IRIS-HEP AGC workshop 2023

Experience with AGC at German facilities

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Objectives

This work is funded by FIDIUM (Federated Digital Infrastructures for Research on Universe and Matter)

- explore, try out, develop and test novel analysis techniques and facilities for HEP analyses
- AGC perfect match to perform reproducable benchmarks
- test distributed dask-based workflow of the AGC ttbar analysis on various sites

Changes in code

The AGC version I used for these tests is a couple of months behind the main branch now (merging jupyter notebooks is a pain)

- construct fileset that uses xrootd-urls to `LRZ-LMU_LOCALGROUPDISK` storage
- in order to be able to authenticate with xrootd, a couple of environment variables have to be set at the top of the notebook, like

```
os.environ["X509_USER_PROXY"] = "/path/to/proxy"
```

Changes in code

I want to use dask to distribute the workload across a SLURM / HTCondor cluster → create a dask client that is backed up by a cluster and pass that client to the coffea executor

```
from dask.distributed import Client
from dask_jobqueue import SLURMCluster

cluster = SLURMCluster(
    name=...,
    cores=...,
    memory=...,
)
cluster.scale(75)     # <-- easily scale the cluster up or down
client = Client(cluster)
```

Sites

LMU

institute cluster at LMU Munich consisting of one very powerful node and desktop computers

LRZ

WLCG Tier-2 site in Munich

Vispa

analysis facility operated by RWTH Aachen; provides a web-based terminal, code editor and jupyter hub: https://vispa.physik.rwth-aachen.de

Software environment

LMU

- distro: Ubuntu 20.04
- installation: all in one python virtual environment
- job-scheduler: SLURM
- reading of data via xrootd from LRZ

LRZ

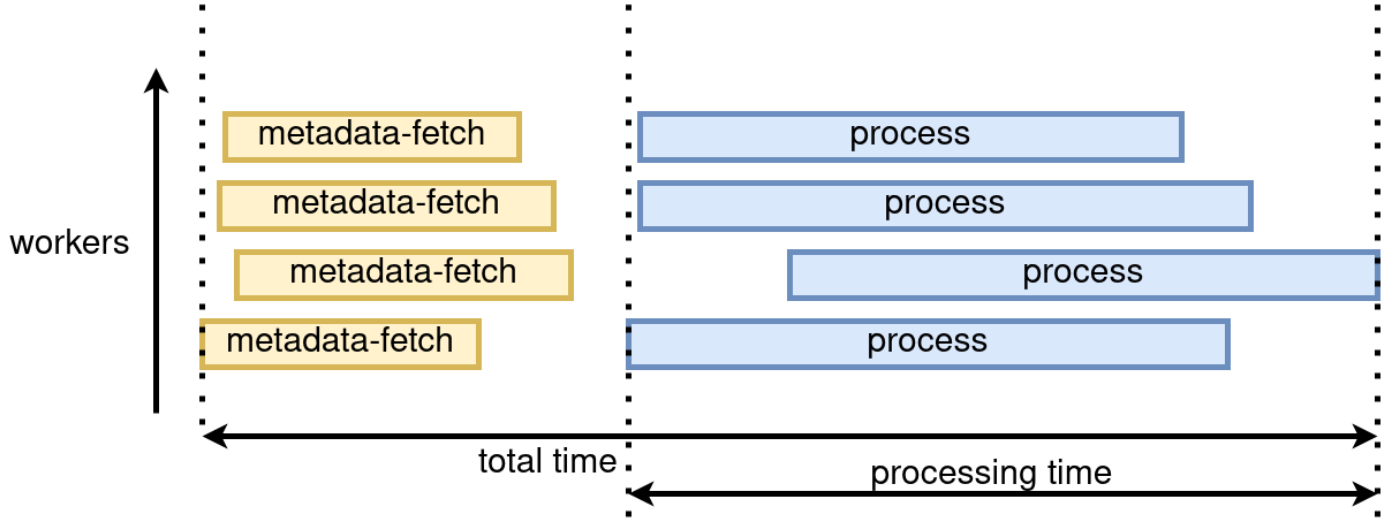
- distro: SUSE Linux
- software environment:
  - usual mode of operation for user-code: people log in, fire up a centos container (`setupATLAS -c centos8 -b`) and run their code in there
  - first I tried to run the AGC analysis from inside the container; was not able to do it technically + it's not expected to be feasable (?) $\rightarrow$ dropped this approach
  - used a conda environment in the end (issues with pip and `xrootd`)
- job scheduler: SLURM
- data is stored on regular Grid storage (HDD) as well as on a XCache server (SSD)

Vispa

- distro: Ubuntu 20.04
- software environment: conda
- jupyterhub is provided by the service, it allows to select your own conda environment as a kernel
- job scheduler: HTCondor
- data is stored on SSDs at Vispa and read via NFS; Vispa also has a very dedicated per node caching-system that I did not test with AGC yet

