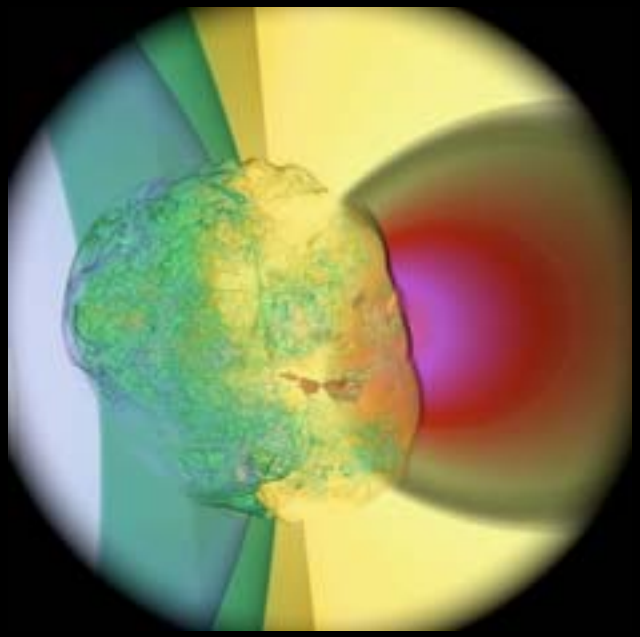
Recent Advances in Volume Rendering



Core-collapse supernova X component of velocity

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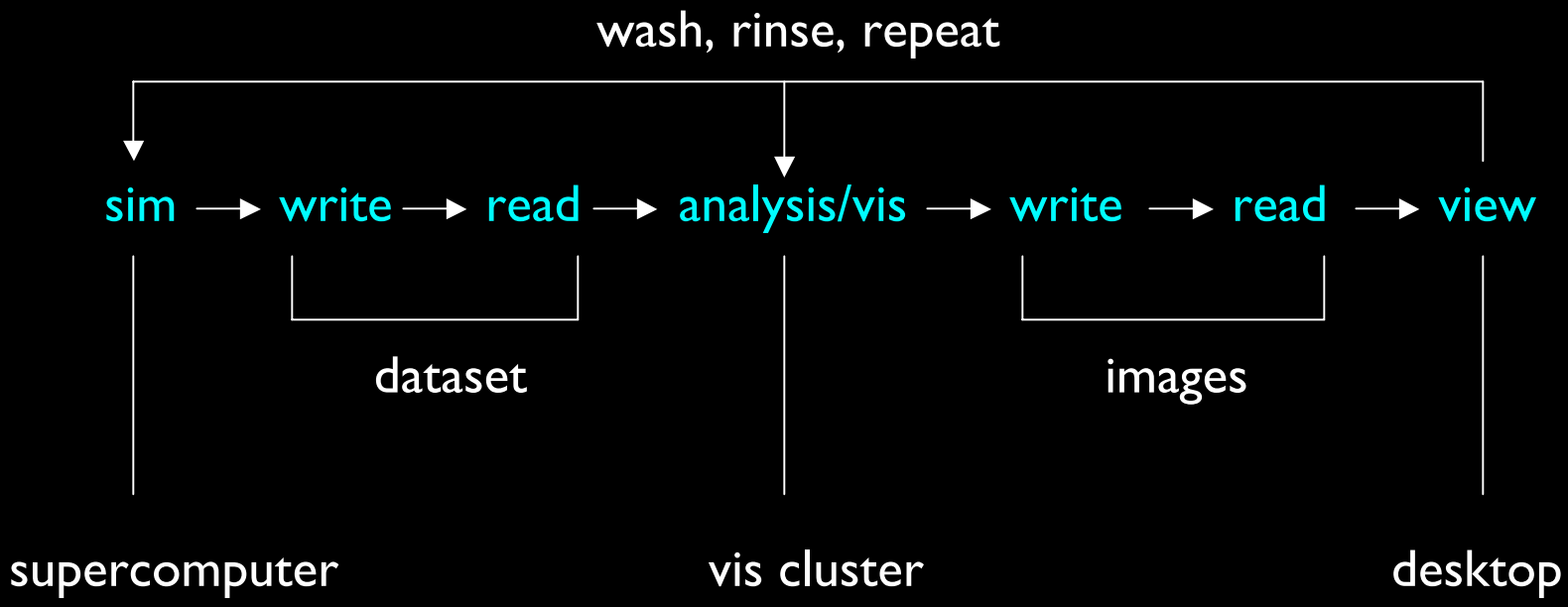
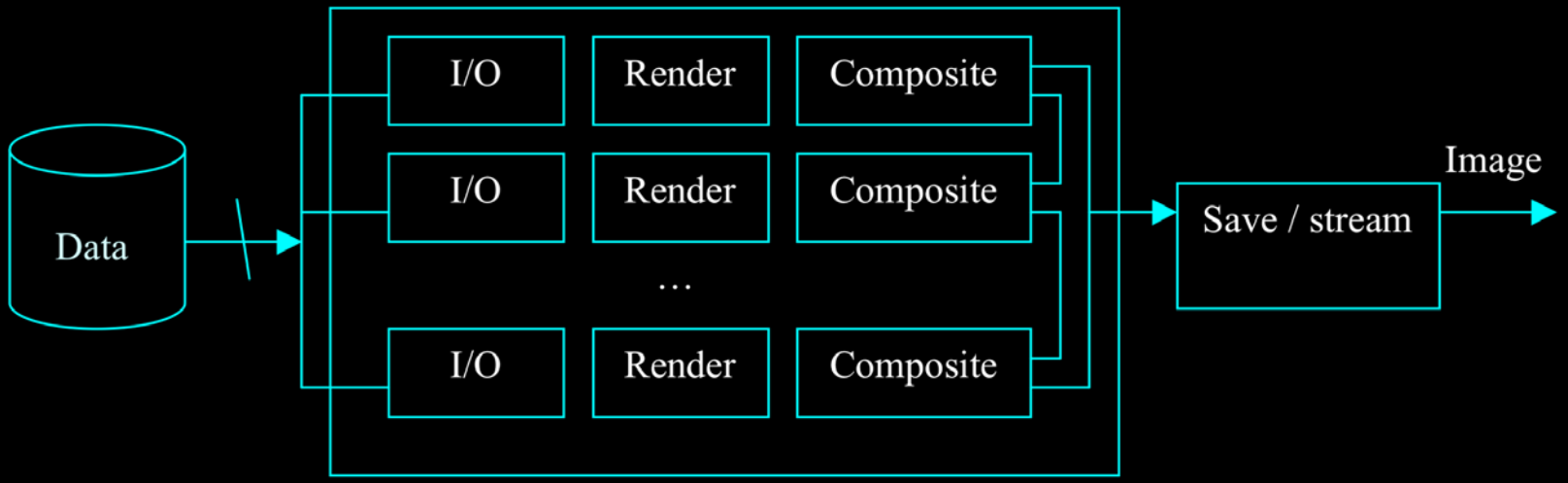
Traditional Workflow

