

# 一篇SIG的背后

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研究兴趣：物理模拟

主页：[lwruan.com](http://lwruan.com)











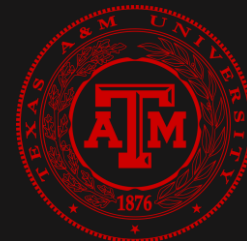
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Bo Zhu



Shinjiro Sueda



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7 August 2003

International weekly journal of science

# nature

• Nature 2002 impact factor: 30.432 •  
**30.4**  
No Nature  
no impact  
Source: Thomson ISI, Philadelphia, PA, USA, 2003

\$10.00

[www.nature.com/nature](http://www.nature.com/nature)

## Walking on water

The physics of  
water strider  
motion

**Accelerated vaccine**  
Targeting Ebola virus

**Early Solar System**  
Comets change their story



## Fluid-Shell-Body Coupling

### Full Coupled System

Combining fluid-shell coupling system at Eq.9 and shell-body coupling system at Eq.15, the full system is

$$\begin{bmatrix} G^T \underline{V} G & -VG^T W & -VG^T J \\ -W^T G V & -\tilde{M}_s & 0 \\ -J^T G V & 0 & -\tilde{M}_r \end{bmatrix} \begin{bmatrix} \hat{p} \\ \dot{X}_s^{n+1} \\ \dot{q}^{n+1} \end{bmatrix} = \begin{bmatrix} VG^T u^* \\ -M_s \dot{X}_s^* - W^T M_F u^* \\ -M_r \dot{q}^* - J^T M_F u^* \end{bmatrix} \quad (24)$$

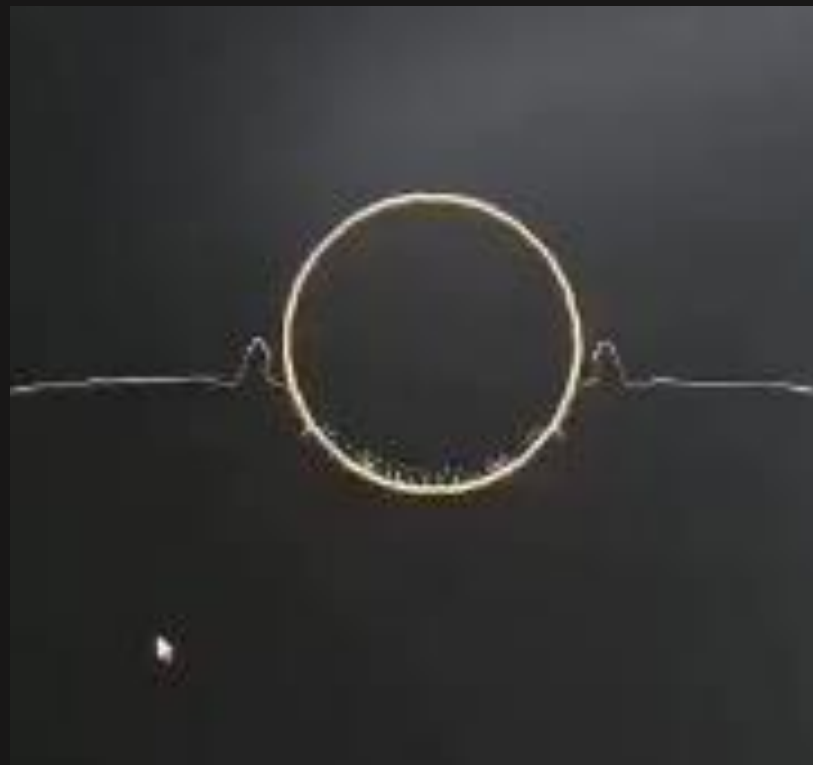
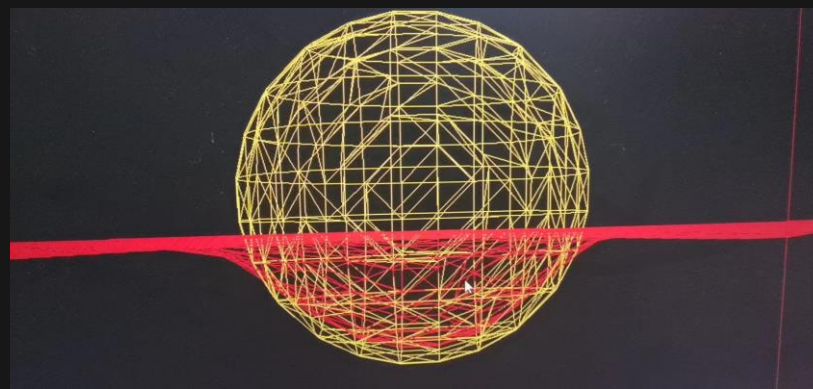
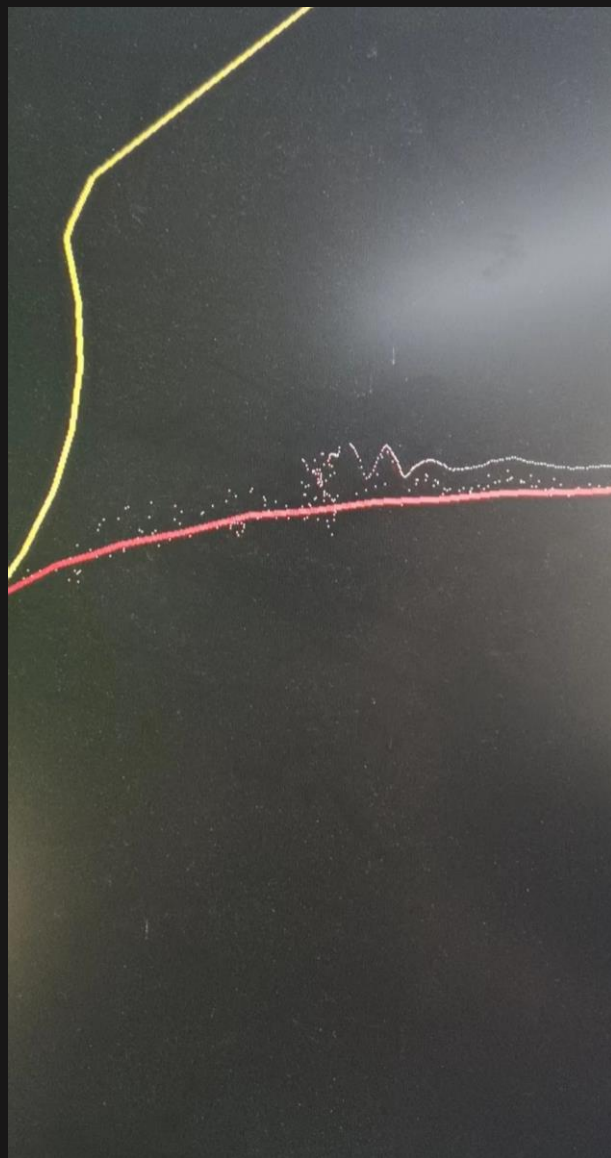
### Time Integration

