X-raying the Bones of the Milky Way

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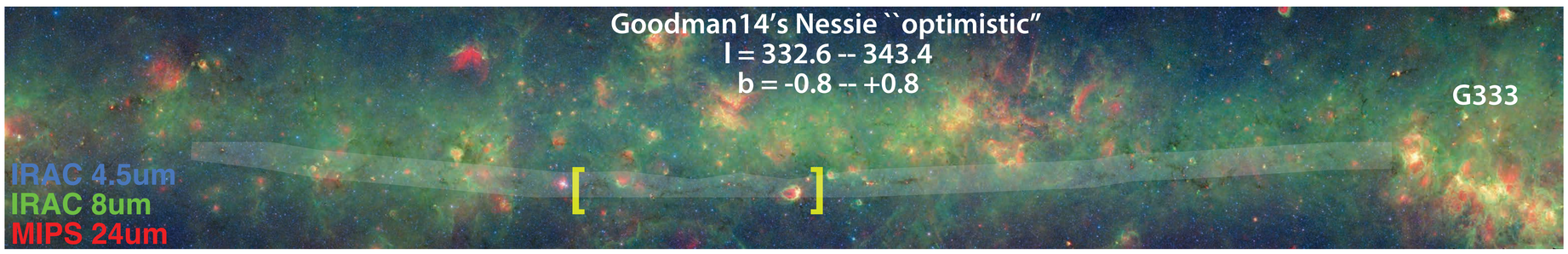
In a Cycle 18 LP, Chandra will study a menagerie of the most prominent and iconic IRDCs in the nearby Galaxy, objects so fundamental to our understanding of star formation and Galactic structure that Goodman14 dubbed them ``The Bones of the Milky Way."

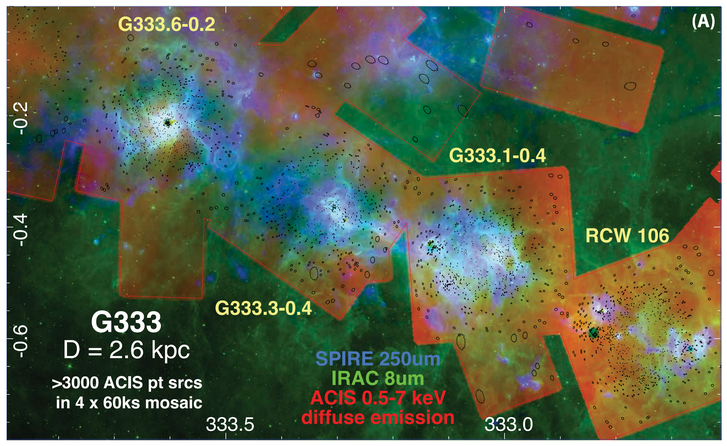
Massive star-forming regions (MSFRs) are formed by supersonic flows compressing gas into dense clumps in massive molecular filaments.

Seen in absorption against the bright IR background of the Galactic plane, these ``Infrared Dark Clouds" (IRDCs) may be the birthplaces of all stars.

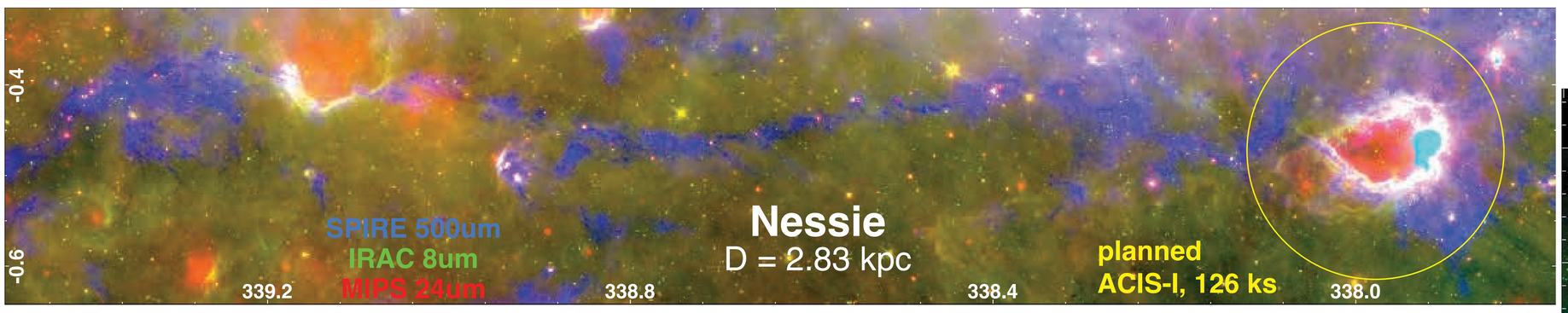
By sampling evolutionary sequences and the two distinct morphologies of IRDCs, Chandra will bring new insight into:
-- how, when, and where molecular clumps form MSFRs,
-- when X-ray emission turns on in massive star birth,
-- the star formation history (and future) of giant molecular clouds (GMCs).



