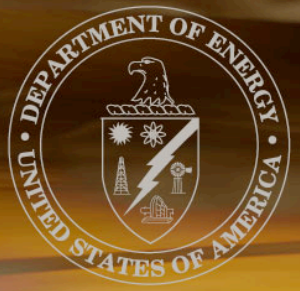


VACET

Current VACET/NERSC Analytics Efforts for Accelerator Modeling Data

Gunther H. Weber

LBNL

3 December 2008

Overview

- Deploying VisIt on Franklin @ NERSC
- Tech X Vizschema plugin parallelization support
- Deploying FastBit-accelerated VisIt prototype

Deploying VisIt on Franklin

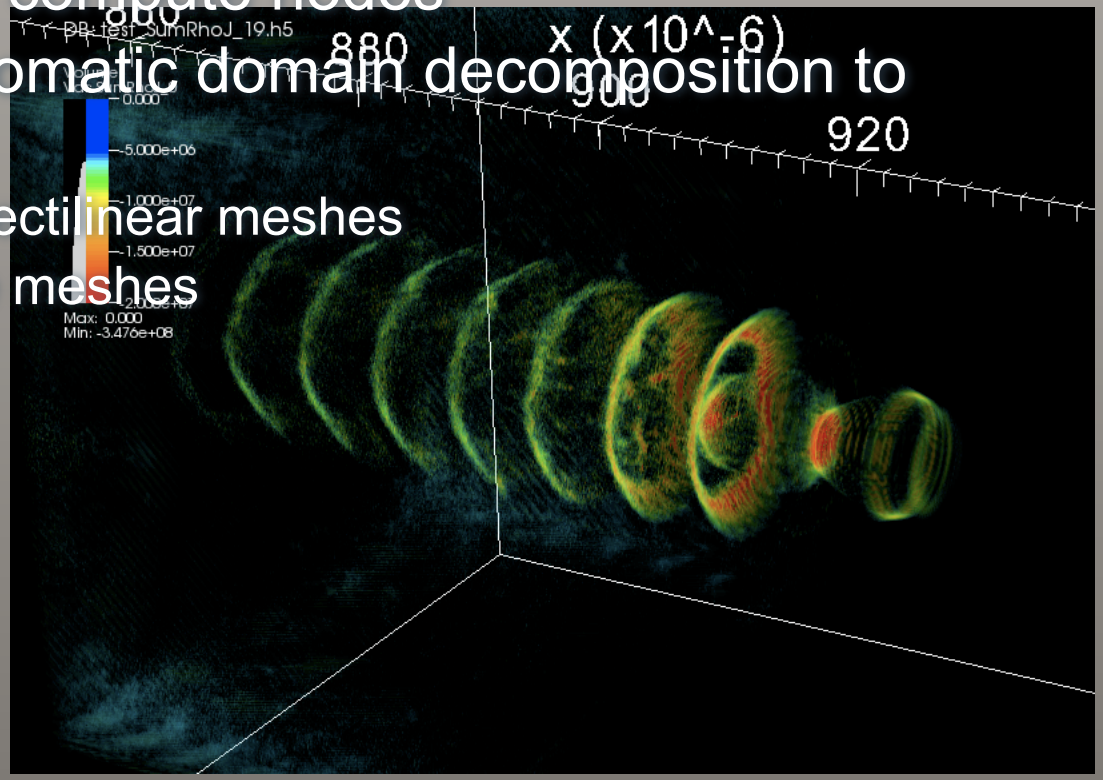
- Problem size becoming larger
  - Requires parallel analysis, more processors for analysis
  - Moving data becomes increasingly cumbersome

➔Run analysis on in parallel on compute nodes

- VisIt now available on Franklin
  - Based on Jaguar @ ORNL effort
  - “Beta”: Need to evaluate stability
  - Caveat: OS upgrade may require new install

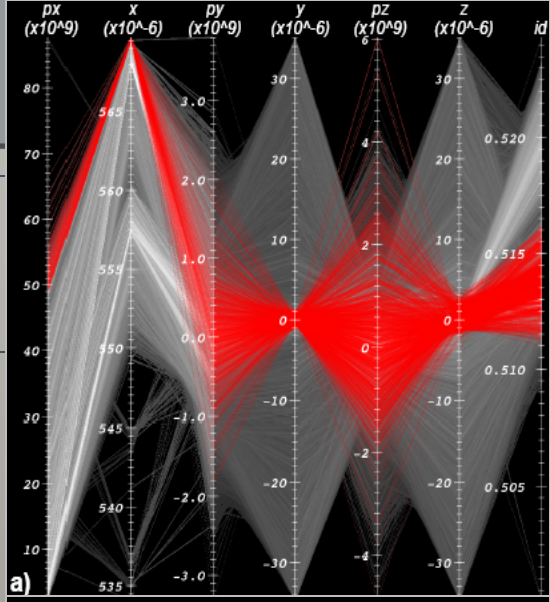
VizSchema Plugin Parallelization Support

