



PDG

particle data group

Reviews, Tables, and Plots

Astrophysics Reviews

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with additional input from

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Reviews

- **Big-Bang Cosmology:** Keith Olive (Minnesota) & John Peacock (Edinburgh)
 - **Big-Bang Nucleosynthesis:** Brian Fields (Illinois) & Subir Sarkar (Oxford)
 - **Cosmological Parameters:** Ofer Lahav (UC London) & Andrew Liddle (Sussex)
 - **Dark Matter:** Manuel Drees (Bonn) & Gilles Gerbier (CEA Saclay)
 - **Cosmic Microwave Background:** Douglas Scott (UBC) & George Smoot (LBL)
- 8 theorists, 2 experimentalists (5 European, 1 Indian & 4 North American)
 - Fast moving field so all reviews need to be updated annually
 - Case for new reviews:

Hubble expansion

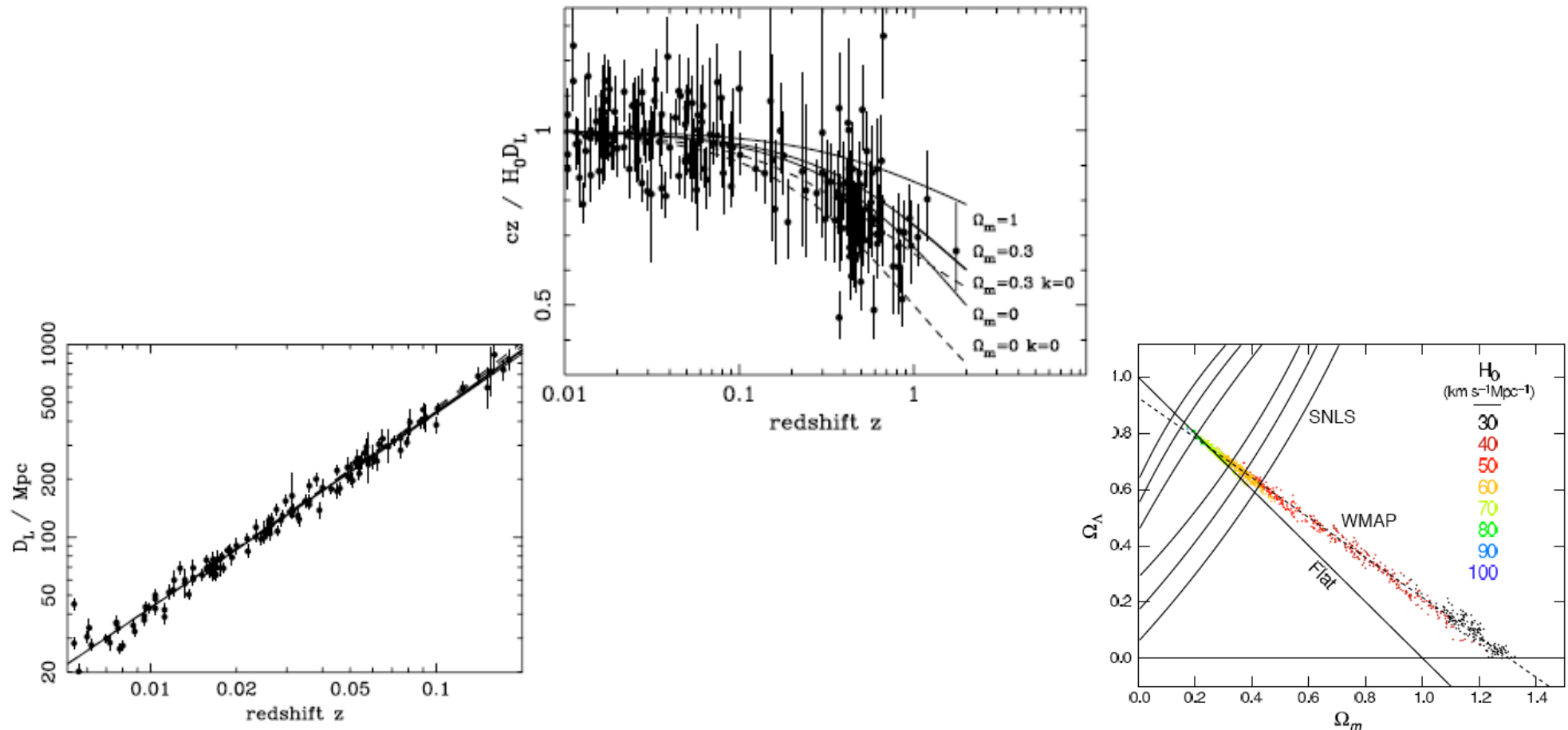
... used to be written by Masataka Fukugita & Craig Hogan - *essential* in view of recent concerns about homogeneity/isotropy, anomalously large bulk flows etc

