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Surface Magnetism of Stars

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As mysterious as decadal variability of magnetic features on the solar surface and in its atmosphere are the magnetic expressions of interdecadal and century variability – like the Maunder Minimum of the 17th century. The decadal variability (also called the sunspot cycle) is widely explained by the action of a subsurface dynamo within or just below the convective zone that produces large-scale dynamo waves. A successful dynamo model should replicate well-observed characteristics of the sun's magnetism. Examples are the two-dimensional, Maunders' "butterfly diagram" of spot position on the sun's surface as a function of phase of the decadal variability, plus the interdecadal and century variability.

Yet, a realistic dynamo model remains obscured by lacunae in knowledge of, e.g., interior solar parameters and even MHD theory. While key studies of the sun proceed, parallel efforts are studying the stellar dynamo – for example, stellar magnetic variability.

Disk-resolved measurements of magnetic features of stars are generally unobtainable at present, thereby foreclosing the ability to observe an equivalent Maunder Butterfly Diagram for starspots. However, cross sectional and time serial surveys of disk-integrated proxies of surface magnetic features in cool stars – those with non-trivial subsurface convection zones – have yielded information on the stellar dynamo. For example, the time-average strength of magnetic surface proxies in the sun and other lower-main sequence stars depends on rotation rate (or age in single stars). Additionally, decadal and interdecadal magnetic variability is prevalent.

Consequences for the dynamo will be discussed, based on results from observational and modeling programs. The programs include the near-four-decades-long monitoring program of Ca II H and K emission fluxes of lower main sequence stars at Mount Wilson Observatory, plus the precision photometry made at Lowell and Fairborn Observatory-Tennessee State University.

Keywords: solar activity; stellar activity; magnetic activity cycles; decadal variability; interdecadal variability; Maunder minimum.