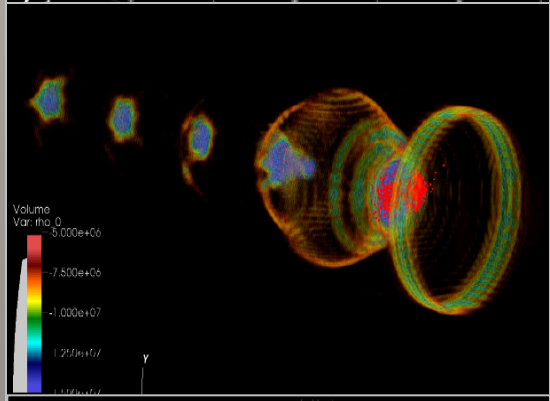
- TechX is developing a plugin for reading VORPAL etc. files in VisIt
- Using VisIt effectively requires multiple domain
- Limited memory on compute nodes
- Add support for automatic domain decomposition to Vs plugin
  - Currently: regular, rectilinear meshes
  - In progress: particle meshes

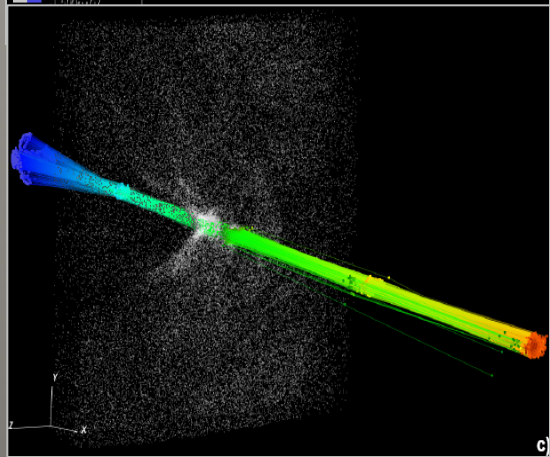


FastBit VisIt Protoype for Accelerator Modeling

- PI: C. Geddes (LBNL), part of SciDAC COMPASS project, Incite awardee.
- Accomplishment:
  - Algorithms and production-quality s/w infrastructure to perform interactive visual data analysis (identify, track, analyze beam particles) in multi-TB simulation data.
- Science Impact:
  - Replace serial process that took hours with one that takes seconds.
  - New capability: rapid data exploration and analysis.
- Collaborators:
  - SciDAC SDM Center (FastBit)
  - Tech-X (Accelerator scientists)





