CUBLAS FOR COLOR MATRIX

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COLOR MATRIX MULTIPLICATION FOR N EVENTS AND M AMPLITUDES/COLORS IN PRECISION T

N events, M amplitudes x matrix MxM colors x N evts, M ampl (conj) = N matrix elements

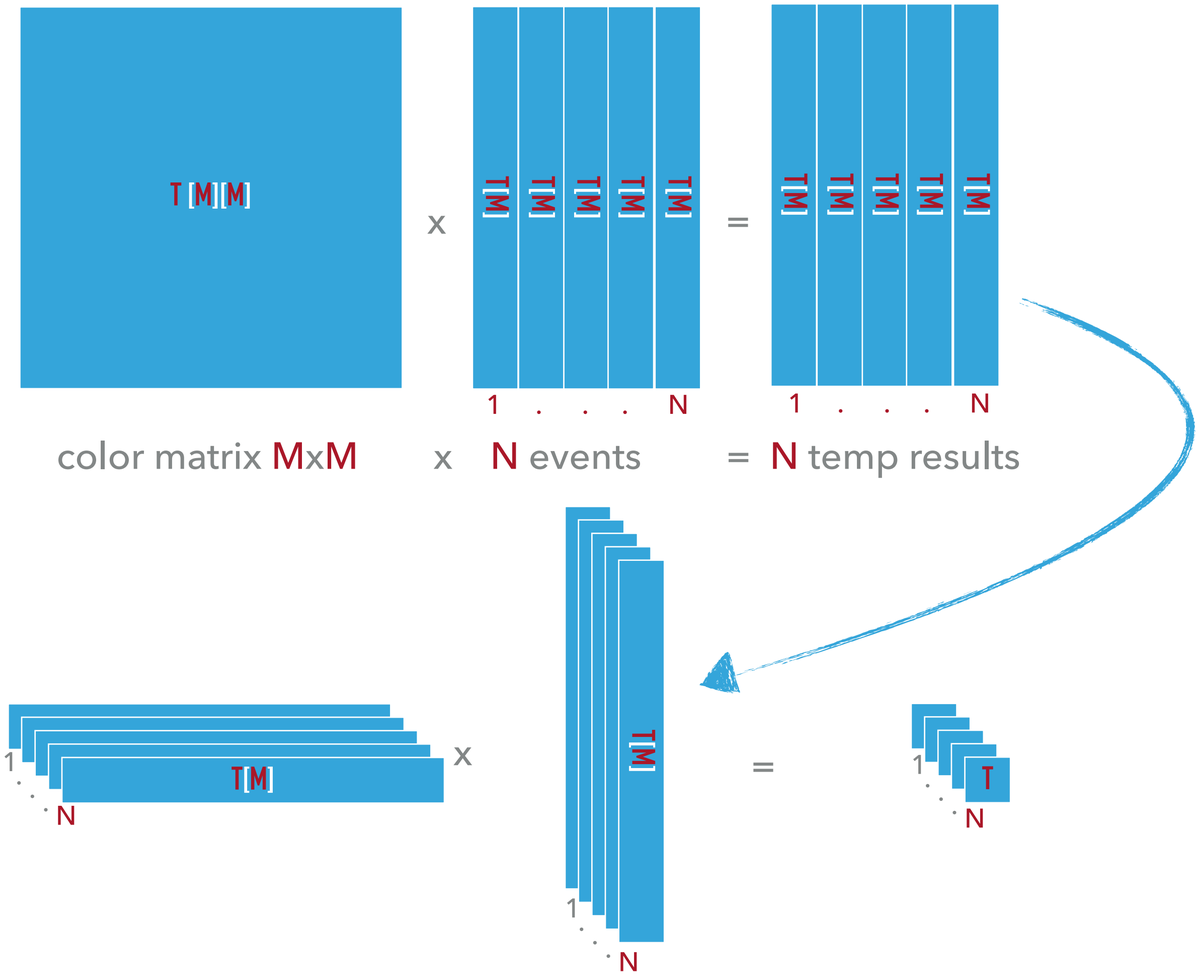
```
T me = 0;

for ( int i = 0; i < ncolor; ++i ) {
  complex<T> temp;
  for ( int j = 0; j < ncolor; ++j ) {
    temp += cm[i][j] * amp[j];
  }
  me += real(temp) * real(amp[i]) + imag(temp) * imag(amp[i]);
}
```

"original" implementation (N times)

"cublas"

- split amplitudes into real and imaginary part
- call cublas with the multiplications above for each
- sum up real and imaginary results

CUBLAS IMPLEMENTATION DETAILS



1st multiplication: **cublasTsymm**

multiply symmetric (color) matrix with matrix (vectors for N events)

2nd multiplication: **cublasDgemvBatched**

multiply N batched matrices (1xM) with N vectors (size M).

