ASTR-5120: RDP ⇒ RDQ .... Initial Guidelines for Group Project (Sep. 10, 2021)

First, let's repeat the original text from the syllabus:

The APS Department aims for these courses to be relevant to your research, and we always want to keep optimizing in that direction. Thus, we're trying something new. Over the semester, the class will work to assemble a document that lists and describes a number of major unanswered *Radiative & Dynamical Questions* (RDQ). The goal is to assemble a sourcebook containing dozens (hundreds?) of potential ideas, projects, and future research directions that can be used for inspiration over the remainder of your time as students—and beyond? More details will be provided, but for now I can give some initial thoughts:

- The goal is to keep the topics relevant to the scope of this course. However, because RDP covers many different fields, we will have to make some judgement calls about what to include and/or exclude.
- For the end-product, let's aim high and envision something comparable to the National Academies Decadal Survey reports or the Science Plans put out by NASA's Science Mission Directorate. (Okay, maybe not as *long* as those doorstop-sized documents.) It's possible that a better format may end up being a Wiki or some other online, hyperlinked thing that's easier to navigate and keep up-to-date.
- There are some well-known lists like this already, but our goal will be to delve deeper. We'll aim to include relevant equations, details about how present-day observations, theory, and simulations prevent us from solving these problems, and (most importantly) suggestions about paths forward.
- I'm also envisioning that, every other week, we will devote half a class to RDQ discussions. There will be a sign-up sheet for students to rotate through various tasks (i.e., researching the week's topics, leading each discussion, taking notes, and writing up the results). The final product will be due on Monday, December 6, 2021.

In the current version of the course schedule, we've got **six** half-class sessions to devote to RDQ discussions. There will be a sign-up sheet that looks like the following:

Date	**Researchers and Discussion Leaders**	**Note Takers**	**Report Writers**
Sep. 13 (organization)	N/A	N/A	N/A
Sep. 27 (Session A)	_____ & _____	_____ & _____	_____ & _____
Oct. 11 (Session B)	_____ & _____	_____ & _____	_____ & _____
Oct. 25 (Session C)	_____ & _____	_____ & _____	_____ & _____
Nov. 8 (Session D)	_____ & _____	_____ & _____	_____ & _____
Nov. 29 (Session E)	_____ & _____	_____ & _____	_____ & _____

I've assumed that each step will be accomplished collaboratively by teams of 2 students, but that can be up for debate as well. However, if we do it that way, that makes 30 tasks to assign. Our current enrollment is 14 students, so 12 of you would have to sign up for 2 tasks, and 2 of you would sign up for 3 tasks. I encourage everyone to sign up in at least two *different* columns, to get

experience doing different things. For the 2 students who sign up for 3 tasks, I think it's best for you to sign up for two note-taking sessions and one of something else (because, of the three roles, note-taking is probably the least time-consuming).

Questions to Answer Soon

Should there also be 2 or 3 extra tasks added at the end (between the November 29 session and the due date) for proofreading and/or cleanup of the final document?

How will the notes be shared? (Google Docs? Overleaf?)

How will writing up the report be handled? (Google Docs? Overleaf? Wiki?)

Is there a desire to formalize and sign a group contract of some kind?

What's the **grading rubric?** I'll need to wait to see how some of these other questions are answered before finalizing it.

Lastly, how should the top-level organization be handled, both for the final document and for the content to discuss in Sessions A, B, C, D, E? I'll gladly provide guidance, but this ought to be your decision. One idea could be to parallel the flow of topics in the class; e.g.,

A. Plasmas: transport and kinetic theory.
B. Plasmas: MHD.
C. Grav. dynamics: few-body systems.
D. Grav. dynamics: $\{N \gg 1\}$-body systems.
E. Radiative transfer.

Another idea could be to organize it by the fields of the APS Department. For example, going from near to far, it might be:

A. Planetary science.
B. The Sun and heliosphere.
C. Stars and the local interstellar medium.
D. Galaxies, AGNs, intergalactic medium, dark matter.
E. Cosmology, black holes, dark energy.

You could also take inspiration from the sections of your favorite Astronomy 101 textbook, or from the arXiv subject categories. A problem with the latter is that there are way more than 5 categories. For reference, on the next page I display all of the arXiv **astro–ph** categories and a subset of relevant **physics** categories.

