



Graphics vs Physics : the light and dark sides of the Force? (which is which ?)

- (I) The physics side (Emmanuel de Langre)
- (II) The graphics side (Fabrice Neyret)
- (III) Questions (both)

(I) A physicist point of view

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(a) A practical example: foliage motion under wind

(b) More general considerations

[typical slide from a physicist.... Clearly not in computer graphics]

(I) A practical example: foliage motion under wind



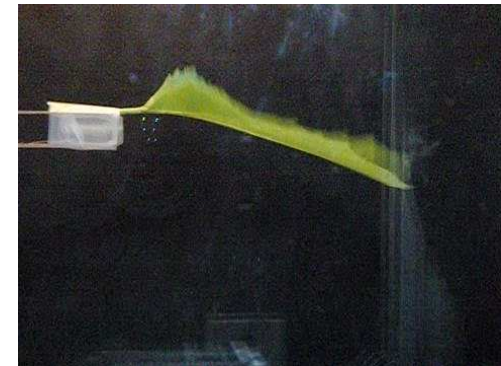
Question: can we predict the « motion » of a foliage under wind

Quantity of interest ?

- Leaf **acceleration** is central to water ejection



- Amplitude (where ?)
- frequency



- « average » leaf acceleration is sufficient
- Norm of acceleration
- Space averaged over each leaf
- Time averaged (R.m.s)
- Space averaged over the tree



G

1 scalar value

Physical law of interest ?

Wind ? : U (m/s) time averaged velocity

Acceleration



G

Tree ? : size ? Shape ? Material ?
Season (leaves) ? Species ?

Wind velocity U (m/s)



Foliage acceleration G (m/s²)

Tree size H (m)

Given species, season



$G(U, H)$?

Experimental approach



Anemometer

U



H

Video
Tracking
Signal processing
Averaging



G

Fails

Wind is not a stationary process

Tree height is ill-defined.

Acceleration cannot be measured everywhere on all axes

Experimental approach (more controlled)