Gamma-ray Astronomy

... amazingly productive field in recent years (HESS, MAGIC, VERITAS; Milagro)
now: GLAST/FERMI; forthcoming CTA, AGIS, HAWC) - will continue to grow

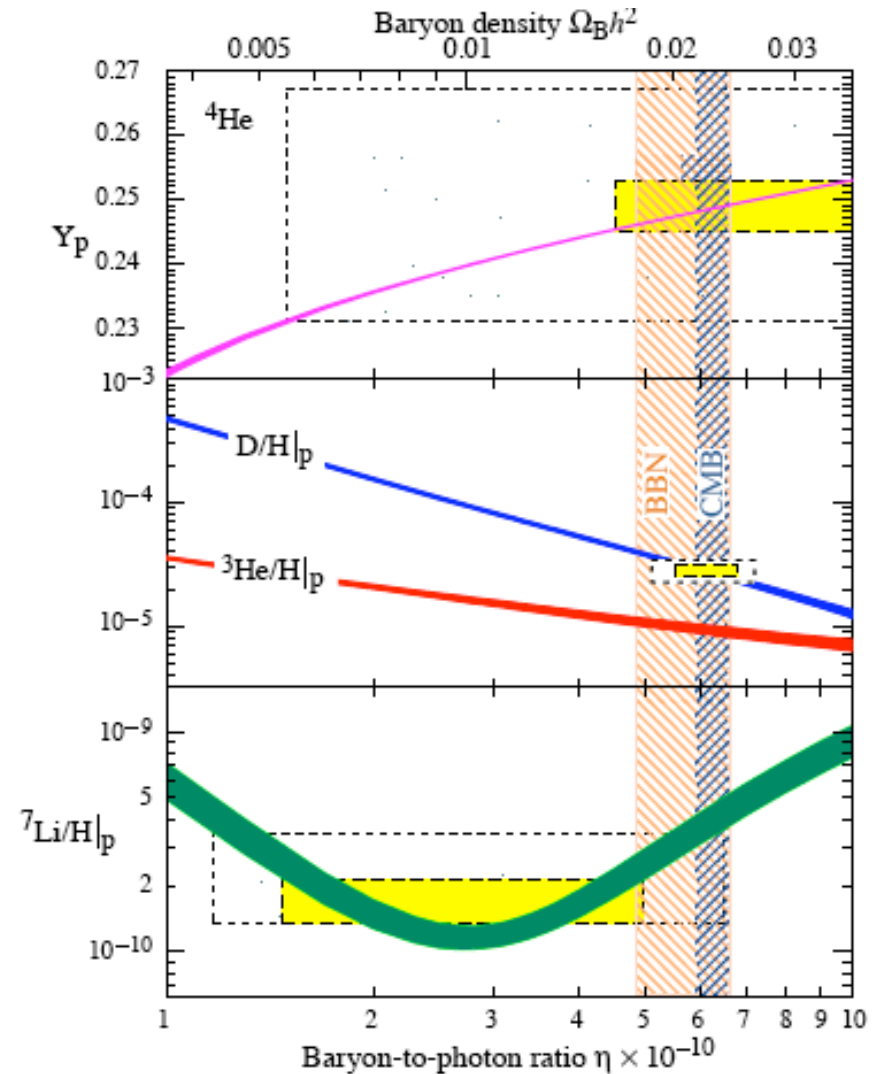
Big Bang Cosmology

- Succint overview of ‘standard model’
- Introduces concepts, notation, links between other reviews
- Discusses observational basis (for dark energy domination)



