

# Predicting the Strength of Solar Flares using Sunspot Characteristics

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This project focuses on predicting the strength of solar flares based on sunspot characteristics. It was hypothesized that the probability of generating an intense solar flare within a sunspot increases as the size and magnetic complexity of the sunspot increases. The Mount Wilson Classification system categorizes sunspots into alpha, beta, beta-delta, beta-gamma (BG), and beta-gamma-delta (BGD) based on magnetic properties. Alpha sunspots are considered to be the least complex, whereas BGD are the most complex. Solar flares are ranked by the amount of x-rays emitted, ranging in intensity from B to the severest X class. For this experiment 100 B, C, and M class flares were analyzed along with 22 X class solar flares. As hypothesized, the greater the size and magnetic complexity of a sunspot, the higher the probability of an intense solar flare event. It was observed that BGD sunspots with areas 200  $\mu$ SH and smaller had a 0% generation of X class flares, whereas BGD sunspots with 600  $\mu$ SH and greater had a 30.2% generation rate. This trend was consistent with B, BG and BGD type structures. A significant change in the behavior of sunspots occurs at 600  $\mu$ SH and greater sunspot size. Sunspots above 600  $\mu$ SH did not exhibit alpha and beta sunspot magnetic characteristics. It is now understood that only BD, BG, and BGD sunspots have the potential to produce X class flares. This research aids in understanding the relationship between these two solar phenomena but also advances current solar flare forecasting models.

**Awards Won:**

