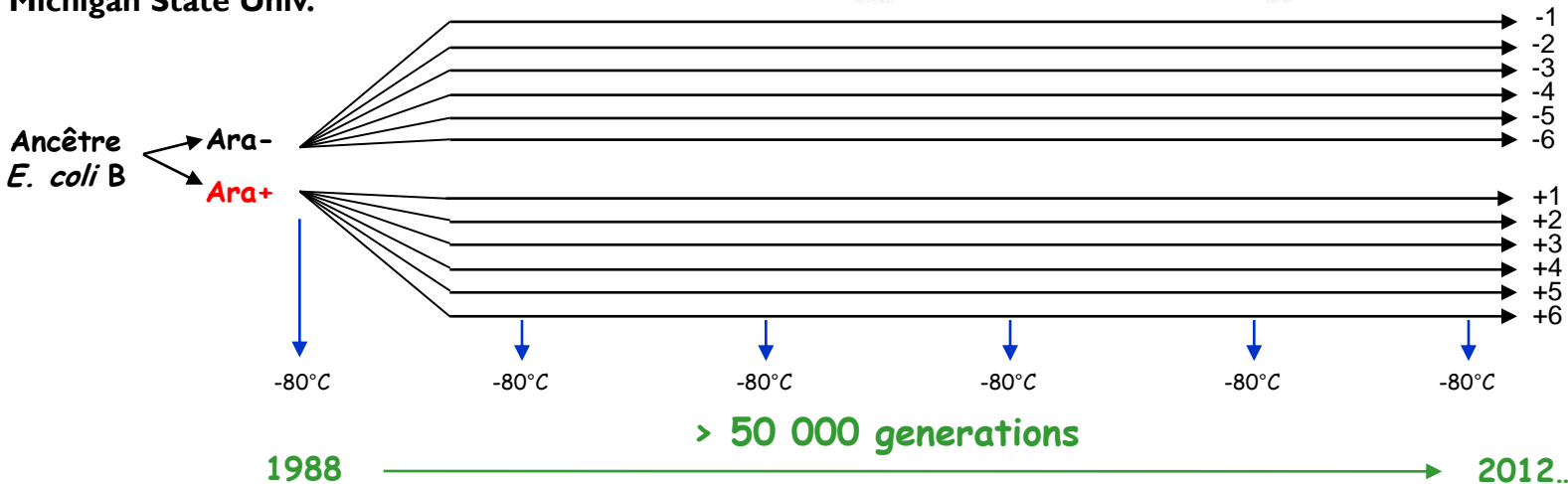
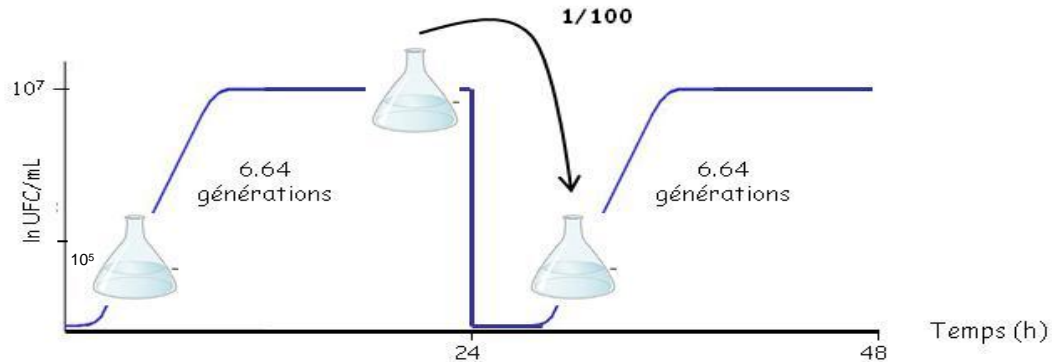
- Evolution is linked to mutation events in genes and genome
 - Natural mutation (error prone during replication)
 - Induced mutation (caused by chemical alterations, radiation)
- Does the level of radiation in the environment affect the evolution process ?
- Use of experimental evolution with *Escherichia coli*
 - No pathogenic
 - Easy to cultivate
 - Short generation time (30-60 min)
 - Large population sizes
 - Cellular process well-known