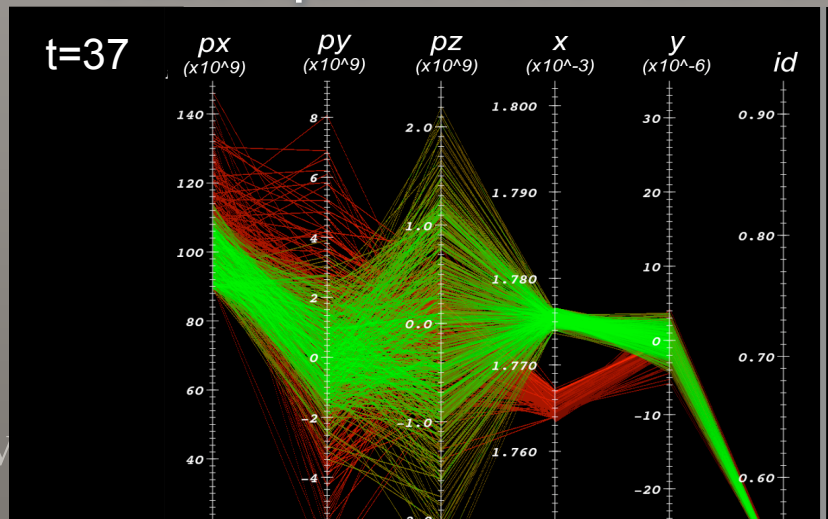


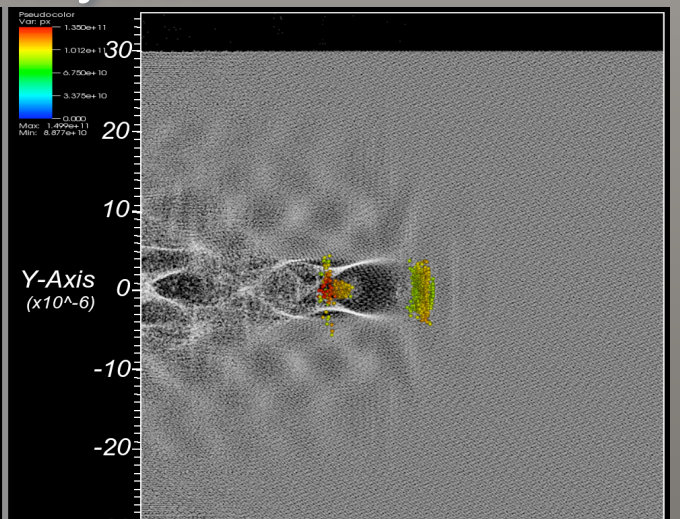
Data Overview

- Simulation: VORPAL, 2D and 3D.
- Particle data:
  - X,y,z (location), px,py,pz (momentum), id.
  - No. of particles per timestep: ~ $0.4*10^6$ – $30*10^6$ (in 2D) and ~$80*10^6$– 200 $*10^6$ (in 3D)
  - Total size: ~1.5GB – >30GB (in 2D) and ~100GB – >1TB (in 3D)
- Field data:
  - Electric, magnetic fields, RhoJ
  - Resolution: Typically ~0.02-0.03μm longitudinally, and ~ 0.1-0.2μm transversely
  - Total size: ~3.5GB - >70GB (in 2D) and ~200GB - >2TB (in 3D)

Analysis Task(s)

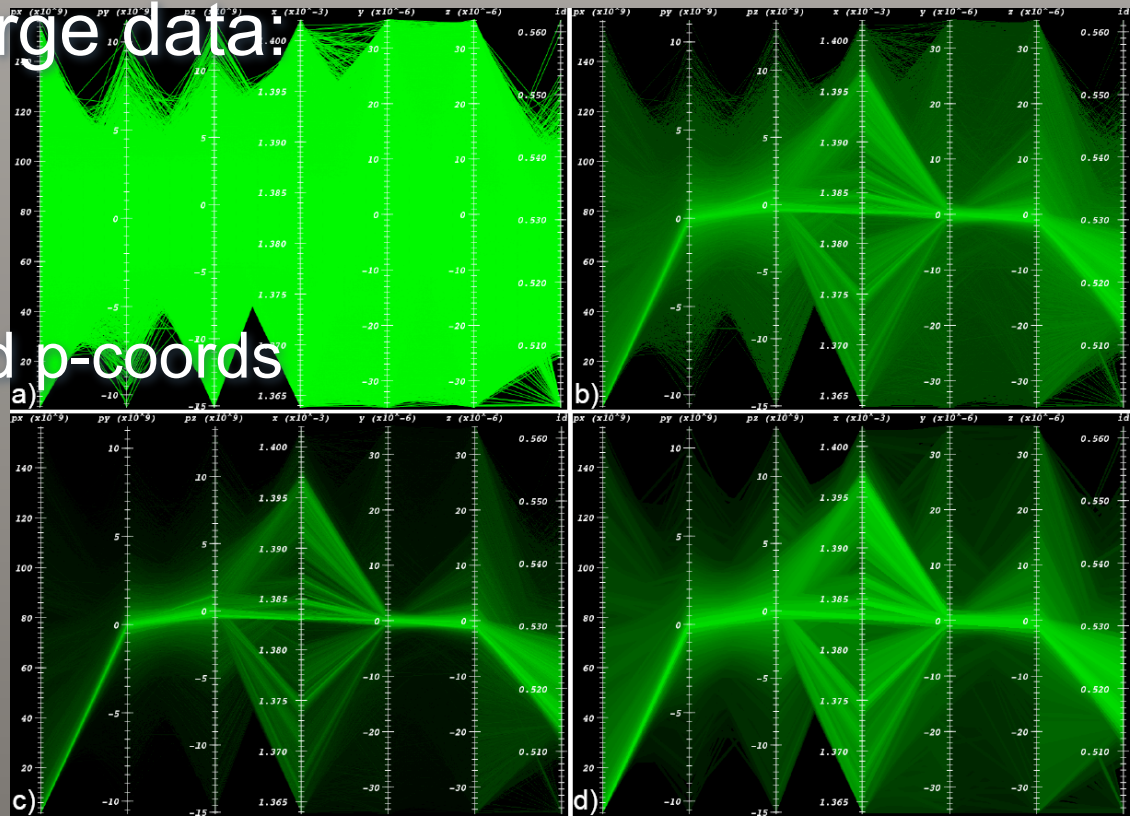
- Identify particles that form a beam
  - Interactive visual data exploration
  - Data subsetting
- Track them over time
  - Given particle ID's from a given time step,
  - Find all those particles in all time steps
  - Subsequent visual data analysis.



