QGP color breaking in the quantum shifted Squark → quark + Goldstino vertex

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The color broken QGP state in the Big Bang explains the near infinite energy and the mass of the universe. The break of confinement gives infinite potential energy for the not white state. If a lone color charge disappears today, the whole universe would turn into a not white QGP again, like 10^{10} years ago in the Big Bang.
The bosonical SUSY propagator contains a measurable quantum leap. The leap nature of SUSY transformations appears in the squark decay $\tilde{q} \rightarrow \mathbf{G} + \mathbf{q}$ what should break the color. In the boson -> Goldstino + fermion vertex the Grassman space changes as quanta and the outgoing propagators become determined for a discrete time, while they can not interact, like to the teleportation. This explanation hides the Goldstone fermion, as a not observable dark matter and locally breaks the energy. In the last chapter I compare the new physical properties with the observations (not observed dark matter, LSP, baryon number breaking, mass of the Universe, black holes, Hubble constant, flatness, SUGRA).

My theory does not allow supersymmetric QGP in flat space time, where the Goldstino can vanish. I think this theory is consistent with the observations, except assumed cosmic ray spectra[1]. So I explain the cosmic rays with space dust and not with protons and nuclei.
In ref. 1 I show that the detection methods (by balloon and ground array detectors) can not differ the 10^{20} eV nuclei or the TeV photons from the cosmic dust.
Another articles says that the maximum and length of air shower is different by dust and nuclei, but ref. 12 made a Aires Monte Carlo simulation, and get that „extensive dust grain air showers must yet be regarded as highly speculative but they cannot be completely ruled out. It has long been known that small solid particles (or dust grains) may be accelerated effectively at strong collisionless shock waves – popularly in supernovae. Grains are unstable with respect to the development of a fracture [12]. On the one hand, subrelativistic dust grains disintegrate in collisions with heavy nuclei of the interstellar gas. On the other hand, electrical stress induced by the photoelectric effect in the light field of the Sun results in the mechanical disruption and subdivision of relativistic grains.
The total number of muons produced by dust showers (the superposition of n individual nucleons) comparing to proton showers:

$$N_{\mu}^{Dust} = n^{0,15} N_{\mu}^{proton} = O(1-20) N_{\mu}^{proton}$$

The muon number in showers differs with a 1-20 constant.

The dangerous cause of Big Bang could be reproducible at the LHC, because it reaches new high energies in flat space-time, where the SUSY quantum leap (teleportation) is measurable. I aim to write a short and interesting summary; the full deduction of equations is found in my article [2]. The 4 part of this article: SUSY, QCD, re Big Bang, observations.

The superparticle disappearance and the SUSY propagator

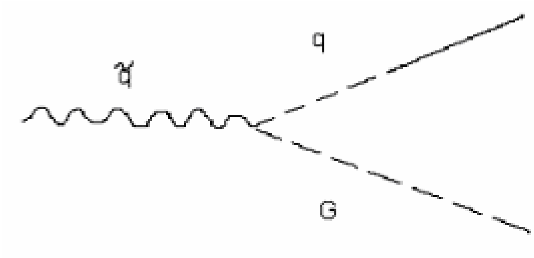
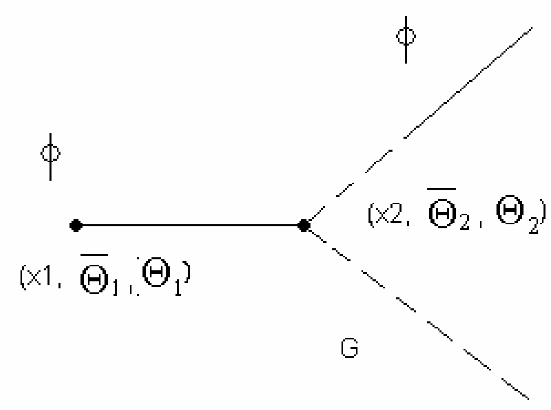


Fig.1.

