

NERSC Analytics Program Status and Update

DOE CGF April 30, 2007







- Describe goals, components, resources, and value of NERSC Analytics Program
- Supported science domains
- Synergy with other analytics programs
- Examples of current technology applications – from scientific data management to data exploration







Facilitate NERSC user knowledge discovery through the

use, adaptation, extension, creation, application, and deployment

of a diverse array of technologies spanning the domains of

high performance computing, data management, data analysis and visualization, and workflow management.





Components of Analytics Program

- Scientific data management (SDM) efficient access to data; data organization and security
- Workflow management systematic approach to data processing & simulation pipelines
- Data analysis/data mining broad category includes tools to processing data, finding features
- Visualization visual data exploration; tools for communicating and sharing results

Integration of these components facilitates data exploration that leads to knowledge discovery.







- Team of seven (three new hires late 2006early 2007) with experience spanning all aspects of analytics, high performance computing, and many science domains.
- SGI Altix 32 processors, 192GB RAM, 40TB attached FC storage
 - Architectural balance favors data intensive operations: large SMP memory, best I/O bandwidth on the floor at NERSC.
- Procurement process underway for new analytics machine.







- For NERSC users, problem sizes are growing larger with larger computational platforms and higher-resolution instruments.
- All sciences need to store, access, process, explore and understand data and information.
 - Science is increasingly data intensive.
- Understanding and managing data is a limiting factor for a wide range of sciences (ASCR SDM Challenge workshop report).
 – There is no science without data analysis.





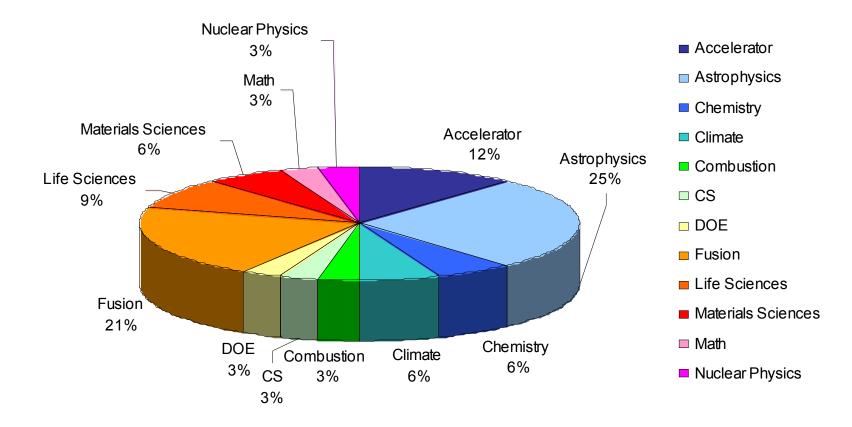


- Generally, no off-the-shelf, general-purpose solutions for analytics exist.
- The Analytics Program adapts, extends, integrates, and sometimes creates technologies to meet user needs.
- Consulting and collaborative projects with users in all aspects of analytics technologies.
- Results and impact on science come through in-depth work with stakeholder/users.





Supported Science Areas



Supported Science Areas 2005-2007



ERSC





Analytics Customer Technology Matrix

	SDM	Workflow	Analysis	Visualization
Accelerator	Х	X	X	X
Astrophysics	Х	X	X	X
Biology			X	Х
Chemistry				X
Climate		X	X	X
Combustion			X	X
CS			Х	X
Fusion	Х		X	X
Math	Х		X	X







Synergy with Other Analytics Programs

- SciDAC Visualization and Analytics Center for Enabling Technologies (VACET)
 - Collaboration of LBNL, LLNL, ORNL, Utah, UC Davis
 - Representatives from both NERSC Analytics and ORNL/CCS Visualization groups
 - Development of analytics infrastructure that will be deployed at DOE's open computing facilities
- DOE Base Program in Visualization
 - New technologies for high performance visualization
- SciDAC Scientific Data Management Center
 - FastBit index/query technology
 - Storage Resource Manger (SRM) technology
 - Expert assistance in applying technologies to user problems







- Scientific Data Management Kurt Stockinger
 SRM, H5Part, FastBit
- Workflow Management Kurt Stockinger
 - Kepler
- Data Analysis and Data Mining Peter Nugent, Raquel Romano
 - Climate modeling and astrophysics
- Visualization Cristina Siegerist, Gunther Weber
 - Current projects and accelerating remote display performance
- Data Exploration Cecilia Aragon
 - SUperNova Factory AssembLy Line





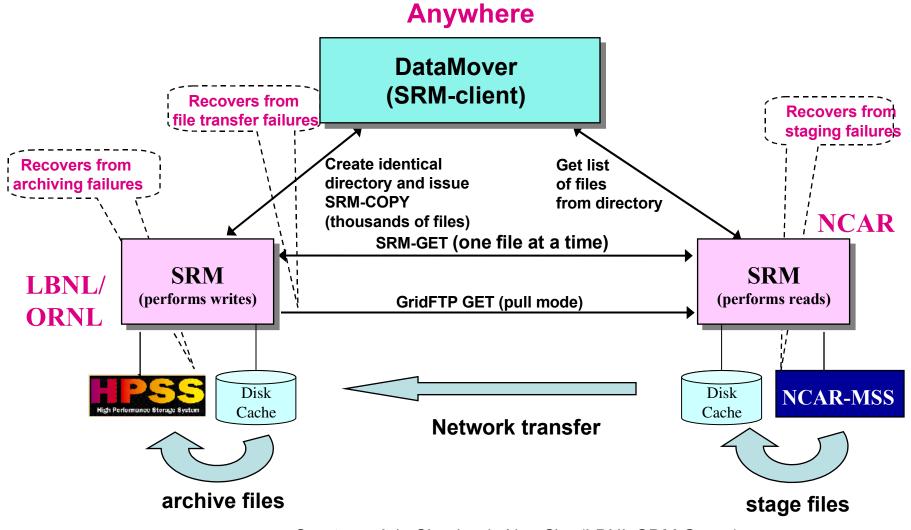


Scientific Data Management Kurt Stockinger

- Storage Resource Manager (SRM) for distributed data management
 - integrated mechanism for transferring files from one location to another, uniform access to heterogeneous storage (disk, tape), fault tolerant
- H5Part is a simplified API on top of the scientific data format HDF5.
 - high-performance, parallel I/O
 - developed for accelerator modeling
- FastBit for efficient indexing and querying
- HDF5 FastQuery combines bitmap indices with HDF5 (no slides).