We combine the time integration of fluid-shell coupling and shell-body coupling to get

- Use all non-pressure based and non-advection based fluid forces to advance the fluid velocity to time  $n + \frac{1}{2}$ .
- Advance  $\dot{X}_s^n$  and  $q^n$  to time  $n + \frac{1}{2}$  with explicit solid forces. Solve system Eq.24 for  $\dot{X}_s^{n+\frac{1}{2}}$  and  $q^{n+\frac{1}{2}}$ . Advance shell and body positions to time  $n + 1$  using these  $n + \frac{1}{2}$  velocities.
- Correct shell and body positions by resolving interpenetration similar to Eq.2 in [3].
- Rewind fluid, shell and body velocities back to time  $n$ .
- \*Find leak-proof fluid velocity at time  $n$  by forcing the fluid to move

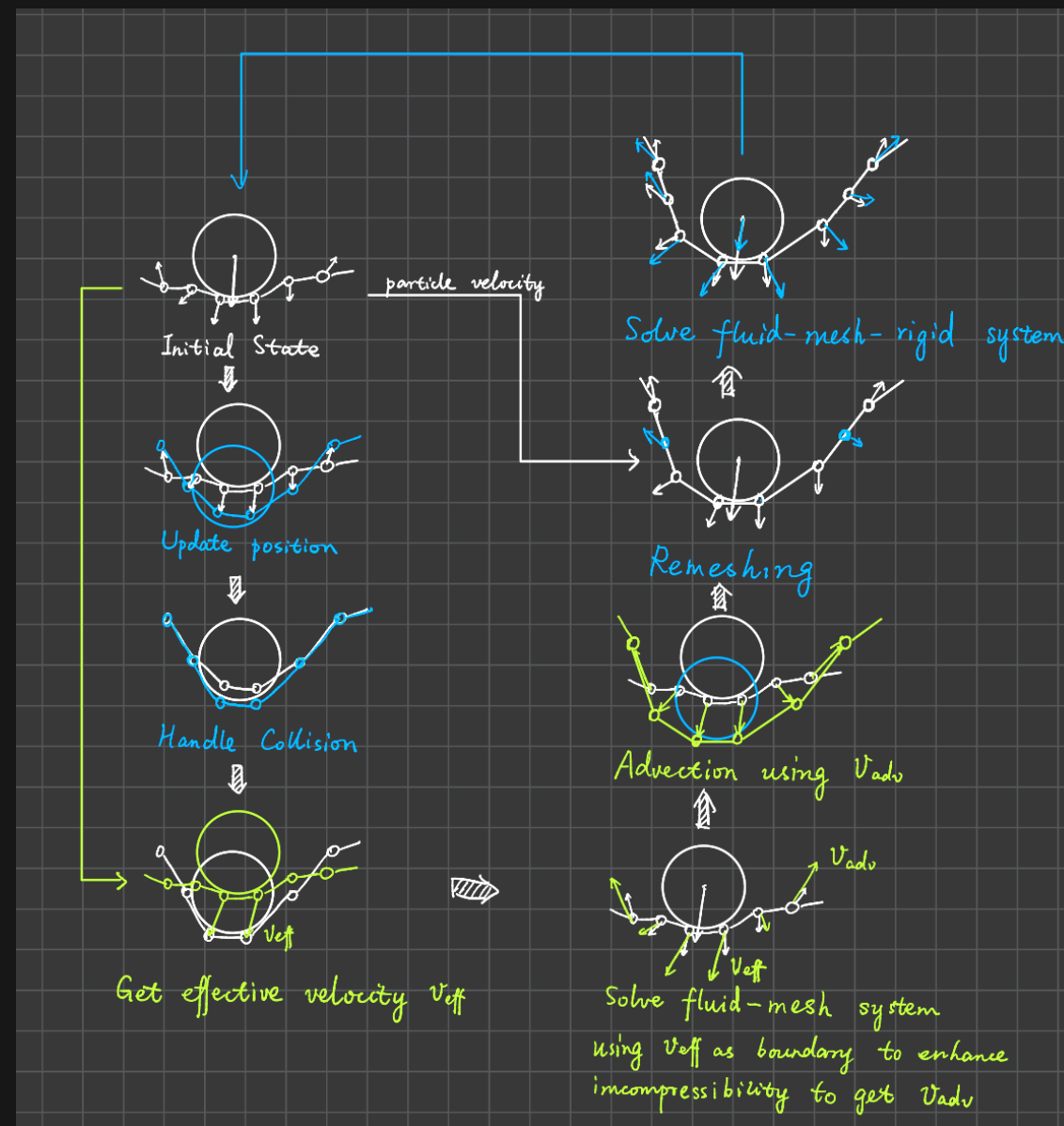
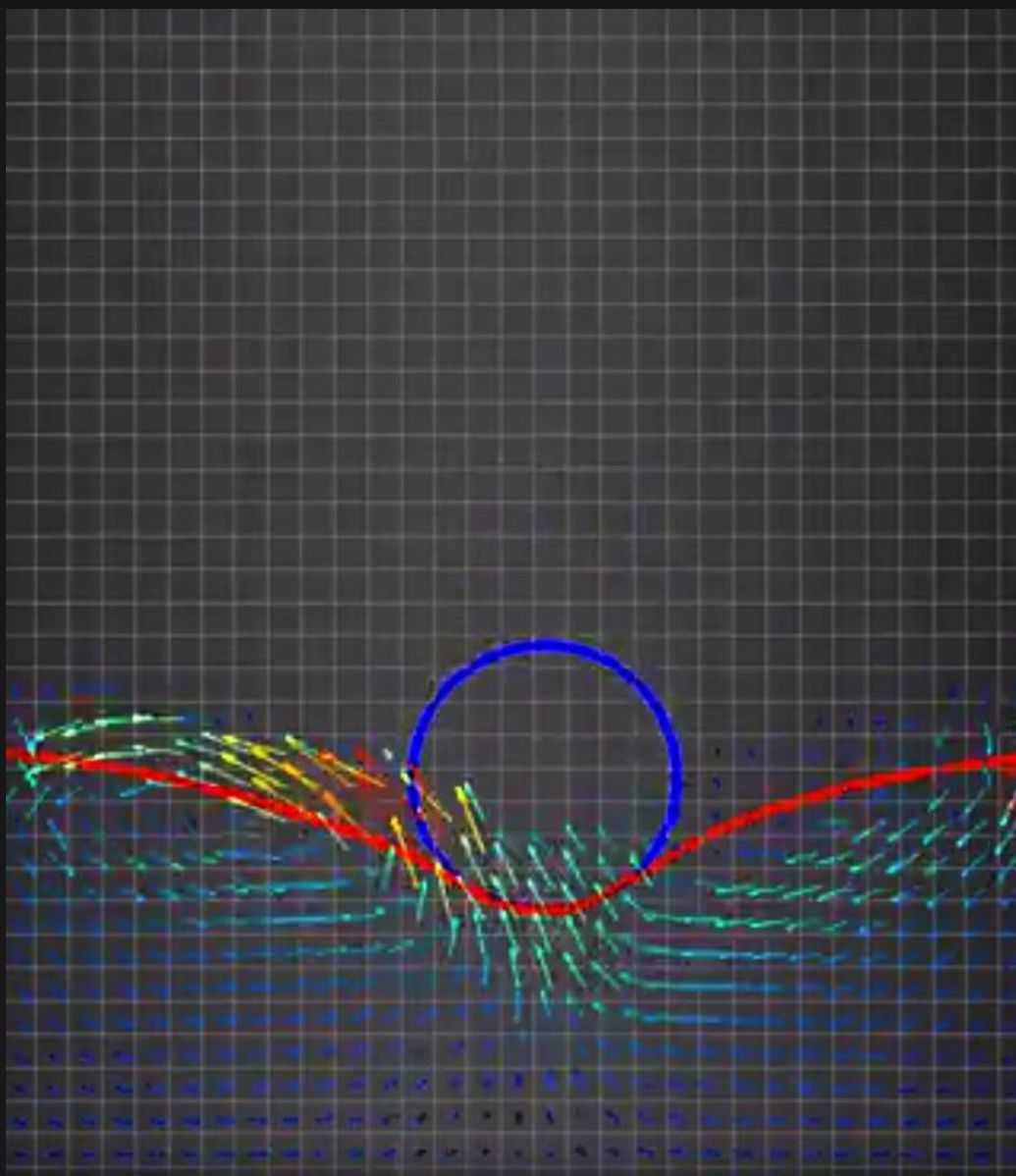
- Advance fluid velocity, shell velocity and body velocity to time  $n + \frac{1}{2}$  with gravity. Get  $\dot{X}_s^{*n+\frac{1}{2}}$ ,  $q^{*n+\frac{1}{2}}$  and  $u^{*n+\frac{1}{2}}$ .
- Solve the fluid-shell-body coupled system to satisfy boundary condition and incompressibility condition. Get  $\dot{X}_s^{n+\frac{1}{2}}$ ,  $q^{n+\frac{1}{2}}$  and  $u^{n+\frac{1}{2}}$  (unused).