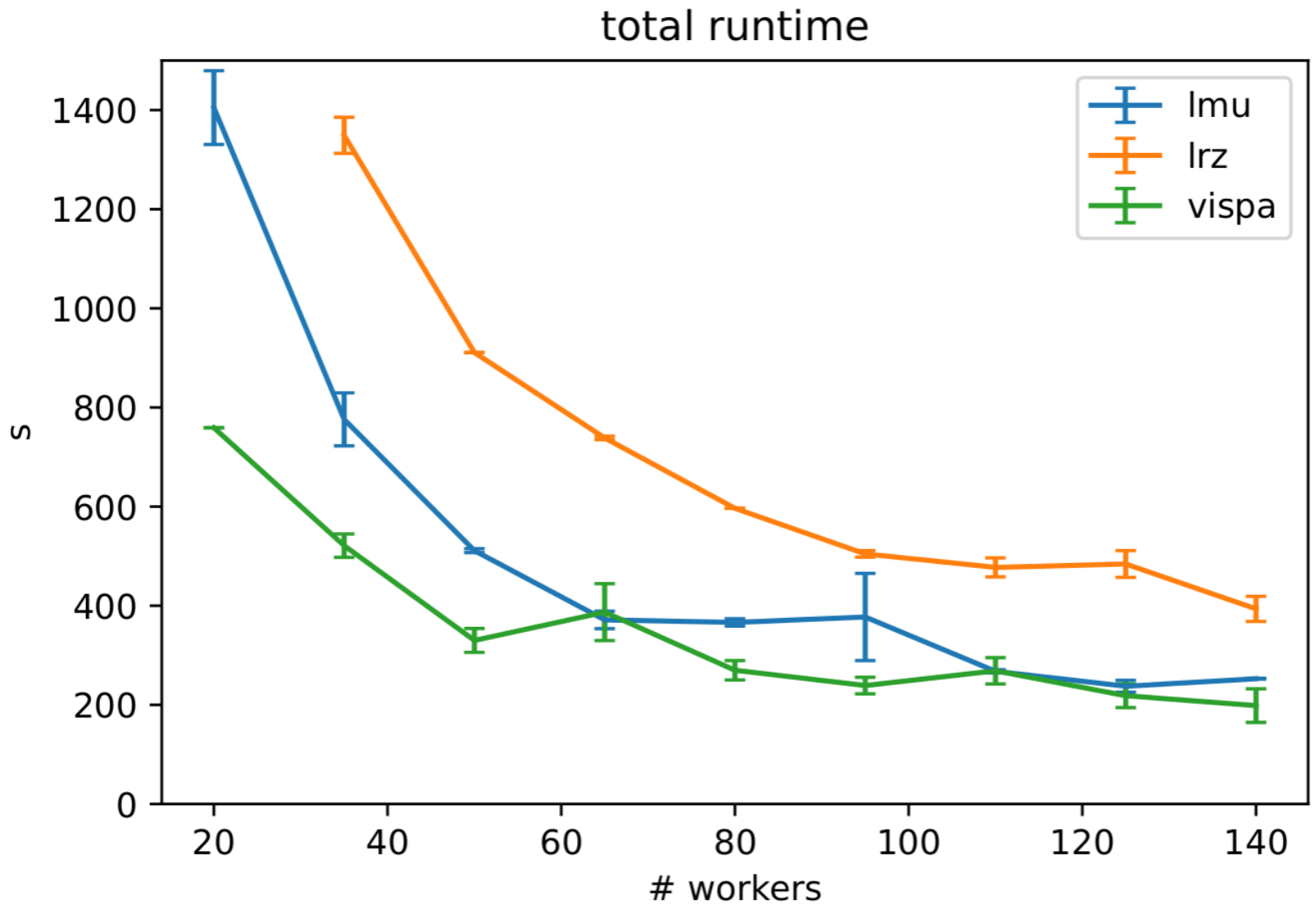
Measurements

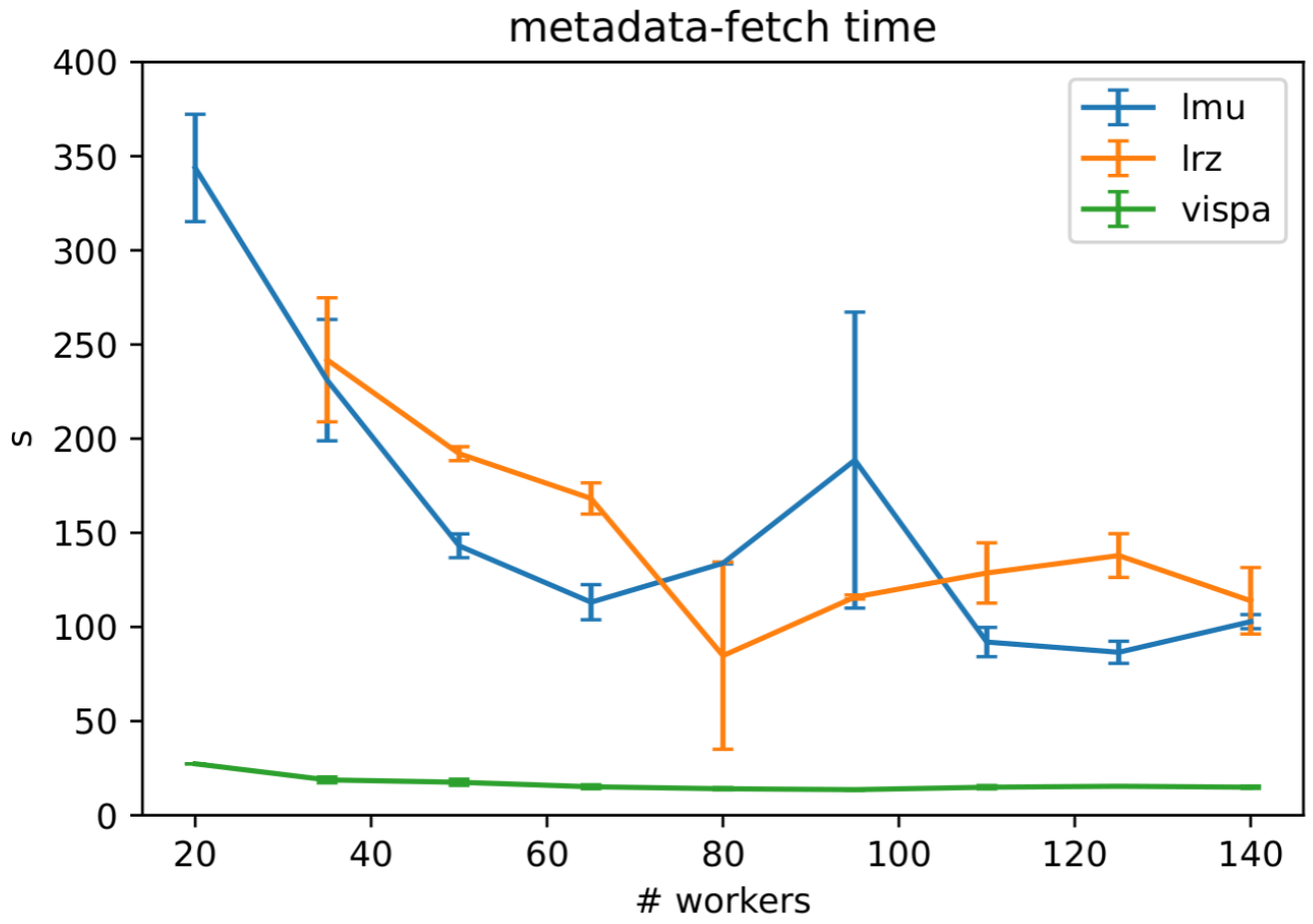
Only the part of the analysis which is run distributed is used for the benchmark → fetching some metadata and reading and processing the data