- **astro-ph.GA - Astrophysics of Galaxies** (new, recent, current month)
  Phenomena pertaining to galaxies or the Milky Way. Star clusters, HII regions and planetary nebulae, the interstellar medium, atomic and molecular clouds, dust. Stellar populations. Galactic structure, formation, dynamics. Galactic nuclei, bulges, disks, halo. Active Galactic Nuclei, supermassive black holes, quasars. Gravitational lens systems. The Milky Way and its contents
- **astro-ph.CO - Cosmology and Nongalactic Astrophysics** (new, recent, current month)
  Phenomenology of early universe, cosmic microwave background, cosmological parameters, primordial element abundances, extragalactic distance scale, large-scale structure of the universe. Groups, superclusters, voids, intergalactic medium. Particle astrophysics: dark energy, dark matter, baryogenesis, leptogenesis, inflationary models, reheating, monopoles, WIMPs, cosmic strings, primordial black holes, cosmological gravitational radiation
- **astro-ph.EP - Earth and Planetary Astrophysics** (new, recent, current month)
  Interplanetary medium, planetary physics, planetary astrobiology, extrasolar planets, comets, asteroids, meteorites. Structure and formation of the solar system
- **astro-ph.HE - High Energy Astrophysical Phenomena** (new, recent, current month)
  Cosmic ray production, acceleration, propagation, detection. Gamma ray astronomy and bursts, X-rays, charged particles, supernovae and other explosive phenomena, stellar remnants and accretion systems, jets, microquasars, neutron stars, pulsars, black holes
- **astro-ph.IM - Instrumentation and Methods for Astrophysics** (new, recent, current month)
  Detector and telescope design, experiment proposals. Laboratory Astrophysics. Methods for data analysis, statistical methods. Software, database design
- **astro-ph.SR - Solar and Stellar Astrophysics** (new, recent, current month)
  White dwarfs, brown dwarfs, cataclysmic variables. Star formation and protostellar systems, stellar astrobiology, binary and multiple systems of stars, stellar evolution and structure, coronas. Central stars of planetary nebulae. Helioseismology, solar neutrinos, production and detection of gravitational radiation from stellar systems

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- **physics.ao-ph - Atmospheric and Oceanic Physics** (new, recent, current month)
  Atmospheric and oceanic physics and physical chemistry, biogeophysics, and climate science
- **physics.atom-ph - Atomic Physics** (new, recent, current month)
  Atomic and molecular structure, spectra, collisions, and data. Atoms and molecules in external fields. Molecular dynamics and coherent and optical control. Cold atoms and molecules. Cold collisions. Optical lattices.
- **physics.geo-ph - Geophysics** (new, recent, current month)
  Atmospheric physics. Biogeosciences. Computational geophysics. Geographic location. Geoinformatics. Geophysical techniques. Hydrospheric geophysics. Magnetospheric physics. Mathematical geophysics. Planetology. Solar system. Solid earth geophysics. Space plasma physics. Mineral physics. High pressure physics.
- **physics.optics - Optics** (new, recent, current month)
  Adaptive optics. Astronomical optics. Atmospheric optics. Biomedical optics. Cardinal points. Collimation. Doppler effect. Fiber optics. Fourier optics. Geometrical optics (Gradient index optics. Holography. Infrared optics. Integrated optics. Laser applications. Laser optical systems. Lasers. Light amplification. Light diffraction. Luminescence. Microoptics. Nano optics. Ocean optics. Optical computing. Optical devices. Optical imaging. Optical materials. Optical metrology. Optical microscopy. Optical properties. Optical signal processing. Optical testing techniques. Optical wave propagation. Paraxial optics. Photoabsorption. Photoexcitations. Physical optics. Physiological optics. Quantum optics. Segmented optics. Spectra. Statistical optics. Surface optics. Ultrafast optics. Wave optics. X-ray optics.
- **physics.space-ph - Space Physics** (new, recent, current month)
  Space plasma physics. Heliophysics. Space weather. Planetary magnetospheres, ionospheres and magnetotail. Auroras. Interplanetary space. Cosmic rays. Synchrotron radiation. Radio astronomy.