- Advance shell and body positions to time  $n + 1$  using  $\dot{X}_s^{n+\frac{1}{2}}$  and  $q^{n+\frac{1}{2}}$ . Correct shell and body positions by resolving interpenetration. Get  $X_s^{n+1}$  (unused) and  $X_b^{n+1}$  (final body position).
- Rewind fluid, shell and body velocities back to time  $n$ . Get  $\dot{X}_s^n$ ,  $q^n$  and  $u^n$ .
- Find leak-proof fluid velocity and shell velocity for advection: solving the fluid-shell coupled system by mapping  $\frac{X_b^{n+1} - X_b^n}{dt}$  as boundary conditions to get  $u_{ADV}$  and  $\dot{X}_{sADV}$ .
- Rewind shell position back to time  $n$ . Get  $X_s^n$ .
- Advect fluid levelset values to time  $n + 1$  using  $u_{ADV}$ . Advance shell position to time  $n + 1$  using  $\dot{X}_{sADV}$ . Get  $\phi^{n+1}$  (final fluid position) and  $X_s^{n+1}$  (final shell position).
- Advect fluid velocity to time  $n + 1$  with  $u_{ADV}$ . Advance fluid velocity, shell velocity and body velocity to time  $n + 1$  with gravity. Get  $\dot{X}_s^{*n+1}$ ,  $q^{*n+1}$  and  $u^{*n+1}$ .
- Solve the fluid-shell-body coupled system to satisfy boundary condition and incompressibility condition. Get  $\dot{X}_s^{n+1}$  (final shell velocity),  $q^{n+1}$  (final body velocity) and  $u^{n+1}$  (final fluid velocity).