SRMs Used in Earth Science Grid for Robust Multi-File Replication



Courtesy: Arie Shoshani, Alex Sim (LBNL SDM Group)

Data Analysis with H5Part

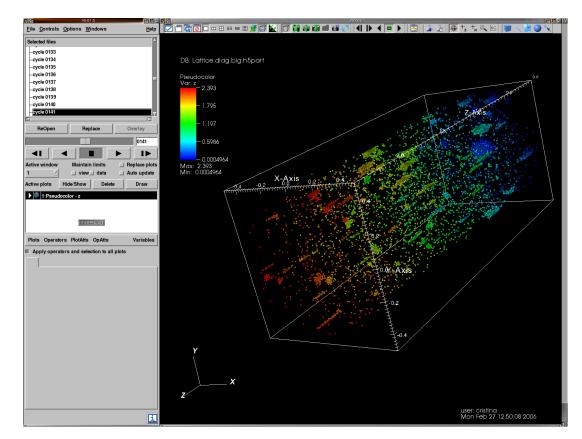
H5Part

 provides high-performance parallel I/O

ERSC

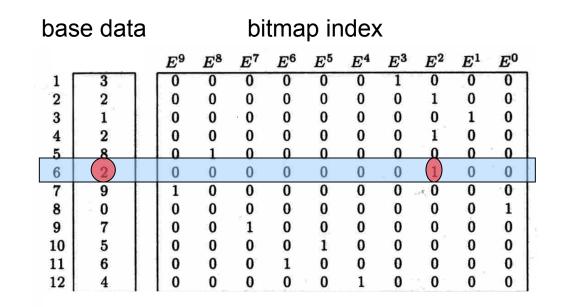
- integrated into codes:
 - BeamBeam3D, MaryLie/Impact (ongoing)
 - Used at LBNL and PSI (Switzerland)
- current focus on particles:
 - 6-vector of coordinates and momenta

Vislt plugin developed by Cristina Siegerist



Vislt user interface showing an H5Part particle file rendered as spheres using the pseudocolor plot option. - visualization by Cristina Siegerist

Bitmap Indices in FastBit



Bitmap index compresses very well due to sparseness. Queries can be answered very efficiently.



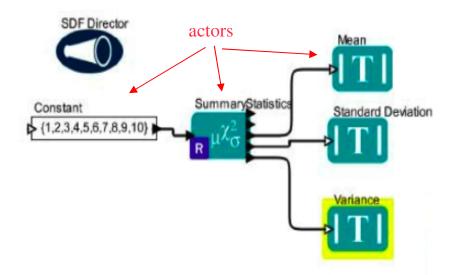




Kepler (www.kepler-project.org)

- software application for building scientific workflows
- collaborative effort

Components consist of directors (scheduler), actors (perform a function), ports, relations, and parameters.

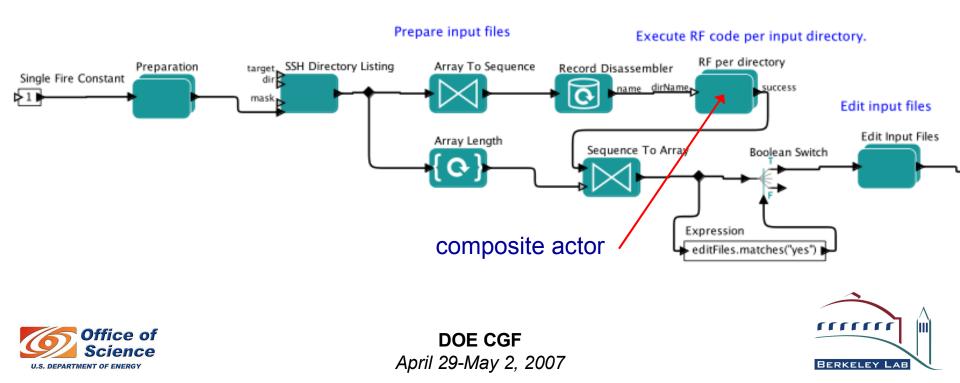


workflow to calculate simple statistics



Accelerator Simulation

- Iterate over input files in different directories
- Execute specific codes remotely
- Edit input files





Benefits of Using Kepler Workflows

Script	Kepler Workflow
Needs to be written from scratch	Contains large number of re- usable actors
Mainly used for local execution	Allows parallel and distributed workflow execution
May be difficult to maintain	Easier to maintain
Often difficult to read ("write- only")	Visual representation of workflows: easier to understand







Analysis of Climate Modeling Raquel Romano

Data analysis techniques used for feature detection and to remove 'model drift' from simulations.

- Blind source separation (BSS)
 - Can be used to find features (tropical storms) when no explicit criteria exist
- Multi-taper method
 - Used to separate model drift from natural variability







- Usual method of detecting tropical storms in GCM is to look for high wind, low SL pressure, high vorticity, etc.
- What if you don't know what explicit criteria to use to find features of interest?
- The BSS method (also known as blind deconvolution, independent component analysis (ICA)) is a statistical method for detecting unusual signals.
- Rachel applied the BSS method (using Matlab) to find features in climate models.