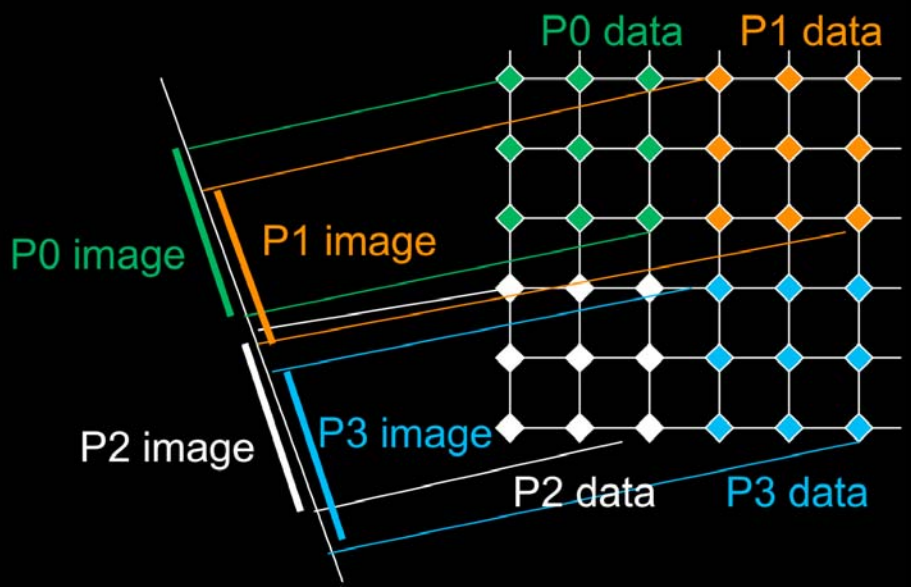
What's wrong with this picture?



Parallel Volume Rendering

Divide and conquer: Input, render, compose, output.





