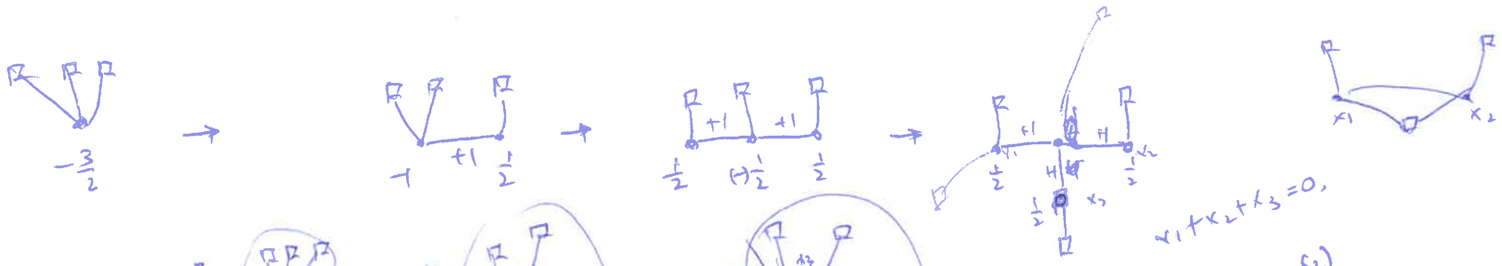
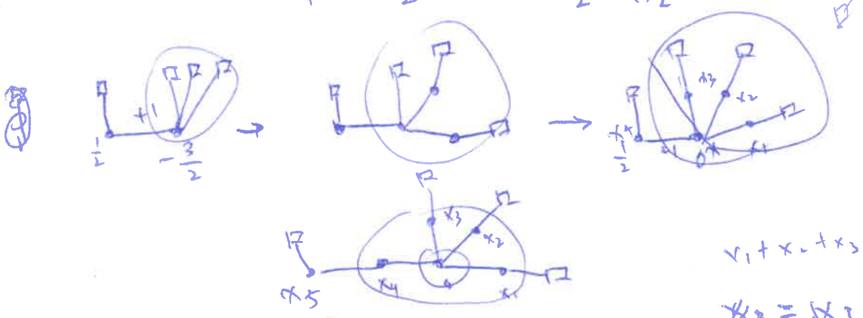
Jun 12



$x_1+x_2+x_3=0,$

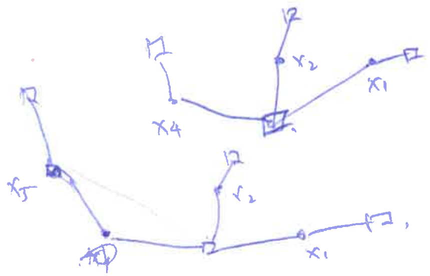
$x_3=-(x_1+x_2)$



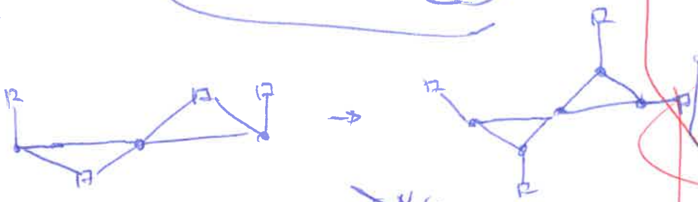
$x_1+x_2+x_3+x_4=0.$

$x_3=-(x_1+x_2+x_4)$

$-k+\frac{N_a-N_f}{2}$

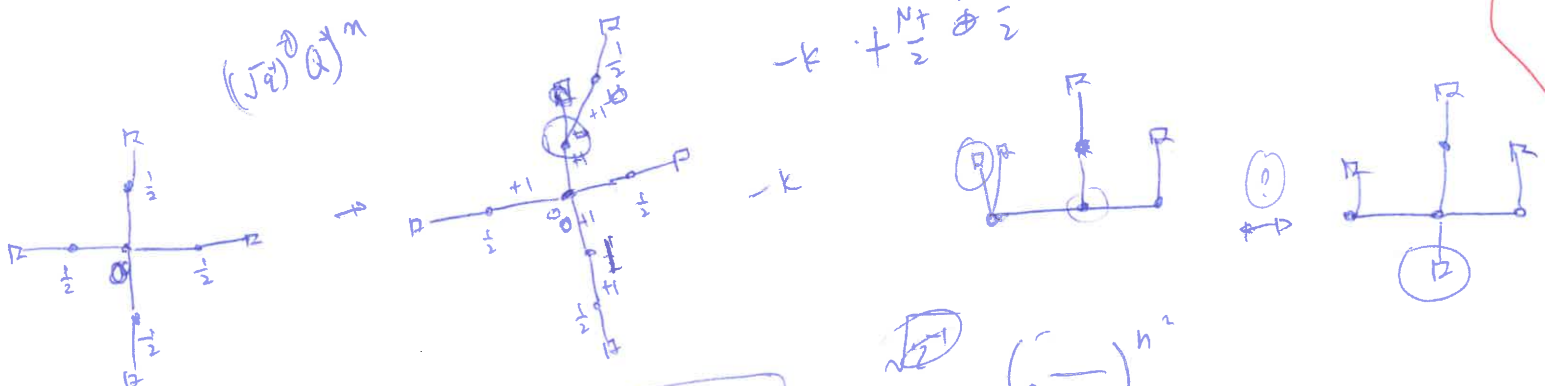


$k-\frac{N_f-N_a}{2}=$



$-k+\frac{N_f}{2}-\frac{N_a}{2}-N_a\ \cancel{-N_f}$

$((\sqrt{q})^{\theta}\alpha)^n$



$-k$

$\sqrt{q^{-1}}$

$\left(\frac{\quad}{-\sqrt{q^{-1}}}\right)^{n^2}$

$(\alpha_i^{-1};\tilde{q})_n$ $\qquad (-\sqrt{\tilde{q}})^{\frac{N_a-N_f}{2}n^2}$ $\qquad (\sqrt{q}\alpha_j)_n$ $\qquad (-\sqrt{q^{-1}})^{n^2}$

$(\sqrt{q}\beta)^n.$

$\sqrt{\tilde{q}}$

$\left(\frac{\tilde{q}\prod_{i=1}^{N_a}\sqrt{\tilde{q}}\alpha_i}{\prod_{j=1}^{N_a}\sqrt{\tilde{q}}\beta_j}\right)^n$

① • Holomorphic blocks

② • Adding matter to plumbing manifolds

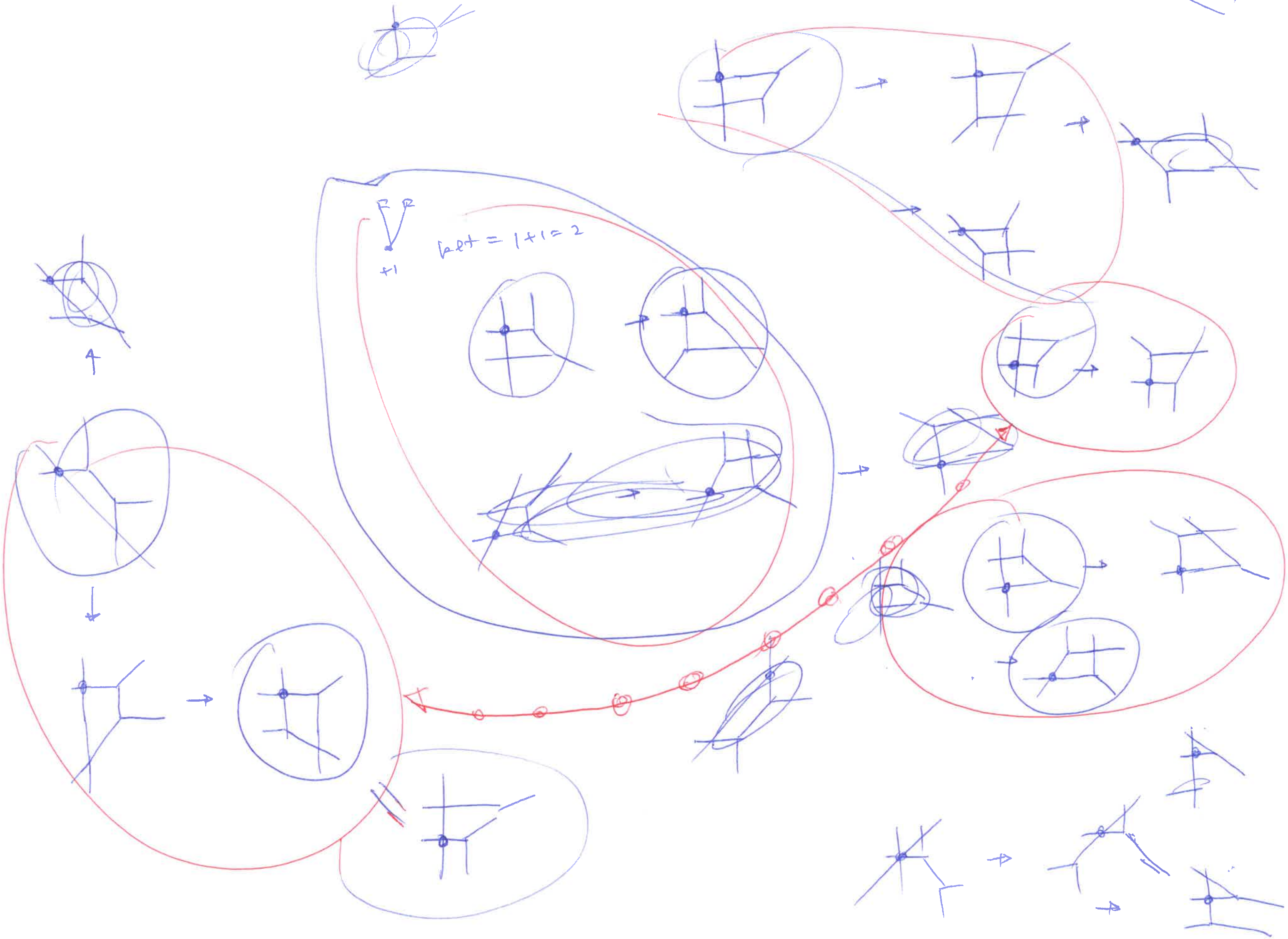
• Adding other types of superpotentials

③ • one-form global sym.

• moduli space

④ ST-trafs.

Jun 11



Jan 12

$k=\frac{-3}{2}$ $r=s=1$

par sym $k=1$

$\frac{2}{2k+1} = m \Rightarrow \frac{2k-1}{2} = m$, $\boxed{k = m+\frac{1}{2}}$

$\frac{2k-3}{2k-1} = \frac{1}{m} \Rightarrow 2mk-3m = 2k-1$

$2k(m-1) = \frac{3m-3+2}{m-1}$

$\boxed{k = \frac{3}{2} + \frac{1}{m-1}}$

very sym
$k = 2, 0$

$\frac{3-2k}{2m} = m$

$\frac{2}{2k-1} = m$, $k - \frac{1}{2} = \frac{1}{m} \Rightarrow \boxed{k = \frac{1}{2} + \frac{1}{m}}$

pml sym
$k = -2, 0$

$\frac{2k-3}{2k-1} = m$, $2km - m = 2k-3$

$2k(m-1) = \frac{m-3}{m-1} \Rightarrow$ -2

$\boxed{k = \frac{1}{2} + \frac{1}{m}}$

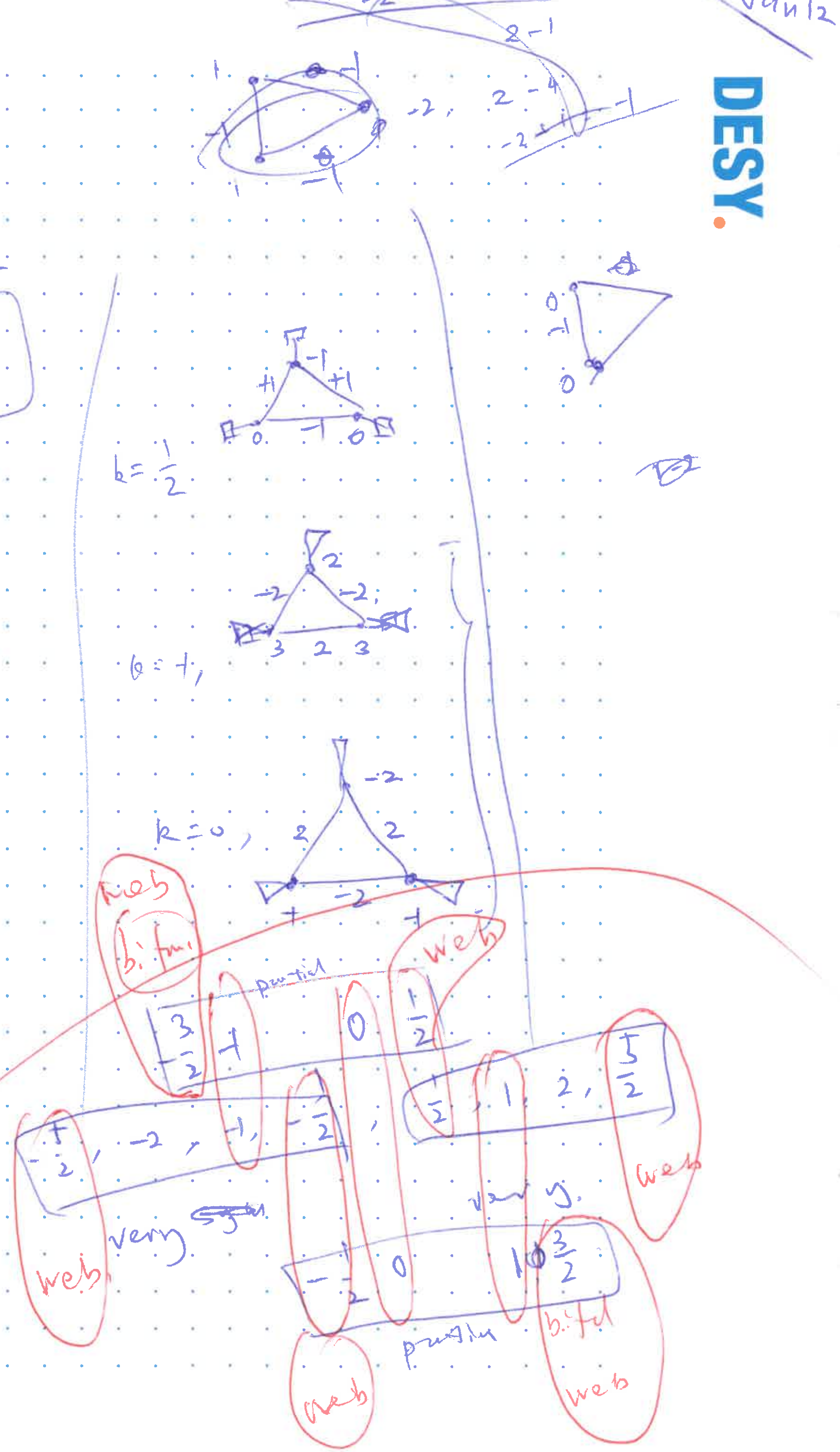
$\frac{2k-1}{2k+1} = m$

$2km + m = 2k-1$

$2k(m-1) = \frac{-m-1}{m-1} = \frac{-(m-1)-2}{m-1}$

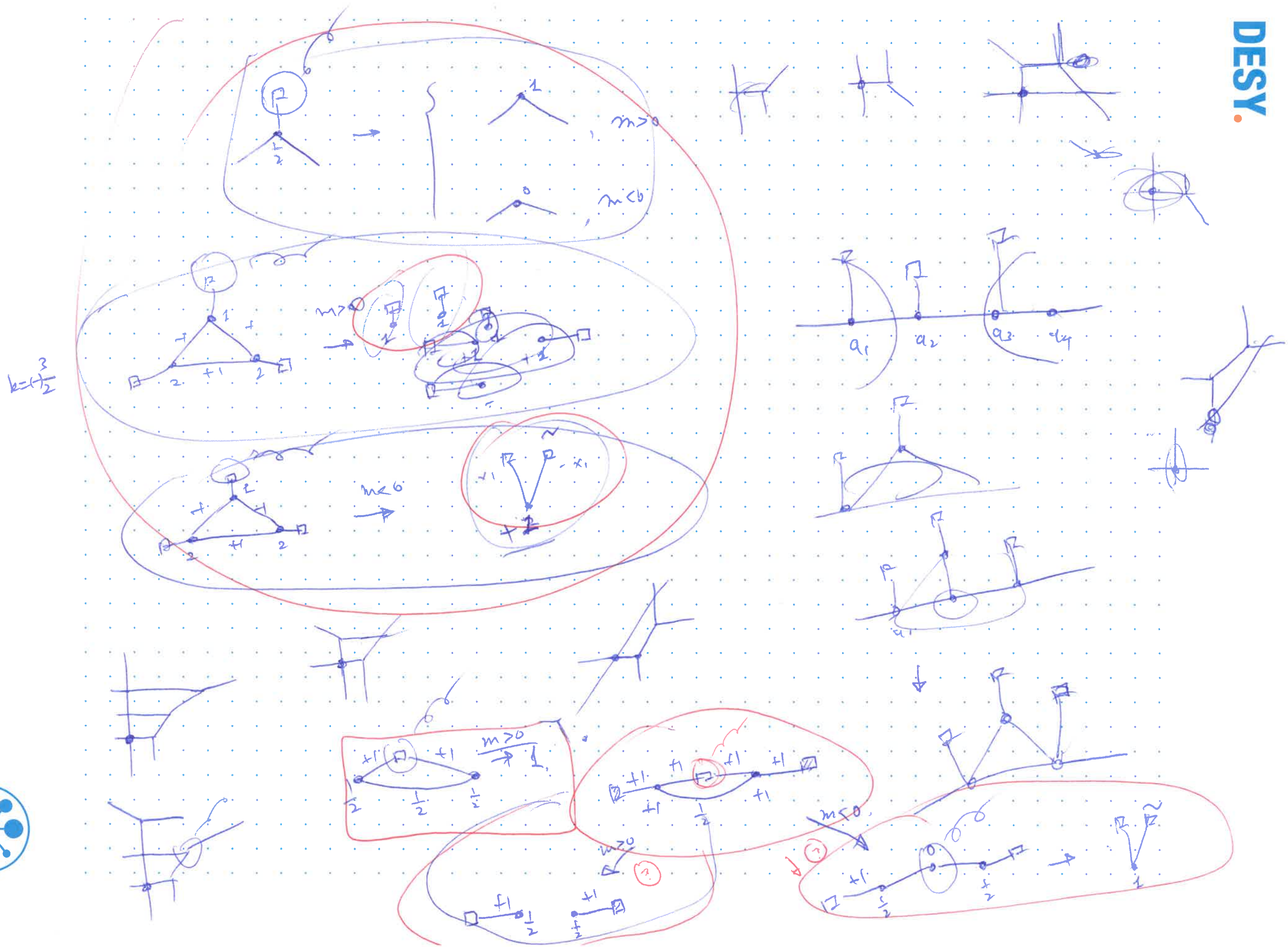
$= -1 - \frac{2}{m-1}$

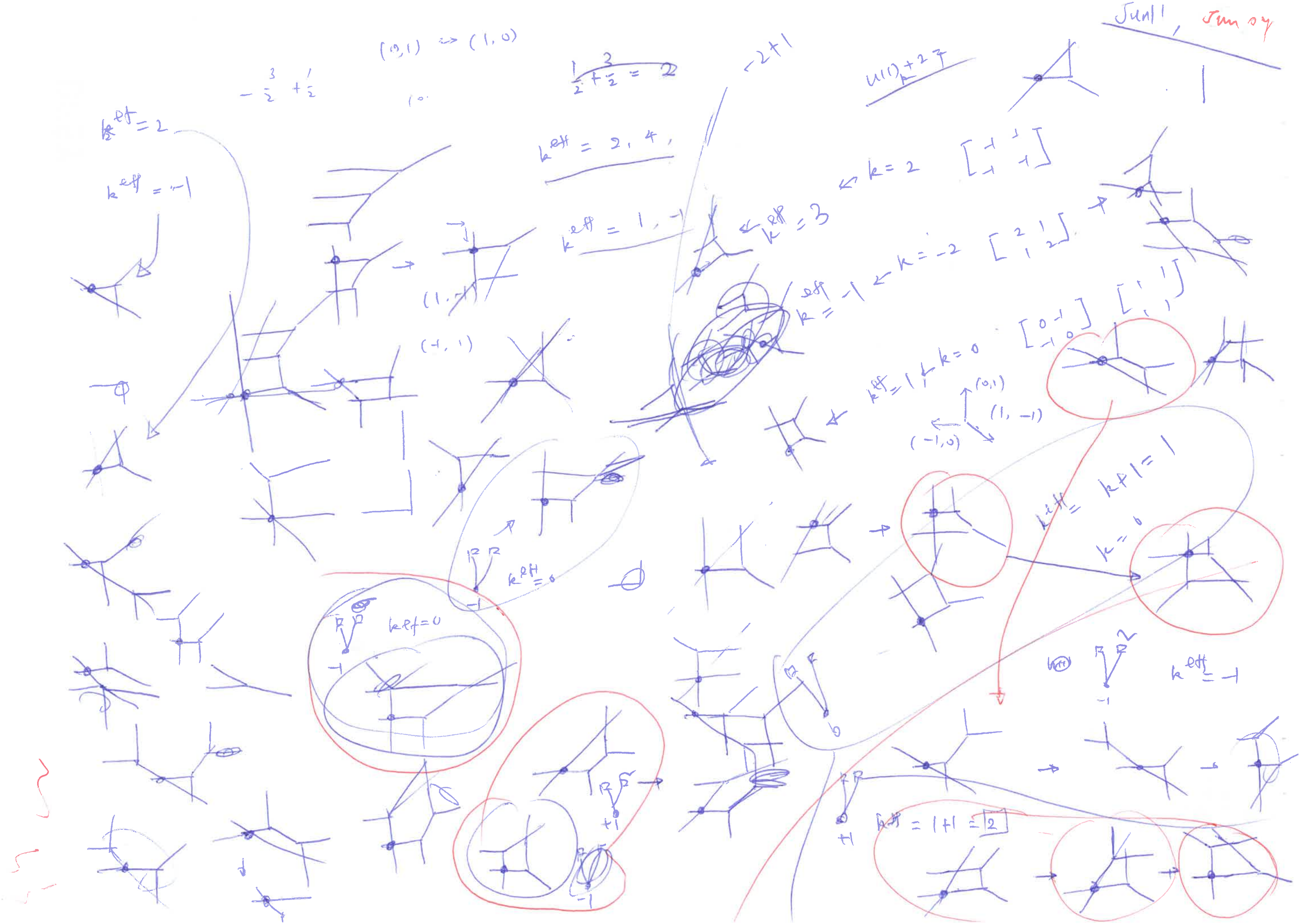
$\boxed{k = -\frac{1}{2} + \frac{1}{m}}$