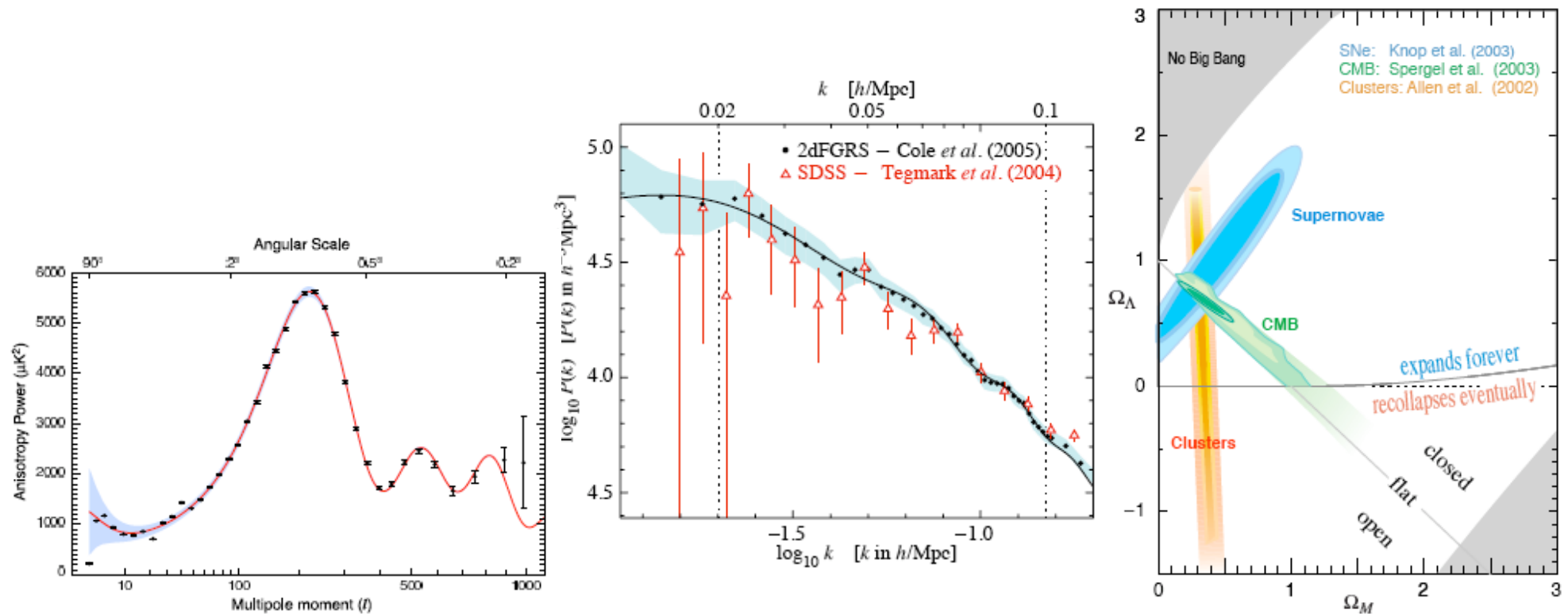
Big Bang Nucleosynthesis

- Summary of ‘deepest direct probe of the early universe’
- Critique of quoted *inferred* primordial abundances
- Emphasises agreement with CMB determination of η
- Constraints on new physics
- ‘Cloud on horizon’ ...
the Lithium problem
(requires new physics?)