# 一些失败的结果



新冠疫情



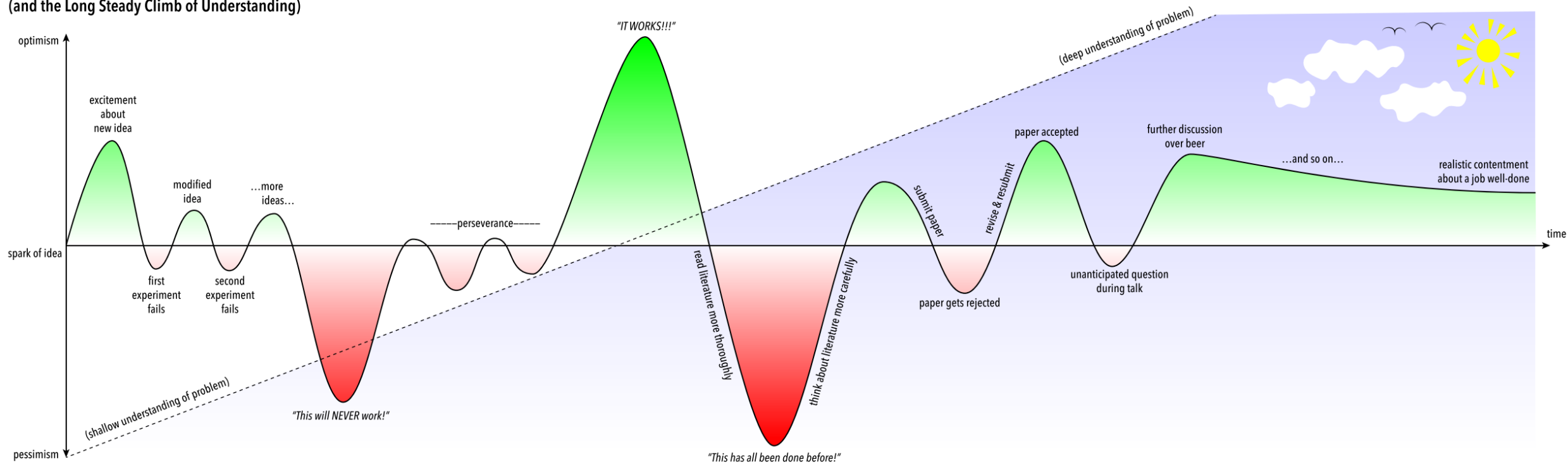






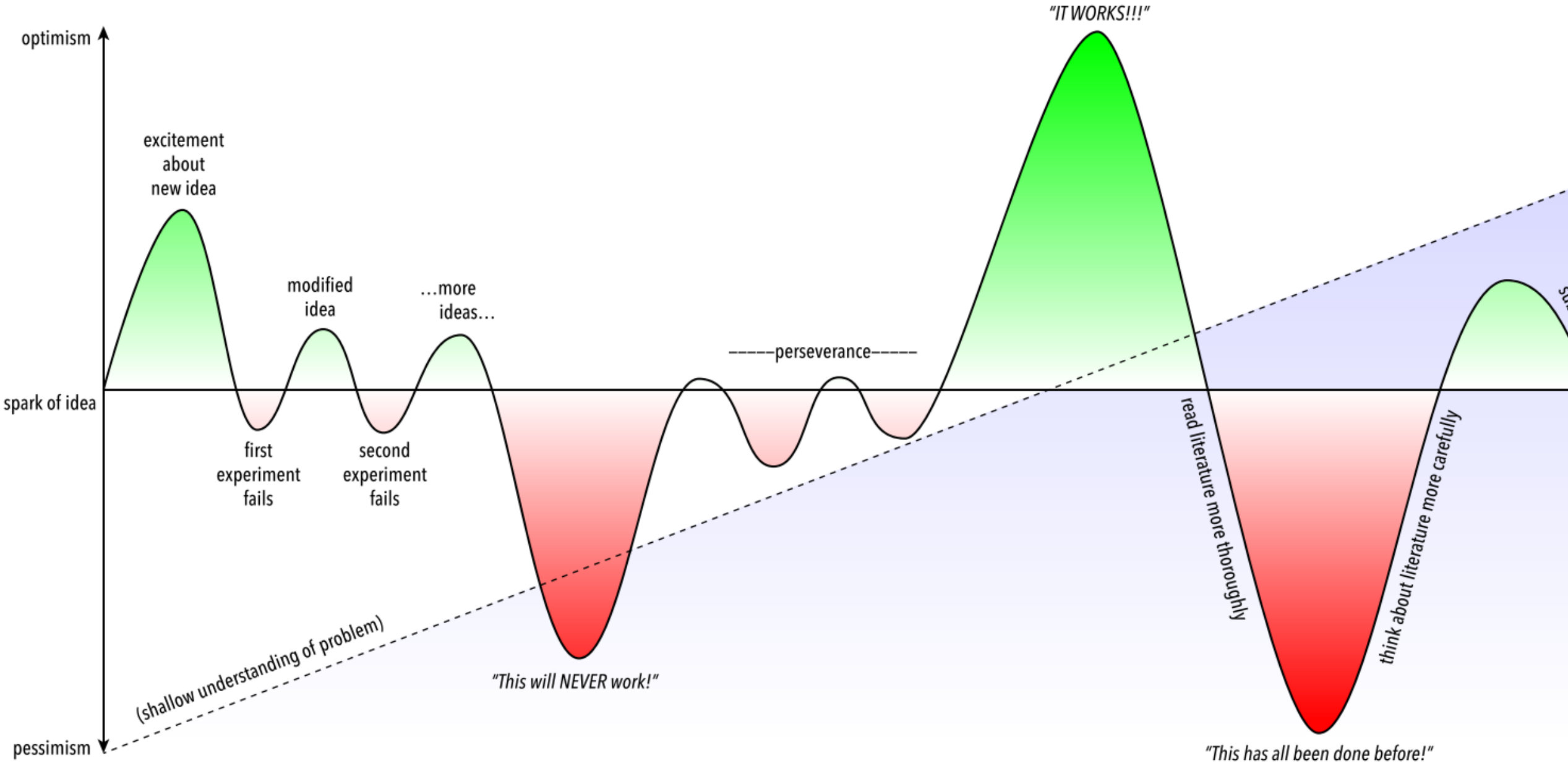
节奏