Local color breaking (quark disappearance) in the squark decay. G is the Goldstone fermion, $\widetilde{q}$ is the scalarquark. The dashed line can't interact for a discrete time.

The dashed line scalarquark (and quark) superfield propagator contains e^{ipa}, space shift in the literatures: [2, 3, 7, 11]:

$$\langle 0 | T\{\Phi(x_1,\Theta_1,\overline{\Theta_1})\Phi^+(x_2,\Theta_2,\overline{\Theta_2})\} | 0\rangle = e^{ip_\mu a^\mu}\Delta_F(x_1-x_2) = \\ = \exp[i(\Theta_1\sigma^m\overline{\Theta}_1 + \Theta_2\sigma^m\overline{\Theta}_2 - 2\Theta_1\sigma^m\overline{\Theta_2})\partial_m]\Delta_F(x_1-x_2) \tag{1}$$



$$\Theta_2 = \Theta_1 + G, \_\overline{\Theta}_2 = \overline{\Theta}_1 + \overline{G}$$

Fig. 2.

The Grassman coordinate changes in the supervertex by the Goldstino (Grassman shift operator), so eq. 1 is quantum shifted. The disappeared quark breaks the color for a discrete time; the quark can't interact with ghosts and gluons. The disappeared quark changes the hadron color from white to red and breaks the confinement. In the chain reaction (gluon flow) the red quark interacts with infinite amount of charges, cause a cosmic catastrophe.

The [3, 7, 11] literatures assumed a continuous shift and infinitesimal ε Grassman shift, but ε=G is the non infinitesimal Goldstino particle (SUSY and EW breaking theory) [3].

If I decompose the $+a^\mu$ (ε), then I didn't get $\sum_{i=1}^{\infty}\delta_{a_i}$:

$$+ap=\left[\varepsilon\overline{Q},\overline{\varepsilon}Q\right]_{-}=\left[\sum_{i=1}^{\infty}\varepsilon_i\overline{Q},\sum_{j=1}^{\infty}\overline{\varepsilon}_jQ\right]_{-}=\sum_{i,j=1}^{\infty}\left[\varepsilon_i\overline{Q},\overline{\varepsilon}_jQ\right]_{-}\neq\sum_{i=1}^{\infty}\left[\varepsilon_i\overline{Q},\overline{\varepsilon}_iQ\right]_{-}=p\sum_{i=1}^{\infty}\delta_{a_i}$$

The commutator and the sum are not commutating.
The product of two conjugated super charges is Hermitian and measurable, because the impulse is measureable:

$$\{Q_\alpha,\overline{Q}_\beta\}_{+}\sim 2\sigma_{\alpha\beta}{}^{\mu}p_\mu \qquad (3)$$

In general the $+a^\mu$ discrete symmetries break the invariance laws, and $\sum_{i=1}^{\infty}\delta_{a_i}$ continuous symmetries keep the invariance laws.
So eq. 1. scalarquark superfield propagator contains a discrete leap.

Between the points: (x, $\Theta,\overline{\Theta}$) and ($x+\overline{\varepsilon}2i\sigma\varepsilon$, $\Theta+\varepsilon,\overline{\Theta}+\overline{\varepsilon}$) the propagator contains a space-time jump phase:

$$\left\langle 0\left|T\{\Phi(x,\Theta,\overline{\Theta})(1+2i[\varepsilon\overline{Q},\overline{\varepsilon}Q])\Phi^{+}(x,\Theta,\overline{\Theta})\}\right|0\right\rangle=$$
$$=\exp[2i(\varepsilon\sigma^m\overline{\varepsilon}+\Theta\sigma^m\overline{\varepsilon}-2\varepsilon\sigma^m\overline{\Theta})\partial_m]\Delta_F(\overline{\varepsilon}2i\sigma\varepsilon)\xrightarrow{\Theta=0,\varepsilon=G} \qquad (1.1)$$
$$\exp[ia^m p_m]\Delta_F(x,x+a)$$

