Robust Parallel Adaptive Smoothing

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CS205 Final Project
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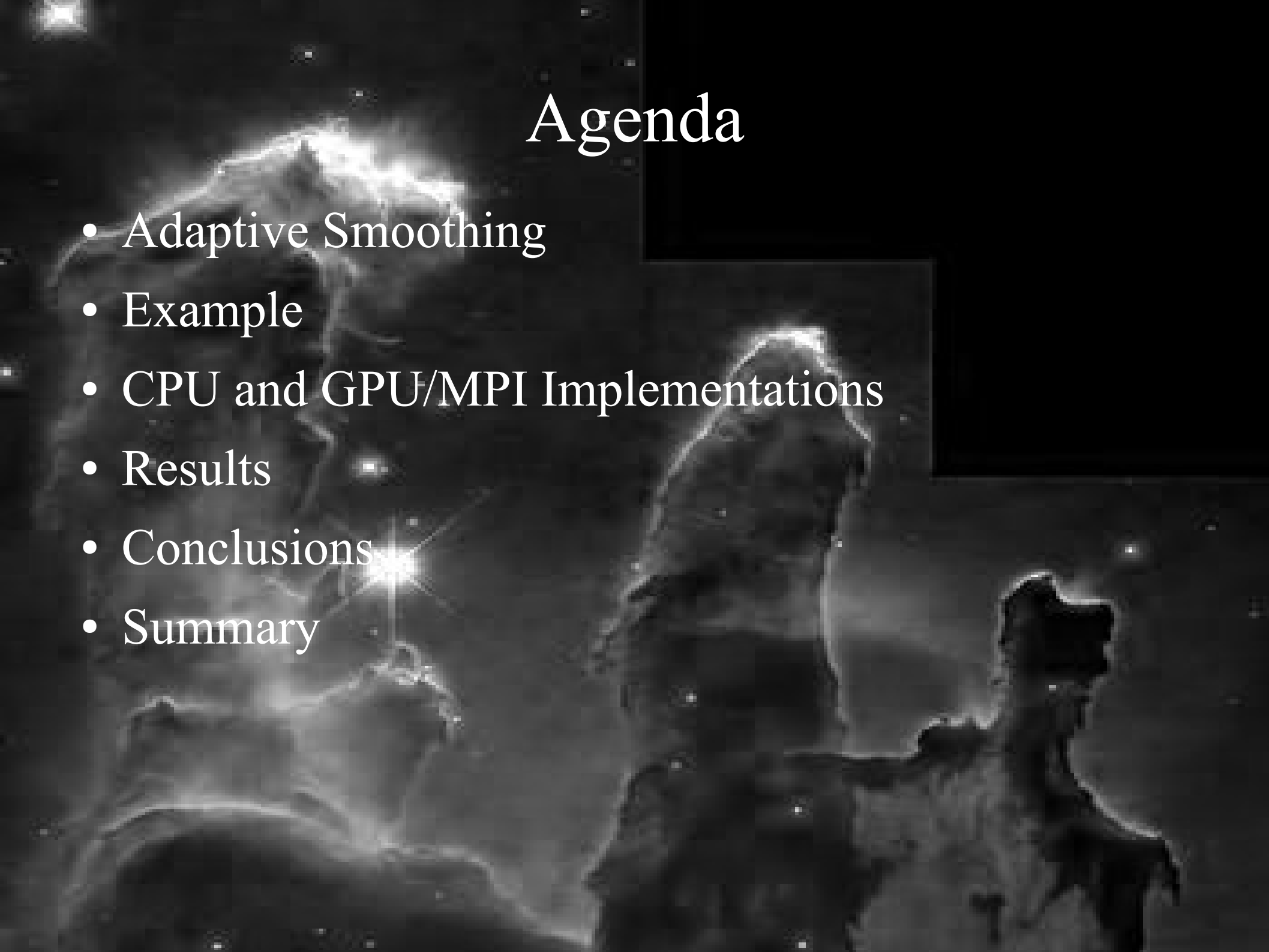


