Entropy growth in the early universe , DM models , with a nod to the lithium problem

(very abbreviated version, 9 pages vs 107 pages)

(Why the quark-gluon model is not the best analogy)

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with material from Rencontres De Moriond, 2009 added

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Overall view, does DM get perturbed via non Gaussian perturbations ?

- **As presented in COMO Italy in July 2009 by Dr. Sabino Matarrese. Our discussion puts up candidates for**
- $f_{NL} \equiv$ **non –Gaussian perturbations, <u>we suggest what they , the perturbations, should be:</u>**

- **Note** $\Phi_L \equiv$ **linear Gaussian Gravitational potential**

- **DM perturbations are from the overall gravitational potential** $\Phi \equiv \Phi_L + f_{NL} \cdot \left[\Phi_L^2 + \left\langle \Phi_L^2 \right\rangle \right] + g_{NL} \cdot \Phi_L^3$
- **DM perturbed by**

$$\delta \equiv -\left[\frac{3}{2} \cdot \Omega_m \cdot H^2 \right]^{-1} \cdot \nabla^2 \Phi$$

Below is a link to the presentation as given in chonquing, Oct 2008.

- **http://sites.google.com/site/abeckwithdocuments/**
- **Down load the following PDF as given**

- **Chongquing - tabulated results 1a.pdf**

- **We will present a question about infinite statistics as compared to Glinka's version of graviton quantum gas involving the Wheeler De Witt equation directly**
- **Ng's quantum infinite statistics**

- **Question1** : Is each "particle count unit" as brought up by Ng, equivalent to a brane-antibrane unit in brane treatments of entropy?

- **Question 2** : Is $\Delta S \approx \Delta N_{gravitons}$

Infinite Quantum statistics. Start with

$$Z_N \sim \left(\frac{1}{N!}\right)\cdot\left(\frac{V}{\lambda^3}\right)^N$$

$$S \approx N \cdot \left(\log\left[V/N\lambda^3\right] + 5/2\right)$$

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$$V \approx R_H^3 \approx \lambda^3$$

We wish to understand the linkage between dark matter and gravitons

To consider just that, we look at the "size" of the nucleation space, V

DM. V for nucleation is HUGE. Graviton space V for nucleation is tiny , well inside inflation/ Therefore, the log factor drops OUT of entropy S if V chosen properly for both 1 and 2. For small V, then

$$\Delta S \approx \Delta N_{gravitons}$$

Some considerations about the partition function

Glinka (2007): if we identify $$\Omega = \frac{1}{2|u|^2 - 1}$$

- as a partition function (with u part of a Bogoliubov transformation) due to a graviton-quintessence gas, to get information theory-based entropy $S \equiv \ln \Omega$

1. Derivation by Glinka explicitly uses the Wheeler De Witt equation
2. 2. Is there in any sense a linkage of Wheeler De Witt equation with String theory results ?

PROBLEM TO CONSIDER:

