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Modeling of magnetic stars

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Magnetic fields can be found at the surface of non-degenerate stars all over the HR diagram. Their nature is split between those contemporaneously generated by dynamo mechanism (e.g. low mass MS stars) and those of fossil origins (e.g. high mass MS stars). This means that there are fundamental differences in their observed properties —for example, while magnetic fields of low-mass stars are ubiquitous and variables on many time scales, magnetic fields are only found in 10% of high-mass stars and their topologies are generally simple and stable.

This said, the way we use polarization to detect these fields, and the way we model this polarization to infer magnetic fields characteristics is very similar for all stars. I will discuss how the modeling of time-domain spectropolarimetry to can be used to recover the field topology.

While the time variation of the polarization signal is necessary for studying field topologies, it can also make the search for fossil fields difficult as they are not present in all massive stars —thus in the context of surveys, it might be ambigous whether a non-detection implies the absence of a field or is a result of a badly-timed observation. I will discuss spectropolarimeric surveys efforts that, when combined with an understanding of detection biases, have been very successful in establishing the properties of fossil fields.

However, these blind survey tactics require too much observing time to efficiently increasing the number of known magnetic massive stars, which would be essential to establish the origin of these fossil fields. I will also discuss targeted survey efforts that leverage other proxies for the presence of fossil fields, such as chemical peculiarities and magnetospheric emission. Finally, I will briefly discuss the impact of fossil field on stellar evolution and on the ultimate demise of massive stars.

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