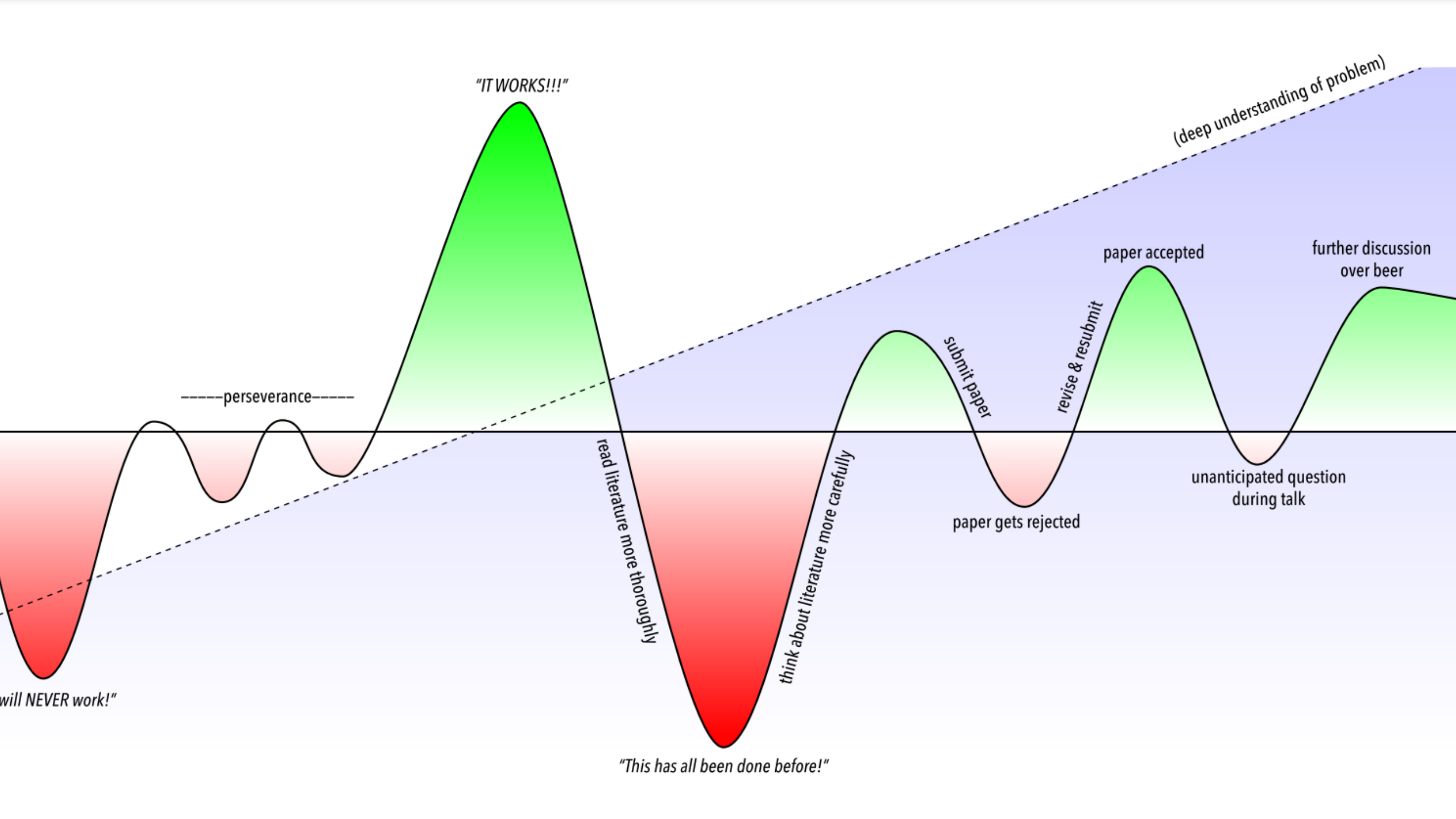
## The Emotional Rollercoaster of Research (and the Long Steady Climb of Understanding)



