QGP color breaking with the help of 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 physicists do not use the bosonical superfield propagator to describe the superparticles, everyone calculate with the Feynman graphs. But the bosonical SUSY propagator contains a measurable quantum leap. The leap nature of SUSY transformations appears in the squark decay $\widetilde{q} \rightarrow$ **G + q** what should break the color. The particles are shifted in the flat space-time by Grassman space shift. *In the boson -> Goldstino + fermion vertex the Grassman space changes as quanta and the outgoing propagators become determined for a discrete time, while they cannot interact,* like to the teleportation. This explanation hides the Goldstone fermion, as a not observable dark matter and locally breaks the energy.

The dangerous cause of Big Bang will be reproducible at the LHC, if it will produce free squarks. This is one more reason for searching this theory. In the last chapter I compare the new physical properties with the observations (not observed dark matter and LSP, baryon number breaking, mass of the Universe, black holes, Hubble constant, flatness, SUGRA). I think this theory is consistent with the observations, except assumed cosmic ray spectra[1].
If the (large scale) asymptotic freedom of squarks will not effective in LHC experiment, then many particles should disappear in the experiment (through Goldstino space leap), the color will not break, but the energy will break.

At first I introduce the relevant interactions with graphs, and later I prove them:

Fig.1. Nowadays the quarks are connected with thin gluon flux tubes

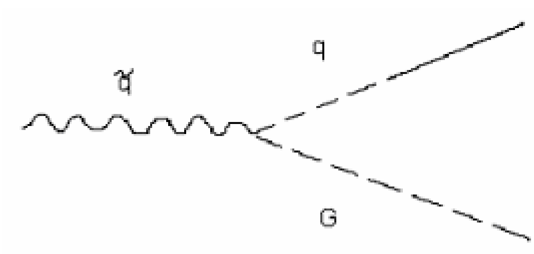
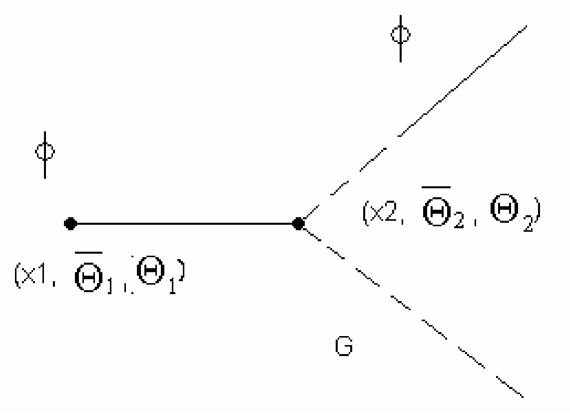


Fig.2. Local color breaking (quark disappearance) in the squark decay. G is the Goldstone fermion, $\widetilde{q}$ is the squark. The dashed line can't interact for a discrete time.

The dashed line q superfield propagator contains e^{ipa}, space shift:

$$\langle 0 | T\{\Phi(x_1,\Theta_1,\overline{\Theta_1})\Phi^+(x_2,\Theta_2,\overline{\Theta_2})\} | 0\rangle =$$
$$= -i\exp[i(\Theta_1\sigma^m\overline{\Theta}_1 + \Theta_2\sigma^m\overline{\Theta}_2 - 2\Theta_1\sigma^m\overline{\Theta_2})\partial_m]\Delta_F(x_1 - x_2) \quad (8)$$



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

The Grassman space changes in the supervertex by the Goldstino, so the outgoing ϕ superfield propagator is quantum shifted.

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. (Gluons and quarks are confined only if they bound to FP ghost[10] with BRS transformation). The disappeared quark breaks the color for a discrete time; it can't interact with ghosts and gluons.

The superparticle disappearance in the SUSY propagator

Only the product of two conjugated super charges is Hermitian and measurable. The $\{Q_\alpha, \overline{Q}_\beta\}_+ \sim 2\sigma_{\alpha\beta}{}^\mu p_\mu$ anticommutator is always Hermitian, so this two Q operators act at once in time. I inserted these measurable $\{Q, \overline{Q}\}_+$ spinor charges in the Goldstino vertex like as coupling constants (charges) are in SM vertices $\rightarrow ge^{i\varepsilon\overline{Q}+i\overline{\varepsilon}Q}$.

