Ultraviolet Emission Mapping of the Intergalactic Medium and Nearby Galaxies

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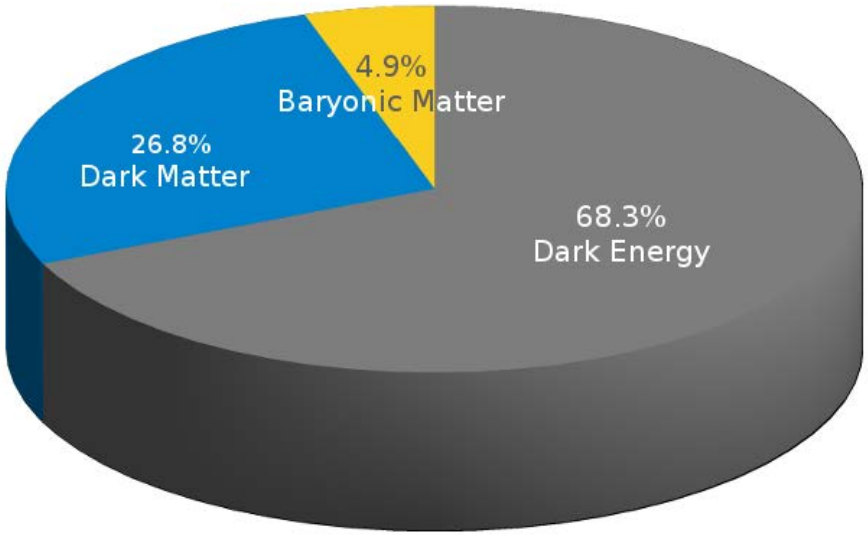
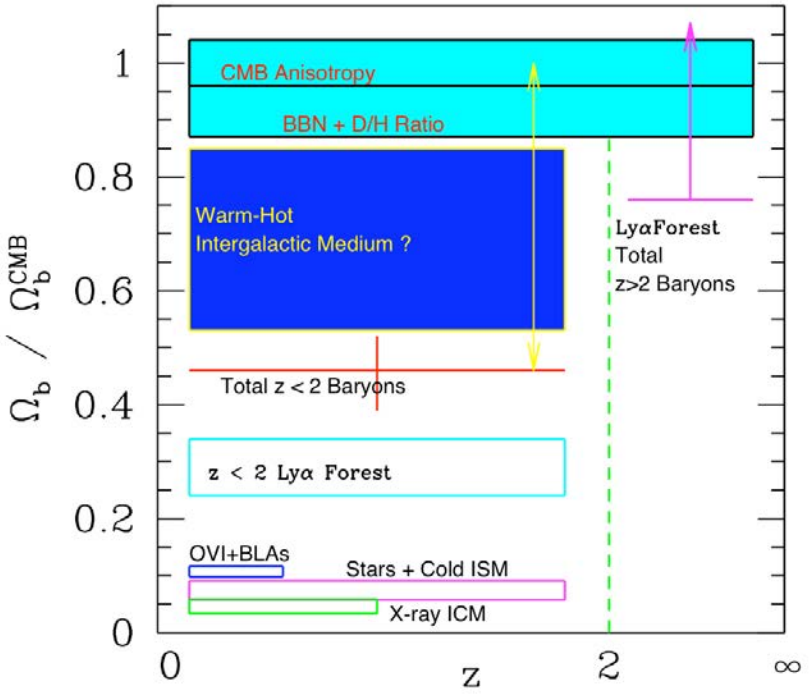
October 21, 2016

The missing baryon problem at low z



after Planck CMB survey 2013



(Nicastro 2007)