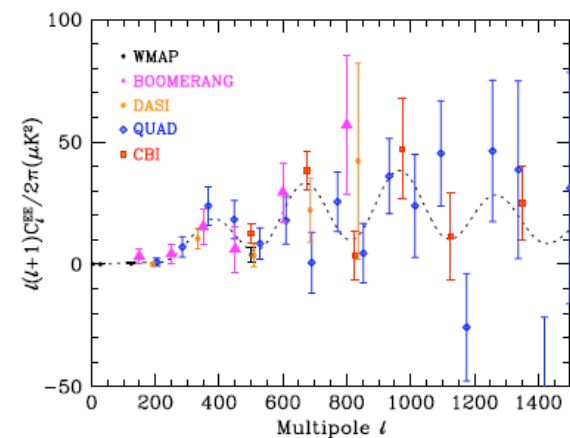
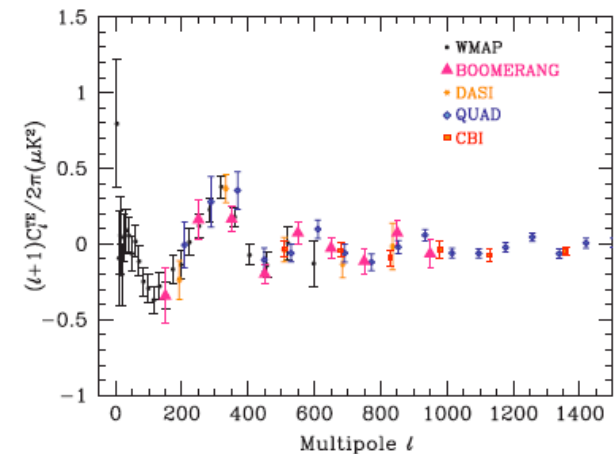
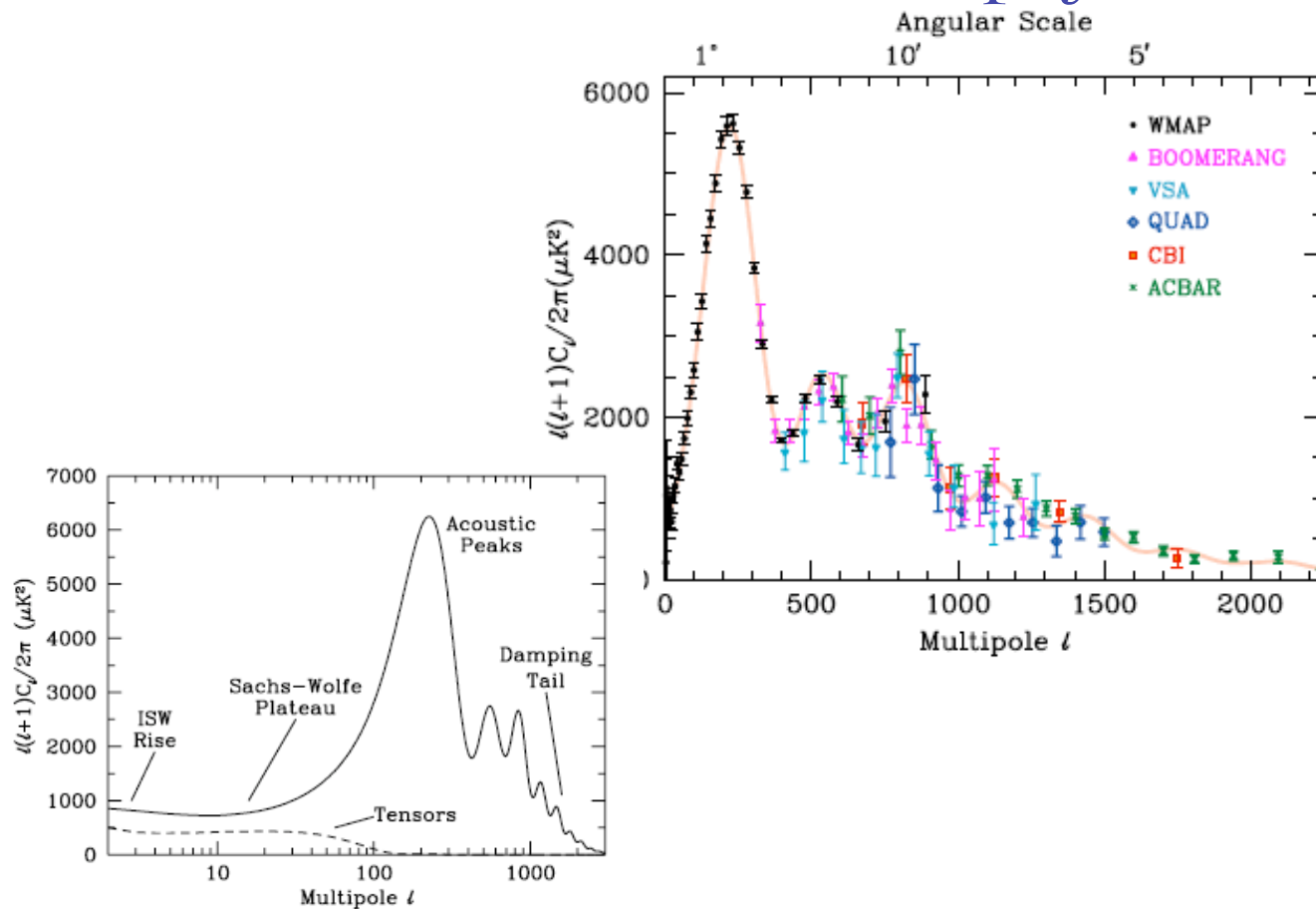
Cosmological Parameters