The product in the SUSY group:

$$e^{i\varepsilon\overline{Q}+i\overline{\varepsilon}Q} e^{i(\Theta\overline{Q}+\overline{\Theta}Q+x^\mu p_\mu)} = e^{i[(x^\mu+\overline{\varepsilon}2i\sigma^\mu\varepsilon)p_\mu+(\Theta+\varepsilon)\overline{Q}+(\overline{\Theta}+\overline{\varepsilon})Q]} \quad 3.$$

The definition of two infinitesimal SUSY transformations is:

$$[\delta_1, \delta_2]\Psi = \left[\varepsilon_1\overline{Q}, \overline{\varepsilon_2 Q}\right]_- \Psi = \overline{\varepsilon}_2 2i\sigma^\mu\varepsilon_1\partial_\mu\Psi = a^\mu\partial_\mu\Psi = \delta_a\Psi \quad (4)$$

The space-time translation of the fermions and bosons is the same:

$$a^\mu = \overline{\varepsilon}_2 2i\sigma^\mu\varepsilon_1 \quad (4.a)$$

If $\varepsilon_2 = \varepsilon_1$, then $a^\mu = \overline{\varepsilon}2i\sigma^\mu\varepsilon \geq 0$ is positive current, $a^0 > 0$ is causal.

On the ($x^{0,1,2,3}$, $\Theta^{1,2}$, $\overline{\Theta_{1,2}}$) supersymmetric coordinates the supersymmetric action gives the same translation:

$$\left[\varepsilon_1\overline{Q},\overline{\varepsilon_2}Q\right]_- : (x,\Theta,\overline{\Theta}) = (x+\overline{\varepsilon}2i\sigma\varepsilon, \Theta+\varepsilon_1, \overline{\Theta}+\overline{\varepsilon}_2) \quad (4.b)$$

This quantum shift was written in many text books, but they assumed that it is infinitesimal small. BUT $\left[\varepsilon_1\overline{Q},\overline{\varepsilon_2}Q\right]_-$ is a discrete constant, isn't a continuous translation, is not dissolvable to the sum of measurable infinitesimal $\left[\delta\varepsilon\overline{Q},\delta\overline{\varepsilon}Q\right]_-$ parts.

$\varepsilon=\sum_{i=1}^{\infty}\varepsilon_i$ is a continuous parameter or field. The discrete shift with a^μ:

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

The (measureable) anticommutator of these sums is different from the sum of anticommutators. The decomposition is not measurable. The measurable +a quantum shift should be *discrete leap.*

In general the discrete symmetries break the invariance laws, and continuous symmetries keep the invariance laws, so the quantum leap breaks the invariance laws.

Spontaneous Symmetry Breaking:
As SUSY and SU(2) $_{EW}$ *spontaneous sym. breaking theorem, we can choose the* ε *constant to the Goldstone fermion field,* $\boldsymbol{\varepsilon} = \boldsymbol{G}$. The Goldstino field is the Grassman space shift operator. There is relationship between the electroweak and the supersymmetrical symmetry breaking. And this trend says that SUSY particles appear at maximum 1 TeV mass.
// SUSY is spontaneously broken (positive VEV) in SUGRA, the Goldstino is mixed with gravitino. Gravitino gets the role of Goldstino and the quantum leap vanishes. //

The $\Phi\Phi^+$ superfield propagator

The $e^{i\varepsilon\overline{Q}+i\overline{\varepsilon}Q}$ phase of SUSY space-time shift appears in the propagator and vertex, because I can put this phase in the supersymmetric Lagrange density and $\delta_\varepsilon L=0$.
I get the vertex from L_{int} and the propagator from the free particle L_0.

The $\Phi\Phi^+$ superfield propagator allows $\Theta\neq\Theta'$ and allows translations where the SUSY particle doesn't "propagate" classically. Wess obtained the bosonical superfield propagator from the free Wess Lagrangian[3]: $\phi=A+\sqrt{2}\Theta\psi+\Theta\Theta F$

$$L=\int(\phi^+\phi+\frac{m}{2}\phi\phi\delta(\overline{\Theta})+\frac{m^*}{2}\phi^+\phi^+\delta(\Theta))d^2\Theta d^2\overline{\Theta}=$$

$$A^*\partial_m^2A+i\partial_m\overline{\psi\sigma^m}\psi+F^*F+m(AF+A^*F^*-\frac{1}{2}\psi\psi-\frac{1}{2}\overline{\psi\psi})$$

We get five non vanishing components of two point functions:

$$\langle 0|T\{FF^*\}|0\rangle = \frac{i\partial_m^2}{\partial_m^2 - m^2} \qquad \langle 0|T\{AF\}|0\rangle + hc = \frac{-im}{\partial_m^2 - m^2}$$

$$\langle 0|T\{AA^*\}|0\rangle = \frac{i}{\partial_m^2 - m^2} \qquad \langle 0|T\{\psi_\alpha \psi_\alpha\}|0\rangle + hc. = \frac{im\delta_{\alpha\beta}}{\partial_m^2 - m^2}$$

$$\langle 0|T\{\psi_\alpha \overline{\psi}_\beta\}|0\rangle = \frac{\sigma^m_{\alpha\beta}\partial_m}{\partial_m^2 - m^2}$$

