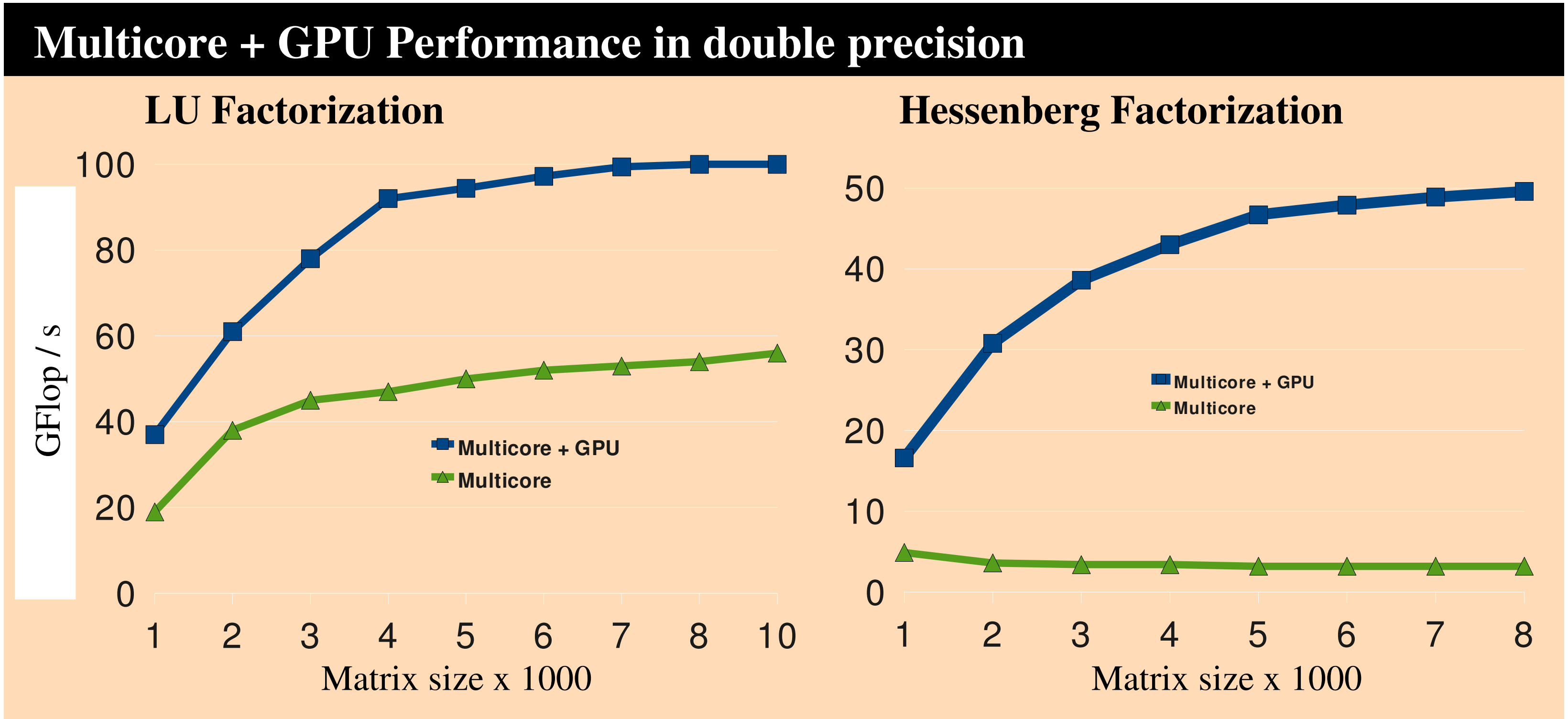
MAGMA - Current and future work

- Algorithms for Multicore + GPU
  - Where performance is % of Multicore peak + GPU peak
- Release the two-sided factorizations [**target release SC09**]
- Complete eigen-solvers
- Communication-optimal algorithms
- User-defined accuracy
  - trade-off accuracy for speed; mixed-precision solvers
- CUDA BLAS kernels
- Portability – demonstrate an easy OpenCL port
- Sparse linear algebra kernels
  - SpMV for structured (e.g. stencils) and unstructured matrices; iterative linear/eigen-solvers

One and **two-sided** Multicore+GPU Factorizations



- These will be included in up-coming MAGMA releases
- **Two-sided factorizations can not be efficiently accelerated on** homogeneous x86-based **multicores** (above) because of memory-bound operations
  - we developed **hybrid algorithms that overcome those bottlenecks** (**16x speedup**!)