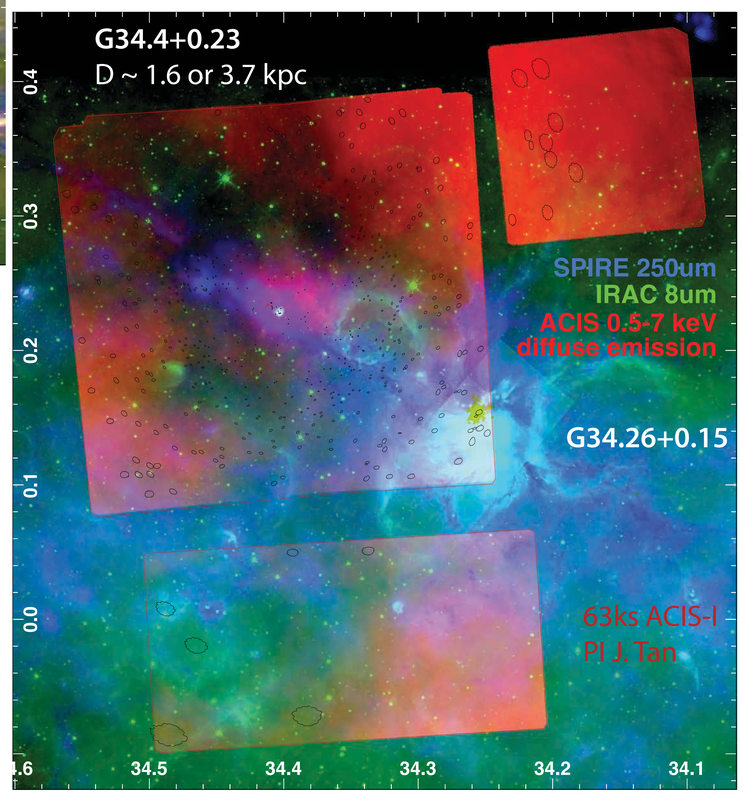
Nessie: spine of a spiral arm. A Spitzer view of the "optimistic" extent of the Nessie IRDC (Goodman14); this exceptional IRDC may stretch 8 degrees (400pc), tracing the Scutum-Centaurus spiral arm all the way to the G333 GMC, which is currently exploding with star formation.



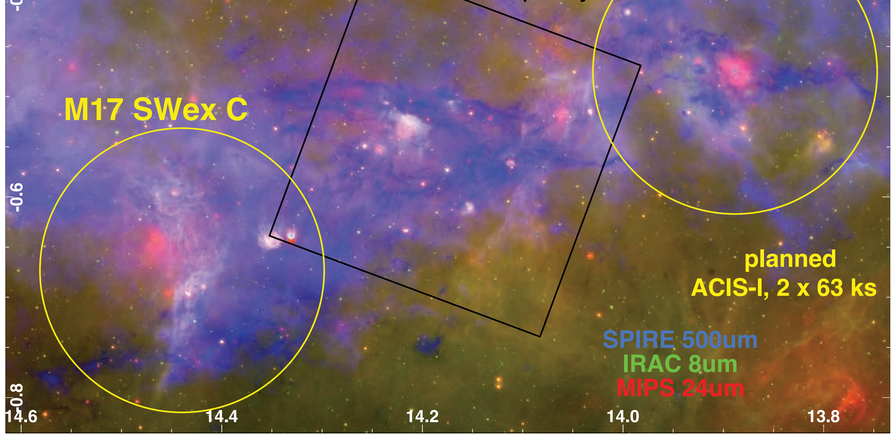
G333, a million-solar-mass GMC, 60×80pc.
Here a massive IRDC has ended its life as a string of MSFRs; Chandra detects their young stars (black) and the hot plasma from massive star winds and supernovae (red) that have shredded this great molecular filament.



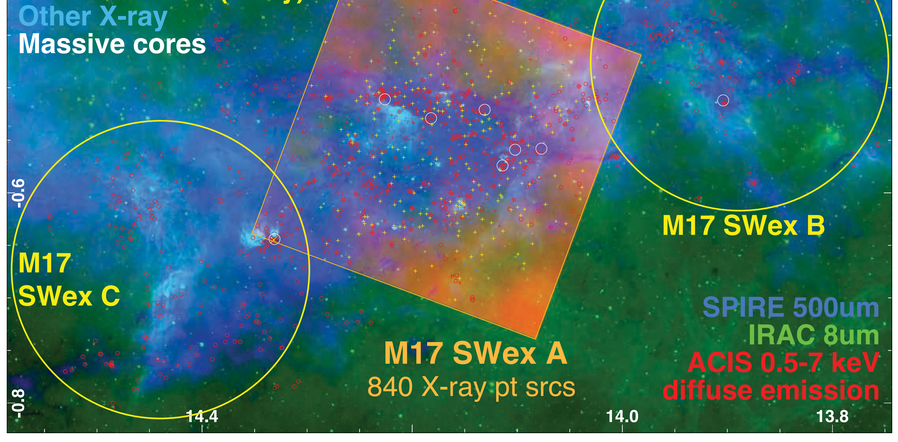
Nessie "classic," the IRDC as defined by Jackson10, extending 84pc (the segment between the two yellow brackets above).
Our ACIS pointing will sample the most active part of the classic filament, Nessie's "eye,"
to understand its star formation history and to look for hot plasma from wind shocks in the bubble.