The **scalar** superfield propagator and the components of superfield:

$$\langle 0|T\{\Phi(y,\Theta)\Phi^+(y',\Theta')\}|0\rangle = \langle 0|T\{[A(y) + \sqrt{2}\Theta\psi(y) + \Theta\Theta F(y)]\times$$
$$[A^*(y') + \sqrt{2}\overline{\Theta'\psi}(y') + \overline{\Theta'\Theta'}F^*(y')]\}|0\rangle =$$
$$\overline{\Theta'\Theta'}\Theta\Theta\langle 0|T\{FF^*\}|0\rangle + \langle 0|T\{AA^*\}|0\rangle + 2\overline{\Theta'^\beta}\Theta^\alpha\langle 0|T\{\psi_\alpha\overline{\psi}_\beta\}|0\rangle$$

Substitute the components, and use $y = x + i\Theta\sigma\overline{\Theta}$ and $y^+ = x - i\Theta\sigma\overline{\Theta}$, we see that this propagator has the following x, x' dependence:

$$\langle 0|T\{\Phi(x_1,\Theta_1,\overline{\Theta}_1)\Phi^+(x_2,\Theta_2,\overline{\Theta}_2)\}|0\rangle =$$
$$= -i\exp[i(\Theta_1\sigma^m\overline{\Theta}_1 + \Theta_2\sigma^m\overline{\Theta}_2 - 2\Theta_1\sigma^m\overline{\Theta}_2)\partial_m]\Delta_F(x_2 - x_1) \qquad (8)$$

Here we can write the Goldstino field $\Theta_2 = \Theta_1 + \varepsilon$ *ε=G in eq. 8.* The $\Phi\Phi^+$ propagator means that the $\Phi(x_1,\Theta_1,\overline{\Theta}_1)$ annihilator operator vanishes the superfield in the x_1 point, then the Φ^+ creating operator creates the superfield at the point x_2: ($x + \overline{\varepsilon}2i\sigma\varepsilon$, $\Theta + \varepsilon, \overline{\Theta} + \overline{\varepsilon}$).

It is not a continuous propagator, because +a is discrete, the $+a \neq \sum \delta_a$ decomposition is not measurable. 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:

$$\langle 0|T\{\Phi(x,\Theta,\overline{\Theta})(1 + [\varepsilon Q, \overline{\varepsilon Q}])\Phi^+(x,\Theta,\overline{\Theta})\}|0\rangle =$$
$$= -i\exp[i(\varepsilon\sigma^m\overline{\varepsilon} + \Theta\sigma^m\overline{\varepsilon} - \varepsilon\sigma^m\overline{\Theta})\partial_m]\Delta_F(\overline{\varepsilon}2i\sigma\varepsilon) \xrightarrow{\Theta=0} \qquad (9)$$
$$-i\exp[ia^m\partial_m]\Delta_F(x, x+a)$$

We get similar discrete space-time translation, like in the definition of SUSY. It's another proof of the discrete space translation among spin(or) transformations. The propagator become determined for a 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 non continuous 4D particle path is available. It likes to the teleportation, where is not vertex, no information exchange during the teleportation. The mixed state of teleportation is given by the mixed state of sq->q+G superfield. In the vertex point G is an eigen state, and gives space-time shift.

The propagator of self adjoint **vector** superfield ($V=V^+$) has not quantum leap phase[11]:

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

From the super Yang-Mills the gluons can't disappear, the Grassman space of gluino can't change. Also the following superfield two point functions have Dirac delta Grassman dependence:

$$\langle 0|T\{\Phi\Phi\}|0\rangle = \frac{-im\delta(\Theta-\Theta')}{\partial_m^2-m^2}$$ and $$\langle 0|T\{\Phi^+\Phi^+\}|0\rangle = \frac{im\delta(\overline{\Theta}-\overline{\Theta}')}{\partial_m^2-m^2}$$

The Goldstino-fermion-boson vertex

The Wess Zumino Lagrange is invariant to SUSY transformations.

$$L=(\frac{1}{2}\phi T\phi-\frac{m}{2}\phi\phi-\frac{g}{3}\phi\phi\phi)_F=(\frac{1}{2}\phi' T\phi'-\frac{m}{2}\phi'\phi'-\frac{g}{3}\phi'\phi'\phi_2)_F$$
$$\phi'=e^{i\varepsilon\overline{Q}+i\overline{\varepsilon}Q}\phi(y) \tag{5}$$