- Some overlap with BB cosmology and CMB reviews
- Discussion of density perturbation generation from inflation and the growth of large-scale structure
- Wide-ranging survey of different techniques for measuring content of universe



Cosmic Microwave Background

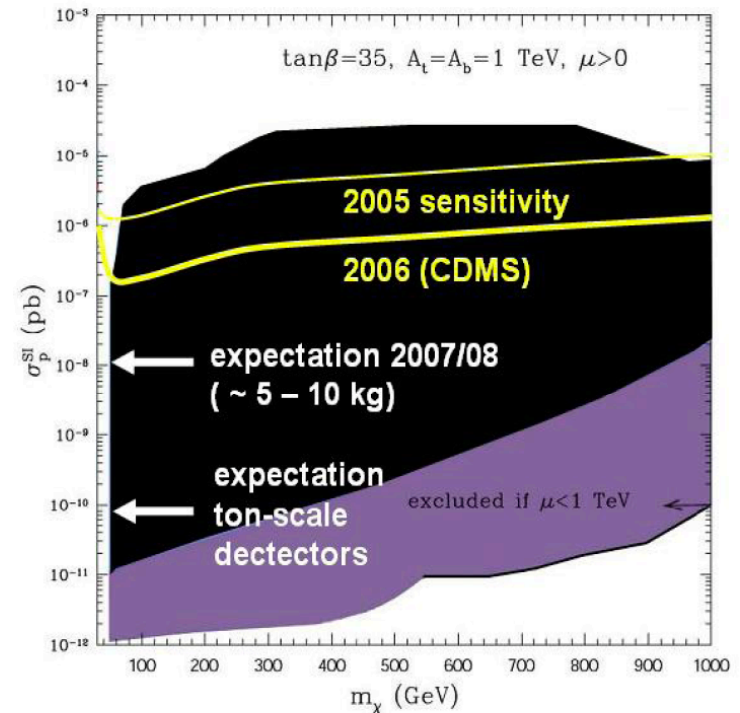
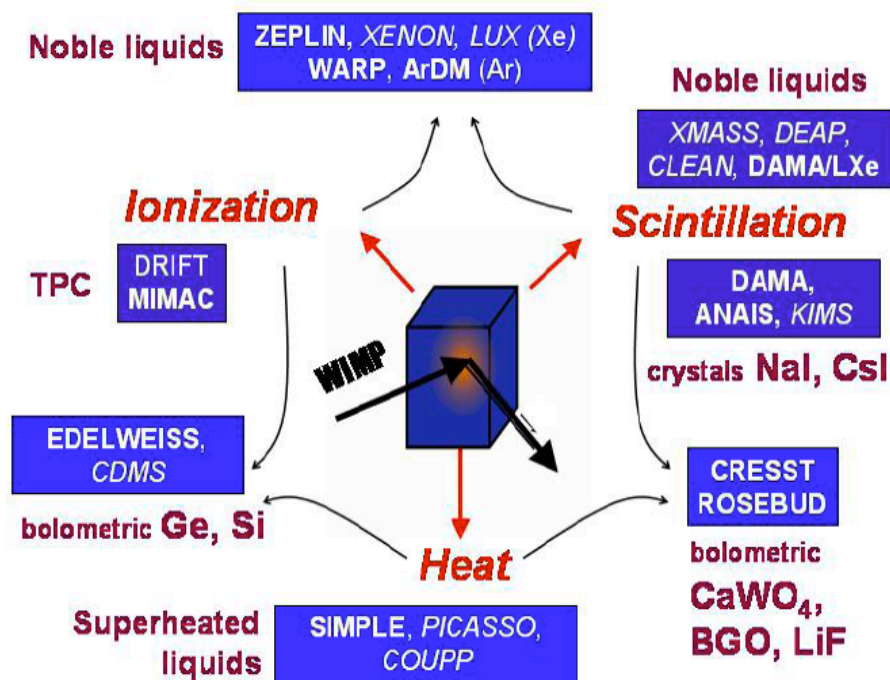
- Nice discussion of physics of CMB anisotropy generation
- Summary of current observations and implications for cosmological parameters
- Constraints on fundamental physics