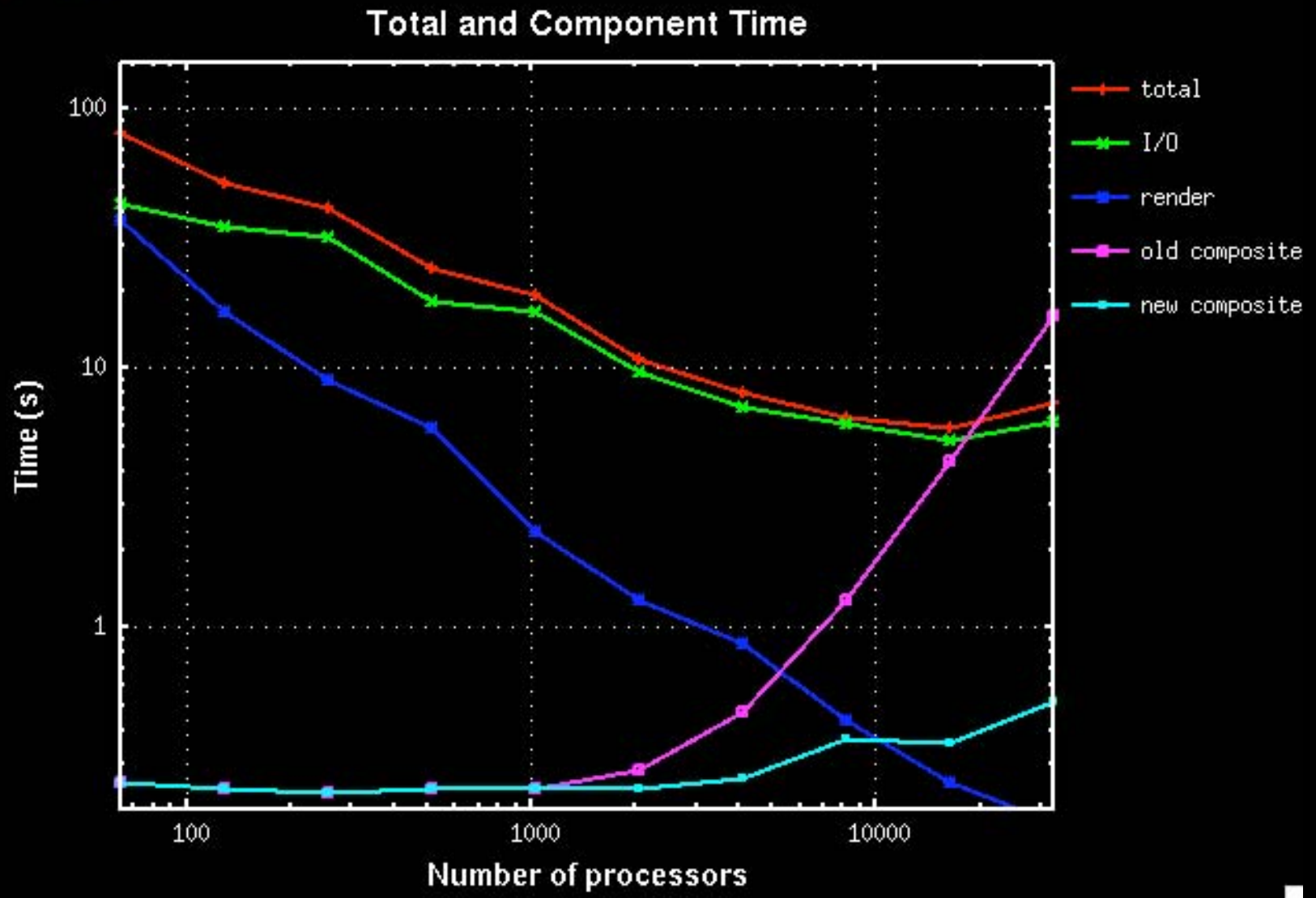
Some Prender Parameters

Knobs to turn, switches to flip, buttons to press

Argument	Sample Values
DataSize	1120x1120x1120
ImageSize	1600x1600
ImageType	ppm, rgb, rgba
IP, port	137.72.15.10, 5000
Stereo	y, n
NumProcs	32768
NumPipes	16
NumCompositors	4096
NumWriters	64
Variable	pressure, !