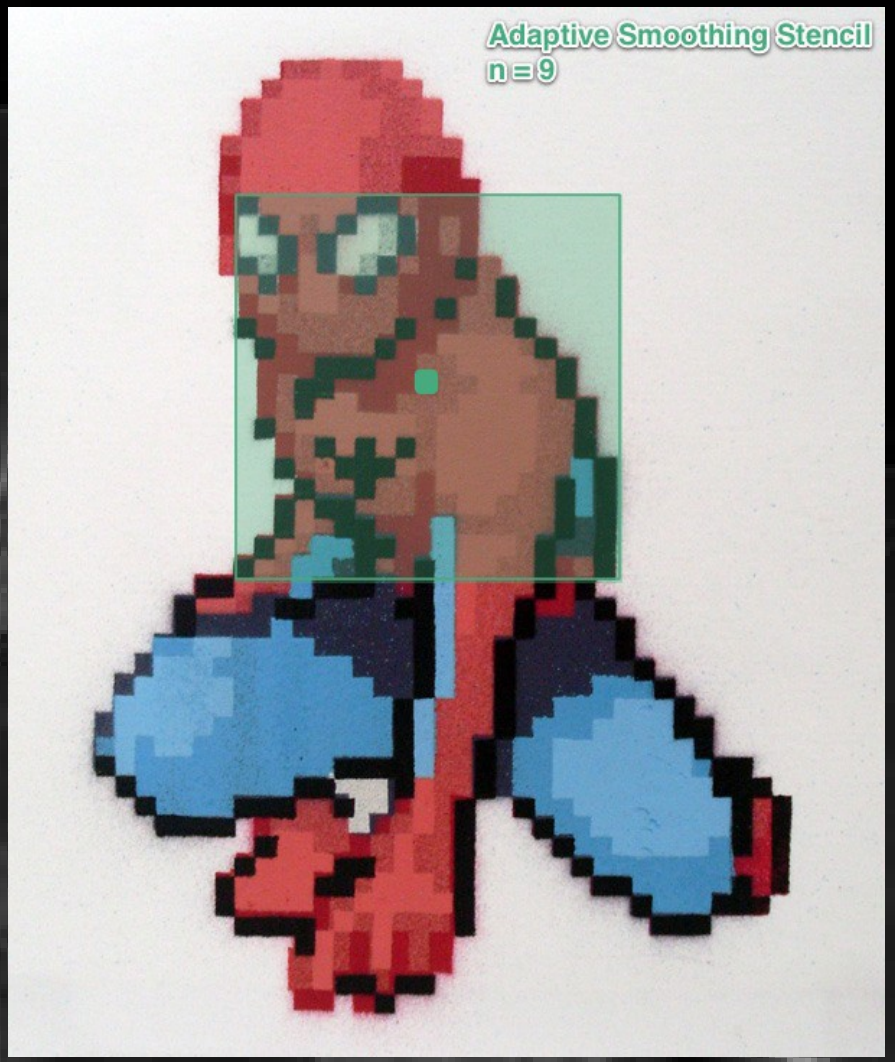
Agenda

- Adaptive Smoothing
- Example
- CPU and GPU/MPI Implementations
- Results
- Conclusions
- Summary

