Domaine Walls of Low Tension in Cosmology

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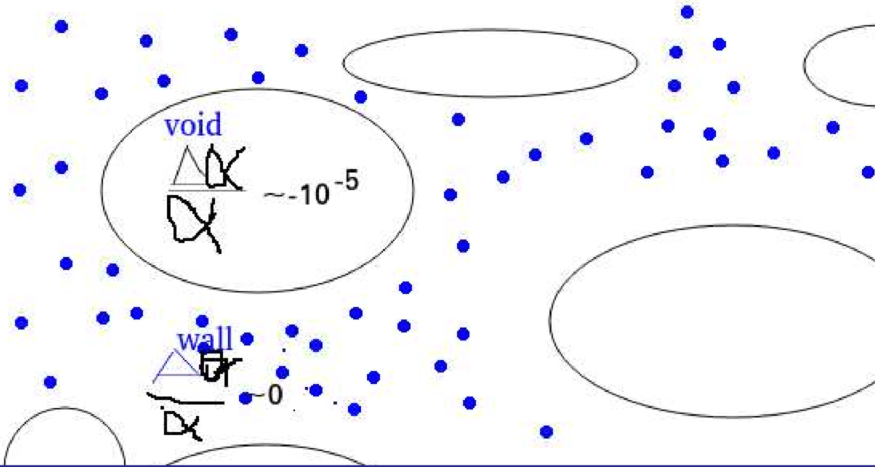
"Artist": Vacua in Universe; Voids one vacuum, clusters of galxies "our" vacuum.



Domaine Walls need Low Tension to be Allowed

The tension or in $c = 1$ notation also the energy per area S of a domaine wall between different phases of vacuum has dimensionality GeV^3, and if an energy scale of the order of the scales at which we look for " new physics" is used the enrgy density gets so high that domaine walls of cosmological scales of extention would be so heavy as to be totally excuded by the already known energy density (the critical density

$$\rho_c = \frac{3H^2}{8\pi G} = 1.8788 * 10^{-26} h^2 kg/m^{-3} \quad (1)$$

$$(\text{where } h = H_0/(100km/Mpc) = 0.674) \quad (2)$$

$$= 2.7754 * 10^{11} h^2 M_{sun} Mpc^{-2}, \quad (3)$$

$$\rho_c = 8.5 * 10^{-27} kg/m^3). \quad (4)$$

"New physics scale" walls excluded.

How High Energy per area possible ?

Say a wall of dimension of the visible universe of length scale

$$R_{visible} = 13 * 10^9 \text{ light years} \quad (5)$$

$$= 1.3 * 10^{10} ly * 9.5 * 10^{15} m/ly = 1.2 * 10^{26} m \quad (6)$$

$$\text{giving} Area \sim 10^{52} m^2 \quad (7)$$

for a domaine wall would allow an energy per area to give the total critical visible energy

$$\text{visible (critical) energy} \sim (1.2 * 10^{26} m)^3 * 8.5 * 10^{-27} kg/m^3 \quad (8)$$

$$= 1.5 * 10^{52} kg \quad (9)$$

being

$$\text{maximal energy per area} \sim \frac{1.5 * 10^{52} kg}{10^{52} m^2} \sim 1.5 kg/m^2. \quad (10)$$

Tolerable Domaine Wall Energy per Area for Astronomic Extention $\sim 1.5 kg/m^2$

$$\text{Tolerable energy per area} = S = 1.5 kg/m^2 \quad (11)$$

$$= \frac{1.5 kg/m^2 * (1.2 * 10^{-12} MeVm)^2}{1.79 * 10^{-30} kgc^2/MeV}$$

$$= 1 * 10^6 MeV^3. \quad (12)$$

So the energy scale pointed out by such a slightly too big wall energy per area is

$$\sqrt[3]{S} = \sqrt[3]{10^6 MeV^3} = 100 MeV. \quad (13)$$

Have long worked on Idea of there being Several Vacua with Same Energy Density.