MAGMA BLAS

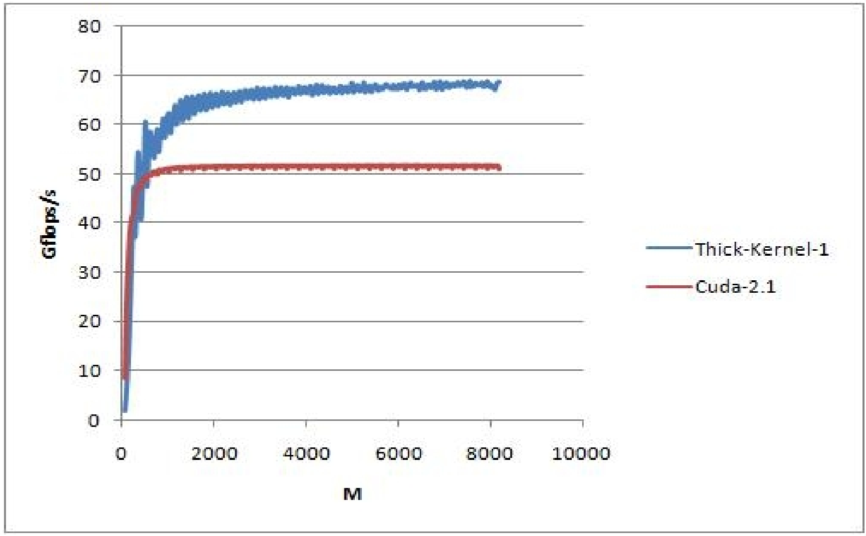
- Accelerate a subset of BLAS that is crucial to the performance of MAGMA routines
  - GEMM on rectangular matrices and sizes not divisible by certain [currently best performing] block sizes
    - approach is based on auto-tuning
    - important for all routines
  - Work with triangular matrices, e.g. TRSM
    - important for many routines
    - sometimes can be avoided
    - crucial for example in mixed-precision iterative solvers while iterating on the GPU
  - GEMV
    - used in Hessenberg and mixed-precision iterative solvers