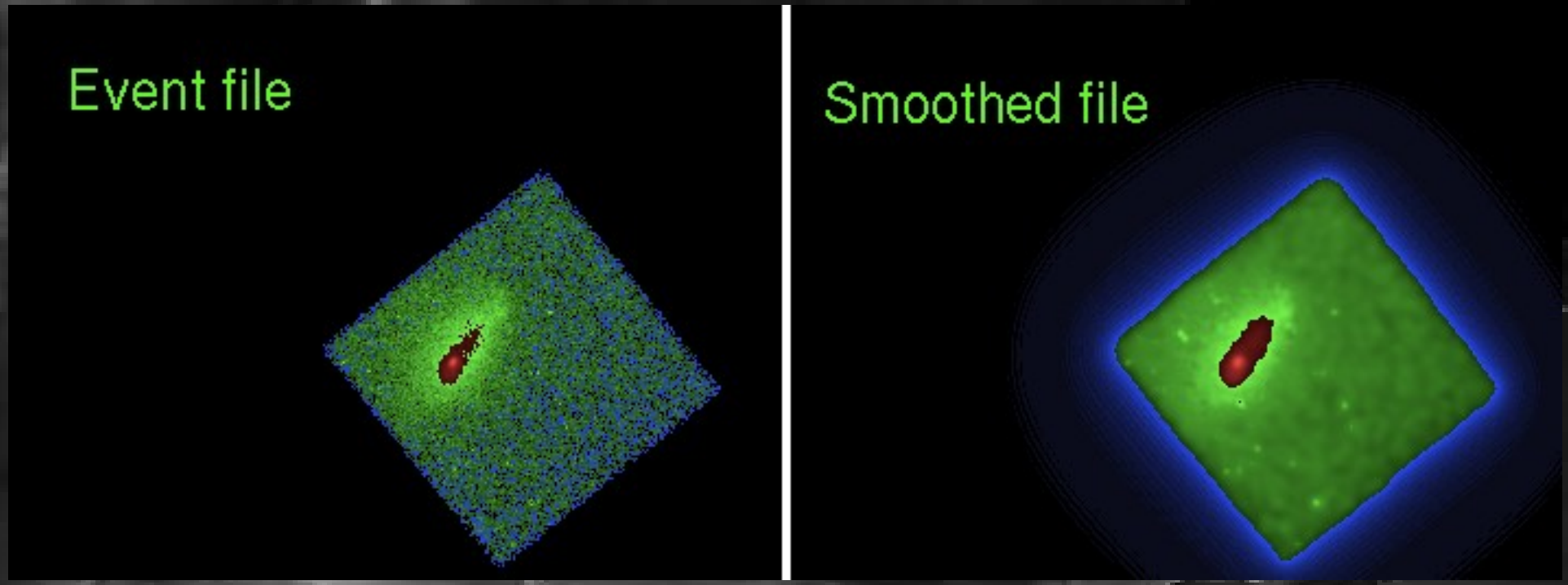
Adaptive Smoothing

- Independently Smooth Each Pixel
- Preserve Small Scale Features
- Larger Features Smoothed Out
- Only Scales To Threshold or MaxRad
- Preserve Energy (Flux)

