Abstract Submitted for the MAR12 Meeting of The American Physical Society

Non-equilibrium coupling and femto-second oscillatory spin torque in non-collinear F/N/F magnetic multilayers<sup>1</sup> JIANWEI ZHANG, QIANG WANG, Dept. of Physics, Tongji University — By employing time-dependent diffusion theory, we study timeevolution behaviors of spin torque and spin current in non-collinear Ferromagnetic/Normal/Ferromagnetic tri-layers structure. We find in ferromagnetic layer spin toque has femto-second oscillatory in its initio building-up process, which indicates that excited itinerant electron's spin process alone background magnetization in femto-second period near the interfacial region. We also find even mismatch of background magnetization at each F/N interfaces is not enough to compensate discontinuity of spin current near interface, however, by introducing non-equilibrium coupling between two F/N interfaces, one can produce a continuous spin current state across both two interfaces without mandating any boundary conditions. In our study, we find a new universal time-dependent propagator to generate all directions continuous spin current across two F/N interfaces. This new spin propagator is also closely related to spin flip scatter at interface. In addition, we also find the coupling of two N/F interfaces enlarges transverse spin diffusion channels into magnetic layer. Finally, our time-dependent spin current and spin torque states also match our pervious self-consistent steady state results.

<sup>1</sup>This work was supported by Science & Technology Commission of Shanghai Municipality (Grant No.10PJ1410300).

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Date submitted: 19 Nov 2011

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