

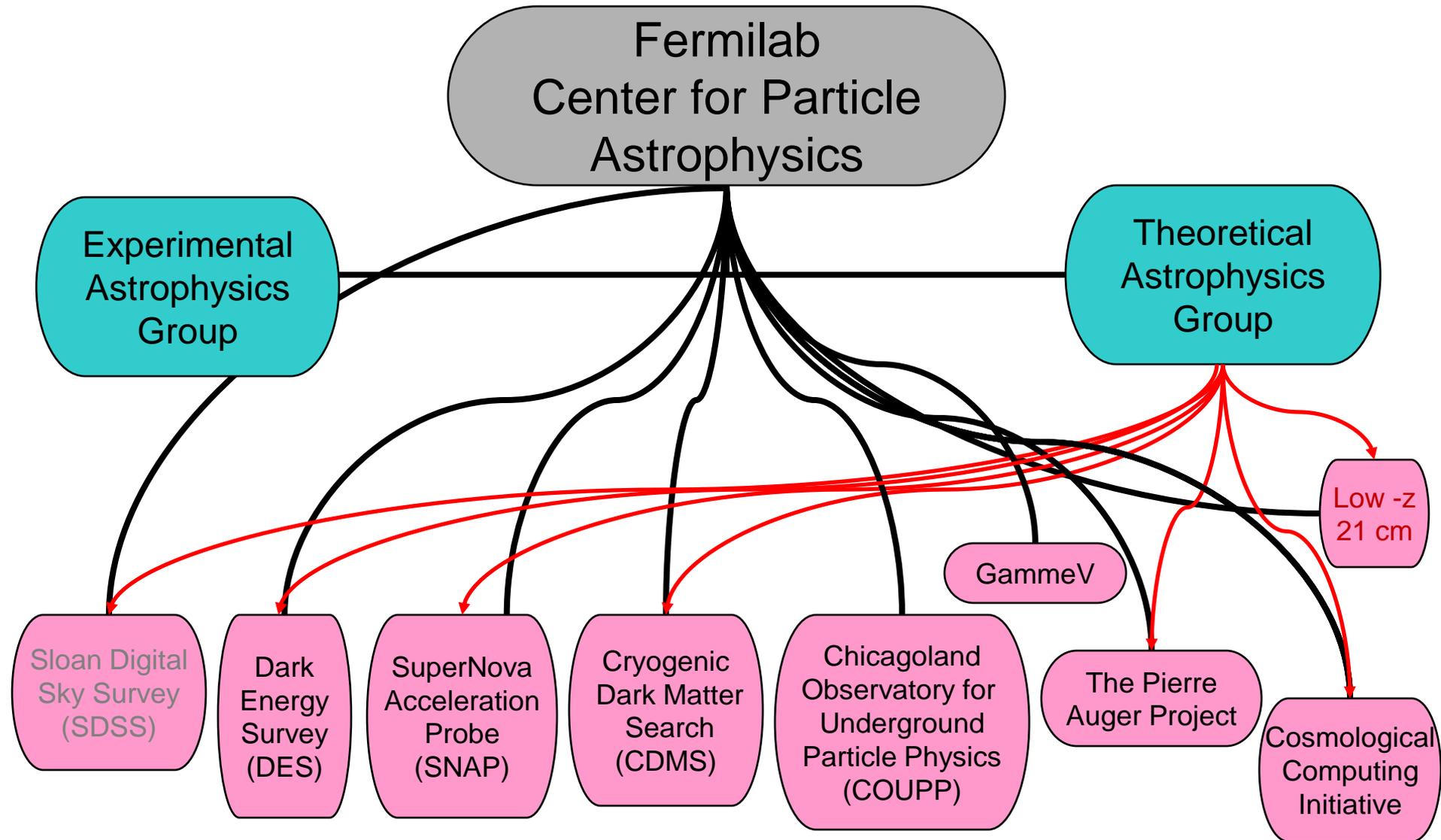


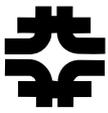
Fermilab Theoretical Astrophysics Group in 2008

