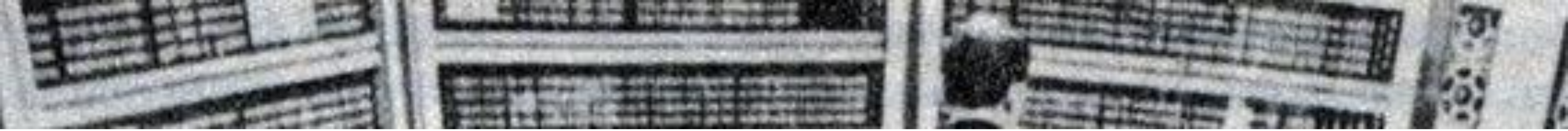

OpenFOAM Solver Based on Regularized Hydrodynamic Equations for High Performance Computing

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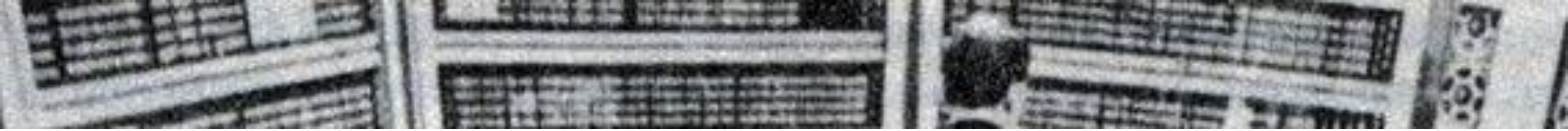
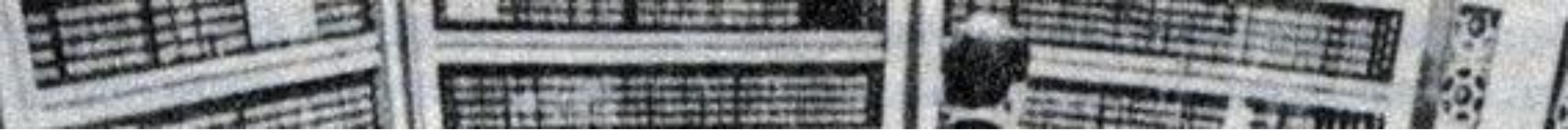


Presentation plan

- Research objectives
- Products
  - mulesQHDFoam solver
  - POD
- Exemplary case
- Resources and settings
- Results
- Conclusion

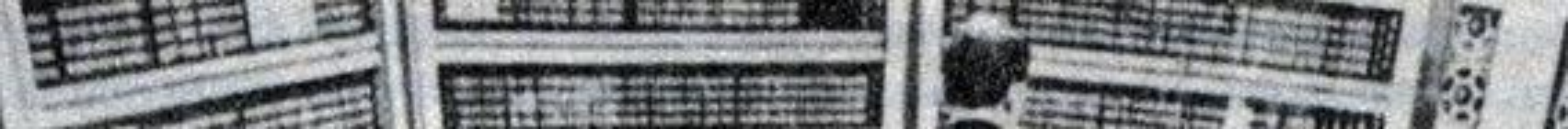


Research objectives

1) Scalability check of the developed solver mulesQHDFoam in different settings

2) POD method and ITHACA-POD realization overview

3) Developed POD method’s impact on performance



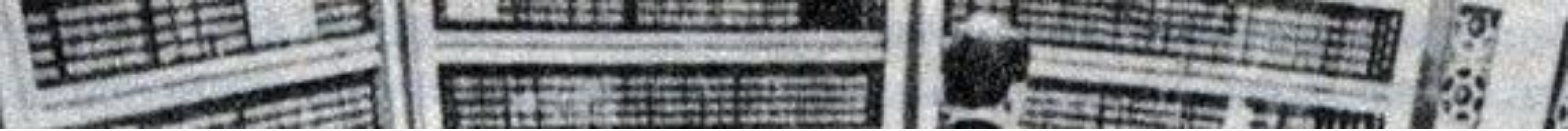
Products

- mulesQHDFoam

$$\nabla \cdot (\vec{U} - \vec{W}) = 0,$$

$$\vec{W} = \tau \left(\vec{U} \cdot \nabla \vec{U} + \frac{1}{\rho_0} \nabla p + \beta \vec{g} \tilde{T} \right).$$

