The vast majority of stars (those with masses less than 1.7 solar masses) have X-ray emitting coronae for all but their brief first 10 million years. Such coronae are believed to be powered by a magnetic dynamo mechanism that results from an interplay between the convective and rotational flows in their outer envelopes. Although the details, e.g., whether coronae are predominantly energized by waves, currents, etc., are still actively debated.

As stars age, they lose angular momentum through their stellar wind, and their coronae become less powerful, e.g., the present solar corona's X-ray luminosity is only \(10^{-7}\) of its total luminosity, and cooler, e.g., the bulk of the solar corona is cooler than 3 MK.

Because of sensitivity limitations, essentially all operating and previous X-ray observatories with high spectral resolution capabilities have studied primarily the exceptional X-ray luminous coronal stars, such as active binaries and stars much younger than the Sun, i.e., the "tip of the iceberg" of the stellar coronal population. The high-resolution instruments on the International X-Ray Observatory (IXO) will enable us to study the complex, fine-structure spectra of a wide range of stellar coronae, e.g., with an AU of 3000, implying a velocity resolution of 100 km/s. We discuss sample programs that IXO could conduct on various classes of stellar coronal sources, and the information that these would yield on coronal abundances, temperatures, electron densities, etc., and potentially on the underlying coronal heating mechanisms.

In this poster, we will focus on just a few of the many varied potential coronal science topics that IXO can address, based on the projected capabilities of the Calorimeter. A detailed simulation of a study of the active dwarf star AB Dor using the IXO Grating is available at http://space.mit.edu/home/phil/xan/xmsridor.html

**IXO and Stellar Coronae: Vastly Improved Capabilities**

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**Outstanding Issues in Coronal Physics and What IXO Will Do**

- **How are coronae maintained and heated?** By quasi-continuous (e.g., MHD waves or currents) or by discrete (e.g., an ensemble of microflares) processes? Remember: one size might not fit all! Coronal temperatures can range over 4 orders of magnitude (\(10^6\) - \(10^{11}\) K), and some stars may have additional sources of coronal heating as well, such as magnetic reconnection at coronal loops. IXO will enable us to study density- and opacity-sensitive line diagnostics, such as coronal Doppler shifts and/or turbulence-broadening on physically meaningful time-scales, such as flare times.

- **How are coronae spatially structured?** Chandra and other current X-ray observatories have given us insight into coronal temperature distributions (IDEAs) but little insight into coronal denser plasma. coronal structures must be influenced by several factors, including the magnetic field geometry, gravitational and rotational forces, and, in the case of binary systems containing stars, thermal effects and/or giant planets, interactions between the components. IXO will enable us to study density- and opacity-sensitive line diagnostics, such as coronal Doppler shifts and/or turbulence-broadening on physically meaningful time-scales, such as flare times.

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- **How do nonthermal processes contribute to non-flaring active coronae?** In the sun, present-day X-ray emission is observed (not for the first time in the Galaxy). T Tau stars (e.g., 131 ksec) for a much wider range of objects than previous X-ray observations have been able to do.

Do nonthermal processes contribute to non-flaring active coronae? In the sun, present-day X-ray emission is observed (potentially for seconds to minutes) only during the impulsive phase of large solar flares. Due to limitations of existing X-ray detectors, such emission has so far been observed (Osten et al. 2007) only in very large flares of the active binary 8 Peg, where it persisted for about 2 hours, yet data from radio observations of gysosynchrotron emission that nonthermal particles are essentially always present in the corona of active stars, not just in flares. The Hard X-ray Imager on IXO will enable high S/N observations of many stars in the 10-40 keV range in which power-law emission may be detected.

Can we disentangle the contributions of corona and accretion in the X-ray emission of protostars, Herbig AeBe stars, and T Tau stars? The X-ray emitting plasma in the accretion column of actively accreting stars is expected to be at much higher densities than for standard coronal plasma, and Chandra and XMM-Newton have found several such objects. IXO will enable us to study the behavior of density-sensitive line ratios, e.g., a much wider range of pre-main sequence stars (some examples of Bp Tauri in the IR)? we will be able to disentangle the contributions of corona versus accretion in a large sample of nearby star-forming regions.