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Project Title: X-raying the Bones of the Milky Way

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Abstract: Infrared dark clouds (IRDCs) are cold, dense, massive Galactic star-forming regions that allow us to understand the physical conditions during the early stages of high-mass star formation (O and early B-types, >20 MSUN). We present a sample of ~3,000 candidate young stellar objects (YSOs) in three IRDCs, G34.43+00.24, the “Nessie” Nebula, and M17 SWex. We use combined Galactic Legacy Infrared Mid-Plane Survey Extraordinaire (GLIMPSE) and Chandra X-ray Observatory point-source photometry catalogs to identify YSOs in each IRDC. YSOs exhibit mid-IR excess emission due to circumstellar material found in protoplanetary disks. By fitting models to their 1-24 μm spectral energy distributions (SEDs), we classified candidate YSOs as envelope-dominated (Stage I), disk-dominated (Stage II), or “ambiguous” (Stage I/II). YSOs that lack mid-infrared emission at 4.5 μm (Stage III) were selected for SED fitting based on X-ray detections. Compared to previous observations, star formation traced by YSOs is even more widespread along the G34.4 IRDC filament, extending past the brightest ultracompact H II region G34.26, which appears to lie at a node where two filaments intersect. The very long Nessie IRDC exhibits clustered star formation at regular intervals, on either side of the bright mid-IR bubble produced by the most massive young cluster. However, neither of these clouds appears to have a large, distributed populations of “diskless X-ray stars” as observed in M17 SWex. Comparing results among these three IRDCs suggests two different cloud morphologies producing distinct modes of vigorous star formation, (1) “ropey” clouds dominated by single, long filaments with predominantly clustered, massive star formation and (2) “feathery” clouds with “hub-filament structure” and more distributed star formation. This material is based on work supported by the National Science Foundation under Award Nos. AST-1559559, PSU ACIS Instrument Team contract,