Albert Stebbins/PPD-Astro
FRA Physics Visiting Committee
April 25/26 2008

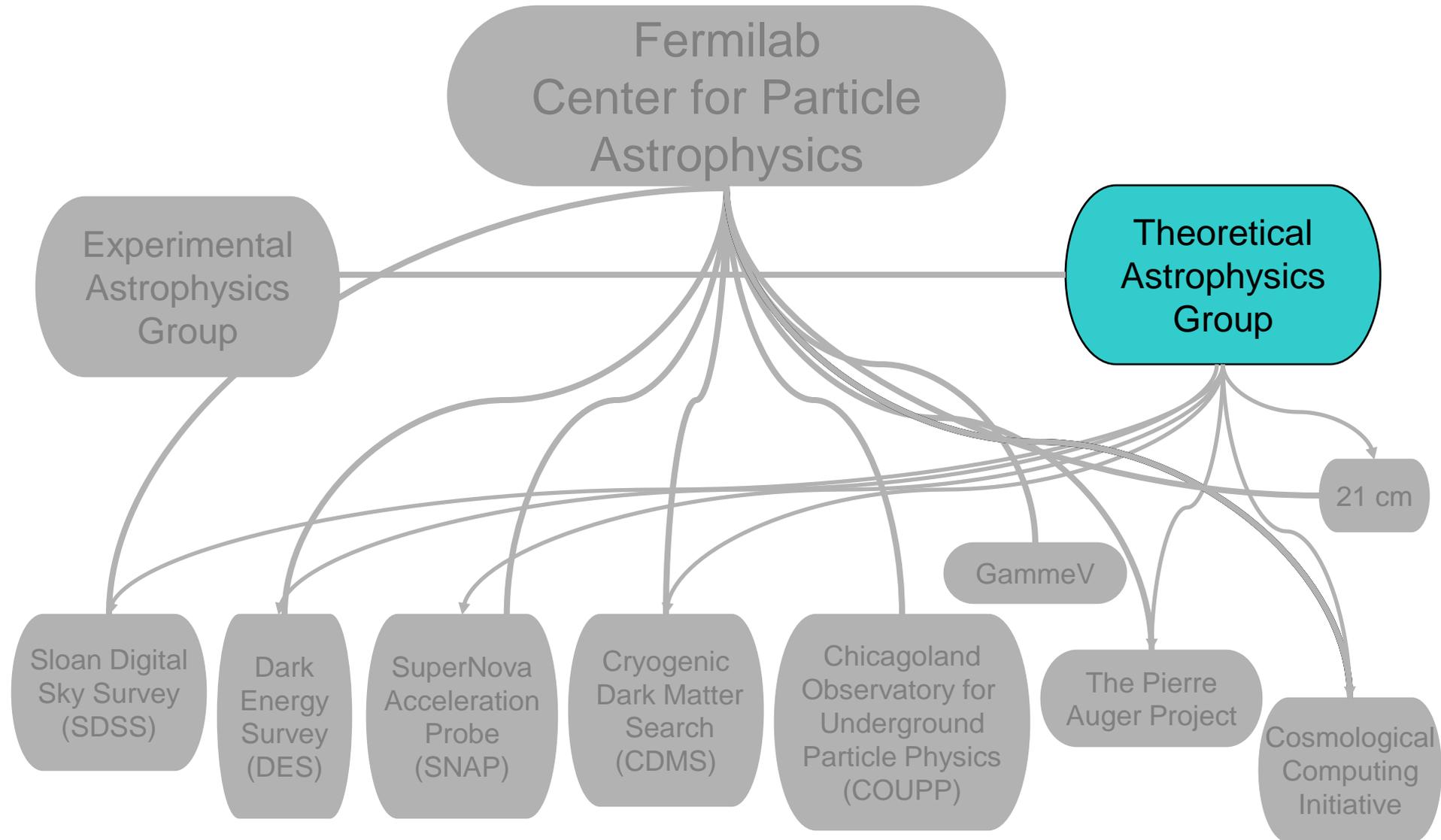


Astrophysics @ FNAL





Theoretical Astrophysics @ FNAL





What We Do

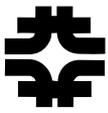


- o **Environment:** Foster exciting, innovative, focused intellectual environment.
 - o Mix of staff scientists, postdocs, and long term visitors/students.
 - o Seminars, workshops, short term visitors.
 - o Individual participation in external collaborations and conferences.
- o **Productivity:** produce new scientific results, support lab programs/projects.
 - o Scientific publications.
 - o New projects (played important role SDSS I&II, SNAP, DES, Auger)
- o **Citizenship:** support of scientific infrastructure (lab/Chicagoland/U.S./world)
 - o **Education/Outreach:** teaching (U.C., summer schools), students (U.C., Colorado, Howard, IMSA), books, public lectures.
 - o **Quality Control:** Refereeing/Editing, Grant/Program Reviews
 - o **Making the Future:** Center for Particle Astrophysics, committees (Dark Energy Task Force).



Who We Are

Head:	Albert Stebbins		
Deputy Head:	Nick Gnedin		
Other Scientists:	(Scott Dodelson)	interim head of Center for Particle Astrophysics	
	Joshua Frieman	<u>NEW</u> promoted to Scientist III	
	Dan Hooper		
	Craig Hogan	<u>NEW</u> head of Center is a theorist! ~ 07/08	
Schramm Fellow:	Kathryn Zurek	<u>NEW</u> ~ 09/08 (U Wisconsin)	Incoming Outgoing
Postdoctoral Fellows:	Emiliano Sefussati	to Saclay	
	Pasquale Serpico	to CERN	
	Chris Vale	leaving field	
	Mark Jackson	shared w/ Particle Theory Group - to Leiden	
	Hee-Jong Seo		
	Savvas Koushiappas	accepted but got faculty job (replacement needed)	
		Schramm+postdoc count cut from 5 to 3!	
Visitors :	Pasquale Blasi	1 year leave from Firenze to 9/08	
	Robyn Levine	U Colorado student	
	Ribamar dos Reis	<u>NEW</u> On Brazilian grant, from Rio.	



