# Jet Directionality and Curvature Activation Gradients under Universal Motion Theory

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**Abstract**

Universal Motion Theory (UMT) predicts that astrophysical jet alignments, particularly those from active galactic nuclei (AGN), correlate with underlying curvature activation gradients. This addendum models jet axis orientations based on $\nabla(\Phi\kappa)$ structures, predicts preferred statistical alignments over cosmological scales, and contrasts these predictions with the randomness expected under standard $\Lambda$CDM cosmology. The derivation strengthens UMT's observational footprint without altering its core framework.

## 1 Introduction

In standard cosmology, AGN jets are modeled as randomly oriented with respect to large-scale cosmic structures, except for local environmental effects. Universal Motion Theory (UMT) proposes an alternative mechanism: jet directionality arises naturally along curvature activation gradients $\nabla(\Phi\kappa)$, which influence large-scale angular momentum generation.

## 2 Curvature Activation and Tension Gradients

The curvature activation function is given by:

$$\Phi(\rho) = \frac{1}{1 + e^{-k(\rho - \rho_{th})}} \tag{1}$$

where $k$ is the steepness parameter and $\rho_{th}$ is the curvature density threshold.

The emergent gravitational field is:

$$G_{eff} = \nabla(\Phi\kappa) \tag{2}$$

Regions where $\nabla(\Phi\kappa) \neq 0$ experience tension gradients, which in turn influence the angular momentum axes of forming structures.

# 3 Jet Axis Alignment Modeling

In UMT, AGN jets are predicted to align statistically along the local curvature tension gradient:

$$\text{Jet Direction} \parallel \nabla(\Phi\kappa) \tag{3}$$

Key modeling features:

- **Preferred alignment**: Jets statistically point along activation tension vectors.
- **Scale dependence**: Alignment strength is stronger on larger scales where activation gradients are coherent.
- **Boundary behavior**: Near voids and filament boundaries, jet alignment may become more pronounced.

# 4 Contrast with ΛCDM Expectations

Standard ΛCDM models predict:

- **Random jet orientations** on large scales.
- **Local alignment** only in the presence of strong environmental shearing.

UMT predicts a more coherent, large-scale alignment pattern directly tied to curvature activation gradients, independent of local matter overdensities.

# 5 Observational Predictions

UMT predicts:

- Statistically significant correlations between AGN jet directions and inferred large-scale curvature gradients.
- Enhanced alignment near void boundaries and along cosmic filaments.
- Departure from isotropic random jet distributions at high significance levels over cosmological scales.

Ongoing and future radio surveys (e.g., VLASS, SKA) provide opportunities to test these predictions by mapping jet orientations across cosmic structures.

# 6 Conclusion

This addendum formalizes the prediction that AGN jet axes align with curvature activation gradients under Universal Motion Theory. Observational tests of jet directionality offer a direct method to evaluate UMT's claims regarding gravitational structure and activation-driven large-scale coherence.

### References


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3. Contigiani, O., Hoekstra, H., Merten, J. (2017). Probing cosmic shear with radio observations.