Jun 12

Jun 11





Sun!!, Sun oy
$(0,1) \leftrightarrow (1,0)$
$-\frac{3}{2} + \frac{1}{2}$
$\frac{1}{2} + \frac{3}{2} = 2$
$-2+1$
$u(1)_{k} + 2\,?$
$k^{eff} = 2$
$k^{eff} = -1$
$k^{eff} = 2, 4,$
$k^{eff} = 1, -1$
$k^{eff} = 3$
$k = 2$
$\begin{bmatrix} -1 & 1 \\ -1 & -1 \end{bmatrix}$
$k^{eff} = -1 \leftarrow k = -2$
$\begin{bmatrix} 2 & 1 \\ 1 & 2 \end{bmatrix}$
$k^{eff} = 1 \leftarrow k = 0$
$\begin{bmatrix} 0 & -1 \\ -1 & 0 \end{bmatrix}$
$\begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix}$
$(1,-1)$
$(-1,1)$
$(0,1)$
$(1,-1)$
$(-1,0)$
$k^{eff} = k+1 = 1$
$k = 0$
$k^{eff} = 0$
$k^{eff} = -1$
$k^{eff} = 1+1 = \boxed{2}$
$+1$
-1

Jun 09

$k = \frac{1}{2} \cdot \frac{m-1}{m}$

$m_1 = 0$

$1 - 2k = \frac{1}{m} \to k = \frac{m-1}{2m}$

$3 - 2k = \frac{1}{m} \to k = \frac{3m-1}{2m} + 1$

$m \in \mathbb{Z}$

$m = \frac{1}{1-2k}$

$1 + 2k = \frac{1}{m} \to k = -\frac{m-1}{2m}$

$3 + 2k = \frac{1}{m} \to k = -\frac{m-1}{2m} - \left(\frac{m-1}{2m} + 1\right)$

$k = \frac{1}{2} \cdot \frac{m-1}{m}$

$k = \frac{1}{2} - \frac{1}{2m} = \frac{1}{2}\left(1 - \frac{1}{m}\right)$

$\frac{1 - 2k + 2}{1-2k} = 1 + \frac{2}{1-2k}$

$\frac{2k+1-2}{2k+1} = 1 - \frac{2}{2k+1}$

$\frac{2k+3-2}{3+2k} =$

$k = \frac{3}{2} - \frac{1}{2m}$

$k = \frac{3m-1}{2m}$

$k = -\frac{1}{2} + \frac{1}{2m}$

$= \frac{1}{2} - \frac{1}{2m}$

$\frac{1}{2}\left(1 - \frac{1}{m}\right)$

$\frac{2}{1-2k} \in \mathbb{Z}$

$\frac{2}{2k+1} \in \mathbb{Z}$

$\frac{1}{\frac{2k+1}{2}} = \frac{2}{2k+1} = \frac{1}{k+\frac{1}{2}} = \frac{1}{n}$

$k + \frac{1}{2} = n$

$k = \frac{1}{n} + \frac{1}{2}$

$k = -\frac{3}{2} - \frac{1}{m}$

$-\frac{1}{2m}$

$1 - \frac{1}{2m}$

$= \frac{1}{2m}$

$\frac{3}{2} - \frac{1}{2m}$

$\frac{1}{2k+1} = \frac{n}{2}$

$(2k+1) = \frac{1}{n} - \frac{1}{2}$

$\frac{1}{\frac{1}{2} - k} = \frac{1}{n}$

$k = n + \frac{1}{2}$

$k = 2(m-1)$

$k = -\frac{3m+2}{2m}$

$-\frac{5}{2} + \frac{3}{2} = -1$

$1 - \frac{1}{n} = 2k$

$\frac{1}{2}$

$\frac{2}{1-2k} = \frac{n}{1}$

$(1-2k) = \frac{2}{n}$

$\frac{2}{3-2k} = m$

$k = \frac{3m-2}{2m}$

$\frac{2k+1}{2k+3} = m+1$

$\Rightarrow k = \frac{-3m+1}{2(m-1)}$

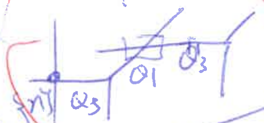
$\to k = \frac{3}{2} - \frac{1}{m}$

DESY.

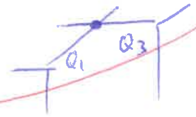
$Q_2 \to \sqrt{\frac{q}{t}}$

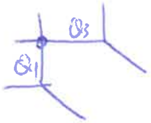
$$Z_{\bar{q}} = \sum_n (Q_3)^n \frac{(\cancel{\ldots})_n \, (Q_1 Q_3 ; t)_n}{(t;t)_n}$$

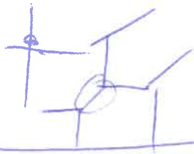
q-dual



$Q_2 \to \frac{1}{q}\sqrt{\frac{t}{q}}$





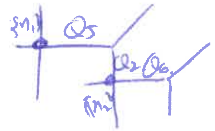


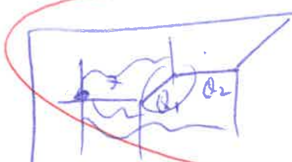
JM 08

$$\left((q^{n_1+1}) \cdot q^{-n_2} ; q\right)_{n_2} = \frac{\left(-q \cdot q^{n_1+1}\right)^{-n_2} (\sqrt{q})^{-n_2^2+n_2}}{(q^{-n_1} ; q)_{n_2}}$$

$$= \frac{1}{(}$$

$$(q^{n_1} ; q)_{n_2} \leftrightarrow (q^{-n_2} ; q)_{n_1}$$

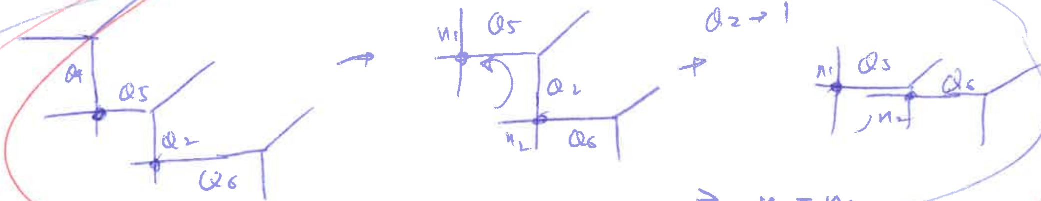




$$Z_{\bar{q}} = \frac{(zQ_1 ; q)_\infty}{(z;q)_\infty \, (zQ_1Q_2 ; q)_\infty}$$

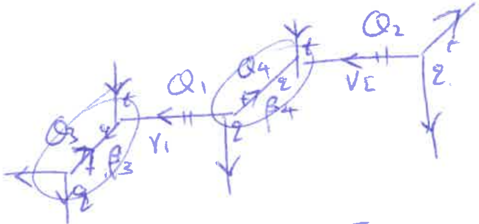
$Q_1 \to 1$

$$\sum_{n_1} \frac{(\sqrt{q})^{2n_1^2} (qQ_5Q_6)^{n_1}}{(q;q)_{n_1}}$$



$Q_2 \to 1$

$\to n_1 = n_2$



topvertex $= C[t,q,h_1,\beta_3,\emptyset,\emptyset]\, C[q,t,h_2,\beta_3^T,\emptyset,\nu_1^T]\, C[t,q,h_3,\beta_4,0,\nu_1]\, C[q,t,h_4,\beta_4^T,0,\nu_2^T]$

$C[t,q,h_6,0,0,\nu_2]$

degree $= L[Q_1,\nu_1]\, L[Q_2,\nu_2]\, L[Q_3,\beta_3]\, L[Q_4,\beta_4]$

Jun06

Jun08

$$Z \to \sum_n Q^n \frac{(Q_3;\varepsilon)_n\,(Q_1 Q_3 Q_2)_n}{(q;\varepsilon)_n \boxed{(Q_1^{Q_3};\varepsilon)_n}}$$

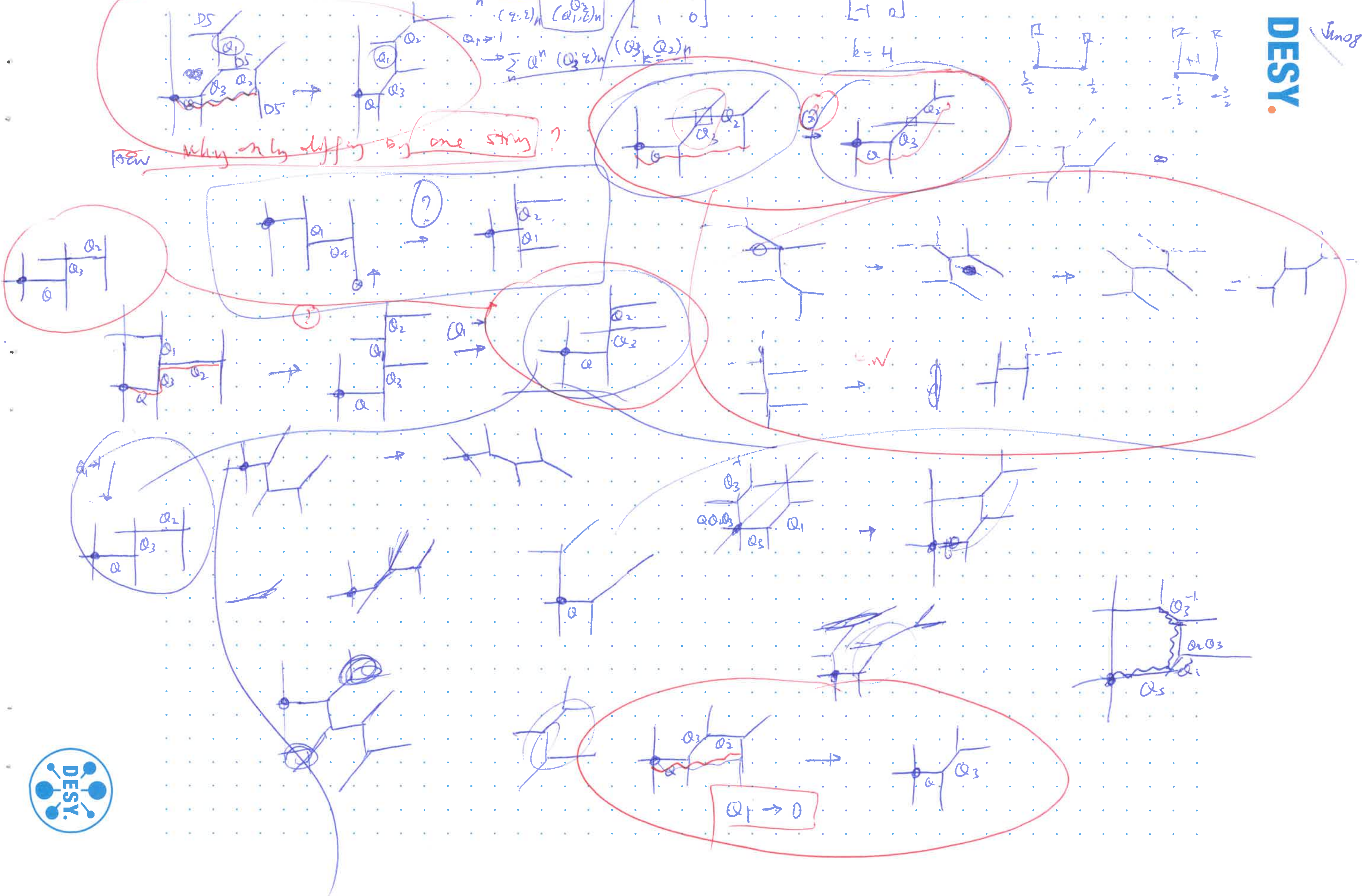
$Q_1 \to 1$

$$\to \sum_n Q^n (Q_3;\varepsilon)_n (Q_3 Q_2)_n$$

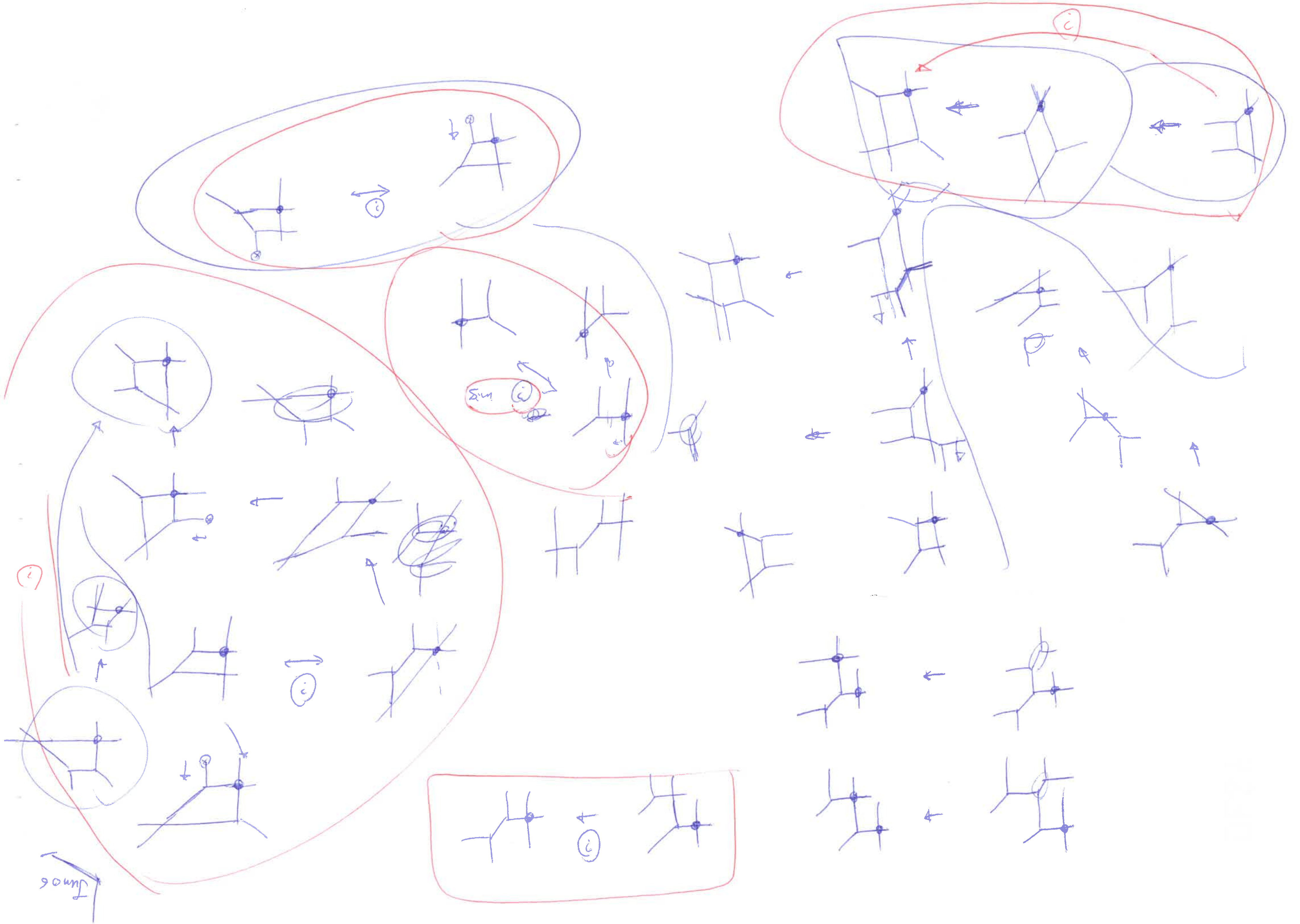
$$\begin{bmatrix} 1 & 1 \\ 1 & 0 \end{bmatrix} \qquad \begin{bmatrix} 1 & -1 \\ -1 & 0 \end{bmatrix}$$

$k = 4$

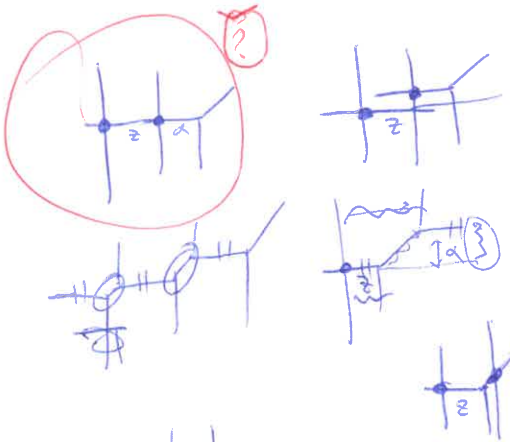
Why only differ by one string ?



