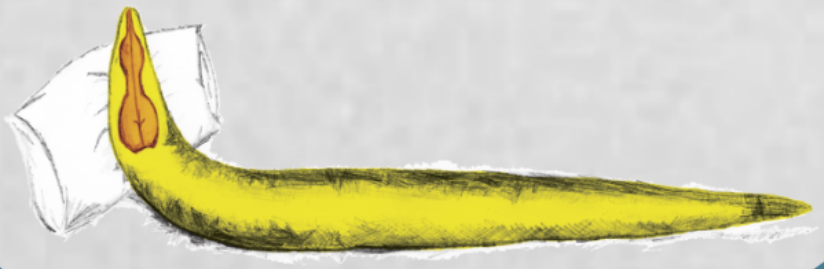

A close(r) look at worm sleep
David Biron
The University of Chicago
david.biron@gmail.com
Introduction
"Precision measurements" of behavior
Homeostasis
Future / Conclusions

A close(r) look at worm sleep

David Biron
The University of Chicago
david.biron@gmail.com



Why sleep?

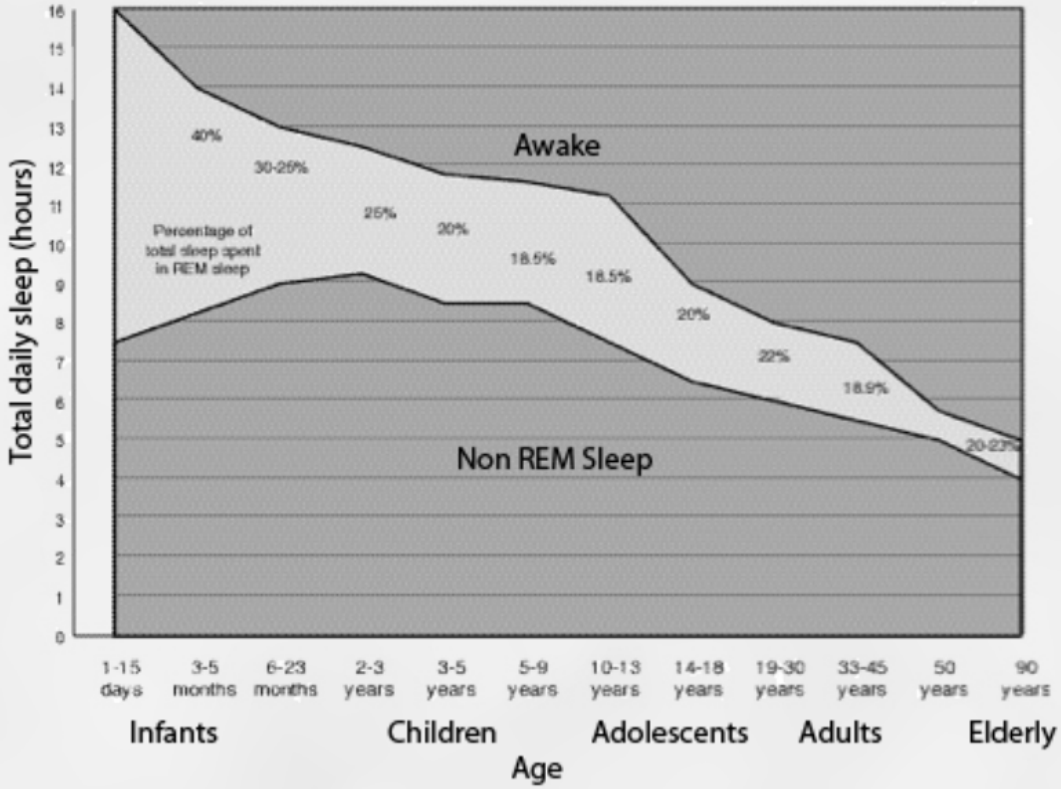
...what we, ***to our detriment***, get around to only once we are done working and entertaining ourselves.

- Universal
- Essential

(Campbell and Tobler, 1984)
(Cirelli and Tononi, 2008)

Sleep affects structural plasticity (notably, during development)