I can measure directly

- the total runtime
- the total processing time
- the sum of all process times across the workers (the sum of all blue rectangles)

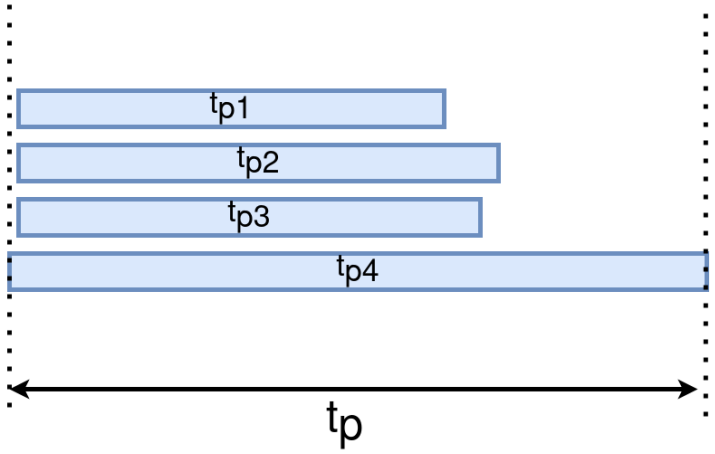

total runtime
lmu
lrz
vispa
1400
1200
1000
800
600
400
200
0
s
20
40
60
80
100
120
140
workers



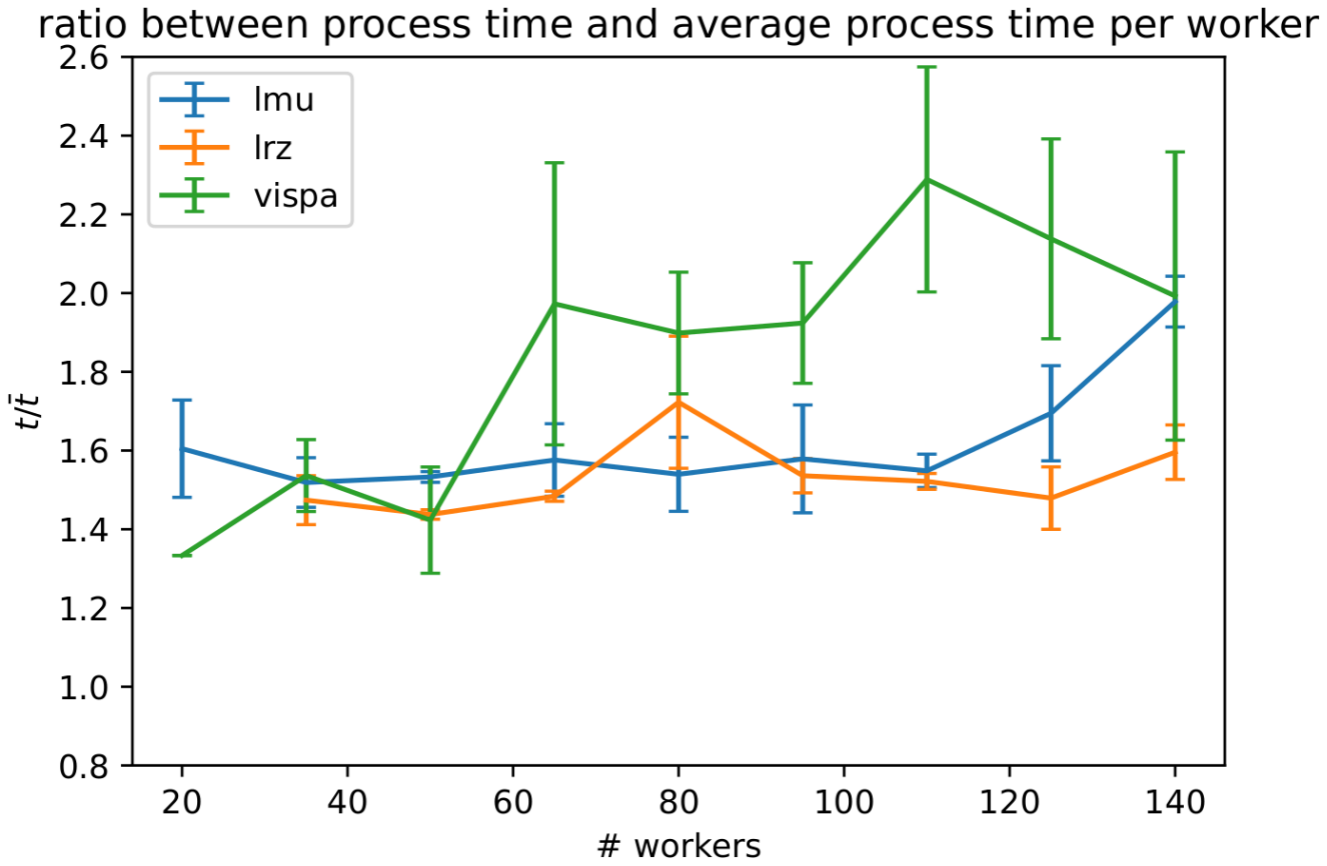
metadata-fetch time (= total - process time, also contains waiting and communication between dask workers)

