distance from the center. The inclination of the field lines is turned out to be somewhat higher than we expected. The field distribution over the sunspot(SPO 5007) fits best to the empirical model suggested by Wittmann(1974).

Multicolor CCD Surface Photometry of Globular Clusters

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In order to investigate the radial distributions of color and luminosity in the central regions of globular clusters, we have analyzed a set of UBV CCD images for 10 southern globular clusters, which were obtained from the 40-inch telescope at Siding Spring Observatory in May 15 and August 18, 1991. Among the ten, seven clusters show clear indication of color gradients; NGC 6266, NGC 6584, NGC 6681 with redder centers and NGC 104, NGC 2298, NGC 6637, NGC 7099 with bluer centers. The amplitudes of color variation is typically around 0.1 magnitude for B-V color. We also classify half of our sample clusters at post-core-collapse family based on the power law cusp in their surface brightness profiles. The other half have flat cores which are very well fitted by conventional King's model. In contrast to Djorgovski et al.(1991)'s claim of co-occurance of cusp and bluer cores, we find cases which conflict with such hypothesis. Using the same CCD frames, we have derived accurate color and magnitudes for all resolved stars brighter than V = 18.5 magnitude. Combined with radial profile information, the CM data set is being used to test possible population changes across globular clusters.

Ages of Old Stellar Populations in the Galaxy

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Recent observations suggest that the peak of the metallicity distribution for RR Lyrae variables in the Galactic nuclear bulge is more metal-rich than that found in the halo of the Galaxy. It is shown that this is what one would expect if the radial variation in horizontal-branch morphology observed in the halo continues to the very center of the Galaxy. Interpreted as an age effect, as supported by recent work, this provides evidence, for the first time, that the oldest stellar population (i.e., RR Lyraes) in the Galactic nuclear

bulge is older than that in the halo by 1.3±0.3 Gyr. Other possibilities can be ruled out from the analyses of the periods of RR Lyrae variables and/or other observations. Implications of this result on the formation of the Galaxy and on the age of the Universe will be discussed.

Instabilities in Cosmic Ray Dominated Shocks

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Previous studies have shown that small compressional disturbances propagating into a cosmic-ray (CR) dominated medium can be amplified by a 1D acoustic instability. If the wavelength of the disturbances is shorter than the CR pressure scale height, and if the CR pressure scale height is shorter than the diffusion length associated with sonic flow, disturbances travelling in the direction of increasing CR pressure can grow, while those travelling in the direction of decreasing CR pressure can be damped out. Here we report that, as a consequence of the 1D acoustic instability, a Rayleigh-Taylor type instability can develop in 2D flow, when the flow is perturbed along the direction parallel to the shock front. In addition to the sound waves propagating along the shock normal. Using the local WKB approximation the growth rate of the secondary instability is shown to be comparable to that of the 1D acoustic instability itself in the cases we have considered. The nonlinear development has been followed numerically with a 2D PPM hydrodynamics code that also incorporates the two-fluid CR energy equation. We show that the secondary instability may cause the precursor and post shock flows to become highly turbulent. However, neither the primary, 1D acoustic instability nor the secondary instability has a significant effect on the cosmic-ray pressure around the shock. That is because CR diffusion through the perturbations is much faster than the growth rate of the instability.

Dynamical Evolution of SNR VRO 42.05.01

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We have numerically simulated the evolution of SNR VRO 42.05.01 (G166.0+4.3) in order to understand the dynamical interaction of the SNR with the surrounding ISM. Radio