Research Publications: $t \geq$ April 2007

- 01 **Weak Lensing Effects on the Galaxy Three-Point Correlation Function** arXiv:0804.0373
- 02 **Dynamical effects of self-generated magnetic fields in cosmic ray modified shocks** arXiv:0804.2884
- 03 **Two More Candidate AM Canum Venaticorum (AM CVn) Binaries from the SDSS** arXiv:0802.2240
- 04 **The Fate of the First Galaxies. III. Properties of Primordial Dwarf Galaxies and their Impact on the Intergalactic Medium** arXiv:0802.2715
- 05 Optimal angular window for observing Dark Matter annihilation from the Galactic Center region: the case of gamma-ray lines arXiv:0802.3245
- 06 Estimating the Redshift Distribution of Faint Galaxy Samples arXiv:0801.3822
- 07 **Average Properties of a Large Sample of $z_{\text{abs}} \sim z_{\text{em}}$ associated Mg II Absorption Line Systems** arXiv:0801.3905
- 08 The Milky Way as a Kiloparsec-Scale Axionscope arXiv:0712.2825
- 09 Photometric Redshift Error Estimators arXiv:0711.0962
- 10 Disentangling neutrino-nucleon cross section and high energy neutrino flux with a km³ neutrino telescope arXiv:0711.0152
- 11 A Test of the Copernican Principle arXiv:0711.3459
- 12 **Resolving Gas Dynamics in the Circumnuclear Region of a Disk Galaxy in a Cosmological Simulation** arXiv:0711.3478
- 13 Extracting the Gamma Ray Signal from Dark Matter Annihilation in the Galactic Center Region arXiv:0711.4621
- 14 **The Mass Of The Coma Cluster From Weak Lensing In The SDSS** arXiv:0709.0506
- 15 **Predictions for the Cosmogenic Neutrino Flux in Light of New Data from the Pierre Auger Observatory** arXiv:0709.0734
- 16 **Cross-correlation Weak Lensing of SDSS Galaxy Clusters I: Measurements** arXiv:0709.1153
- 17 **Cross-correlation Weak Lensing of SDSS galaxy Clusters II: Cluster Density Profiles and the Mass--Richness Relation** arXiv:0709.1159
- 18 **Cross-correlation Weak Lensing of SDSS Galaxy Clusters III: Mass-to-light Ratios** arXiv:0709.1162
- 19 **Clustering properties of ultrahigh energy cosmic rays and the search for their astrophysical sources** arXiv:0709.2712
- 20 Prospects For Detecting Dark Matter With GLAST In Light Of The WMAP Haze arXiv:0709.3114
- 21 **Are There Enough Ionizing Photons to Reionize the Universe by $z=6$?** arXiv:0709.3308
- 22 **A Galaxy Photometric Redshift Catalog for the SDSS Data Release 6** arXiv:0708.0030
- 23 **The SDSS Quasar Lens Search. 3. Constraints on Dark Energy from the Third Data Release Quasar Lens Catalog** arXiv:0708.0825
- 24 **The SDSS Quasar Lens Search. 2. Statistical Lens Sample from the Third Data Release** arXiv:0708.0828
- 25 **The SDSS-II Supernova Survey: Technical Summary** arXiv:0708.2749
- 26 **High Energy neutrino signals from the Epoch of Reionization** arXiv:0707.0515
- 27 **Escape of Ionizing Radiation from High Redshift Galaxies** arXiv:0707.0879
- 28 A New Constraint on the Escape Fraction in Distant Galaxies Using Gamma-ray Burst Afterglow Spectroscopy arXiv:0707.2594
- 29 **The Sixth Data Release of the SDSS** arXiv:0707.3413
- 30 **Interactions of cosmic superstrings** arXiv:0706.1264
- 31 Galaxy-CMB Cross-Correlation as a Probe of Alternative Models of Gravity arXiv:0706.1775
- 32 Combining Weak Lensing Tomography with Halo Clustering to Probe Dark Energy arXiv:0706.2395
- 33 **Astrophysical interpretation of the medium scale clustering in the ultrahigh energy sky** arXiv:0706.2864
- 34 Detecting Axion-Like Particles With Gamma Ray Telescopes arXiv:0706.3203
- 35 **PARthENoPE: Public Algorithm Evaluating the Nucleosynthesis of Primordial Elements** arXiv:0705.0290
- 36 **The bispectrum of galaxies from high-redshift galaxy surveys: Primordial non-Gaussianity and non-linear galaxy bias** arXiv:0705.0343
- 37 **Possible evidence for dark matter annihilations from the excess microwave emission around the center of the Galaxy seen by the WMAP** arXiv:0705.3655
- 38 **Modeling the three-point correlation function** arXiv:0704.0255
- 39 **The SDSS Quasar Catalog. 4. Fifth Data Release** arXiv:0704.0806
- 40 Probing Gravity at Cosmological Scales by Measurements which Test the Relationship between Gravitational Lensing and Matter Overdensity arXiv:0704.1932
- 41 **MeV Dark Matter and Small Scale Structure** arXiv:0704.2558
- 42 Signatures of axion-like particles in the spectra of TeV gamma-ray sources arXiv:0704.3044

THEORY

TECHNIQUES

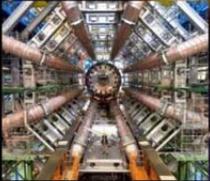
DATA

DATA INTERPRETATION



The Hunt for Dark Matter

A Symposium on Collider, Direct and Indirect Searches
Fermilab May 10-12, 2007



Registration
Program
Plenary speakers

Organizers
Sponsors
Participants

-Video Archive

Hosted by the Fermilab Center for Particle-Astrophysics

WORKSHOP ON CMB POLARIZATION: THEORY AND FOREGROUNDS

FERMILAB

JUNE 23-26, 2008

WEBSITE: [HTTP://ASTRO.FNAL.GOV/CMB/](http://astro.fnal.gov/cmb/)