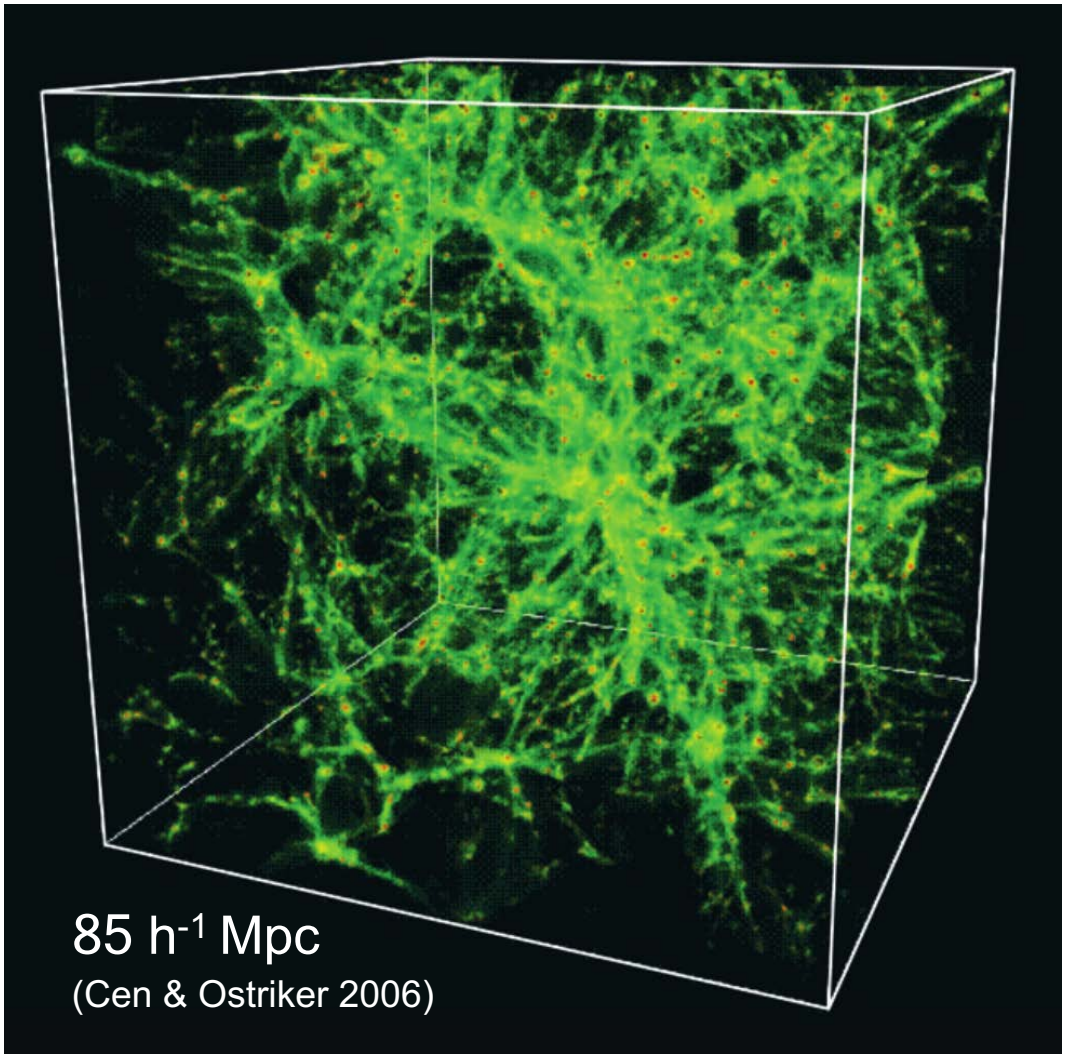
Missing baryon in Warm-Hot Intergalactic Medium (WHIM) ?

WHIM shock-heated to temperatures of 10^5 - 10^7K during structure formation.

Absorb or emit FUV and soft X-ray photons primarily at lines of highly ionized C, O, Ne, and Fe.

