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P5.4011 On frequency of ion cyclotron radiation in connection with its observability

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Magnetic activity of distant objects can manifest itself in electron cyclotron emission. While it was detected from a large number of stellar objects (including pulsars) and brown dwarfs, not detection does not necessarily mean it does not happen. Being a highly directed radiation, it leaves the magnetospheres shaped as hollow cones centered around magnetic poles, which rotate with the object and get detected when the beam points towards the Earth.
Ion cyclotron emission, also expected to happen on the same objects, would be directed differently and hence could provide an alternative root to detecting the objects' magnetic activities. The expected frequency of radiation though is much lower then for electron cyclotron emission, if expecing it to be close to ion cyclotron frequency, which makes it more difficult to detect.
Here we analyse the range of frequencies which can be expected from ion cyclotron radio emission, based on a horseshoe-shaped magnetically confined velocity distribution function Since coming out at a different frequency and direction from those of electron cyclotron emission from the same object, it can be observable even when the electron cyclotron
signals were not detected from that object. We analyse the possibilities of such detection based on expected frequency of radiation. Ion cyclotron maser instability based on magnetic confinement is considered2, and the results show that the frequency of ion cyclotron emission can be significantly different from the local cyclotron frequency. Some combinations of parameters provide up to ten times higher frequency of the emission, when the radiation direction is substantially different from normal to the beam. This is in line with some observations, and suggests a number of instruments will be capable of detecting such emission from Brown Dwarfs.

1 I. Vorgul et al, Phys. Plasmas, 12, 122903 (2005)

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