EWASS 2016

Symposium S02 – Understanding CMB Polarization Foregrounds –
Clearing the path to inflationary B modes

Athens 4-8 July 2016

Preliminary solution of the CMB dipole within the ECM rotating Universe :

A sample test on the historic G7 survey

ECM paper XXI by L. Lorenzi

Understanding the CMB

Together with polarization, there is another important feature of the cosmic microwave background:

The CMB dipole

The canonical hypothesis, a rapid motion of the Local Group

relative to the Local Hubble Flow, is contrary to the observed redshifts.

One can show that the cosmic component of the CMB dipole is due to a

deceleration of the Local Hubble Flow, in which LG is almost motionless.

EVIDENCE FOR A COSMIC DIPOLE

$$z = z_0 + u(z_0) \cdot \cos\gamma$$

$$\cos\gamma = \sin b_{VC} \sin b + \cos b_{VC} \cos b \cos(l - l_{VC})$$

being $VC(\alpha_{VC} \approx 9^h; \delta_{VC} \approx +30^\circ \;\; or \;\; l_{VC} \approx 195^\circ; b_{VC} \approx +40^\circ)$ the center of a huge void,

extending $\sim 100^\circ$ across the sky at $z \approx 0.03 - 0.08$ ***(Bahcall & Soneira 1982, ApJ 262, 419)***

$\boldsymbol{z_0 \equiv \langle z \rangle}$ is the **central redshift**, corresponding to z at $\cos\gamma = 0$ and **coinciding with the mean redshift** $\langle z \rangle$ of a defined z-bin whose single redshifts are corrected only for the Sun's motion in the Local Group. **Hemisphere I has $\boldsymbol{\cos\gamma > 0}$, II has $\boldsymbol{\cos\gamma < 0}$.**

The z-dipole is statistically confirmed, **in accordance with ECM** and even as an **RFR effect *(Rubin, Ford, Rubin 1973),*** at

$\boldsymbol{z_0 \equiv \langle z \rangle}$ **= 0.0025,0.0040,0.0042,0.0046,0.0058,0.0066,0.012,0.02,0.2,0.5,1.00** *(cf. Lorenzi 1991-93 & papers I,II,V,VI,X,XV,XVIII,XIX)*

4 sample checks of the ECM z-dipole

AA1 308 galaxies & G7 130 groups *(Aaronson et al. 1982 – Faber et al. 1989)*

paper XIX : **As RFR effect at** $\langle\langle \mathrm{z} \rangle\rangle = \mathbf{0.00460} \;\Rightarrow \langle \boldsymbol{u} \rangle = -\mathbf{0.00083} \pm \mathbf{0.00004} \;\; (\boldsymbol{u_{ECM}} = -\mathbf{0.00082})$

paper XIX : **As RFR effect at** $\langle\langle \mathrm{z} \rangle\rangle = \mathbf{0.0121} \;\Rightarrow \langle \boldsymbol{u} \rangle = -\mathbf{0.0021} \pm \mathbf{0.0002} \;\; (\boldsymbol{u_{ECM}} = -\mathbf{0.0021})$

SCP Union & Union2.1 supernovae *(Kowalski et al. 2008 - Amanullah et al. 2010 - Suzuki et al. 2011)*

papers X-XV **: A crucial dipole test at** $\langle\langle \mathrm{z} \rangle\rangle = \mathbf{1.00} \;\Rightarrow \langle \boldsymbol{u} \rangle = -\mathbf{0.078} \pm \mathbf{0.008} \;\; (\boldsymbol{u_{ECM}} = -\mathbf{0.078})$

paper XVIII : **As RFR effect at** $\langle\langle \mathrm{z} \rangle\rangle = \mathbf{1.05} \;\Rightarrow \langle \boldsymbol{u} \rangle = -\mathbf{0.071} \pm \mathbf{0.041} \;\; (\boldsymbol{u_{ECM}} = -\mathbf{0.081})$