Low density
$n \sim 10^{-6}$ - 10^{-4} cm^{-3}

High temperature

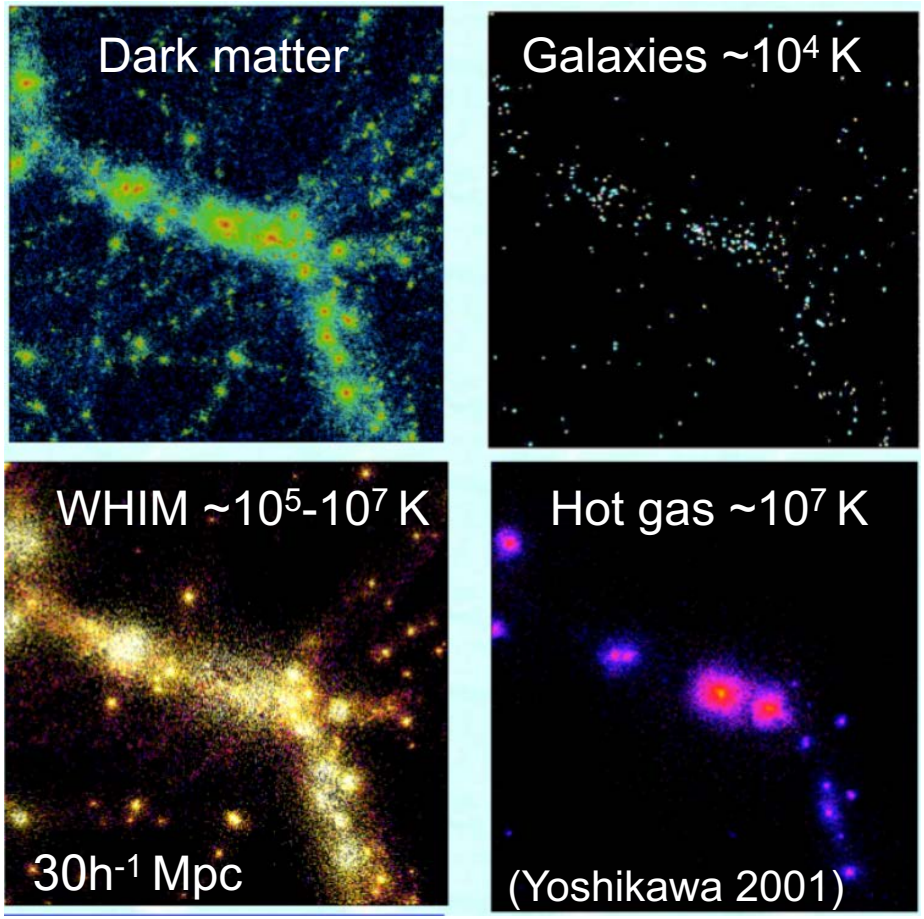


Baryon census in galaxy cluster

Galaxy clusters are the largest gravitationally bound systems in the universe.

Strong gravitational potential implies baryons cannot easily escape.

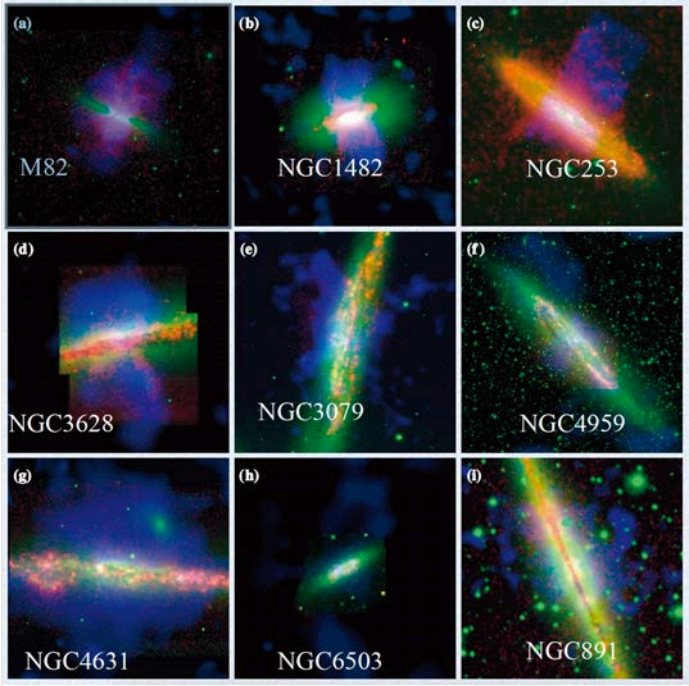
Clusters are expected to retain the cosmic baryon fraction



UV mapping

Table 1: Components of the IGM				
		T (K)	Primary Metal-Line Tracers	Waveband
Cool Photoionized Lyα forest		$< 3x10^4$	C II, C III, Si II, Si III	UV
Warm Photoionized Lyα forest		$3x10^4$ - 10^5	C III, CIV, O III, O IV, O VI	UV
Warm-Hot IGM (WHIM)	Warm	10^5 - 10^6	O VI, O VII, Ne VIII	UV, X-ray
	Hot	10^6 – 10^7	O VII, O VIII	X-ray

(Sembach 2010)



(Strickland 2004)

