Abstract for an Invited Paper
for the APR11 Meeting of
The American Physical Society

X-rays Flares and Protoplanetary Disks[1]

ERIC D. FEIGELSON, Pennsylvania State University

X-ray observations of star forming regions show that magnetic reconnection flares are powerful and frequent in pre-main sequence solar-type stars. Well-defined samples in the Orion Nebula Cluster and Taurus clouds exhibit flares with peak X- ray luminosities $L_x \sim 10^{29} - 10^{32}$ erg/s, orders of magnitude stronger and more frequent than contemporary solar flares. X-rays are emitted in magnetic loops extending 0.1-10 R $_*$ above the stellar surface and thus have a favorable geometry to irradiate the protoplanetary disk. Several lines of evidence - fluorescent iron X-ray emission line, forbidden [NeII] infrared line, and excited molecular bands - support X-ray irradiation of cold material in some young systems. Several astrophysical consequences of X-ray irradiation are outlined. As ionization fractions need only reach 10^{-12} to induce the magnetorotational instability and associated turbulence, X-rays may be the principal determinant of the extent of the viscous "active zone" and laminar "dead zone" in the layered accretion disk. X-ray irradiation may thus play a major role in planet formation processes: particle settling; meter-size inspiral; protoplanetary migration; and dissipation of the gaseous disk.

[1]Work supported by NASA grants SV4-74018, NNX09AC74G and NSF grant AST-0908038.