Chapter 23

Solving the Mystery of the Space Roar and Photon Underproduction Crisis by CFLE Theory

23.1.1 Theory and Expectations

At the 213th meeting of the American Astronomical Society on 7 January 2009, Alan Kogut reported the discovery of a new natural phenomenon, the so-called space roar. This strange radio signal comes from the distant cosmos, but is six times brighter than the combined emission of all known radio sources in the universe. The important point is that modern cosmology, astrophysics, and physics cannot explain this phenomenon.

NASA's Alan Kogut and his team recorded this space roar using the balloon-tethered Absolute Radio Meter for Cosmology, Astrophysics, and Diffuse Emission (ARCADE2), an instrument designed to measure the temperature of the cosmic microwave background (CMB), at centimeter wavelengths, for deviations from a blackbody spectrum resulting from energy releases in the early universe. Because long wavelength distortions in the CMB spectrum are basically predicted in all viable cosmological models, detecting these distortions is an important step for understanding the early universe.

During first star formation, the energy from particle decay transferred into the heat of diffuse matter, followed by cooling via interaction with background radiation, distorting the radiation spectrum away from the blackbody. The amplitude and shape of the resulting distortion depended on the magnitude and red shift of the energy transfer. Measurements across the peak of the CMB spectrum limit deviations from a blackbody to less than 50 parts per million. Therefore, direct observational limits at longer wavelengths are weak. However, distortion as large as 5% could exist at centimeter wavelengths without violating existing observations, as shown in Figure 23-1-1-1.

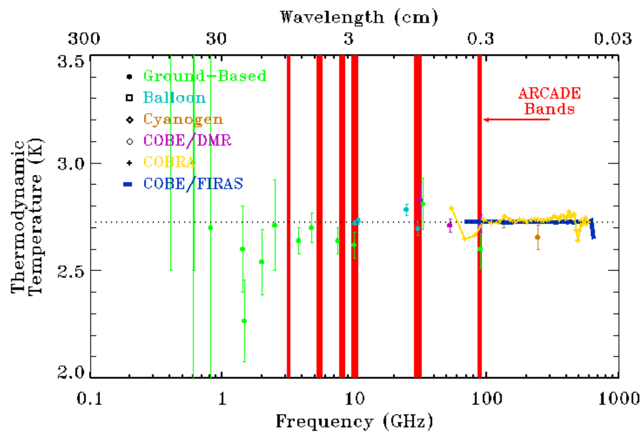


Figure 23-1-1-1 **(Source: http://asd.gsfc.nasa.gov/archive/arcade/cmb_spectrum.html)**

Plausible physical processes are expected to generate observable distortions without violating the limits established at shorter wavelengths. The thermal Bremsstrahlung (free-free emission) from re-ionization and related structure formation adds photon to the diffuse background, producing a spectral distortion as

$$\Delta T_{ff} = \frac{T_\gamma Y_{ff}}{x^2} \qquad 23\text{-}1\text{-}1\text{-}1$$

where T_γ is the undistorted photon temperature, and x is the dimensionless frequency $\frac{h\nu}{kT_\gamma}$.

The optical depth to free-free emission is

$$Y_{ff} = \int_0^z \frac{k[T_e(z) - T_\gamma(z)]}{T_e(z)} \frac{8\pi e^6 h^2 n_e^2 g}{3m_e(kT_\gamma)^3\sqrt{6\pi m_e kT_e}} \frac{dt}{dz'} dz' \qquad 23\text{-}1\text{-}1\text{-}2$$

where g is the Gaunt factor. The distorted CMB spectrum is characterized by a quadratic in temperature at long wavelengths. The amplitude of the free-free signal depends on the column $\int n_e^2$ of ionized gas and thus on the red shift z_r at which the first collapsed objects formed.

Such a distortion must exist, with predicted amplitude of a few mK at 3 GHz. Detection of the free-free distortion would place important constraints on the era of luminous object formation and the extent of clumping in galactic halos. The decay of massive particles or other relics produced near the Big Bang would distort the CMB spectrum too. A chemical potential distortion is a primary signature for the decay of relics from GUT and Planck-time physics. Such relics are expected to exist. Figure 23-1-2 shows the current upper limits to spectral distortions at long wavelengths. The CMB spectrum is poorly constrained at centimeter or longer wavelengths, where observable signals from re-ionization or relic decay are expected to exist.

