

- Coronal loops are bright, arched structures in the corona, have temperatures of the order of million kelvin. Mechanisms that cause this heating are yet to be fully understood.
- Determining the 3D structure of coronal loops is crucial to unravel these heating mechanisms.
- Recent MHD simulations demonstrate that integrated emission from thin veil-like sheets in the corona can also be confused as coronal loops (Malanushenko et al. 2022)¹.
- High-resolution stereoscopic observations provide a unique opportunity to observe loops from two vantage points.
- Our analysis reveals similar intensity variation patterns when observed from two vantage points and along their length (from a single vantage point).
- Loops exhibit nearly circular cross-sections from two vantage points.
- These findings indicate that loops are three-dimensional tube-like structures.

Spatio-temporal Coherence

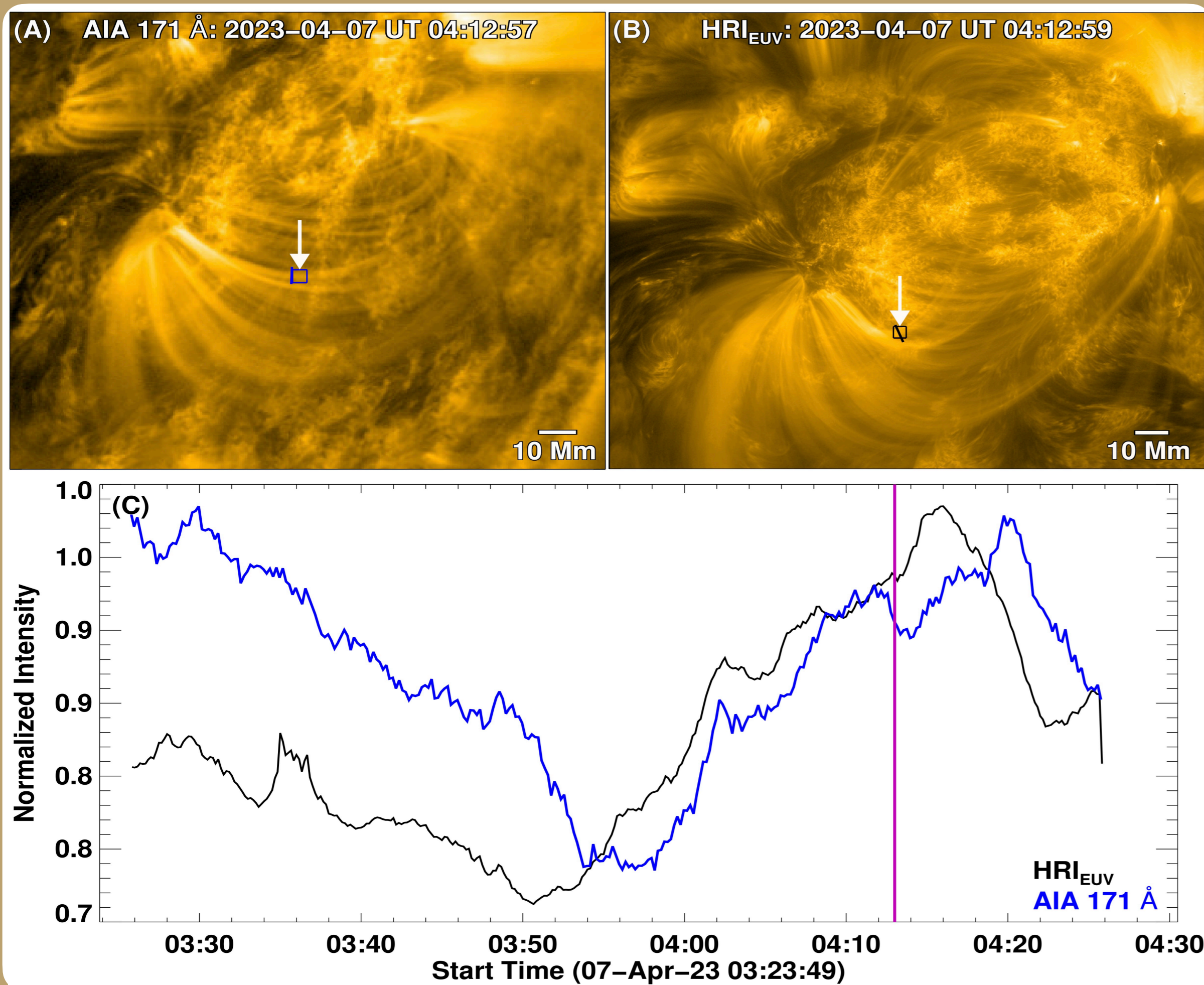


Figure 1: Coherent evolution of a loop shown from two vantage points. Panels (A) and (B) show the loop as seen from the AIA 171 Å and HRI_{EUV} respectively. Panel (C) shows that the loops exhibit similar intensity variations at timescales around 30 minutes. We identified ten such loops in our analysis.