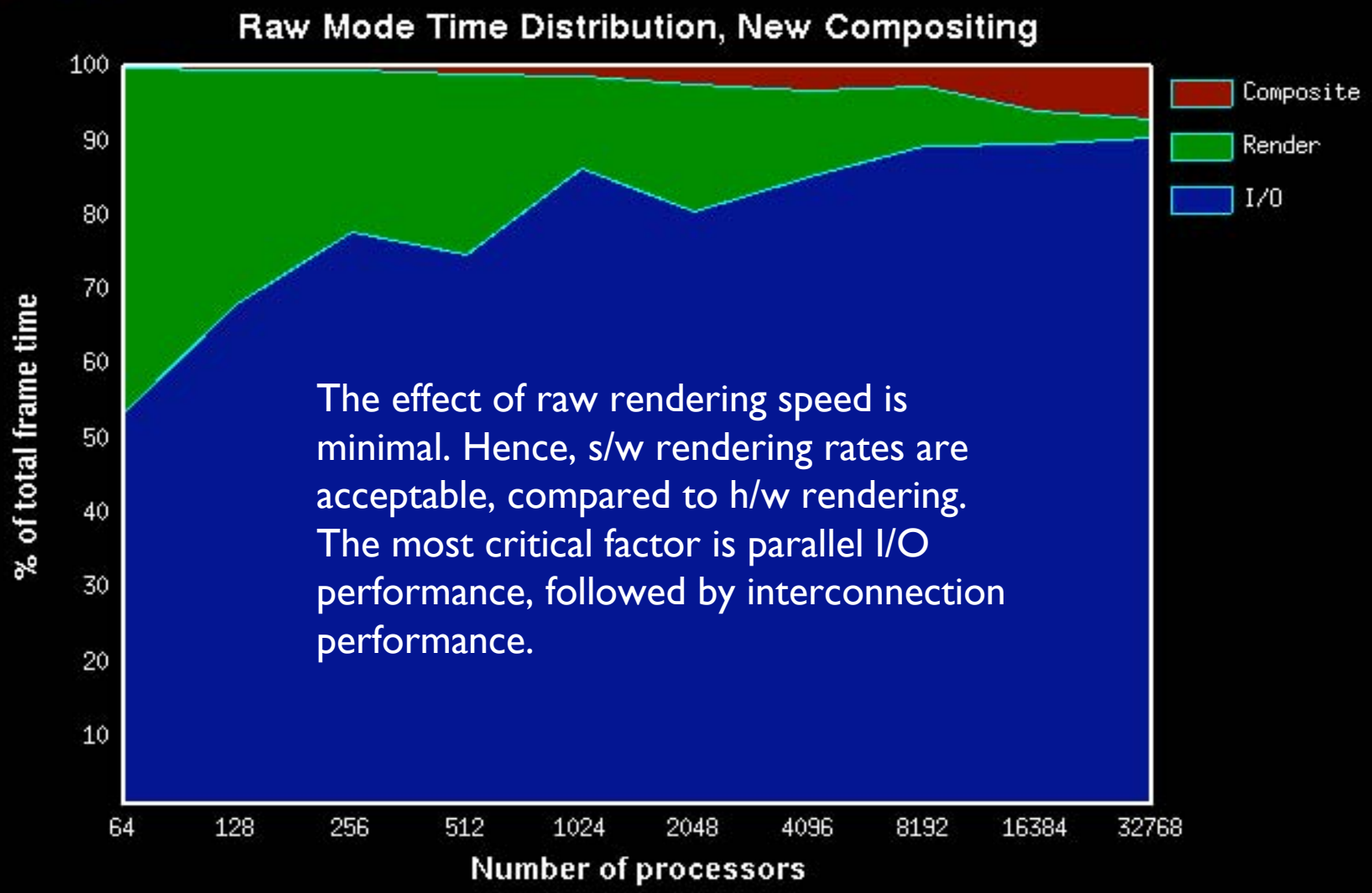
Performance Results

Limiting the number of compositors improves compositing time by up to 30X.



Time Distribution

Reading the data from storage dominates the total cost of a time step.