Richard Lenski's experimental evolution



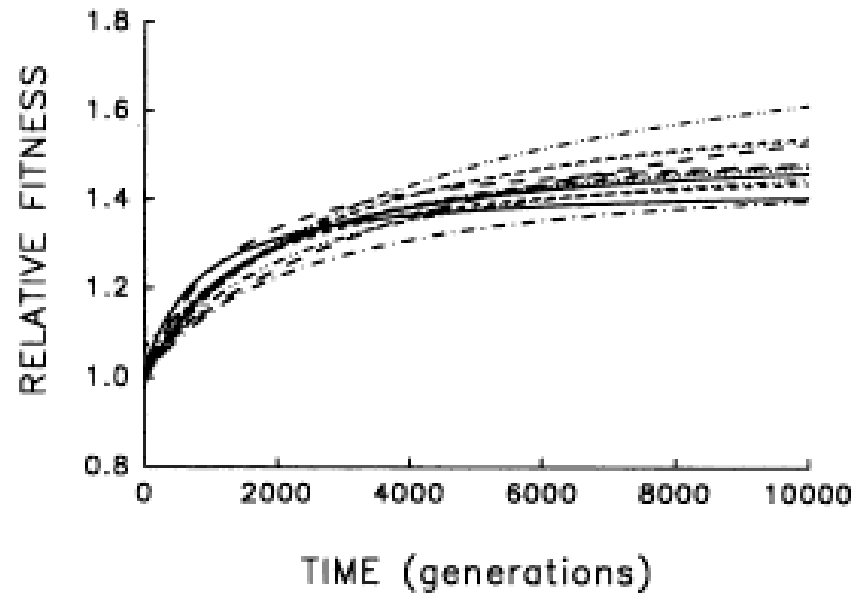
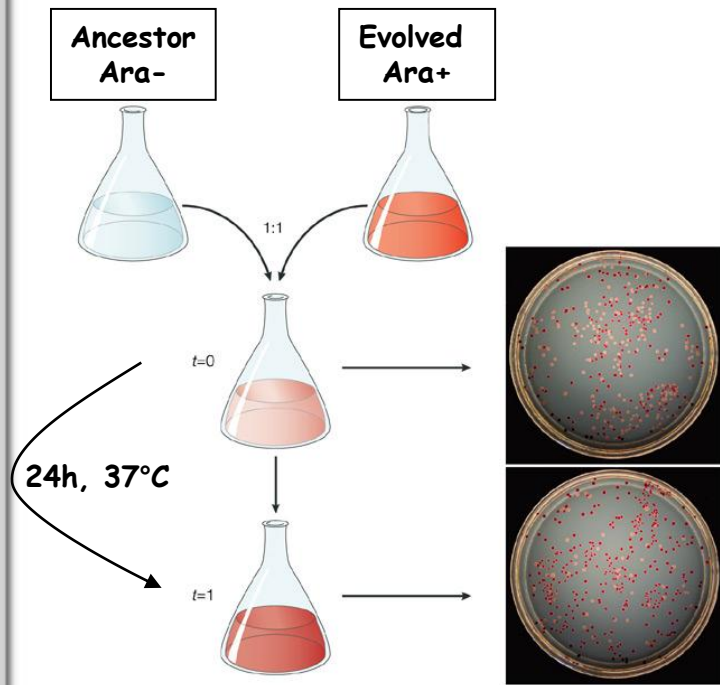
Richard Lenski
Michigan State Univ.



- Daily transfer in the same glucose limited medium
- 12 populations at the same time
- Populations are sampled every 500 generations and conserved as a frozen fossil that can be revived