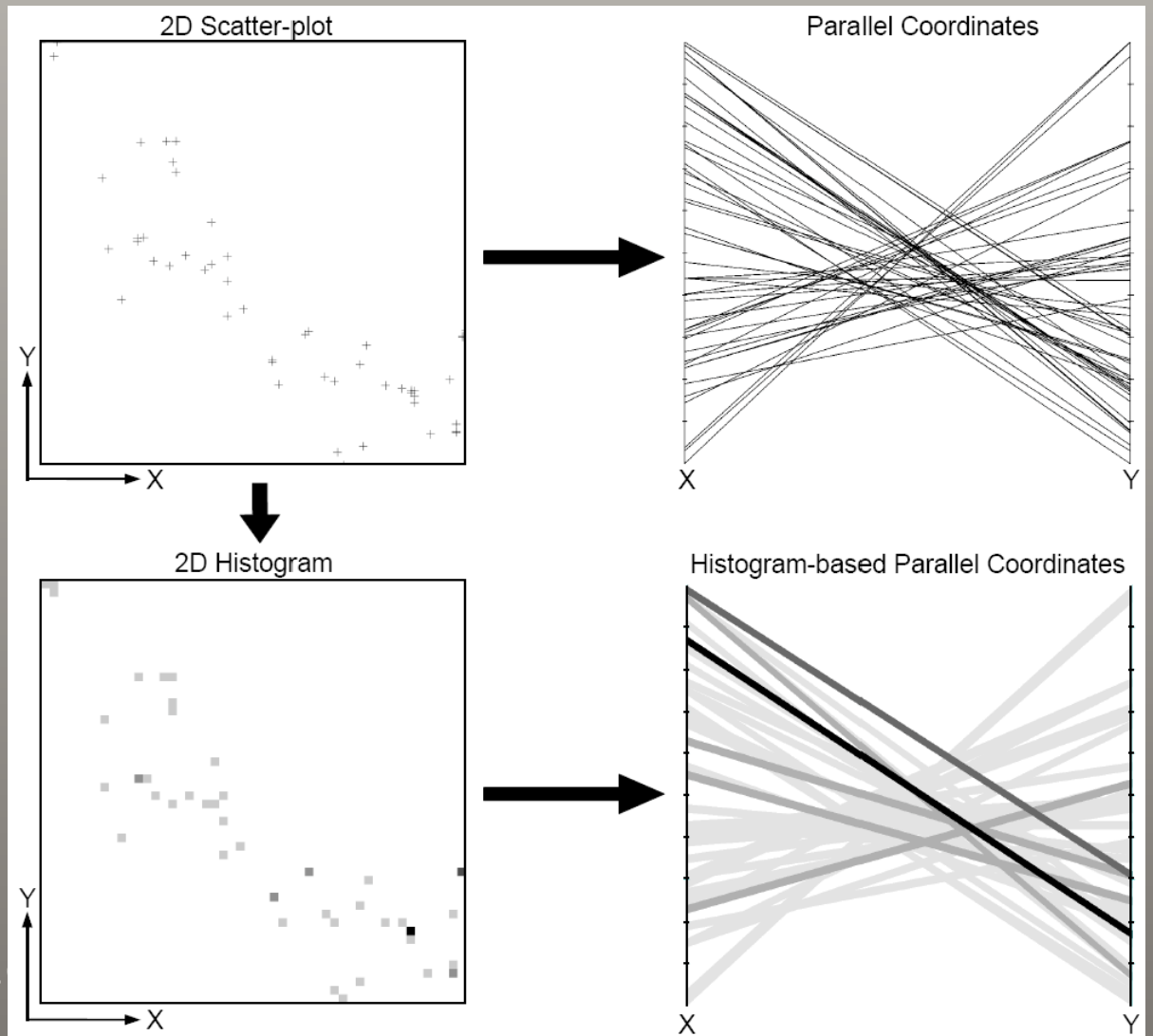


Fundamental Problem #1 - Interface

- Parallel coordinates
  - An interface for subset selection.
  - A mechanism for displaying multivariate data.
- Problems with large data:
  - Visual clutter
  - O(n) complexity
- Solution
  - Histogram-based p-coords