Analysis of the Local Group kinematics

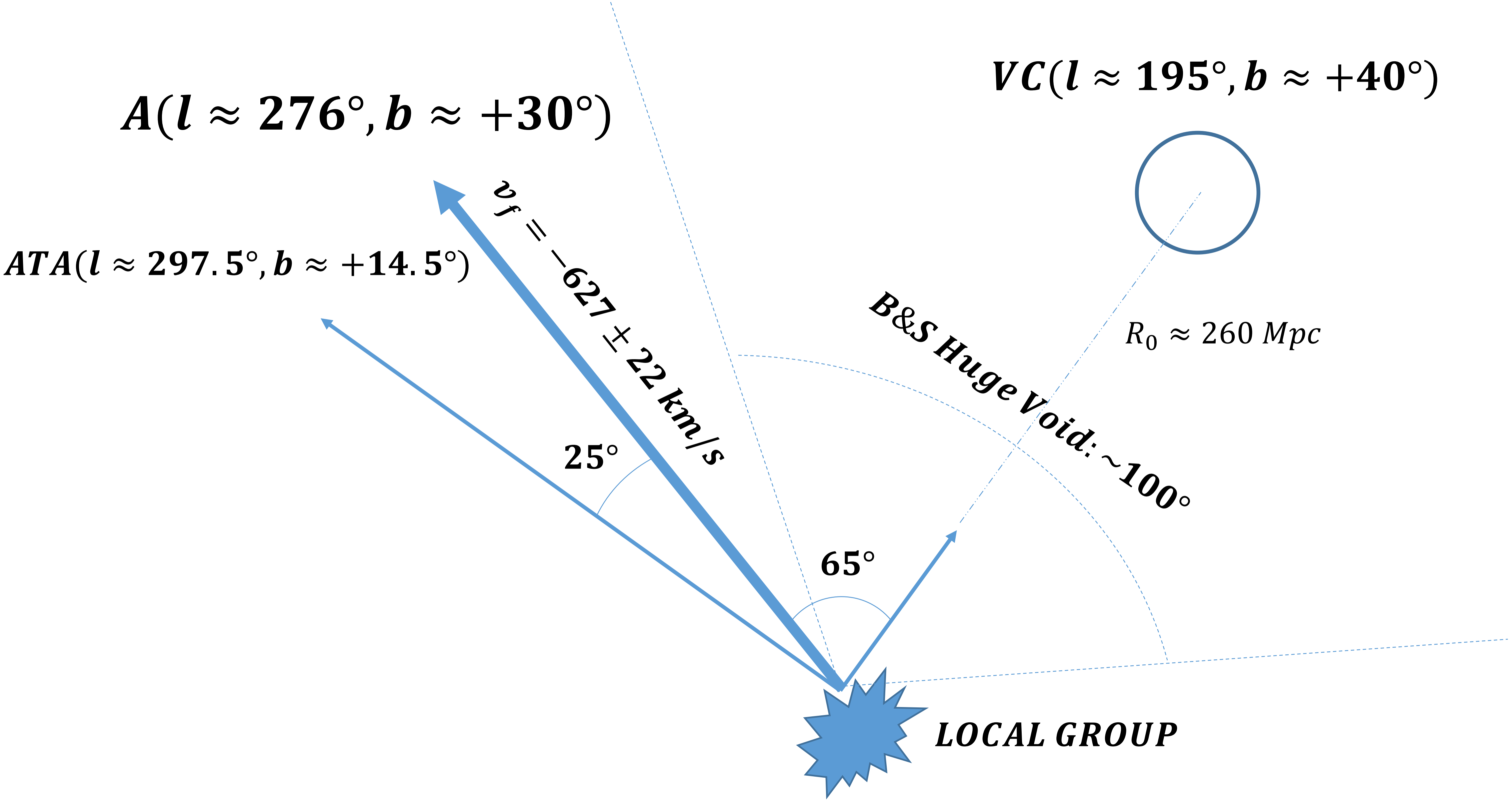
«The Local Group is a typical, small group of nebulae which is isolated in the general field»
(Hubble 1936)
«… the Local Group is more compact and isolated from its surroundings than previously believed»
(Courteau & van der Bergh 1999)
The z-dipole as a cosmic dipole (in accordance with the ECM framework) **is obtained by correcting the redshifts** of the very nearby Universe **only for the motion of the Sun in the Local Group** *(cf. Lorenzi 1991-93 & ECM paper I).*

Preliminary solution of the CMB dipole as a combined cz-dipole:

The first component is due to the velocity of the Sun in the LG assumed motionless relative to the Hubble flow;
the second component (**CMB dipole2**) derives from a combined cz-dipole able to generate the velocity vector of $\mathbf{627 \pm 22\ km/s}$ **towards the apex A at** $\boldsymbol{l \cong 276°, b \cong +30°}$ (Cox 2000), which is **at about 65° from the huge void center VC**.
Such a CMB dipole2 has two orthogonal components, whose apices are provisionally fixed at

$$\boldsymbol{VC(l \approx 195°, b \approx +40°)} \quad \textit{and} \quad \boldsymbol{ATA(l \approx 297.5°, \approx +14.5°)}$$