Example of Adaptive Smoothing

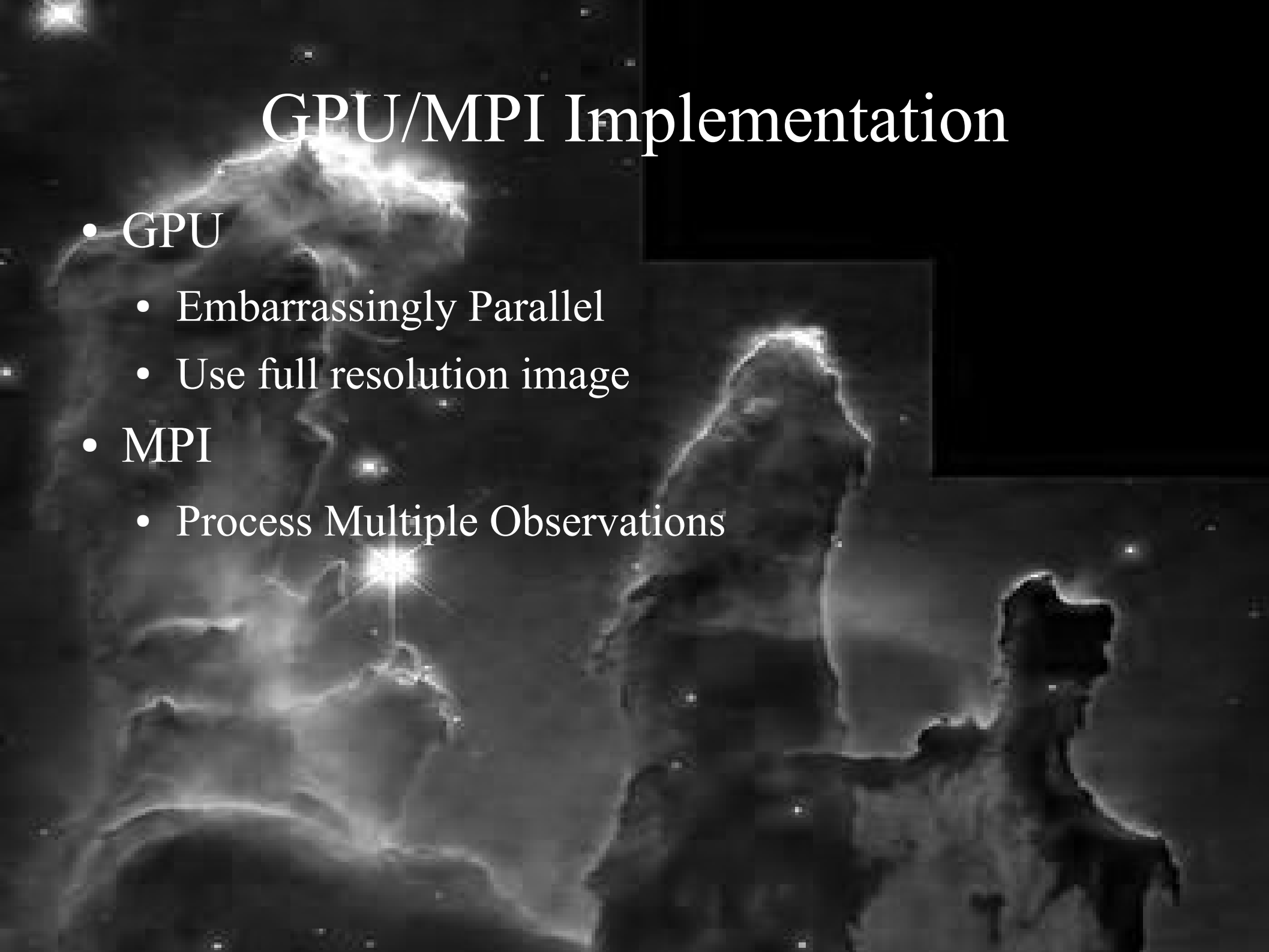


Observation ID: 11759



CPU Implementation

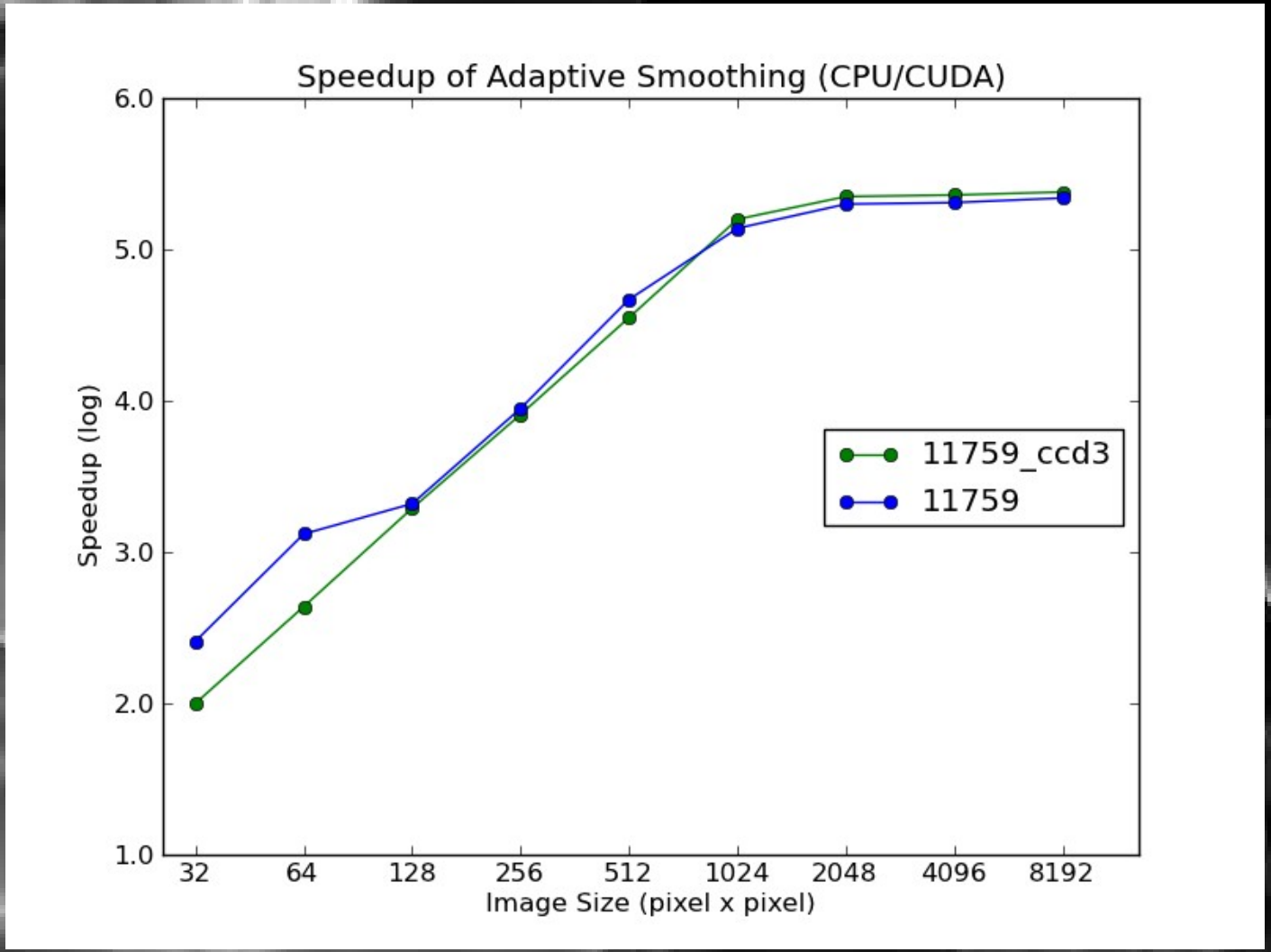
- Traditional Chandra Observation
  - dmimgadapt()
  - Worst Case: $O(n^4)$
  - 8192x8192 binned to 1024x1024
  - Run Time: ~ 30 minutes