Histogram-Based Parallel Coordinates



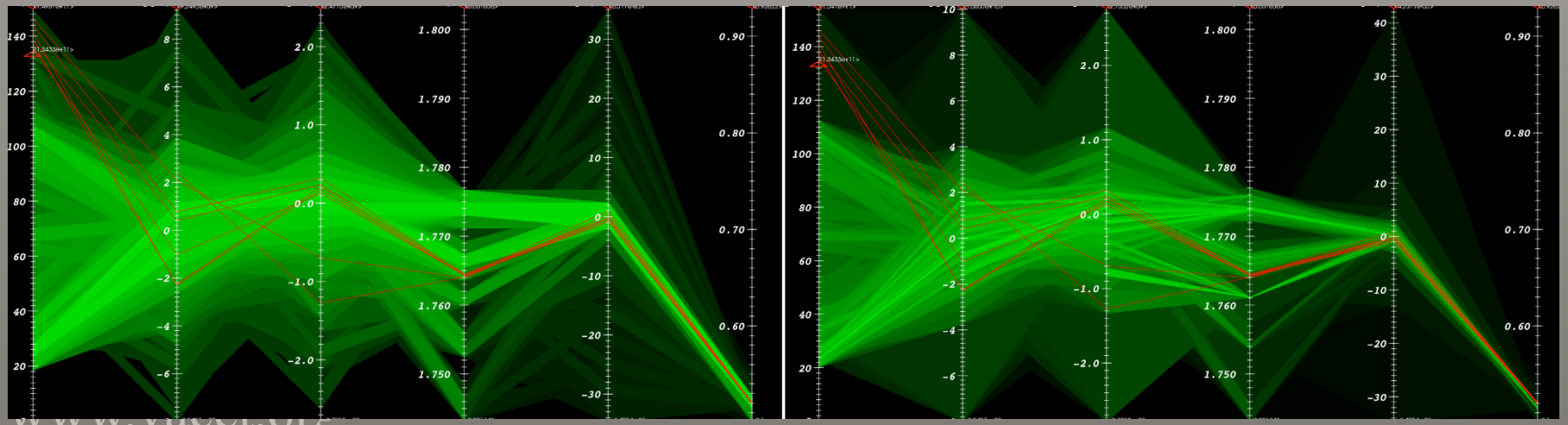
Histogram-based Parallel Coordinates

Histograms are computed on request:

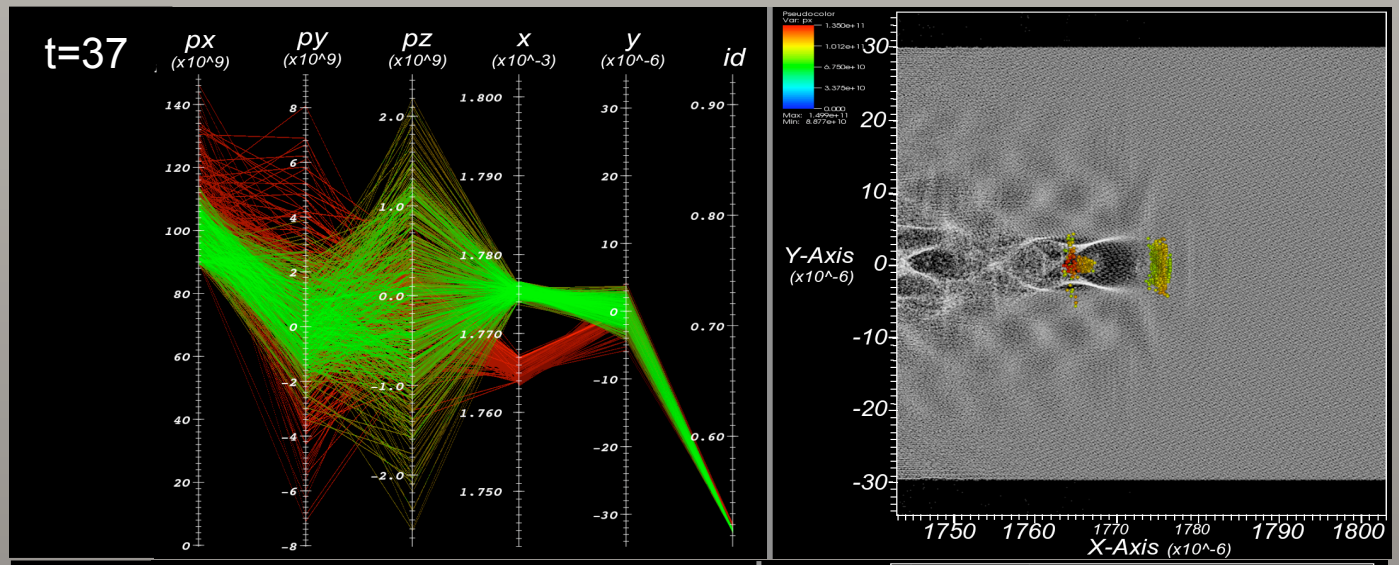
- Enable rendering also of data subsets using histogram-based parallel coordinates
- Enable close zoom-ins and smooth drill-downs into the data
- Enable rendering with arbitrary number of bins