measure for the amount of overhead
relative to the runtime

$$\frac{t_p}{\sum t_{p_i}/n}$$

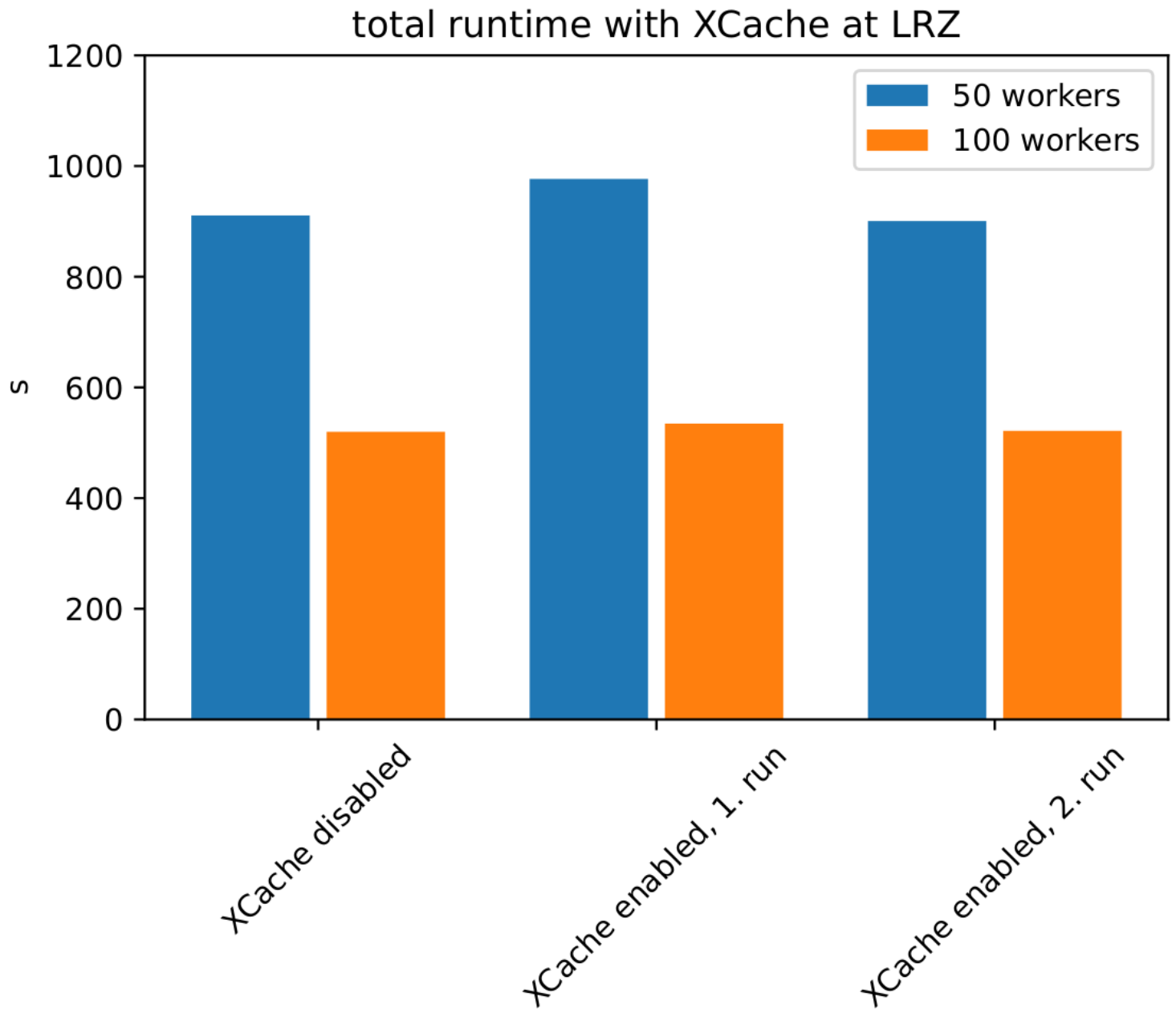


$\sum t_{p_i}/n =: \bar{t}$ is the average process time per worker without overhead