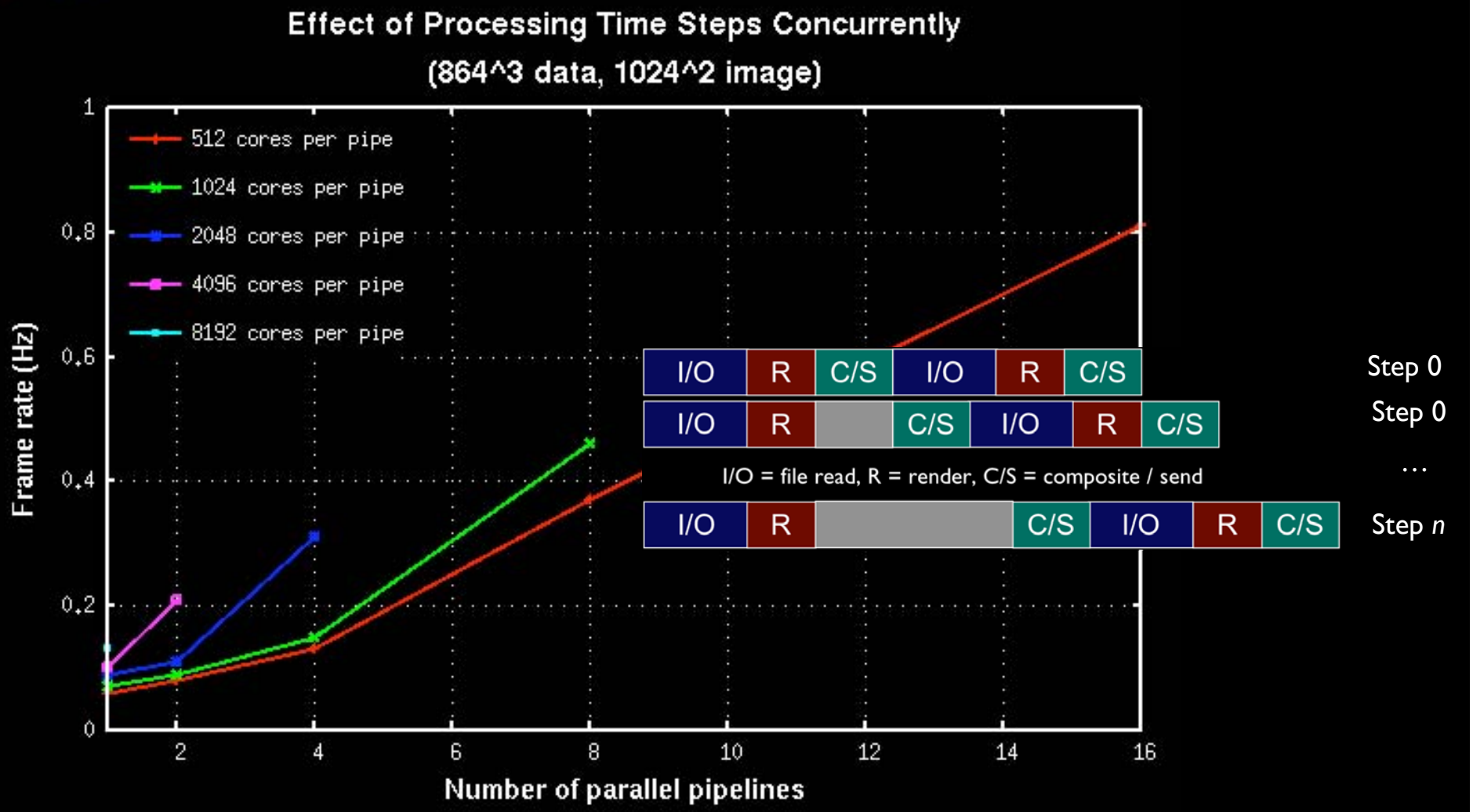


Efficiency

Welcome to the real world.