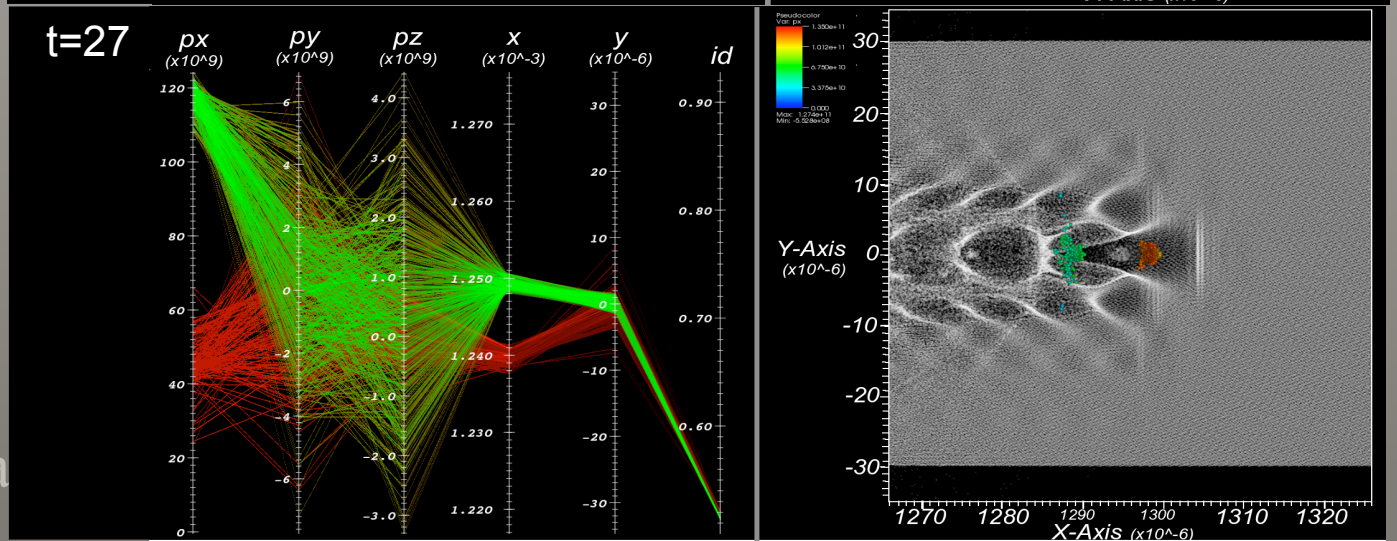
Allow use of adaptively binned histograms:

- Enable more accurate representation of the data in lower-level-of-.detail views