NB: vector reorganised as a T**

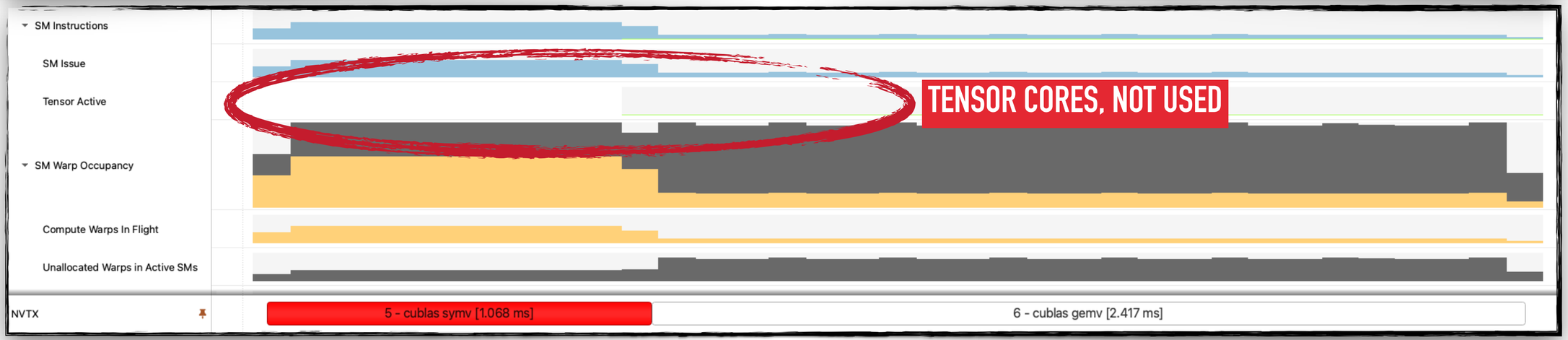
Repeat the above for real and imaginary part and sum up the two.

USE OF TENSOR CORES

- Cublas decides itself whether to use tensor cores for a multiplication or not

Same Matrix (120 x 120) calculation in:

double precision

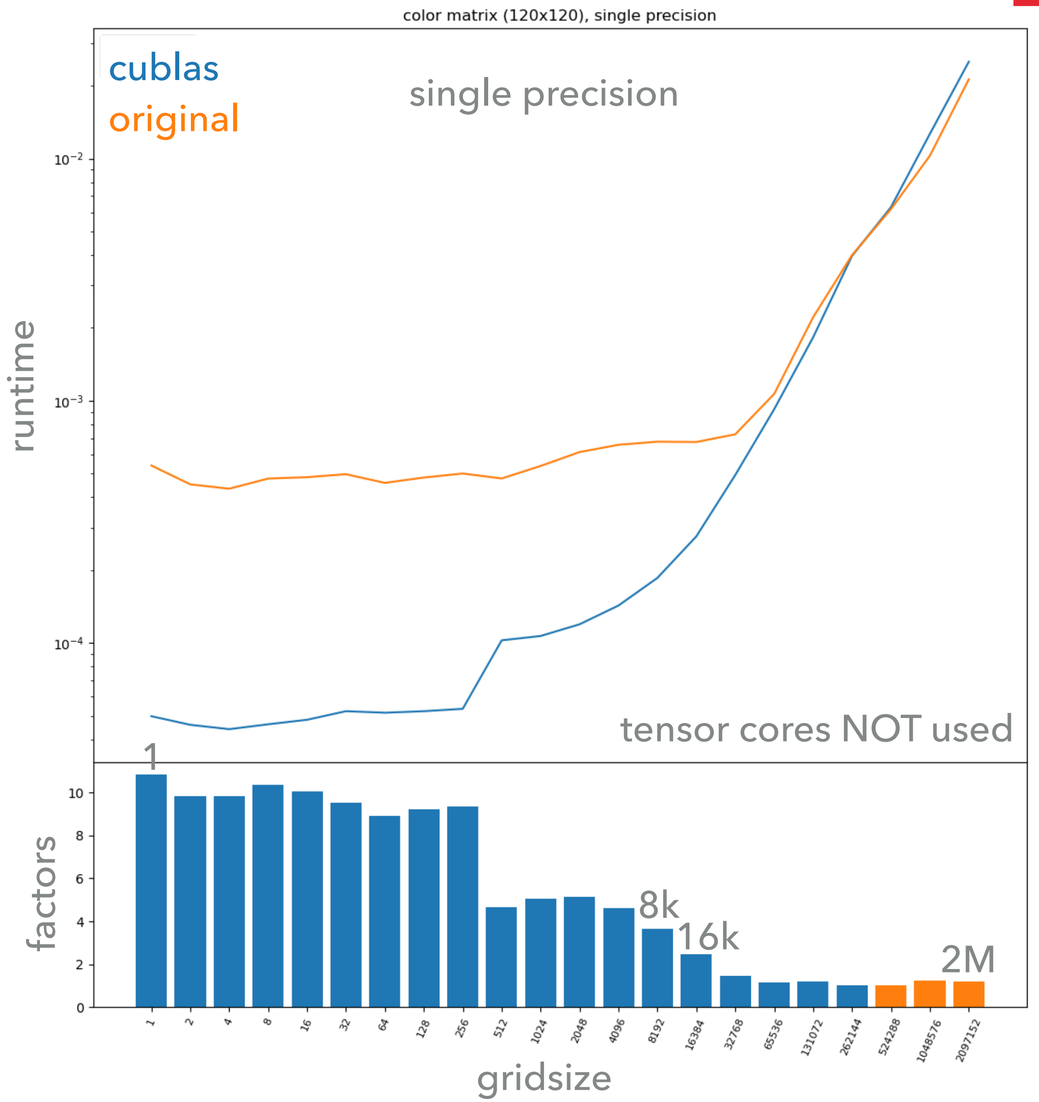


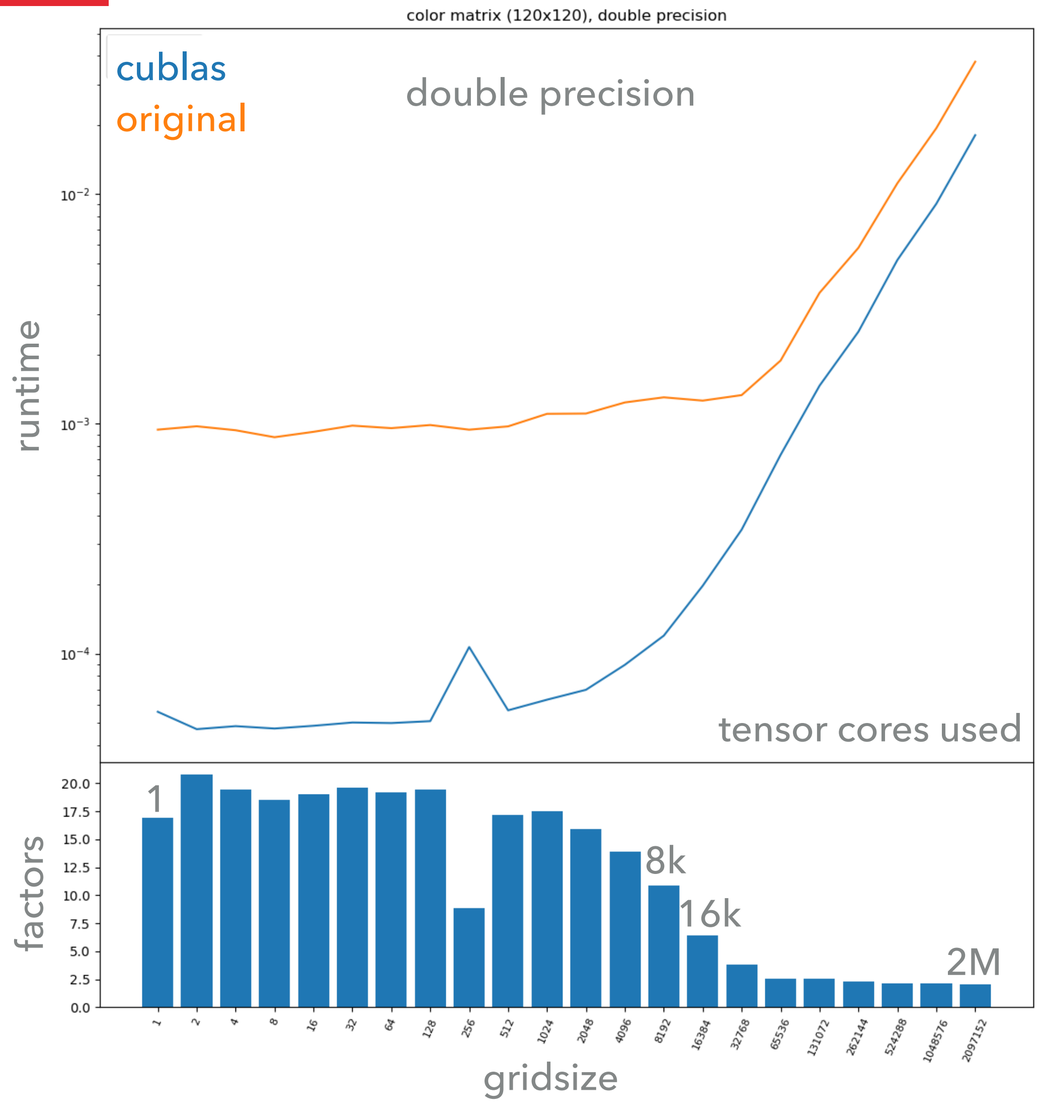
single precision

- NB: for smaller matrices, e.g. 24 x 24 tensor cores not used at all

COMPARISON ORIGINAL TO CUBLAS IMPLEMENTATION: COLOR MATRIX 120 X 120

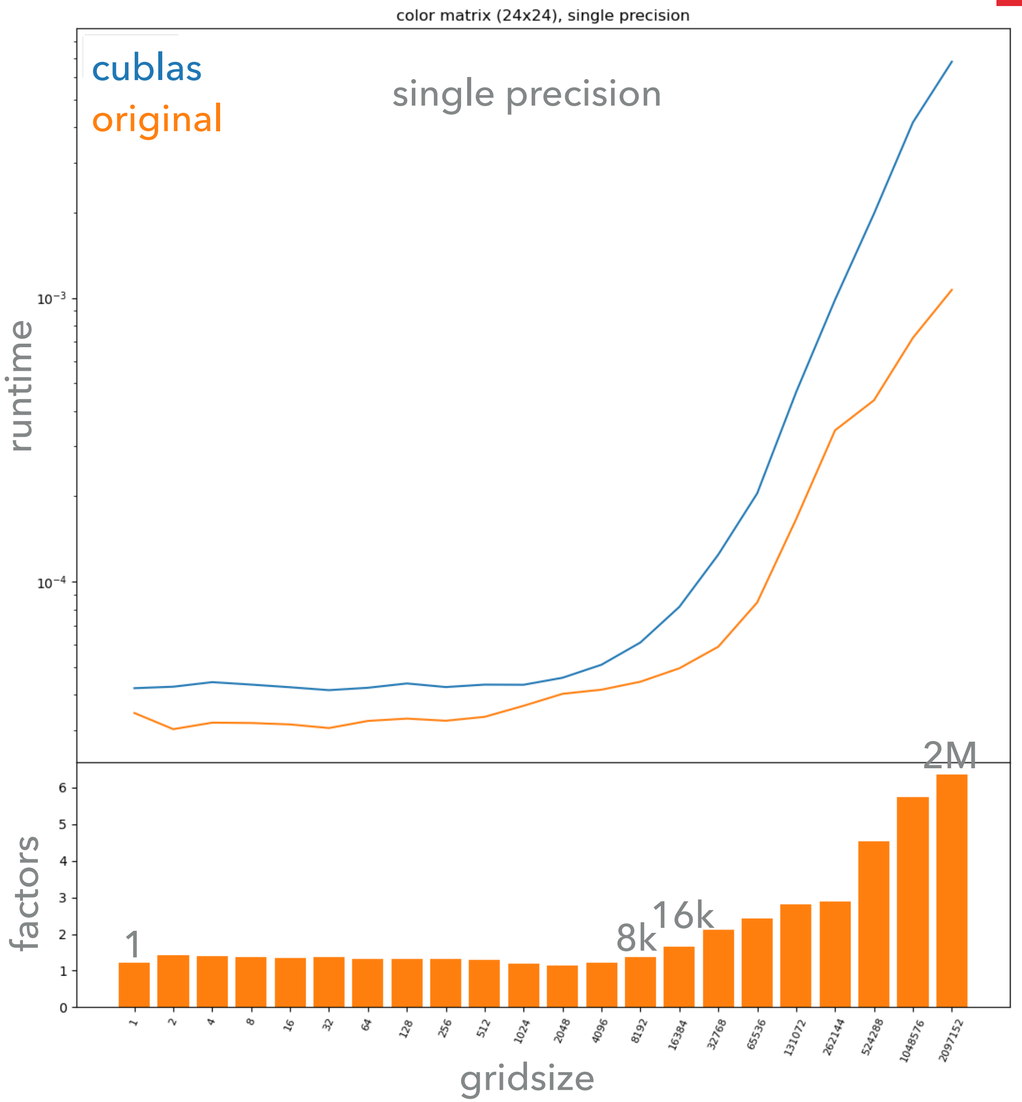