Automatic Feature Extraction by Blind Source Separation

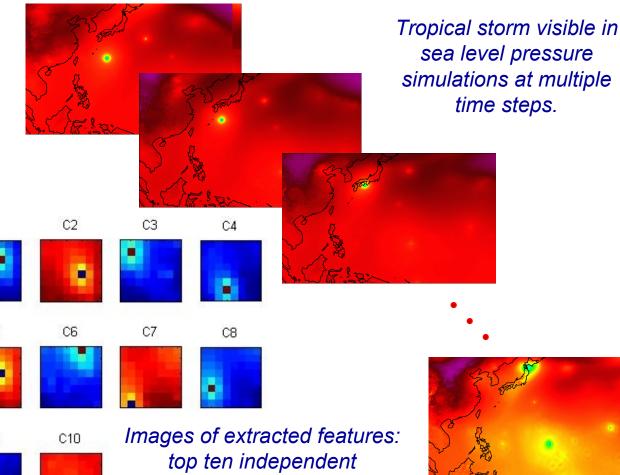
Extracted features can be used as templates for finding similar features.

C1

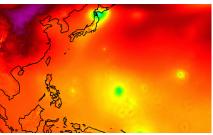
C5

C9

In this case, the features were variations on rotating low-pressure systems. This was not assumed a priori.



components were extracted from set of all 8x8 subimages.





- Model-induced drift occurs in 1000-year surface air temperature simulations.
- Need to separate periodic oscillations due to natural variability from background trends (model drift).
- Multi-Taper Method (MTM): combines spectral frequency analysis with a statistical model.
- MTM used to find spatially varying nonlinear trends in order to detect spatio-temporal patterns of interest.

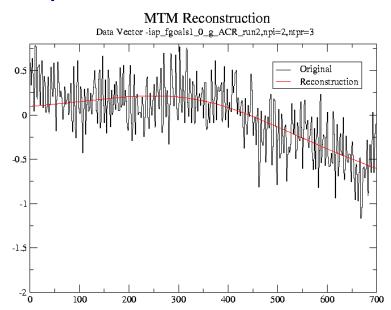


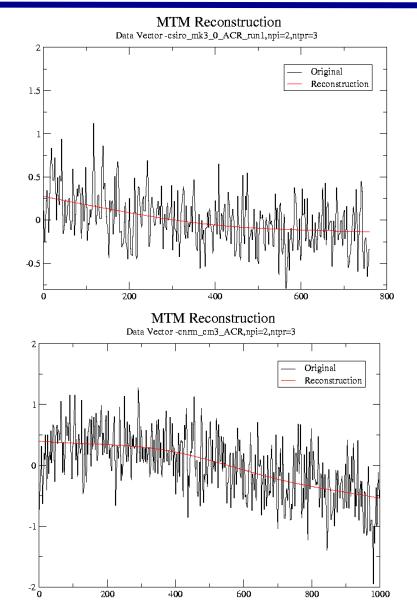




Statistical Detrending of Surface Air Temperature Using MTM

The red line is the trend that the modelers want wanted to remove. MTM was used to find trends both on a global scale, and on smaller spatial scales.







Analytics in Astrophysics Peter Nugent

- Analysis of supernovae data led to the detection of the first Super Chandrasekhar Mass Type la supernova.
- Analysis of simulation results of supernova detonation facilitated comparisons with observations
- Workflow developed for processing 1 M 10 MB sky images to produce a library of reference images to use in investigating transient objects.



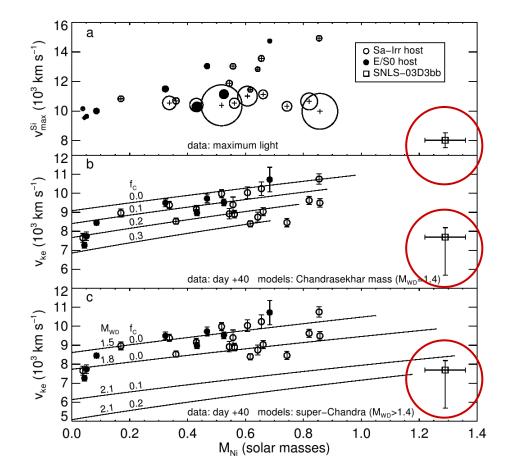


Confirmation of Type 1a SN from "Super-Chandrasekhar" Mass WD

 Visualization and analysis used to test and confirm theory of new type of Type Ia SN – one having "Super-Chandrasekhar" mass.

ERSC

- Top: brightness vs. velocity and amount of deceleration.
- Middle: velocity vs.mass and unburned carbon using a 1.4 solar mass model.
- Bottom: moving to a 2 solar mass model includes new observation.

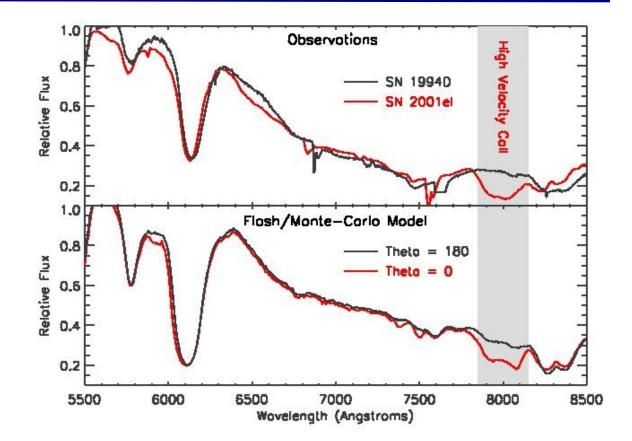


D.A. Howell, M. Sullivan, P.E. Nugent, R.S. Ellis, A.J. Conley, D. Le Borgne, R.G. Carlberg, J. Guy, D. Balam, S. Basa, D. Fouchez, I.M. Hook, E.Y. Hsiao, J.D. Neill, R. Pain, K.M. Perrett and C.J. Pritchet. The type Ia supernova SNLS-03D3bb from a super-Chandrasekher-mass white dwarf star. *Nature*, 443, 308-311, 21 September 2006.



Spectrum Synthesis

- The spectrum synthesis of the Incite model simulations compares favorably to observations.
- This may be the first explosion model that "naturally" explains the transition from deflagration to detonation in thermonuclear supernovae.