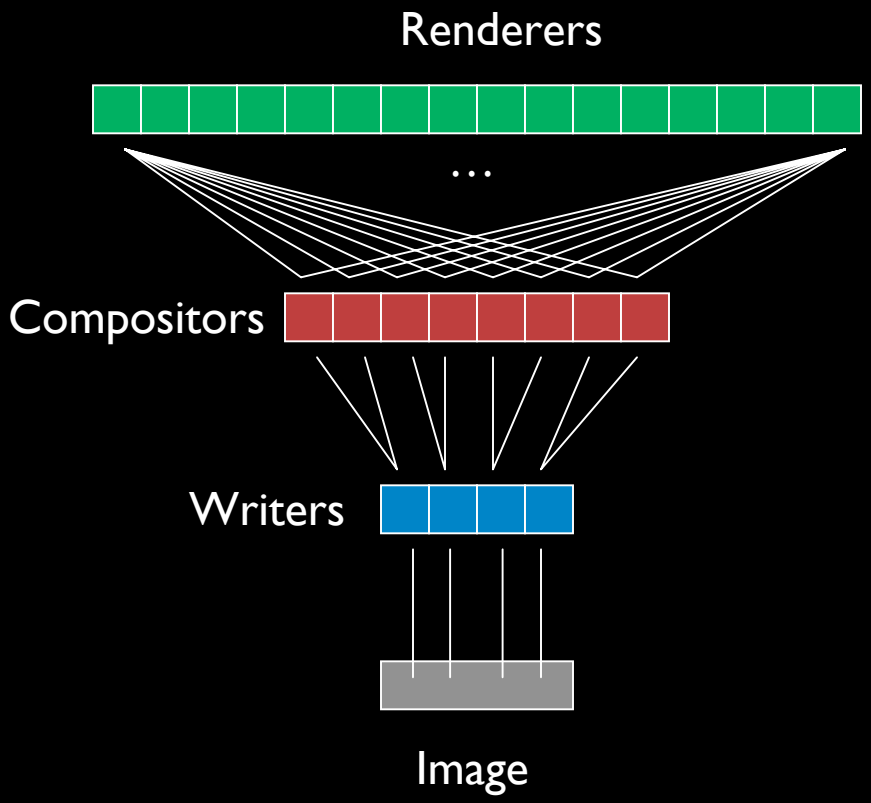
Multiple Parallel Pipelines

Hide I/O latency by extending concurrency between time steps.



Multiple Writers

Reduce memory footprint, gather time, overall composite and output time.