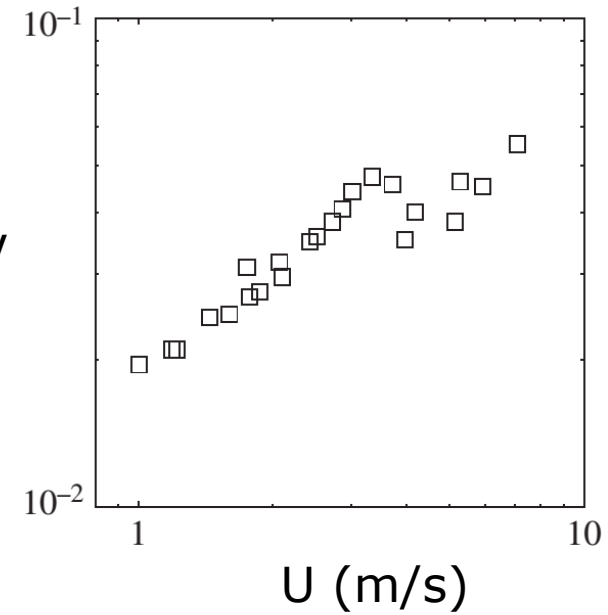


Wind tunnel



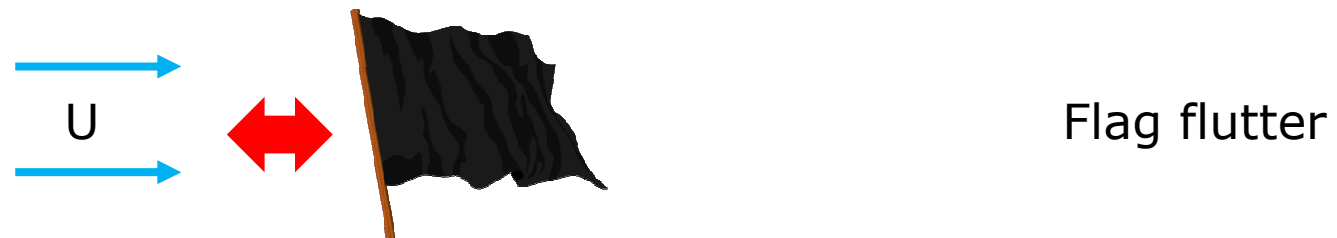
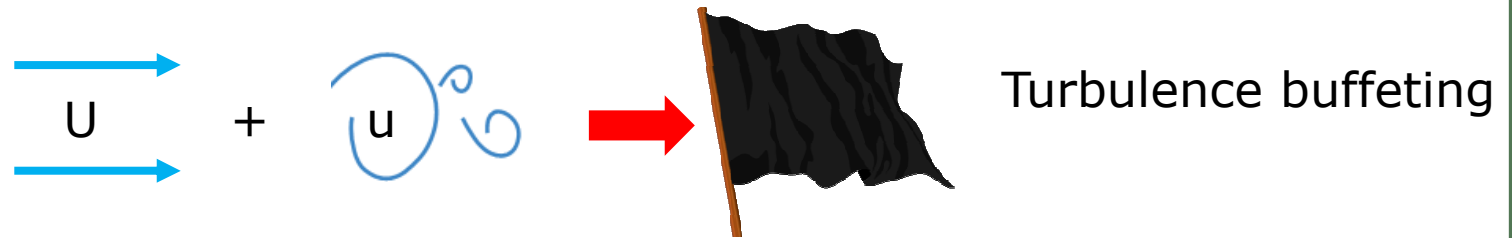
Model tree

Not G but V
(velocity)
(m/s)