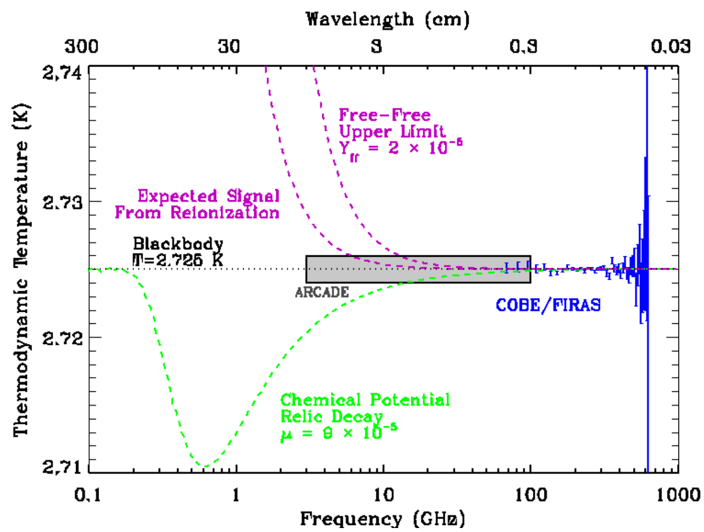


Figure 23-1-1-2 **(Source: http://asd.gsfc.nasa.gov/archive/arcade/cmb_spectrum.html)**

23.1.2 Instruments and Observations

To achieve such measurement with mK accuracy, Alan Kogut and his team needed fine instruments. They had to design their instruments to reduce all of unwanted systematic errors from the rest of the world that are hotter than CMB. In order to satisfy this condition, the following had to be done:

• The entire instrument was cooled with liquid helium to 2.7° above absolute zero, because when the instrument temperature is the same as the CMB, it cannot contaminate the signal.

•The instrument had an unobstructed view to deep space, with no warm objects allowed between the antenna and the sky, because when there are no warm objects in the beam, there will be no signal contamination.

• The instrument used multiple levels of comparison to eliminate any residual contamination. Each radiometer continuously compared the signal coming in through the antenna to a stable internal reference load. Each antenna viewed the sky or a precision blackbody calibration target.

All of the different frequency channels viewed the same target. Since the target was known to be a precise blackbody, by comparing the output when the antennas view the target with the output when the antennas view the sky, one could immediately tell whether or not the sky is also a blackbody.

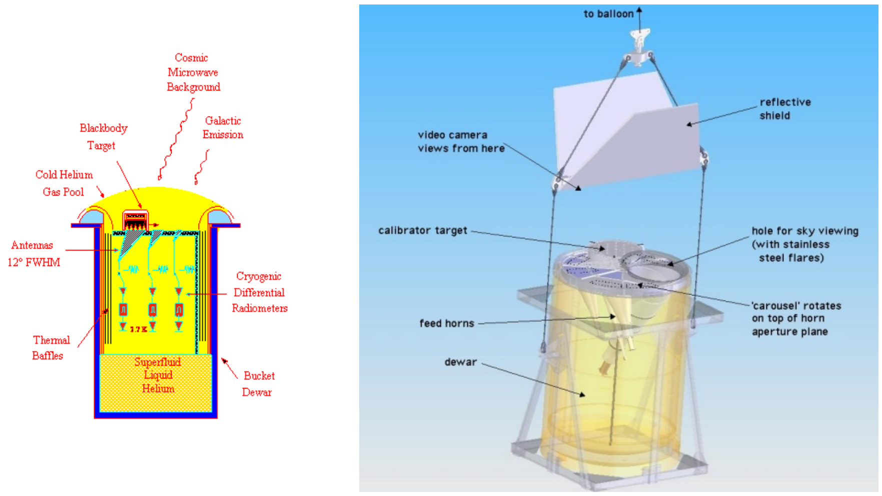


Figure 23-1-2-1 Schematic structure of the instrument
(Source: http://asd.gsfc.nasa.gov/archive/arcade/instruments.html)

On 22 July 2006 at 1:15 UT, this instrument was launched from Palestine, Texas, on a 29 MCF balloon.