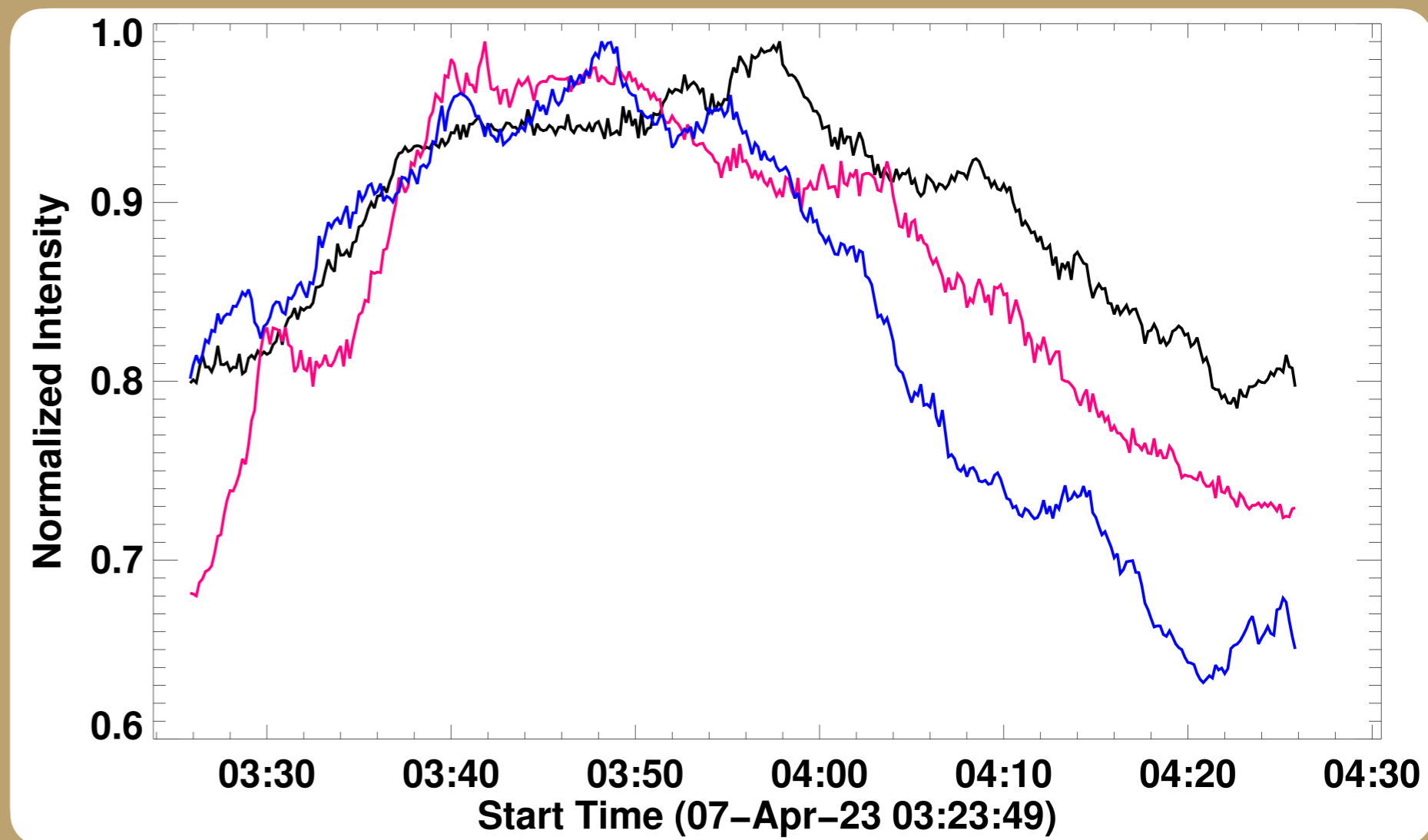


Figure 2: Coherent evolution along the length of the loop. Light curves display the intensity variations from three locations on a loop axis.

Loops demonstrate similar temporal variations when viewed from two different vantage points (Figure 1) and along their lengths from a single vantage point (Figure 2).

Such similarities in evolution patterns are unlikely to stem from a superposition of numerous veil-like, individual structures aligned with the line of sight.

This indicates that the emission originates from well-defined coherent structures rather than coronal veils that are randomly oriented.