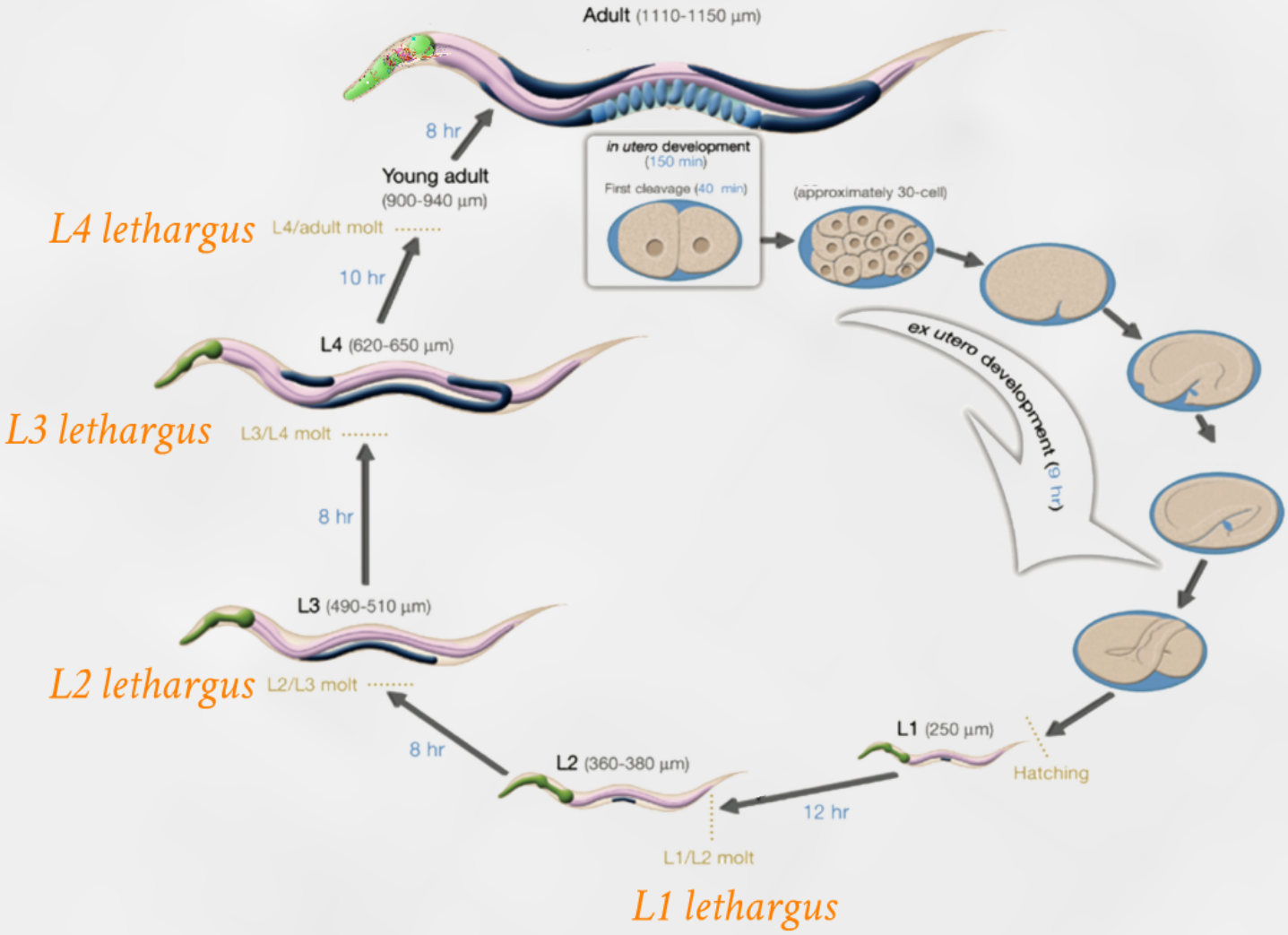
...although these effects have been minimally explored.

