Does Betelgeuse have a magnetic field?

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Betelgeuse (alpha Ori) is an example of a nearby cool super-giant (M1–2 Ia–Iab) that displays temporal brightness fluctuations and irregular surface structures. Recent numerical simulations by Freytag of the entire star under realistic physical assumptions, have shown that the fluctuations in the star's apparent luminosity may be caused by giant cell convection, very dissimilar to solar convection. These detailed simulations bring forth the possibility of solving another question regarding the nature of Betelgeuse, and of super-giants in general; namely whether these stars may harbor magnetic activity, which in turn may also contribute to their variability. A possible astrophysical dynamo in Betelgeuse would most likely be very different from those thought to operate in solar type stars, due to both its slow rotation and to the fact that only a few convection cells appear to be present at its surface at the same time. Taking detailed numerical simulations of the entire star at face value, we have applied a kinematic dynamo analysis to study, whether or not the flow field of this super-giant may be able to amplify a weak seed magnetic field. We find that the giant cell convection does indeed allow a positive exponential growth rate of magnetic energy corresponding to a characteristic amplification time of 4–5 years (depending on magnetic Reynolds number). The dynamo of Betelgeuse can be characterized as belonging to the class called "local small-scale dynamos" another example of which is the dynamo action in the solar photosphere responsible for the formation of small-scale flux tubes (magnetic bright points). However, in the case of Betelgeuse this designation is less meaningful since the generated magnetic field is both global and large-scale.