$Q_1 \to 0$

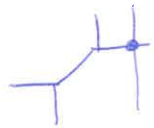


Jun 05



$$\boxed{\frac{(z\alpha;t)_\infty}{(\alpha,t)_\infty} \xrightarrow{\alpha\to\infty} 1}$$

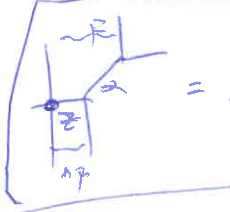
$$\frac{1}{(\alpha,t)_\infty} = \sum_{n=0}^{\infty} \frac{\alpha^{d}\, z^{n}\, (\alpha,t)_n}{(t,t)_n\,(t,t)_n}$$



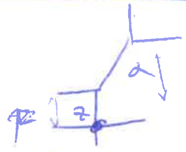
$$\boxed{\overset{?}{=} Z_{\bar q} = \frac{\sum_{n\ge 0} (-tq)^{kn^2} z^n}{(t,t)_\infty}}$$

$$Z_{\bar q} = \frac{1}{(\alpha,t)_\infty} \sum_{n=0}^{\infty} z^n \frac{(\alpha;t)_n}{(t;t)_n}$$

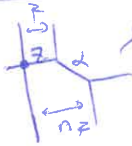
$$\boxed{= \frac{1}{(\alpha,t)_\infty}\,\frac{(z\alpha;t)_\infty}{(z,t)_\infty}}$$

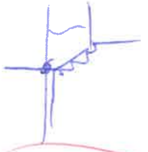


$$= \frac{(z\alpha,t)_\infty}{(z,t)_\infty} \qquad = \frac{(z,t)_\infty}{(z\alpha,t)_\infty}$$

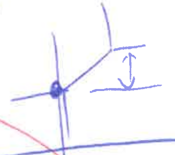


$$\overset{?}{=} \frac{(z,t)_\infty}{(z\alpha,t)_\infty}$$

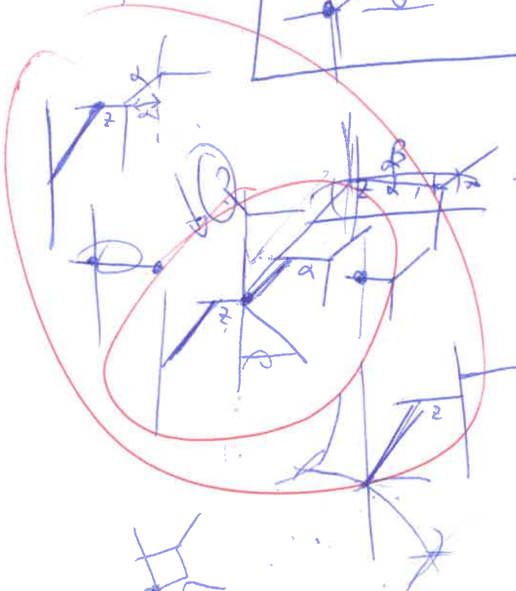




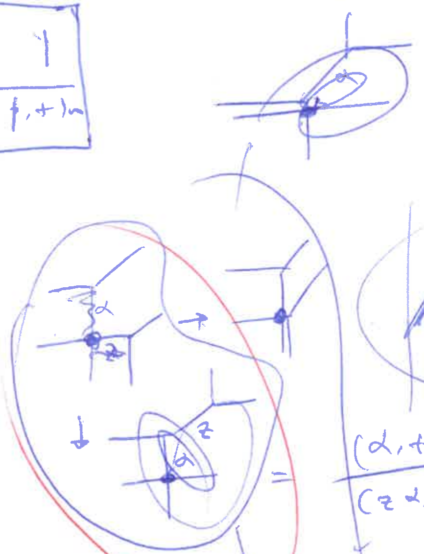
$$\boxed{Z_{\bar q} \xrightarrow{z\to 1} \frac{1}{(t,t)_\infty}}$$

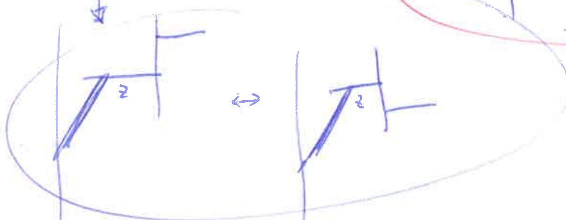


$$\frac{(z\alpha;t)_\infty}{(z,t)_\infty}$$

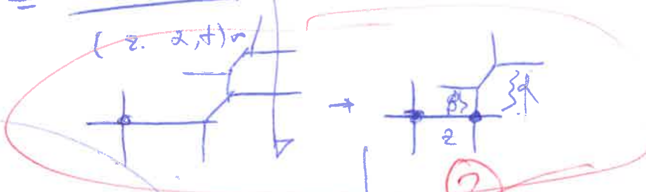


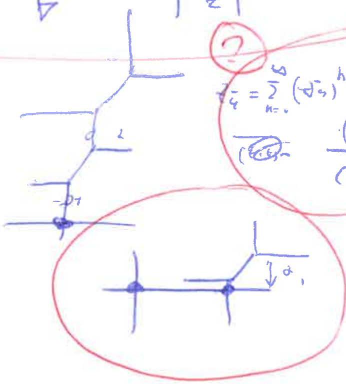
$$= \frac{(\alpha,t)_\infty}{(z\alpha,t)_\infty}$$



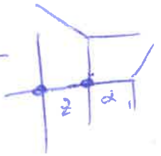


$$Z_{\bar q} = \sum_{n=0}^{\infty} (-tq)^{kn^2} z^n \frac{(\beta,z;t)_n}{(\beta,z)_n}$$

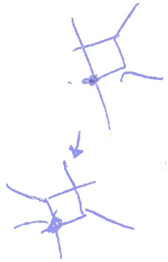




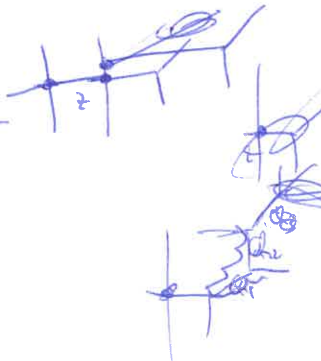
$$\frac{1}{(\alpha^{-1};t)_\infty} \sum_{n=0}^{\infty} z^n \frac{(\alpha^{-1};t)_n}{(t,t)_n}$$



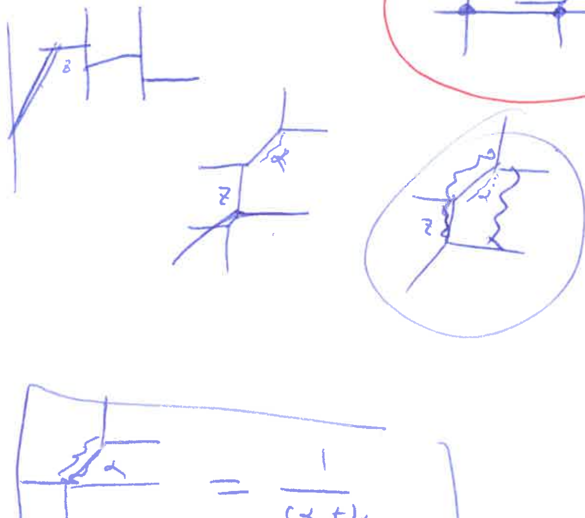
$$\frac{1}{(\alpha^{-1},t)_\infty}\,\frac{(z\alpha^{-1};t)_\infty}{(z,t)_\infty}$$



$$\boxed{\frac{1}{(z^{-1};t)_\infty}\,\frac{(\alpha z^{-1};t)_\infty}{(\alpha,t)_\infty}}$$

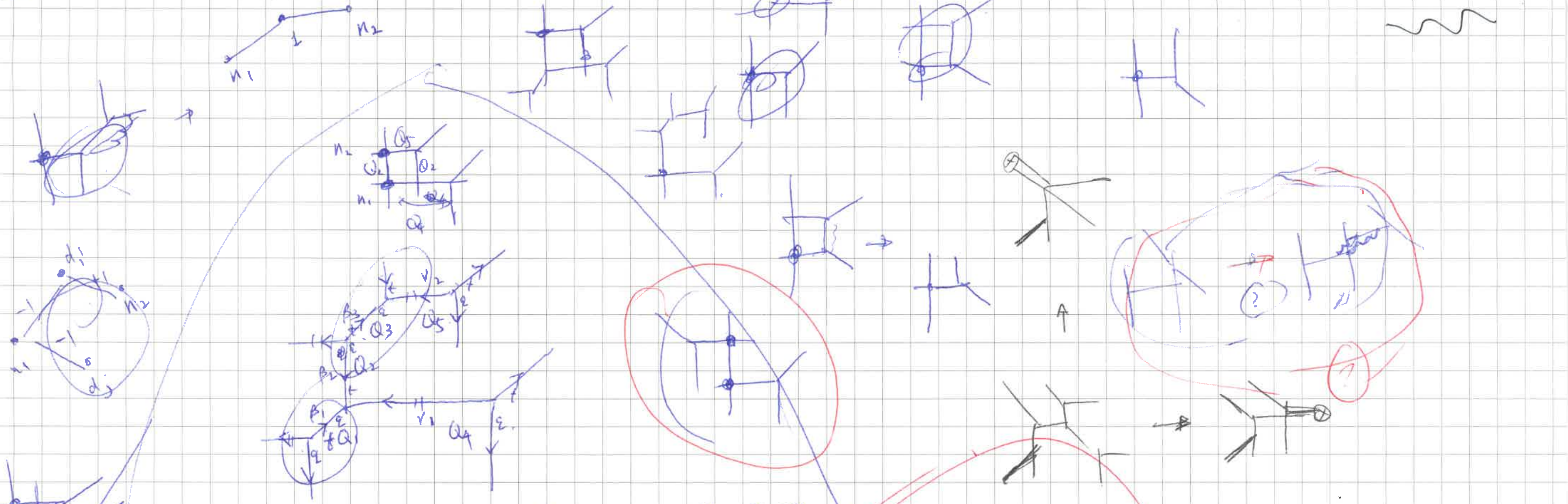


$$\frac{(Q_1,t)_n}{(Q_1Q_2)_n} \qquad \frac{(Q_1Q_2)_\infty}{(Q_1,t)_\infty}$$



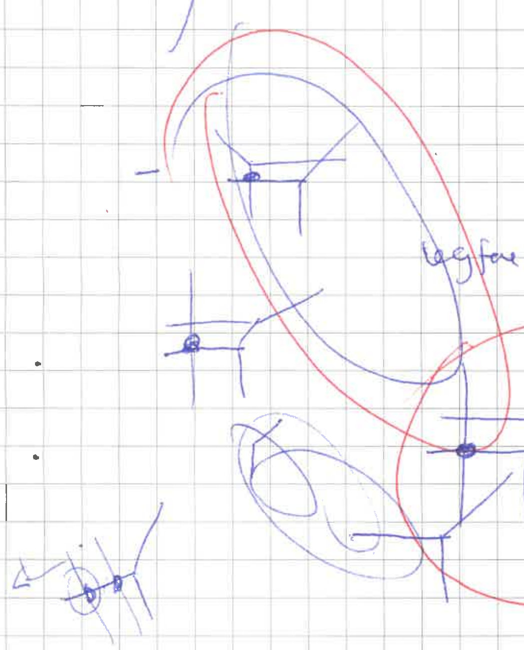
$$\boxed{= \frac{1}{(\alpha,t)_\infty}}$$

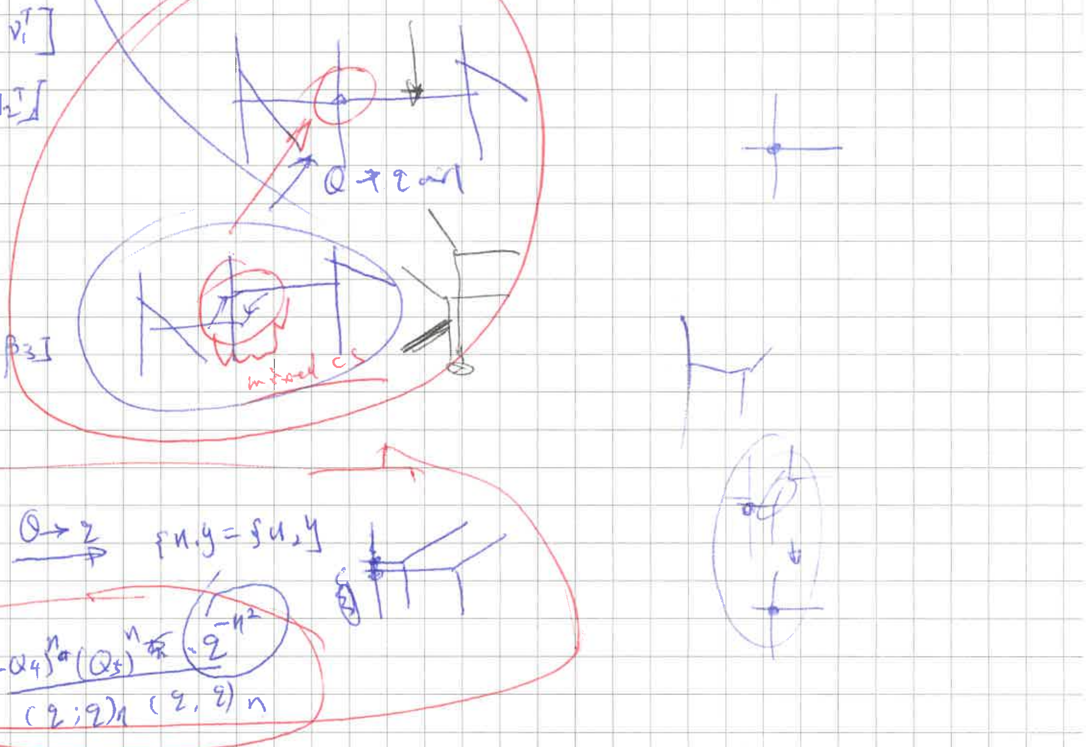
Jun04

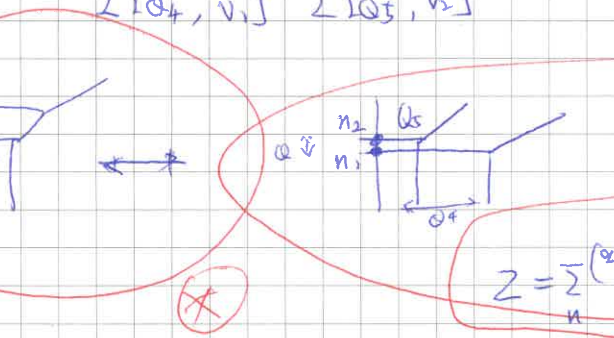


$$\text{topvec} = C[t,q,h_1,\beta_1,\emptyset,\emptyset]\, C[q,t,h_2,\beta_1^T,\beta_2^T\, v_1^T]$$
$$C[t,q,h_3,\beta_3,\beta_2,\emptyset]\, C[q,t,h_4,\beta_3^T,\emptyset,v_2^T]$$
$$C[t,q,h_5,\emptyset,\emptyset,v_2]$$
$$C[t,q,h_6,\emptyset,\emptyset,v_1]$$

$$\text{legfac} = L[Q_1,\beta_1]\, L[Q_2,\beta_2]\, L[Q_3,\beta_3]$$
$$L[Q_4,v_1]\, L[Q_5,v_2]$$







$\Theta \to q$ $\quad$ $\{x,y = \{u,y]$

$$Z = \sum_n \frac{(\alpha Q_4)^{n}(Q_5)^n\, q^{-n^2}}{(q;q)_n\,(q,q)_n}$$

Jun 04

17:24

48

22-11

20:07

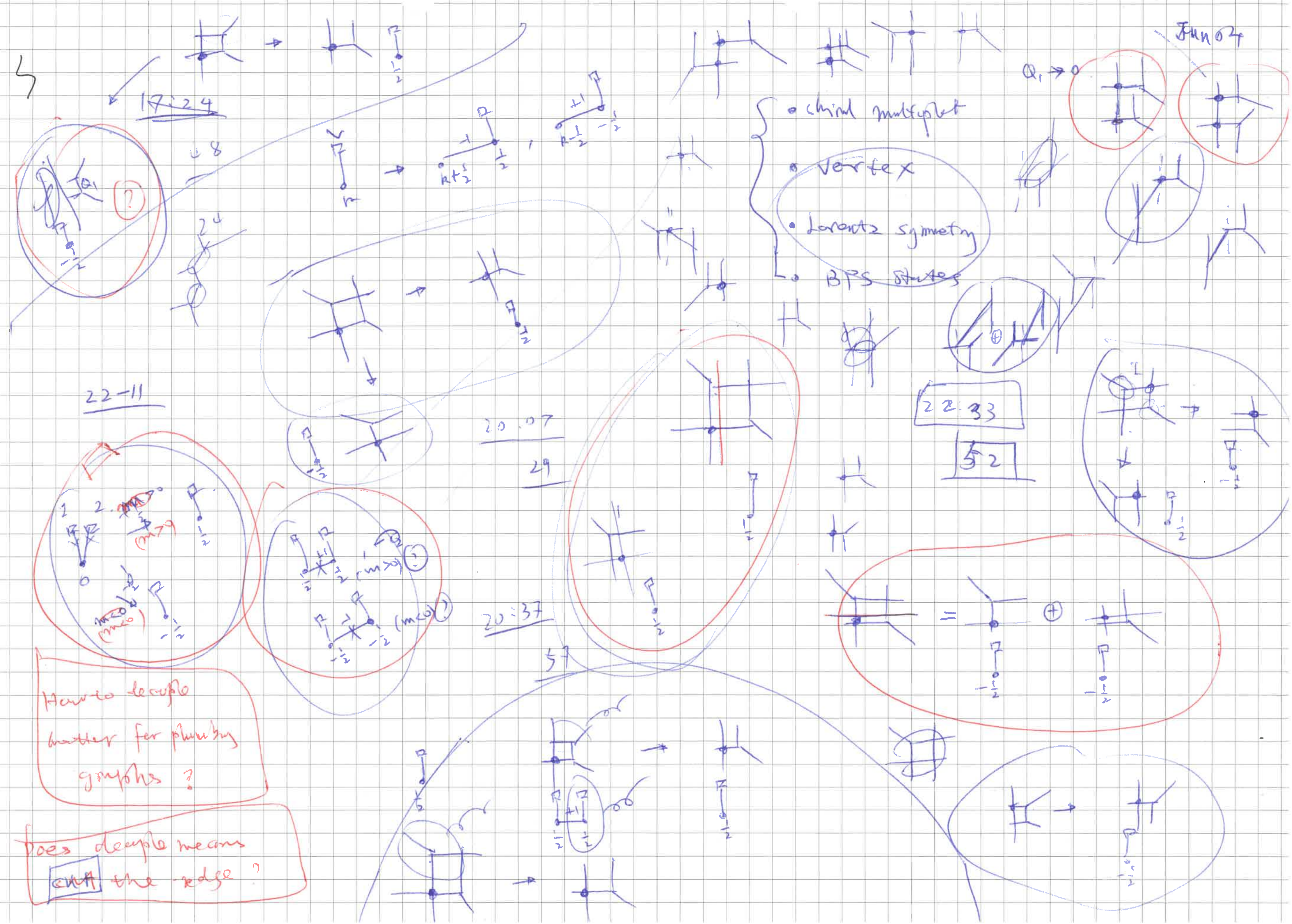
29

20:37

57

22:33

3 2



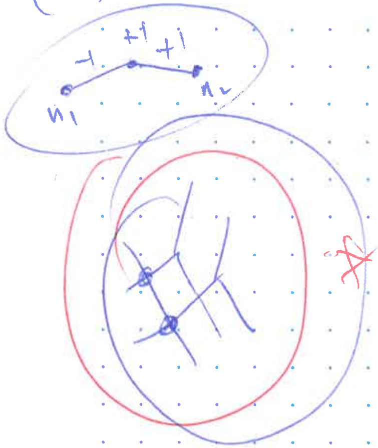
- chiral multiplet
- vertex
- Lorentz symmetry
- BPS states

How to decouple matter for plumbing graphs ?

Does decouple means $\boxed{\text{cut}}$ the edge ?

Jun 07

$(-\sqrt{q})^{2n_2 d + d^2 - 2n_1 d}$, $\beta^d q^{-n_1 d}$



$$\frac{1}{(\beta q^{-n_1};q)_\infty} = \frac{(\alpha;q)_\infty}{(\alpha;q)_{n_1}}$$

mixed CS comes from 3-fold chiral (V)

$$(Qq^{-n_1};q)_{n_2}\,(Qq^{n_2};q^{-1})_{n_1}$$

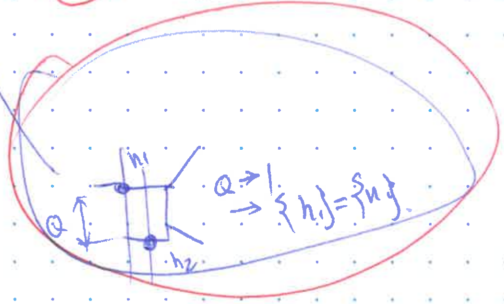
$$= (Q^{-1}q^{n_1};q)_{n_2}\,(-\sqrt{q})^{n_2^2}\,(\sqrt{q}\,Q^{-1}q^{n_1})^{-n_2}\,(Qq^{n_2};q^{-1})_{n_1}$$

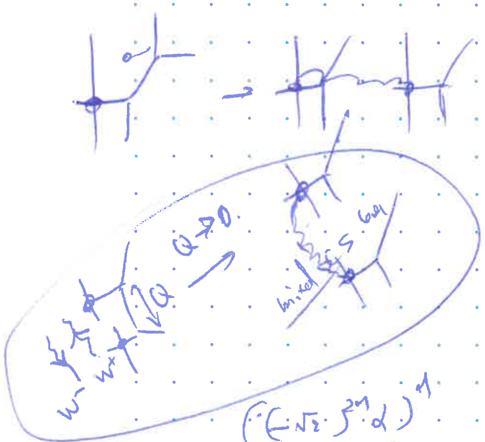
$$= (-\sqrt{q})^{n_2^2}\,(\sqrt{q}\,Q^{-1})^{-n_2}\,q^{-n_1 n_2}\,\underbrace{(Q^{-1}q^{n_1};q^{-1})_{n_2}\,(Qq^{n_2};q^{-1})_{n_1}}_{(\mathrm{I})}$$

(I) $\overset{Q=1}{=}$ $(q^{n_1};q^{-1})_{n_2}\,(q^{n_2};q^{-1})_{n_1}$

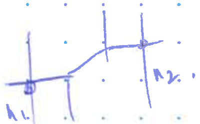
if $n_1 > n_2$ (I) $= (q^{n_1-n_2+1};q)_{n_2}\,(q^{n_2-n_1+1};q)_{n_1}$

$= (q;q)_{n_2}(q;q)_{n_1}\,\delta_{n_1,n_2}$





$$\frac{((-\sqrt{q})^{2n}\alpha)^{n}}{(q,q)_n}$$



$q^{n_1} = \tilde{Q} q^{-1}$ / $q^{-n_2}\tilde{Q} = q^{n_1+1} q^{-n_2}$

$\tilde{Q} q^{-n_1} = q^{n_2+1-n_1}$

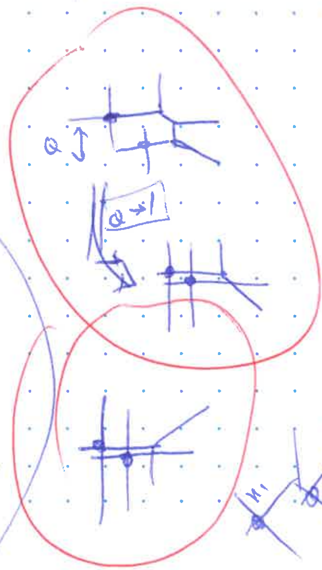
$\tilde{Q} q^{-1} = q^{n_2}$ $n = n_1$

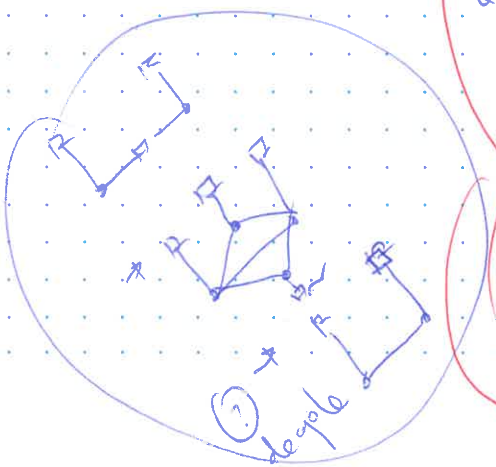
$Q\to 1$: $(Qq^{-n_1};q)_{n_2}\,(Qq^{n_2};q^{-1})_{n_1} \xrightarrow{Q\to1} (-\sqrt{q})^{n^2}(\sqrt{q})^{-n}\,q^{-n^2}$

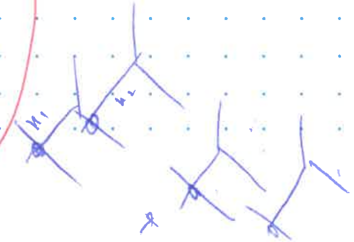
$= (-)^{n^2}\sqrt{q}^{-n^2}\ldots$

$$= (-\sqrt{q})^{-n^2}(\sqrt{q})^{-n}\,(q;q)_n^2 \quad (n_1=n_2)$$

$$= \frac{\ldots}{(\sqrt{q})^{n^2}}$$







May 30

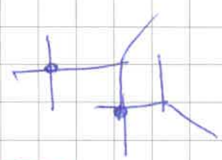
Form 5d $\mathcal{N}=1$ dual pair
to 3d $\mathcal{N}=2$ dual pair ?