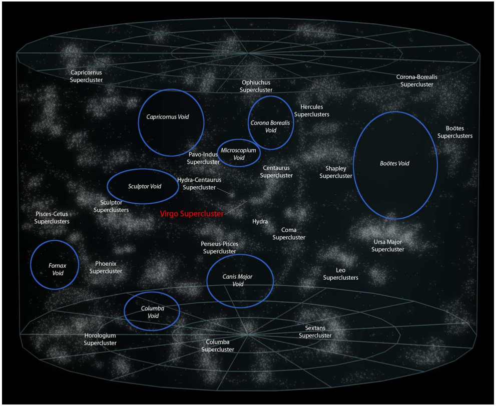
- **PRE**dicted the Higgs mass before it was found.
- In a rather complicated model with each family of fermions having its own set of gauge fields - like the ones in Standard Model - I and Niels Brene ... fitted the fine structure constants by using the number of families as parameter and **got 3 before this number was measured.**
- We model dark as bubbles of a new vacuum on top of which is highly compressed ordinary matter. We get the surface tension S of domaine wall between the vacua to have its cubic root of the order

$$S^{1/3} \sim 10MeV. \tag{14}$$

Idea of Domaine walls around Voids

Since our dark matter model has one vacuum inside the dark matter, a large region of such inside the dark matter vacuum would be formally a huge pearl of dark matter, and there could not be true dark matter inside it. Thus it would be much less easy for the contraction to get started early in such a region. If further as we shall see a region of inside-dark matter-vacuum would tend to be heated up, then the chanse for forming stars and galaxies would also later be reduced.
So let us investigate as an example the hypotesis that the domaine walls follow the boarders of the voids - the regions with few or no galaxies - because these voids really are "formally huge dark matter pearls".

But we speculate if the new vacuum might be found inside the large voids (galaxy free regions) ? (Same vacuum as inside the dark matter could be in voids?)



kunstmaler lars andersen http://www.23.dk/skak.htm

Lars Andersen

Historiemaler Portrætmaler Provokunstner Om Lars Andersen CV/omtale Kontakt

Several degenerate Vacua (MPP) $\sim$ Slush $\Rightarrow 0^0C$

Parameters of Domaine Walls from Our Dark Matter Fitting

- Cubic root of tension in wall S or of energy density per unit area:

$$\sqrt[3]{S} = 10MeV \text{ (allowed for cosmological domaine walls).}$$

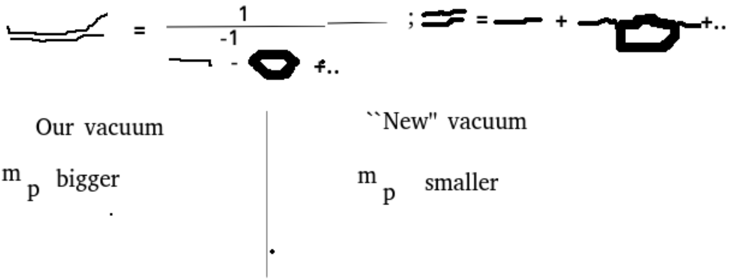
- Potential lowering for a nucleon by entering into the "new" vacuum (the one inside the dark matter bubbles)

$$\Delta V = 2MeV. \tag{15}$$

Nuceons 2 promille lighter in the "new" vacuum.

- Energy density in the two vacua exactly the same. (Also a theorem by Gia Dvali)

E.G. Photon self energy diagram Proton loop part gets changed



Sign and order of magnitude of $\frac{\Delta\alpha}{\alpha}$

- In the approximation that one could use nonrelativistic second order perturbation theory for the sign we expect that the (bare) photon is mixed more with the proton anti-proton pair in the phase with the smallest nuceon masses, and thus the photon in this (m_p small) phase couples the weaker than in the m_p big phase.
- The relative correction to the fine structure constant α, i.e. $\frac{\Delta\alpha}{\alpha}$ has thus one factor α in addition to the $2/940$, the relative difference in nucleon mass in tthe two phases:

$$\frac{\Delta\alpha}{\alpha} \approx -\alpha * \frac{2}{940} = -1.4 * 10^{-5} \tag{16}$$

- The deviations found (?) with 3.9 sigma are of this 10^{-5} order of magnitude, but they are in litterature rather fitted by a dipole variation in space, than with voids versus clusters.

m_e/m_p ratio not varying to 10^{-6} catastrophe for our model

Using molecule absorbtion lines the ratio of the electron to proton mass was found not to vary by more than 1 in a million.
We would of course predict it should vary on promille level because we have the proton vary on promille level from phase to phase.
Our only resue hope: **Very few molecular cloud in the voids, so they were not measured.**