WORKING GROUPS:

INFLATION • LENSING • REIONIZATION
FOREGROUND SCIENCE • FOREGROUND
REMOVAL

ORGANIZING COMMITTEE:

DANIEL BAUMANN	AL KOGUT
SCOTT DODELSON (CHAIR)	LAWRENCE KRAUSS
JOANNA DUNKLEY	KENDRICK SMITH
AURELIAN FRAISSE	MATIAS ZALDARRIAGA
MARK JACKSON	



Computing Initiative: Hardware Status

- **Current Status**
 - 69 nodes / 560 cores / 16GB per node*.
 - ~25 users including KICP/Uchicago
 - Running @ ~70% capacity
- **Hardware goals for this year**
 - 125 nodes / 1000 cores.
 - w/ Center for Particle Astrophysics funding
 - PPD hardware funding \$0'd (may be restored w/ suppl. funding)
- **Reasons**
 - 1 billion particle simulation for DES.
 - Large hydro simulation for modeling cosmic 21cm signal

- * for comparison
 - MareNostrum 2048 nodes / 10240 cores / 10GB per node
 - MPI Garching 512 processors / 1024 cores / 4GB per node



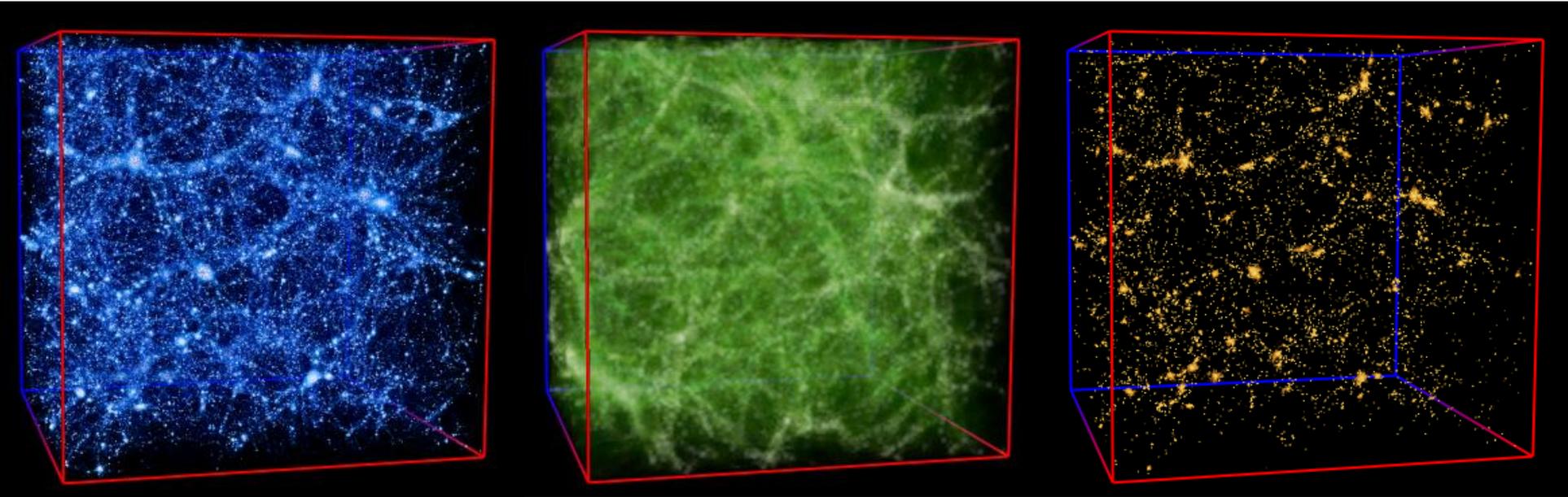
Computing Initiative: Current Projects

- Large scale simulations of cosmic structure
 - calibrating future Dark Energy experiments; DES, SNAP.
 - Gnedin, Kravtsov, Rudd, Seo, Tinker, Zentner
 - For lo-redshift ($z \sim 1-2$) 21cm measurements of BAO
 - + Dodelson, Stebbins
- Simulations of galaxy / black-hole formation
 - systematic for Dark Energy experiments; DES, SNAP.
 - Gnedin, Leitner, Levine, Kravtsov, Robinson, Tassis
- Cosmic Ray shower simulations
 - modeling Auger Observatory signals.
 - Wakely, Wissels
- Cosmological simulations of **MO**dified **N**ewtonian **D**ynamics.
 - Oyaizu
- Software development for DES simulation.
 - Insley, Kuhlmann, Van grummen