In general the $\phi(y)$ derivates of eq 5. give the new vertex and the new propagator. Eg.: the gluon-gluino- gluino vertex from the interacting Lagrange:

$$\Gamma_{super}=\frac{\partial^3 L_{\text{int}}}{\partial\phi\partial\phi\partial\phi}=\frac{\partial^3 L'_{\text{int}}}{\partial\phi\partial\phi\partial\phi}=\frac{\partial^3(g\phi'\phi'\phi)}{\partial\phi\partial\phi\partial\phi}\Big|_{components} \tag{6.1}$$

$$\Gamma_{g,\tilde{g}}=g_s f^{abc}\gamma_\mu \tag{6.2}$$

I want to create Goldstino field to shift the Grassman space:
I show that the **g→G+** $\tilde{g}$ and **q→ G +** $\tilde{q}$ vertices exist. The first description is the derivate coupling of Goldstino and super current (like to $p^+\to n^0+\pi^+$):

$$L_{derived}^{\text{int}}=\frac{1}{F}\partial_\mu G^a J_a^\mu+h.c. \tag{7.1}$$

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].

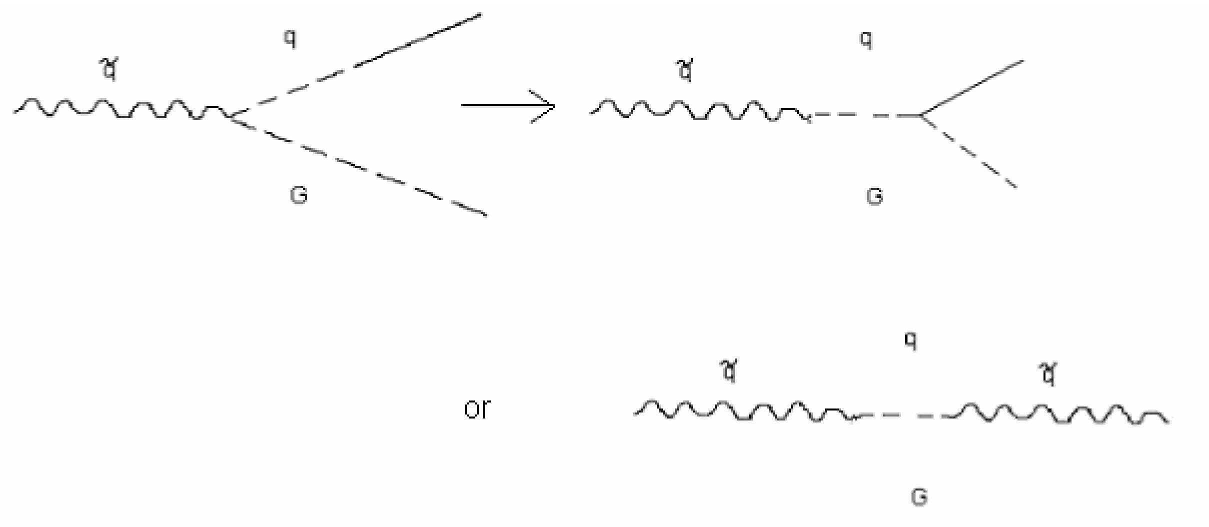
The following non-derived interacting Lagrangian describe the
g→G + $\widetilde{g}$ and **q→ G +** $\widetilde{q}$ processes:

$$L_{ND}^{sQCD} = \frac{m_{\widetilde{q}}^2 - m_q^2}{F} Gq\widetilde{q}* + \frac{im_{\widetilde{g}}}{\sqrt{2}F} G\sigma^{\mu\nu}\widetilde{g}^a F_{\mu\nu}^a - \frac{g_S m_{\widetilde{g}}}{\sqrt{2}F} G\widetilde{g}^a \widetilde{q}_i^* T_{ij}^a \widetilde{q}_j$$

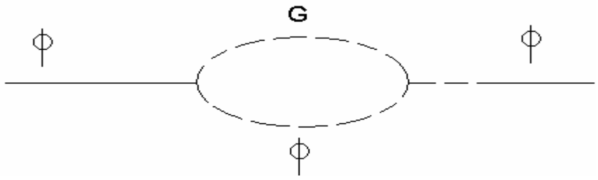
where $\widetilde{q}$ is the squark, q_i represents the quark, $\widetilde{g}$ is a gluino, G is the Goldstino, g_S is gauge coupling and T_{ij}^a is the generator, $F_{\mu\nu}^a$ is the gluon energy momentum tensor.
The new **q→ G +** $\widetilde{q}$ vertex:

$$\Gamma_{q,\widetilde{q},G} = \frac{m_{\widetilde{q}}^2 - m_q^2}{F} \gamma_\mu e^{iG\overline{Q}+i\overline{G}Q} \delta_{i,j} \tag{7.4}$$

