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Magnetic Activity in the Galactic Center Region

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By performing a global magnetohydrodynamical (MHD) simulation for the Milky Way with an axisymmetric gravitational potential, we propose that spatially dependent amplification of magnetic fields possibly explains the observed noncircular motion of the gas in the Galactic centre (GC) region. The radial distribution of the rotation frequency in the bulge region is not monotonic in general. The amplification of the magnetic field is enhanced in regions with stronger differential rotation, because magnetorotational instability and field-line stretching are more effective. The strength of the amplified magnetic field reaches >~ 0.5 mG, and radial flows of the gas are excited by the inhomogeneous transport of angular momentum through turbulent magnetic field that is amplified in a spatially dependent manner. As a result, the simulated position-velocity diagram exhibits a time-dependent asymmetric parallelogram-shape owing to the intermittency of the magnetic turbulence; the present model provides a viable alternative to the bar-potential-driven model for the parallelogram shape of the central molecular zone. In addition, Parker instability (magnetic buoyancy) creates vertical magnetic structure, which would correspond to observed molecular loops, and frequently excited vertical flows. Furthermore, the time-averaged net gas flow is directed outward, whereas the flows are highly time dependent, which would contribute to the outflow from the bulge.

References

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Figure xx

Note: Abstract should be in 1 page.