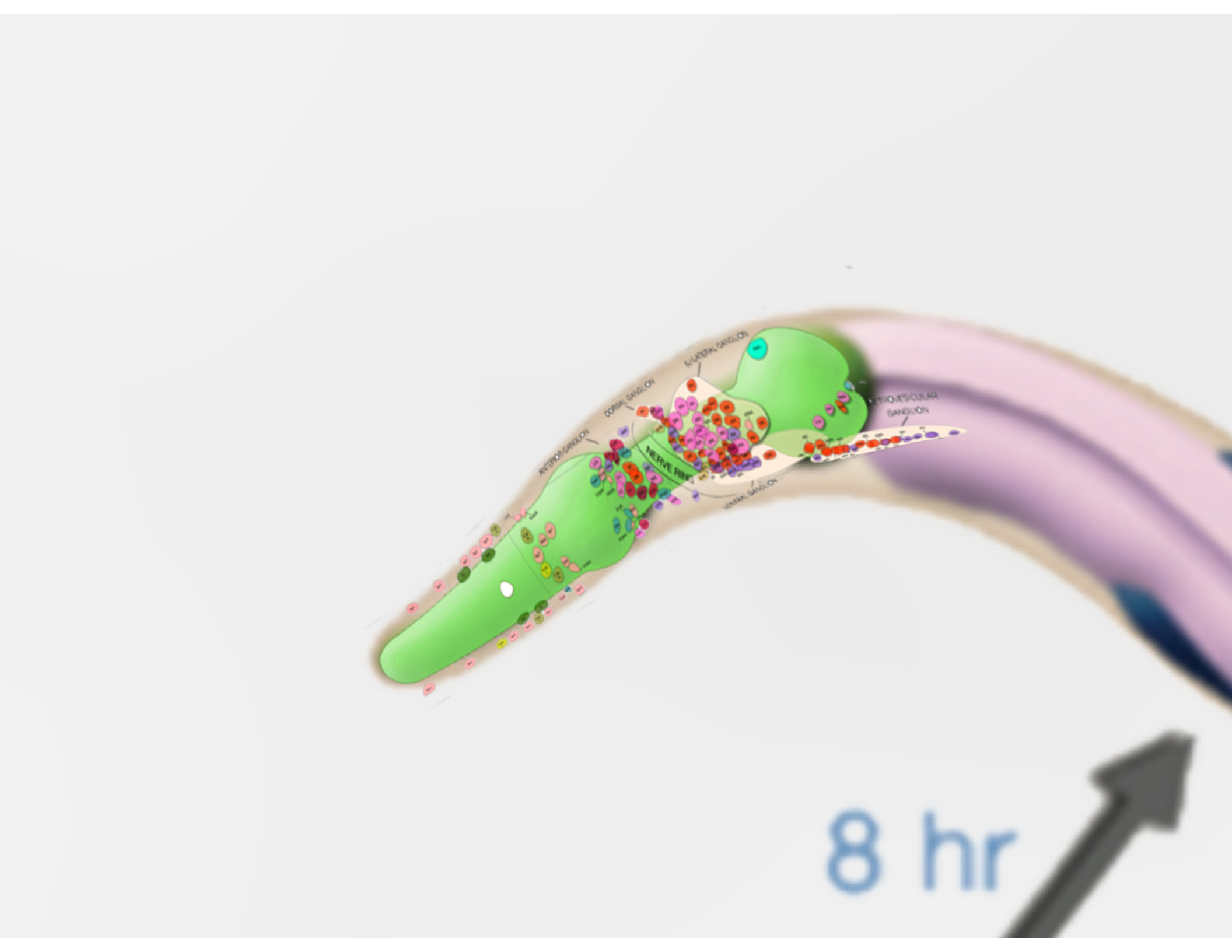


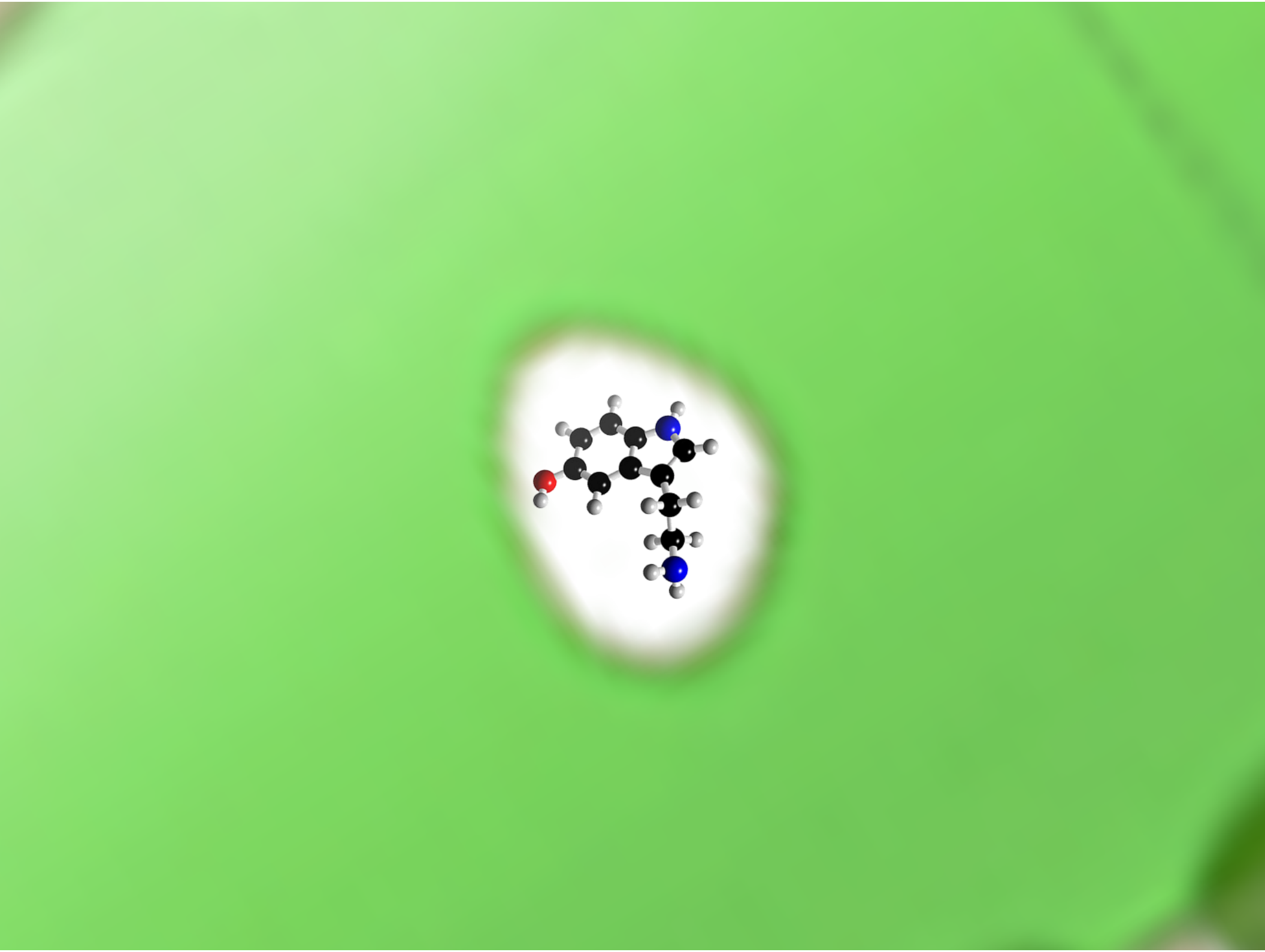
"The prime role of "dreaming sleep" in early life may be in the development of the central nervous system."