$(a;q)_n \xrightarrow{Q\to 0} 1$

$$k_{ij} = \begin{bmatrix} 1 & -\frac{1}{2} \\ -\frac{1}{2} & 1 \end{bmatrix}$$

$$k_{ij}^{eff} = \begin{bmatrix} 2 & -1 \\ -1 & 2 \end{bmatrix}$$

0.0.0 9 a.

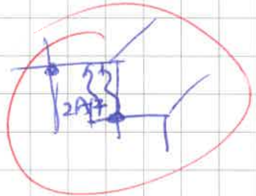


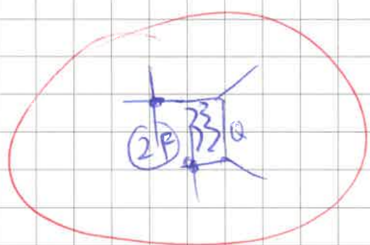
$$\frac{1+p_1^2}{2} = 1, \quad \frac{1+p_2^2}{2} = 1 \qquad |p_1| = |p_2| = 1$$

$p_1 = 1 \quad p_2 = -1$

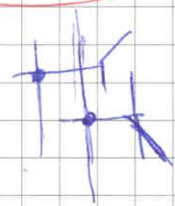
$p_1 = -1 \quad p_2 = 1$

$$\frac{p_1 p_2}{2} = -\frac{1}{2} \qquad -\frac{1}{2} + \frac{1}{2}$$



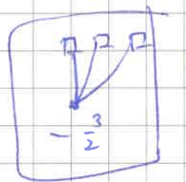


$Q \to 0$

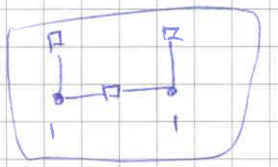


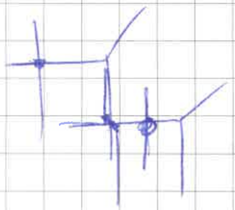
$1 + \frac{1 + 1}{2} = 1+1=2$

$k_1 = k_2 = 1$



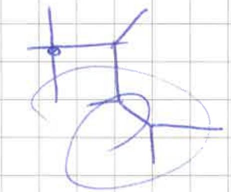
$\longleftrightarrow$



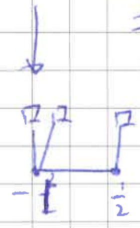


$k_{eff} = -\frac{3}{2} + \frac{3}{2}$

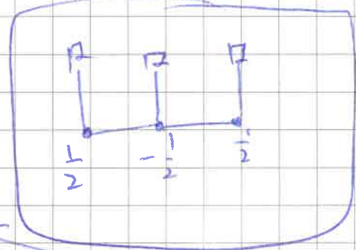
$= 0,$



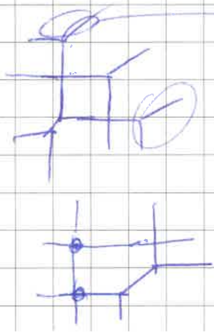
$$\Delta K_{ij} = \begin{bmatrix} \frac{1+p_1^2}{2} & \frac{p_1 p_2}{2} \\ \frac{p_1 p_2}{2} & \frac{1+p_2^2}{2} \end{bmatrix}$$

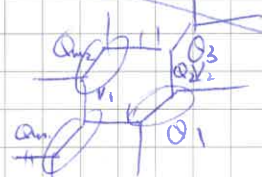


$\rightarrow$

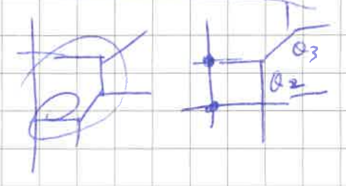


$\frac{p_1 p_2}{2} =$



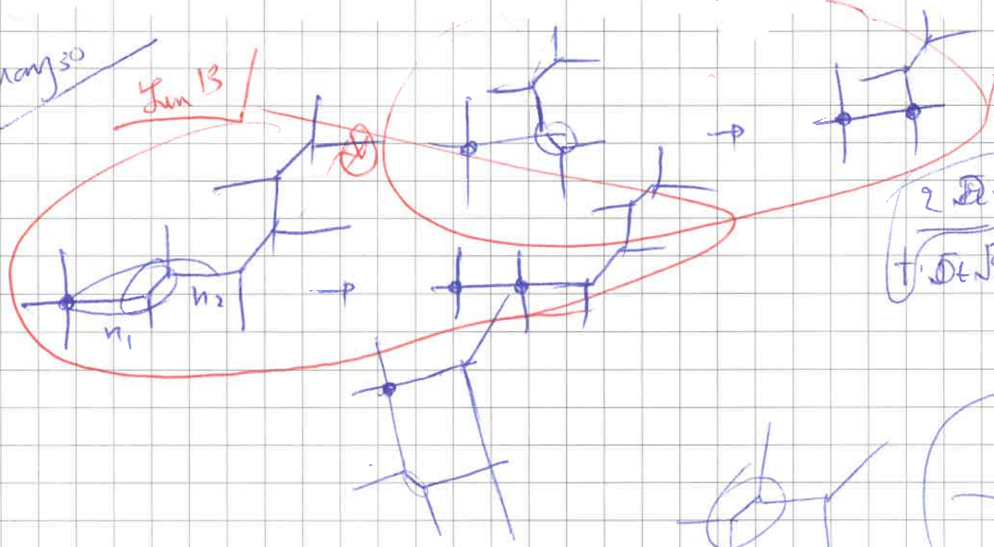


$\rightarrow$



May 30

Jun 13



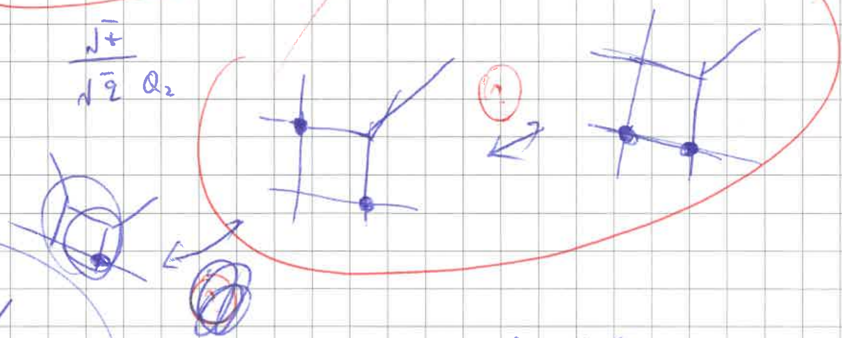
What is this ? Is there mixed OS ?

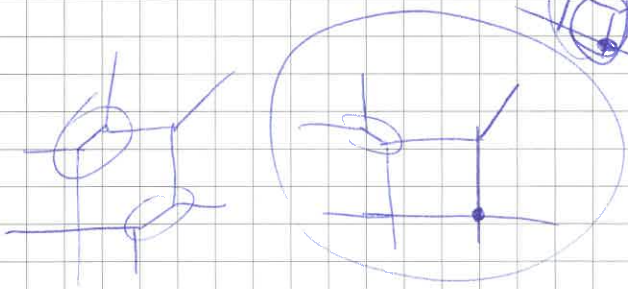
May 29

$q \sqrt{t} \cdot q \sqrt{t}$

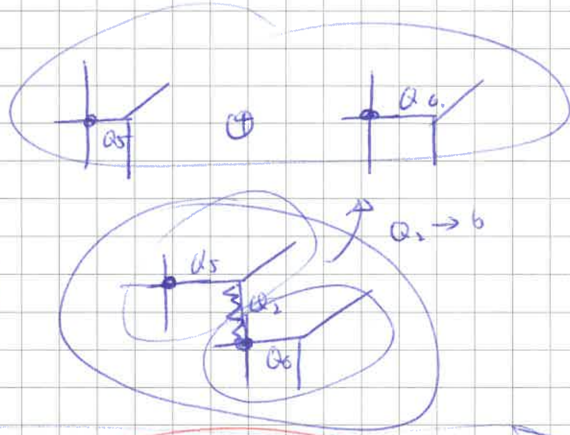
$t \sqrt{t} \sqrt{q} Q_2$

$\frac{\sqrt{t}}{\sqrt{q}} Q_2$



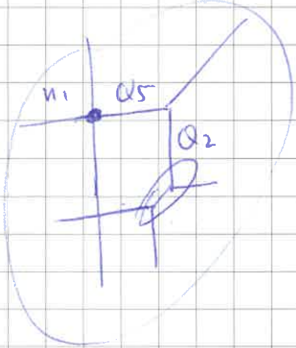


$Q_4 \to 0, \quad Q_2 \to 0$



$Q_2 \to 6$

$\frac{1}{1+q^n}$

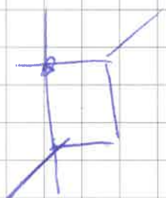


what is zero-loop part for bifund ?

$$\frac{(Q;q)_n}{(qQ;q)_n} = \frac{1-Q}{1-q^n Q}$$

$$Q \to \infty \quad \to q^{-n}$$

$Q = e^{-t}$

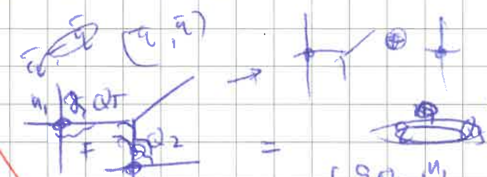


$$\frac{1}{1-Q^{-1}} = \frac{1}{(Q^{-1};q)_1} = \frac{(qQ_2^{-1};q)_\infty}{(Q_2^{-1};q)_\infty}$$

$Q_2 \to$, $Q_4 \to 0$, $Q_6 \to 0$

?

(q,q)



$$= \frac{(qQ_5)^{n_1}}{(q;q)_{n_1}} \quad \frac{(Q_2^{-1};q)_{n_1}}{(qQ_2^{-1};q)_{n_1}}$$

?

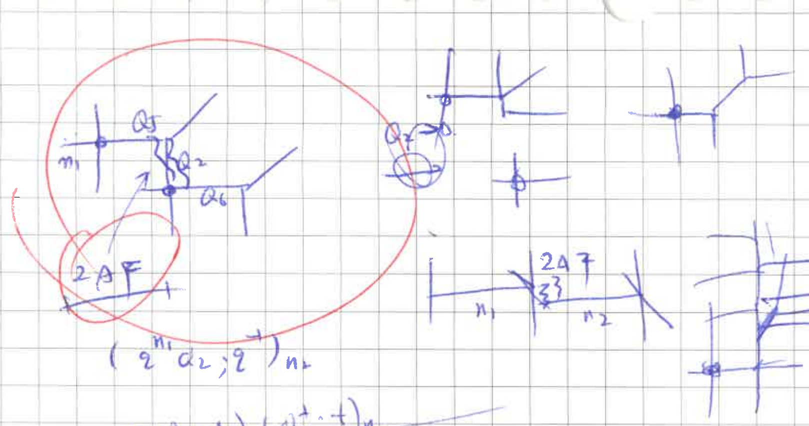
$Q_2^{-1} \to \infty$

$$\to \frac{(qQ_5)^{n_1}}{(q;q)_{n_1}} \cdot q^{-n_1} = \frac{Q_5^{n_1}}{(q;q)_{n_1}}$$

May 30

$Q_1 = t\sqrt{\frac{q}{t}}$ $\boxed{Q_1 Q_2 = 1}$ $Q_2 = \frac{1}{t}\sqrt{\frac{t}{q}}$

Does Higgsing 1F ⊕ 1A7 produces mixed CS level and a new gauge node ?



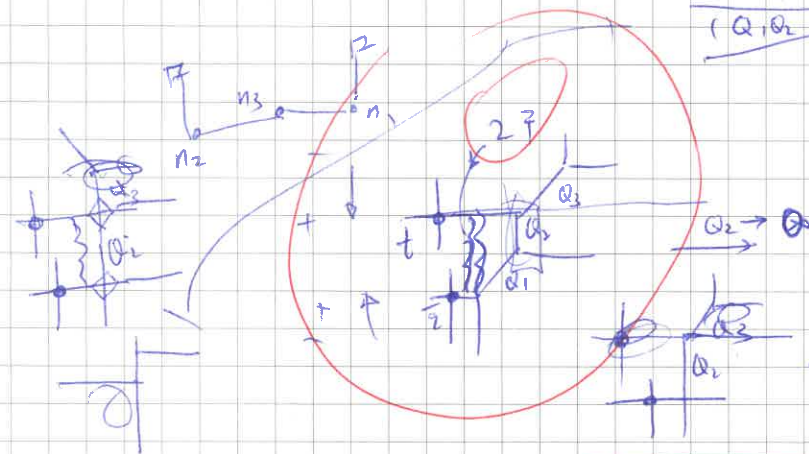
$(q^{n_1} Q_2; q^{-1})_{n_2}$

$\cancel{(Q_2 t; t)_{n_1} (Q_2^{-1}; t)_{n_1}}$

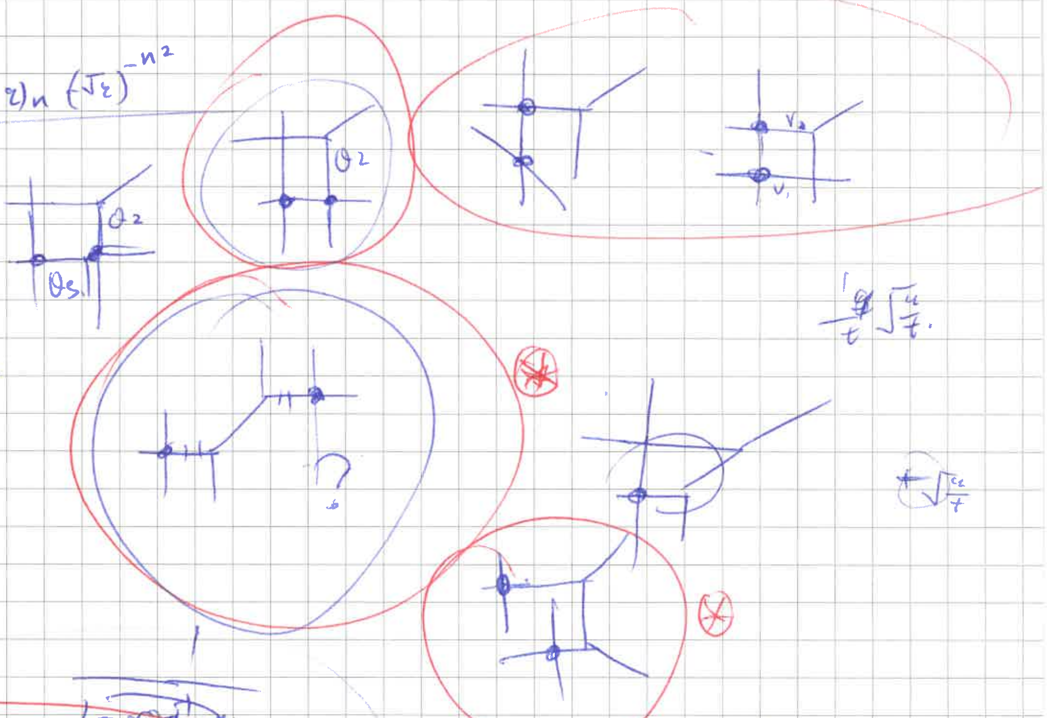
$(-\sqrt{q})^{2n_1 n_3 + 2n_2 n_3}$

$(Q q^{-1}; q^{-1}) \simeq (q Q^{-1}; q)_n (\sqrt{q})^{-n^2}$

$\cancel{\frac{(-\sqrt{q})^{n_2^2}}{(Q_1 Q_2; q)_{n_2}}}$



$Q_2 \to 0$

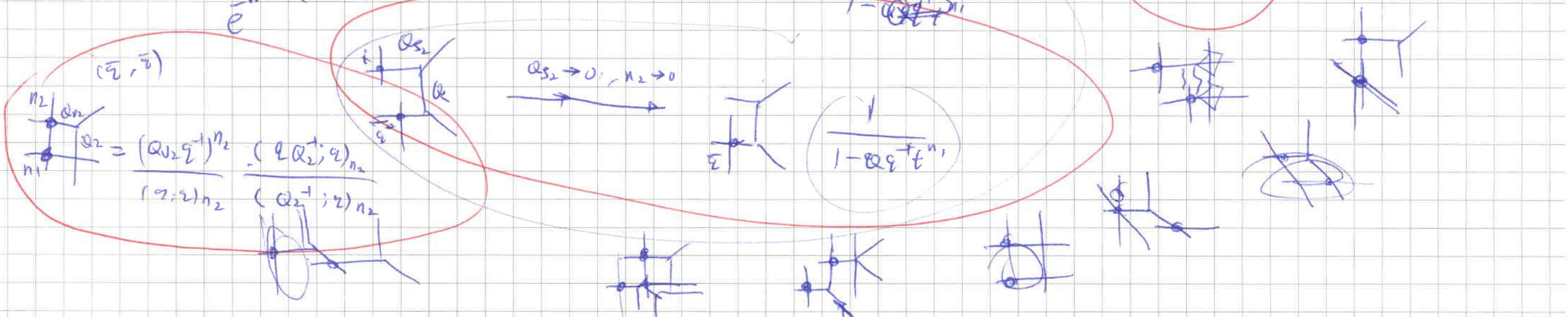


$\frac{1}{t}\sqrt{\frac{q}{t}}$

$t\sqrt{\frac{q}{t}}$

e^{-m}

$\frac{1}{1 - Q q^{-t} t^{n_1}}$



$Q_{S_2} \to 0,\ n_2 \to 0$

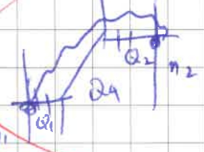
$\frac{1}{1 - Q q^{-t} t^{n_1}}$

$(q, \bar{q})$

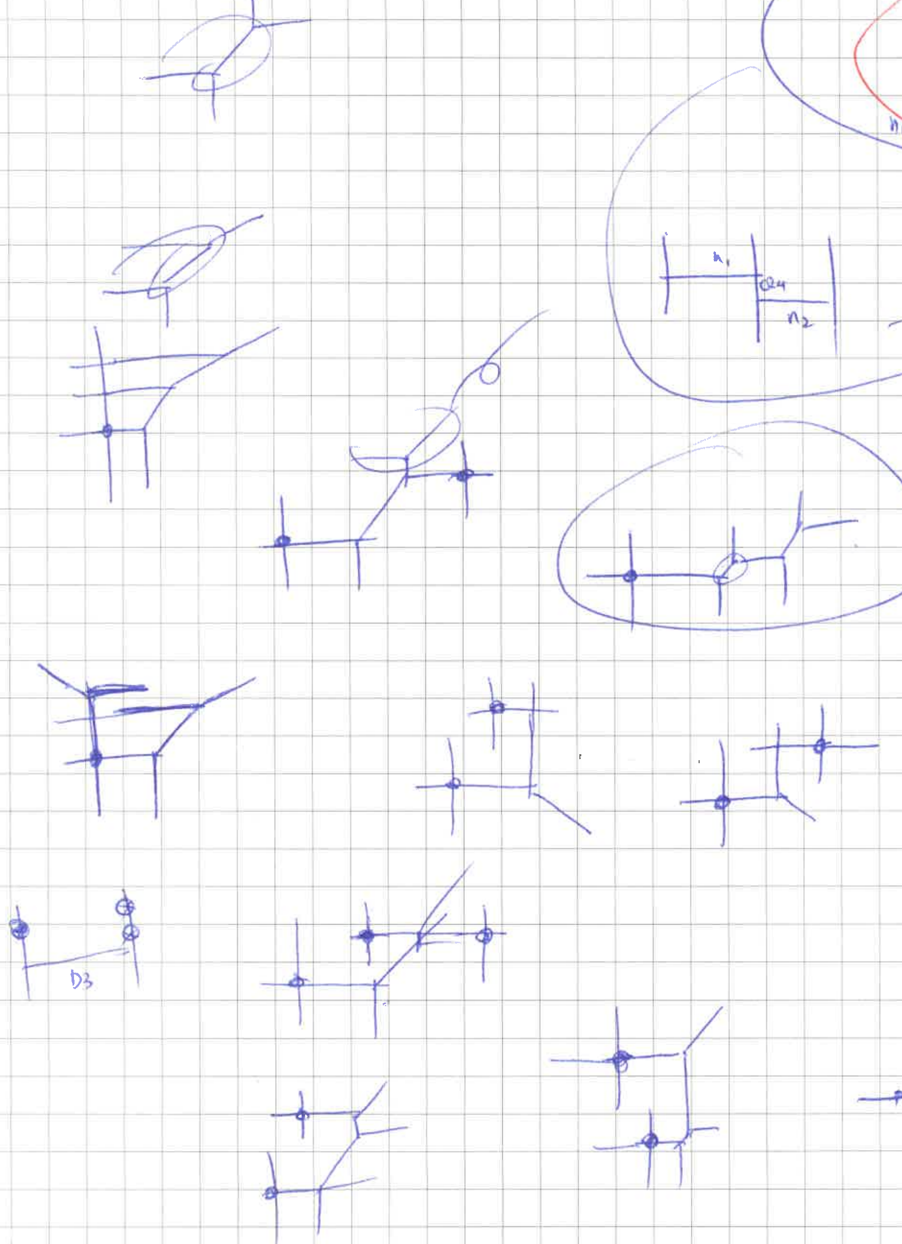
$Q_2 = \frac{(Q_{v_2} q^{-1})^{n_2}}{(q;q)_{n_2}} \frac{(q Q_2^{-1}; q)_{n_2}}{(Q_2^{-1}; q)_{n_2}}$

