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Signatures of ubiquitous magnetic reconnection in the lower solar atmosphere

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Ellerman Bomb-like brightenings of the hydrogen Balmer line wings in the quiet Sun, also known as quiet Sun Ellerman bombs (QSEBs), are a signature of the fundamental process of magnetic reconnection at the smallest observable scale in the lower solar atmosphere. We analyze high spatial resolution observations (0."1) obtained with the Swedish 1-m Solar Telescope to explore signatures of QSEBs in the $H\beta$ line. We find that QSEBs are ubiquitous and uniformly distributed throughout the quiet Sun, predominantly occurring in intergranular lanes. We find up to 120 QSEBs in the field of view for a single moment in time; this is more than an order of magnitude higher than the number of QSEBs found in earlier $H\alpha$ observations. This suggests that about half a million QSEBs could be present in the lower solar atmosphere at any given time. The QSEB brightenings found in the $H\beta$ line wings also persist in the line core with a temporal delay and spatial offset toward the nearest solar limb. The observed QSEBs vary significantly in their properties, such as lifetime, brightness, and size. Our results suggest that QSEBs emanate through magnetic reconnection along vertically extended current sheets in the lower solar atmosphere. The apparent omnipresence of small-scale magnetic reconnection may play an important role in the energy balance of the solar chromosphere.

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