import numpy as np

from astropy.coordinates import SkyCoord

import astropy.units as u

import matplotlib.pyplot as plt

# CMB cold spot galactic coordinates

cmb\_l, cmb\_b = 209, -56

cmb\_coord = SkyCoord(l=cmb\_l\*u.deg, b=cmb\_b\*u.deg, frame='galactic')

# Generate N random MBT bell centers across the sky

N = 10000

rand\_l = np.random.uniform(0, 360, N)

rand\_b = np.random.uniform(-90, 90, N)

mbt\_coords = SkyCoord(l=rand\_l\*u.deg, b=rand\_b\*u.deg, frame='galactic')

# Compute angular separations

separations = mbt\_coords.separation(cmb\_coord).deg

# Plot histogram of separations

plt.figure(figsize=(8, 5))

plt.hist(separations, bins=50, color='skyblue', edgecolor='black')

plt.axvline(32, color='red', linestyle='--', label='Observed MBT-CMB Separation (~32°)')

plt.xlabel("Angular Separation from CMB Cold Spot (°)")

plt.ylabel("Number of Random MBT Roots")

plt.title("Random MBT Bell Root Alignment Test")

plt.legend()

plt.grid(True, alpha=0.3)

plt.tight\_layout()

plt.show()

# Print probability of getting ≤32° separation

hits = np.sum(separations <= 32)

prob = hits / N

print(f"Fraction of MBT roots within 32° of CMB cold spot: {prob:.4f} ({hits} out of {N})")

I then did this