Conclusion

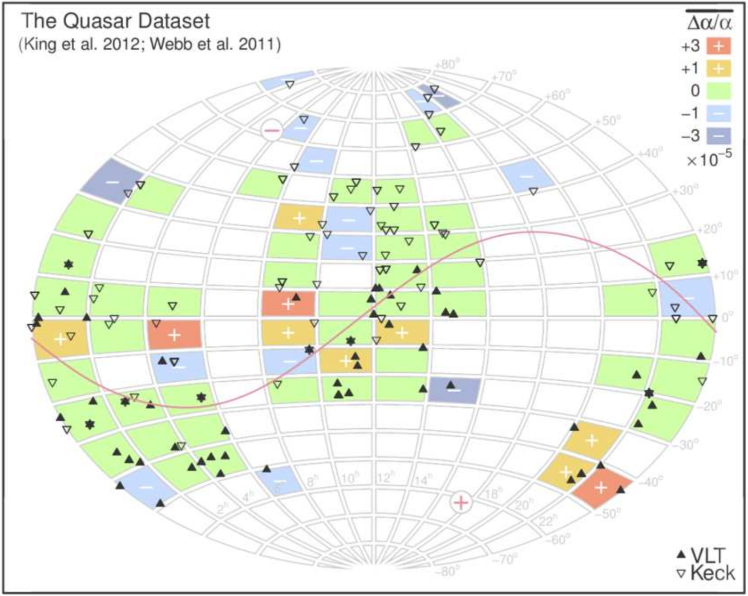
- we long worked on a model with:
  - Only Standard model for Dark Matter,
  - speculating that there is in Standard Model more than one vacuum phase. Asuming same energy density in the different phases.
  - Fitting size of the dark matter particles give roughly suface tension $S = (10MeV)^3$.
- Most likely the different vacuum-phases should have similar order of magnitudes of space-time extension. (Microcanonical ensemble).
- Different vacuum-phases different “constants” of nature, e.g. fine structure constant α. Such variation possibly found, but not yet tested for void versus cluster dependence.

Reserve Slides

The X-SHOOTER spectral resolution does not resolve individual absorbing components. However, we simultaneously fit multiple transitions at the same redshift, with tied parameter constraints, such that the Voigt profile parameters and α measurements are reasonably well constrained. Nevertheless, the lower spectral resolution of X-SHOOTER (compared to echelle spectrographs such as UVES and HIRES) would lead us to expect that some absorption components are missed. In a small number of cases, elevated b-parameters in the final models reinforce that expectation (full model parameter details and estimated uncertainties for all four absorption systems are provided via the online Supplementary Materials associated with this paper). Even so, Figure 2 indicates that α is likely to be insensitive to missing components because α stabilises in relatively early model generations and subsequently varies only slightly as model complexity increases. The same insensitivity of α to missing components was borne out in the numerically simulated spectral simulations described in (57). The

Altogether our final sample comprises a total of 323 measurements spanning the redshift range $0.2 < z_{abs} < 7.1$ enabling an updated estimate of the spatial dipole model reported in (30): the updated dipole amplitude, $A = 0.70 \pm 0.16 * 10^{-5}$, the dipole sky location is right ascension 17.12 ± 0.95 hours and declination -57.18 ± 8.60 degrees. Using the bootstrap method described in (30) to estimate statistical significance, this deviates from a null result at a level of $\sim 3.68\sigma$. We can also directly compare the dipole model prediction (using the new parameters above) with the actual weighted mean from the 3 new X-SHOOTER measurements: the dipole prediction for the weighted mean is $\frac{\Delta\alpha}{\alpha} = 0.07 \times 10^{-5}$, in agreement with the actual measurement of $\frac{\Delta\alpha}{\alpha} = -2.18 \pm 7.27 * 10^{-5}$. The X-SHOOTER data presented here highlight an important benefit that is generally not

Local Void: Right ascension $18^h 38^m$; Declination $+18.0^0$.


The Quasar Dataset
(King et al. 2012; Webb et al. 2011)
$\overline{\Delta\alpha/\alpha}$
+3
+1
0
−1
−3
$\times 10^{-5}$
VLT
Keck

The spots with lowest α

$$\text{Right ascension} = 1^h; \text{declination} = 35^0 \quad (17)$$
$$\text{Right ascension} = 14^h; \text{declination} = -25^0 \quad (18)$$

Only Slides for Information oon Litterature; Not for showing

[Submitted on 21 Feb 2012] Spatial variation in the fine-structure constant – new results from VLT/UVES Julian A. King, John K. Webb, Michael T. Murphy, Victor V. Flambaum, Robert F. Carswell, Matthew B. Bainbridge, Michael R. Wilczynska, F. Elliot Koch

(abridged) We present a new analysis of a large sample of quasar absorption-line spectra obtained using UVES (the Ultraviolet and Visual Echelle Spectrograph) on the VLT (Very Large Telescope) in Chile. In the VLT sample (154 absorbers), we find evidence that alpha increases with increasing cosmological distance from Earth. However, as previously shown, the Keck sample (141 absorbers) provided evidence for a smaller alpha in the distant absorption clouds.