Computing Initiative: Highlights: Large-Scale Structure

w/ state of the art Adaptive Mesh Refinement



Dark matter

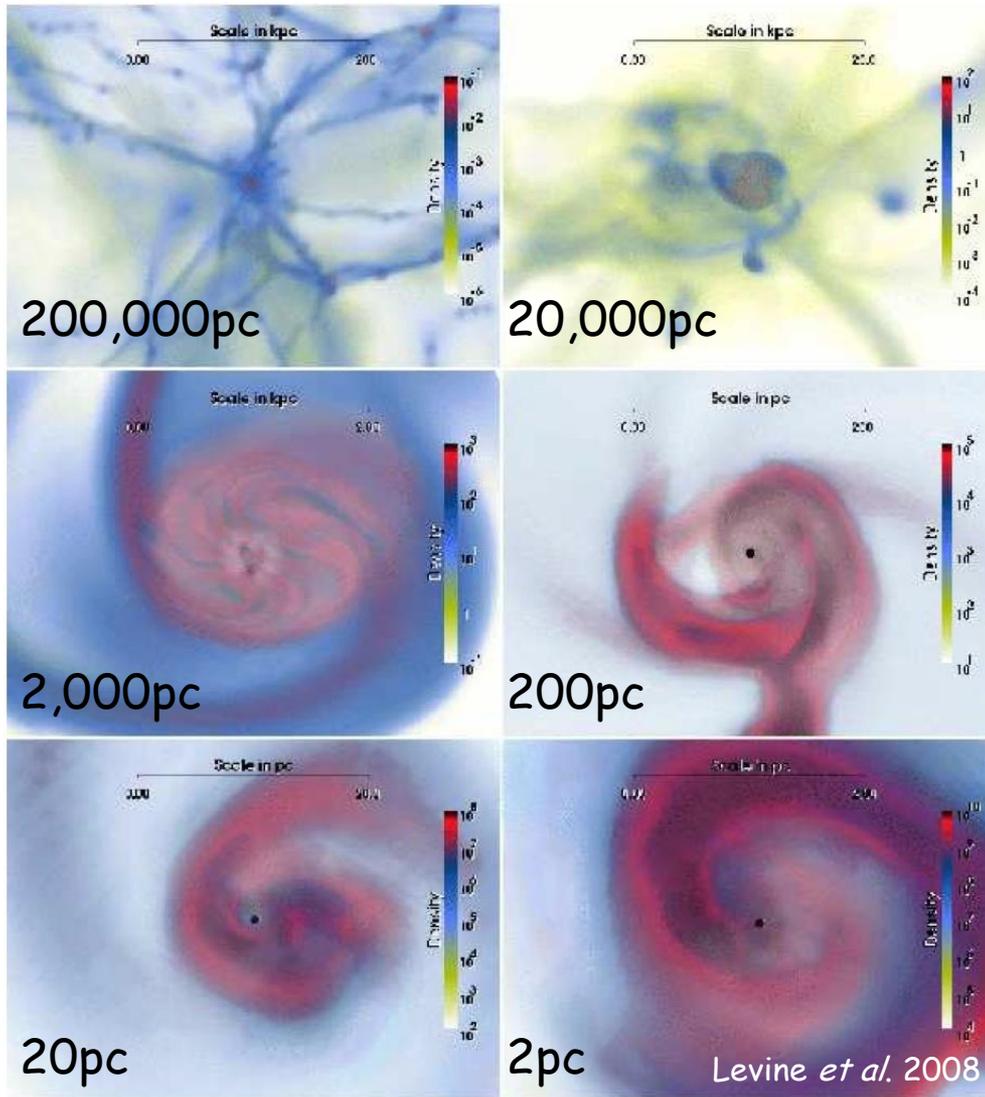
Gas

Galaxies

Modeling baryonic effects on large scales is important for unbiased calibration of weak lensing signal from future Dark Energy experiments.

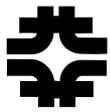


Computing Initiative: Highlights: Galaxy/BH Formation



Mpc to mpc
using
Adaptive
Refinement
Tree

Understanding galaxy
and black hole
formation is a primary
goal of modern