Figure 23-1-2-2. Tiny Tim and the ARCADE 2 payload at launch. The parachute connecting the payload to the balloon is clearly visible.
(Source: http://asd.gsfc.nasa.gov/archive/arcade/flight_2006.html)

The instrument reached a float altitude of 37 km at 4:41 UT. The cover protecting the cryogenic components was opened at 5:08 UT. The calibrator was moved 28 times from 5:30 to 8:11 UT, providing at least eight cycles between calibrator and sky for each of the radiometers.

During this time, their entire gondola with the instrument was rotated at ~0.6 rpm, observing 8.4% of the full sky.

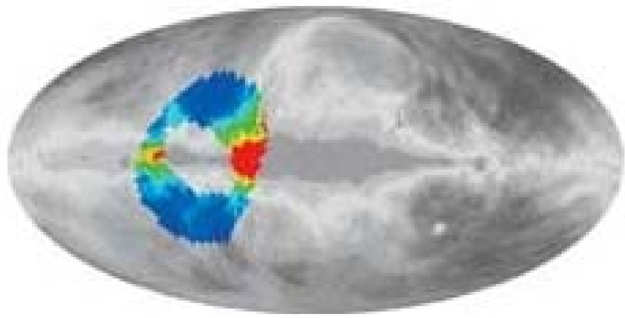


Figure 23-1-2-3. The observed region is the circle on the left side on this all-sky map. The plain of the Milky Way runs across the center.
(Source: http://www.nasa.gov/centers/goddard/news/topstory/2009/arcade_balloon.html)

The most useful observations were from 5:35 to 7:40 UT. During this time, the calibrator temperature was controlled between 2.2 and 3.1 K with a main temperature of 2.72 K.

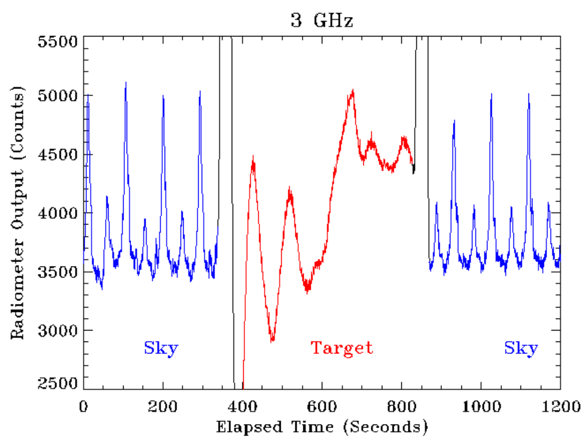


Figure 23-1-3-1. "*The universe really threw us a curve*" [Alan Kogut]
(Source: http://asd.gsfc.nasa.gov/archive/arcade/results_2006.html)

The instrument rotates once every 100 s, sweeping its antenna beam in a circle 60° in diameter centered on the zenith. The spikes in the sky data (blue) show the increased signal as the antenna beam sweeps over the galactic plane. To determine the temperature of the sky at any point, they can simply find data from the calibrator (red) with same radiometer voltage as the sky data, and then read off the calibrator temperature using the embedded thermometer.

23.1.3. Results and Discrepancy

Before the ARCADE 2 measurements were made, the Cosmic Background Explorer (COBE) satellite had already observed the spectrum of the cosmic microwave background (CMB) with the Far-Infrared Absolute Spectrophotometer (FIRAS) instrument (Mather *et al.* 1990) at wavelengths between 1 cm and 100 μm. The FIRAS results reported by Fixsen *et al.* (1996), Mather *et al*. (1999), and Fixsen & Mather (2002) were consistent with a blackbody spectrum at a temperature of $T_{CMB} = 2.725 \pm 0.001$ K.