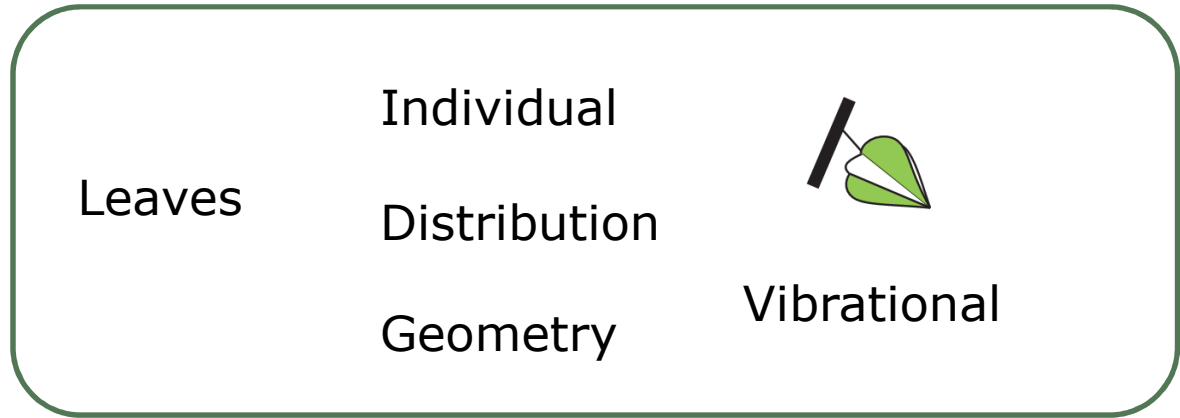
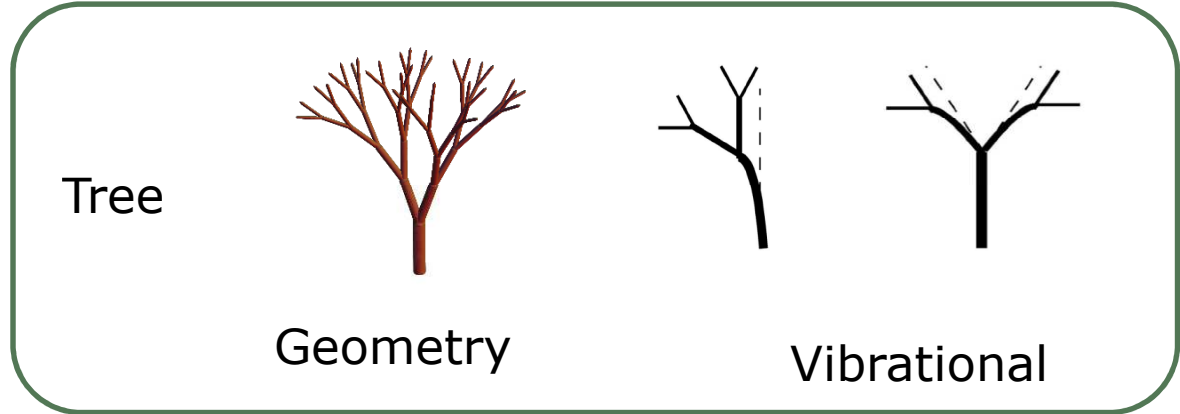
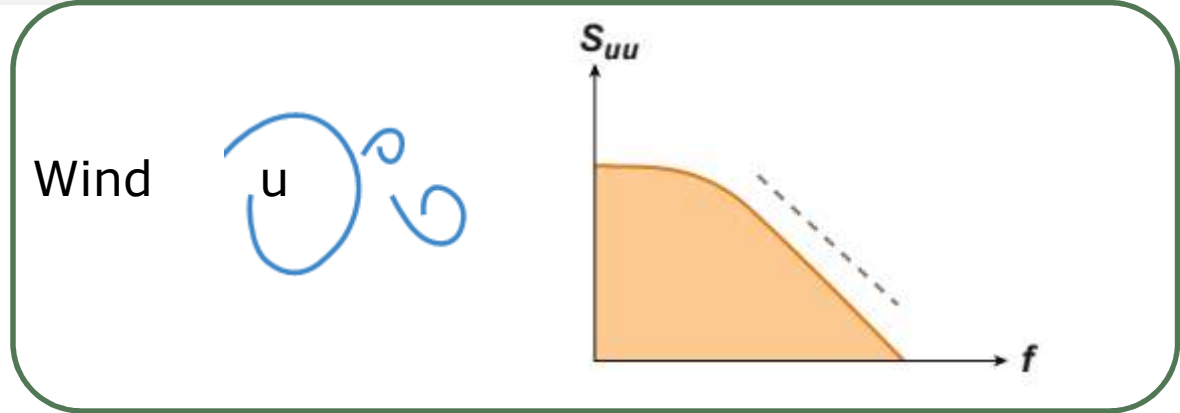


Modeling

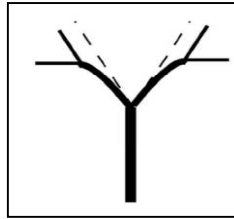
Physical mechanisms involved ?



Toolbox of existing models

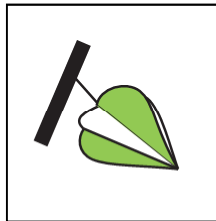
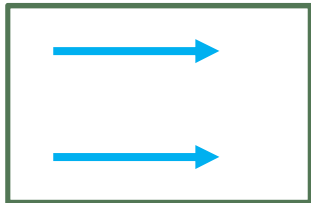


Turbulence buffeting model for branches



G (branches)

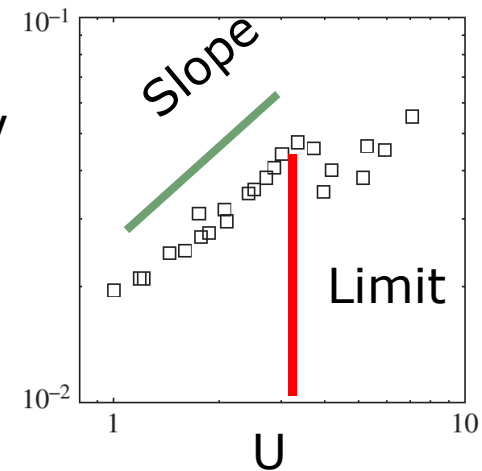
Flag flutter model for leaves



G (leaves)



Not G but V
(velocity)



Computer graphics ?