(Roffwarg et al., 1966; Peterson, 1997)

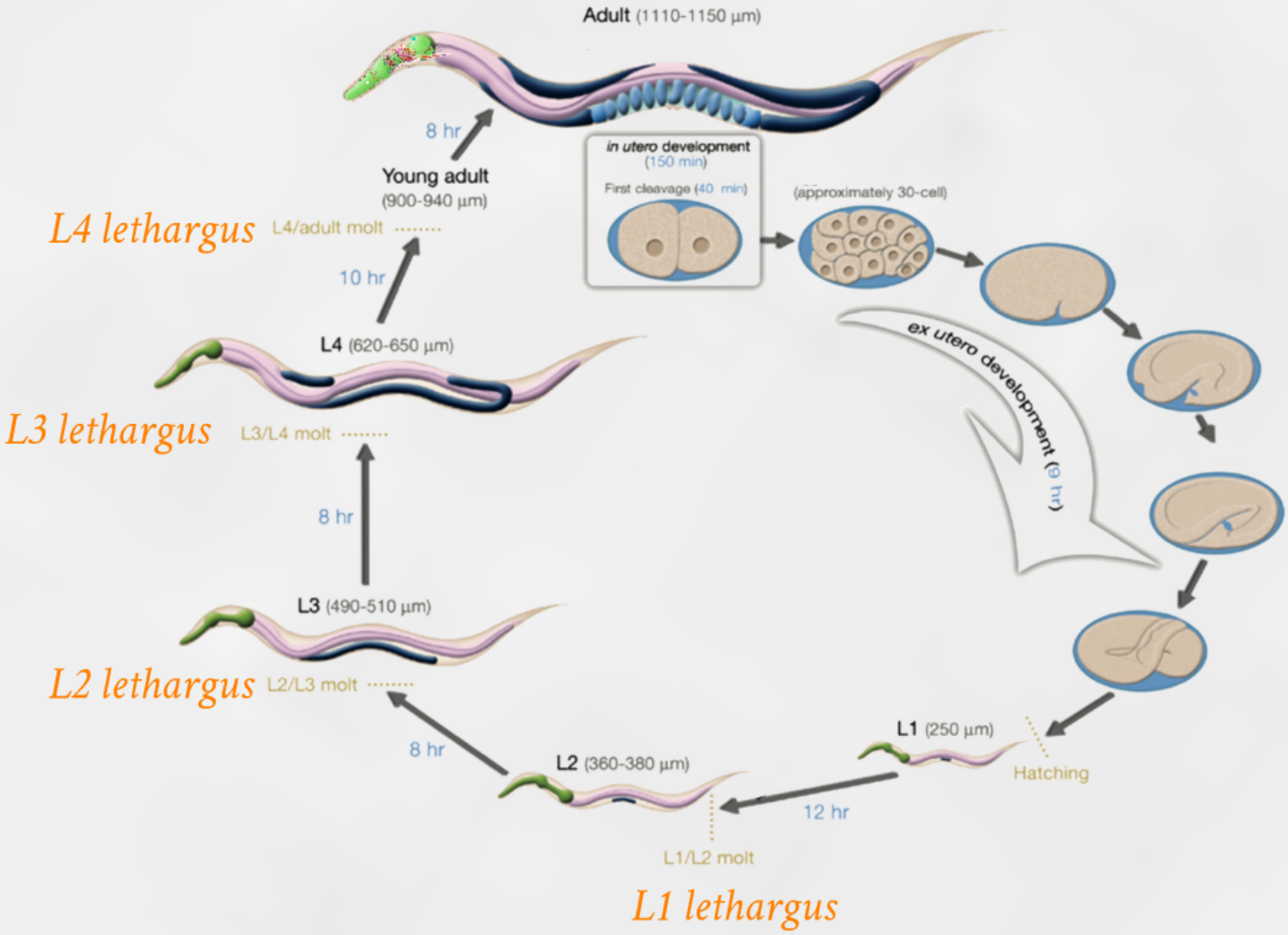
Why worms?


Adult (1110-1150 µm)
8 hr
Young adult
(900-940 µm)
L4 lethargus
L4/adult molt
10 hr
L4 (620-650 µm)
L3 lethargus
L3/L4 molt
8 hr
L3 (490-510 µm)
L2 lethargus
L2/L3 molt
8 hr
L2 (360-380 µm)
L1/L2 molt
12 hr
L1 (250 µm)
Hatching
L1 lethargus
in utero development
(150 min)
First cleavage (40 min)
(approximately 30-cell)
ex utero development (9 hr)

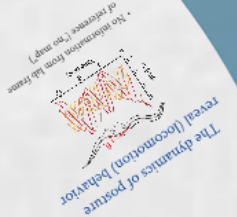

ANTERIOR GANGLION
DORSAL GANGLION
LATERAL GANGLION
NERVE RING
VENTRAL GANGLION
RETROVESICULAR GANGLION
8 hr

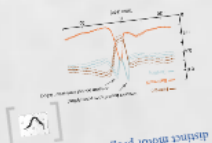


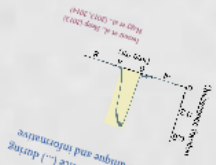
Why worms?


Adult (1110-1150 µm)
8 hr
Young adult
(900-940 µm)
L4 lethargus
L4/adult molt
10 hr
L4 (620-650 µm)
L3 lethargus
L3/L4 molt
8 hr
L3 (490-510 µm)
L2 lethargus
L2/L3 molt
8 hr
L2 (360-380 µm)
L1/L2 molt
12 hr
L1 (250 µm)
Hatching
L1 lethargus
in utero development
(150 min)
First cleavage (40 min)
(approximately 30-cell)
ex utero development (9 hr)