Absolutely calibrated measurements of the CMB at wavelengths longer (lower frequency) than FIRAS have been performed with ground-based and balloon-borne experiments. Among the most sensitive of these measurements were those of Johnson & Wilkinson (1987), Levin *et al*. (1992), Bersanelli *et al*. (1994, 1995), Staggs *et al.* (1996a, 1996b), Raghunathan & Subrahmnayan (2000), Fixsen *et al*. (2004), Singal *et al.* (2006), and Zannoni *et al*. (2008).

The ARCADE 2 instrument has since measured the absolute temperature of the sky at 3, 8, 9, 30, and 90 GHz, using an open-aperture cryogenic instrument, observing with no emissive windows between the beam-forming optics and the sky. An external blackbody calibrator provides an *in situ* reference. Systematic errors were greatly reduced by using a differential radiometer and by cooling all components to physical temperatures close to the CMB temperature.

After observation, the team used absolutely calibrated data between 3 and 90 GHz, along with previous measurements at other frequencies, to constrain models of extragalactic emission. Such emission was a combination of the CMB monopole, galactic foreground emission, the integrated contribution of radio emission from external galaxies, any spectral distortions present in the CMB, and any other extragalactic source.

After removal of estimates of foreground emission from the Milky Way, and an estimated contribution of external galaxies, they presented fits to a combination of the flat-spectrum CMB and an estimated contribution of external galaxies, as well as fits to a combination of the flat-spectrum CMB and potential spectral distortions in the CMB.

They found 2σ upper limits to CMB spectral distortions of $\mu < 6 \times 10^{-4}$ and $|Y_{ff}| < 1 \times 10^{-4}$. But there was also a significant detection of a residual signal. The residual signal is consistent with emission in the form of a power law with amplitude 18.4 ± 2.1 K at 0.31 GHz and a spectral index of −2.57 ± 0.05, as shown in Figure 23-1-3-2.

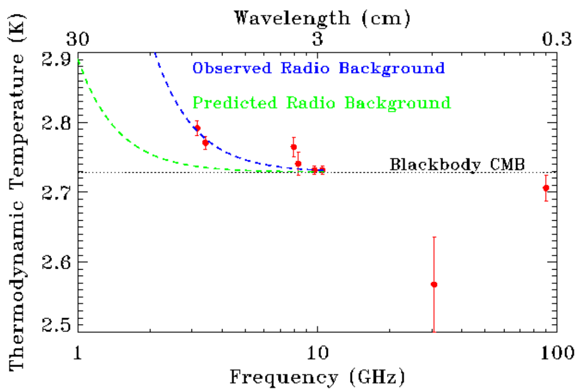


Figure 23-1-3-2 **(Source: http://asd.gsfc.nasa.gov/archive/arcade/results_2006.html)**

Detailed analysis of this residual signal ruled out any primordial star or known radio sources, including gas, in the outermost halo of the Milky Way. The residual signal was measured to be factor of six times brighter than the combined emission of all known radio sources in the universe. This means that the signal could not be associated with any star, galaxy, or other object in the universe.

23.1.4. Solving the Mystery of the Space Roar by CFLE Theory

However, theory of curve of force lines can solve this deep-seated illness of modern physics. According to the standard model of cosmology, the universe expanded, and adiabatic cooling caused the energy density of the plasma to decrease until it became favorable for electrons to combine with protons, forming hydrogen atoms. This recombination event happened when the temperature was around 3000 K or the universe was approximately 379,000 years old. At this point, photons no longer interacted with the electrically neutral atoms and began to travel freely through space, resulting in the decoupling of matter and radiation. The temperature of the decoupled photon has continued to drop down to 2.72548 $\pm$ 0.00057 K (or 0.235 meV). The spherical surface of decoupling at this moment is called the last scattering surface. According to the standard model of cosmology, this time can be calculated as follows:

$$t_{dec} = t_o(\frac{T_o}{T_{dec}})^{3/2} \qquad 23\text{-}1\text{-}4\text{-}1$$

where t_{dec} is the time of decoupling, T_{dec} is the temperature of decoupling, and T_o is the present temperature.

