Abstract Submitted
for the MAR12 Meeting of
The American Physical Society

Theory of the ac spin valve effect: a new method to measure spin relaxation time[1] DENIS KOCHAN, MARTIN GMITRA, JAROSLAV FABIAN, University Regensburg — Parallel (P) and antiparallel (AP) configurations of FNF junctions have, in a dc regime, different resistivities ($R_{AP} > R_P$), giving rise to the giant magnetoresistance (GMR) effect, which can be explained within the spin injection drift-diffusion model. We extend the model to include ac phenomena and predict new spin dynamical phenomenon; the resonant amplification and depletion of spin accumulation in the P and AP configurations, respectively. As the major new effect, the spin valve magnetoimpedance of the FNF junction oscillates with the driving ac frequency, which leads to negative GMR effect ($|Z_{AP}| < |Z_P|$). We show that from the spin-valve oscillation periods, measured all electrically in the GHz regime, the spin relaxation times could be extracted without any magnetic field and sample size changes (contrary to other techniques). For thin tunnel junctions the ac signal becomes pure Lorentzian, also enabling one to obtain the spin relaxation time of the N region from the signal width. This work, was published in Physical Review Letters,10, 176604 (2011).

[1]This work was supported by DFG SFB 689

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Date submitted: 10 Nov 2011 Electronic form version 1.4