runtimes at LRZ with and without XCache enabled: makes no significant difference

$\Rightarrow$ with this setup, the analysis is hardly I/O limited



WIP / Further ideas

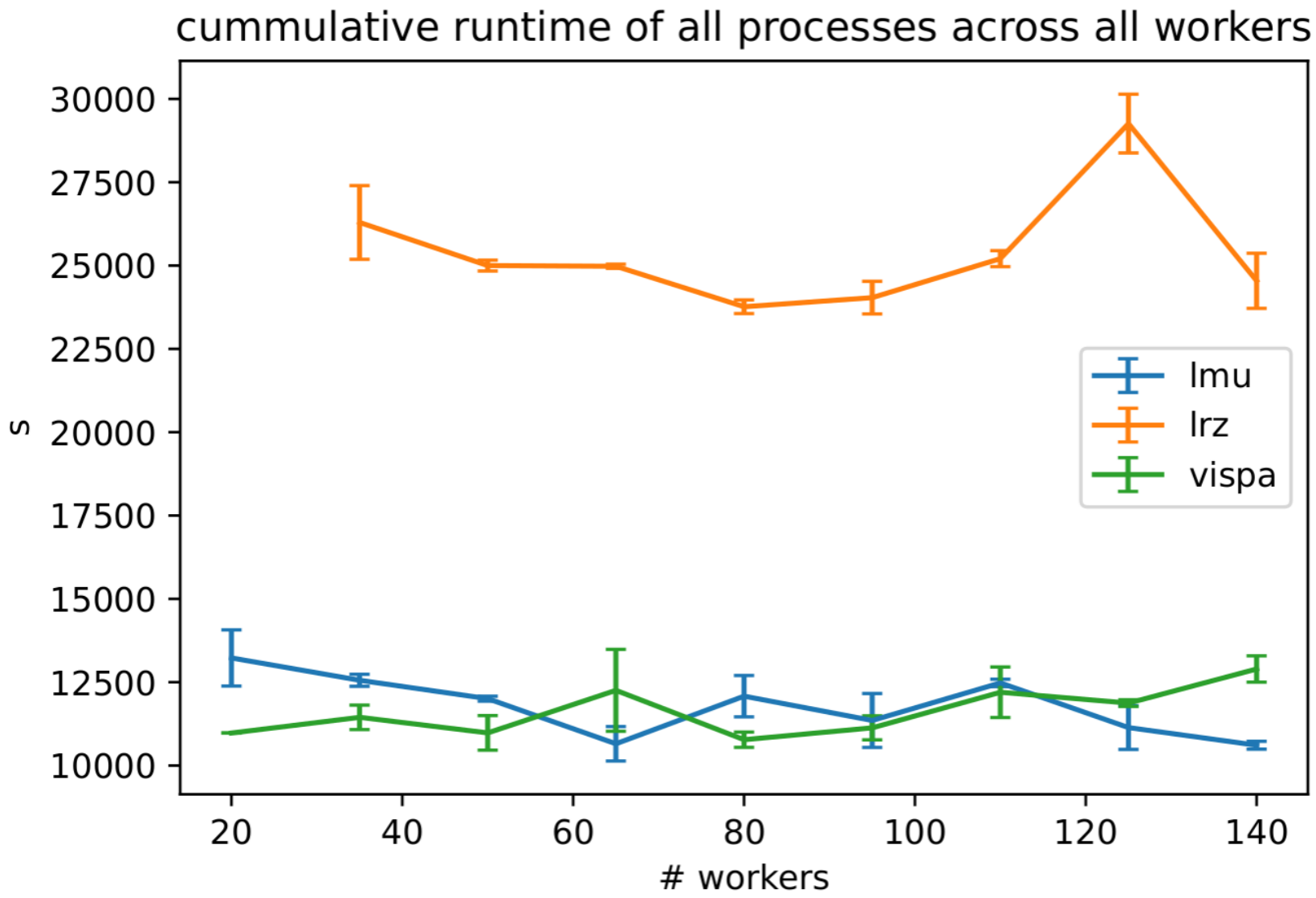
- find out what causes the overhead
- measure scaling of runtime with amount of data
- possible future project: have a benchmark analysis for Belle2