"Precision measurements" of behavior



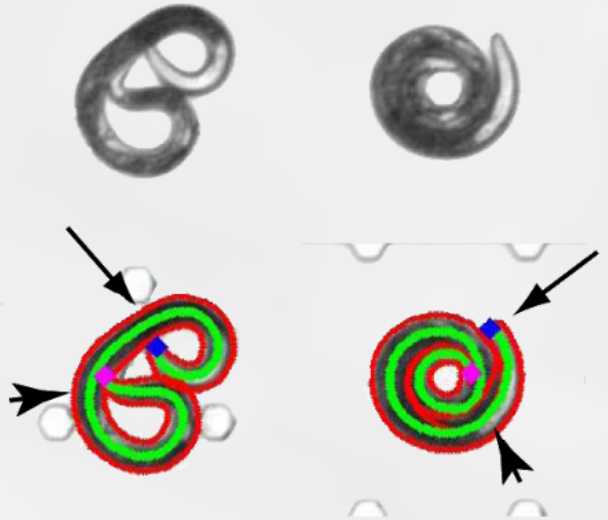




Continuous, prolonged, low error rate

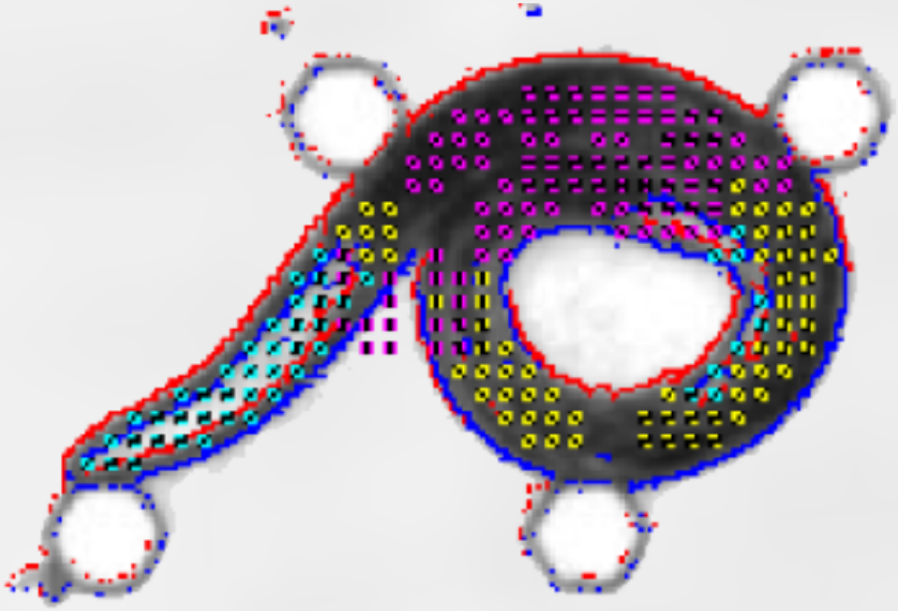
- Wild-type maneuvers

- Mutations affecting posture



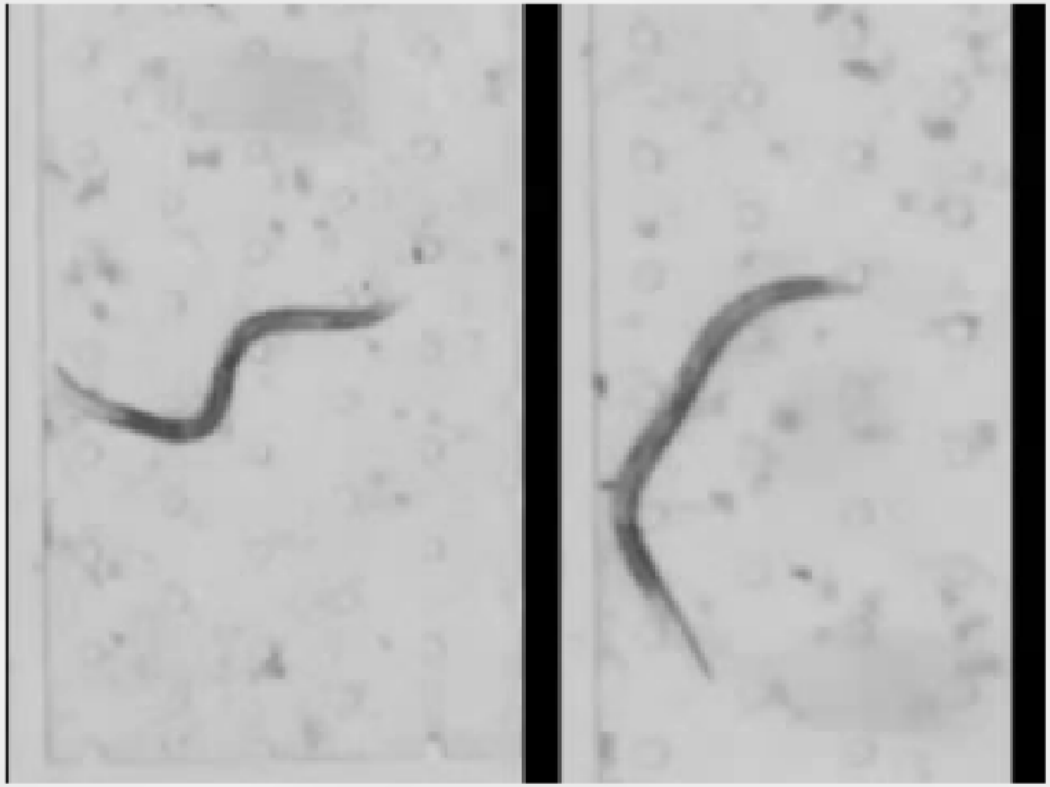
(In collaboration with Marc Goessling, Yali Amit)