We get similar discrete space-time translation, like in the definition of SUSY. The propagator is determined for a^0 discrete time, it can't interact, hasn't mass, so the particle disappear in the interval between (x, $\Theta,\overline{\Theta}$) and ($x+\overline{\varepsilon}2i\sigma\varepsilon$, $\Theta+\varepsilon,\overline{\Theta}+\overline{\varepsilon}$). The path depends on discrete spin transformations and does not depend on the time.

$$\Phi(x_1,t_1)=\mathrm{e}^{\mathrm{i}p_\mu a^\mu}\Phi(x_0,t_0)=\frac{A}{\sqrt{2}}\mathrm{e}^{\mathrm{i}p_\mu(a^\mu+x^\mu)}=\frac{A}{\sqrt{2}}\mathrm{e}^{\mathrm{i}p_\mu(\overline{G}2i\sigma^\mu G+x_0{}^\mu)} \qquad (4)$$

$$\partial_t\Phi(x_1,t_1)=\frac{A}{\sqrt{2}}\mathrm{i}p_\mu\mathrm{e}^{\mathrm{i}p_\mu(\overline{G}2i\sigma^\mu G+x_0{}^\mu)}\partial_t(\overline{G}2i\sigma^\mu G+x_0{}^\mu)=0 \qquad (4.1)$$

G and x_0 is constant or discrete.

The propagator of self adjoint gauge boson **vector** superfield ($V=V^+$) like gluon (and gluino) has not quantum leap[11]:

$$\left\langle 0\left|T\{V(x_1,\Theta_1,\overline{\Theta_1})V(x_2,\Theta_2,\overline{\Theta_2})\}\right|0\right\rangle=-\frac{1}{8\pi^2}\Delta_F(x_2-x_1)\delta(\Theta_1-\Theta_2)$$

From the super Yang-Mills the gluons can't disappear, the gluino can't break the color.

The Goldstino-fermion-boson vertex

I want to create a Goldstino to shift the Grassman space:
Ref. [9] shows that the **g→G+** $\widetilde{g}$ and **q→ G +** $\widetilde{q}$ vertices exist. The first description is the

derivate coupling of Goldstino and super current (like to $p^{+} \to n^{0} + \pi^{+}$):

$$L_{derived}^{iteraction} = \frac{1}{F} \partial_{\mu} G^{a} J_{a}^{\mu} + h.c. \qquad (5)$$

where G denotes the Goldstino, F is the decay constant, J is the supercurrent. This Lagrangian is equivalent to the following nonderivate Goldstino interaction Lagrange, where the Goldberg-Treiman relation fixes the goldstino-boson-fermion coupling to the mass difference of boson and fermion[9].
The following non-derived interacting Lagrangian describe the
g→G + $\widetilde{g}$ and **q→ G +** $\widetilde{q}$ processes:

$$L_{ND}^{sQCD} = \frac{m_{\widetilde{q}}^{2} - m_{q}^{2}}{F} G q \widetilde{q}^{*} + \frac{i m_{\widetilde{g}}}{\sqrt{2} F} G \sigma^{\mu\nu} \widetilde{g}^{a} F_{\mu\nu}^{a} - \frac{g_S m_{\widetilde{g}}}{\sqrt{2} F} G \widetilde{g}^{a} \widetilde{q}_{i}^{*} T_{ij}^{a} \widetilde{q}_{j}$$

where $\widetilde{q}$ is the squark, q_i represents the quark, $\widetilde{g}$ is a gluino, G is the Goldstino, g_S is gauge coupling and T_{ij}^{a} is the generator, $F_{\mu\nu}^{a}$ is the gluon energy momentum tensor.

The Goldstino mass is given by the selfinteraction: $L = \frac{g}{4} G^{4}$ (7)

This selfinteraction quantum shifts the Goldstino, and so G disappears forever in space-time. The Goldstino propagates in Grassman space and non-propagate in space-time.