astrophysics, and is
also important for
calibrating Dark
Energy experiments.

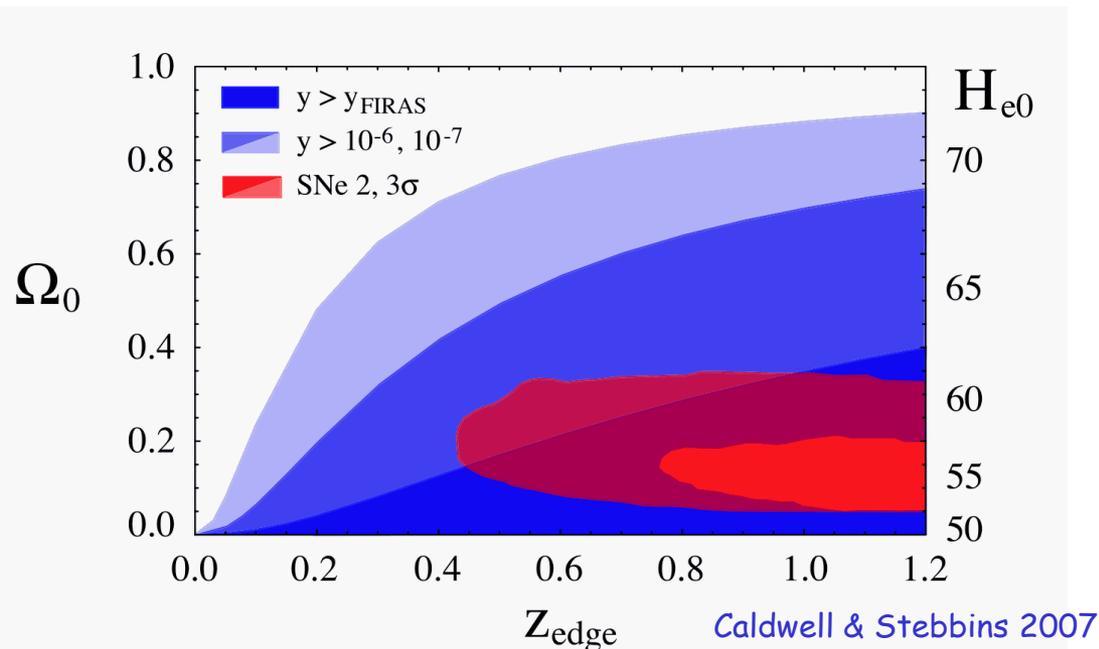


Highlights: Alternatives to Dark Energy

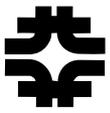
Dropping some of our most cherished assumptions about the universe (large scale homogeneity) allows for different interpretations of the "dark energy phenomena".

Namely the Earth is near the center of a very large underdense region.

This is compatible with LSS, CMBR, and the SNe data w/o need for repulsive dark energy.