Richard Lenski's experimental evolution

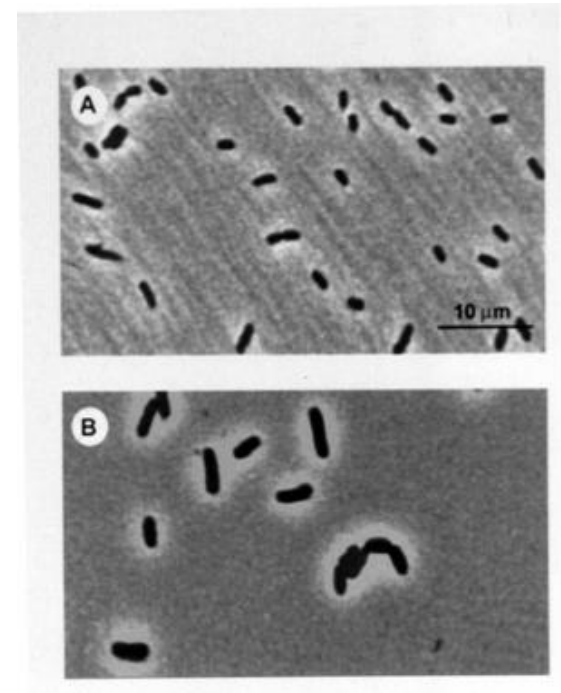
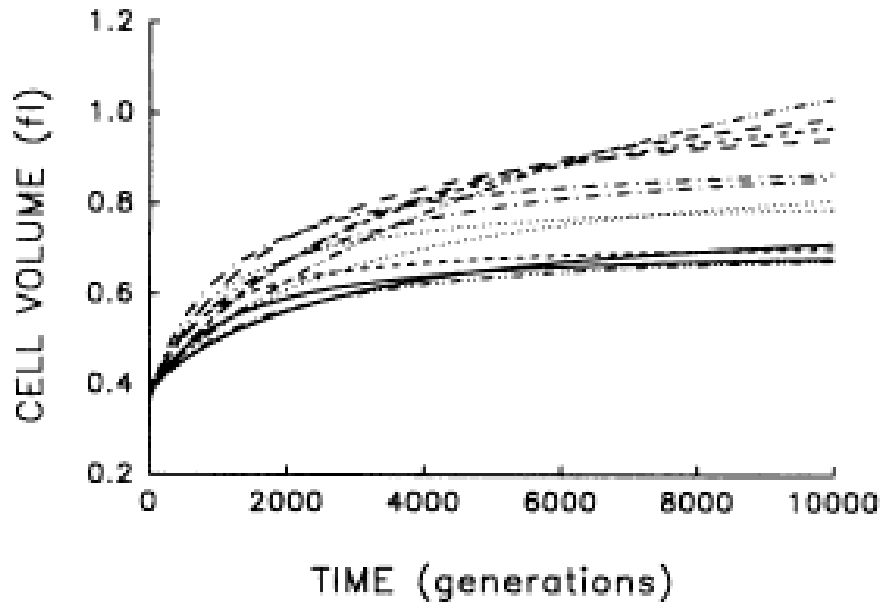
- Direct competition between ancestor and evolved bacteria to measure adaptation : Relative Fitness
 - Which grows up the quickest ? ancestor or evolved bacteria



Relative Fitness increases in the 12 evolved populations

Richard Lenski's experimental evolution

- Cell volume measurement for ancestral and evolved strains



Volume increases in the 12 evolved populations



Does the level of radiation in the environment impact the evolution process ?

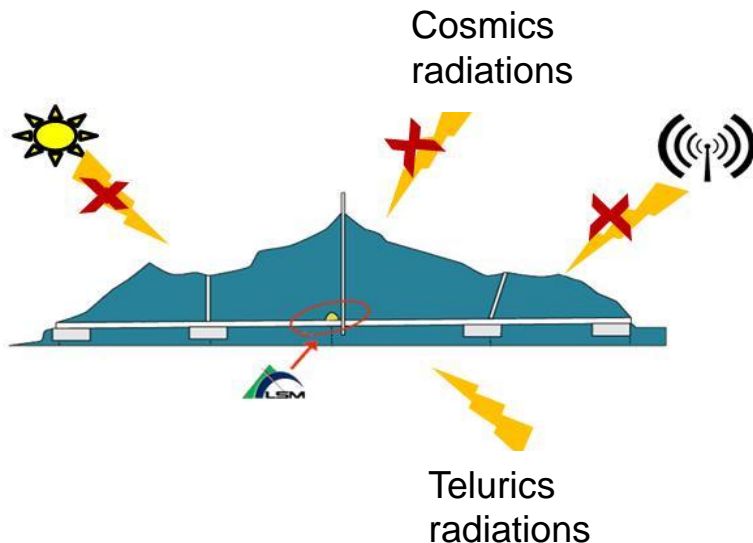
- Start experiments in three different environments
 - Underground Laboratory of Modane (LSM) as « zero » radiation (around 5nSv/h) – Done
 - Laboratory of Corpuscular Physics (LPC) around 150nSv/h – in progress
 - LPC around 150nSv/h + 0.5Gy/week – not start
- Protocole is similar to Lenski's one
 - Same bacteria E.coli B Ara- ,Ara+
 - 12 replicates of Ara-, 12 replicates of Ara+
 - 37°C – Daily transfer in limited glucose medium
 - 8.23 generation per day
- Biological data used for modeling bacterial evolution



Experimental evolution at LSM

□ Culture at LSM

- No radiations come from cosmos, sun and electronic waves
- Protected from others telurics radiations thanks to the lead castle
- Traditional culture conditions (37°C, agitation)