Dark Matter

- Summary of astronomical evidence for dark matter
- New particle candidates
- Detailed discussion of experimental approaches to WIMP and axion detection ... both direct and indirect searches

No pictures! (... so here are some from the ASPERA roadmap)



Why is a review of Hubble expansion necessary?

The HKP data do show significant variations of up to $9 \text{ km s}^{-1} \text{ Mpc}^{-1}$ across the sky

Not all observers agree on interpretation of HKP data
eg. 62.3 ± 1.3 vs $72 \pm 8 \text{ km/s/Mpc}$

“... our model independent test cannot exclude the case of the deceleration of the expansion at a statistically significant level”

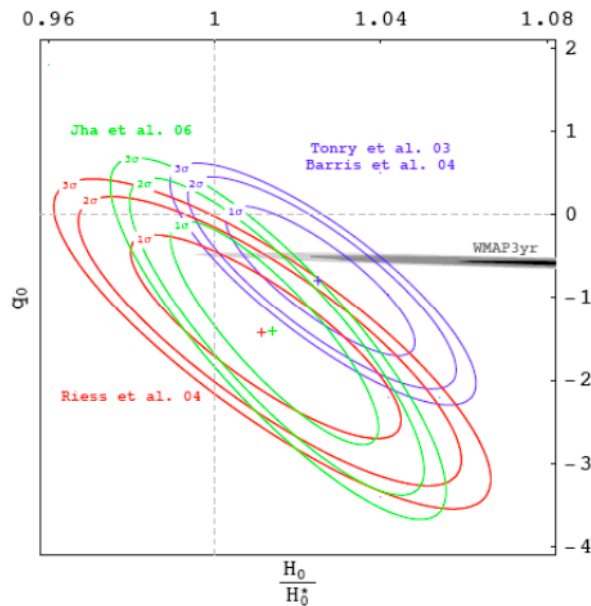
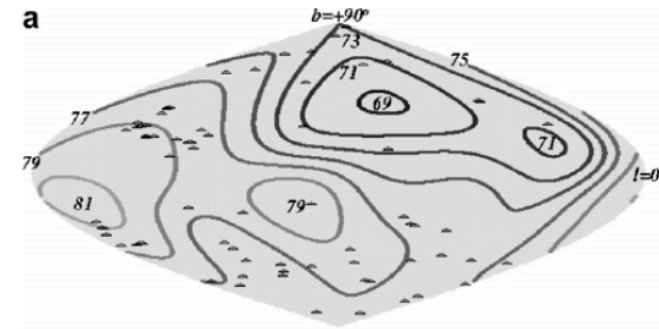
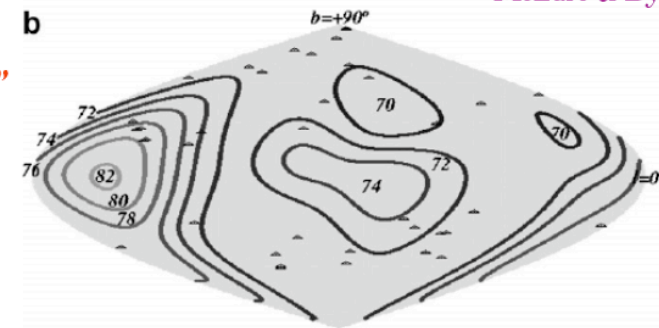