Workflow Management in the SN Factory

- Goal: make better reference images to use when investigating transient objects (*e.g.*, supernovae).
- About ~20,000 sq deg on the sky has been covered about 50 separate times: approximately 1 million, 10 Mb images resides on NGF.
- Images processed in 2 X 2 square degree chunks; half of the processing is a serial task and half is a parallel task.
- Serial task: Determine image "zero point" and astrometry.
- Parallel task: co-addition of 500-1000 images into one 250 Mb image of 2 X 2 square degrees.
- Each part takes roughly the same amount of time ~ 100 wallclock days.







Workflow Management in the SN Factory

- To handle the serial part in "parallel", Peter wrote mpibatch, a script to perform a round-robin execution of a list of serial commands (or even scripts of several commands) through mpi.
- Other steps:
 - Perl script converts text list into Fortran namelist.
 - Fortran namelist read as character strings on the master processor, spit out to slaves to execute, who then ask for more when they are done.
 - The threaded code 'swarp' is run to co-add each of the sub-images into one large image.
- Example the Coma Cluster...







Workflow Management in SN Factory



500 images went into this incredibly deep coaddition of the Coma Cluster.





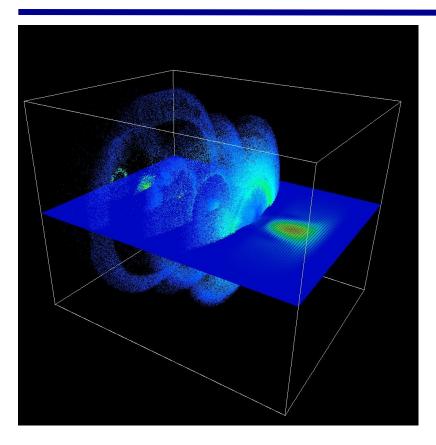


- Particle-in-Cell Simulation of Laser
 Wakefield Particle Acceleration
- Accretion-Induced Collapse of White Dwarfs
- Vislt plugin for H5Part shown earlier
- Vislt plugin for NIMROD output in HDF5
- Journal covers

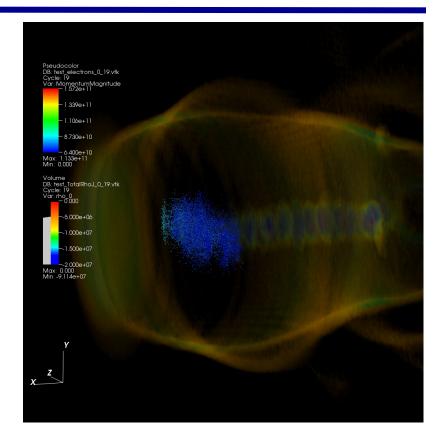




PIC Simulation of Laser Wakefield Particle Acceleration



This image shows a horizontal slice through the electric field; the electrons are colored by the magnitude of the momentum. (AVS/Express)



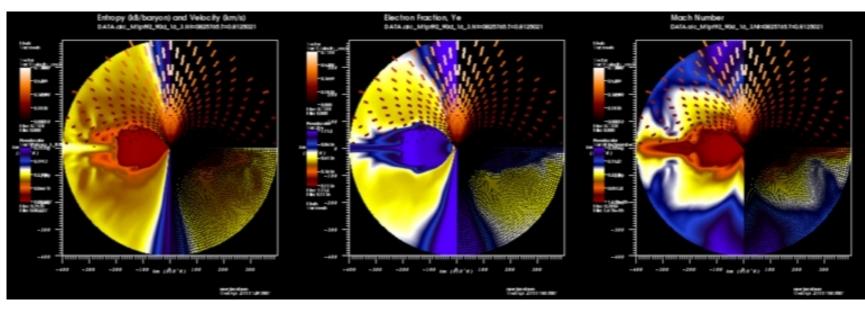
This image uses volume rendering to show the plasma density field. *(Vislt)*

2006 INCITE Project. PI: Cameron Geddes, LBNL



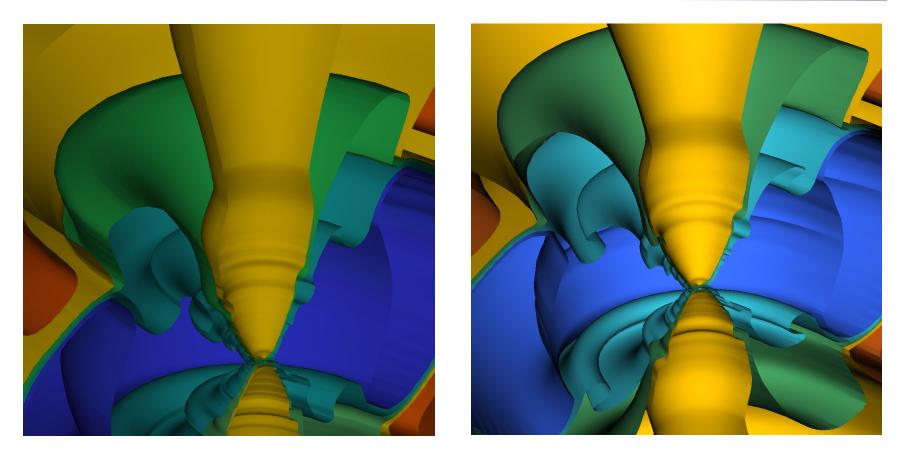
Accretion-Induced Collapse of White Dwarfs

- Data from 2D radiation-hydrodynamics simulations visualized using both AVS/Express and Vislt.
- Data include 68 scalar fields and 25 vector fields.
- Cristina wrote a reader for AVS/Express and converted the data to vtk format for Vislt.
- Future simulations will be 3D.





Accretion-Induced Collapse of White Dwarfs

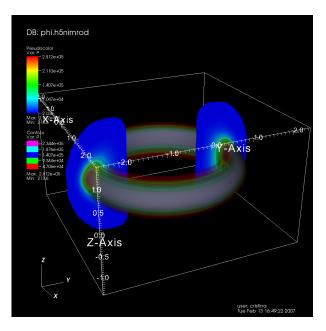


These are images of isosurfaces of entropy. One of these images was made with AVS/Express, and the other with Vislt.