Non heuristic / generalizable

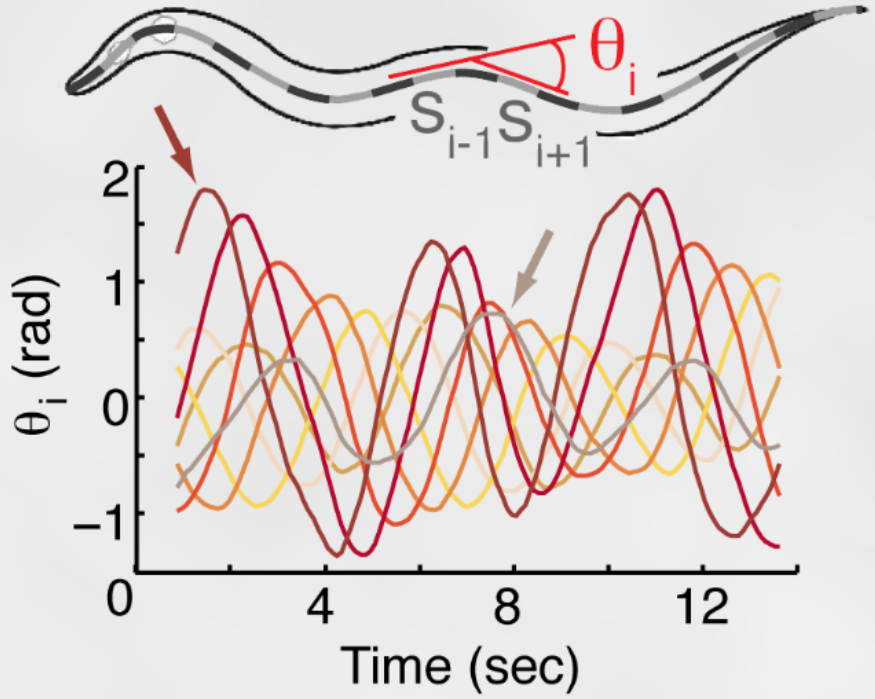


- Object recognition using a statistical model
- Big data requires high power computing resources

(In collaboration with Marc Goessling, Yali Amit)



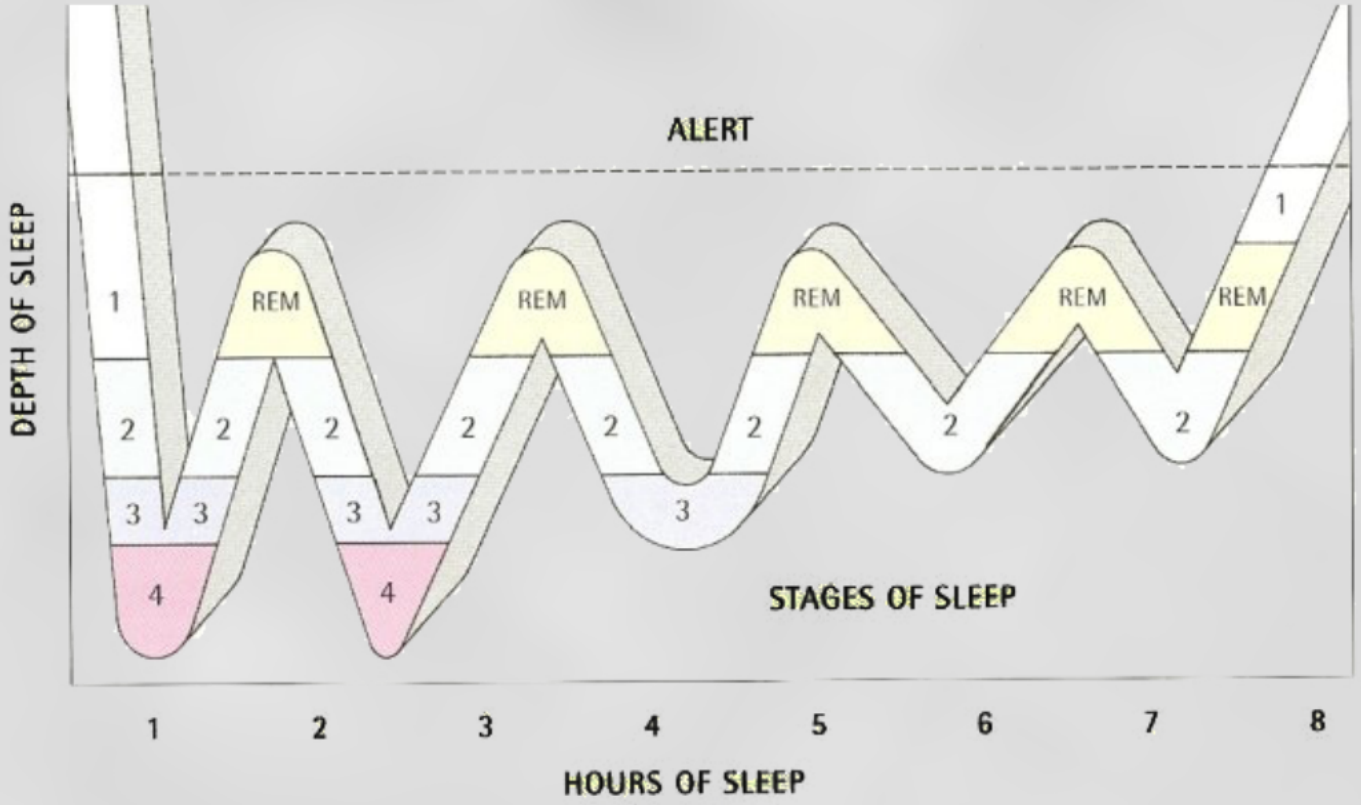
The dynamics of posture reveal (locomotion) behavior