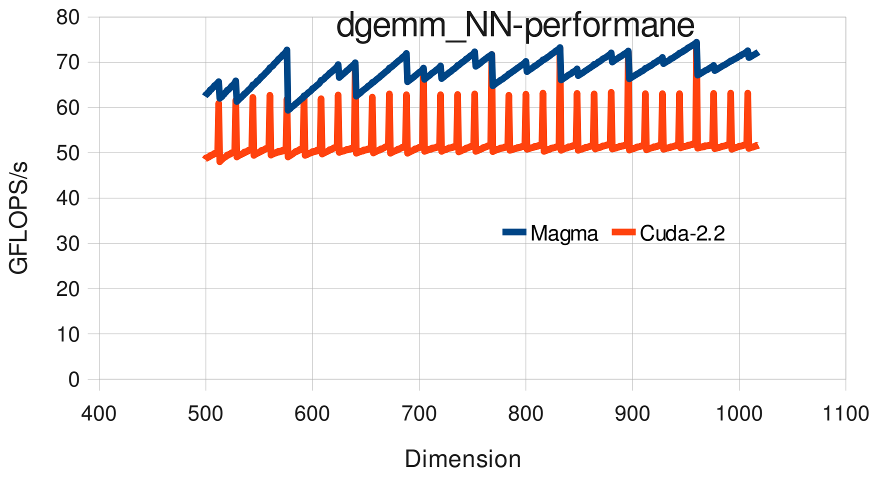
GEMM Acceleration

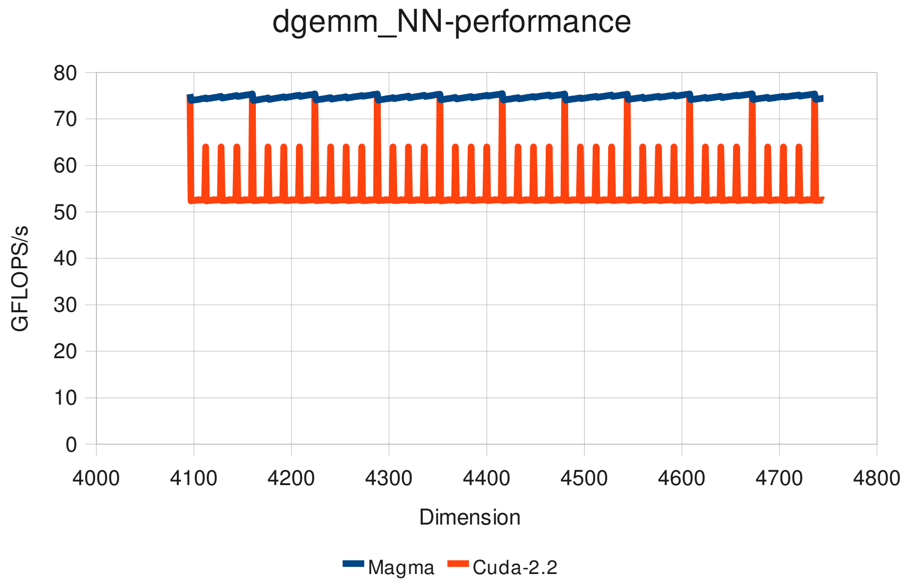
- GEMM on rectangular matrices
  - various kernels needed for the one and two-sided factorizations, e.g.

  magma_dgemm('n', 'n', n-k, n-k-32, 32, ...)

- Remove performance oscillations

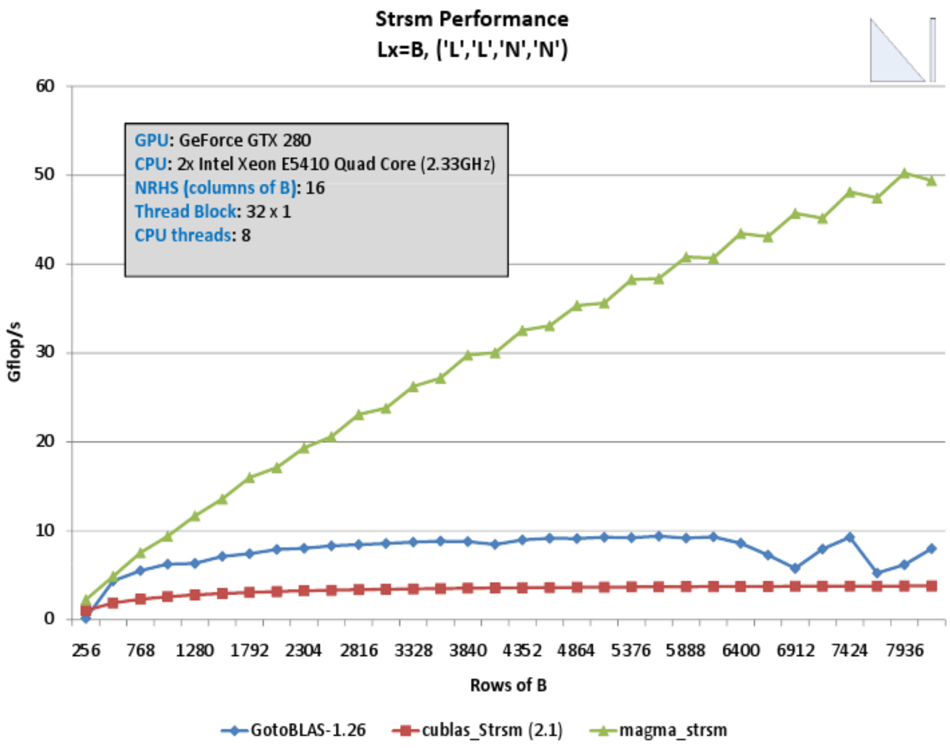






MAGMA TRSM and GEMV

STRSM



DGEMV