Cosmoclub - UCSC weekly cosmology seminar - Winter 2010 - Mondays 12:30-1:30 - ISB 102

Jan 4 Michael Williams, Oxford/ESO (host Romanowsky) - Tully Fisher Relation for Spiral and S0 Galaxies
Jan 11 Organizational meeting
Jan 18 (M L King Day) Arti Garg, APS Congressional Fellow/LLNL (host Eliza Miller-Ricci) - MWy MACHOs
Jan 25 Sandy Faber - Highlights of AEGIS and Oberguergl, Austria conferences
Feb 1 Rychard Bouwens (UCSC) - Very high redshift galaxies from HST/WFC3
Feb 8 Hagai Perets, Rochester Institute of Technology (host Enrico Ramirez) - Stellar dynamics near massive black holes: Young stars, hypervelocity stars and gravitational wave sources
Feb 15 Roberto Trotta, Imperial College (host Tesla Jeltema) - Prospects for Astrophysical Dark Matter Detection from SUSY Global Scans
Feb 22
Mar 1
Mar 8 Hume Feldman, Univ of Kansas (Host: Joel) - Cosmic Flows on 100 Mpc/h Scales: Standardized Minimum Variance Bulk Flow, Shear and Octupole Moments
Mar 15 Marina Cortes, UC Berkeley (host Serena Bertone) - Selecting between inflationary models: Careful CMB forecasts

Jan 4 Abstract: Firstly, I introduce the axisymmetric Jeans approach to dynamical modelling, and show how it can be combined with radially extended kinematics to constrain the halo mass of pressure- and rotationally-supported galaxies. I show the results of its application to a sample of local S0s and spirals. Secondly, I demonstrate that previous comparisons of the Tully-Fisher relations of early- and late-type galaxies have been subject to significant and uncertain biases due to the mixing of different kinematic tracers and modelling approaching. Finally, I bring these two sections of my talk together to investigate the relationship between S0s and spirals. I compare the Tully-Fisher relations of S0s and spirals using homogeneous kinematic data and modelling for the first time. S0s are systematically 0.5 mag fainter at a given velocity. I show how this result rules out one of the dominant models of S0 formation: truncation of star formation in spirals, and speculate on a possible non-homology between the two classes, which would require spirals to undergo a dynamical transformation to become S0s.

Jan 18 Abstract: The SuperMACHO Project is a five-year survey toward the Large Magellanic Cloud (LMC) aimed at understanding the nature of the populations of lenses responsible for the excess microlensing rates observed by MACHO (Alcock et al. 2000). Survey observations were completed in 2006. A rich side-product of this survey is a catalog of variable sources down to a depth of VR~23. I will discuss some preliminary findings from the survey and describe simulation techniques used to determine the project's detection efficiency. I will also present some of the auxiliary science from the project including: light echoes of ancient supernovae, type Ia supernova rise times, unusual transients, and periodic variable stars. The purpose of this talk is to provide an overview of the many exciting and diverse areas of astronomical research that can be explored in the time domain. I also hope to highlight some of the challenges associated with such surveys and present recent progress toward overcoming them.

Feb 8 Abstract: A massive black hole resides in the center of most, perhaps all galaxies. The one in the center of our home galaxy, the Milky Way, provides a uniquely accessible laboratory for studying in detail the connections and interactions between a massive black hole and the stars in its vicinity. Due to the the extreme conditions in this region (highest stellar densities, velocities and tidal fields) unique processes can occur there. These processes and their implication on the stellar population near the massive black hole open new possibilities in our understanding of gravitational dynamics and of post-Newtonian gravity in the weak- and strong-field limits. They may also explain and predict the existence of stars with exotic properties. In recent years young stars have been observed at the center of our Galaxy where such stars can not regularly form. At the outskirts of the Galaxy hypervelocity stars have been observed to escape from the Galaxy at extreme velocities. I will discuss the origin and evolution of these two unique population of stars and the possible connection between them, through the dynamical processes occurring near the massive black hole in the Galactic center. In addition I will discuss the possibility of using hypervelocity stars as probes of the Galactic potential; the production of gravitational wave sources both in the Galactic center and in other galactic nuclei [detectable by the planned Laser interferometer space antenna (LISA) mission]; and the possibility of directly probing the properties of the massive black hole in the Galactic center (its mass and its spin) and their general relativistic effects.

Feb 15 Abstract: Strong cosmological and astrophysical evidence points to the existence of non-baryonic dark matter in the Universe. One of the most promising candidates is neutralino dark matter, a natural consequence of supersymmetric (SUSY) theories. Beside investigating (and hopefully discovering) SUSY at the LHC, there are a number of astrophysical probes that can provide highly complementary information on the neutralino properties,

thereby opening the exciting possibility of increasing the constraining power of the LHC thanks to astroparticle physics data.
In this talk I will focus on the potential of direct and indirect detections techniques to discover and characterize dark matter, emphasizing the need to describe accurately both the particle physics sector and the astrophysics sector if one is to extract unbiased information about dark matter from current and future experiments. I will examine current constraints on the CMSSM parameter space from global scans and compare the discovery potential of underground direct detection experiments and of neutrino telescopes such as IceCube. I will also present a new method that fully incorporates galactic modelling uncertainties into direct detection constraints, thereby mitigating the risk of incurring in a potentially catastrophic 15-sigma bias in the reconstructed dark matter properties.

Mar 1 Abstract: The low order moments of the large scale peculiar velocity field are sensitive probes of the matter density fluctuations on very large scales. However, peculiar velocity surveys have varying spatial distributions of tracers, and so the moments estimated are hard to model and thus are not directly comparable between surveys. In addition, the sparseness of typical proper distance surveys can lead to aliasing of small scale power into what is meant to be a probe of the largest scales. We formulate an optimization analysis of the bulk flow, shear and octupole moments where velocities are weighted to give an optimal estimate of the moments of an idealized survey, with the variance of the difference between the estimate and the actual flow being minimized. These ``minimum variance'' (MV) estimates can be designed to calculate the moments on a particular scale with minimal sensitivity to small scale power, and thus different surveys can be directly compared. The MV moments have almost no correlations between them so that they are virtually orthogonal. Our estimate of the bulk flow on scales of ~100 Mpc/h has a magnitude of |v|= 416 ± 78 km/s towards Galactic l = 282 ± 11degrees and $b = 6 ± 6 degrees, in good agreement with our previous result found fitting only the bulk flow, but in disagreement with WMAP5 cosmological parameters at the 99.5% CL. The shear and octupole moments are consistent with WMAP5 power spectrum, but the measurement noise is larger for these moments than for the bulk flow. The relatively low shear moments suggest that the sources responsible for the bulk flow are at large distances.

Mar 15 Abstract: Detecting the amplitude for the primordial gravitational waves, i. e. detecting r, would be a “smoking gun” for inflation and help determine the particular physics model behind the inflationary mechanism. On the other hand, determining the exact shape of the potential for the inflaton field, i.e. measuring the scalar tilt with great accuracy and/or detecting its running, would be also be very powerful in pinpointing inflation.
If there's no possibility that both types of experiments will be carried out, if the inflationary community had to choose between the two, which experiment do we want to select?

A search for gravitational waves -- with the possibility of null results, or a better measurement of the scalar spectrum which is an assured result, although its efficiency as a model discriminator depends on the precision of the instrument? We work together with members of the two opposite ends of the CMB data-analysis pipeline, and are able to make more realistic forecasts for upcoming CMB experiments, while at the same time having an effective separation of the profusion of inflation models currently under study, so that model falsification is optimized.