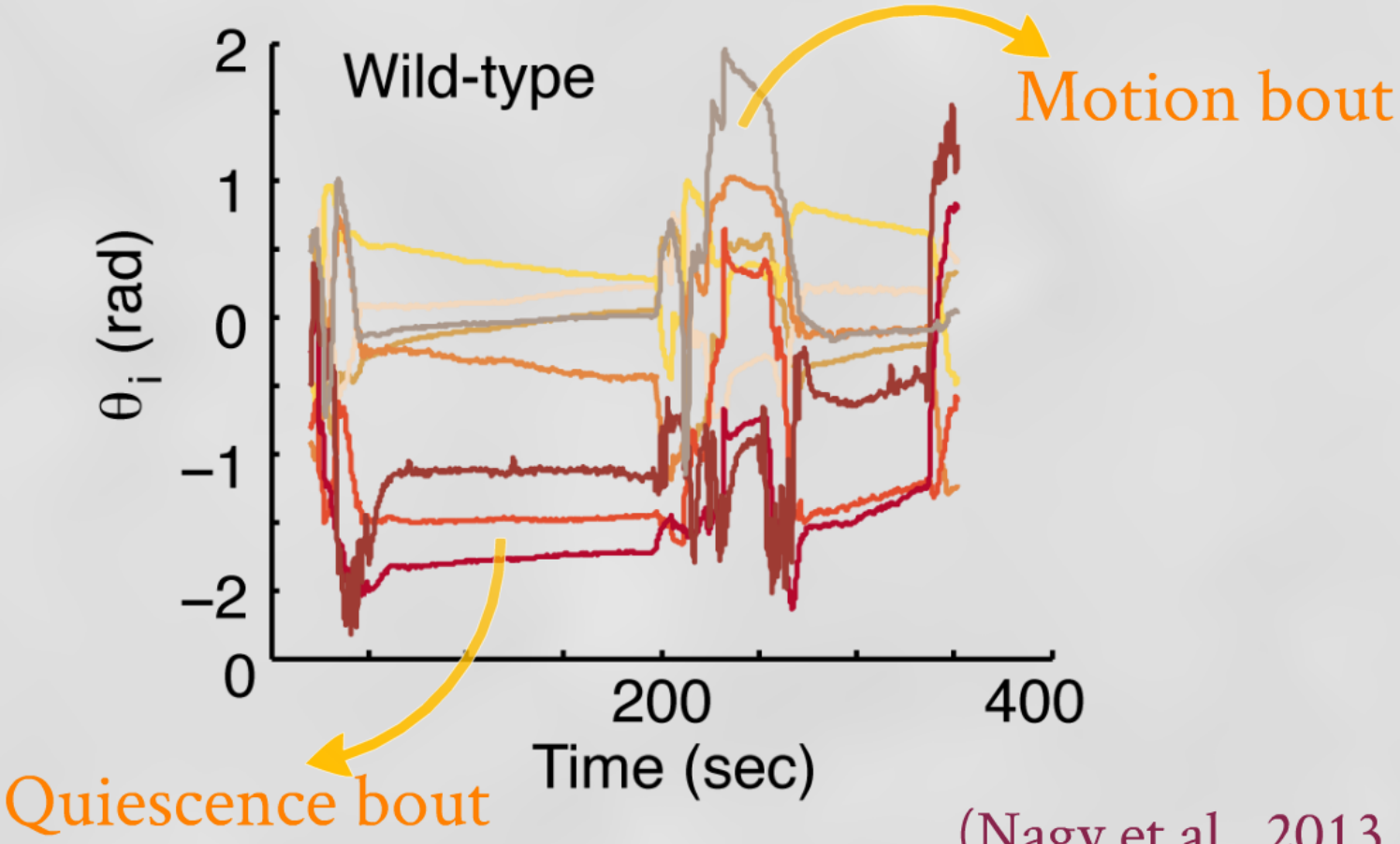
- No information from lab frame of reference ("no map")

Homeostasis

Sleep has an architecture and disruptions are ***compensated*** for (homeostasis)