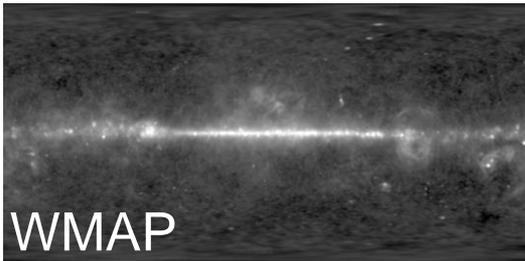


Scattering of CMBR by such voids produce leads to deviations from a blackbody spectrum which produces severe constraints on the model

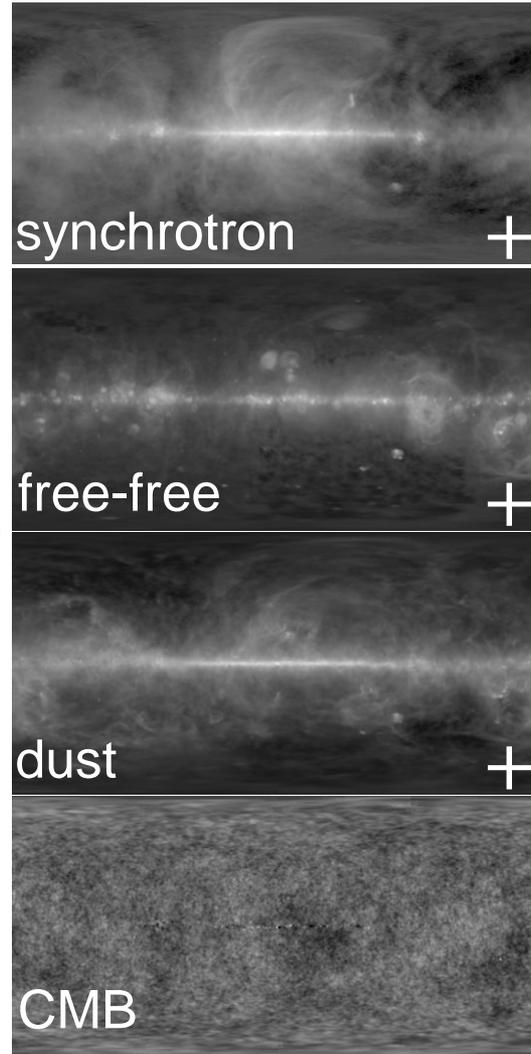


Highlights: WMAP-haze

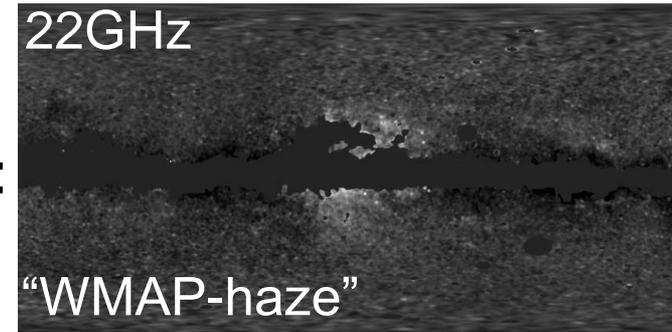
Residuals detected by WMAP near Galactic center



Producing hot electrons and synchrotron emission.



Consistent with signature of 10^{2-3}GeV WIMP dark matter annihilation



Hooper, Dobler & Finkbeiner 2007



Summary

- Extremely productive cosmology group
 - 42 Papers
 - New Projects: DES, SNAP, 21cm
- Stimulating Intellectual Environment
 - interactions, visitors, seminars, workshops
 - decrease in postdoc count a negative!
- Strengthened base in particle astrophysics
 - Hooper, Zurek
- Forward looking for Fermilab
 - Proto-projects:
 - 21cm working group: theorists & accelerator physicists
 - Gnedin, Seo, Stebbins, Marriner, McGinnis, Steffan
 - Opportunities in CMBR polarization, γ -ray astronomy, ...



BACKUP SLIDES