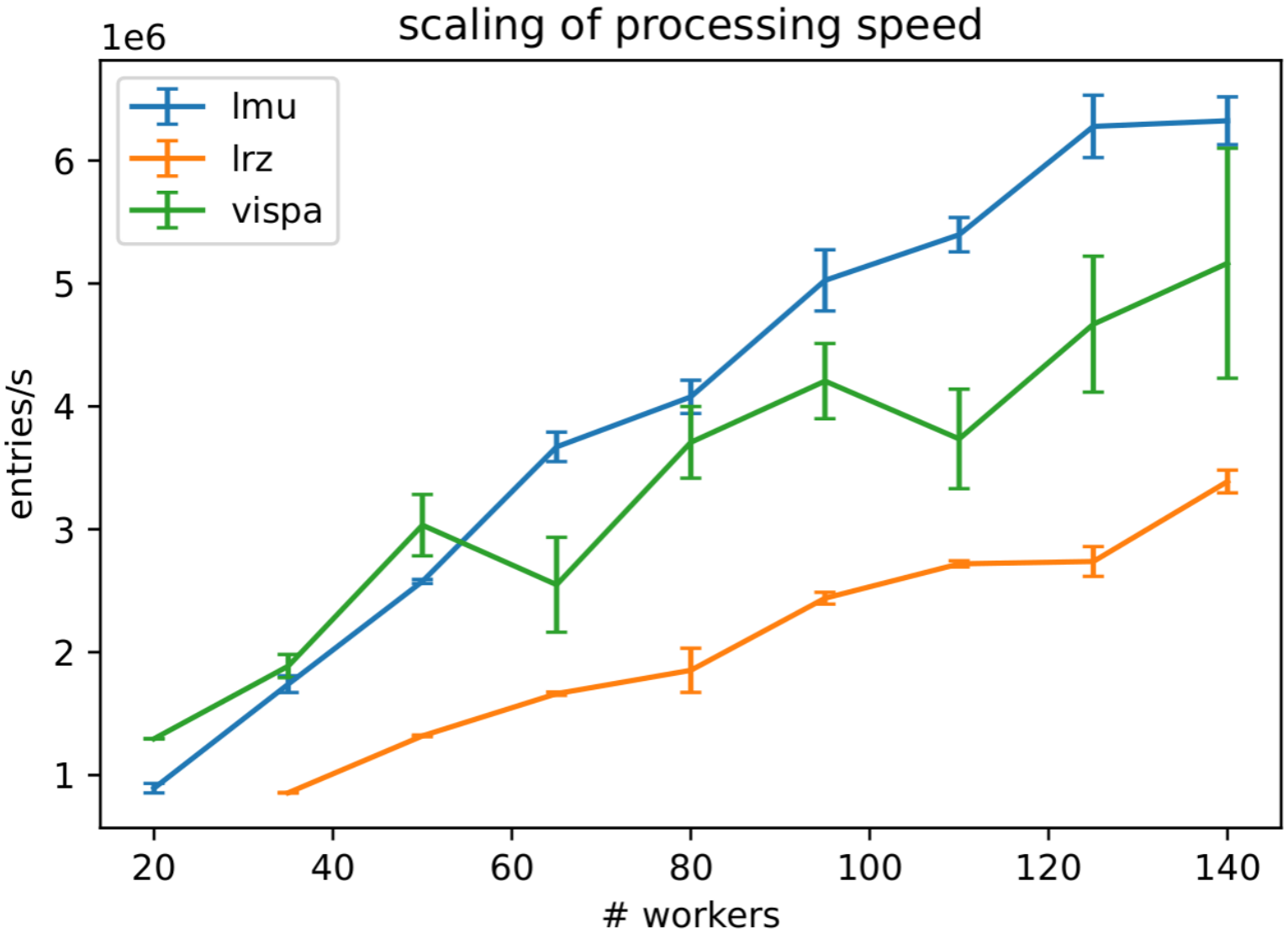
Questions?

