Pwning Level Bosses in MATLAB:

Student Reactions to a Game-Inspired Computational Physics Course

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Good video games are highly optimized learning systems, carefully engineered to keep players engaged for long periods of time while they develop and refine skills, explore and become facile navigating novel and often bizarre environments, overcome increasingly difficult challenges at the threshold of their abilities, and piece together understanding of a complex and initially mysterious back-story.(1-6)

Can we develop classroom-based courses that use game-like principles to teach physics more effectively?

(In order to tap into students' intrinsic motivation, engage them more deeply, and develop better content mastery.)(7-8)

game-like features (9-11)

- Organize content into **levels with minions and bosses**
- Use a mastery approach with **infinite re-tries** for full credit
- Frame activity as a game with **video-game terminology**
- Link grades to "leveling up" in a **game-style point system**
- Provide automated test code for **immediate, on-demand feedback**
- **no deadlines** except for the end of the semester

1 credit course: computational physics 1

- basics of **procedural programming**
- using **MATLAB**
- **numerical calculation**
- **pseudorandom numbers**
- **debugging**
- **random walk** Monte-Carlo models
- statistical & graphical **data analysis**

1 credit course: computational physics 2

- organizing **complex programs**
- **MATLAB** power tools
- **integrating ODEs** for equations of motion
- avoiding **numerical instability**
- **self-testing programs** with special cases
- **physics:** air drag, oscillation, electrostatics...
- **mesh relaxation methods** for Laplace & Poisson Eq.

fall 2013 teaching experiment

- semi-structured **interviews** at end of course (11 of 15 students)
- **course evaluations** (13 of 15 students)

spring 2014 teaching experiment

- **course evaluations** (10 of 13 students)
- semi-structured **interviews** at end of course (7 of 13 students) → (still being analyzed)

data & analysis

- **theory-driven coding** of transcripts for game-like features
- **emergent coding** of transcripts for student reactions
- constant comparison (12)
- inter-rater reliability: $0.33 \leq \kappa \leq 1$, $\langle\kappa\rangle = 0.67$
- identification of **code co-occurrences**

findings

- 7/11 — A majority claim the **self-paced** nature either strengthened or revealed deficiencies in their **self-discipline.**
- 6/11 — A majority claim that **infinite retries increased content learning.**
- 5/11 — Many claim the **leveling-up point system increased motivation.**
- 5/11 — Many claim the complex authentic **level bosses** helped prepare them for **real-world work.**
- 8/11, 11/13, 10/10 — Most students claim the design **increases their motivation.**
- 9/11, 11/13, 9/10 — Most students **liked the course design.** Some liked it fanatically. None disliked it.

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* All enemies were vanquished! *
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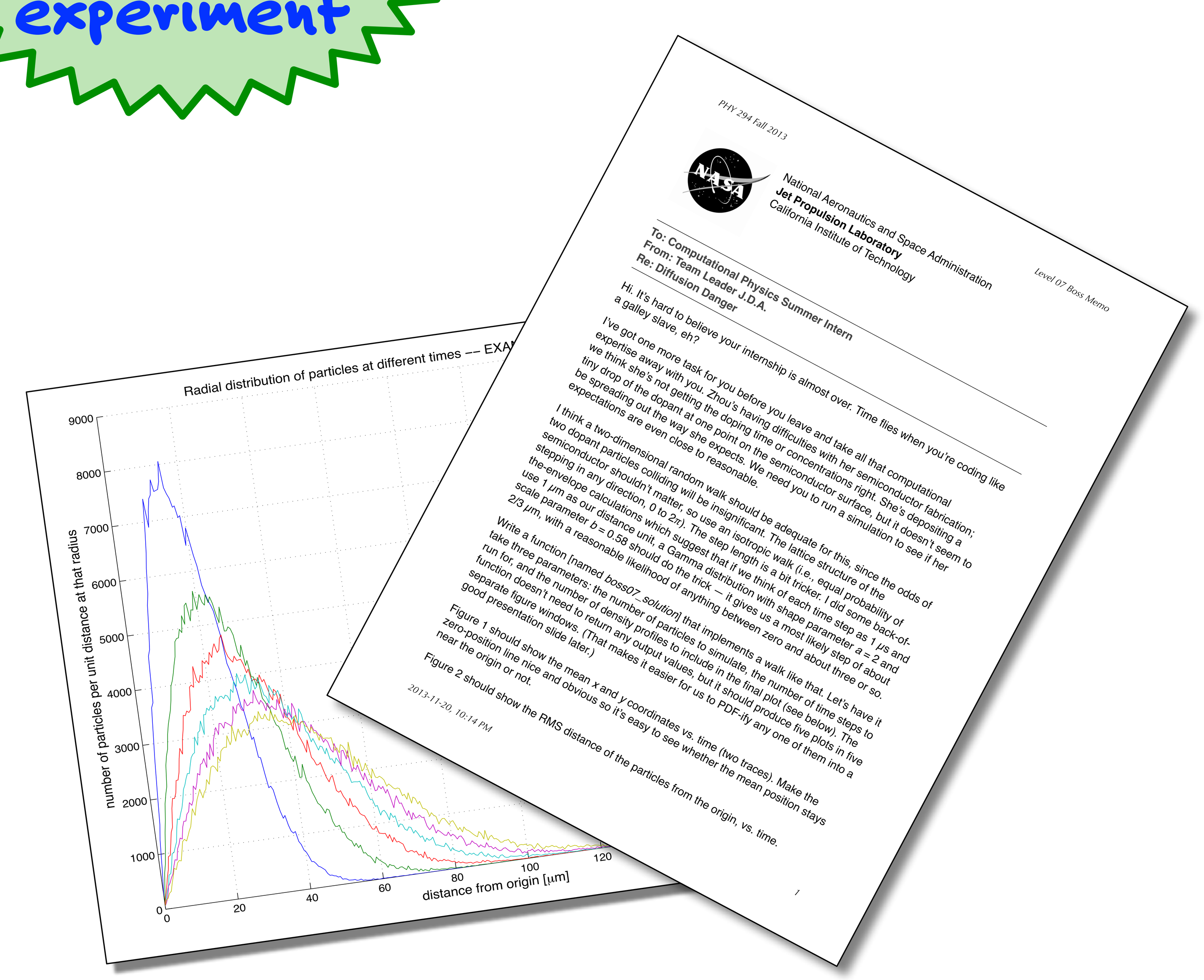

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