1096-58-272 **Xiangjin Xu*** (xxu@math.binghamton.edu), Department of Mathematical Sciences, Binghamton University-SUNY, 4400 Vestal Parkway East, Binghamton, NY 13902. *New Heat Kernel Estimates on Riemannian Manifolds with Negative Curvature.* Preliminary report.

Apply the new Li-Yau type Harnack estimates for the heat equations on manifolds with $Ric(M) \geq -K$, $K \geq 0$, which established by Junfang Li and the author [Advance in Mathematics 226(5) (2011), 4456-4491], we prove a new upper bound estimate for the heat kernel $H(x,y,t)$ of manifolds with $Ric(M) \geq -K$,

$$H(x,y,t) \leq A_K(t) V_x^{-1/2}(\delta(t)) V_y^{-1/2}(\delta(t)) \exp\left[-\frac{d^2(x,y)}{4t} + [1 + d^2(x,y)] B_K(t) \right],$$

where $A_K(t), B_K(t) : [0,\infty) \to [0,\infty)$ are bounded functions, and $\delta(t) \sim t$ as $t \to 0$ and $\delta(t) \sim 1$ as $t \to \infty$. While in the seminal work of Li-Yau [Acta Math. 156 (1986) 153-201.], the heat kernel upper bound estimates had δ-loss:

$$H(x,y,t) \leq C(\delta,n) V_x^{-1/2}(\sqrt{t}) V_y^{-1/2}(\sqrt{t}) \exp\left[-\frac{d^2(x,y)}{(4+\delta)t} + C_1 \delta K t \right],$$

where constant $C(\delta,n) \sim \exp\left[\frac{c_1}{\delta}\right]$ as $\delta \to 0$, due that there was non-sharp Harnack estimates on manifolds with negative curvature. Some new lower bound estimates of the heat kernel are also discussed. (Received August 26, 2013)