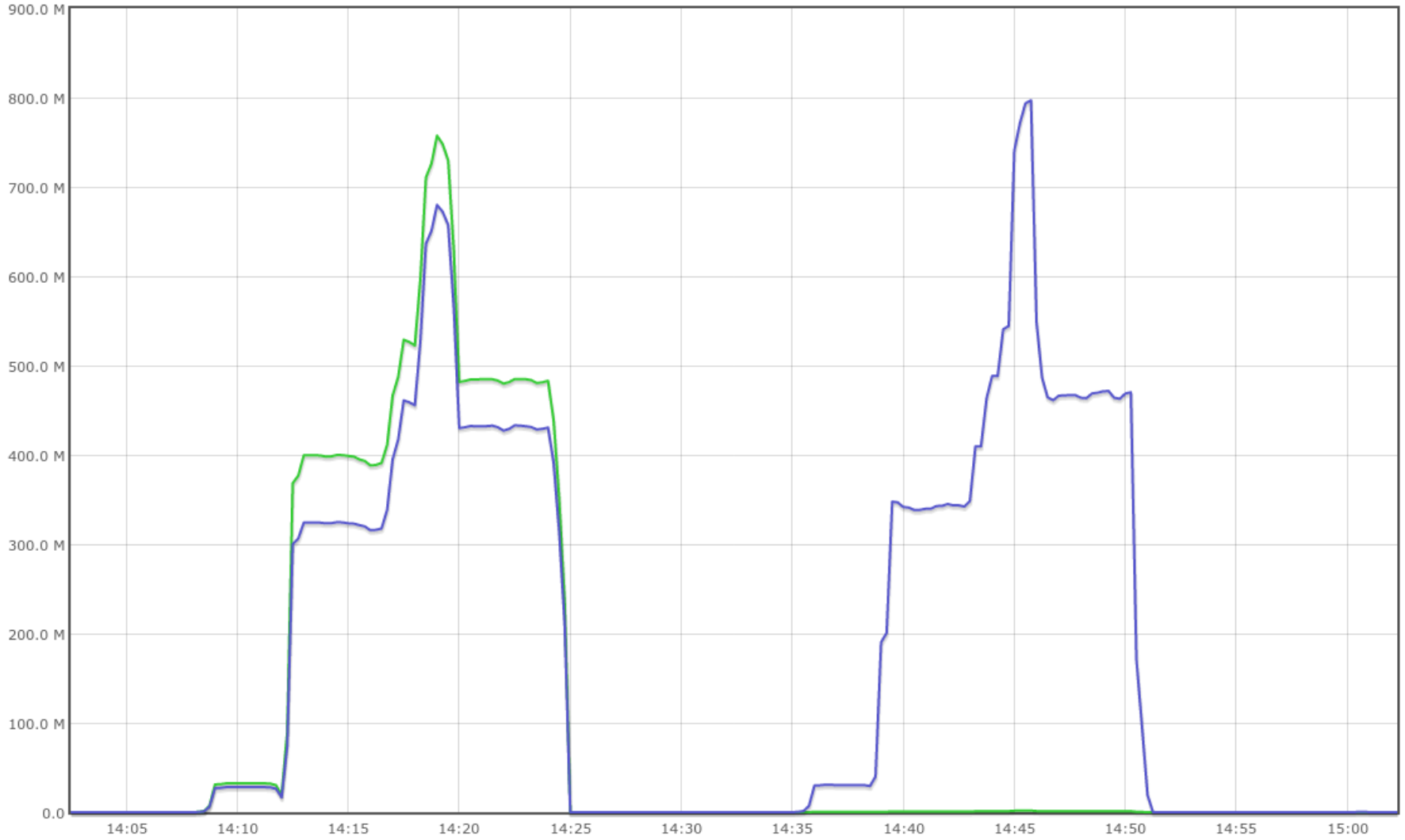
Backup

installation with conda + pip

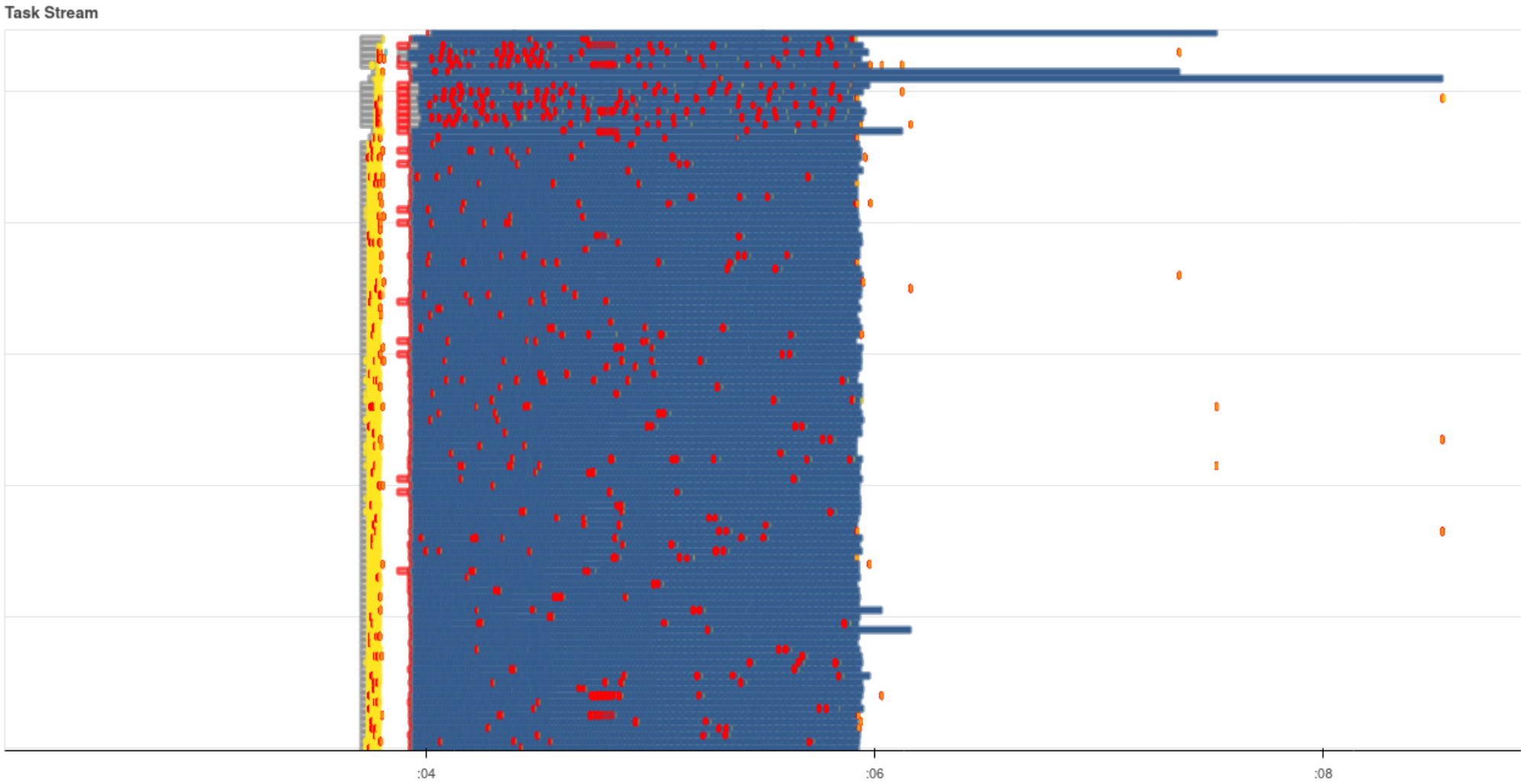
```
conda create -n agc python=3.8.10
conda activate agc
conda install -c conda-forge cabinetry
conda install -c conda-forge coffea vector awkward uproot
pip install servicex func-adl-servicex func-adl aiostream
conda install -c conda-forge dask dask-jobqueue
conda install -c conda-forge xrootd
conda install -c conda-forge jupyter
```


cummulative runtime of all processes across all workers
30000
27500
25000
22500
20000
17500
15000
12500
10000
s
20
40
60
80
100
120
140
workers
lmu
lrz
vispa