$$t_{dec} = 1.373 \times 10^{10} \text{ years } (\frac{2.725 \text{ K}}{3000 \text{ K}})^{3/2}$$

$$= 375{,}900 \text{ years}$$

$$\approx 380{,}000 \text{ years} \qquad 23\text{-}1\text{-}4\text{-}2$$

Because T_{dec} of the CMB is a function of the red shift (z_{dec}), this red shift can be calculated.

$$T_{dec} = T_o(1 + z_{dec}) \qquad 23\text{-}1\text{-}4\text{-}3$$

$$3000 \text{ K} = 2.725(1 + z_{dec})$$

$$z_{dec} \approx 1100 \qquad 23\text{-}1\text{-}4\text{-}4$$

The time before 380,000 years ago is called the period of radiation, and that after the moment of last scattering is called the period of recombination.

However, according to CFLE theory, these results are only partly true. When the electric force line and its element curve, the neutrolateral force starts interaction along the degree of curve of the force line (cf. §6, §7). Therefore, protons and electrons can build neutral hydrogen atoms at higher temperature than 2.72534 K, as hot neutral hydrogen atoms in the solar photosphere, despite that the temperature of the photosphere is unbelievably higher than 6000 K (cf. §8).

Because the maximum degree of curve of the proton force line in the present time is the permitted g = 6.545979, at least this degree of curve of the force line must be considered at the period of recombination.

The electrical permittivity difference between the present and at that time for protons and electrons is

Q_{dec} = (g^2)(0.000579)

= $(6.545987)^2$ (0.000579)

= 0.024810

x_{dec} = 1.024810 23-1-4-5

where g^2 comes from the force line curve of the proton and corresponds to the force line curve from the heat of energy full space, and 1.000579 is the electrical permittivity of the electric force line of the near-electric surface of the proton. The effective force line curve is

g_{eff} = (6.545979) (1.024810)

= 6.708385 23-1-4-6

According to CFLE theory (cf. §16), the possible temperature of recombination at g_{eff} = 6.708385 is

T_{dec} = (3000 K) (6.708385)

= 20,125 K 23-1-4-7

The permitted start time of last scattering at g_{eff} = 6.708385 is

$t_{dec} = t_o(\frac{T_o}{T_{dec}})^{3/2}$

$= 1.373 \times 10^{10}$ years $(\frac{2.725\text{ K}}{20{,}125\text{ K}})^{3/2}$

= 21,640 years

≈ 22,000 years 23-1-4-8

The permitted red shift of last scattering at g_{eff} = 6.708385 is

$T_{dec} = T_o(1 + z_{dec})$

20,125 K = 2.725(1 + z_{dec})

$z_{dec} = 7383 \approx 7400$ 23-1-4-9

The permitted temperature of the present observer at $g_{eff} = 1$ is

T_o = (2.72548 K) (6.708385)

= 18.2836 K

≈ 18.3 K 23-1-4-10

The observed value by Alan J. Kogut and his team is

T_{oOb} = 18.4 ± 2.1 K 23-1-4-11

In the standard model of cosmology, there is only one last scattering surface with z_{dec} = 1089, as illustrated in Figure 23-1-4-1

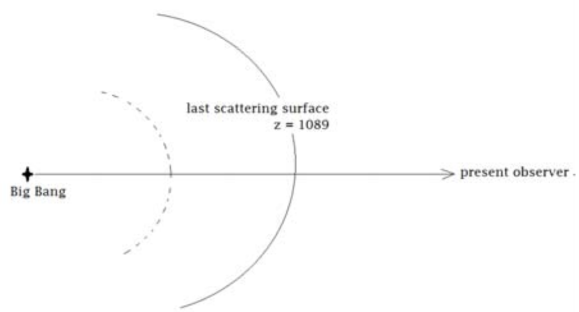


Figure 23-1-4-1

Photons can be free from the atom and can leave freely from the last scattering surface. But in CFLE theory, there are two surfaces of last scattering (Figure 23-4-2).

