Contribution ID: **23** Contribution code: **CC03** Type: **Talk**

Are AU Mic b and c on mutually inclined orbits?

Thursday, January 8, 2026 4:45 PM (15 minutes)

Young planets offer a unique window into the early stages of planetary evolution. Insights into their orbital architectures are powerful to trace their formation environment and constrain the timescales of various dynamical processes. AU Mic is one of the nearest pre-main sequence stars (~20 Myr), hosting 2 Neptune-sized planets and a debris disk. Previous studies have shown that the rotation of the central star, the debris disk, and the inner planet b are all aligned, suggesting that the system has not undergone violent evolution. Here we report new Rossiter–McLaughlin (RM) measurements for both AU Mic b and c using Magellan Planet Finder Spectrograph (PFS), which happened to transit back-to-back on August 25 and 26, 2024. We confirm the aligned orbit of AU Mic b, but an unexpected stellar signal during ingress and the large TTV of AU Mic c prevent us from obtaining a precise constraint on its obliquity. We employed multiple sets of methods to correct for stellar jitter, and most methods favor a solution of a high obliquity for planet c. A recent independent measurement by ESPRESSO also reported a loose constraint that favored a similar solution. If the misalignment is confirmed, AU Mic will be the first known case of a misaligned young planet as well as a rare example of a highly mutually inclined system. This finding could indicate a complex formation process beyond traditional pictures or the presence of rapid dynamical processes during the early stages of planetary systems.

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Session Classification: Contributed talks

Track Classification: CC03: Exoplanet and Astrobiology