Fig. 3. Confidence contours for a model-independent full-sky fit to the Hubble law at second order for three SNe Ia data sets. SNe up to redshift $z = 0.2$ are included in the fits. (Schwarz & Weinhorst 2007)



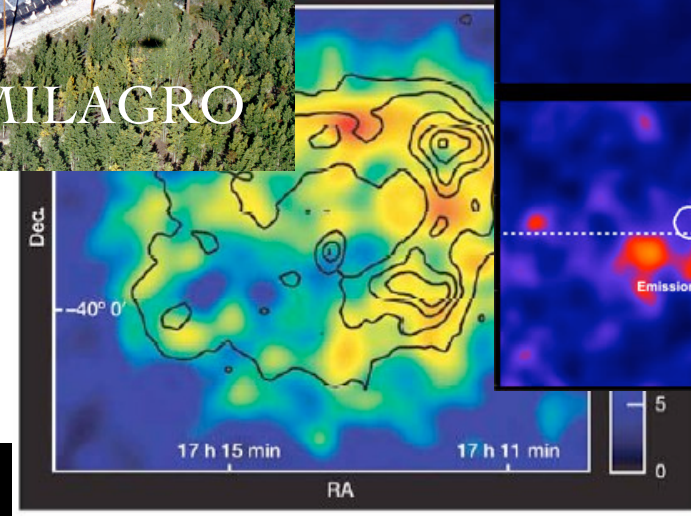
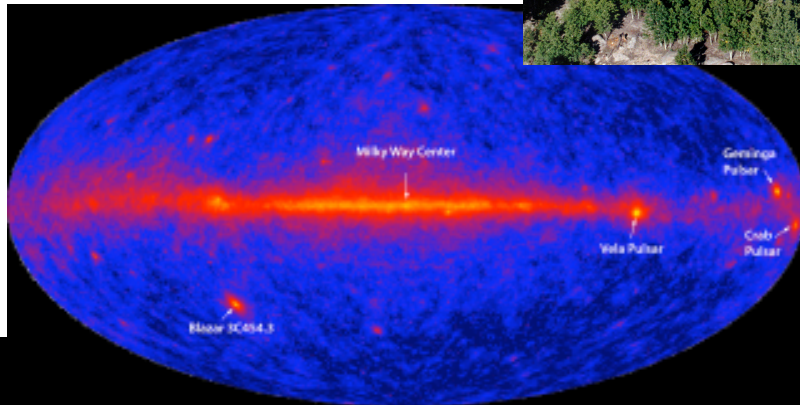
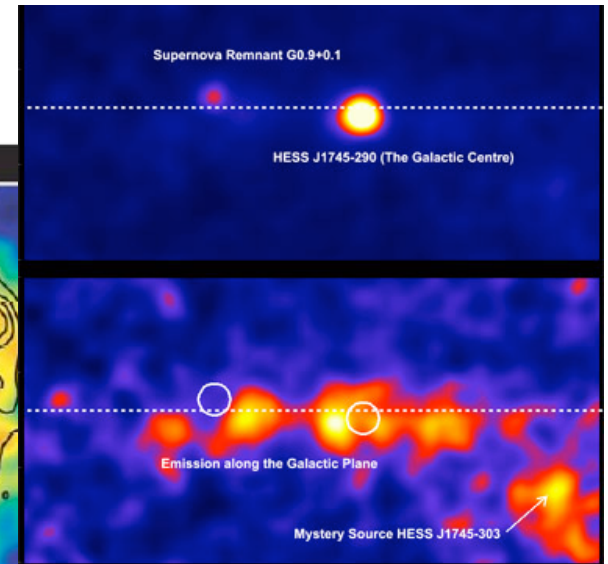
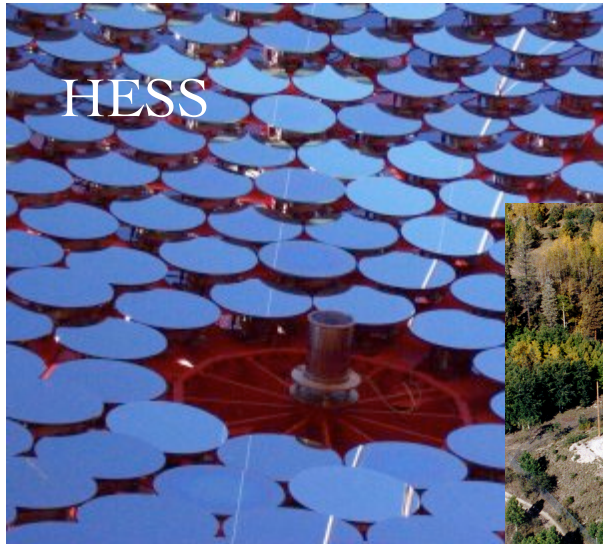
McLure & Dyer (2007)