The QCD response to the local color breaking of SUSY

If a lone color charge disappears today, the whole universe would turn into a not white QGP again, like 10^{10} years ago in the Big Bang. I examined the infinite color potential of the color charge breaking. The color antiscreening (**quark confinement**) forbids this escape of quarks and gluons from the hadrons, and forbids the existence of free quarks.

The static quark potential is linear on large distance [1, 2, 5]:

$$V(r) = -k(\alpha_S)\ r \qquad (8)$$

The "k" constant depends on the $\alpha_S(\Delta q)$ strong coupling constant, and $\alpha_S(\Delta q)$ depends on the impulse difference[1] (running coupling constant):

$$k(\alpha_S) = \frac{3}{5} \alpha_S(q) M_{gap}^{2}(q) \qquad (9)$$

M_{gap} is the gluon mass gap in the confined hadron, it is in relationship with the effective range of gluon. The linear (spring) potential bounds the quarks and orders the gluons in narrow flux tubes.

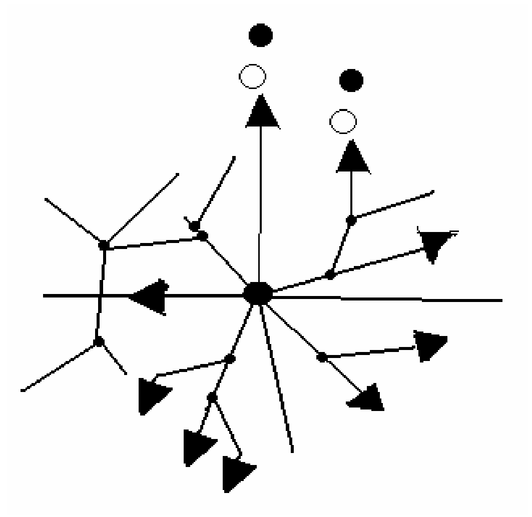


Fig.3.
The central extra color charge creates gluons ⟶, charges ● ○ and with the gluons attracts other hadrons

If we create an extra quark color, the non singlet potential energy in (8) would be around infinity, it is the first definition of quark confinement. The "spring" potential connects **all** quarks. The infinite bound energy *approach* is the integral of the "k" number.

$$E = \sum_{j}^{Sources} \sum_{i}^{quarks} \int_{0}^{r_{ij}} dr(-k(\alpha_S(q^2{}_{ij}))) \to -\infty \qquad (2.2)$$

In QGP k=0 means the free plasma state. So we get again a very dense, hot and charged QGP universe. k=0 is a compulsion, because k>0 rises the energy. This extra color charge polarizes all other hadrons and accelerate them until $k(\alpha_S(q^2)) \to 0$. The color breaking would be cosmic catastrophe.

For example: a red quark attracts the blue and green quarks of any nucleon and repulses the red quark of the nucleons. But the quark color charge is random in the hadrons, so this potential attracts with 2/3-1/3 force the hadrons.

The color restoration dissolves the infinite bound energy. The globally white QGP gas can expand and cool:

$$p = \alpha * n^{4/3} - \frac{1}{3} k * n^{2/3} \qquad (10)$$

The re- Big Bang process:

1. The quantum leap breaks the charge and energy for a discrete time.
2. The free gluons expand like the photon ball, connect all quarks and accelerate them. The not white state has got infinite energy. The total color becomes a random parameter, because more and more quarks disappear. In the accelerated world the particles become massless in EW restoration, the vev. of Higgs boson vanish. The universe contracts into a color QGP sphere.
3. The baryon genesis (exponential B number grow) and matter anti matter breaking needs long time (>sec) and therefore not white state. Because the sphaleron and GUT baryon number breaking rates are slow[8]. The time of doubling of the Baryon number

