Abstract Submitted
for the DFD15 Meeting of
The American Physical Society

Retrograde rotation of the large-scale flow in turbulent rotating Rayleigh-Benard convection with high Rossby number[1] JIN-QIANG ZHONG, HUI-MIN LI, XUE-YING WANG, Tongji University — We present measurements of the azimuthal orientation $\theta(t)$ of the large-scale circulation (LSC) for turbulent Rayleigh-Bénard convection in the presence of week rotations Ω. Linear retrograde rotations of the LSC circulating plane are observed over the entire Rossby-number range ($1 \leq Ro \leq 300$) studied. When the Ro increases, the ratio of the retrograde rotation rate, $\gamma = -\langle\dot{\theta}\rangle/\Omega$ remains nearly a constant 0.12 in the range of ($1 \leq Ro \leq 80$) and starts to increases when $Ro > 80$. When $Ro \simeq 300$, γ approaches a value of 0.36 close to the prediction from previous theoretical models. In a background of linear rotations, erratic changes in $\theta(t)$ accompanied by decreasing in the LSC amplitude δ are observed. These small-δ events give rise to the increasing γ with very high Ro numbers ($80 \leq Ro \leq 300$). In this range, the diffusivity of θ is proportional to δ^{-2}. Moreover, the occurrence frequency of the small-δ events, and their average duration are independent on Ro. We propose a model to include additional viscous damping for the LSC azimuthal motion due to turbulent viscosity and provide theoretical interpretations of the experimental results.

[1]Work supported by NSFC Grant No. 11202151.

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Date submitted: 01 Aug 2015 Electronic form version 1.4