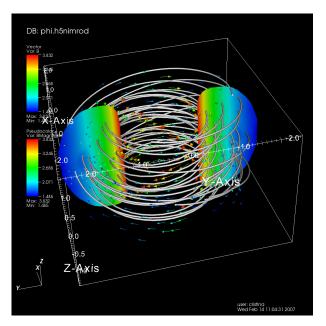




- NIMROD: Fusion Magnetohydrodynamics Simulation Project
- Cristina wrote a Vislt plugin for NIMROD output that has been converted to HDF5.



Pressure field visualized with cut planes and volume rendering.

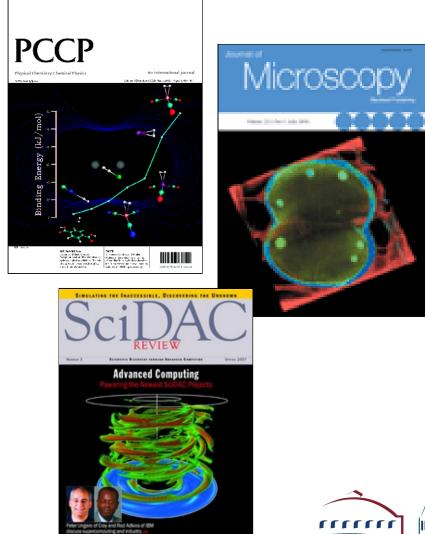


Magnetic field vectors and cut planes showing magnitude of field.



Journal Covers Cristina Siegerist

- Journal of Physical Chemistry/Chemical Physics, March 2006
- Journal of Microscopy, July 2006
- SciDAC Review, Spring
 2007







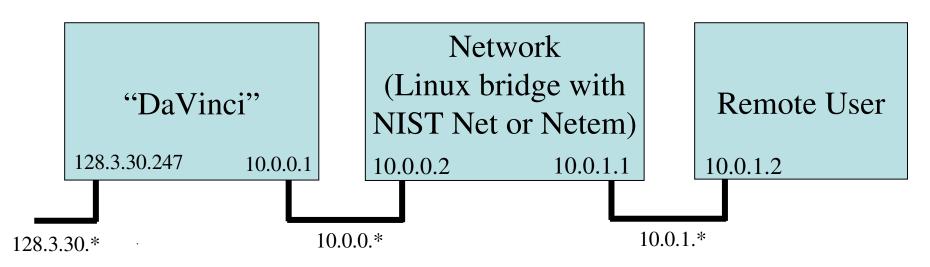
- Poor X11 network performance makes it difficult for remote users to use NERSC resources.
- Identify and evaluate alternatives to X11.
- Two alternatives under consideration: VNC (different vendors) and (Free)NX
- Evaluation criteria: speed/interactivity (usable over high latency link? frames/sec? time to finish update), deployability, security
- Must provide OpenGL/GLX functionality.







Simulating the Network



- Run most test applications locally on fake "DaVinci"
- Use LBNL/NERSC network to test some applications (Matlab, ...) on real DaVinci







- Test with existing applications (Matlab, Maple, IDL, ...)
 - Subjective speed experience
 - Time between "mouse click" and "last screen update" (using XTrap and XDamage extensions)
 - Frame per second updates
 - Draw alternating frames and measure frame change rate at remote client
 - Aliasing?
- Mock-up application
 - Need to be careful to ensure that application uses
 X11 in the same way as Matlab, Maple, IDL, etc.







Data Exploration using SUNFALL Cecilia Aragon

- SNfactory data pipeline in 2005 involved many manual, repetitive tasks.
- The SUperNova Factory AssembLy Line (SUNFALL) is a software framework for data capture, data management, data analysis, data and information visualization, and workflow management.
- The SUNFALL project has
 - automated and is continuing to automate many repetitive tasks,
 - developed a suite of tools for data management (Data Forklift),
 - -developed a Web-based monitor for workflow management,
 - -developed improved image processing algorithms,
 - -salvaged legacy code.







Palomar

SNfactory Supernova Search Data Flow

HPSS@NERS

SNIFS UH 2.2-m

Oschin

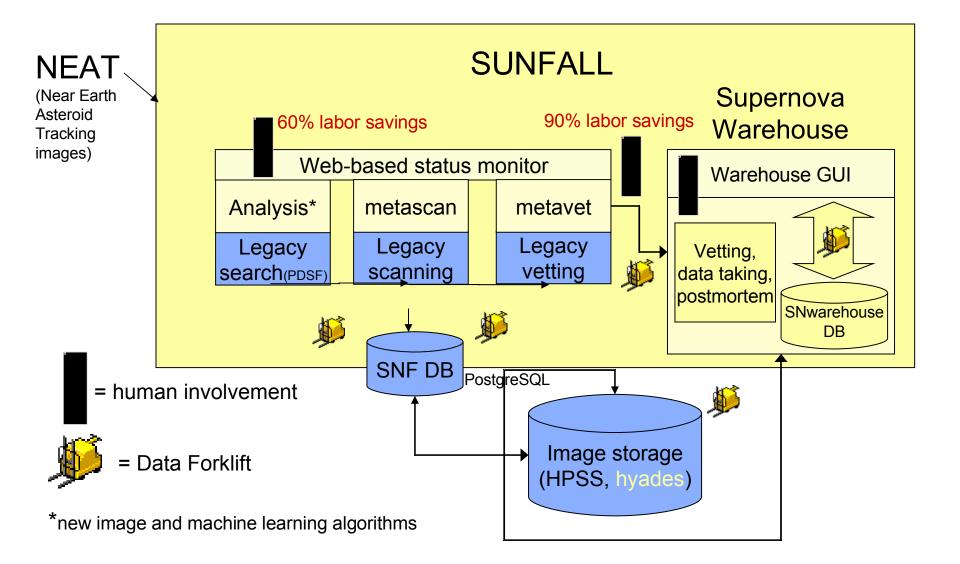
Per night: 30k images 50 GB compressed 500 square degrees