A vectorial representation of the CMB dipole2 and its two orthogonal components



A combined cz-dipole of the expansion center universe

The new Hubble law for a cosmic expansion from the huge void center $VC(l \approx 195°, b \approx +40°)$:

1999 ECM paper I : $$\dot{\boldsymbol{r}} = (\boldsymbol{H} + \Delta\boldsymbol{H}) \cdot \boldsymbol{r} - \boldsymbol{R}\Delta\boldsymbol{H}\cos\boldsymbol{\gamma} + \boldsymbol{R}\dot{\boldsymbol{w}}\sin\boldsymbol{\gamma} \qquad (1)$$

Eq. (1) as a normal cz-dipole: $\mathbf{cz} = \boldsymbol{cz_0} + \boldsymbol{cu}(\boldsymbol{z_0}) \cdot \boldsymbol{cos\,\gamma}$ being $\langle R\dot{w}\rangle \equiv 0$ in case of differential rotation

$\boldsymbol{R\dot{w}\sin\gamma \equiv -R\Delta\dot{\vartheta}\cos\beta}$

$\Delta\dot{\vartheta}$ like ΔH is apparent and due to a light-time effect : $\Delta\dot{\vartheta} = \dot{\vartheta}(t) - \dot{\vartheta}_0$; $\Delta H = H(t) - H_0$

$\cos\beta = \sin b_{ATA} \sin b + \cos b_{ATA} \cos b \cos(l - l_{ATA})$ being $ATA(l \approx 297.5°, b \approx +14.5°)$

Eq. (1) as a combined cz-dipole pointing towards the apex $A(l \cong 276°, b \cong +30°)$ of the CMB dipole2:

2016 ECM paper XXI : $$\boldsymbol{cz} = \boldsymbol{cz_0} + \boldsymbol{cu}(\boldsymbol{cos\,\gamma} - \boldsymbol{\xi}\cos\boldsymbol{\beta}) \qquad (2)$$

The expansion center model with apparent differential rotation

(ECM papers series: I → XXI : Lorenzi 1999a → 2016)

ECM : $z_0 = \frac{x}{3}\left(\frac{1+x}{1-x}\right) \Longrightarrow x = x(z_0)$ $\qquad u =-0.0605 \cdot x(1-x)^{-\frac{2}{3}}$

$$\xi = -\frac{R\Delta\dot{\vartheta}}{R\Delta H} = y_0 x^{-1}\left[(1-x) - (1-x)^{\frac{1}{3}}\right] = -\tan\gamma^* \qquad \dot{\vartheta}_0 = y_0 H_0$$

being $z_0 \equiv \langle z \rangle$; $x = \frac{3H_0 r}{c} < 1$; $r = -c(t-t_0)$; $\dot{r} = cz$; $y_0 = 3.2^{+0.4}_{-0.3}$ $(paper\ VII) \Longrightarrow \xi_0 = -2.15 \pm 0.23 \Longrightarrow \gamma_0^* = 65° \pm 3°$

The values $\boldsymbol{H_0 = 70 \pm 3\ km\ s^{-1} Mpc^{-1}}$ and $\boldsymbol{-0.0605} \cong -\frac{\boldsymbol{H_0 R_0}}{\boldsymbol{c}}$, with $\boldsymbol{R_0} \cong \boldsymbol{260^{+23}_{-14}}\ Mpc$, were obtained in *paper II*, through a calibration on 83 individual galaxies at $z < 0.02$ and $\langle z \rangle$=0.0066 with single z corrected only for the Sun's motion in the Local Group.

(data by Sandage & Tammann 1975a, ApJ 196 ,313)

The fictitious velocity of the combined z-dipole

$z = z_0 + \Delta z_0$ being $z_0 = \frac{\lambda_0 - \lambda}{\lambda}$; $\Delta z_0 = u(\cos\gamma - \xi\cos\beta)$; $1 + z_0 = \frac{T}{T_0}$

$$\Delta z_0 = \int_{z_0}^{z_0+\Delta z_0} dz_0 = -T\int_{T_0}^{T_0+\Delta T_0} \frac{dT_0}{T_0^2} = -\frac{T}{T_0}\cdot\frac{\Delta T_0}{T_0 + \Delta T_0}$$

$$\frac{\Delta z_0}{1+z} = \frac{u\cdot(\cos\gamma - \xi\cos\beta)}{1+z} = -\frac{\Delta T_0}{T_0} \equiv \frac{v_f}{c}\cos\alpha \Longrightarrow$$

$$v_f = \frac{cu(\cos\gamma - \xi\cos\beta)(\cos\alpha)^{-1}}{1 + z_0 + u(\cos\gamma - \xi\cos\beta)}$$

with hemispheric asymmetry at the poles A($\alpha = 0$) and B($\alpha = 180°$):

$$\Delta v_f = (v_f)_B - (v_f)_A \Longrightarrow (\Delta T_0)_B + (\Delta T_0)_A \neq 0$$

v_f = a fictitious velocity !