https://github.com/unicfdlab/QGDsolver



Products

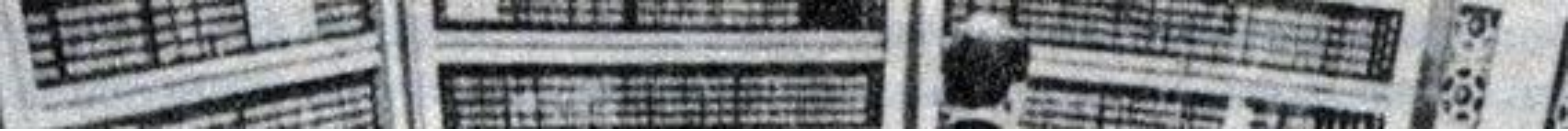
- POD

$$D_{k \times n} = [B_{k \times m} \times A_{m \times n}]$$
$$m << k << n$$

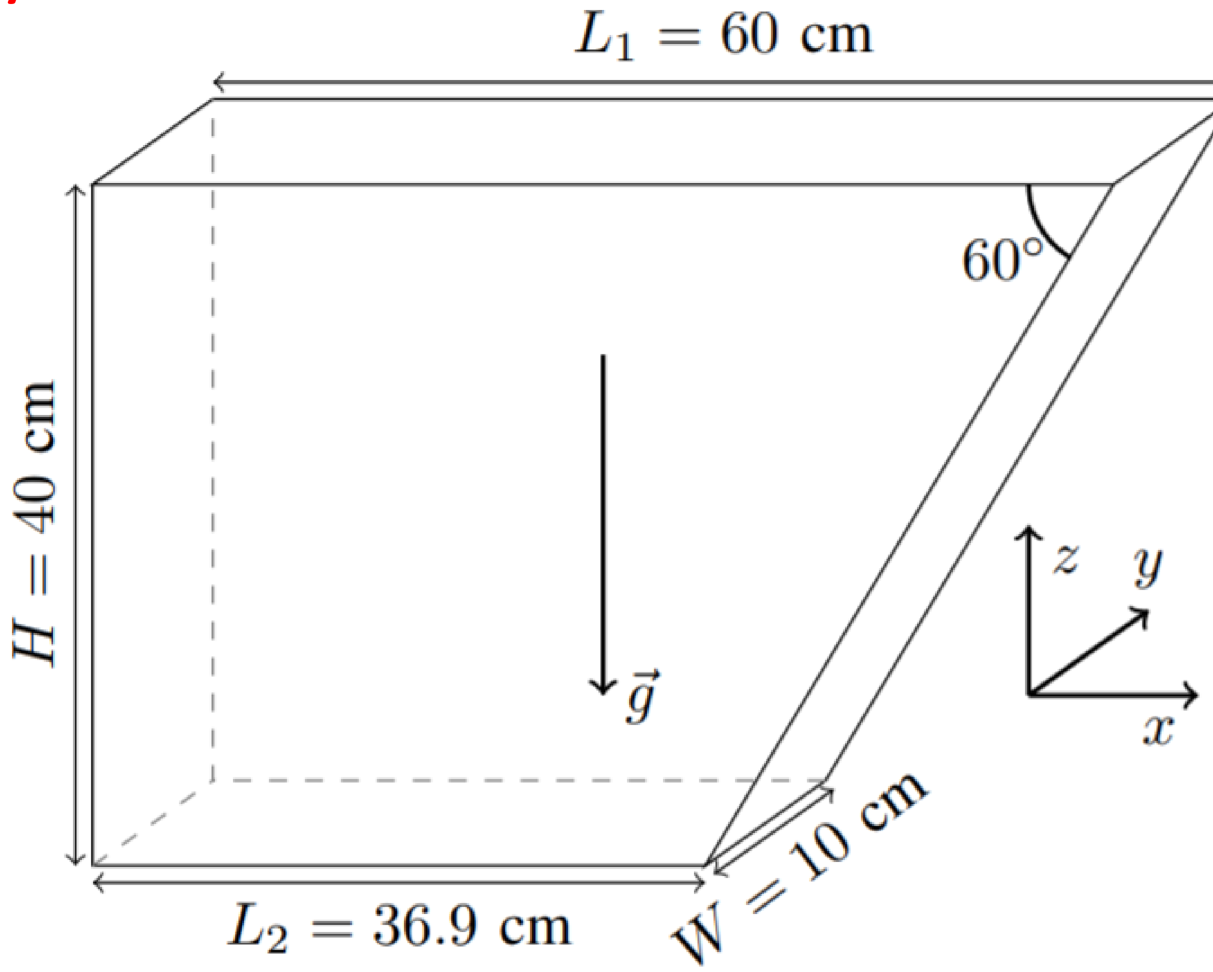
ITHACA-POD doesn’t create averaged snapshots, that leads to accuracy decrease