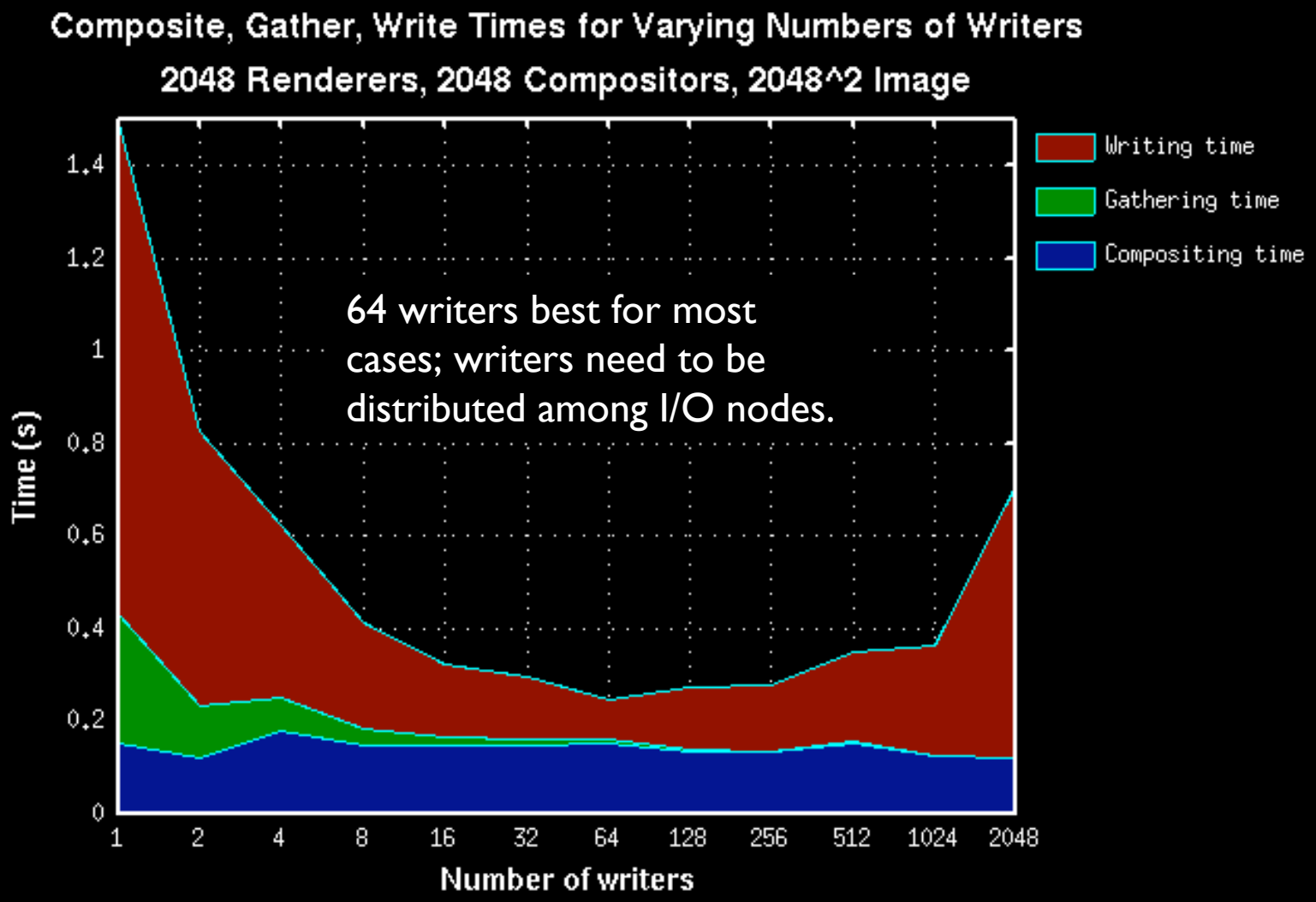


Memory footprint per core =
70MB +
2.5KB * image size / writing_cores +
4 * volume size / rendering_cores

Eg.,
512 MB - 2 MB OS per core (vn mode):
2048 ^3 volume, 2048^2 image
-> Need ~128 cores minimum

Multiple Writers Performance

Improve overall output time by selecting the optimal number of writers.



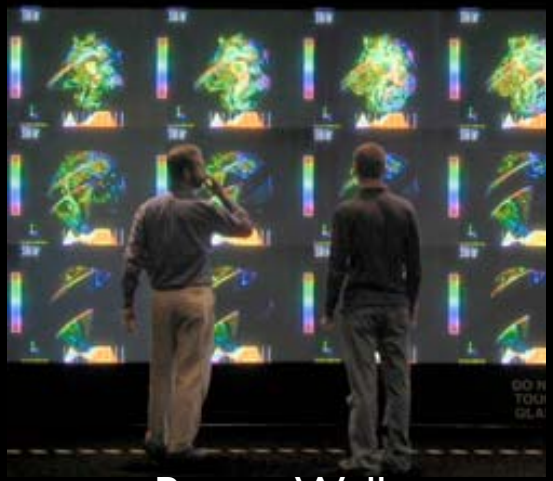
Virtual Reality for Sci Vis

Be the data.