e.g. gg–>ttggg

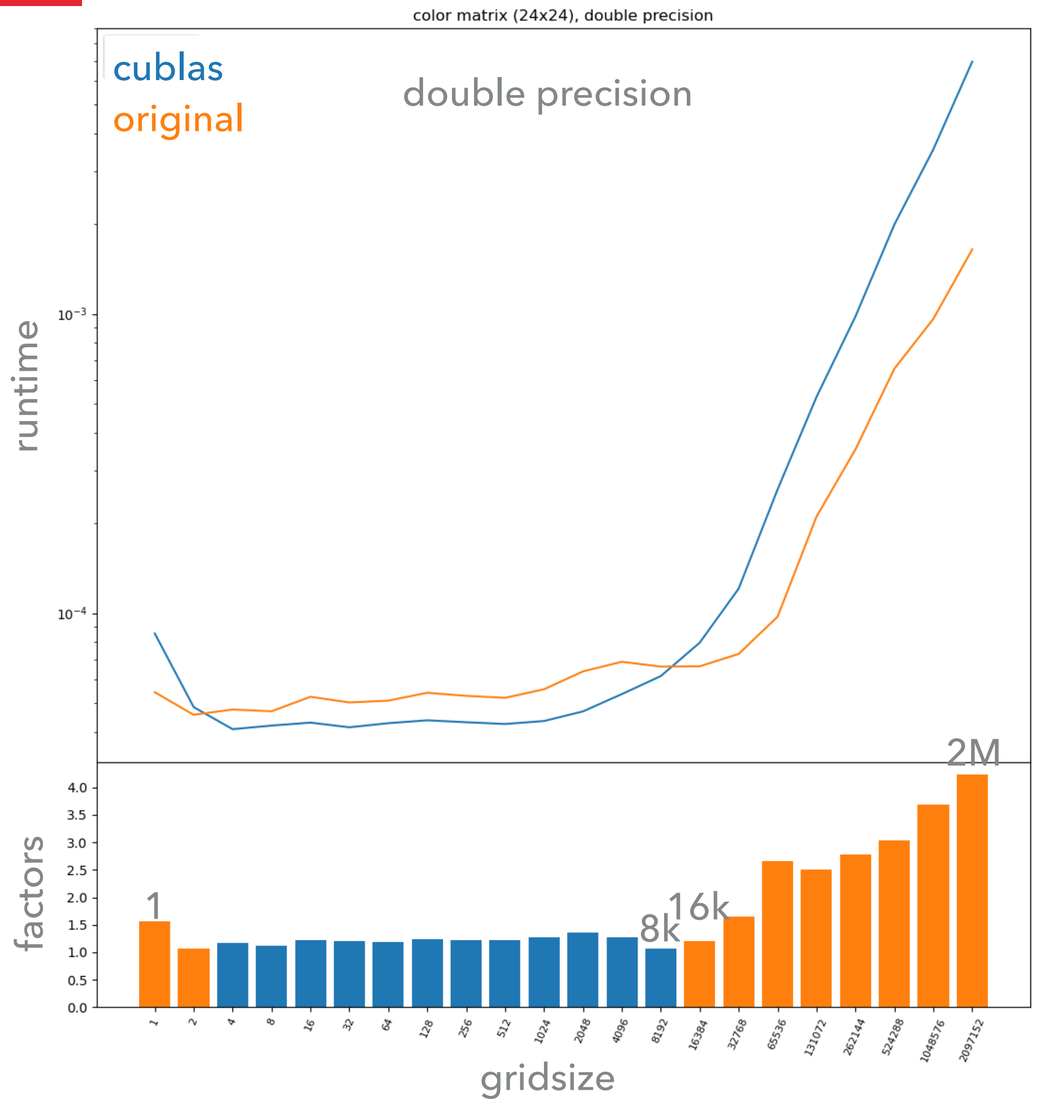




COMPARISON ORIGINAL TO CUBLAS IMPLEMENTATION: COLOR MATRIX 24 X 24

e.g. gg–>ttgg





MORE IDEAS

- Run with even bigger matrices, e.g. 6 particles in final state –> color matrix 720x720
  - I expect to use tensor cores with more computational load
- Tensor cores are only used by cublas for matrix - matrix multiplications
  - Re-organise the second (currently batched) multiplication of matrix - vector to matrix - matrix, will it pay off?
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