Disk space accuracy

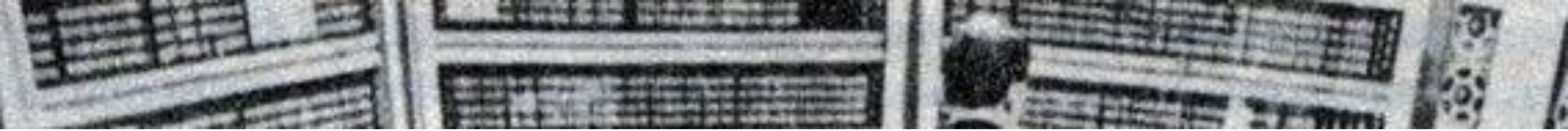
Different time discretization synchronization



Exemplary case



480x80x320 = 12 228 000 cells



Resources and settings

Tested cases:

1) PODSampler enabled

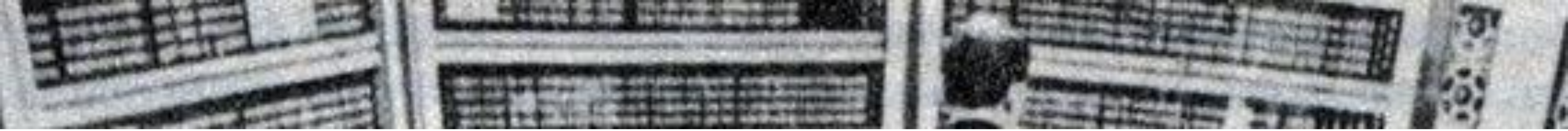
2) PODSampler disabled

3) Simplified approximation of regularization schemes with enabled PODSampler

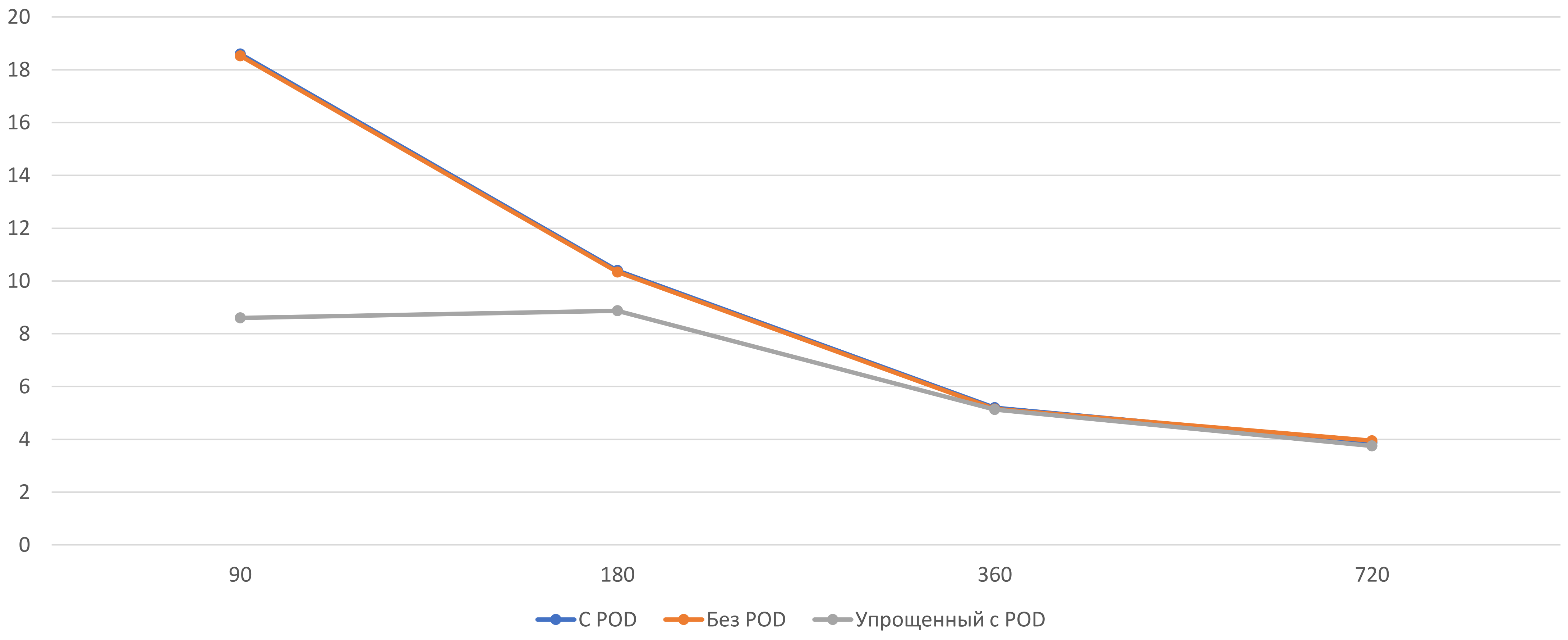
Scalability settings:

90, 180, 360, 720 cores

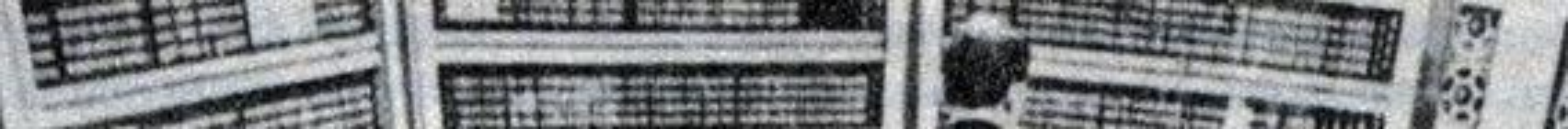
Kurchatov Institute cluster



Results



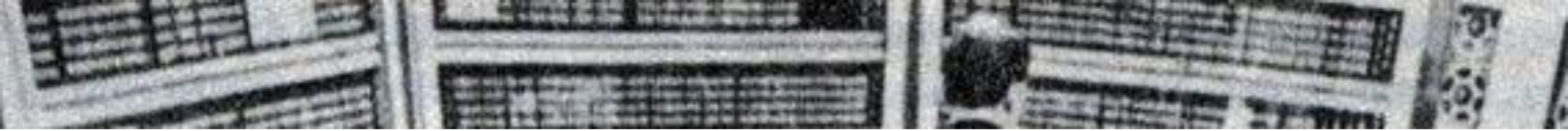
20
18
16
14
12
10
8
6
4
2
0
90
180
360
720
С POD
Без POD
Упрощенный с POD



Conclusion

1) PODSampler does not affect performance

2) The program is being scaled until the “saturation” of 30000 cells per core



Aknowledgements

- The results of the work were obtained using computational resources of MCC NRC “Kurchatov Institute”, http://computing.nrcki.ru/

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