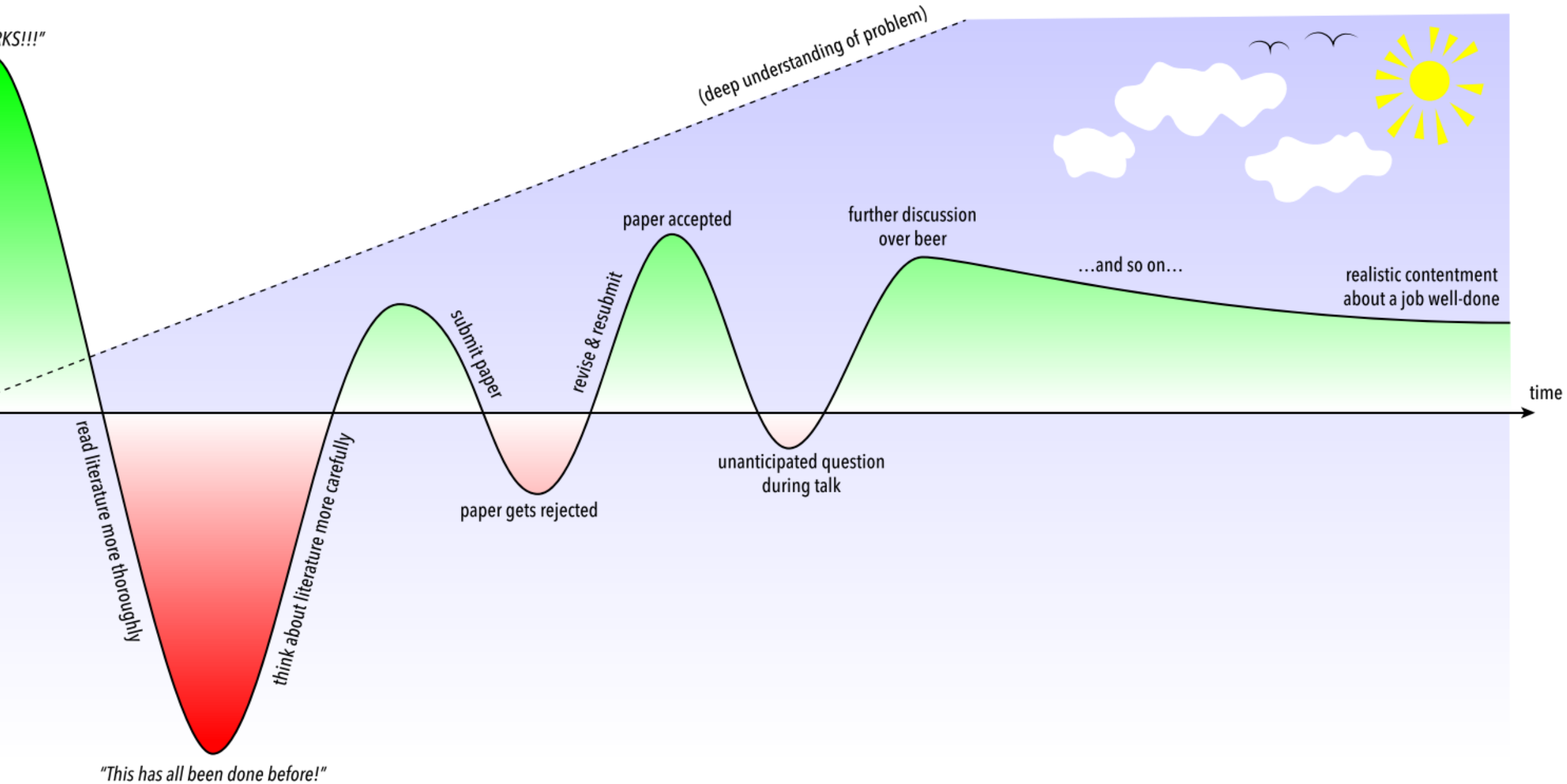


# The Emotional Rollercoaster of Research (and the Long Steady Climb of Understanding)

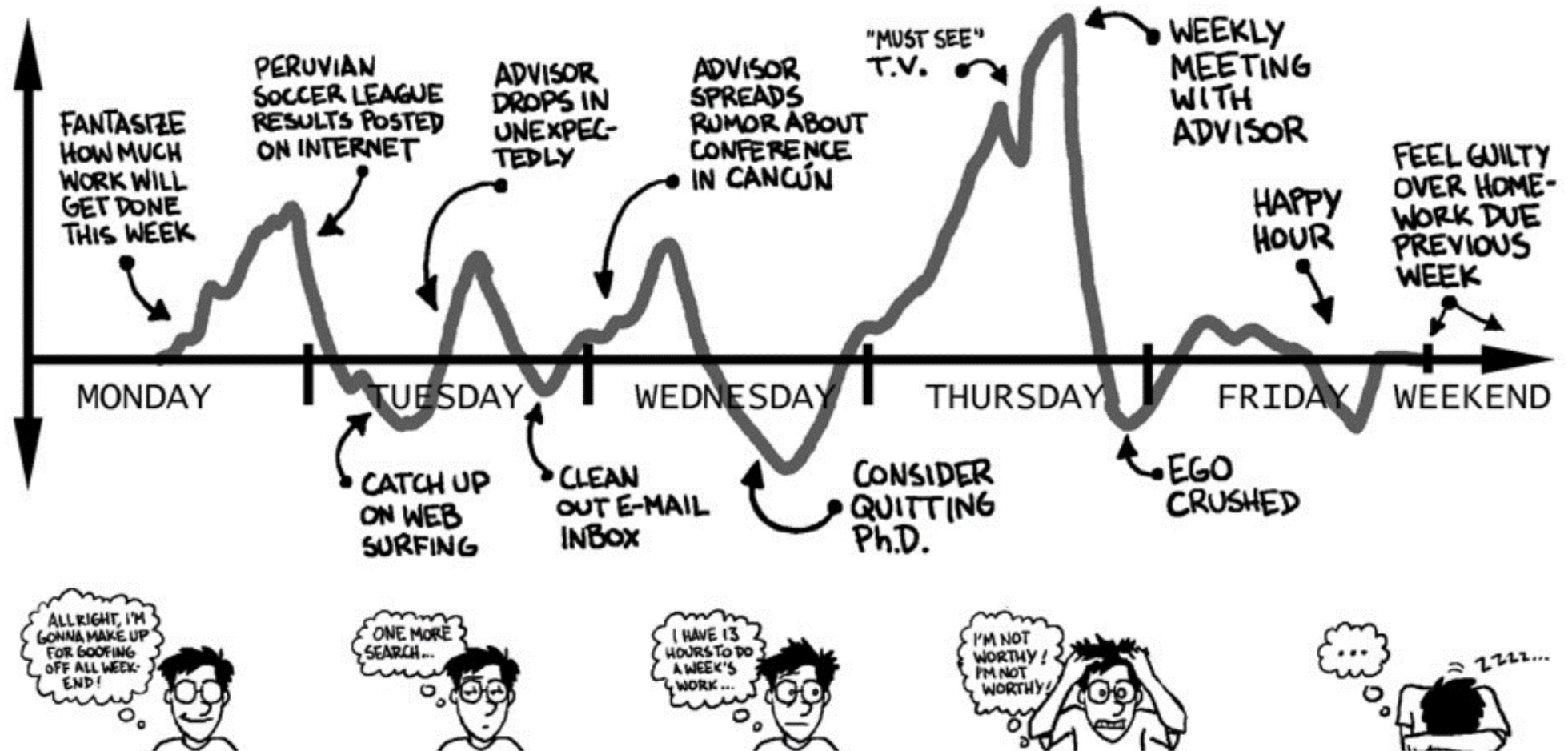