The $\widetilde{q}$ **→ G +** q processes with the components of superfield propagator:

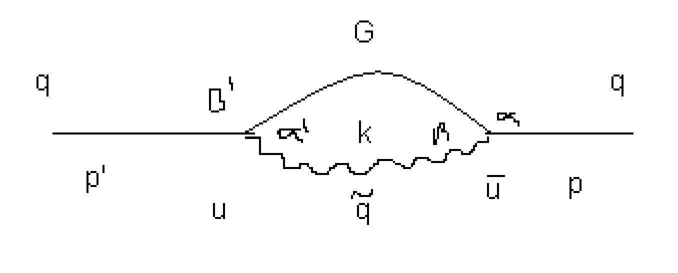


The quantum shift is equal to the boson and fermion, they reappear in the same space-time point, where q can absorb the emitted G.
The teleportation of free quark or superfield:



The dashed line Φ is quantum shifted, so the fermion and scalar components have the same quantum leap.

The scatter matrix of the quark teleportation:



$$S=\frac{\overline{u}(p')}{(2\pi)^{3/2}}\frac{u(p)}{(2\pi)^{3/2}}\int d^4k/(2\pi)^4\,\frac{g_{\mu\nu}(-i)}{k^2-m_{sq}^2}e^{ika}\frac{1}{k_{Gm}\gamma^m-m_G}e^{ik_Ga}$$

$$\{(-i)(2\pi)^4\frac{m_{sq}^2-m_q^2}{F}\gamma_\nu\delta^4(p'-k-k_G)(-i)(2\pi)^4\frac{m_{sq}^2-m_q^2}{F}\gamma_\mu\delta^4(p-k-k_G)\}=$$

$$(\frac{m_{sq}^2-m_q^2}{F})^2(2\pi i)\overline{u}(p')[\frac{1}{(p-k_G)^2-m_{sq}^2}e^{ipa}\frac{1}{k_{Gm}\gamma^m-m_G}]u(p)\delta^4(p-p')$$

The outgoing field is quantum shifted: $\overline{u}(p')e^{ip'a}$. The component field of superfield propagator contain space-time shift. The coupling is strong $g=\frac{m_{sq}^2-m_q^2}{F}\approx 1$, because the mass difference is high. *If the particle energy exceeds the Goldstone fermion mass, then the quantum leap will work.*

$$e^{ipa}=e^{iG\overline{Q}+i\overline{G}Q}\propto 1+\overline{G}2\sigma^\mu G\partial_\mu+...=1+2j_G^\mu\partial_\mu \qquad (7.5)$$

The power series contains Goldstino current. The Goldstino mass is given by the selfinteraction: $L=\frac{g}{4}G^4$

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

The $e^{iG\overline{Q}+i\overline{G}Q}$ positive time shift creates the outgoing superfield later.

Note: simple Q is an hermitian operator only on the Goldstino Hilbert space.

$$\delta_\varepsilon G=\varepsilon/\kappa+i\kappa(\varepsilon\sigma^m\overline{G}-G\sigma^m\overline{\varepsilon})\partial_m G$$

The Goldstino is shifted by ε/κ and quantum shifted by $a^m=i\kappa(\varepsilon\sigma^m\overline{G}-G\sigma^m\overline{\varepsilon})$.

Hopes in the concurrent vertices before the sq → q + LSP vertex

Missing impulse in the gluino→gluon + LSP vertex

Would be a surprise, when the Lightest Supersymmetrical Particle would not be detectable in the gluino decay? Missing energy and missing impulse would show the creation of LSP. As in the beta decay the not detectable neutrino carries the missing impulse. The difference between LSP and neutrino is the mass and assumed cross section: $m_{LSP} \approx 10^{11} m_{\nu^0}$ and $\sigma_{LSP} >> \sigma_{\nu^0}$. And the LSP really vanish if LSP=Goldstino. The LSP should be everywhere from the remnant of Big Bang. The LSP is infinite stable particle, can't decay. But LSP was not detected until now.