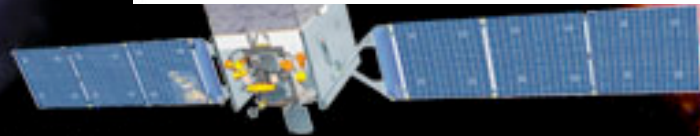
.. as does an independent sample of objects

Concerns about consistency between different SNIa datasets and analyses, ...

Why is a review of gamma-ray astronomy necessary?



Fermi
Gamma-ray Space Telescope



Arguably most productive area of astroparticle physics ... for both astro- and particle-

Listings

❖ Recent overhaul of neutrino section

Maintain sections on ν s and astrophysical constraints

❖ Relation between dark matter and supersymmetry

Many new direct (and indirect) dark matter searches

Limits on neutralino properties

Competition with accelerator limits

❖ New particle listings pending LHC results

❖ Axion Searches

Increasing number of experiments in astroparticle physics ...

(see e.g. AStroParticle European Research Area (ASPERA) roadmap)

❖ **Dark Matter**

Susy/Axion Searches - potential impact on particle listings
CDMS, ZEPLIN, COUPP, XENON, CRESST, LUX, ...

❖ **Cosmic Microwave Background**

WMAP, polarization expts (CLOVER, SPIDER, ...), Planck, ...

❖ **Gamma-ray**

HESS, MAGIC, MILAGRO, GLAST/Fermi, CTA, HAWC ...

❖ **Cosmic-Rays & Neutrinos**

Auger, Pamela, AMS ... IceCube, Antares, ANITA, Km³NeT ...

❖ **Gravitational Waves**

Virgo, Advanced LIGO, LISA/Pathfinder, BBO, ET ...

Concerns:

Astro community does not take adequate notice of RPP/PDG ?!

Possible reasons:

- 1) RPP is published in mainstream *physics* journals ...
- 2) Astro community less used to the notion of 'standard' numbers?
- 3) Astro 'culture' more Bayesian rather than frequentist?

Suggested strategies:

- 1) Submit all reviews to arXiv [astro-ph] *concurrently* with publication in RPP (provide hyperlink to PDG webpage)
- 2) Organise meetings on topics of common interest (e.g. statistical analysis) to bring communities together and stimulate debate

News:

ASPERA roadmap recommends setting up of **Centre for Astroparticle Theory**, at CERN (still to be approved but idea well received at CERN). Could this take up the responsibility for commissioning/maintaining astroparticle reviews/listings?