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On the low frequency break of IMF power spectrum recently observed in slow solar wind

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Fluctuations of solar wind magnetic field and plasma parameters exhibit a typical turbulence power spectrum with a spectral index ranging between 5/3 and 3/2. In particular, at 1 AU, magnetic field spectrum, observed within fast corotating streams, shows also a clear steepening for frequencies larger than the typical proton scales, of the order of $3x10^{-1}$Hz, and a flattening towards f^{-1} at frequencies smaller than say 10^{-3}Hz. However, present literature reports observations of the low frequency break only for fast streams. Slow streams, observed so far, never showed a clear low frequency break. The reason for the lack of a clear break was commonly attributed to the fact that slow wind intervals were not long enough compared to the duration of corotating fast streams. Recently, a long survey on WIND observations, spanning between 2005 and 2016, unraveled the presence of several time intervals lasting more than 6 days and characterized by low bulk speed and lack of transient events. Some of these slow speed flows were corotating and it was possible to analyze them more than once. A preliminary analysis (https://sppgway.jhuapl.edu/sites/default/files/SWGs/20171002/presentations/Oct5th/2_Solar_Wind_Heating/6_Bruno_PSP-SO_talk.pptx) unraveled, for the first time in literature, evidence for the presence of a low frequency break in slow speed wind. The frequency break was observed to be at about 1 decade lower than in fast wind. In particular, assuming the same radial dependence (Bruno and Carbone, 2013) of the break location for fast and slow wind but considering different advection time, we should observe the break at higher frequency than observed. Thus, the longer transit time is unable to explain the observed break location and, consequently, slow wind turbulence appears to be “older” than it should be. In addition, to further complicate things, we found that a remarkable time length of a slow speed interval does not always guarantee the presence of the break. In this presentation, we will report a detailed analysis of the fluctuations found in these long lasting slow speed intervals aiming to solve this intriguing puzzle.