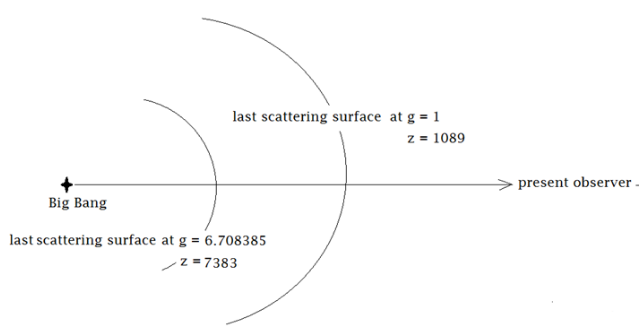


Figure 23-1-4-2

One is the last scattering surface at g_{flat}= 1 with $z_{\text{flat}} = 1089$, where the decoupling energy of the photon is only

E_{dec} = 0.25 eV 23-1-4-12

The other is the last scattering surface at g_{curve}= 6.708385 with $z_{\text{curve}} = 7383$, where the decoupling energy of the photon is

E_{dec} = (0.25 eV) (6.708385)

= 1.68 eV!!! 23-1-4-13

Despite that the energy of recombination is stronger than 0.25 eV, protons and electrons can build a neutral hydrogen atom by the strong force that occurs from the curve of electric force lines and elements; this is called the neutrolateral force (cf. §6,§7) as the force of chromo dynamics. Therefore, photons could freely leave the last scattering surface at g = 6.708385 from t_{dec} ≈ 22,000 years after the Big Bang.

The residual signal that Alan Kogut and his team discovered is another cosmic microwave background spectrum, T_0= 18.3 K, with red shift z_{curve} = 7383. Therefore, this radio signal must have longer wavelengths or centimeter wavelengths that were more strongly red shifted than the regular cosmic microwave background. Now, we can understand why the residual signal that Alan Kogut and his team found has no association with any star, galaxy, or other object in the universe.

In conclusion, the instruments, measurements, detections, and discoveries of NASA's Alan Kogut and his team are historically successful. However, the Standard Model of cosmology is wrong, because this model does not have right calculable theory of general relativity.

23.2. Solving Photon Underproduction Crisis by CFLE Theory.

23.2.1. Observation and Calculation

A team lead by Juna Kollmeier, they examine the statistics of the low-redshift Lyman-alpha forest from smoothed particle hydrodynamic simulations in light of recent improvements in the estimated evolution of the cosmic ultraviolet background (UVB) and recent observations from the Cosmic Origins Spectrograph (COS). They find that the value of the metagalactic photoionization rate required by their simulations to match the observed properties of the low-redshift Lyman-alpha forest is a factor of 5 larger than the value predicted by state-of-the art models for the evolution of this quantity.

They reported an unexpected deficit of roughly factor of 5 between ionizing light from known sources and the actual observations of intergalactic hydrogen. It's like going outside in the middle of the night and getting sunburn, where are these photons coming from?

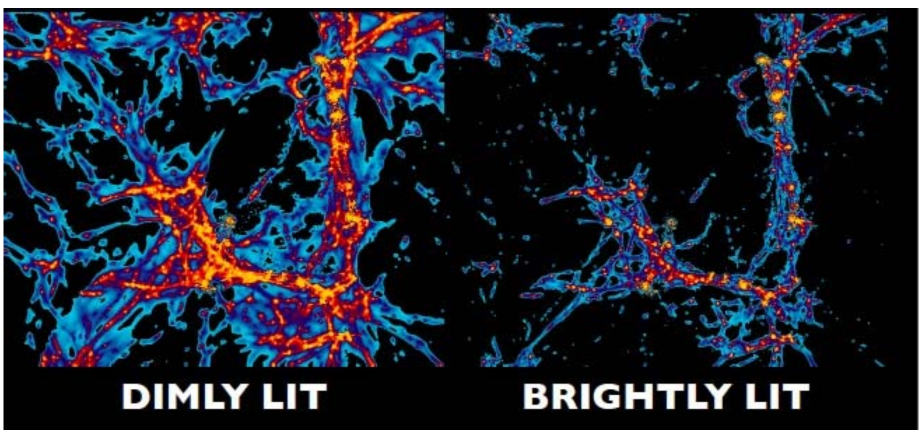
This crisis shows a significant discrepancy between our current models and our observations of the present-day universe.