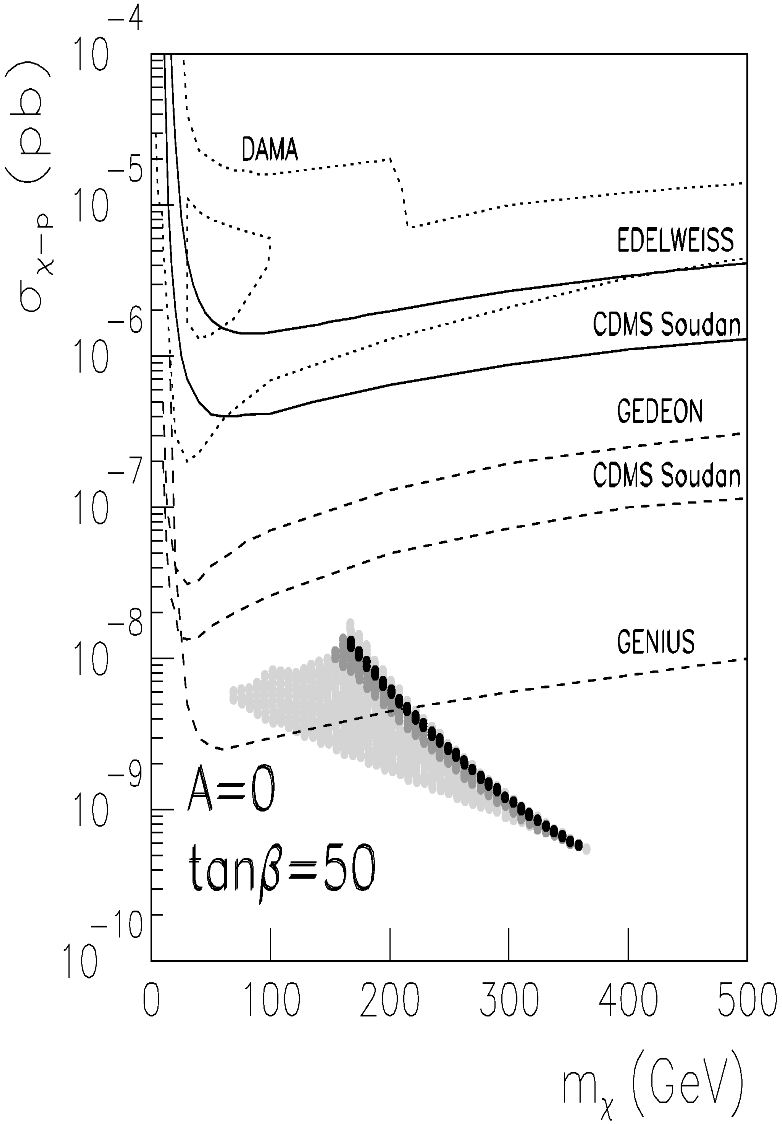
Ng's result quantum counting algorithm is a **STRING theory** result.Glinka is **Wheeler De Witt equation**. **Equivalent ?**

Questions to raise.

Can we make a linkage between Glinka's quantum gas argument, and a small space version/ application of Ng's Quantum infinite statistics ?

In addition, if the quantum graviton gas is correct, can we model emergent structure of gravity via linkage between Ng particle count, and Q.G.G argument?

Issue, detection vs assumed mass of the DM



What is known

Experimental constraints:

-- masses of the Higgs and superpartners,

e.g. ***mh >***114 GeV

$\sigma\big|_{Neutralino-DM}$ < 3×10^-8 pb

Supposition to investigate consider a clump model of DM, as a profile density

- as given by **<u>Berezinsky, Dokuchaev, and Eroshenko</u>,** there is a power law for clumps of DM given, for galactic structure
- using
- $\tilde{\rho}$ as the mean clump density,

  R as mean radius of a clump , and r is spatial regions within the DM halo

- and

  $$\beta \cong 1.8 - 2.0$$

- as a power law coefficient. This could be for MACHOS, which usually are ruled out via gravitational lensing. We are asking if the DM clump is composed of neutralinos. This would be a way of inferring an observational way of confirming

$$\rho_{\text{int}}(r) \equiv \frac{3-\beta}{\beta} \cdot \tilde{\rho} \cdot \left(\frac{r}{R}\right)^{-\beta}$$

Known

- Neutralinos with masses **≈ (10-400) GeV** can be obtained within the reach of detectors. This may be sutiable for DM
- Can we use this to confirm-falsify the Ng hypothesis as given in slide 3 ?
- Can the neutralino candidates be part of the DM clumping as given in slide 7 ?

Open question?

- If a certain number of neutralinos of mass of at least 28 to 100 GeV is produced, as implied by G. Belanger (2004), the following needs to be investigated:

- Is there roughly a one-to-one correspondence between gravitinos, neutralinos , and relic gravitons, leading to in the first 1000 seconds ? $\Delta S \approx \Delta N_{gravitons} \approx 10^{20}$

And if true, are there enough gravitinos and neutralinos to account for Jedamzik's (2008) data, indicating suppression of Lithium 6 and 7?