- red: H α (optical)
- green: R band (optical)
- blue: 0.3-2keV (soft X-ray)
- **No data for 10^5 K gas !**

CAFE - A Proposal for UV Small Mission

CAFE:

Census of WHIM,

Accretion,

Feedback

Explorer

Initial weekly discussion time after lunch about this proposal with free coffee offered

Science objectives

- give first direct view of the processes by which matter is exchanged between galaxies and the IGM.
- determine the fraction of missing baryons in the ~10^5 K gas in galaxies and their vicinities
- provide fundamental insight into the effect of feedback on the IGM
- characterize the transfer of matter into galaxies that allows continuous star formation
- directly demonstrate the existence of cooling flows in clusters and characterize them

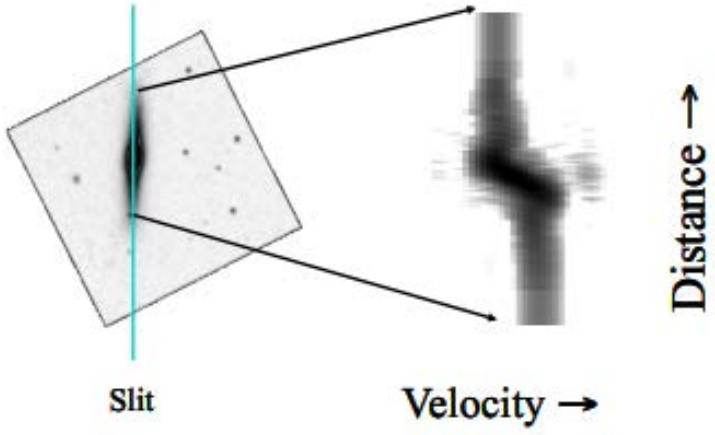
Science targets

- map the 10^4 – 10^6 K gas of the Warm-Hot Intergalactic Medium within a volume of 7500 Mpc^3 (redshift z~0-0.05) , ~200 galaxies, 20 clusters
- produce detailed maps of about 10 galaxies
- The fields selected will overlap with the Sloan Digital Sky Survey (SDSS) so we can compare baryonic mass in warm/hot IGM gas with those in collapsed objects (i.e. galaxies).

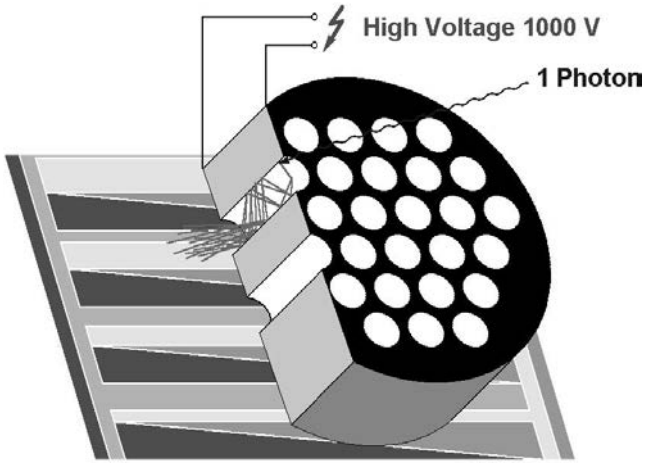
Science Requirement

- wide FOV (20'x20'), > *FUSE, HST/COS*
- angular resolution: at least 30" x30" to resolve most nearby galaxies
- Spectra resolution: at least $\lambda/\Delta\lambda=R \sim 500$
- survey mode with sensitivity of detection limit of 500 photons $cm^{-2}\ s^{-1} ster^{-1}$ with an exposure time about 10.3 ks

LSS imager & MCP detector



Long Slit Spectrograph



microchannel plate detector

- Long Slit Spectrograph
- two science instruments (the OVI imager and the H-Lyman imager) each consisting of a (using a tunable monochromator) narrow band imager
- detectors proposed are microchannel plate detectors

Mission Summary

- **Science:** Unique experiment on a key forefront topic
- **Launch Vehicle:** Long March 2C/2D or VEGA
- **Spacecraft Bus:** Chinese or European (e.g. German TET-1)
- **Science Orbit**: low-Earth orbit, circular 550 km, inclination < 5°; on-orbit calibration
- **Flight System:** 3yr baseline mission, mass ≤ 60 kg, power ~ 60 W

Thank you!

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