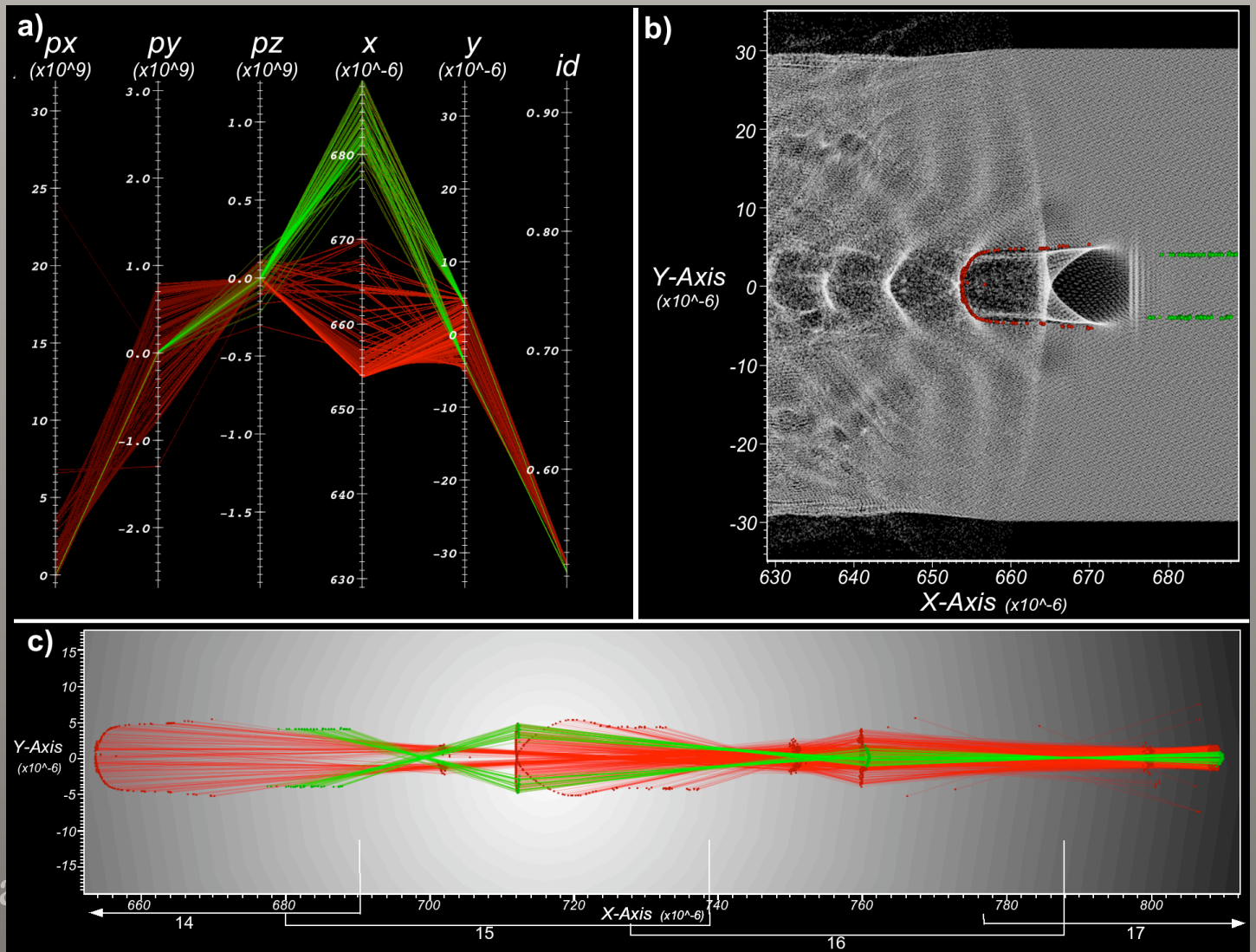


Beam Selection

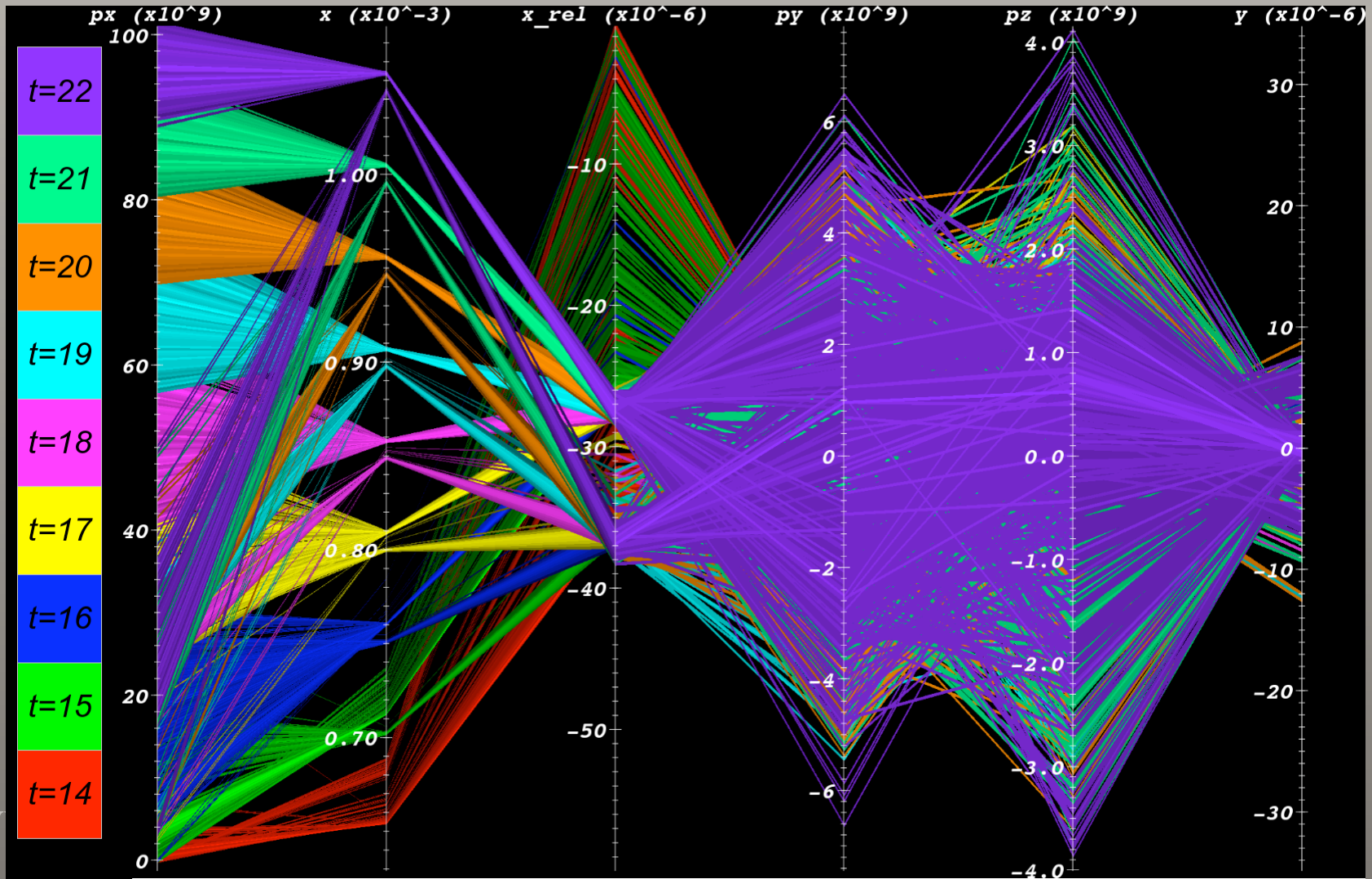




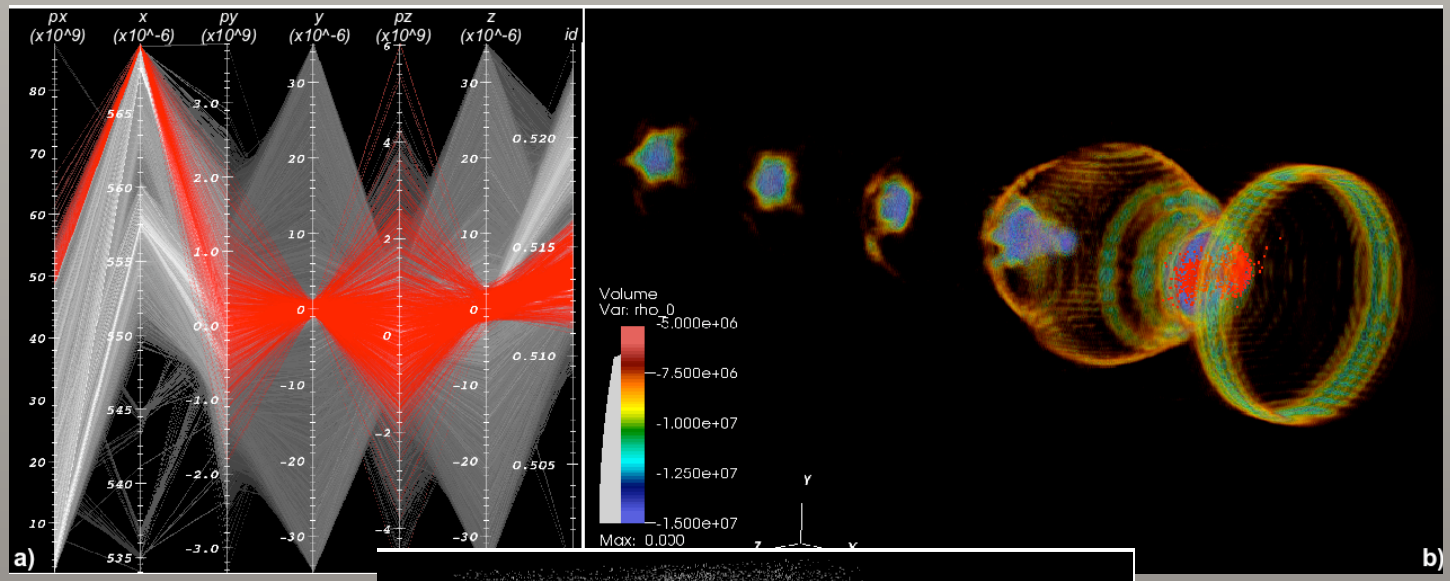
Beam Refinement

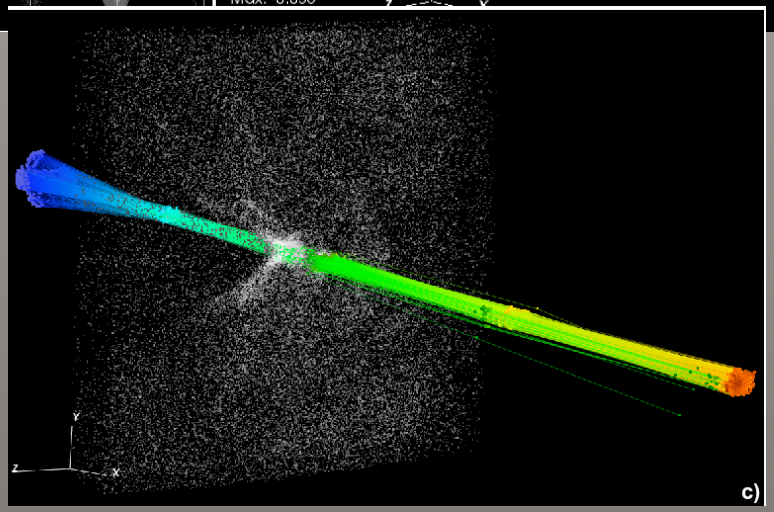


Beam Evolution



3D Example


px (x10^9)
x (x10^-6)
py (x10^9)
y (x10^-6)
pz (x10^9)
z (x10^-6)
id
a)
Volume
Var: rho_0
-5.000e+06
-7.500e+06
-1.000e+07
-1.250e+07
-1.500e+07
Max: 0.000
b)


c)

Recent Publications

- SC08 Technical Paper: High-Performance Multivariate Visual Data Exploration for Extremely Large Data. O. Rubel, et al.
- 2008 International Conference on Machine Learning: Automated Analysis for Detecting Beams in Simulations. D. Ushizima, et al.

The End

- Thanks for your time.
- More information: www.vacet.org