In this letter, we explore the implications of high-quality Event Horizon Telescope (EHT) data for M87. The comparison of EHT data with a comprehensive library of mock images, generated through General Relativistic Magnetohydrodynamics (GRMHD) simulations and General Relativistic Ray-Tracing (GRRT) calculations, yields consistent results. The compact 1.3 mm emission in M87 is suggested to originate within a few gravitational radii (rg) of a Kerr black hole. The observed ring-like structure is attributed to strong gravitational lensing and Doppler beaming. The asymmetry in the image is linked to the black hole's spin, indicating that the black hole in M87 spins clockwise on the sky, pointing away from Earth.

Models predict a significant energy flux directed from the black hole's poles, indicating electromagnetic dominance. If accurate, this implies that the M87 jet's central engine is powered by the electromagnetic extraction of free energy associated with black hole spin through the Blandford–Znajek process. The study emphasizes the critical role of the electron distribution function (eDF) in physical inferences, acknowledging current uncertainties in modeling sub-Eddington black hole accretion.

Despite uncertainties, many models produce images consistent with the EHT2017 data, highlighting the dominant influence of gravitational lensing and spacetime geometry over plasma physics details. The rejection of certain models based on physical grounds, variability, radiative efficiency, X-ray luminosity, and jet power criteria further refines the understanding. Future investigations, including polarization maps and lower-frequency VLBI observations, promise to constrain models further. The study anticipates the potential impact of future EHT campaigns, multiwavelength data, and new theoretical approaches, emphasizing the complementarity of experiments studying black holes across scales and confirming their adherence to general relativity predictions.

在這封信中，我們探討了高品質事件視界望遠鏡 (EHT) 資料對 M87 的影響。 將 EHT 數據與透過廣義相對論磁流體動力學 (GRMHD) 模擬和廣義相對論射線追蹤 (GRRT) 計算產生的綜合模擬影像庫進行比較，得出一致的結果。 M87 中的緊湊 1.3 毫米發射被認為起源於克爾黑洞的幾個引力半徑 (rg) 內。 觀察到的環狀結構歸因於強引力透鏡效應和多普勒光束。 影像中的不對稱性與黑洞的自旋有關，顯示 M87 中的黑洞在天空中順時針旋轉，指向遠離地球的方向。

模型預測黑洞兩極會產生大量能量通量，顯示黑洞具有電磁優勢。 如果準確的話，這意味著 M87 噴射機的中央引擎是透過布蘭德福德-茲納耶克過程中與黑洞旋轉相關的電磁提取自由能來提供動力的。 該研究強調了電子分佈函數（eDF）在物理推論中的關鍵作用，承認目前在亞愛丁頓黑洞吸積建模中存在不確定性。

儘管存在不確定性，許多模型產生的影像與 EHT2017 數據一致，凸顯了重力透鏡和時空幾何對等離子體物理細節的主導影響。 基於物理基礎、變異性、輻射效率、X 射線光度和噴流功率標準對某些模型的拒絕進一步完善了理解。 未來的研究，包括極化圖和低頻 VLBI 觀測，有望進一步限制模型。 該研究預測了未來 EHT 活動、多波長數據和新理論方法的潛在影響，強調了研究跨尺度黑洞的實驗的互補性，並證實了它們符合廣義相對論的預測。