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Observations of Ion Cyclotron Waves at and near the Moon in the Magnetotail

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We observed a unique class of ion cyclotron waves at and near the Moon in the Earth's magnetotail. These waves are narrow-banded waves with frequencies close to the local proton cyclotron frequency, and they exhibit circular, left-handed polarization. We found these waves in the partially restored Apollo 15 Lunar Surface Magnetometer (LSM) data only when the Moon was located in the magnetotail. Currently in the Earth-Moon libration orbit, the ARTEMIS spacecraft have also observed these ion cyclotron waves in the magnetotail when the spacecraft moved very close to Moon. In the LSM data recorded on the lunar surface these waves appear in multiple wave packets of which each series of packets can last for more than an hour. In contrast when ARTEMIS observed these waves in the magnetotail the waves only lasted for the several minutes when the spacecraft was near the closest approach to the Moon, suggesting a lunar origin of the waves. In this paper the possibility for the pick-up ions in the lunar exosphere to generate these ion cyclotron waves is discussed.