Diener, J., Rodriguez, M., Baboud, L., & Reveret, L. (2009, April). Wind projection basis for real-time animation of trees. In *Computer graphics forum*

[using parts of our dynamical models]



Zhao, Y., & Barbič, J. (2013).. *ACM Transactions on Graphics*

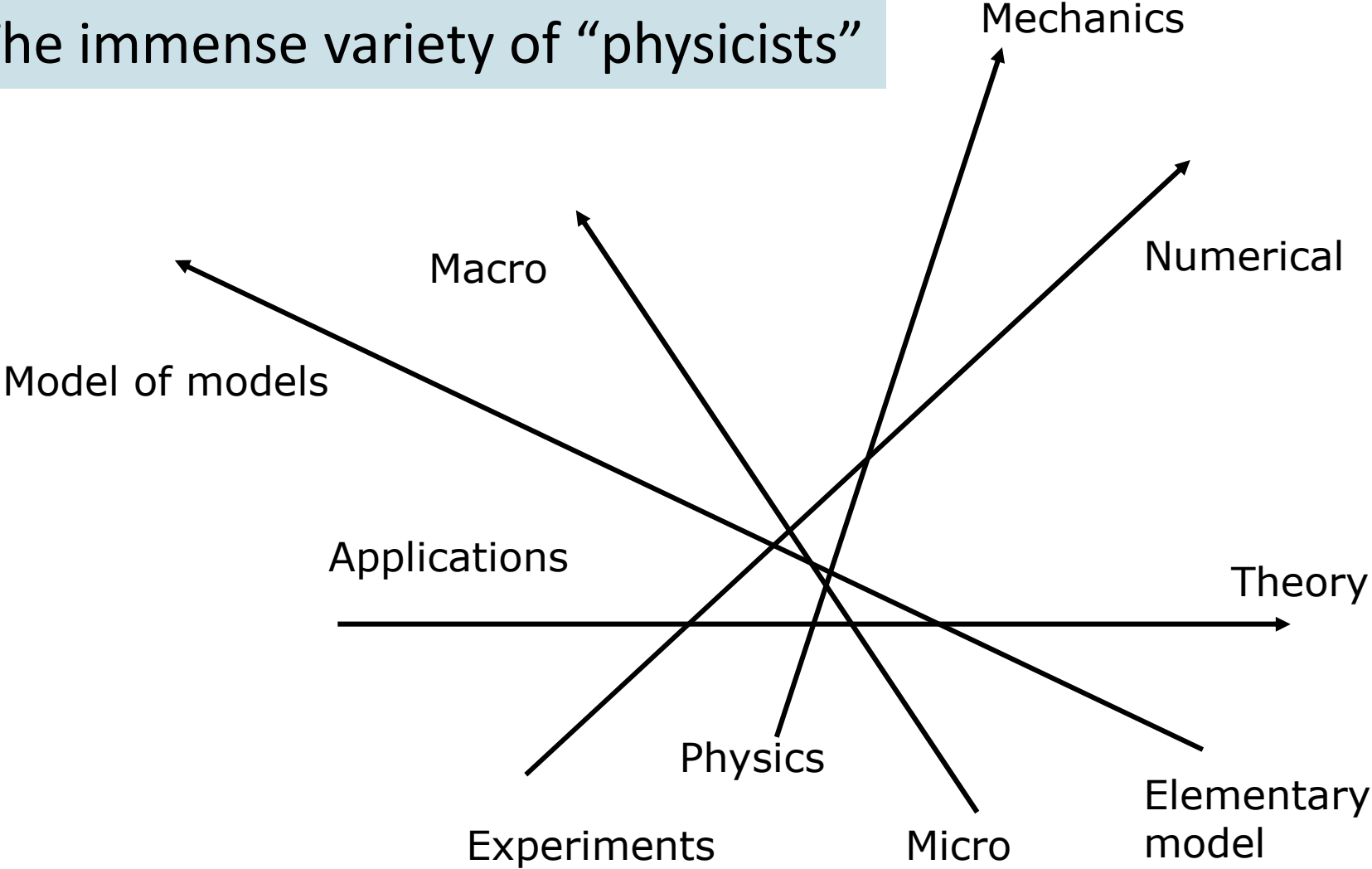


Ota et al. (2004). *The Visual Computer*

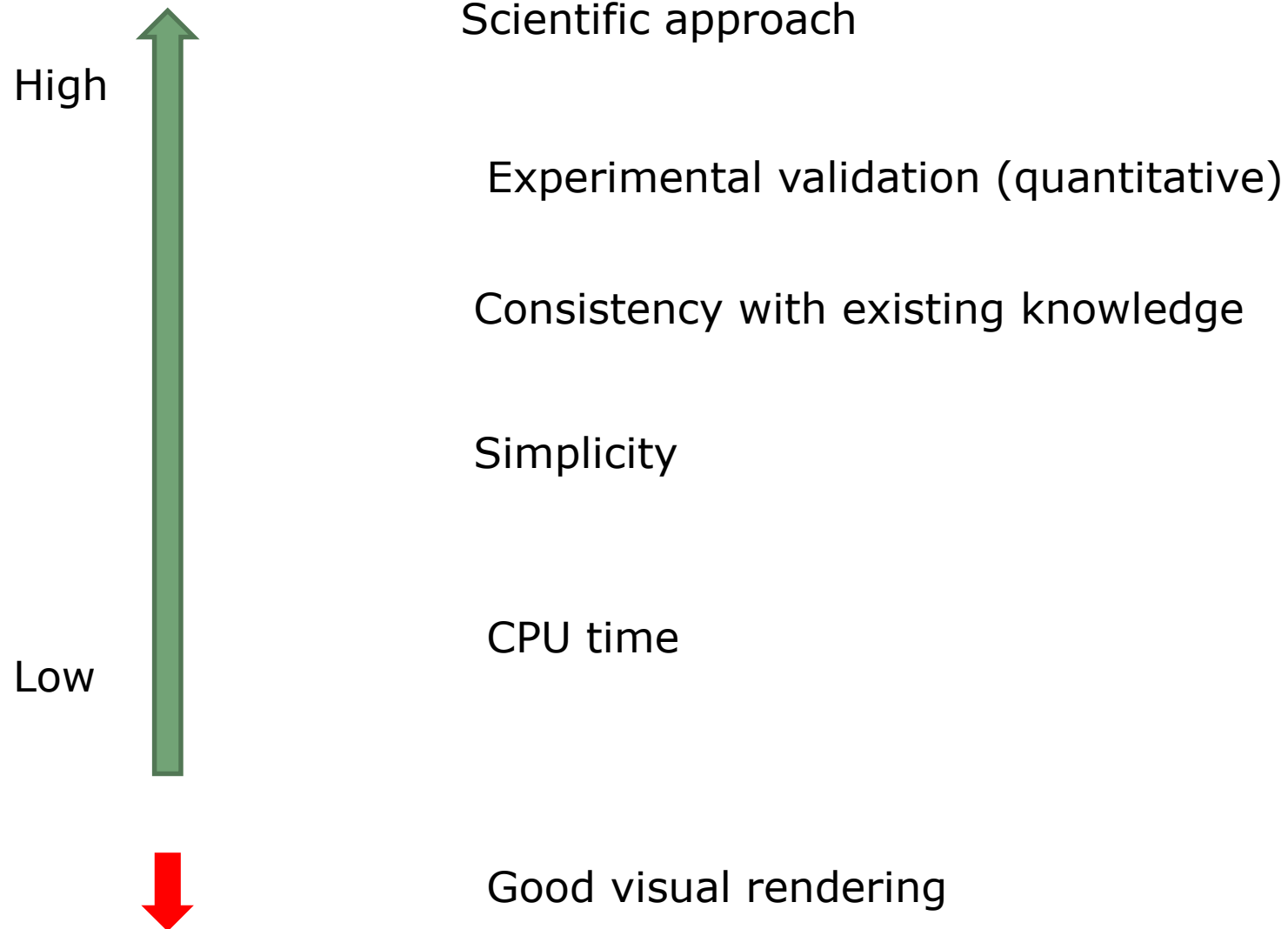
Wind= random noise

(b) More general considerations