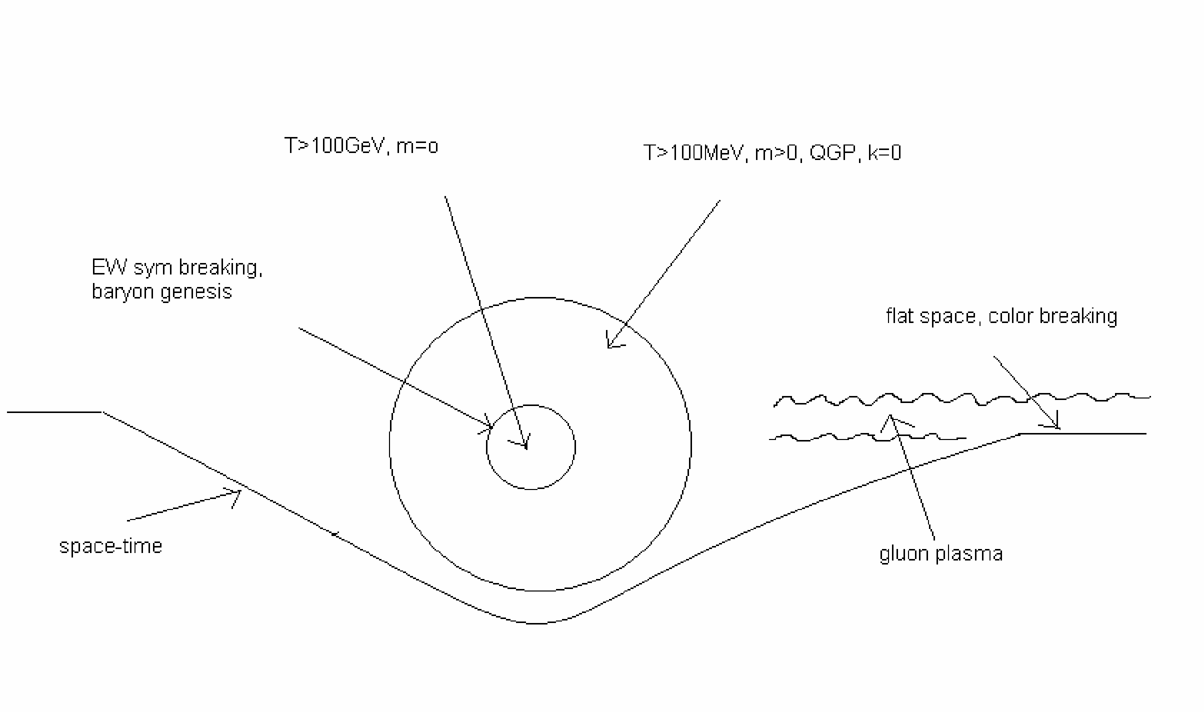
on high temperature is about t_{2x} ~second. So in the standard Big Bang theory, where nothing was before the Big Bang, and the SSB of EW hold on 3 sec:

$$B = B_0 2^{\frac{t}{t_{2x}}} = ?0 * 2^3 ?$$

$$1/t_{sph} = \kappa\alpha_W^4 T \ll 1/t_{GUT} = \kappa\alpha_{GUT}^2 T \qquad (11)$$

It is easy to heat the system, but how can it explode and cool?

4. The plasma is able to explode, if the color restore to white (noise). The restoration is solvable in strongly curved space-time, because the quantum shift in SUGRA becomes non- hermitian. The squarks can't more disappear.



5. The inflation begins if all quark are in the in the curved space-time. In curved space-time the gravitino get the role of Goldstino, there is not Grassman shift.
6. If the plasma can cool down in curved space-time, then in the flat Universe wouldn't contain squark. And the inflation can continue.
7. 6 is a critical requirement, need equithermal particles in the expansion.
   The temperature: $T \sim 1/R^3$ and the metric $g \sim m/R$.
   Where the curvature became negligible $g \sim 0$, there the radius of flat space is large.
   T could be smaller if m is bigger:

$$0 \approx g = \frac{m}{R \longrightarrow \infty} \quad \text{and} \quad T \xrightarrow{space \to flat} T_{confinement}$$

Consistence with the observations

-If a vertex contains Goldstino, then there are quantum shifted outgoing legs.

