GEORG-AUGUST-UNIVERSITÄT
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Vectorization of the Geometry Navigation

ACTS Parallelization Meeting

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Vectorization for detray

Considerations

- Large number of line plane intersections during navigation
- At the moment: different LA backends, but mainly Eigen
- Parallelize over multiple surface intersections to find candidates
- VecGeom parallelizes over multiple particles

=> Speedup by Vectorization: theoretically up to 8x for the intersections (depends on the floating point precision, instruction set),

=> Overall limitation by Amdahl's law tbd

Feasibility study:

- Simple line plane intersections using Vc library
- Tested different methods (horizontal vs vertical)
- Some preliminary benchmarking

Source: https://github.com/niermann999/IntersectionTests

Preliminary Results

Vectorization Implementations

- **Vertical :** use simdArray class, no changes in data layout
- **Horizontal:** reorder data in memory to fill Vc vectors in batches
- **'Hybrid' :** use gather operation on the fly to transform data into horizontal layout, data vector needs to contain struct

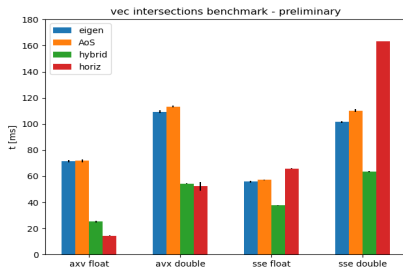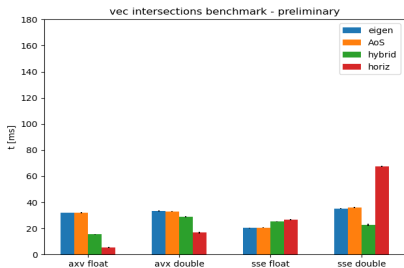## speedup for the vectorized intersections:
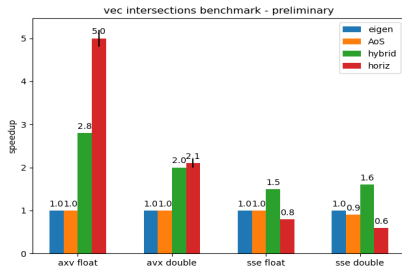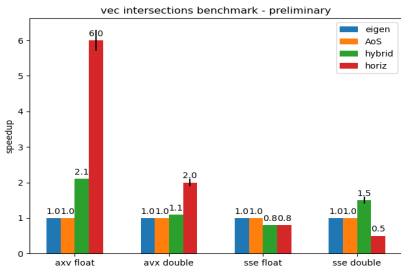
⇒ Using vectors as containers for results seems to introduces a large penalty (right)

Outlook

exec time for the vectorized intersections:

vec intersections benchmark - preliminary

vec intersections benchmark - preliminary

TODO

- Some investigations left (more realistic setup fro detray, compiler flags, passing of results ...)
- Implement veccore (consider portability)
  `https://github.com/root-project/veccore`
- Also consider other possibilities for vectorization