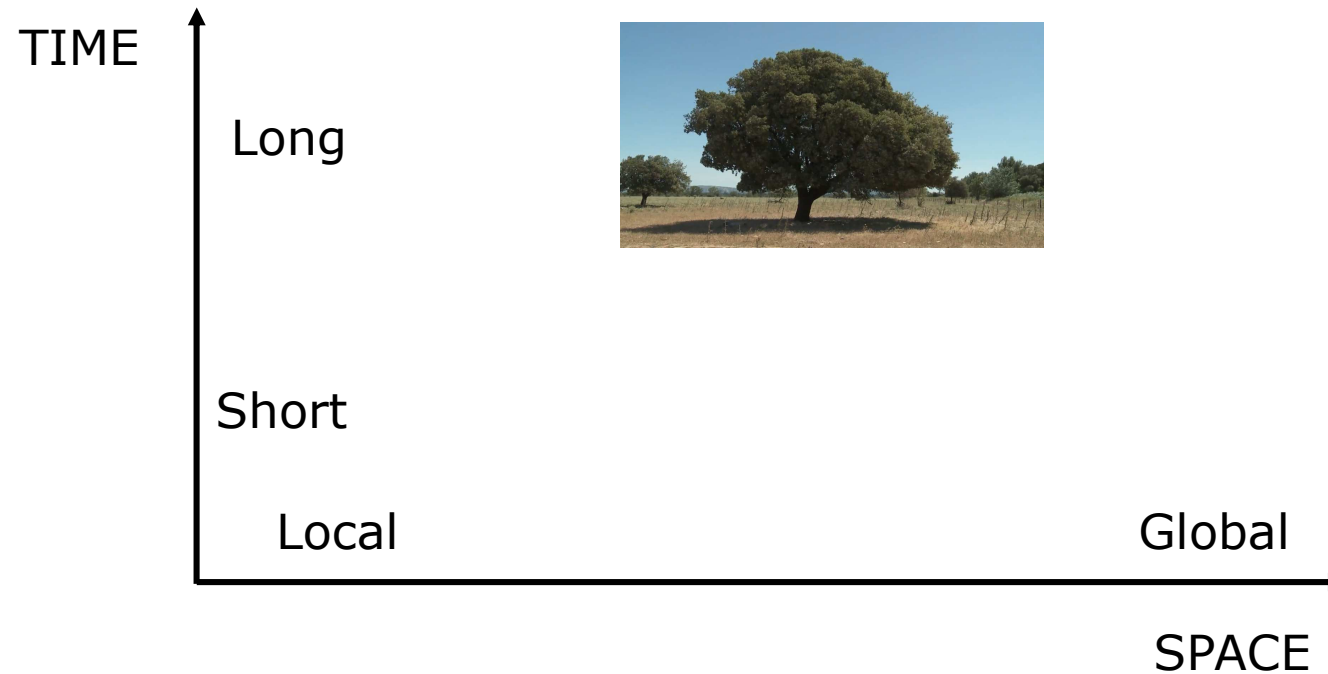
The immense variety of “physicists”



Criteria for quality



Choice of relevant scales (time/space) and variables



Kinematic quantities (displacements ? Deformations? ...)