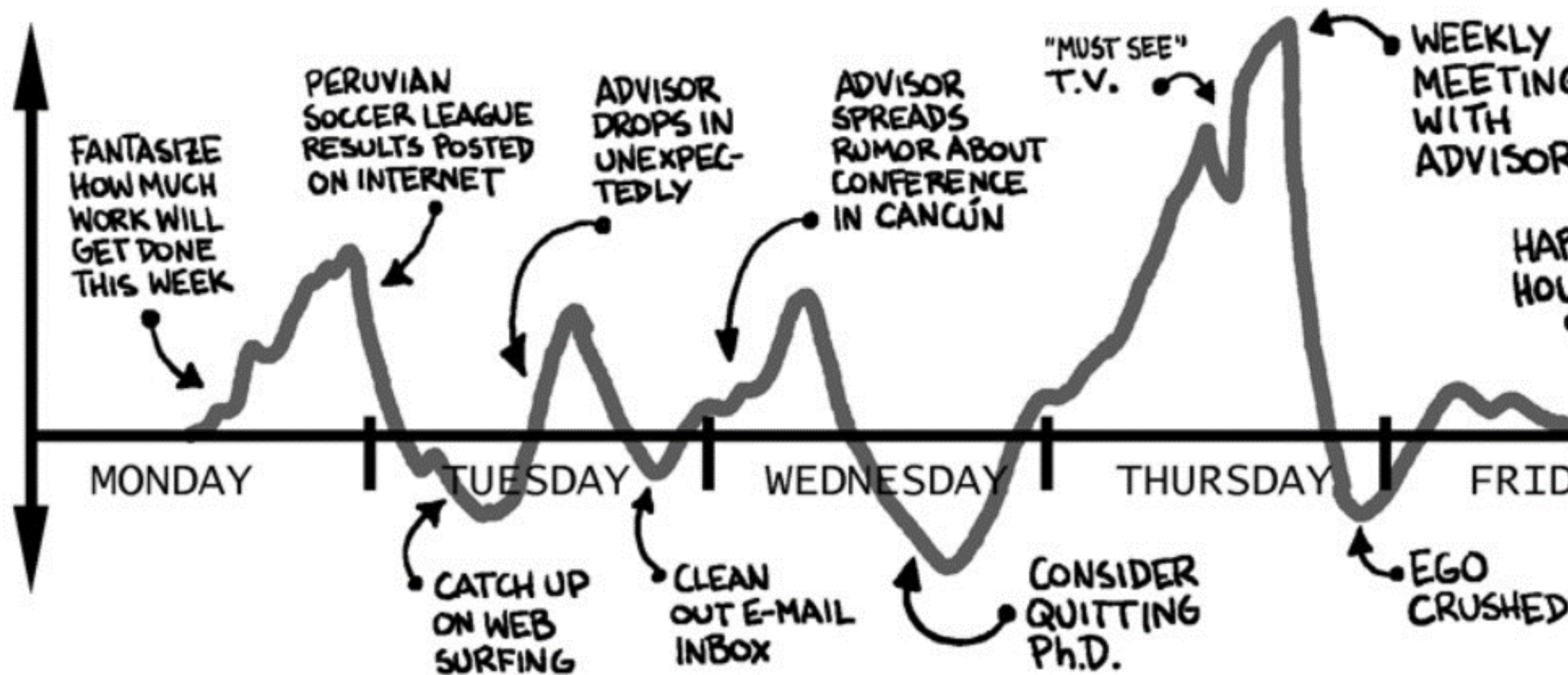




# Grad Student Work Output

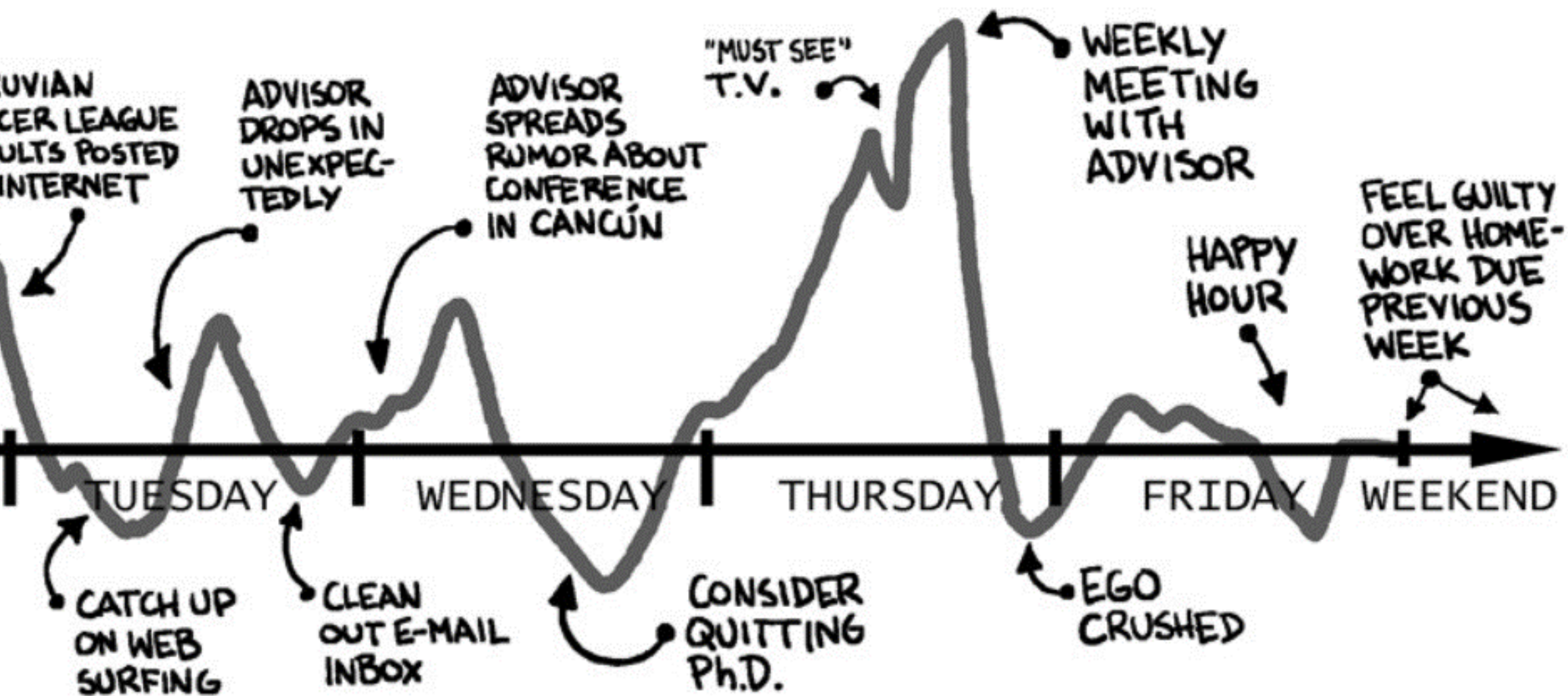


# Grad Student Work Output





# Grad Student Work Output



Creation is Hard

**Pursuing a Ph.D. has been one of the most fulfilling experiences of my life, and I feel extremely lucky to have been given the opportunity to be creative during this time.**

—— The PhD Grind



谢谢大家