

# *Mitigating Extremely Slow Corner Cases in the GNU Math Libraries on TLCC2 and BG/Q*

LC User's Meeting

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# In ~2008 the GNU math library decided to sacrifice performance for accuracy

- Drops into 768 bit emulation mode for some inputs
  - For BG/Q (Seq) bgxlc -O3 -qstrict or bgxlc -O2 or bggcc -O3
    - `pow(0.999999999999999998L, 1.5)` -> 898 cycles
    - `pow(0.999999999999999999L, 1.5)` -> 8,675,748 cycles
    - `exp(0.111E-15L)` -> 374 cycles
    - `exp(0.11102230246E-15L)` -> 1,675,327 cycles
  - Hits TLCC2 (Zin) also for gcc (all optimization levels)
    - `pow(0.999999999999999997L, 1.5)` -> 1,127,464 cycles
    - `exp(0.11102230246E-15L)` -> 203,397 cycles
- Recently caused unexplained 4X slowdown on BG/Q
- Diagnostic: STAT & profiling shows descriptive names
  - `__slowexp`, `__slowpow`, `__mpexp` (called by `slowexp` & `slowpow`)

# Mitigation Strategy: Don't Use GNU Math Library!

- On TLCC2 (Zin) with gcc, link to Intel's Math Libraries
  - `-L/usr/local/tools/ic-14.0.174/lib -Wl,-rpath,/usr/local/tools/ic-14.0.174/lib -limf -lintlc`
  - Automatic for Intel Compilers (why we haven't seen much)
  - However gives slightly different answers for these corner cases
- On BG/Q (Seq) link to IBM's MASS Library
  - `-L/opt/ibmcmp/xlmass/bg/7.3/bglib64 -lmass`
  - Automatically inlined for IBM Compilers with `-O3` **if don't specify `-qstrict`**
  - Slight differences in accuracy possible for 'exceptional' values
- Surprisingly tricky to get link line right
  - Must be placed just before first `-lm` or `-lxlmath`
  - Must be placed after everything else (`.o` files, etc.)
- Link line check for library that provided exp
  - `-Wl,-y,exp` -> want exp found first in `libimf` or `libmass`
  - I can help -> [gyllen@llnl.gov](mailto:gyllen@llnl.gov), 4-5485



"Mr. Osborne, may I be excused? My brain is full."