HMD

CAVE

GeoWall



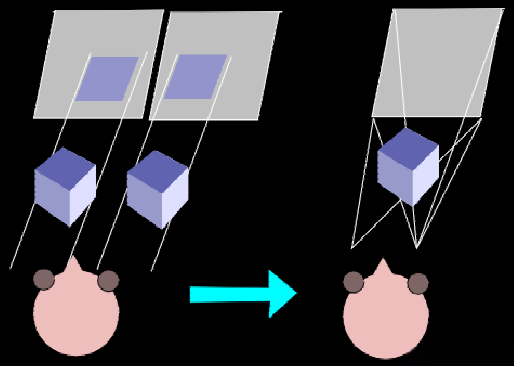
Power Wall

Tiled Display

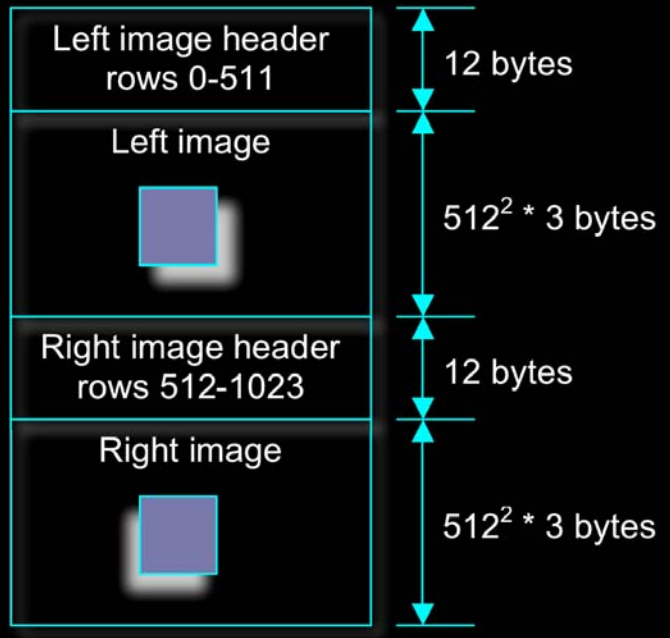
Autostereo

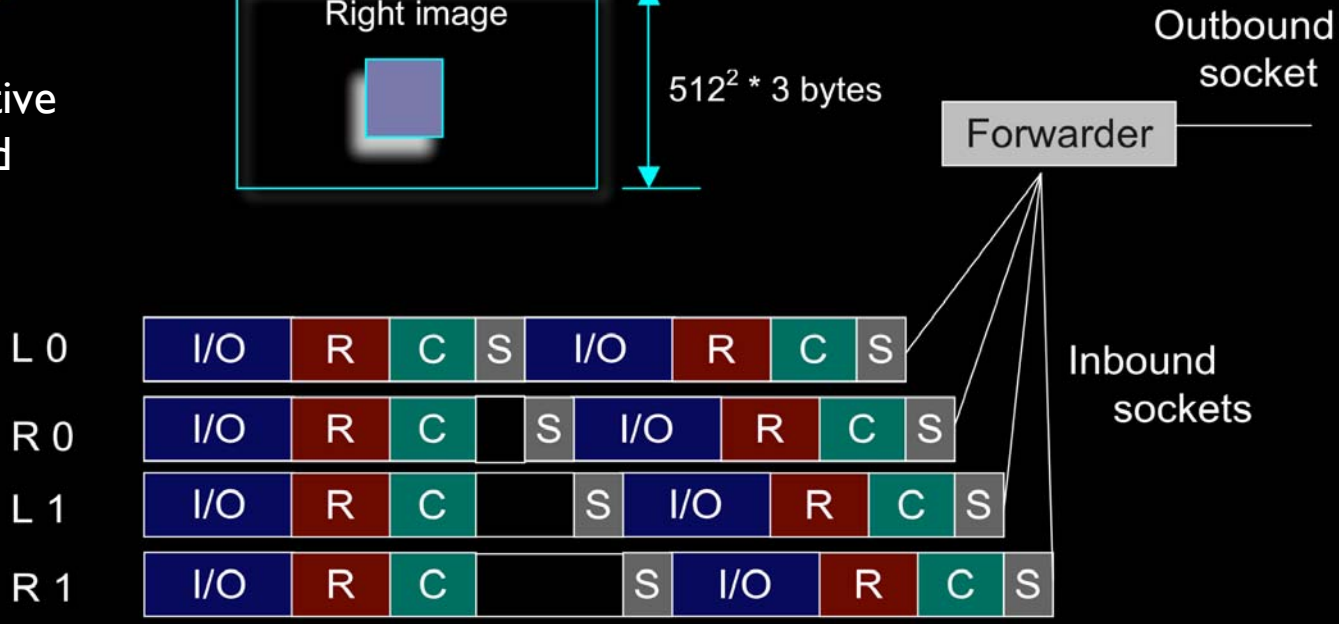
Generating Stereo Images

By reorganizing parallel pipelines, casting perspective rays, streaming image pairs.



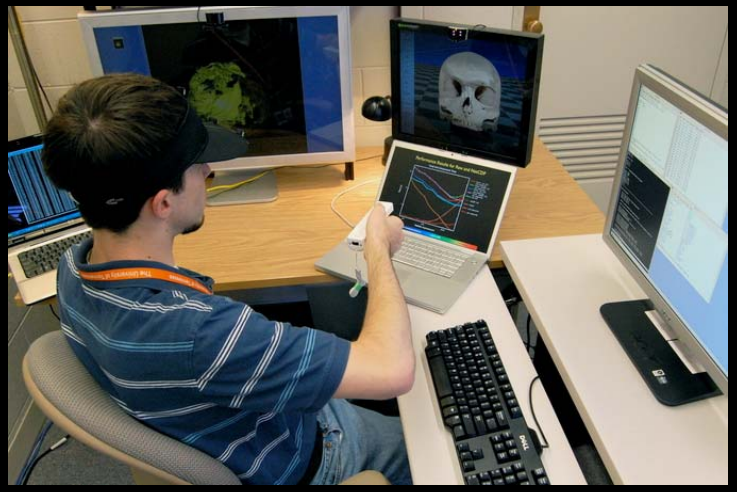
Parallel Projection Method Perspective Method





Viewing Stereo Images

Applying VR concepts to sci vis: autostereo viewing and natural interactions, from display wall to desktop.



Recent Advances in Volume Rendering

Challenges, questions, looking ahead

	Technical	Nontechnical
Performance	Interactive rate	Leadership resource justifcation
Structure	Grid types	Conflicting decompositions
Linking	In situ API	In situ collaboration
Usability	Interaction model	Role of visual analysis in science discovery
Programming	Exploit multicores	Legacy code (and programmers)
Resources	Other architectures	Collaboration
Application	Adoption into tools	All of the above

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