A recent study of the local universe's ultraviolet background finds a "photon underproduction crisis" that indicates a serious miscounting of nearby ultraviolet sources, a failure to understand the intergalactic medium, or possibly both.
The ultraviolet background pervading the universe comes from two main sources: quasars and young, hot stars. Their UV photons interact with the sparse gas that permeates intergalactic space, converting neutral hydrogen atoms into electrically charged ions. Quasars probably account for most of the extragalactic UV background because stars' ultraviolet light is usually absorbed by gas in their host galaxies before it can interact with intergalactic hydrogen.

Because the UV background is too dim for astronomers to measure directly, they instead add up all the possible sources of ultraviolet radiation and account for how much is absorbed and reemitted by intergalactic gas.

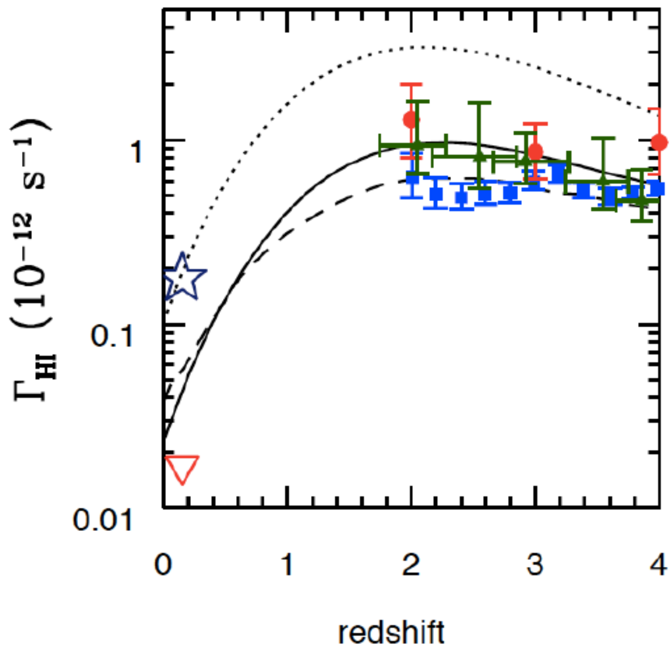
Observations of the distant cosmos show near-perfect agreement between the number of ultraviolet sources and the ionization rate of intergalactic gas. But a study conducted by Juna Kollmeier (Carnegie Observatories) and colleagues shows a far more peculiar result for the nearby universe.

The result puts astronomers in a bind. On the one hand, it's difficult to believe that they have miscounted UV sources in the local universe by such an extreme amount, explains Romeel Davé (University of the Western Cape, South Africa and University of Arizona). On the other hand, it would be surprising if astronomers' understanding of intergalactic hydrogen is way off the mark, since current models have explained observations so well for the past two decades



Simulations of intergalactic hydrogen in a "dimly lit" universe (left) compared to a "brightly lit" universe (right) with five times more of the UV photons that destroy neutral hydrogen atoms. Hubble observations of the intergalactic medium match the picture on the right, but simulations using only the known cosmic UV sources produced the much thicker structures on the left. Ben Oppenheimer and Juna Kollmeier Figure 23-2-1-1

Figure 23-2-1-2 shows that the predicted Γ_{HI} from HM12 (solid line) compared to observational determinations. The dashed line shows an independent model of the UVB from Faucher-Gigu_ere et al. (2009), which overall is quite similar to that of HM12.



The photoionization rate as a function of redshift for the HM12 UVB (solid) compared to observational constraints at z = 2 - 4 (circles Bolton & Haehnelt (2007), triangles Becker et al. (2007) and squares Faucher-Gigu_ere et al. (2008)) and the value we infer from our Lyman-αforest modeling at z = 0:1 (open star). The red triangle shows the low-redshift upper limit inferred by Adams et al. (2011) from non-detection of Hαemission in the galaxy UGC 7321. The dashed line shows an alternative UVB model from Faucher-Gigu_ere et al. (2009). The dotted line shows a model, discussed in x4.1, with a constant galaxy escape fraction f_{esc} = 15%.