The difference between gluino → gluon + LSP and squark → quark + LSP decay is that the first interaction doesn't break the color charge invariance and the second break both energy and charge. The gluon *vector* superfield propagator hasn't quantum leap, but the *scalar*quark superfield propagator has quantum leap. The disappeared quark color has infinite energy and makes a new Big Bang. **LHC has to stop the further research for sq after the detection of missing impulse in gluino decay.**

The sq decay can be: sq → q + LSP or sq → q + ξ^0 and ξ^0 → particle + LSP. The end of decay is LSP. The ξ^0 neutralino would make the decay safe, because a neutral particle would disappear. But the sq → q + LSP vertex exist, can break the color:

1. The *scalar* bosonical superfield propagator contains e^{ipa} quantum leap:

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

Here we write the Grassman space change in the vertex: $\Theta_2 = G\_and\_\Theta_1 = 0$

we get $a^\mu = \overline{G}i\sigma^\mu G \geq 0$ leap.

On the ($x^{0,1,2,3}$, $\Theta^{1,2}$, $\overline{\Theta_{1,2}}$) supersymmetric coordinates the supersymmetric action gives the same leap:

$$\left[\varepsilon_1\overline{Q}, \varepsilon_2\overline{Q}\right]_- : (x,\Theta,\overline{\Theta}) = (x + \overline{\varepsilon}2i\sigma\varepsilon, \Theta + \varepsilon_1, \overline{\Theta} + \overline{\varepsilon}_2)$$

This commutator is not continuous, not infinitesimal function of epsilon, so this shift is discrete. In general discrete symmetries break the invariance laws, so the discrete propagator breaks the energy. The particle disappears at x_1 and reappears at x_2 and the particle isn't measurable between x_1 and x_2.

2. The propagator of self adjoint *vector* superfield ($V=V^+$) hasn't quantum leap phase:

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

From the super Yang-Mills the gluons can't disappear, the Grassman space of gluino can't change.

With λG^4 self interaction the Goldstino vanish forever.
If the Goldstino is the lightest supersymmetrical particle, than the LSP isn't measurable.
It explains why we can not see the LSP remnant from the Big Bang. The LSP is a stable particle, can't decay if R-parity isn't broken. Infinite amount of LSP particle should be in the universe from the Big Bang, but it can't interact, because it isn't in space time.

The QGP plasma life time is very short in the further heavy ion colliders. The strong internal friction makes the speed of quarks equal. If one particle's impulse changes shortly all particles' impulse will change, too (through the strong interaction). If one particle's Grassman space change then all particles' Grassman space will change, I hope. And the quantum leap of the color singlet superQGP matter will equal. Because the quantum leap operator is equal to the impulse (space shift) generator. So here we can speak about confined vertex $p^+ + G \longrightarrow \tilde{p}$. Missing baryons will show the discovery of SUSY, the color will not break but the energy will break. Another *hope* is the missing anti Goldstone fermion for non catastrophic squark decay. The quantum leap needs the change of Grassman and anti Grassman coordinates: $\Theta_2 = \Theta_1 + G, \_\overline{\Theta_2} = \overline{\Theta_1} + \overline{G}$. Hopefully the Goldstino shifts the Grassman space only in one dimension. If we choose $G = \frac{1}{\sqrt{2}}(\varepsilon + \bar{\varepsilon})$, the quantum leap is causal, and Goldstino vanish as dark matter $a^\mu = \bar{\varepsilon} 2i\sigma^\mu \varepsilon$ then $a^0 \geq 0$.

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 forbids the escape of quarks and gluons from the hadrons, and forbids the existence of free quarks.
The equal definitions of **quark confinement**:
1. the not color singlet state has got infinite energy,
2. at infinite distance the singlet quark- antiquark potential becomes infinite,
3. the gluon spectrum has mass-gap on low energy,
4. the color charge rises with the distance.
5. Singlet states: $\left|Barion\right\rangle = \frac{1}{\sqrt{6}}\varepsilon^{i,j,k} q^i q^j q^k \quad \left|Meson\right\rangle = \frac{1}{\sqrt{2}}\delta^{i,j} q^i \overline{q}^j$
6. The renorm group confinement exists only if:
$Z^{-1}{}_3=0$; $N_{flavor} \leq N_{color} + 1$; the Lie group is not broken and non-Abelian. And bound state exists with anticommutating FP ghosts[10].