Cross-sectional Shape

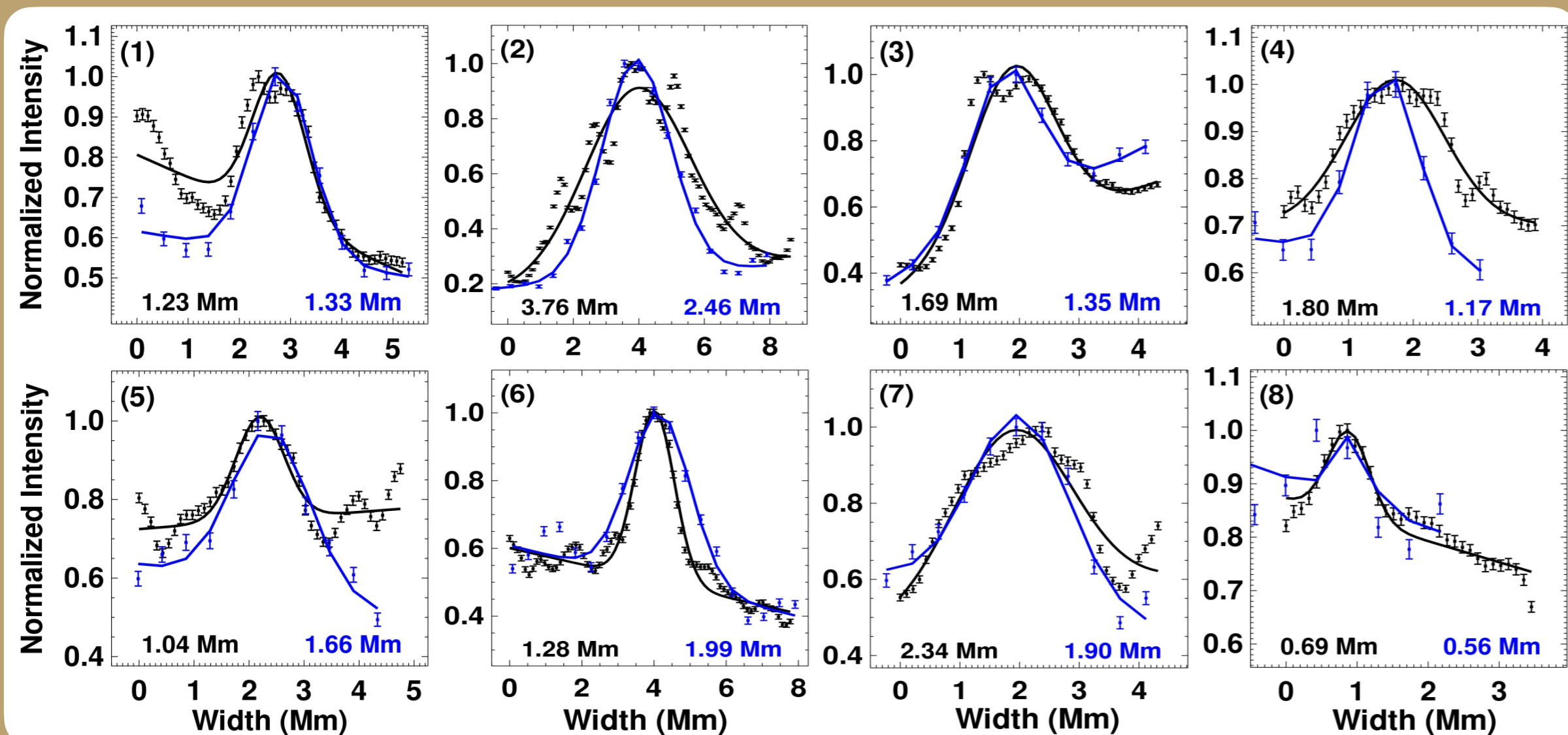


Figure 3: Cross-sectional widths of loops included in the study from two vantage points. Top left panel shows the location where we measure the widths of eight loops in panels (1) - (8). Black and blue curves in these panels are the single peaked gaussian fits for the cross-sectional intensity profile in HRI_{EUV} and AIA 171 Å filter respectively.

These measurements demonstrate that the widths as seen from both the vantage points are similar and indicate the nearly circular three-dimensional tubelike structures.

Summary and conclusions

- Loop Morphology:** Similar intensity variations and cross-sectional widths imply that coronal loops are three-dimensional nearly circular tube-like features.
- 'Coronal veil' hypothesis?:** Our findings hint that observed loops might not be overlapping emissions from many small, randomly aligned two-dimensional current sheets.
- Implications for Coronal Heating Models:** Our results are in line with the nanoflare heating models. Further investigations are needed to determine the distribution of nanoflares inside these structures.

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References

- Malanushenko et al. 2022, ApJ 927 1
- Ram et al 2024 (To be submitted)