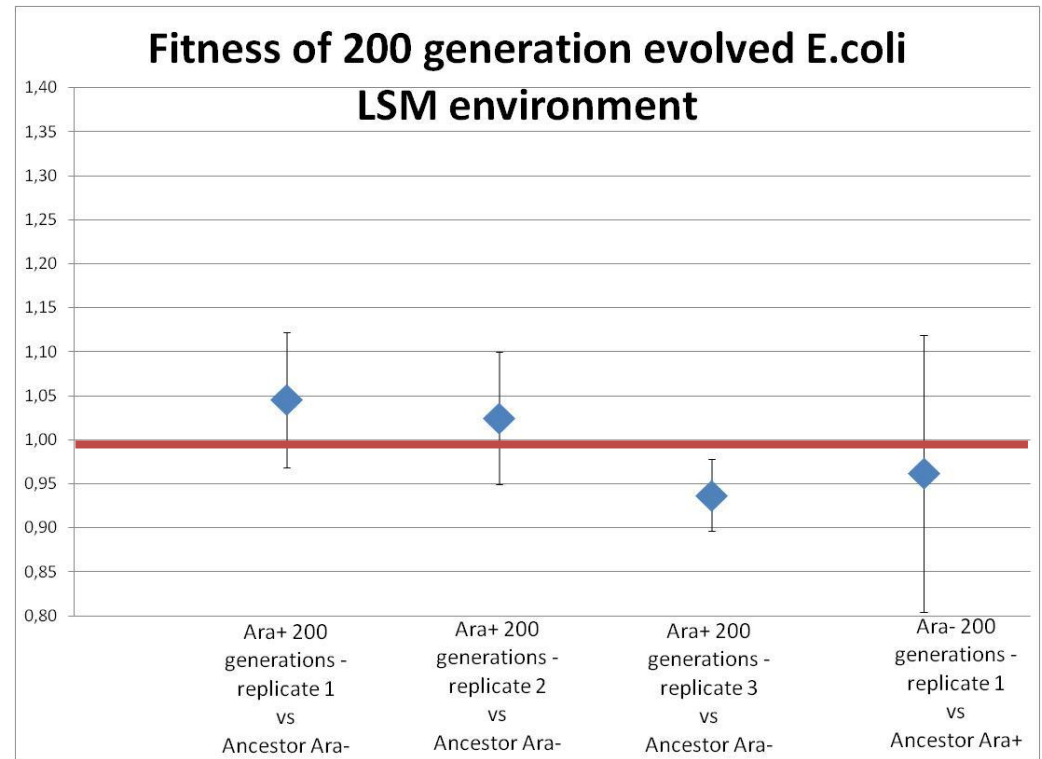
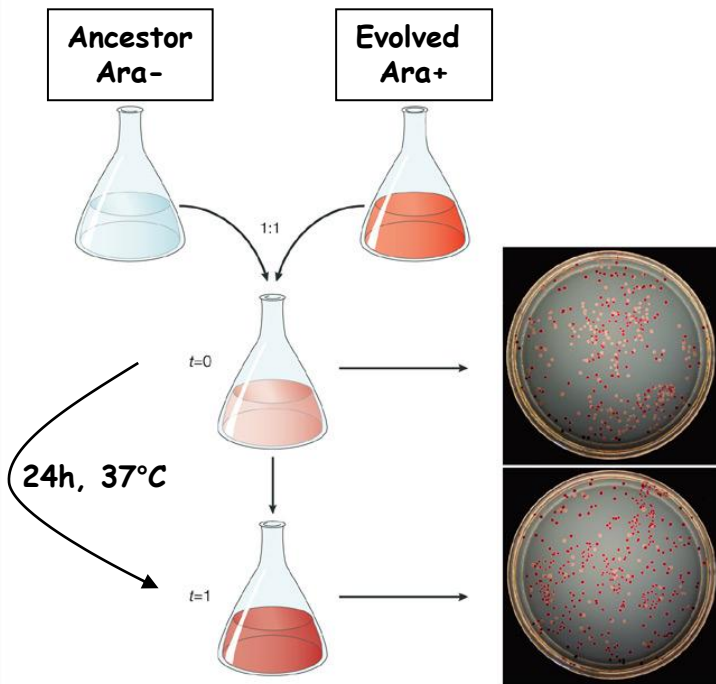
Experimental evolution at LSM

- *E. coli* populations have been propagated for 200 Generations (8000 years at the human scale) – 45 days experiment
- Comparison of 200 Generations evolved *E. coli* at LSM to ancestor
 - Fitness test
 - 40Gy survival rate



Experimental evolution at LSM

□ Fitness test



➤ Fitness around 1 - No increase of fitness for evolved E.coli

E. Coli behavior after high dose radiation

□ Purpose

- Low radiation environment = less oxydative damages on E.coli genome
- Are evolved bacteria lost capacity to fight against oxydative damages during strong irradiation ?