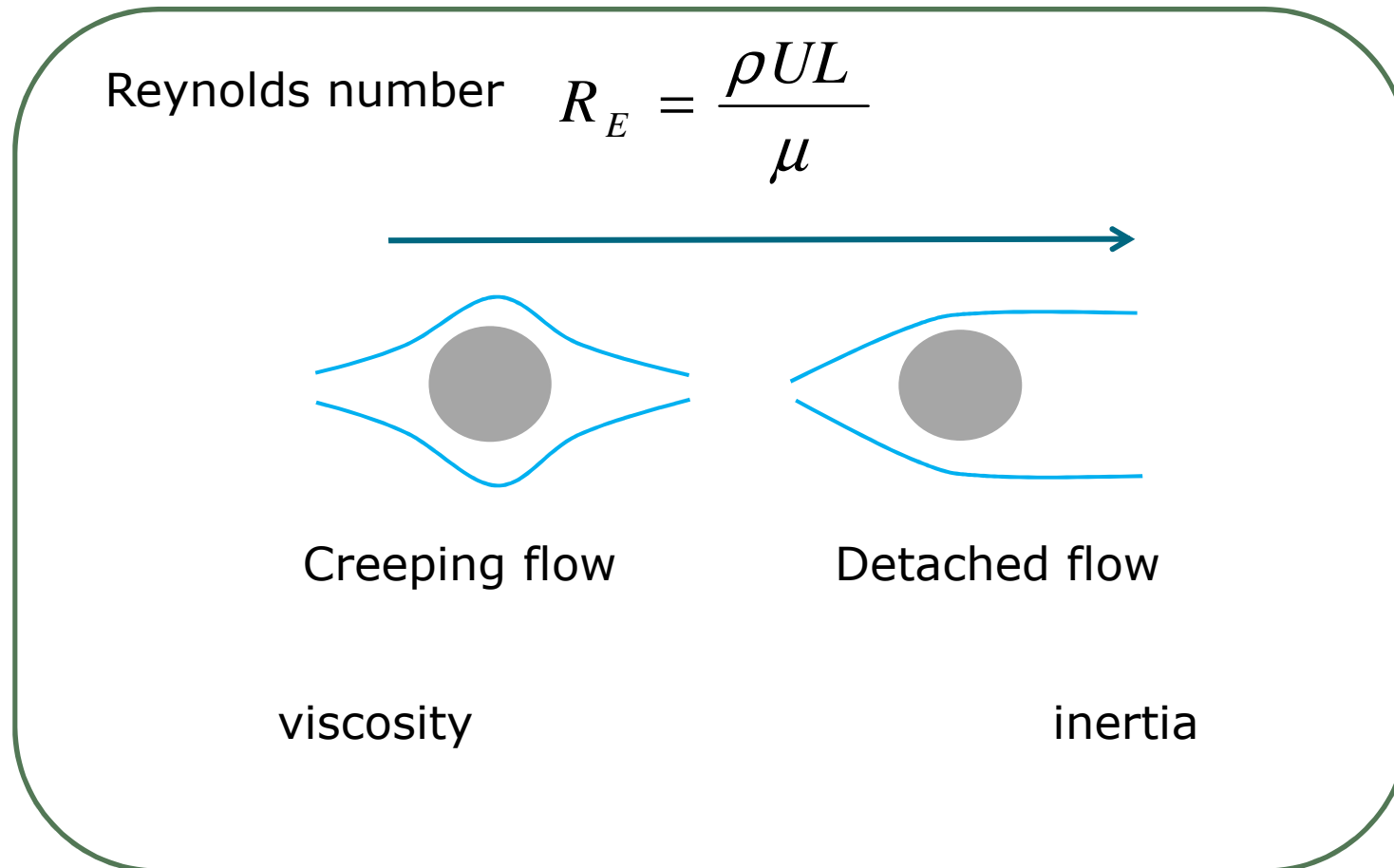
Dynamic quantities (Forces ? Stresses ?..)

Energies ?

