值得一提的是，输入参数可以直接通过 -nx -ny -nz 指定， hpcg.sh 脚本会接受这几个参数然后作为指定问题规模，否则会读取 ./bin/sample-dat/hpcg.dat 中的数据文件。

其他的修改只要在 Make.CUDA\_X86 中直接修改即可。

在配置基本完成后，开始针对提示进行修改尝试。

HPCG输入文件在这里可以用hpcg.sh脚本的参数传递来替代，整体上来讲是问题规模越大运算能力越强，但是当问题规模出现203 203 203这类奇数甚至质数时性能下降比较严重（不用SPRASE编译的文件运行结果对比来看，97和264，在第一次采用稀疏矩阵库编译后会有分块奇偶检测）

网络上有帖子说使用clang代替nvcc编译可以获取更好的性能，但是使用clang之后计算性能反而下降了40%左右。

原编译选项是-O3+-Ofast，gpu部分已经最优，cpu部分经过修改调试，影响不大。

至于不同的数学库，由于官方文档强调cuda内的稀疏矩阵数学运算库是性能很关键的一环，而且gpu代码似乎也只有cuda一家提供的数学库符合源代码里面调用的的接口，所以这部分最后我没有做。

更换mpi时，更换其他的mpi都会出现ompi\_mpi\_开头的名称找不到链接库的问题，似乎源代码使用了openmpi特有的接口和变量，我不打算去修改源代码，所以这部分没能完成。

调整核心数和进程数。经过反复调整-np 2时效果最好，因为sbatch最多1个节点两块卡，选择进程多了反而会计算性能下降，可能是出现了抢SM的现象。进程过多会直接出现超出内存限制的情况。即使是保持进程总占用内存不变，也是-np 2最快。-np 3和-np 4速度都比较慢。

测试结果简要总结如下：  
1. 256 256 256, nvcc, -O3&-Ofast, -np 1

Final Summary::HPCG result is VALID with a GFLOP/s rating of=138.041

Final Summary::HPCG 2.4 rating for historical reasons is=138.327

Final Summary::Results are valid but execution time (sec) is=11.1961

Final Summary::Official results execution time (sec) must be at least=1800

1. 256 256 256, nvcc, -O3&-Ofast, -np 2 最优

Final Summary::HPCG result is VALID with a GFLOP/s rating of=268.367

Final Summary::HPCG 2.4 rating for historical reasons is=268.981

Final Summary::Results are valid but execution time (sec) is=11.5315

Final Summary::Official results execution time (sec) must be at least=1800

1. 16 16 16, nvcc, -O3&-Ofast, -np 2

Final Summary::HPCG result is VALID with a GFLOP/s rating of=2.47372

Final Summary::HPCG 2.4 rating for historical reasons is=2.79026

Final Summary::Results are valid but execution time (sec) is=9.93131

Final Summary::Official results execution time (sec) must be at least=1800

1. 128 128 128, nvcc, -O3&-Ofast, -np 2

Final Summary::HPCG result is VALID with a GFLOP/s rating of=236.219

Final Summary::HPCG 2.4 rating for historical reasons is=237.312

Final Summary::Results are valid but execution time (sec) is=10.3391

Final Summary::Official results execution time (sec) must be at least=1800

1. 203 203 203, nvcc, -O3&-Ofast, -np 2

Final Summary::HPCG result is VALID with a GFLOP/s rating of=64.7172

Final Summary::HPCG 2.4 rating for historical reasons is=65.1909

Final Summary::Results are valid but execution time (sec) is=9.47067

Final Summary::Official results execution time (sec) must be at least=1800

这个测试案例比较神奇，我自己都没有复刻成功。最开始我没使用稀疏矩阵库的时候测出来了这个结果，但是后来即使我make clean之后不用稀疏矩阵库，也会提示稀疏矩阵生成文件的GenerateCoarseProblem函数里有个%2论断错误。很神奇，没有再次复刻过这个测试，但是它确实第一次在偶然间成功了。

1. 256 256 256, clang++, -O3, -np 2

Final Summary::HPCG result is VALID with a GFLOP/s rating of=158.087

Final Summary::HPCG 2.4 rating for historical reasons is=158.959

Final Summary::Results are valid but execution time (sec) is=11.6416

Final Summary::Official results execution time (sec) must be at least=1800

1. 16 16 16, clang++, -O3, -np 2

Final Summary::HPCG result is VALID with a GFLOP/s rating of=0.592648

Final Summary::HPCG 2.4 rating for historical reasons is=0.598816

Final Summary::Results are valid but execution time (sec) is=10.1518

Final Summary::Official results execution time (sec) must be at least=1800

1. 16 16 16, nvcc, -O3&-O3, -np 2

Final Summary::HPCG result is VALID with a GFLOP/s rating of=0.366568

Final Summary::HPCG 2.4 rating for historical reasons is=0.368847

Final Summary::Results are valid but execution time (sec) is=10.0563

Final Summary::Official results execution time (sec) must be at least=1800

1. 256 256 256，nvcc，-O3&-O3，-np 2

Final Summary::HPCG result is VALID with a GFLOP/s rating of=264.233

Final Summary::HPCG 2.4 rating for historical reasons is=267.233

Final Summary::Results are valid but execution time (sec) is=11.606

Final Summary::Official results execution time (sec) must be at least=1800

1. 256 256 256，nvcc，-O3&-O2，-np 2

Final Summary::HPCG result is VALID with a GFLOP/s rating of=266.509

Final Summary::HPCG 2.4 rating for historical reasons is=267.175

Final Summary::Results are valid but execution time (sec) is=11.6082

Final Summary::Official results execution time (sec) must be at least=1800

1. 16 16 16，nvcc，-O3&-O2，-np 2

Final Summary::HPCG result is VALID with a GFLOP/s rating of=2.5577

Final Summary::HPCG 2.4 rating for historical reasons is=2.59437

Final Summary::Results are valid but execution time (sec) is=9.319

Final Summary::Official results execution time (sec) must be at least=1800

1. 256 256 128, nvcc, -O3&-Ofast, -np 4

Final Summary::HPCG result is VALID with a GFLOP/s rating of=200.48

Final Summary::HPCG 2.4 rating for historical reasons is=201.083

Final Summary::Results are valid but execution time (sec) is=12.3582

Final Summary::Official results execution time (sec) must be at least=1800

1. 256 256 256, nvcc, -O3&-Ofast, -np 4

Final Summary::HPCG result is VALID with a GFLOP/s rating of=107.445

Final Summary::HPCG 2.4 rating for historical reasons is=107.622

Final Summary::Results are valid but execution time (sec) is=11.5908

Final Summary::Official results execution time (sec) must be at least=1800