slide by S. Bailey

PDSF @ NERSC

SNfactory Data Pipeline – Today



ERSC



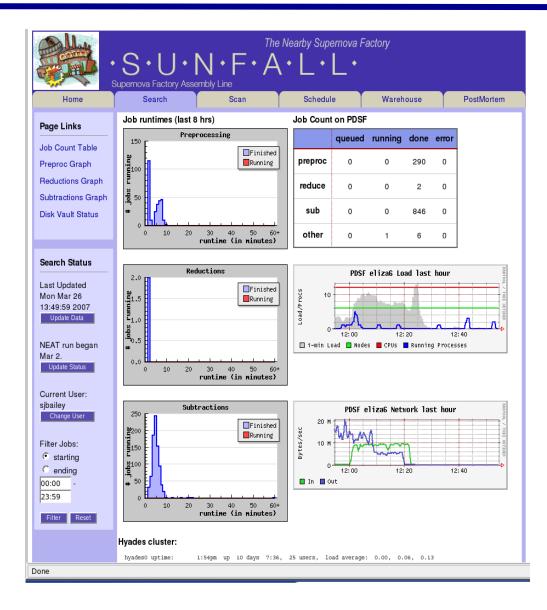
- SUNFALL went into production in the fall of 2006. New capabilities continue to be incorporated.
- Number of false positive candidate supernovae reduced by 80%.
- Labor costs reduced dramatically: from 6 to 8 people working 4 hr/day to one person working 2 hr/day.
- Less time spent doing repetitive tasks means more time to do science, publish results.







SUNFALL Workflow Manager





Supernova Warehouse

Provides tools for data management, data analysis, and data, information, and workflow visualization.

