Examples of Term Projects

These are just meant as suggestions to get you started thinking about a term project. Projects will all start with reading some relevant papers, but might include – or lead to – some original research. A number of term projects in previous years have led to published papers. Please do some further thinking about your project, and plan to meet with me soon to discuss it further. I'll try to help you choose a topic and find suitable articles to get you started.

Examples of topics to summarize from the literature:
    Small scale problems with cold dark matter
    Angular momentum problems in galaxy formation
    Feedback effects in galaxy formation
    Outflows from galaxies
    Black holes in galactic centers – origins, correlations, and effects
    Dwarf galaxies, and the galaxy luminosity function
    Tidal streams

Is there any way to test Eternal Inflation theory, multiverses, or string/brane cosmology?

Black Hole formation in the early universe and observational implications

CMB Polarization Measurements and Implications

Redshift Surveys and Implications
    Broad Redshift Surveys: 2dF and SDSS
    Deep Redshift Surveys, especially DEEP

Alternatives to the Standard ΛCDM Ω_m=0.3 Cosmology
    Warm Dark Matter, Interacting Dark Matter, Decay-product Dark Matter
    Modified Newtonian Dynamics (MOND) and other alternatives to GR

Structure of ΛCDM Dark Matter Halos (might involve analyzing simulations)
    Small scale CDM fluctuations
    Centers of dark halos
    Phase-space properties of substructure
    Halo shapes – triaxiality, velocity anisotropy, radial dependence, implications
    Angular momentum distribution
    Effect of clump dynamical friction on dark matter distribution near cluster centers
    Power sources for cluster heating – e.g., supernovae, AGN, DM annihilation?
    Formation of the Local Group in the standard ΛCDM cosmology

Constraints on Cosmology from Gravitational Lensing
        Weak Lensing
        Strong Lensing

Detection of WIMP Dark Matter
        Cryogenic Detectors (e.g. CDMS, EDELWEISS, CRESST, ZEPLIN)
        Directional Detectors, Dependence on Halo Shape and $\mathbf{v}$-Distribution
        Are Dark Matter Caustics Important? (Sikivie vs. Moore)
        Indirect Detection, e.g. of dark matter annihilation in galaxy centers
            using Atmospheric Cherenkov Telescopes, GLAST, AMANDA/IceCube
        Using DarkSUSY www.physto.se/~edsjo/darksusy or MicrOMEGAS
            lappweb.in2p3.fr/lapth/micromegas/ WIMP density software

Hydrodynamic simulations of galaxy formation and evolution
        Formation of galaxies
        The first stars
        The first quasars
        Galaxy merger simulations
        Evolution of galaxy populations
        Correlations of galaxies and of galaxy properties

Applying new galaxy morphology statistics
        Nonparametric galaxy morphology statistics – e.g., G/M20, shapelets
        Applied to galaxy merger simulations
        Applied to various observational data sets
        Correlations with other galaxy properties

Semi-Analytic Modeling of galaxy formation – e.g.
        Formation and evolution of low-mass galaxies, origin of scaling relations
        Understanding the growing data on damped Lyman alpha systems
        Formation and evolution of massive galaxies
        Extremely Red Objects
        Understanding the origin of galaxy color bimodality

Extragalactic Background Light and implications; models including ISO and Spitzer data
        EBL lower limits by integrating the luminosity function
        To what extent is the 850 micron EBL accounted for by known sources?
        How much room is there for grey dust (revisit Aguirre & Haiman 2000)