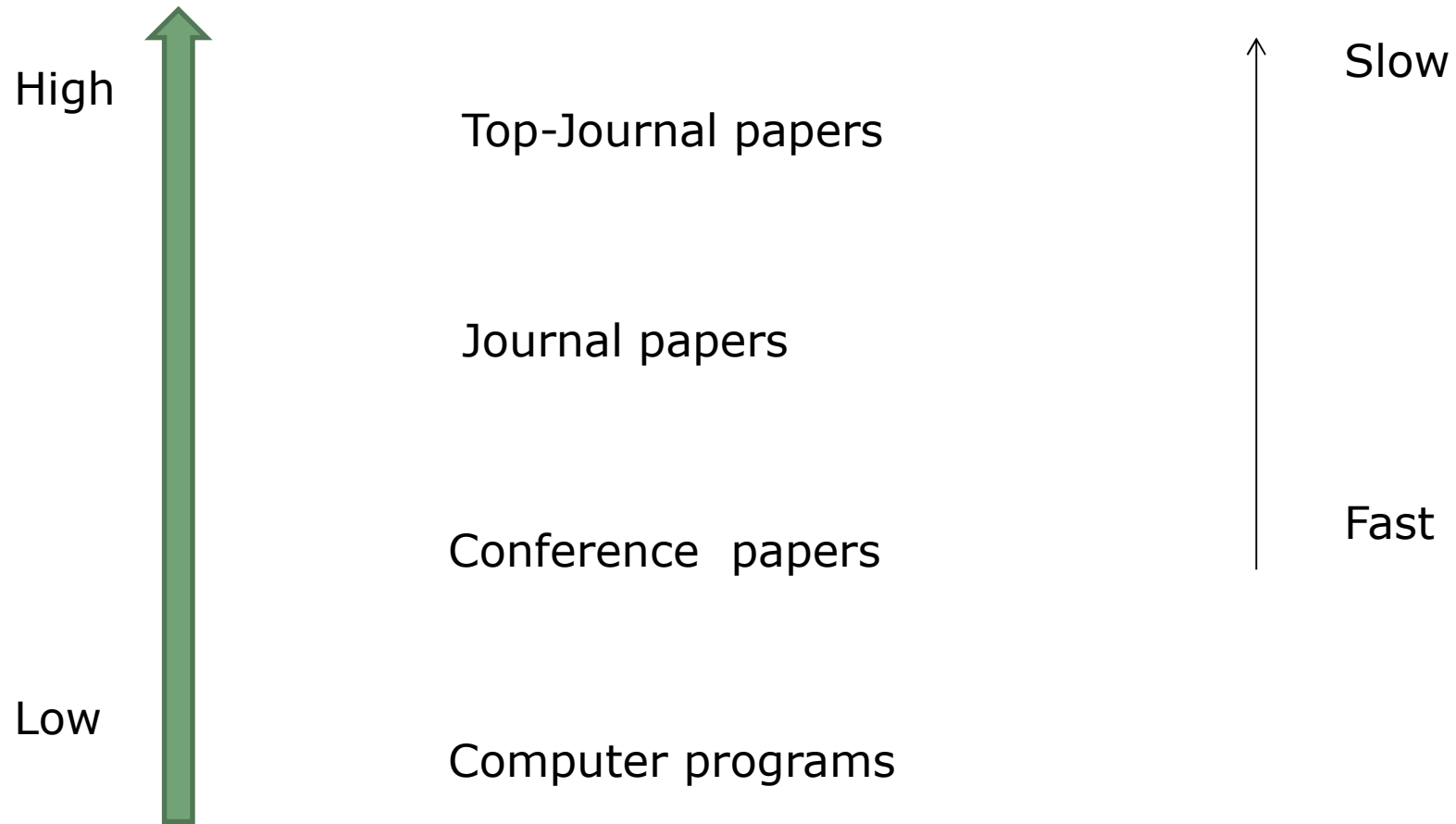
...

Focus on the dominant physical phenomenon involved

A very common tool : dimensional analysis



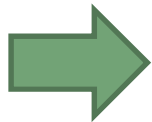
The world they live in





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Questions (Emmanuel)

Are physicists (secretely) jaleous of what graphists are doing ?

Are graphists (secretely) ashamed of what they are doing ?

Why don't graphists use our simple (and good) models ?

Do graphists bring anything to physics ? (a new point of view ?)

Why is it so difficult to build up joint research programs ? (do we want to ?)