Figure 23-2-1-2

Figure 23-2-2-2 shows the CDD, defined here to be the mean number of absorbers per logarithmic interval of column density per unit redshift path length, for the simulated Lyman-αforest created with the HM12 and HM01 backgrounds. The COS CDD measurements from Danforth et al. (2014) are shown as magenta symbols.

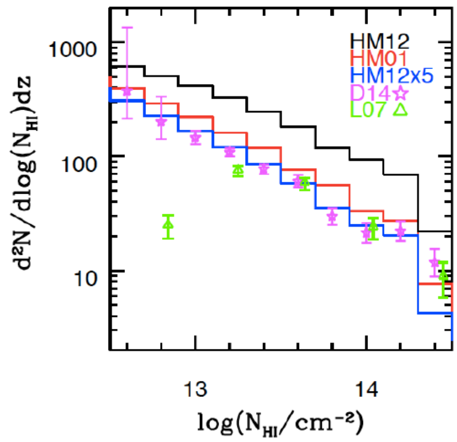


Figure 23-2-1-3

Earlier CDD measurements by Lehner et al. (2007) (green symbols) are in excellent agreement at column densities above $10^{13} cm^{-2}$ and are likely affected by incompleteness in the lowest column density bin. The simulated IGM is a thicker beast with the HM12 UVB determination, over predicting the observed CDD by a factor of ≈3.3 over the column

density range 10^{13}~10^{14} cm^{-2} With the HM01 back ground, the simulated CDD is slightly but consistently above the COS measurements.

For a highly ionized system in photoionization equilibrium, the neutral column density is inversely proportional to the photoionization rate, $N_{HI} \propto \frac{1}{\Gamma_{HI}}$ .The slope of the simulated and observed CDDs in Figure 23-2-2-2 is approximately $N_{HI}^{0.75}$, so reducing the amplitude of the CDD by a factor of 3.3 requires lowering the column densities of individual systems by a factor of $3.3^{1/0.75}$ ≈5. The simulations fit the data beautifully in the early universe, and they fit the local data beautifully. However, the large mismatch between the low-redshift photoionization rates predicted by HM12 and inferred from matching the observed CDD "challenges" current understanding of the sources of the UVB, the physical state of the IGM, or both. To date scientists discuss a number of possible resolutions to this discrepancy.

23.2.2. Solving the Mystery of the Missing Source of Photon

Such discrepancy says us why do galaxies and quasars produce about 5 times less ultraviolet light than expected in the low-red shift universe?

According to CFLE theory answer is simply that this UVL come from not stars and quasar, but come from early universe like CBM. High energy photon of early universe is changed UVL of present universe by red shift as we discussed in 23-1 space roar. This means that photon under production crisis can be answer about mystery of space roar.

Because factor of $3.3^{1/0.75} \approx 4.7$ is, we can analyze that this value of discrepancy is force line curve difference between early universe (high red-shift universe) and present universe (low red-shift universe)

Observed value of Ω_B by WMAP is

$\Omega_B = 0.04628$ %. 23-2-2-1

$\frac{1}{\Omega_B} = \frac{1}{0.046} = 21.74$ 23-2-2-2

Therefore, each force line curve of gravity and electricity is

$g = \sqrt{21.74} = 4.663$ 23-2-2-3

However, the photoionization rate problem is purely curve of electromagnetic force line problem only same as dark matter problem.

Therefore, effect of miscounted force line curve for the photoionization rate must be

$g_{mis} = 4.663 \approx 4.7 = 3.3^{1/0.75}$ 23-2-2-4

This means that neutrolateral energy interact as strong as $g = 4.663$. But real static energy is only $g = 1$

Vikram Khair and Raghunathan Srianand (IUCAA, Post Bag 4, Pune, India – 411007), they assert “Interestingly, we find that the contribution from QSOs alone can explain the recently inferred Γ_{HI} by Shull et al. (2015) which used the same observational data but different simulation. Therefore, we conclude that the crisis is not as severe as it was perceived before and there seems no need to look for alternate explanations such as low luminosity hidden QSOs or decaying dark matter particles.” However, by CFLE theory we can find that historical observations and results of Kollmeier and her team was right.