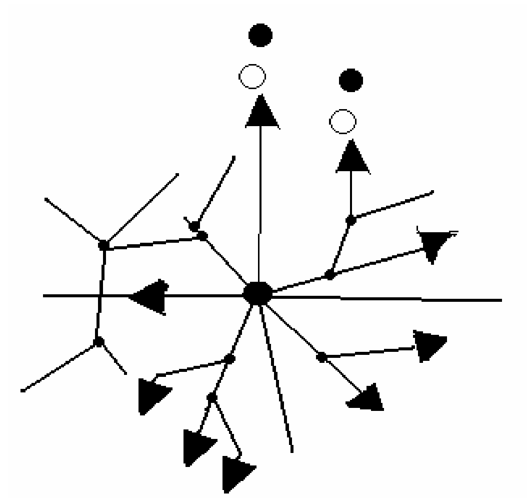


Fig.6. The central extra color charge creates gluons →, charges ● ○ and with the gluons attracts other hadrons

The static quark potential is linear on large distance (ref.1):

$$V\ (r) = -k(\alpha_S)\ r \qquad (2)$$

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):

$$k(\alpha_S) = \frac{3}{5}\alpha_S(q)M^2_{gap}(q) \qquad (2.1)$$

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.

If we create (or disappear) an extra quark color, the non singlet potential energy in (2) 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.

$$E = \sum_{j}^{Sources} \sum_{i}^{quarks} \int_0^{r_{ij}} dr(-k(\alpha_S(q^2_{ij}))) \to -\infty \qquad (2.2)$$

Where N is the number of the quarks of the universe and r_i is their place. 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. In the free plasma the *range of gluons* is ∞, and $M^{gap}_{gluon} \to 0$. This extra color charge polarizes all other hadrons and accelerate them until $k(\alpha_S(q^2)) \to 0$. The color QGP gas pressure in the infinite bound potential:

$$pV = NRT + V(r_{ij}) \to -\infty \qquad (2.3)$$

The negative pressure in the $V=-kr$ extra color potential collapse the distant hadrons into a not white QGP. The color breaking would be cosmic catastrophe.

For example: an anti red quark disappears then the color charge begins to rise with the distance. The lone red quark color seems infinite red from large distance. This red 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 white hadrons can't neutralize this extra red color. The red quark accelerate the hadrons until the impulse difference becomes q, where $k(\alpha_S(q))=0$.

The re-appearance of the missing anti red charge(s) dissolve the infinite bound energy and the gluon range confined to some fermi; $M_{gap}>0$; $k>0$. The globally white QGP gas can expand and cool:

$$p = \alpha * n^{4/3} - \frac{1}{3} k * n^{2/3} \tag{2.4}$$

The physicists don't break the Energy and charge, but the infinite E is in the QCD, and if SO(10) GUT were, SUSY should break the "T_i" O(8) generators. The commutation relation of O(8) super group generators $1 \leq j \leq 8$:

$$[Q_{ai}, T_j] = (b_j)_i^k Q_{ak}; \quad [\bar{Q}_{\dot{a}i}, T_j] = -(b_j)_i^k \bar{Q}_{\dot{a}k} \tag{10}$$

We get different eigen charges if we first measure T then Q, or first Q then T. In this case Q is Hermitian, but there is no complex representation of charged fermions in O(8).

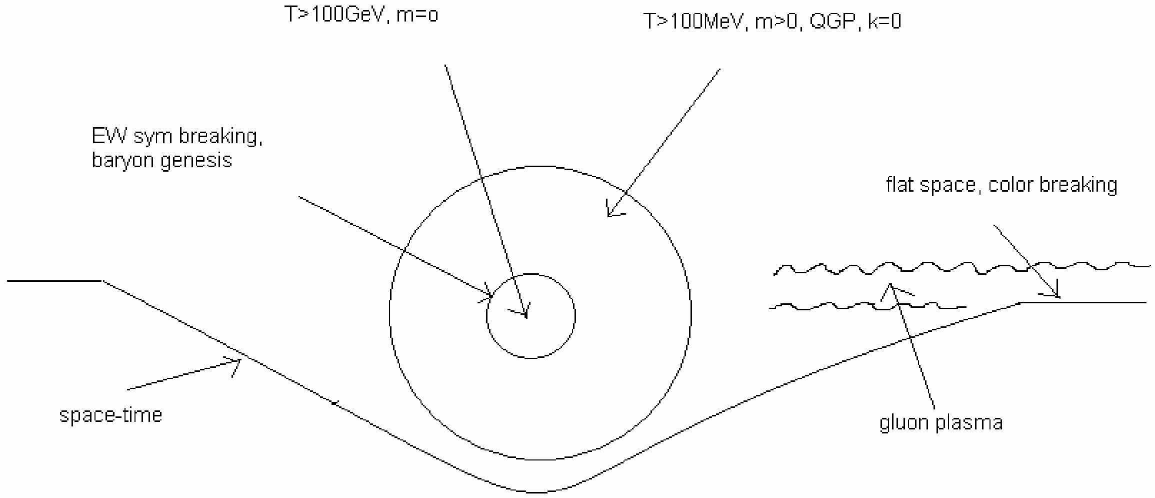
Quantum shift[7] is the name of the space-time shift: any fluctuation of the Grassmann space generates a space shift. I used discrete Grassmann (spin) leaps instead of fluctuations, because the Grassman shift is proportional with the quanta of Goldstino current[3].