GPU/MPI Implementation

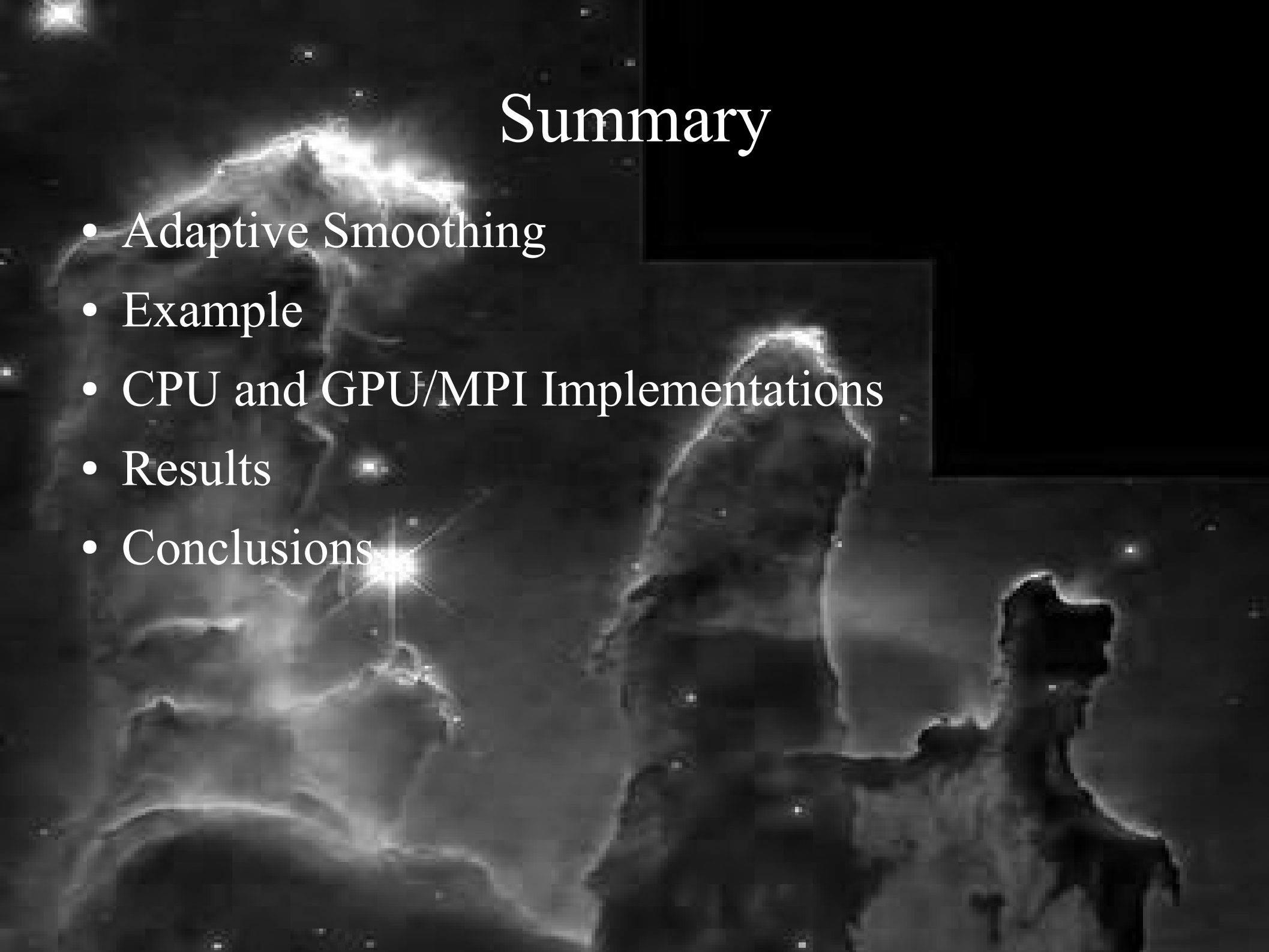
- GPU
  - Embarrassingly Parallel
  - Use full resolution image
- MPI
  - Process Multiple Observations

Results


Speedup of Adaptive Smoothing (CPU/CUDA)
Speedup (log)
6.0
5.0
4.0
3.0
2.0
1.0
32
64
128
256
512
1024
2048
4096
8192
Image Size (pixel x pixel)
11759_ccd3
11759

Conclusions

- CPU vs GPU
  - Full Resolution Image
    - CPU: ~ 4.5 Days
    - GPU: ~ 1.65 sec
  - Speed Up of ~10^5



Summary

- Adaptive Smoothing
- Example
- CPU and GPU/MPI Implementations
- Results
- Conclusions

Acknowledgments

CIAO: Chandra's data analysis system

Fruscione et al. 2006, SPIE Proc. 6270, 62701V, D.R. Silvia & R.E. Doxsey, eds.

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