- If the lightest SUSY particle is the Goldstino it will *vanish forever,* because with self interactions we can add infinite amount of time shifts $G(t+\sum a_0)$. Some physicists assumed that the LSP has a low cross-section like to the neutrino, but the LSP mass is billion times bigger then the neutrino mass. Goldstino is a not observable trace of the Big Bang, like to **dark matter.**
- Only the gravitational interaction of Goldstino doesn't give time shifts. Dark matter gravitates continuously between two disappearances. But the gravitating time is very short. If previous Big Bangs disperse the dark matter in a large volume, the Hubble expansion could be faster: more dark matter is out of the Universe, then inside the observable Universe. (Dark matter gravitational interaction is weaker then other matters gravitation, so it can expand super freely.)
- The *cosmic ray* energy (10^{12}-10^{20} eV/amu) is overestimated, so nowhere in the Universe may be SUSY particle. Cosmic ray detectors can't differ the E=1000 TeV Z=8 oxygen ion and E=1000 TeV Z=8 M=10^{10} amu ionized **space dust**. Because the ionization is independent from the mass! The initial cosmic dust has Z=10^6 e^- negative charge, what is easy to accelerate to E=1000 TeV with the 3μG interstellar magnetic field, then the dust lose the negative charges with the interaction with the cosmic matter. Dust can't be very positive. The dust has Z=1-14 positive charge, what can explain the observed cosmic ray charge spectrum and the origin of the 1000 TeV ray. You can find more about balloon and ground air shower experiments in ref 1.
- In the nature isn't supersymmetric QGP (nor by supernovas nor by star collisions, by black holes SUSY particles have not quantum shift)
- In the near of the black holes the space time is strongly curved $[x_1, x_2] \neq 0$.
In SUGRA the double SUSY transformation for vector superfield changes to:

$$(\delta_\eta \delta_\varepsilon - \delta_\varepsilon \delta_\eta) V^A = V^D \varepsilon^C \eta^B R^A_{BCD} - \varepsilon^C \eta^B T^D_{BC} D_D V^A \quad (12)$$

These equations are more complicated because new gravitational fields appear in eq. 12. The c**urved SUSY shift isn't hermitian operator.** The covariant derivate and so the double SUSY transformation is not measurable in SUGRA[3].

- Fermions and bosons have equal mass m=0 during the disappeared translation, this is the same mass multiplet of unbroken SUSY. Fermions and bosons have equal occupation of states because T=0. (But before and after the disappearance these particles have high temperature.)
- With the nowadays measured Hubble constant we can't differ the Universe will expand forever, or will collapse. But the accelerated expansion assumes the dark matter and means forever expansion. The viewed kinetical energy is about the gravitation potential energy.
Classically: $E_{kin} \approx -E_{grav}$ $\quad E_{universe} = E_{kin} + E_{mass} + E_{grav} \approx E_{mass} \approx \infty$
This condition is ideal to cool down the plasma in strongly curved space, so all squark can decay without quantum shift.
-The slow QGP collapse and inflation has enough time to reach the thermal equilibrium state, so the matter density and γ background is homogeneous. Slow mean more then 3 sec.
- Matter existed before the Big Bang. B (baryon number) increase in high energy phase transformations (previous Big Bangs), and decrease in Black holes.

Ref.:
[1] http://www.geocities.com/iczovek/TeVdetectors.pdf;
Email: ufo123@freemail.hu
[2] My article: http://arxiv.org/abs/hep-ph/0510086
[3] J. Wess and J. Bagger: Supersymmetry and Supergravity 64. p.
[4] J. A. Casas and C. Munoz: Some Implications of Charge and Color Breaking in the MSSM hep-ph/9606212
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[7] Masato Arai, Masud Chaichian, Kazuhiko Nishijima, Anca Tureanu: Non-anticommutative Supersymmetric Field Theory and Quantum Shift, hep-th/0604029.
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[11] Luigi Genovese PhD dissertation, Conformal invariance in quantum field theory
[12] Luis A. Anchordoqui, Cosmic dust grains strike again, astro-ph/9911044v2