M26a Characteristics, evolution, and fate of NOAA active region 12665

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NOAA AR 12665 which transited in mid-July 2017, exhibited an unexpected evolution that contradicts our standard views. Despite being a low-complexity active region without a strong gradient Polarity Inversion Line (PIL), AR 12665 produced M-class flares and a fast CME. Using data from Hinode SOT/XRT, SDO AIA/HMI, and SMART/SDDI Hα, we examine AR 12665 in light of the appearance of bald-patch separatrix surfaces (BPs) on the photosphere, evolution of Hα filaments, formation of a coronal sigmoid, and the later M-class flare on July 14. We found that the appearance of BPs spatially coincides with the formation of the Hα filament, but without immediate evidence of a magnetic flux rope in the corona. During this period, highly red- and blue-shifted plasma also manifest in the photosphere, and the vertical electric current is also enhanced. Subsequently, the horizontal field strength across the PIL decreased and re-oriented, during which we observed the disintegration of BPs and the formation of a twisted flux rope in the corona. We address the fundamental question of how much magnetic energy was accumulated from the initial activities in the photosphere to the flare time on July 14 by computing the Poynting flux and magnetic helicity. The total magnetic energy supplied from the photosphere to the corona amounted to $\sim 4.2 \times 10^{33}$ erg, with the largest contribution coming from the photospheric shear motion. Such an accumulated magnetic energy, which eventually a great amount of it was released during the flare, may account for the energetic events produced by AR 12665.