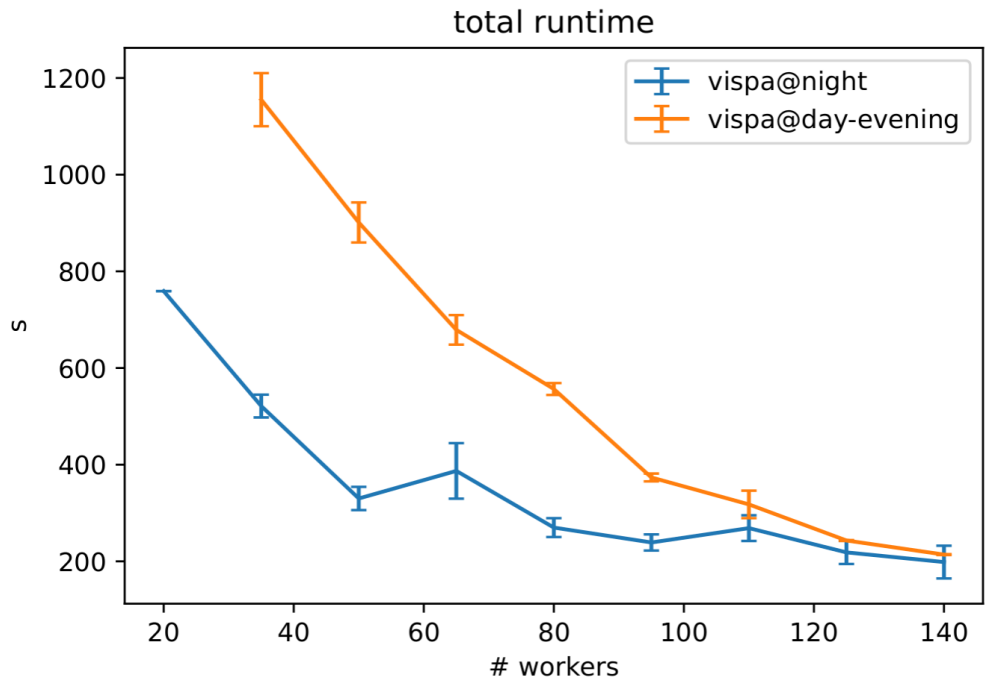

scaling of processing speed
1e6
lmu
lrz
vispa
entries/s
1
2
3
4
5
6
20
40
60
80
100
120
140
workers

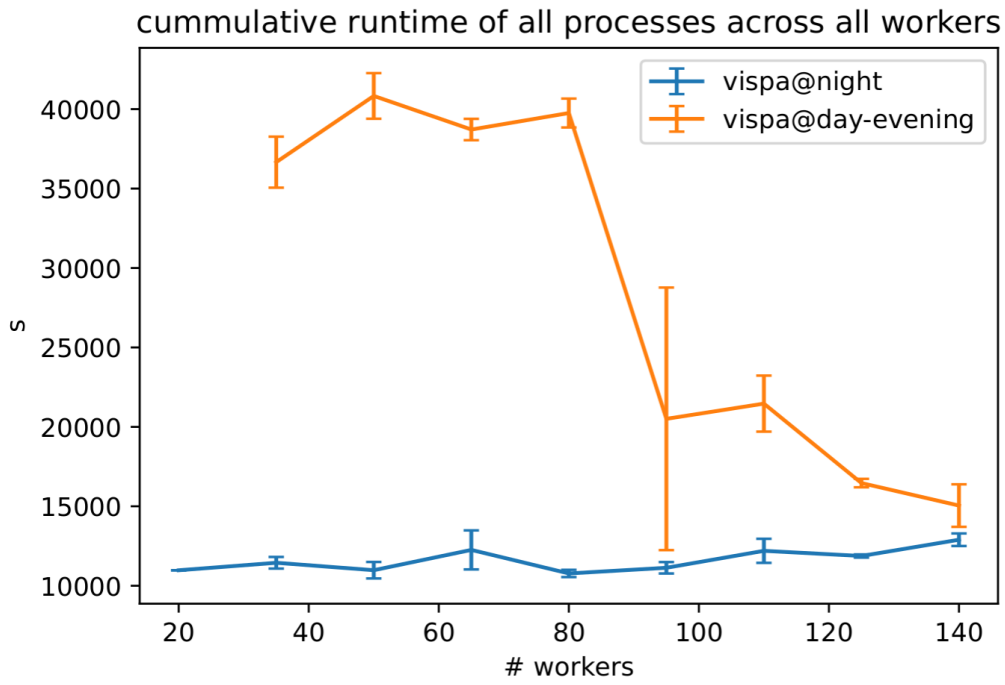


XCache load during two consecutive runs with 50 workers



Dask dashboard @ Vispa





Runtimes @ Vispa during the day and night