Timelines

- 12/31/17—NDSEG `http://www.ndsegfellowships.org/application`
  - *Please submit a proposal relevant to the DoD Agency (AIRFORCE, ARMY, ONR)/field that interest you.* (Pitch as "science of extreme materials, results that can be useful in understanding turbulence"?)
  - 3 page proposal.
- 01/10/17—NNSA SSGF `https://www.krellinst.org/ssgf/about-doe-nnsa-ssgf/fields-study`
  - Promote stewardship science (National Nuclear Security Administration).
  - Fields of study: **High Energy Density Physics, Materials under Extreme Conditions and Hydrodynamics**.
  - Ask to propose *program of study*, I picked:
    - Advanced Plasmas
    - Physics of BHs, WDs, stars
    - Theory stellar structure/evolution
    - Applications of Parallel Computers
    - Computational fluid dynamics
    - Turbulence/turbulent flows (not sure this one)
  - Essays:
    - 500w area of research
    - 300w intellectual excitement
    - 300w "how your research will directly compile to stockpile stewardship in your area" Advice from theoretical astrophysicist: "*I pretty much argued that SNe are labs for many different types of extreme physics and can help inform ground-based experiments. Also many of the same principles in my simulations could be applied to other things. Depending on what you study it shouldn't be too hard to justify (especially if you're into plasmas, high energy particles, fluid dynamics, etc.)*"
- 01/17/17—DOE CSGF `https://www.krellinst.org/csgf/about-doe-csgf/fields-study`
  - Math + Computers to study fields e.g. astrophysics, etc., promote interdisciplinary, require broad program of study.
  - Possible proposal: **Propose to develop new software? Or just say that we'll be ready to, just in case.**
  - Program of Study:
    - (Science/Eng) Physics BH, WD, NS
    - (Science/Eng) Computational Fluid Dynamics
    - (Math/Stats) Applied Dynamical Systems
    - (Math/Stats) Functional Analysis
    - (Computer Science) Applications of Parallel Computers
    - (Computer Science) Advanced Programming Languages
  - Essays:

        * 2250c Field of Interest, role of CS
        * 2250c use of CS + math in proposed research
        * 2250c justify program of study.

- 02/01/17—NSPIRES NESSF `https://nspires.nasaprs.com/external/solicitations/summary.do?method=init&solId={1A7F0A8C-1126-EA39-6584-10DBD500C8AC}&path=open`
    - **Adviser starts**, check instructions at here
    - Proposal limit 6 pages

Nonlinear Tidal Dissipation in White Dwarfs

Yubo Su

1 Introduction

1.1 Background

- *Steal a bunch from Fuller et al*
- WD-WD systems are important, produce sdO stars, giant stars, Ia supernovae (Fuller Paper II citations)
- WD-BH systems, tidal disruption produces observable flares (https://arxiv.org/pdf/1701.08162.pdf)
- WD binaries are in LISA sensitivity band, GW astronomy is powerful tool evidenced by the recent LIGO success (FullerII)
- Tidal dissipation can contribute significantly to the brightnesses of these binaries (FullerII)

1.2 Previous Work

- Fuller + Lai determined in WD binaries, interval gravity waves are excited that propagate towards the surface and nonlinear dissipate in some WDs.
- Predicted dissipation luminosity dominates black body dissipation, significant contribution to energy dynamics. (FullerII)
- State of the art is WKB (FullerIV)
- Sensitive probe of WD conditions/models, e.g. discern whether certain white dwarfs are undergoing strong tidal heating (FullerIV).
- Require numerical simulations to determine dissipation profile.

2 Proposed Research

Propose to study nonlinear wave breaking in white dwarf binaries via numerical simulation.

- Research Plan
  - For various WD models + compositions, run simulations to determine $E, \vec{L}$ dissipation distribution.
  - Start with spectral code (Dedalus), existing literature shows that handles instability-driven turbulence with high accuracy and speed.

  - Have the computational expertise to modify existing codes/build new code if existing ones are insufficient.
  - Determine whether observed events e.g. Brown et al 2011 match our predictions for any models, other observational signatures.
  - Study model output for simpler models to develop analytical tools.

- Further applications
  - Forming hot Jupiters (Michelle paper)
  - **LIGO detecting kilonovae means many energetic phenomena to study, any chance to apply similar approach?**