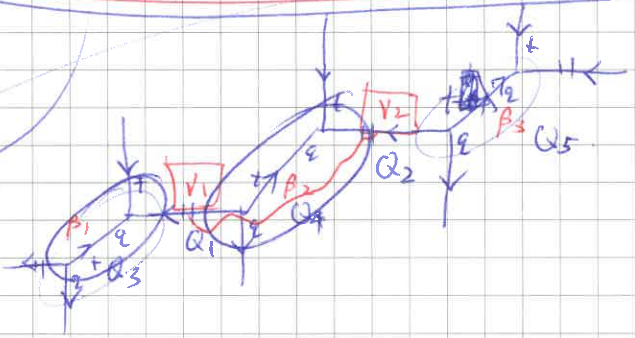
May 30

$(\bar{q}, q)$,



$$= \frac{(-)^{n_2}\left(Q_1\frac{\sqrt{t}}{\sqrt{q}}\right)^{n_1}\left(-Q_2\sqrt{q}\right)^{n_2} t^{\frac{n_2^2}{2}} N_{\{n_2\}_{11}\{n_1\}^\vee}\left(Q_4\sqrt{\tfrac{t}{q}}\right)}{(t;t)_{n_1}\,(t;t)_{n_2}}$$





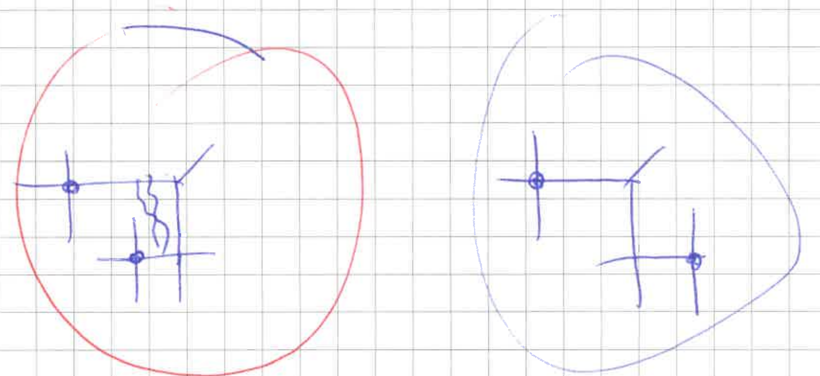
top vex $= C[t,q,h_1,\beta_1,\emptyset,\emptyset]\; C[q,t,h_2,\beta_1^T,\emptyset,\nu_1^T]$

$C[t,q,h_3,\beta_2,\emptyset,\nu_1]\; C[q,t,h_4,\beta_2^T,\emptyset,\nu_2^T]$

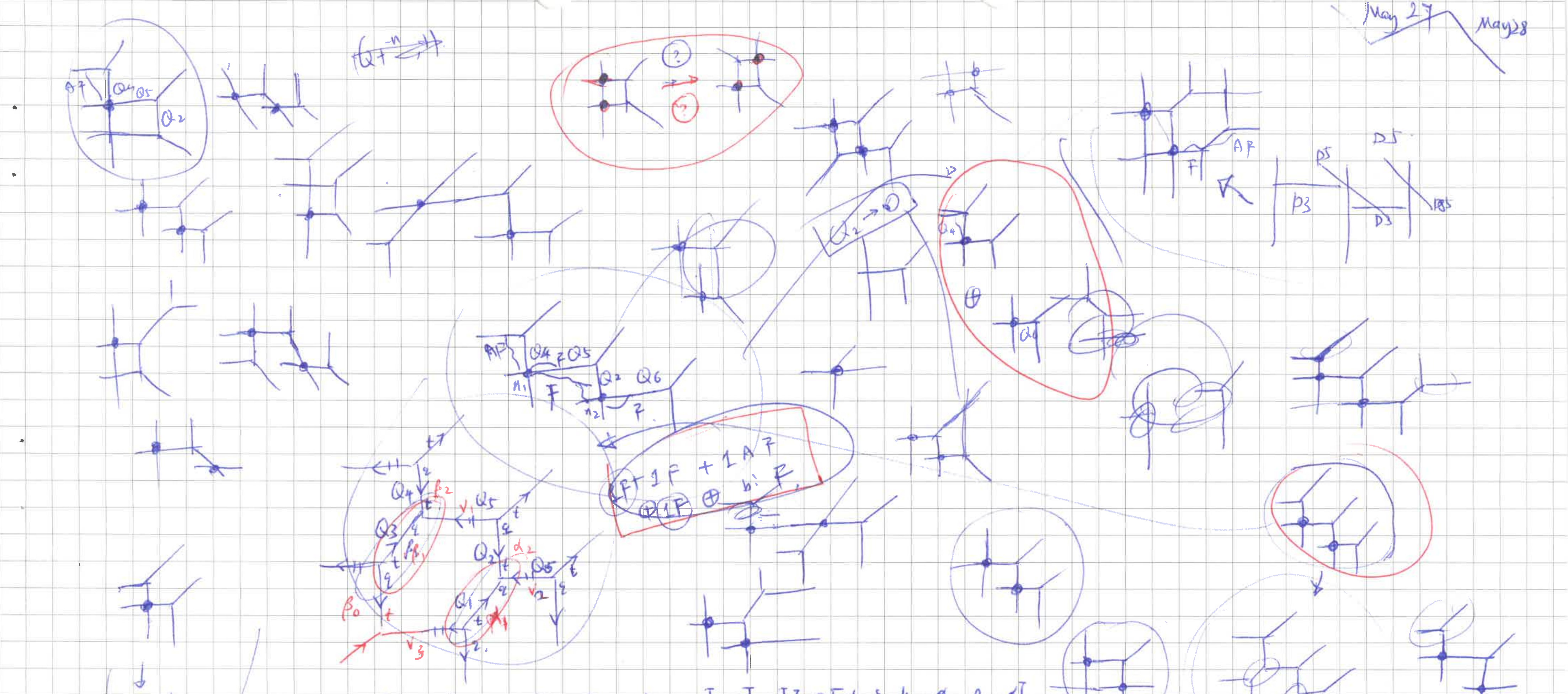
$C[t,q,h_5,\beta_3,\emptyset,\nu_2]\; C[q,t,h_6,\beta_3^T,\emptyset,\emptyset]$

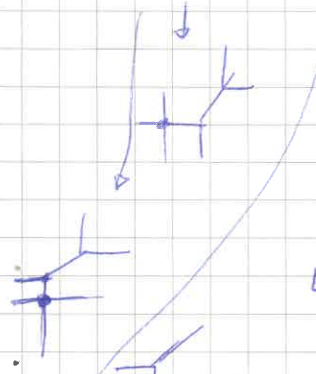
Legfac $= L[Q_1,\nu_1]\, L[Q_2,\nu_2]\, L[Q_3,\beta_1]\, L[Q_4,\beta_2]$

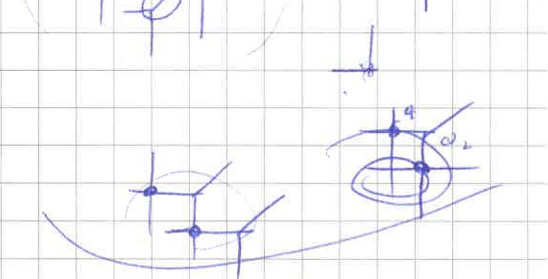
$L[Q_5,\beta_3]$



May 27 May 28





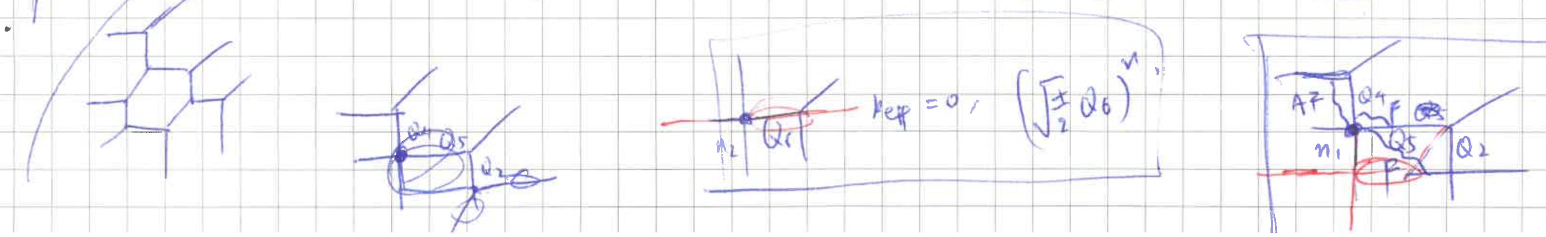


topvex $= C[t, q, \eta_1, \beta_1, \emptyset, \emptyset]\; C[q, t, \eta_2, \beta_1^T, \beta_2^T, \nu_1^T]\; C[t, q, \eta_3, \emptyset, \beta_2, \emptyset]$

$C[t, q, \eta_4, \alpha_1, \emptyset, \emptyset]\; C[q, t, \eta_6, \alpha_1^T, \alpha_2^T, \nu_2^T]\; C[t, q, \eta_7, \emptyset, \alpha_2, \nu_1]$

$C[t, q, \eta_8, \emptyset, \emptyset, \nu_2]$

legface $= L[Q_3, \beta_1]\; L[Q_4, \beta_2]\; L[Q_5, \nu_1]\; L[Q_1, \alpha_1]\; L[Q_2, \alpha_2]\; L[Q_5, \nu_2]$



kep = 0, $\left(\sqrt{\tfrac{t}{2}}\, Q_6\right)^n$

$\left(\frac{t\, q}{\sqrt{t}\, Q_2}\, Q_5\right)^{n_1} \left(\sqrt{t}\right)^{n_1^2}$

$\left(-\sqrt{t}\right)^{n_1^2} \left(\frac{q}{\sqrt{t}\, Q_2}\, Q_5\right)^n$

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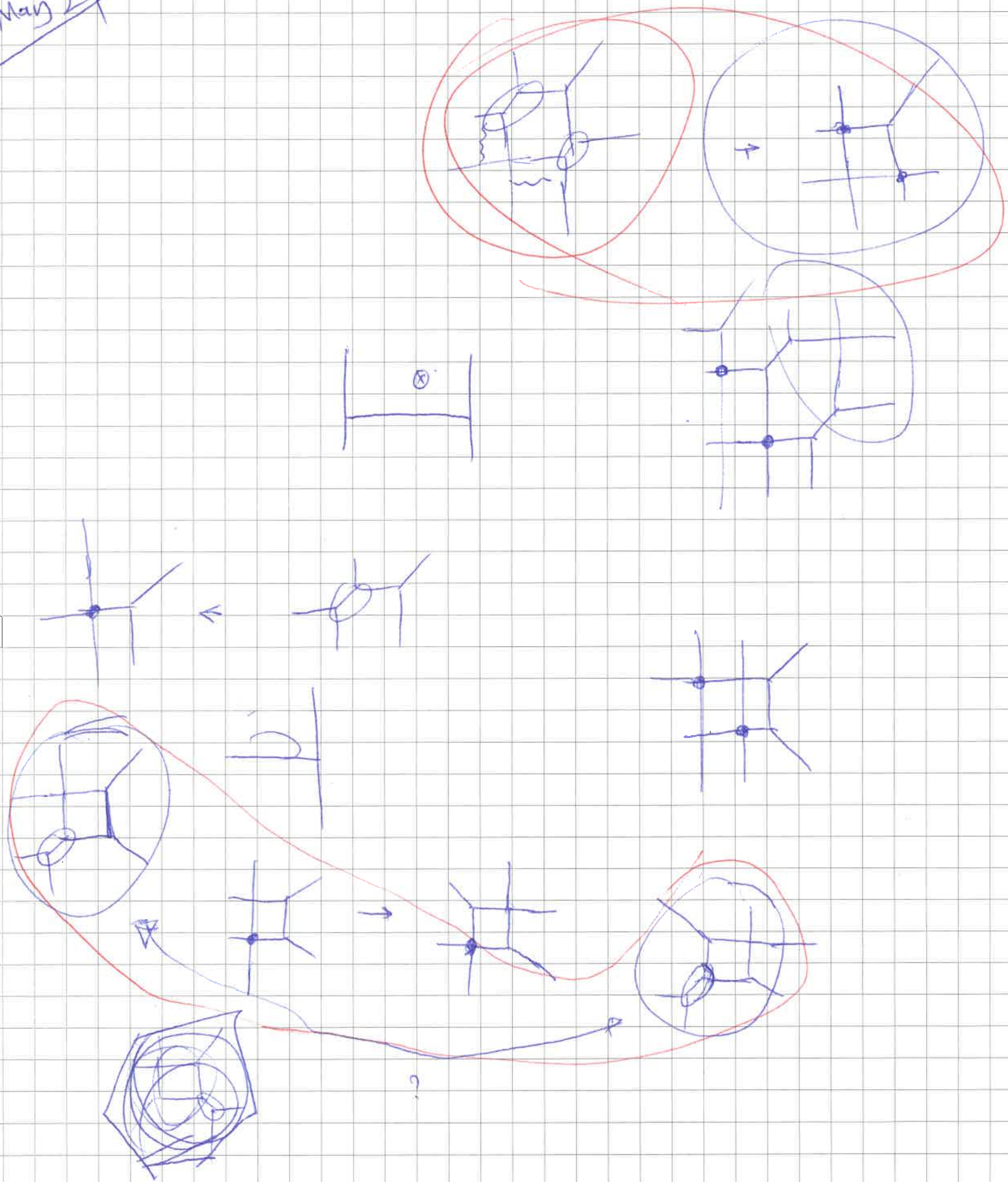
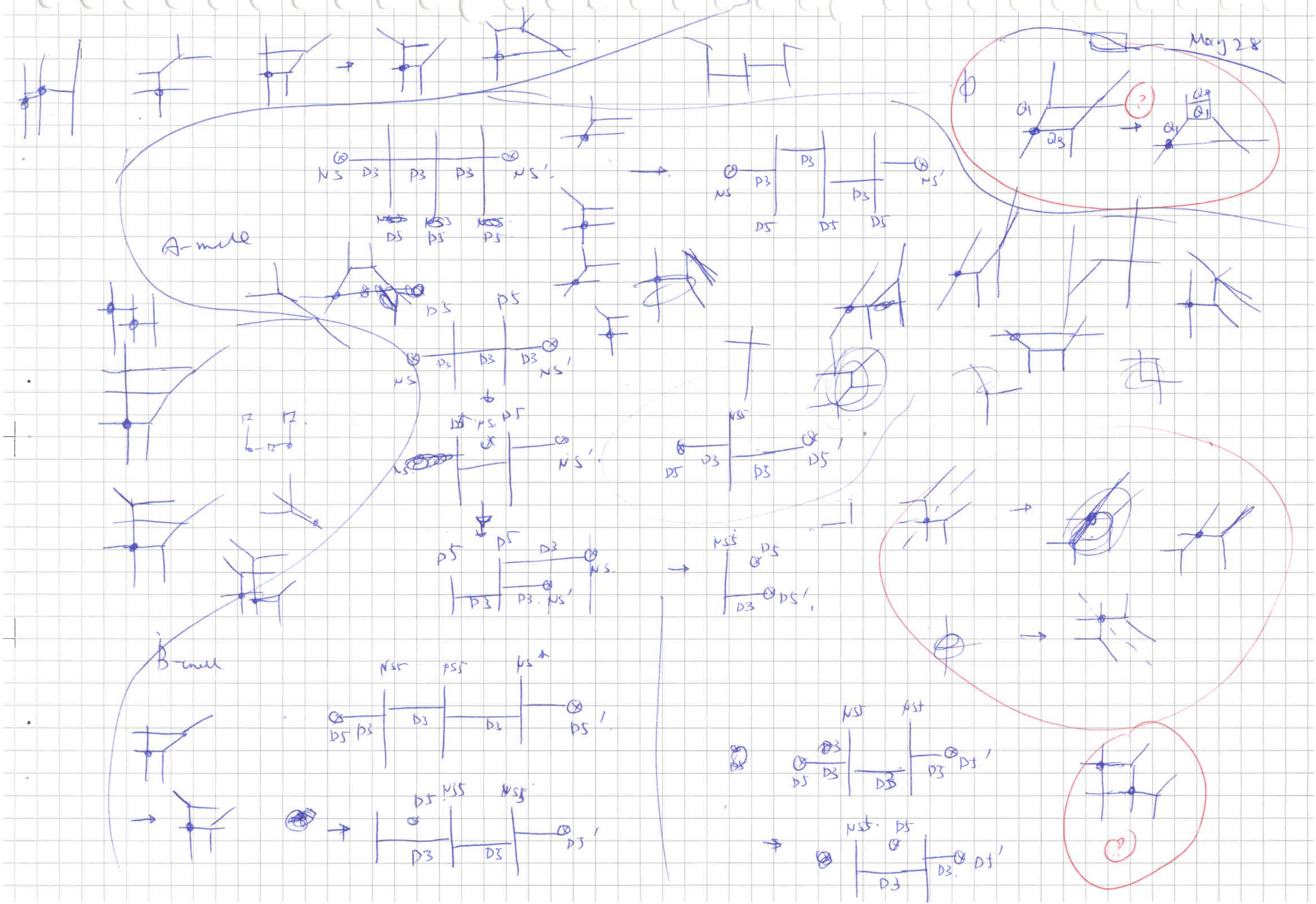
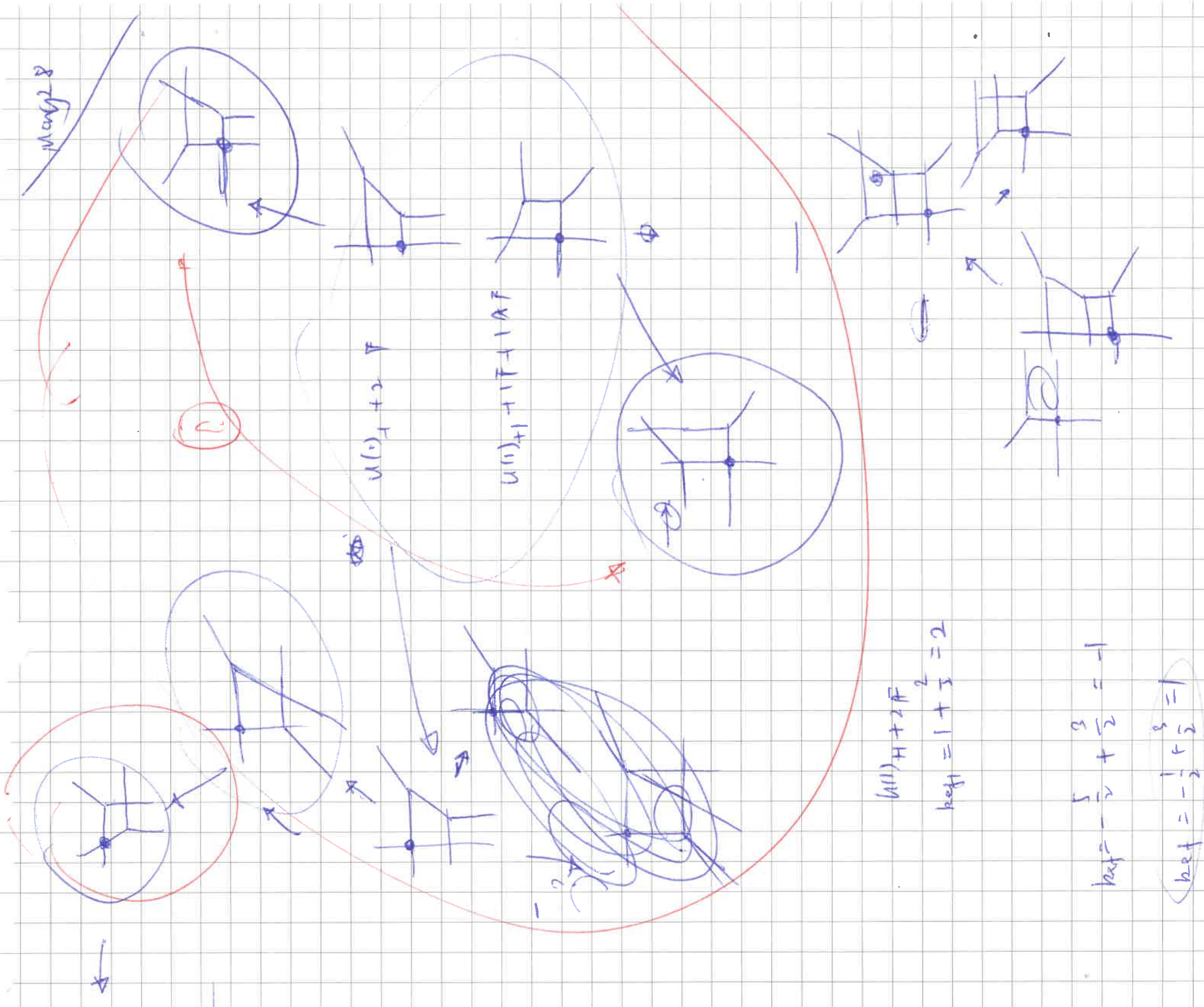