At $\boldsymbol{\alpha = 0 = \gamma}$ and $\boldsymbol{\beta \equiv 90°}$ (pole VC), experimentally one finds:

$$z_0 \equiv \langle z\rangle = 0.00460 \Longrightarrow u = -0.00082 \Longrightarrow v_f = -248 \pm 12\ km\ s^{-1}$$

$$z_0 \equiv \langle z\rangle = 0.0121 \Longrightarrow u = -0.0021 \Longrightarrow v_f = -623 \pm 60\ km\ s^{-1}$$

$$z_0 \equiv \langle z\rangle = 1.00 \Longrightarrow u = -0.078 \Longrightarrow v_f = -12066 \pm 1304\ km\ s^{-1}$$

$$\mathbf{x} = 0.999999225 \Longrightarrow u_{ECM} \cong -717 \Longrightarrow z_0 \cong 8.6\times 10^5 \Longrightarrow v_f \cong -250\ km\ s^{-1}$$

ECM solution of the CMB dipole2

$\boldsymbol{v_f = -627\ km\ s^{-1} \Longrightarrow x \Longrightarrow r = \frac{cx}{3H_0}}$ **being** $\boldsymbol{z_0 = z_0(x)\ ,\ u = u(x)}$

Apparent apex $AA(\gamma \approx 65°, \beta \approx 25°, \alpha = 0, \xi = -\tan\gamma \approx -2.15) \Longrightarrow x = 0.0145 \Longrightarrow \boldsymbol{r \cong 21\ Mpc}$

Solution I $\boldsymbol{\Longrightarrow z_0 \cong 0.0050\ \ and\ \ u_{ECM} \cong -0.00089 \Longrightarrow (\Delta T_0)_B + (\Delta T_0)_A \cong 0.024\ mK}$

Solution I implies a 3K radiation coming out from the very nearby rotating Universe!

Apparent apex $AA \equiv VC(\gamma = \alpha = 0, \xi \equiv 0) \Longrightarrow x = 0.999987835 \Longrightarrow \boldsymbol{r \cong 1427\ Mpc}$

Extrapolated solution II $\boldsymbol{\Longrightarrow z_0 \cong 54801\ \ and\ \ u_{ECM} \cong -114 \Longrightarrow (\Delta T_0)_B + (\Delta T_0)_A \cong 0.024\ mK}$

The extrapolated solution II requires a primordial expansion centred on the apex AA.

Testing the historic G7 survey

Table 4 in Faber et al. or G7=FWBDDLT 1989 lists the values of v_{gr}^{hel}

S&T standard correction applied: $$cz = v_{gr}^{hel} + 300 \cos b \sin l$$

From two RFR z-tests on 130 & 117 groups at $\langle z \rangle = 0.012$

$$\langle u \rangle = -0.0020 \pm 0.0003 \ ; \ \langle \xi \rangle = -2.3 \pm 0.5$$

From 3 least square linear fittings of eq. (2) on all the 130 G7 groups :

$$z_0 = 0.0126 \pm 0.0007 \ ; \ u = -0.0025 \pm 0.0011 \ ; \ u\xi = +0.0043 \pm 0.0011 \ ; \ s = 0.007033$$

$$u \equiv -0.0021 \Longrightarrow z_0 = 0.0125 \pm 0.0007 \ ; \ \xi = -2.0 \pm 0.5 \ ; \ s = 0.007009$$

$$u \equiv -0.0021 \ and \ z_0 \equiv 0.012 \Longrightarrow \xi = -1.9 \pm 0.5 \ ; \ s = 0.007003$$

Conclusions

New CMB dipole $\Longrightarrow$ New cosmic scenario confirmed

(cf. paper XVII : A briefing on the expansion center universe)

The CMB dipole is simply due to a combined z-dipole resulting from a light-time effect tied to the cosmic deceleration of the Local Group.

The origin of the CMB dipole should be the same as that of the observed cz-dipole referring to the very nearby rotating Universe.

The 3K radiation should come from a mean depth of 21 Mpc.

The sample test on the G7 survey fully confirms ECM.

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