•••			SNF20061021-003 - SNwarehouse									
File View	Actions											
SNF2000	61021-003			1	7.0	SNF200	61021-	003 mag	vs. DOY	2006		
Target State		Target Type:	la		2.20		-					
Magnitude:	19.11 (11-08)	Redshift:	0.061		7.5							
Magnitude: RA:	9.05723	DEC:	7.168929	-	8.0					~		
na: Disc Phase:	-9	Cur Phase:	129		8.5							
Disc Phase: -3	Cui Priase:	120		9.0		l						
				1	9.5					···· } ···		
				2	0.0	290	295	300	305	310	31	-
IOTODY					205	290	295	300	305	510	51	2
IISTORY Date (UTC)	State	Type Redshift	DiecT M	dDv Dose	one: Com	monte						
	8:59:29 following			ley clarifyi	ng comm	nents: the la	st two co	mments	n the targ	et histor	y belon	q
				with s	pecific ob	servations,	not the ta	arget as a	whole			1912
:006-10-30 1	8:20:06 following	la 0.061	-9 ba		ld have n d target	harked this :	as a failu	re in the f	irst place	CCD ji	unk	
2006-10-30 1	8:17:44 following	la 0.061	-9 ba	ley Ishou		harked this :	as margi	nal in the	first place	CCD	junk	
	8:42:25 following			omas Pleas		e followup o	n this fin	e SN Ia.				
		la 0.061		omas (No co								
	10:14:21 vetted 10:14:03 saved	SN? - SN? -		omas Let us omas Nothir			c at 10.1	0 on 101	10120	n 1020 a	nd that	n
.000-10-23 0	10.14.05 Saveu	ONY -	e enn		on 1021.		s at 19.1	9 011 101:	9, 19,12 0	n 1020 a	inu iner	1
	1:57:02 saved	Cand -	- rth	mas Nice S	N on hos	A constant of the second second		h iff				
Add Commer	st.				IN OIL HOS	st with unkni	own reas	mu.		15		
saa Commer	R.				in on nos	st with unkni	own reas		add	Edit	Target	
						st with unkni	own reas					_
Gelect: <u>allnor</u>				Re			own reas		SI	now 🗆 s		_
		8			es type: t		own reas	FIRE		now 🗆 s		_
		8		St	es type: T ate: s	IEAI		Filter	ମ ଅନ୍ତ-ଜୀ : ୧୨	now 🗌 s U		_
				St St	es rype: r ate: s ib: <u>s</u>	NEAT Success)6palom	Filter Phas baz52939	Si : RG-61 :e:-9 200610	now 🗌 s U		_
				St Su "p	estype:r ate: s ib: <u>ş</u> re-discov	VEAT Success Suboct20200 ery but obvio)6palom	Finel Phas baz52939 re" - baile	Si : RG-61 se:-9 200610 y (10-30)	now 🗌 s U	pec 🔽	pho A
				St Su "p Re	es type: m ate: s ib: s re-discov esDate: 2	NEAT Success Suboct2020(ery but obvio 2006-10-19)6palom	Filter Phas baz52939 re" - baile Mag	Si : RG-61 :e: -9 200610 y (10-30) -	10W [] S U 21 20		pho A
				St Su "p Re Re	estype: r ate: s ib: <u>s</u> re-discov esDate: 2 esType: h	VEAT Success Suboct2020(Pry but obvio 2006-10-19 VEAT)6palom	Finter Phas baz52939 re" - baile Mag Filter	Si : RG-61 :e: -9 200610 y (10-30) - : RG-61	10W [] S U 21 20	pec 🔽	pho A
				St Su "p Re Re St	estype: r ate: s ib: <u>s</u> re-discov esDate: 2 esType: f ate: f	VEAT Success Suboct2020(Pry but obvio 2006-10-19 VEAT ailure)6palom ously the 06:15:22	Filter Phas baz52939 re" - baile Mag Filter Phas	Si RG-61 200610 y (10-30) - : RG-61 se: -10	10W [] S U 21 20	pec 🔽	pho A
				St Su "p Re Re St	estype: r ate: s ib: <u>s</u> re-discov esDate: 2 esType: f ate: f	VEAT Success Suboct2020(Pry but obvio 2006-10-19 VEAT)6palom ously the 06:15:22	Filter Phas baz52939 re" - baile Mag Filter Phas	Si RG-61 200610 y (10-30) - : RG-61 se: -10	10W [] S U 21 20	pec 🔽	pho A
				St Su "P Re Re St St	es type: F ate: s ib: <u>s</u> re-discov esDate: 2 es Type: F ate: f ib: <u>s</u>	VEAT Success Suboct2020(Pry but obvio 2006-10-19 VEAT ailure	Dépalom Dusly the Dépalom	Filter Phas baz52939 re" - baile Mag: Filter Phas baz61522	SI 200610 y (10-30) - RG-61 se: -10 200610	10w []s 0 21 20 0 19 16	pec 🔽	pho A
				St Su "p Re Re St Su "O	es type: F ate: s ib: <u>s</u> re-discov esDate: 2 es Type: M ate: f ib: <u>s</u> ther; I sh	VEAT suboct20200 ery but obvir 006-10-19 VEAT ailure suboct19200	Dépalom ously the Dépalom Dépalom	Filter Phas baz52939 re" - baile Mag Filter Phas baz61522 is as a fa	SI 200610 y (10-30) - RG-61 se: -10 200610	10w []s 0 21 20 0 19 16	pec 🔽	pho A
				St Su P Re St St St St St St St St St St St St St	es type: F ate: s ib: <u>s</u> re-discov esDate: 2 es Type: M ate: f ib: <u>s</u> ther; I sh	VEAT Suboct20200 ery but obvio 1006-10-19 VEAT ailure suboct19200 ould have m 1006-10-19	Dépalom ously the Dépalom Dépalom	Filter Phas baz52939 re" - baile Mag Filter Phas baz61522 is as a fa Mag	SI RG-61 9200610 9(10-30) - RG-61 9200610 " - bailey	0 1 <u>9 16</u> (10-30)	pec 🔽	pho A
				St Su P Re St St Su O Re Re Re St St St St St St St St St St St St St	es Type: r ate: s ib: s re-discov esDate: 2 esType: h ate: f ib: s ther, l sh ther, l sh esDate: 2 esType: h	VEAT Suboct20200 ery but obvio 1006-10-19 VEAT ailure suboct19200 ould have m 1006-10-19	Dépalom ously the Dépalom Dépalom	Firter Phas baz52939 re" - baile Mag: Filter Phas baz61522 is as a fa Mag: Filter	SI RG-61 9200610 9(10-30) - RG-61 9200610 200610 " - bailey 19.19	0 1 <u>9 16</u> (10-30)	pec 🔽	pho A
				Sting Stress Str	es Type: F ate: s ib: s es discov es Date: 2 es Type: N ate: f ib: s ther; I sh es Date: 2 es Type: N ate: s	VEAT UCCess Suboct2020(ery but obvin 1006-10-19 VEAT Suboct1920(Suboct1920	Depalom Dusly the Deci15:22 Depalom Derked th Deci13:39	Filter Phas baz52939 re" - baile Mag Filter Phas baz61522 is as a fa Mag Filter Phas	Si RG-61 200610 y (10-30) - RG-61 200610 200610 " - bailey 19.19 RG-61 se: -10	0 0 19 16 (10-30)	pec 🔽	pho A
				St St St St St St St St St St St St St S	es Type: F ate: s ib: s e-discov ssDate: 2 ssType: f ate: f ib: s ther, I sh esDate: 2 ssType: f ate: s ib: s stb:	NEAT NUCCESS NUBOCT20201 ery but obvir 1006-10-19 NEAT NUCCESS NUCCE	Depalom Dusly the Depalom Depalom Depalom Depalom	Filter Phas baz52939 re" - baile Mag: Filter Phas baz61522 is as a fa Mag: Filter Phas baz61339	Si RU-61 se: -9 200610 y (10-30) - : RG-61 se: -10 200610 " - bailey 19.19 : RG-61 se: -10 200610	0 0 19 16 (10-30)	pec 🔽	pho
				Standard Sta	es Type: n ate: s ib: s ssType: 1 ssType: 1 ate: f ib: s ther, 1 sh esDate: 2 ssType: 1 ste: s ate: s ib: s re-discov	NEAT NUCCESS NUCCES	Depalom Dusly the Decident of the	Firrer Phas baz52939 re" - baile Mag Filter Phas baz61522 Filter Phas baz61338 ore" - baile	8 200610 9 (10-30) - 200610 9 (10-30) 9 (10-30) 9 (10-30) 8 (10-30) 9 (10-30) 9 (10-30)	0 0 19 16 (10-30)	pec 🗹	pho
				Still St	es type: T ate: s ib: <u>s</u> re-discov esDate: 2 esType: h fate: f ib: <u>s</u> ther, I sh esDate: 2 esType: h ate: <u>s</u> ib: <u>s</u> re-discov esDate: 2	NEAT NUCCESS NUBOC120201 ery but obvi. 1006-10-19 NEAT NUBOC13201 NUBOC13201 NEAT NUCCESS NUBOC13201 NU	Depalom Dusly the Decident of the	Finten Phas baz52939 re" - baile Mag Fitten Phas baz61522 is as a fa Mag Fitten Phas baz61339 reiten Phas baz61339 reiten Phas baz61339	Si : RG-61 y (10-30) - : RG-61 y (10-30) - : RG-61 y (10-30) : RG-61 se: -10 200610 y (10-30) -	100 S 10 21 20 0 19 16 (10-30) 0 19 16 19 16	pec 🔽	pho
				Participation of the second s	es type: " ate: s ib: <u>s</u> re-discov esDate: 2 esType: N ate: f ib: <u>s</u> ther, 1 sh esDate: 2 esType: N ate: <u>s</u> ib: <u>s</u>	NEAT NUCCESS NUBOC12020(ery but obvi 1006-10-19 NEAT NUBOC1920(1006-10-19 NEAT NUCCESS NUBOC1920(ery, but obvi 1006-10-13 NEAT	Depalom Dusly the Decident of the	Firter Phas baz52935 re" - baile Phas baz61522 is as a fa Mag Filter Phas baz61335 re" - baile Mag Filter	Si RG-61 9 200610 9 (10-30) - : RG-61 9 200610 " - bailey 19,19 : RG-61 9 200610 200610 200610 9 (10-30) - : RG-61	100 S 10 21 20 0 19 16 (10-30) 0 19 16 19 16	pec 🗹	pho
				References of the second secon	es Type: T ate: s ib: s state: 2 es Type: N es Type: N f ib: s state: s ib: s es Type: N ate: s ib: s ss Type: N ate: s ss Type: N ate: 2 es Type: N so 2 es Type: N ate: s stype: N so 2 es Type: N stype: N styp	VEAT Auccess ery but obvio 2006-10-19 VEAT Auboct1920(ould have m 2006-10-19 VEAT Auccess Auccess Auccess 2006-10-13 VEAT 2	Depalom busly the Depalom harked th Depalom ously the D5:39:42	Firten Phas baz52938 re" - baile Mag Filten Phas baz61522 is as a fa Mag Filten Phas baz61339 ere" - baile Mag Filten Phas	SI RG-61 200610 y (10-30) - : RG-61 200610 "-bailey 19.19 : RG-61 200610 y (10-30) - : RG-61 se: -16	0 21 20 0 19 16 (10-30) 0 19 16 0 0 0	pec 🗹	pho
				References of the second secon	es Type: T ate: s ib: s state: 2 es Type: N es Type: N f ib: s state: s ib: s es Type: N ate: s ib: s ss Type: N ate: s ss Type: N ate: 2 es Type: N so 2 es Type: N ate: s stype: N so 2 es Type: N stype: N styp	NEAT NUCCESS NUBOC12020(ery but obvi 1006-10-19 NEAT NUBOC1920(1006-10-19 NEAT NUCCESS NUBOC1920(ery, but obvi 1006-10-13 NEAT	Depalom busly the Depalom harked th Depalom ously the D5:39:42	Firten Phas baz52938 re" - baile Mag Filten Phas baz61522 is as a fa Mag Filten Phas baz61339 ere" - baile Mag Filten Phas	SI RG-61 200610 y (10-30) - : RG-61 200610 "-bailey 19.19 : RG-61 200610 y (10-30) - : RG-61 se: -16	0 21 20 0 19 16 (10-30) 0 19 16 0 0 0	pec 🗹	pho
				Stars	es Type: F ate: s ib: <u>s</u> sesDate: 2 sesType: F ate: f ib: <u>s</u> ther, I sh esSDate: 2 sesType: K ate: s ib: <u>s</u> re-discover sesType: K setter: s ib: <u>s</u> setter: s ib: <u>s</u> setter: s ib: <u>s</u> setter: s ate: s setter: s ate: s setter: s setter: s ate: s setter: s ate: s setter: s ate: s setter: s ate: s setter: s ate: s setter: s s s s s s s s s s s s s s s s s s s	VEAT Auccess ery but obvio 2006-10-19 VEAT Auboct1920(ould have m 2006-10-19 VEAT Auccess Auccess Auccess 2006-10-13 VEAT 2	Depalom Dusly the Depalom Depalom Depalom Depalom Depalom	Filter Phas baz52939 re" - baile Phas baz61522 is as a fa Mag Filter Phas baz61335 ere" - baile Mag Filter Phas baz63942	SI 200610 y (10-30) - - - RG-61 98:-10 200610 - - bailey 19.19 : RG-61 - - - - - - - - - - - - -	0 21 20 0 19 16 (10-30) 0 19 16 0 0 0	pec 🗹	pho