May 28
A-model
B-model
NS
D3
P3
NS'
D5
P5
NS5
D5'
Q1
Q2
Q3



$u(1)_H + 2F$

$h_{eff} = 1 + \frac{2}{2} = 2$

$h_{eff} = -\frac{5}{2} + \frac{3}{2} = -1$

$h_{eff} = -\frac{1}{2} + \frac{3}{2} = 1$

$\nabla \times \vec{E} = -\frac{\partial \vec{B}}{\partial t}$

$\nabla \times \vec{B} = \frac{\partial \vec{E}}{\partial t}$

$\frac{i}{\omega} \nabla \times \vec{B} = \cancel{-i\omega}\, \vec{E}$

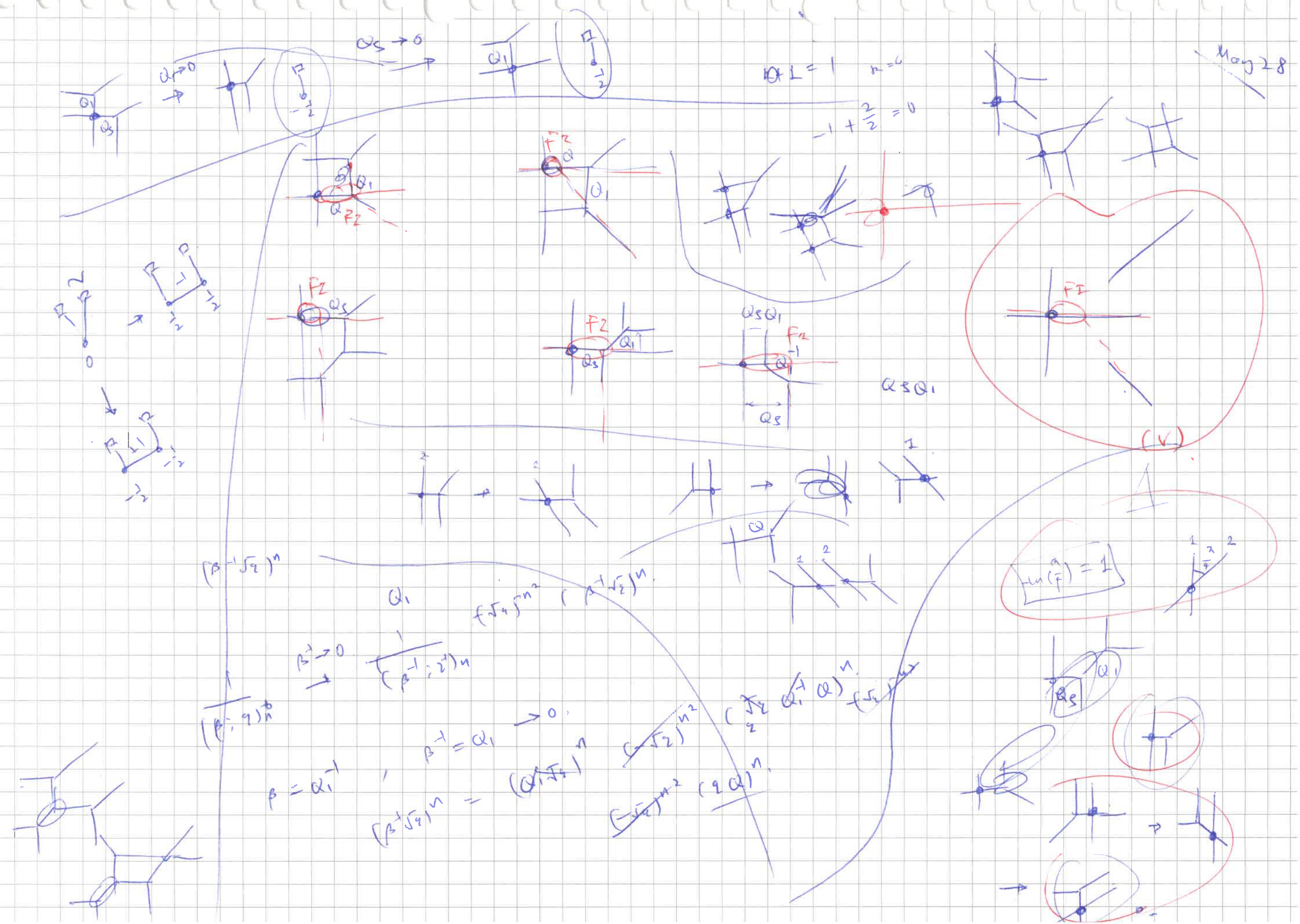
$\frac{ic}{k}$

$\frac{e^{ik(R - \vec{e}_R \cdot \vec{x}')}}{R} \left(1 + \vec{e}_R \cdot \vec{x}' \right)$

$= \frac{\cancel{e^{ik\, \vec{e}_R \cdot \vec{x}'}}}{R} + ik\, \vec{e}_R \cdot \vec{x}' \quad k = \frac{\omega}{c}$

$\nabla \times \vec{B} = -\frac{\partial \vec{E}}{\partial t} \qquad \frac{i \mu_0 \omega}{4\pi R c}$

$= \frac{k}{ic} \vec{E}$



May 28
$Q_1 \to 0$
$Q_5 \to 0$
Q_1
Q_5
$Q1 = 1$
$-1 + \frac{2}{2} = 0$
F2
F1
$Q_5 Q_1$
(V)
Q_1
$(\beta^{-1}\sqrt{q})^n$
$(-\sqrt{q})^{n^2}(\beta^{-1}\sqrt{q})^n$
$\beta^{-1} \to 0$
$\frac{1}{(\beta^{-1};q^{-1})_n}$
$\frac{1}{(\beta;q)_n}$
$\beta = Q_1^{-1}$
$\beta^{-1} = Q_1 \to 0$
$(\beta^{-1}\sqrt{q})^n = (Q_1\sqrt{q})^n$
$(-\sqrt{q})^{n^2}$
$(\frac{\sqrt{q}}{q} Q_1^{-1} Q)^n$
$(-\sqrt{q})^{n^2}(qQ)^n$

$I \, d\vec{l}$ $\qquad I \, d\vec{l}$

$\vec{J} = q \vec{v} \times \vec{B}$ $\quad + q \vec{e}$

15°, 120°, 56

$\nabla \times \vec{E} = -\frac{\partial \vec{B}}{\partial t}$ $\quad W$

$\int \vec{f} \cdot \vec{v} \, dv$ $\qquad \nabla \cdot \vec{B} = 0$

$$\frac{1}{2}\int \rho(\vec{r}\,') \frac{r^2 \vec{r}\,' \cdot \vec{r}\,' - 3(\vec{r} \cdot \vec{r}\,')^2}{r^5} \, d\vec{r}\,'$$

$\nabla \cdot \vec{E} = \frac{\rho}{\varepsilon_0}$

$$= \frac{1}{2} \frac{1}{r^5} \int d\vec{r}\,' \, \rho(\vec{r}\,') \, \frac{\delta_{ij} \, r_i' r_j' - 3 r_i r_j'}{2}$$

$\nabla \times \vec{B} = \mu_0 \vec{J} + \mu_0 \varepsilon_0 \frac{\partial \vec{E}}{\partial t}$

$\nabla \times \vec{E} = -\frac{\partial \vec{B}}{\partial t}$

$$\nabla \times \vec{B} = \mu_0 \vec{J} + \frac{\partial \vec{E}}{\partial t} \frac{(r_i' \, \delta_{ij} \, r_j')^2}{r^3} \quad - 3 \, \vec{r} \cdot \vec{r}\,'$$

$\nabla \times \vec{B} = \vec{J} + \frac{\partial \vec{E}}{\partial t}$

$\nabla^2 \phi = -\frac{\rho}{\epsilon_0}$

$E = -\nabla \phi$

$$\frac{1}{|\vec{r} - \vec{r}\,'|} = \frac{1}{r} + \frac{\vec{r}\,' \cdot \vec{r}}{r^3} + \frac{1}{2} \frac{3(\vec{r} \cdot \vec{r}\,')^2 - \vec{r}\,' \cdot \vec{r}\,' r^2}{r^5}$$

$\dot{p} = \frac{\partial H}{\partial q}$ $\qquad \dot{q} = \frac{\partial H}{\partial p}$

$\nabla \times \vec{E} = -\frac{\partial \vec{B}}{\partial t}$

$3 \, r_i r_j' \quad \delta_{ij} r_i' r_j' \, r^2$

$$= \left(\frac{\partial L}{\partial q} - \frac{d}{dt} \frac{\partial L}{\partial \dot{q}} \right) \delta q_i = 0$$

$p = p_i - q A_i$

$d \cdot \nabla = d_i \partial_i$

$\frac{\partial L}{\partial \dot{q}} \frac{d}{dt} \delta q$

$\delta \frac{d}{dt} q = \frac{d}{dt} \delta q$

$\nabla \left(\frac{1}{r}\right) \nabla$

$$\frac{\vec{p} \cdot \vec{r}}{r^2} + \frac{1}{2}\left(\frac{\vec{p} \cdot \vec{d} \, r^2 - 3(\vec{d} \cdot \vec{r})^2}{r^5}\right)$$

$$\nabla \frac{\vec{p} \cdot \vec{r}}{r^3} + \frac{1}{2}\left(\nabla \frac{}{r^3}\right.$$

Jun 13

May 23

$k^{\text{eff}}=0$ $\qquad$ $k^{\text{eff}}=1$

$$\sum_{n=0}^{\infty}\frac{z^n}{(q,q)_n}=\sum_{n=0}^{\infty}\frac{z^n\,(-\sqrt{q})^{-n^2}(\sqrt{q})^{-n}}{(q^{-1};q^{-1})_n}\xrightarrow{q^{-1}\to\tilde{q}}\sum_{n=0}^{\infty}\frac{z^n(-\sqrt{\tilde q})^{n^2}(\sqrt{\tilde q})^{n}}{(\tilde q;\tilde q)_n}$$

$k=-\frac{1}{2}$

$$(q,q)_n=(q^{-1},q^{-1})_n\,(-\sqrt{q})^{n^2}(\sqrt{q})^{n}$$

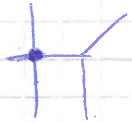
$$(\sqrt{q}\,q^{-1})^{-n}=(q^{+\frac{1}{2}})^{-n}=(\sqrt{q})^{n}$$

$Q=q^{-1}$

$-k^{\text{eff}}+N_F$

$k^{\text{eff}}\xrightarrow{q\to q^{-1}}k^{\text{eff}}+1$

$-k+1$



ST $\rightarrow$

$k_{\text{eff}}=0$, $k=-\frac{1}{2}$ $\qquad$ $k_{\text{eff}}=1$, $k=\frac{1}{2}$

$$\boxed{z\to 0 \overset{?}{=} z^{\text{one-loop}}}$$

$$\boxed{\text{a free chiral} \overset{?}{=} FI\to\infty}$$

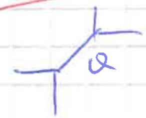
$k+\frac{N_F}{2}\longrightarrow k\to\frac{N_F}{2}$, $\tilde q=q^{-1}$

$k+\frac{N_F}{2}\xrightarrow{q\to\tilde q^{-1}}-k+\frac{N_F}{2}$

$$\frac{(-\sqrt{q})^{-n^2}}{(Q,q)_n}\simeq\frac{1}{(Q^{-1};\tilde q)_n}$$

$$\frac{1}{(Q,\tilde q^{-1})_n}\not\simeq\frac{(-\sqrt{\tilde q})^{n^2}}{(Q^{-1};\tilde q)_n}$$

$$(-\sqrt{q})^{k_{\text{eff}}n^2}\to(-\sqrt{\tilde q})^{-k_{\text{eff}}n^2}$$

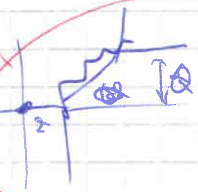


$z\to 0$ $\qquad$ Q

$$z^{3d}=\frac{1}{(Q;q)_\infty}=z^{\text{one-loop}}$$

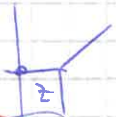
$z\to 1$ $\qquad$ $z\to 1$

$$z^{3d}=\frac{1}{(Q;q)_\infty}$$



$$z^{3d}=\frac{1}{(Q;q)_\infty}\sum_{n=0}^{\infty}z^n\frac{(Q;q)_n}{(q;q)_n}=\frac{(zQ;q)_\infty}{(q;q)_\infty(Q;q)_\infty}$$

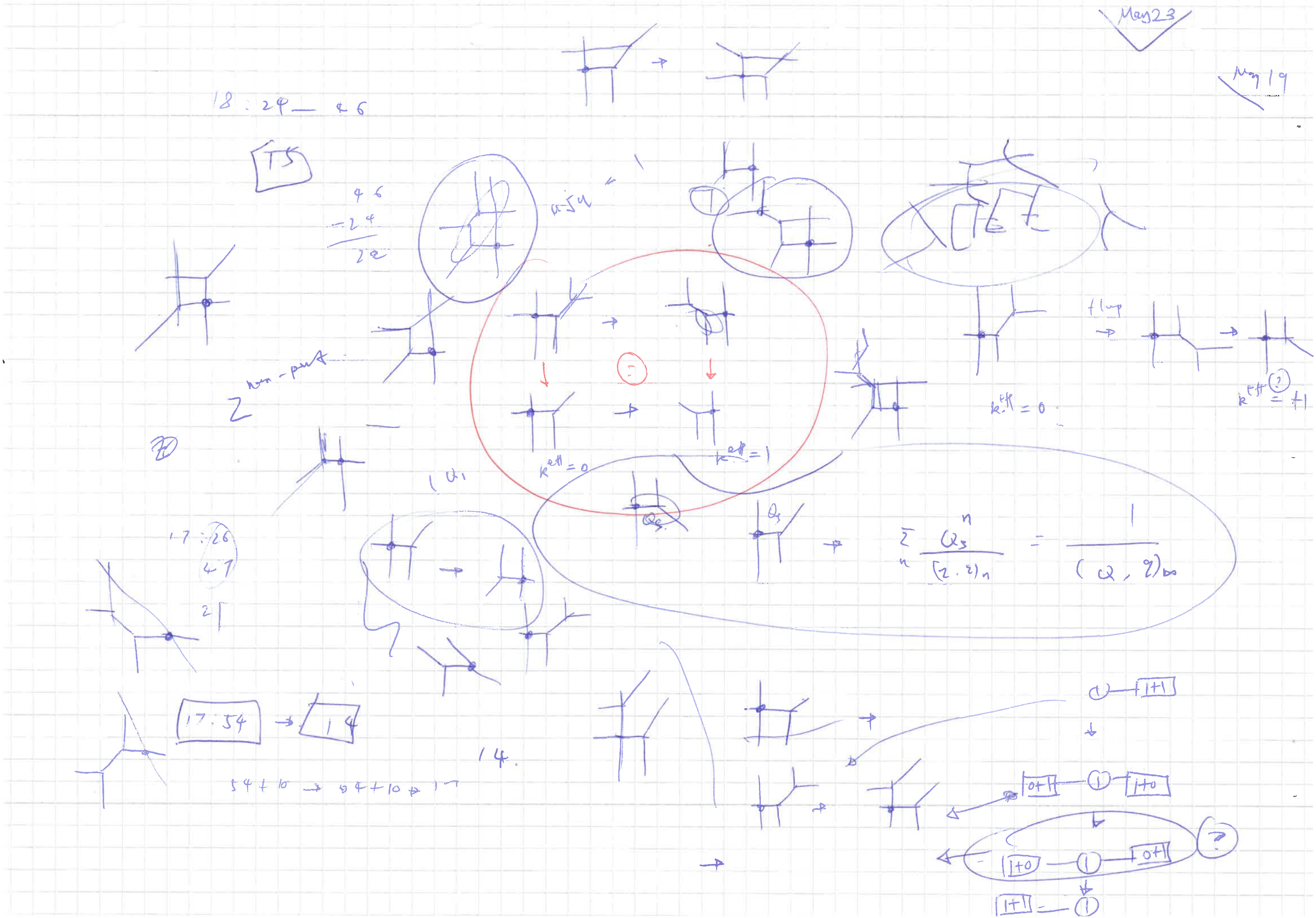
$\mathcal{N}=2$ superpotential



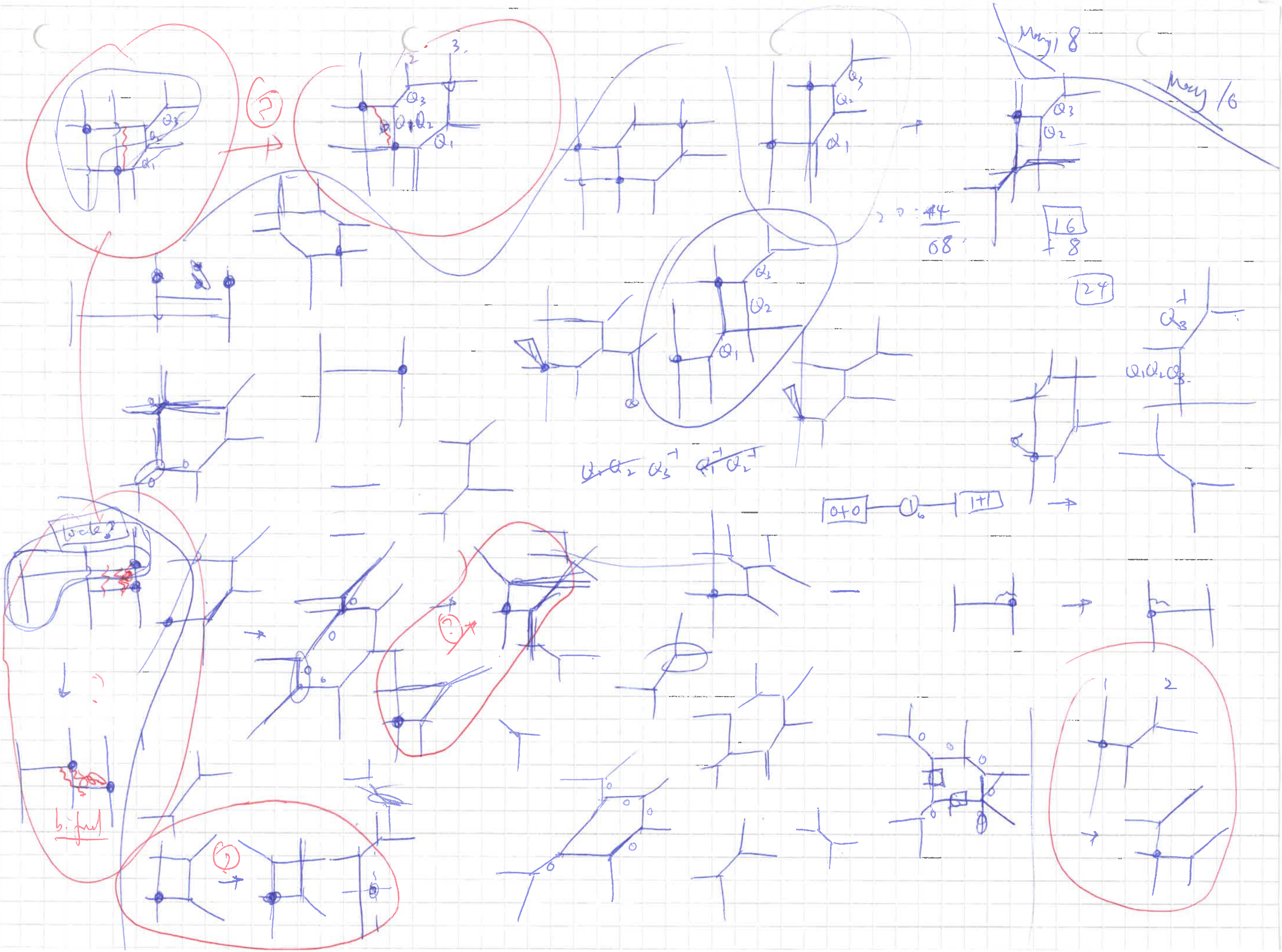
$$z^{3d}=\sum_{n=0}^{\infty}z^n\frac{1}{(q;q)_n}=\frac{1}{(z;q)_\infty}$$