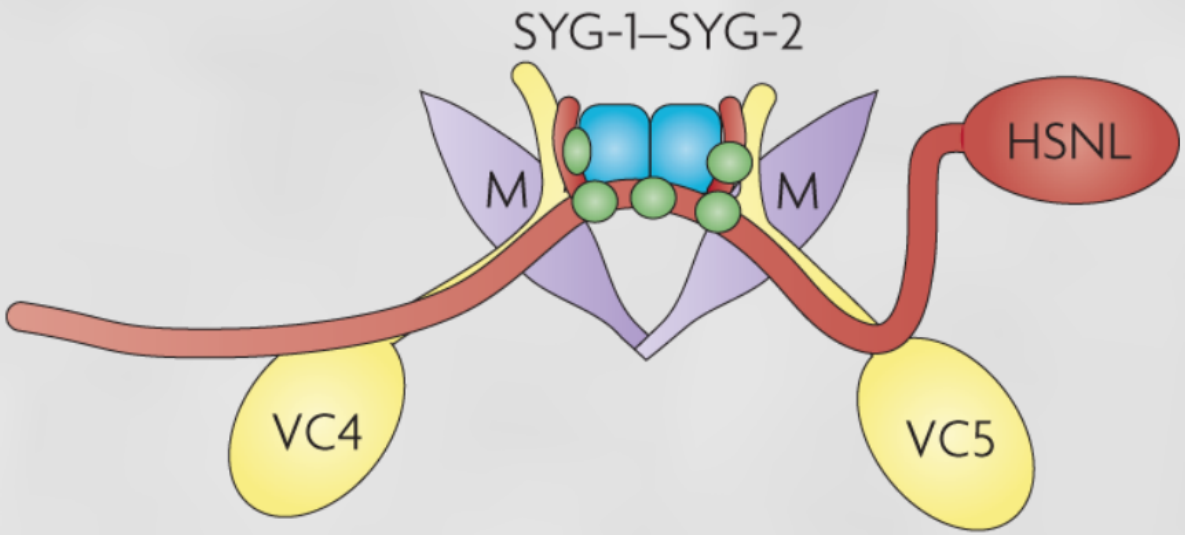


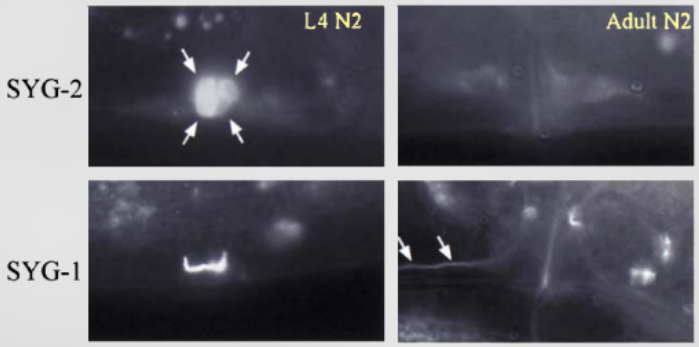
Stabilization of sleep in mild noise is distinct from compensation after severe agitation



(Nagy et al., 2013
Nagy et al., 2014)

The egg-laying circuit matures during or near the time of sleep

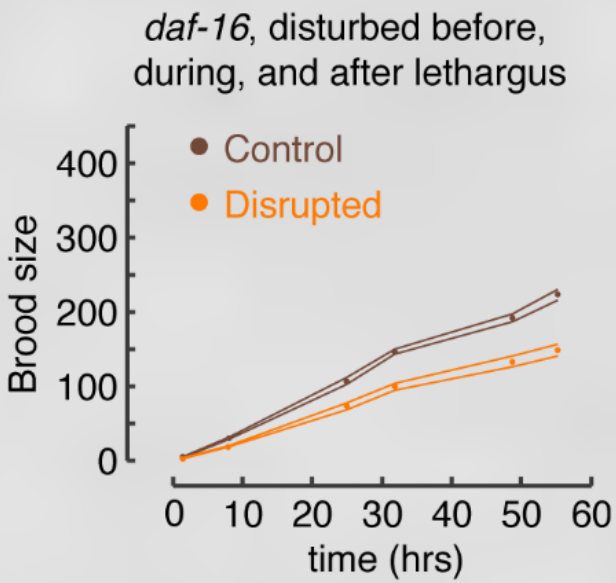


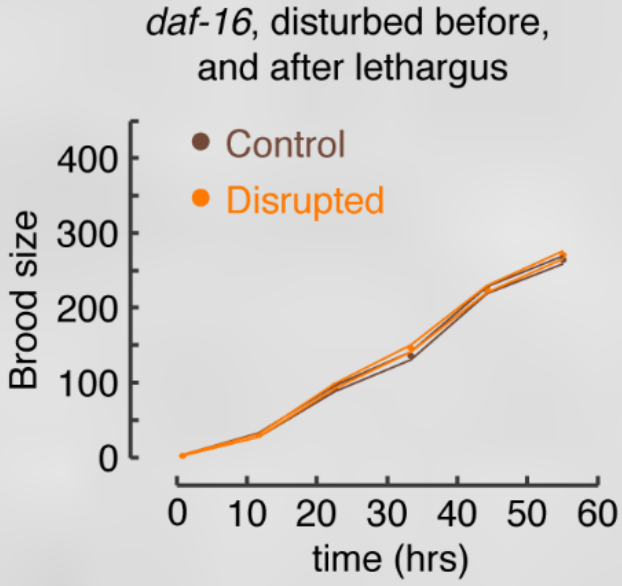


Shen et al., (2004)
Chao and Shen, (2009)

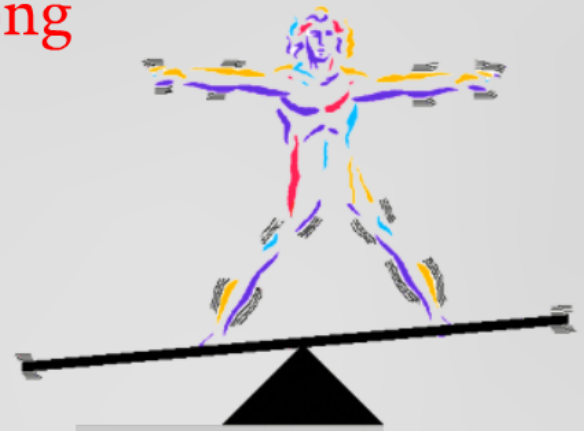
Severe agitation ***specifically during sleep*** can negatively affect egg-laying

(but is it a deficiency in neuronal function?)





Any state, realistically, would require to withstand finite noise;
routine stabilization in mild noise is distinct from compensation for strong agitation.



An ***ancient*** relation between sleep (?) and development, where plasticity scales with brain size.

Universality?


A close(r) look at worm sleep
David Biron
The University of Chicago
david.biron@gmail.com
Introduction
"Precision measurements" of behavior
Homeostasis
Future / Conclusions