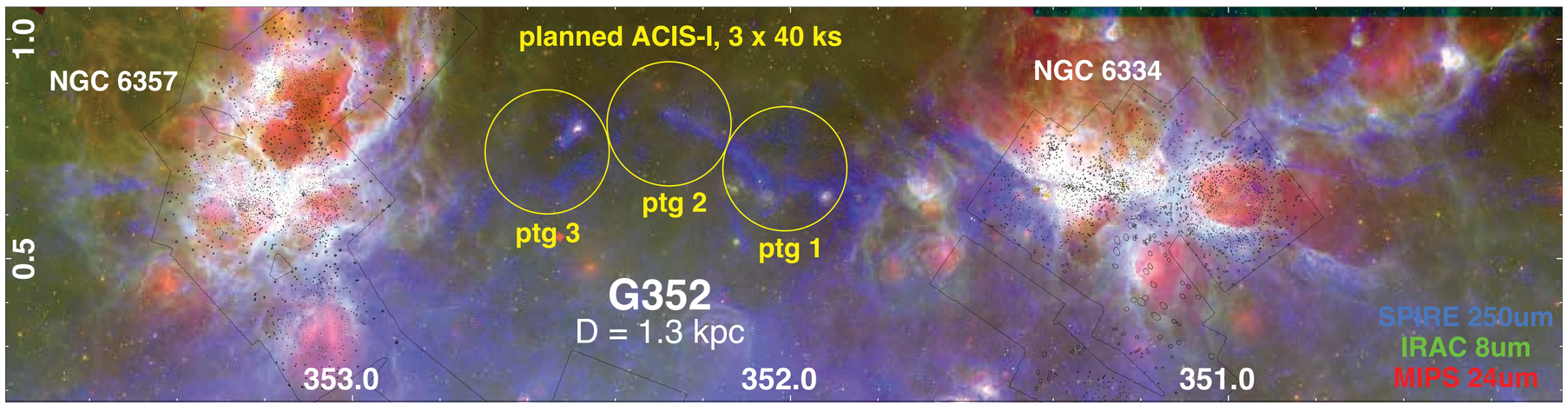
The second Chandra observation of an IRDC yielded faint detections of embedded massive stars and again showed shadowing of background diffuse X-rays (another XRDC). Central extended emission is probably unresolved stars, as the larger distance is now favored. The adjacent, more evolved MSFR G34.26+0.15 may show true diffuse emission; an on-axis ACIS observation is required to find out.



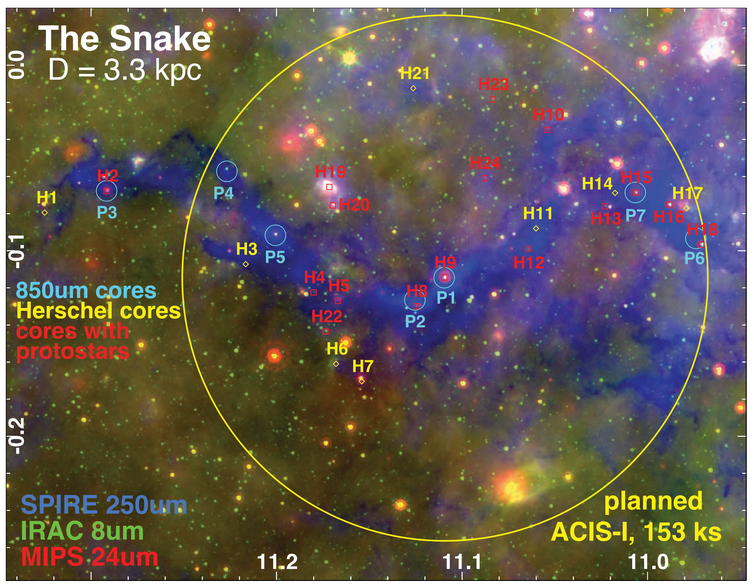
M17 SWex, a great "Hub Filament Structure" network (Myers09, Busquet13). New ACIS-I pointings on the Dragon's head and tail will search for an age sequence across the GMC (Elmegreen&Lada76).



This first Chandra observation of an IRDC yielded a whopping 840 X-ray sources (Povich16). The IRDC strongly shadows background diffuse X-ray emission at its center (making it the first "XRDC"), but that around its edges may be leaking from the IRDC itself.



The G352 GMC and its twin MSFRs NGC 6357 and NGC 6334;
existing ACIS mosaics with >6000 X-ray point sources in massive clusters are outlined in black (Townsley14).
An ACIS-I mosaic of the filament "bridge" between G352's giant HII regions will reveal the star formation future of a giant molecular cloud.



The Snake, a very young, massive, monolithic IRDC full of molecular cores and protostars (Johnstone03, Henning10).