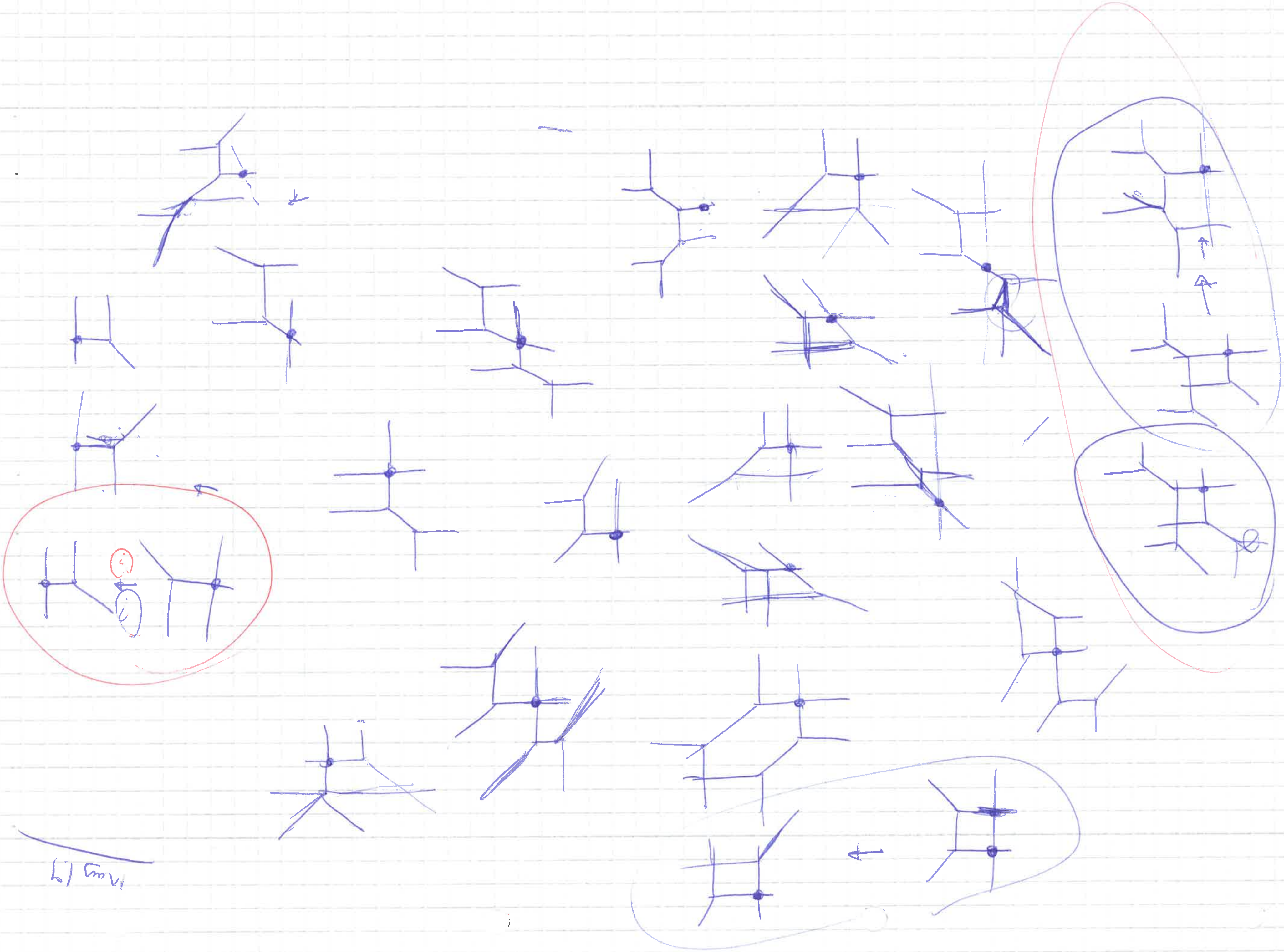
$z\to 0$

$$\boxed{\longrightarrow z^{3d}=1}$$



May23
May 19
18 : 24 — 46
15
46
−24
22
flop
non-pert
$k^{eff} = 0$
$k^{eff} = 1$
$k^{eff}(?) = +1$
Q_s
$\sum_n \frac{Q_s^n}{(q,q)_n} = \frac{1}{(Q,q)_\infty}$
17 : 26
47
21
17 : 54
14
54 + 10 → 94 + 10 → 104
1+0
0+1
1+1
?


May 18
May 16
Q3
Q2
Q1
16
+ 8
24
44
68
Q1Q2Q3
Q1 Q2 Q3^-1 Q1^-1 Q2^-1
0+0
1+1
wake?
bifurl
2
3
1



b) Conv

Apr 30

$$\frac{1}{(q^{-1},q^{-1})_n} = \frac{(-q)^n (\sqrt{q})^{n^2-n}}{(q,q)_n}$$

$$(qz^{-1},z)^p = \frac{\theta(-q^{-\frac{1}{2}}z)}{(z,q)_\infty} = \frac{\theta(-q^{-\frac{1}{2}}z)}{\theta(-q^{-\frac{1}{2}}\cdot z^{-1})} \quad (qz^{-1};z)_\infty$$

$\theta(-q^{-\frac{1}{2}}z^{-1})$

$n \to -n$

$q^{-1}z = q z_1^{-1}$

$z_1 = q z^{-1}$

Mar 09

$$\left(\frac{\beta^{-1}q}{\sqrt{t}}\right)^n \sqrt{t}$$

$1 = \frac{1}{2} + \frac{1}{2}$

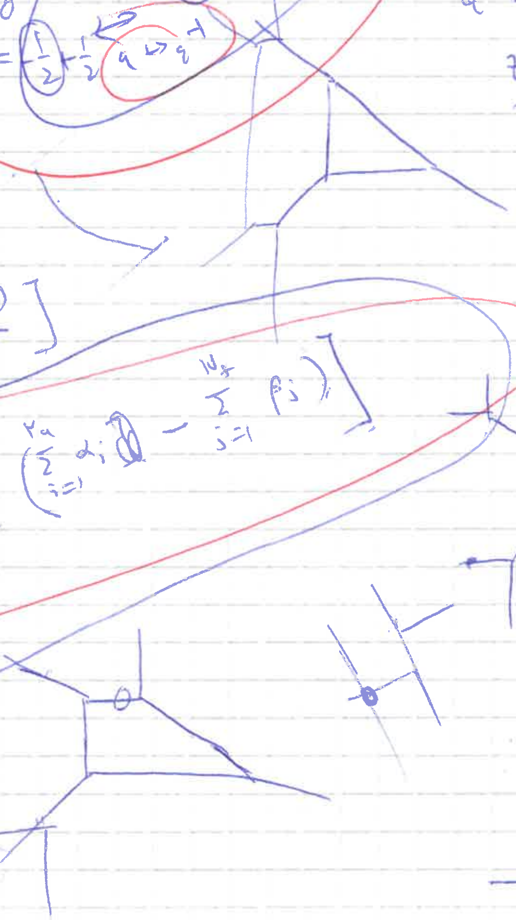
$0 = -\frac{1}{2} + \frac{1}{2}$

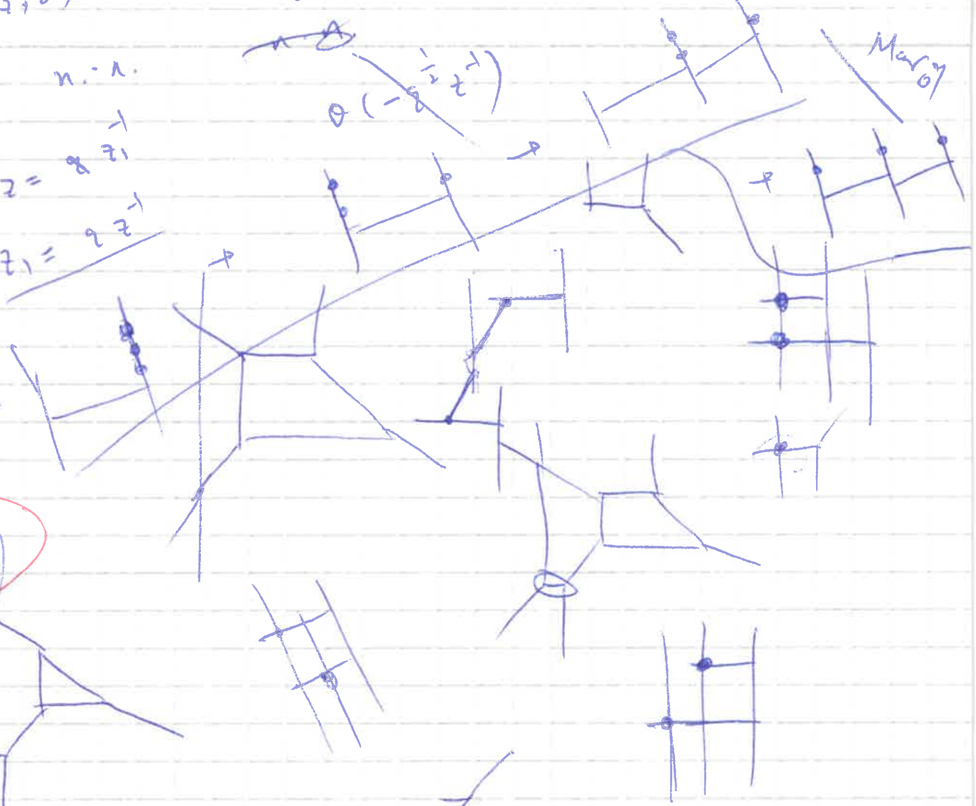
$q \leftrightarrow q^{-1}$

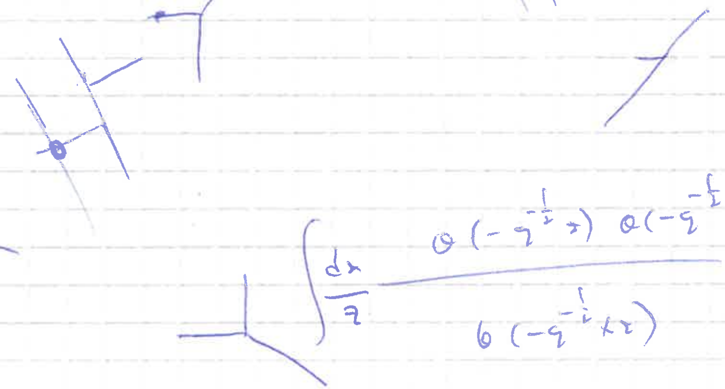
$$\prod_{a=1}^{N_c} \prod_{j=1}^{N_a} q^{-n_i n_j} \to (-\sqrt{q})^{-2n_i n_j}$$

$$(\alpha_i;q)_n = PE\left[\frac{\alpha(q^n-1)}{1-q}\right]$$

$$\frac{\prod_{i=1}^{N_a}(\alpha_i;q)_n}{\prod_{j=1}^{N_f}(\beta_j;q)_n} = PE\left[\frac{(q^n-1)}{1-q}\left(\sum_{i=1}^{N_a}\alpha_i - \sum_{j=1}^{N_f}\beta_j\right)\right]$$







$$\int \frac{dx}{x} \frac{\theta(-q^{-\frac{1}{2}}x)\,\theta(-q^{-\frac{1}{2}}x)}{\theta(-q^{-\frac{1}{2}}xz)} \int \frac{dz_1}{z_1} \frac{\theta(-q^{-\frac{1}{2}}z_1)\,\theta(-q^{\frac{1}{2}}z)}{\theta(-q^{-\frac{1}{2}}zz_1)}$$

$r = s = k = 1$

$2 \times 2 - 1$

Apr 27

$q\cancel{z}\, z^{-1} = q\tilde{z}^{-1}$

$qz = \tilde{z}$ $\quad z^{-1}0=$

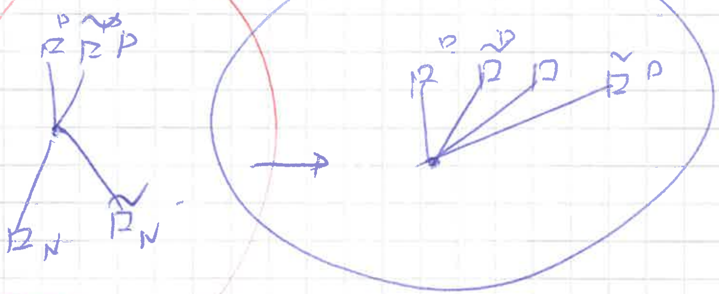
$t=-1$

$$\frac{(q;q)_\infty\,(z;q)_\infty\,(z^{-1};q)_\infty}{(\cancel{z};q)_\infty\,(qz;q)_\infty\,(qz^{-1};q)_\infty}$$

$(\tilde{z};q)^2$

$$= \frac{(z;q)_\infty\,(qz^{-1};q)_\infty\,(z^{-1};q)_\infty\,(qz;q)_\infty}{(qz^{-1};q)_\infty^2\,(qz;q)_\infty^2}$$

$$= \boxed{\frac{\theta(-q^{-\frac{1}{2}}z)\,\theta(-q^{\frac{1}{2}}z)}{[(qz;q)_\infty(qz^{-1};q)_\infty]^2}}$$

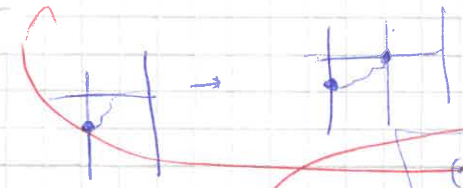


$U(1)_1$ + adj Φ $\longleftrightarrow$ 2 free chiral.

Could this be interpreted using plumbing graph ?

How the Higgsing of □+□ change 2d boundary theory $\theta(z;\cdot)$

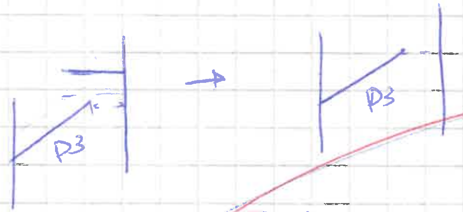
or how it changes boundary conditions ??



~~Mayft~~

$$\frac{(q;q)_\infty}{(q;q)_n} = \frac{1}{(\sqrt{q})^n}\sum_{d=0}^{\infty}(-\sqrt{q})^{-n^2-2nd}\frac{1}{(q;q)_d} = \frac{(\sqrt{q})^{n^2}}{(\sqrt{q})^n}\sum_{d=0}\frac{q^{-nd}}{(q,q)_d}$$

$$(q;q)_\infty\sum_{n=0}^{\infty}(-\sqrt{q})^{k_{eff}n^2-n}\frac{z}{(q;q)_n} = \sum_{n=0}^{\infty}(\sqrt{q})^{(k_{eff}-1)n^2-2nd}\frac{\left(\frac{z}{\sqrt{q}}\right)^n (\ldots)^d}{(q,q)_d}$$



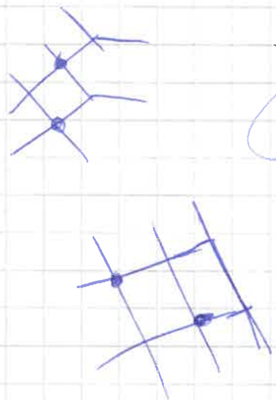
$$\frac{(q;q)_\infty}{(q;q)_n} = \sum_{d=0}^{\infty}(-\sqrt{q})^{2nd+d^2}\frac{1^d}{(q,q)_d}$$

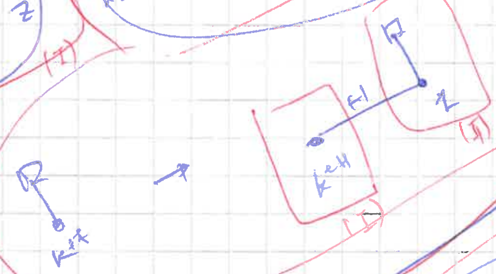
$$k_{eff} = \frac{N_f}{2} - \frac{N_a}{2} + N_a - N_f$$

$$(q;q)_\infty\sum_{n=0}(-\sqrt{q})^{k_{eff}n^2}\frac{z^n}{(q;q)_n} = \sum_{n=0}^{\infty}\sum_{d=0}^{\infty}(-\sqrt{q})^{k_{eff}n^2+2nd+d^2}\frac{z^n}{(q,q)_d}$$

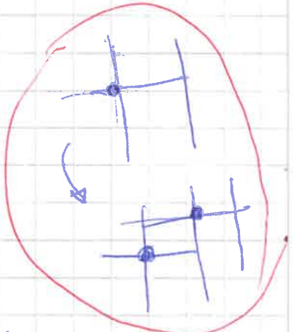
$$= \sum_{n=0}^{\infty}(-\sqrt{q})^{k_{eff}n^2}z^n \sum_{d=0}(-\sqrt{q})^{d^2}\frac{\left[(\ldots)^n\right]^d}{(q,q)_d}$$

(I) (II)

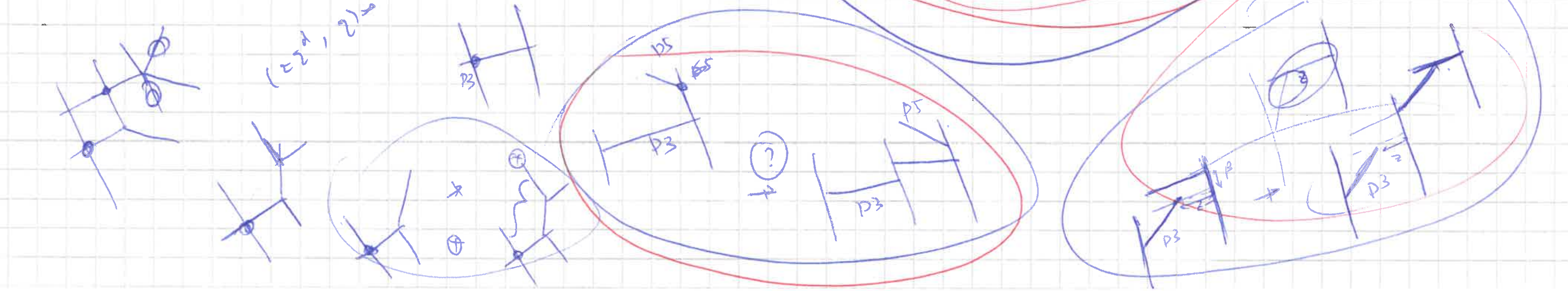


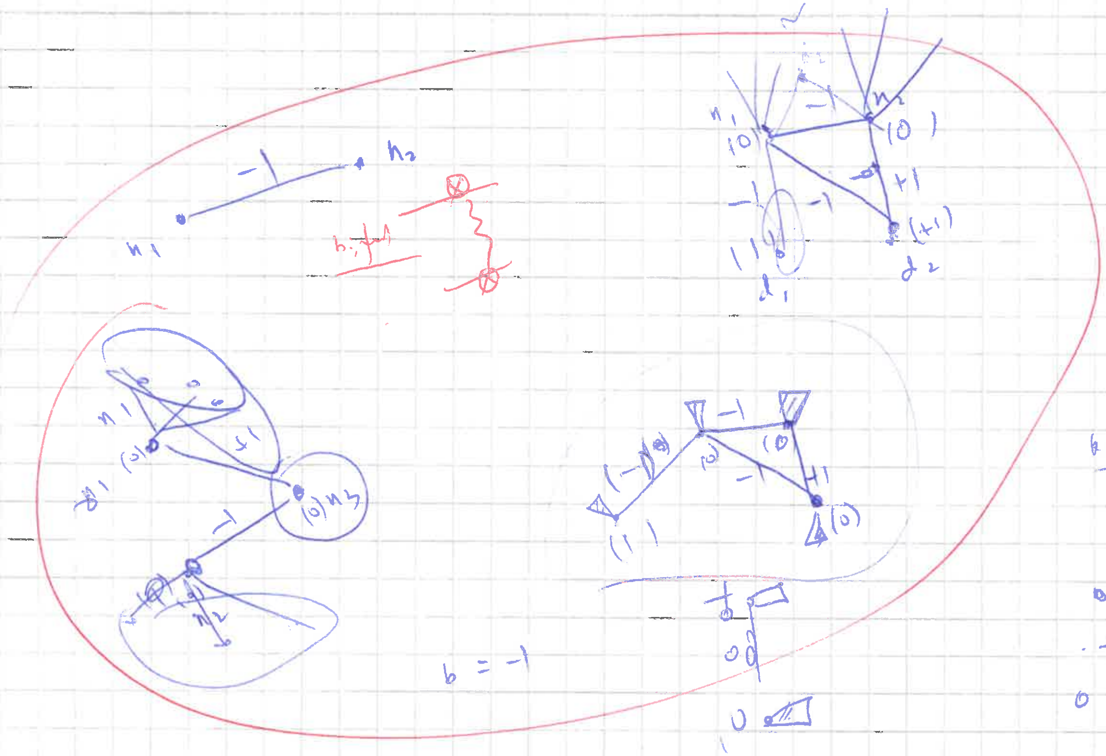


$k^{\pm1}$ (I) $k^{\pm1}$ (II)