$\Theta \Theta \Theta$	SNF20061109	-002 - SNwarehouse	
File View Actions			
SNF20061109-002 Target State: following Ta Magnitude: 18.59 (11-11) Re Ra: 46.381382 DE Disc Phase: -4 Cu	r Phase: 120 Redshift DiscT ModBy 0.043 -4 rthomas	17.0 17.5 18.0 18.5 19.0 19.5 20.0	2 mag vs. DOY 2006
2006-11-13 21:24:10 vetted Ia 2006-11-12 01:14:32 vetted SN 2006-11-10 21:20:21 vetted SN? 2006-11-10 21:12:04 saved Cand Add Comment:		(No comment) presence confirmed; upgrading to 5 Not there Oct 27 ss crikey, shes a beauty!	add Edit Target
Select all none complete	A DECIMAL DESCRIPTION OF THE DES	ResDate: 2006-11-30 12:13:33 ResType: SNIFS_SPEC State: complete WILMin: 3301.06 FluxUnits: erg/s/cm2/A EvenType: Supernova headers B ascil ResDate: 2006-611-27 12:43:53	Show @ spec ♥ phot Run: 06_334_081 ↔ Phase: 17 Airmass: 1,528 WLMax: 9704.16 ExpTime: 1800.06799 NumExp: 1
		ResType: SNIFS_SPEC State: complete WLMin: 3301.06 FluxUnits: erg/s/cm2/A EventType: Supernova headers B ascil ResDate: 2006-11-22 13:00:10 ResType: SNIFS_SPEC State: complete	Phase: 14 Airmass: 1.68 WLMax: 9704.16 ExpTime: 1300.06799 NumExp: 1 Run: 06_326_089 Phase: 9 Airmass: 1649
		WLMin: 3301.06 FluxkInits: erg/s/cm2/A EventType: Stypernova headers: B ascii ResDate: 2006-11-17.12:34:21 ResType: SNIFS_SPEC State: complete WLMin: 3301.06 FluxUnits: erd/s/cm2/A	WLMax: 9704.16 ExpTime: 1300.06799 NumExp: 1 Run: 06_321_081 Phase: 4 Airmass: 1.345 WMAx: 9704.16 ExpTime: 1200.06799
Mark all checked obs as success	v submit	EventType: Candidate headers B ascii R ascii OhsDate: 2006-11-17.03:48:44	NumExp: 1 Prior med Ist Photo New Phot Result



Acknowledgments

Members of Vis Group/ NERSC Analytics

- Wes Bethel (GL)
- Cecilia Aragon
- Peter Nugent
- Cristina Siegerist
- Kurt Stockinger
- Gunther Weber
- Raquel Romano (now at Google)