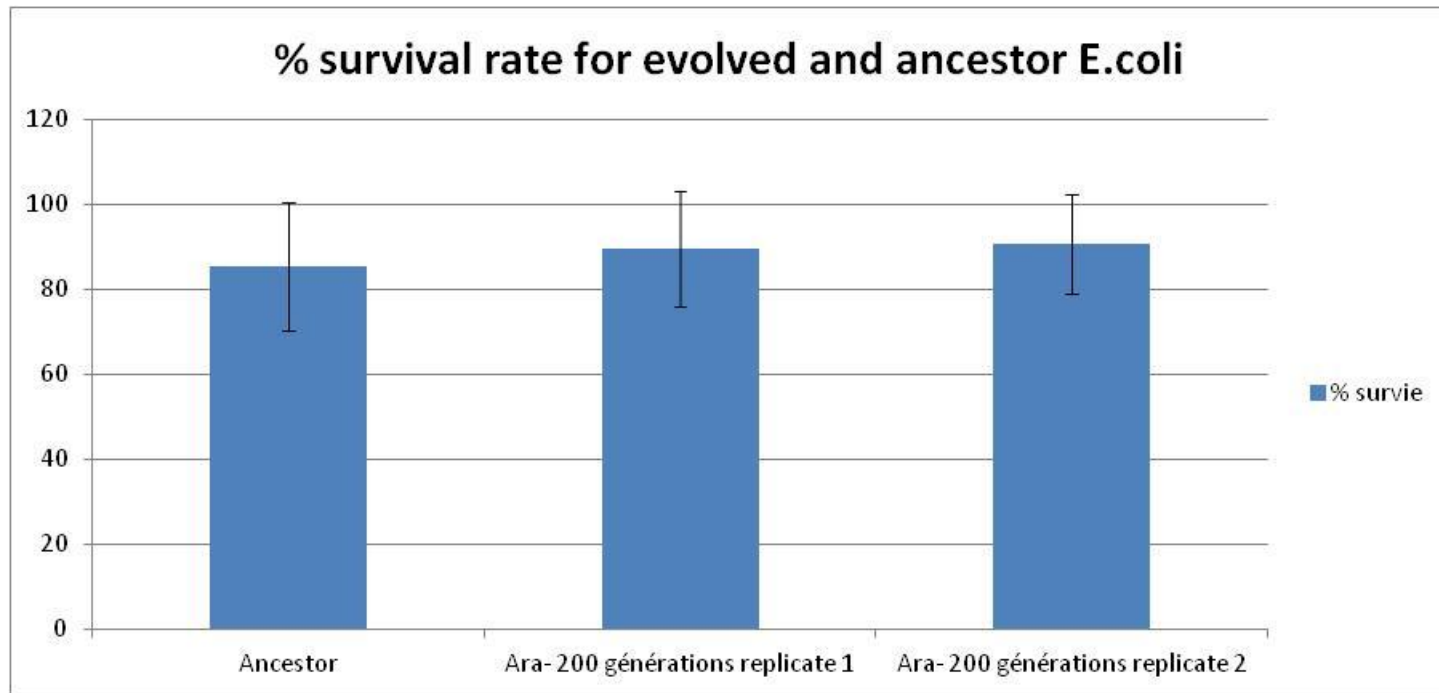
□ High dose radiation using medical linac

- 18 MV photon beam
- Dose = 40 Gy
- Tests and sample analysis:
 - Survival rates of two evolved and ancestral *E. coli*



E. Coli behavior after high dose radiation

□ Results:



➤ **Ancestor and evolved E.coli have the same resistance to irradiation**

Conclusions - Perspectives

- **E. coli populations have been evolved during 200 generations in the low radiation environment (LSM)**
 - Same fitness between ancestor and evolved E.coli
 - Same survival rate to short strong irradiation
 - 200 generations in LSM environment not enough to characterize modifications of evolution process
- **Propagated E.coli during more generations at LSM**
- **TO DO NEXT: Comparisons between *E. coli* in natural radiation exposure and *E. coli* in low radiation environment**
 - Fitness measurement
 - 40Gy survival rate

Acknowledgements



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