Upon combining the samples an apparent variation of alpha across the sky emerges which is well represented by an angular dipole model pointing in the direction $RA = (17.3 \pm 1.0)hr$, $dec. = (-61 \pm 10)deg$, with amplitude $(0.97 \ +0.22/-0.20) * 10^{-5}$. The dipole model is required at the 4.1 sigma statistical significance level over a simple monopole model where alpha is the same across the sky (but possibly different to the current laboratory value). The data sets reveal a number of remarkable consistencies: various data cuts are consistent and there is consistency in the overlap region of the Keck and VLT samples. Assuming a dipole-only (i.e. no-monopole) model whose amplitude grows proportionally with 'lookback-time distance' (r=ct, where t is the lookback time), the amplitude is $(1.1 \pm 0.2) * 10^(-6)GLyr^(-1)$ and the model is significant at the 4.2 sigma confidence level over the null model $[\Delta\alpha]/\alpha = 0)$.

We apply robustness checks and demonstrate that the dipole effect does not originate from a small subset of the absorbers or spectra. We present an analysis of systematic effects, and are unable to identify any single systematic effect which can emulate the observed variation in alpha.

Four direct measurements of the fine-structure constant 13 billion years ago Michael R. Wilczynska https://orcid.org/0000-0002-4264-8038, John K. Webb https://orcid.org/0000-0002-0004-9360 , Matthew Bainbridge, John D. Barrow, Sarah E. I. Bosman, Robert F. Carswell https://orcid.org/0000-0002-0185-1144, Mariusz P. Dabrowski https://orcid.org/0000-0001-8722-9470, Vincent Dumont https://orcid.org/0000-0002-4718-1051, Chung-Chi Lee, Ana Catarina Leite https://orcid.org/0000-0001-8361-6684, Katarzyna Leszczyńska, Jochen Liske https://orcid.org/0000-0001-7542-2927, Konrad Marosek https://orcid.org/0000-0002-5681-8245, Carlos J. A. P. Martins https://orcid.org/0000-0002-4886-9261, Dinko Milaković https://orcid.org/0000-0001-6283-4041, Paolo Molaro https://orcid.org/0000-0002-0571-4163, and Luca Pasquini https://orcid.org/0000-0001-7517-8274 Science Advances 24 Apr 2020 Vol 6, Issue 17 DOI: 10.1126/sciadv.aay9672 3,952 10 Metrics Total downloads3,952

Four direct measurements...;Michael R. Wilczynska et al.

Abstract:
Observations of the redshift z = 7.085 quasar J1120+0641 are used to search for variations of the fine structure constant, , over the redshift range 5.5 to 7.1. Observations at z = 7.1 probe the physics of the universe at only 0.8 billion years old. These are the most distant direct measurements of α to date and the first measurements using a near-IR spectrograph. A new AI analysis method is employed. Four measurements from the X-shooter spectrograph on the Very Large Telescope (VLT) constrain changes in a relative to the terrestrial value ($\alpha 0$).

abstract continued

The weighted mean electromagnetic force in this location in the universe deviates from the terrestrial value by $\Delta\alpha/\alpha = (\alpha_z - \alpha_0)/\alpha_0 = (-2.18 \pm 7.27) \times 10^{-5}$, consistent with no temporal change. Combining these measurements with existing data, we find a spatial variation is preferred over a no-variation model at the 3.9σ level.

A Model of Varying Fine Structure Constant and Varying Speed of Light J. W. Moffat

The recent evidence for a cosmological evolution of the fine structure constant $\alpha = e^2/(\hbar c)$ found from an analysis of absorption systems in the spectra of distant quasars, is modelled by a cosmological scenario in which it is assumed that only the speed of light varies. The model fits the spectral line data and can also lead to a solution of the initial value problems in cosmology. Comments: 8 pages, 1 figure, Latex file. Minor changes in notation. References added Subjects: Astrophysics (astro-ph); General Relativity and Quantum Cosmology (gr-qc); High Energy Physics - Phenomenology (hep-ph); High Energy Physics - Theory (hep-th) Cite as: arXiv:astro-ph/0109350 (or arXiv:astro-ph/0109350v2 for this version) https://doi.org/10.48550/arXiv.astro-ph/0109350