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 gluino 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 (T_{2x} ~sec) on high QGP temperature[8]:

   $$1/T_{sph} = \kappa\alpha_W^4 T \ll 1/T_{GUT} = \kappa\alpha_{GUT}^2 T \tag{1}$$

   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. 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 free charges are in the near of the plasma, and are in curved space-time.
6. The white (noise) color can be stable, if first cool down the plasma, then will be flat the space. Universe can continue the inflation.
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, and T could be smaller if m is bigger:

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

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. And the coupling of G is $g=\frac{m_{sq}^2-m_q^2}{F}\approx 1$ is very strong. Goldstino is a not observable trace of the Big Bang, like to **dark matter.**
- In the nature isn't supersymmetric QGP (nor by supernovas, not 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:

$$(\delta_\eta\delta_\varepsilon-\delta_\varepsilon\delta_\eta)V^A=V^D\varepsilon^C\eta^B R^A_{BCD}-\varepsilon^C\eta^B T^D_{BC}D_D V^A \quad (11)$$

These equations are more complicated because new gravitational fields appear in eq. 11. The c**urved SUSY shift isn't hermitian operator.** In curved space the super particle can not vanish, so the black holes eat the dark matter.
The covariant derivate of bosons and fermions in SUGRA contains the gravitino product with superpartner:

$$\Phi_i=A_i+\sqrt{2}\Theta\chi_i+\Theta\Theta F_i$$

$$D_a A^*_i=e_a{}^m\partial_m A^*_i-\frac{\sqrt{2}i}{2}\overline{\psi}_{a\dot\kappa}\overline{\chi}_i^{\dot\kappa}$$

$$D_a\overline{\chi}_{i\dot\alpha}=e_a{}^m D'_m\overline{\chi}_{i\dot\alpha}+\frac{\sqrt{2}i}{2}\overline{\psi}_\alpha{}^\beta\sigma^b_{\beta\dot\alpha}D_b A^*_i-\frac{\sqrt{2}}{2}\overline{\psi}_{a\dot\alpha}F^*_i$$

The covariant derivate and so the double SUSY transformation is not measurable in SUGRA[3].
- The confined space of black holes confines the quarks, gluons can't leave the event horizon. The Hawking radiation is the black body radiation of the high temperature black hole.
- 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) is overestimated, so nowhere in the Universe aren't SUSY particles. Cosmic ray detectors can't differ the E=1000 TeV Z=8 oxygen ion and E=1000 TeV Z=8 M=1000 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, because if the charge > +14 the Si dust loses Si ion and the charge decrease.

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, see in ref 1.

- 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 say that either 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: $E_{universe} = E_{kin} + E_{mass} + E_{grav} \approx E_{mass} \approx \infty$
The initial inflation has a critical point, where the curved space goes to flat space in first order.
In the case $E_{kin} < E_{grav}$ the Universe has lower temperature at R_{crit} size, can go through the critical point, without the appearance of super vertices. But this Universe will collapse by gravitation.
In the case $E_{kin} > E_{grav}$ the plasma temp. is high, superparticles appear in the inflation, and break the color.
($T_{crit} >> 10^{-2}$ sec after the Big Bang and after the quark confinement.)
- I explain the flat early Universe with the collapsed Universe (like supernova explosion). The spherical QGP collapse and flow out by a flat plane ($J_{in}=J_{out\ flow}$).
-The slow QGP collapse and inflation has enough time to reach the thermal equilibrium state, so the matter density and γ background is homogeneous.
- Antimatter galaxies are not observable, because matter existed before the Big Bang. (B (baryon number) grow in high energy phase transformations (previous Big Bangs), and decrease in Black holes).

re-Big Bang:

I find very interesting that a little charge breaking can cause infinite universe contraction and explosion. The disappearance of a lot of color particles give a white noise color and could give a quasi stable, quasi white state.
The number of vertices relates to the number of discrete time shifts. The contraction continues until all baryon become QGP state. Until $k_{source} > 0$ the hadrons move in the direction of the source. This takes for long time (billions of years) if we collect all baryons. But it's not a long time for the time shifted super particles. The sphaleron process can raise the baryon number in the high temperature. After the restoration of SUSY the Goldstone fermion VEV vanishes. If all color move in curved space, the quantum shift is not measurable, and the color restore to white. The QGP can expand, during the white expansion the color will not break, because in curved space-time in SUGRA the charge can't break.
If you have any question don't hesitate please contact me:

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