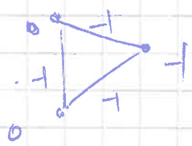


$(zq^d, q)_\infty$





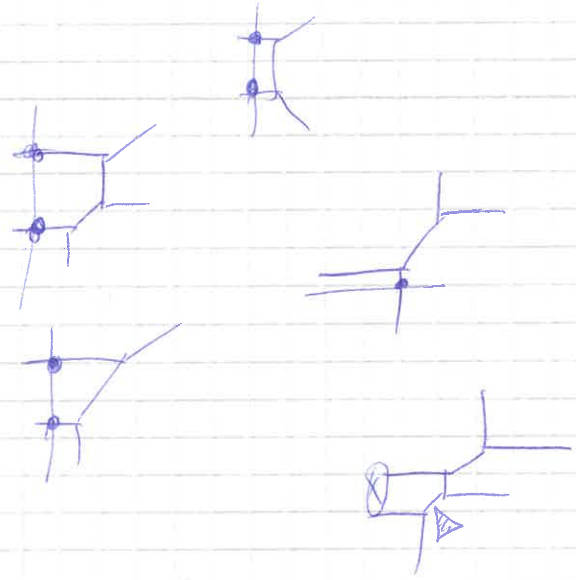
$b = 0 \quad r = 0, \; s = 0$



$r-1 =$

$g-1$

Apr 2 6



$11 - 6 = 5$

$K_{IJK} = D_I \cdot D_J \cdot D_K$

$$\int_{X_3} \underbrace{\omega_I \wedge \omega_J \wedge \omega_K \wedge A^I \wedge F^J \wedge F^K}_{11} = K_{IJK} \underbrace{A^I \wedge F^J \wedge F^K}_{5}$$

5d,

$$= \int_{X_3} (A^I \wedge \omega_I) \wedge (F^J \wedge \omega_J) \wedge (F^K \wedge \omega_K)$$

$$\int dB \wedge (A^I \wedge \omega_I)$$

$C_3 = A^I \wedge \omega_I$

$G_4 = dC_3 = dA^I \wedge \omega_I = F^I \wedge \omega_I$

$C_3 \wedge G_4 \wedge G_4 = (A^I \wedge \omega_I) \wedge (\cancel{d} F^J \wedge \omega_J) \wedge (F^K \wedge \omega_K)$

n 5

6 - 1

$$\int_{X_4} A^I \wedge F^J$$

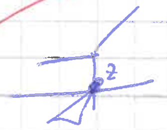
3d, $K_{IJ} = D_I \cdot D_J \cdot G_4$

$$= \int_{X_4} \underbrace{\omega_I \wedge \omega_J \wedge G_4 \wedge A^I \wedge F^J}_{4 + 4 + 3 = 11} = K_{IJ} A^I \wedge F^J$$

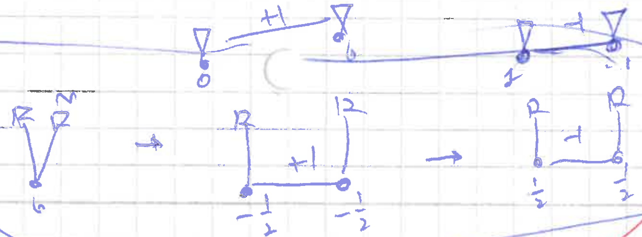
$$= \int_{X_4} (A^I \omega_I) \wedge (F^J \wedge \omega_J) \wedge G_4 = \int_{X_4} (C_3 \wedge G_4) \wedge G_4$$

~~Apr 25~~

$= \frac{1}{(z,t)_\infty}$



$= (z,t)_\infty$

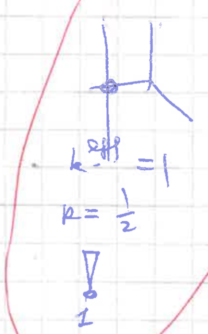


$+ \frac{(Q-1)z}{1-z}$

$\beta_i = 0$, $\alpha = Q$,

$= \frac{(-1+Q)z}{-1+z}$

$$\sum_{n=0} (\tilde z \alpha)^n \frac{(\alpha\sqrt{\frac{t}{q}},t)_n}{(t,t)_n} = \frac{(\tilde z \alpha \sqrt{\frac{t}{q}}, t)_\infty}{(\tilde z \alpha, t)_\infty}$$

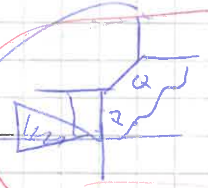


$k^{eff} = 1$

$k = \frac{1}{2}$

$k^{eff} = 0$ $k = -\frac{1}{2}$

$$\frac{1}{(z,t)_\infty} = \sum_{n=0}^\infty \frac{z^n}{(t,t)_n}$$



$$= \frac{(z\frac{t}{q},t)_\infty}{(zQ\sqrt{\frac{t}{q}},t)_\infty}$$

$\begin{bmatrix} 0 & +1 \\ +1 & 0 \end{bmatrix}$

$\begin{bmatrix} 0 & -1 \\ -1 & 0 \end{bmatrix}$

$=$

is it trivial?

$z=1$ } one-loop

$$= \frac{(z\frac{t}{q},t)_\infty}{\ominus}$$

$k_{eff} = 1$

only if $z = \sqrt{\frac{q}{t}}$

$(Q\sqrt{\frac{t}{q}})$

$(z\sqrt{\frac{t}{q}},t)_\infty$

$$1 = \frac{(zQ\frac{t}{q},t)_\infty}{(z\sqrt{\frac{t}{q}},t)_\infty} = \sum_{n=0}^\infty \frac{(Q\sqrt{\frac{t}{q}})^n (Q\sqrt{\frac{t}{q}},t)_n}{(t,t)_n}$$

$(zQ\frac{t}{q},t)_\infty$

$$\frac{(zQ\frac{t}{q},t)_\infty}{(z\sqrt{\frac{t}{q}},t)_\infty} \cdot \frac{(t,t)_\infty}{(Q\sqrt{\frac{t}{q}},t)_\infty} = P_{c_{ij}}(x)$$

If $z = \sqrt{\frac{q}{t}}$,

then $P_{c_{ij}}(0) = 1$.

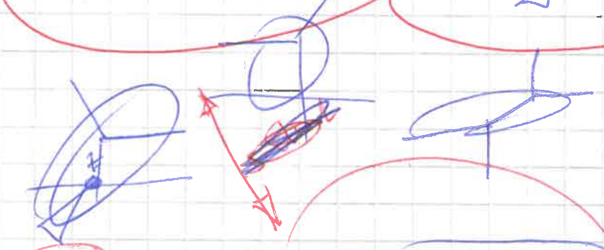
$\tilde z^n \frac{(z,t)_\infty}{(t,t)_n}$

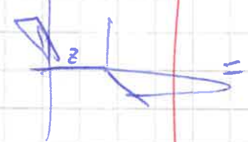
$$= \sum_{d,n} \frac{(-\sqrt{q})^{2nd}\, \tilde z^n Q^d}{(t,t)_n (t,t)_d}.$$

$$\sum_{n=0} (\tilde z)^n \frac{(\alpha\sqrt{\frac{t}{q}},t)_\infty}{(t,t)_n}$$

$(t,t)_\infty$

S-dual





Apr 24

$$\Theta^{k_{ij}}(x) = \Theta(x^{k_{ij}}) \rightarrow \frac{k_{ij}}{2}\, \delta^2.$$

$$\frac{\Theta(x)}{\Theta(y)} = \frac{\delta^2 - \gamma^2}{2}$$

$$\left[\frac{\Theta(x_i)\,\Theta(x_j)}{\Theta(x_i x_j)}\right]^{k_{ij}} \qquad \frac{k_{ij}}{2}\, \delta_i \delta_j$$

$\vec{n} \in \mathbb{Z}^L$

$n_i \in \mathbb{Z}$

$k_{ij} n_i = m_i$

$i \quad j$

$$\frac{(\delta_i + \delta_j)^2}{2}.$$

$$= \frac{\Theta(x_i^{k_{ij}})\,\Theta(x_j^{k_{ij}})}{\Theta(x_i^{k_{ij}} x_j^{k_{ij}})} = q^{\frac{n^2}{2}k_{ij}}\, x_i^{n} \sum_{m_i m_j} \sqrt{q}^{\frac{m_i m_j}{k_{ij}}}\, x_i^{m_i} x_j^{m_j}$$

$(q^{\frac{1}{2}})^{i}$

$$\sqrt{2}^{\frac{m_i m_j}{k_{ij}^2}} \quad n_i \qquad m_i m_j.$$

$k_{ij} n = m$

$$\vec{m} \in k \cdot \mathbb{Z}^L$$

$\tilde{q}^{\frac{1}{4}} \qquad q = q$

$q \to q^{\frac{1}{2}}$

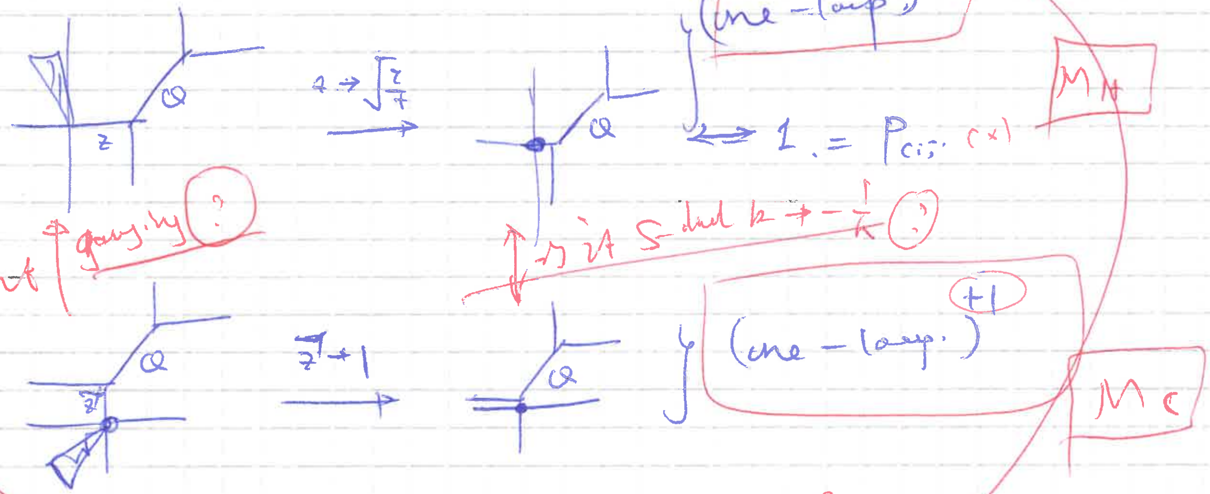
$\mathbb{Z}/2\mathbb{Z} = \mathbb{Z}_2$

$$(m_i + a)(m_j + a_j) \qquad x_i^{m_i + a},$$

$$\frac{\sqrt{q}^{\frac{m_i a_i}{k_{ij}}}\;\sqrt{q}^{\frac{m_j m_j}{k_{ij}}}\;\sqrt{q}^{\frac{a_i a_j}{k_{ij}}}\;x_i^{a_i}\, x_i^{m_i}\; x_j^{a_j}\, x_i^{m_j}}{\sqrt{q}^{\frac{m_i m_j}{k_{ij}}}\;\underbrace{\left(\sqrt{q}^{\frac{a_i}{k_{ij}}} x_i\right)}_{\tilde{x}_i}^{m_i}\;\underbrace{\left(\sqrt{q}^{\frac{a_j}{k_{ij}}} x_j\right)}_{\tilde{x}_j}^{m_j}} \qquad \sqrt{2}^{\frac{a_i a_j}{k_{ij}}}$$

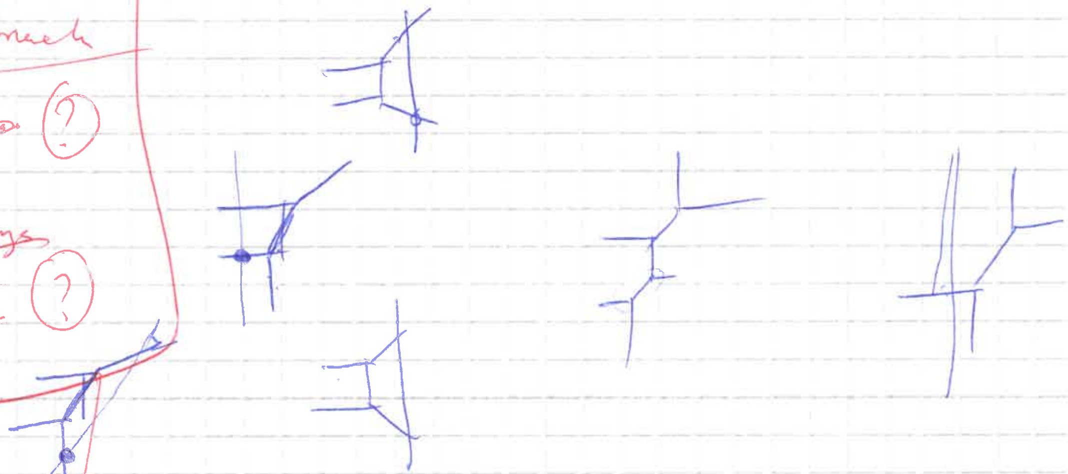
Apr 26

~~Apr 25~~



Is there mixed branch caused by GWs ?

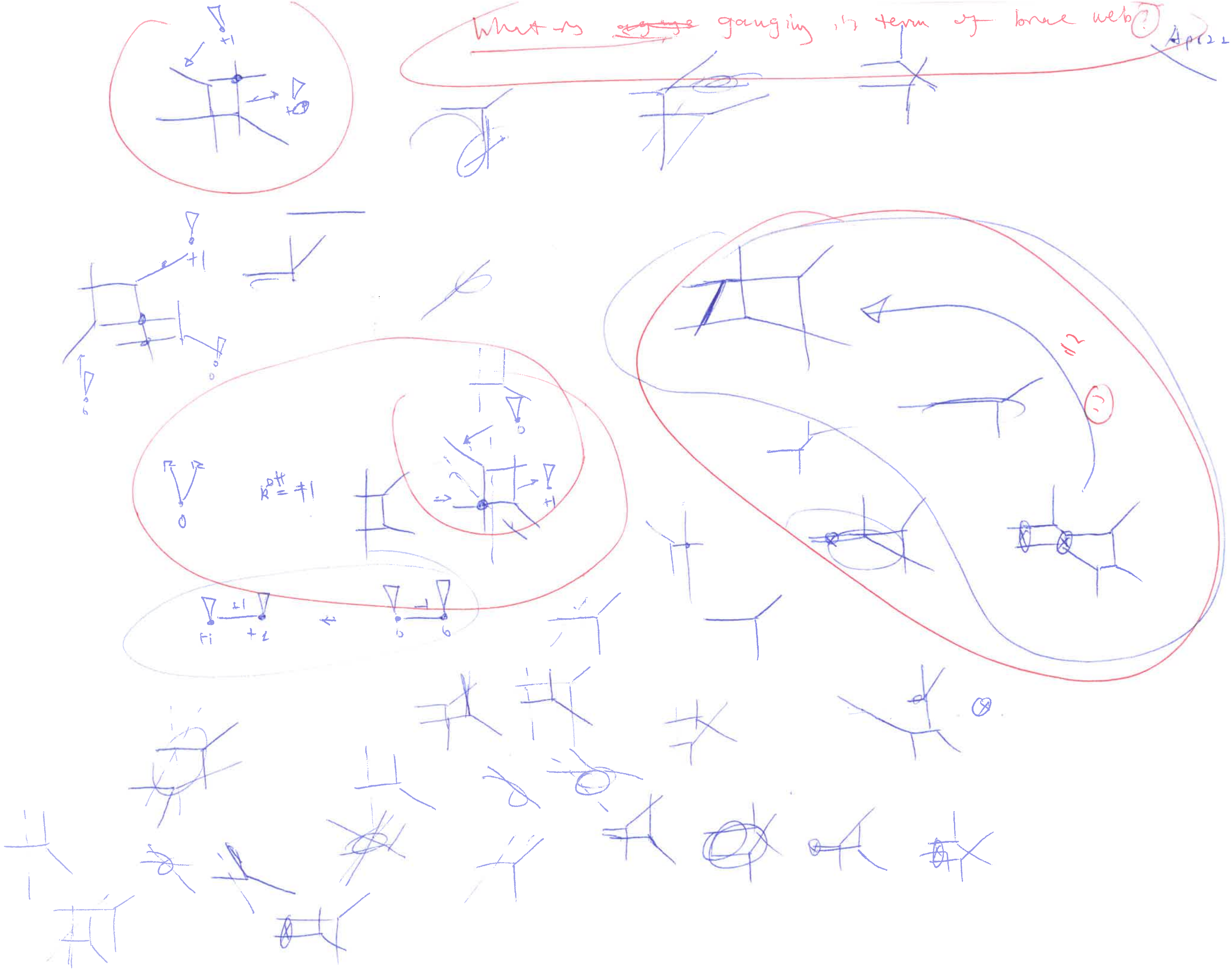
Is the extra open strings some states in M_C ?



What is the ST-conf. for brane webs ?

What is ~~gauge~~ gauging in term of brane web ?

Apr 22



Apr 21

$k \in \mathbb{Z}$

$\boxed{\frac{1}{k+1} = m \in \mathbb{Z}}$ $\Rightarrow$ $k=0,\ m=1$; $k=-1,\ m=\infty$; $k=-2,\ m=-1$

$\frac{1}{m} = k+1$

$\boxed{k=-3}$

$k+1 = m$

SQED: $(k=0)$

$T^a \to T^{a+1} S T$

$T^{a-1} S$

$a+1-\frac{1}{1} = a$

$a-1+(+1) = a$

$T^a \to T^a \boxed{T S^{-1} T}$

$T^a \to T^a \boxed{T^{-1} S^{-1} T}$

$T^a \to T^{a+1} S T = T^a \boxed{T S T}$

$T^a \to T^{a-1} S T^{-1} = T^a \boxed{T^{-1} S T^{-1}}$

$\begin{bmatrix} 0 & 1 & 2 \\ 1 & -2 & -3 \\ 2 & 3 & -3 \end{bmatrix}$

$k = 0, \pm 1, \pm 2$

$\Rightarrow k^{eff} = \boxed{-1, 0, 1, 2, 3}$

$= k+1$

$k=+1$ $\begin{bmatrix} 1 & -1 \\ -1 & 0 \end{bmatrix}$

$k=-1$ $\begin{bmatrix} 1 & +1 \\ +1 & 0 \end{bmatrix}$

$\begin{bmatrix} k+1 & 1 \\ 1 & 1 \end{bmatrix}$, $\begin{bmatrix} k & -1 \\ -1 & 0 \end{bmatrix}$

$k^{eff}=0$

$k^{eff}=-1$

Is it to prove the [illegible] in terms of [illegible] to be one?

$a+1 = r+s-2k$

$r + \frac{a+1-s}{2} = 2(r-$

$4\overline{)180}$

Apr 21

$S = \begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}$, $T = \begin{pmatrix} 1 & 1 \\ 0 & 1 \end{pmatrix}$

$T = \begin{pmatrix} 1 & 0 \\ 1 & 1 \end{pmatrix}$

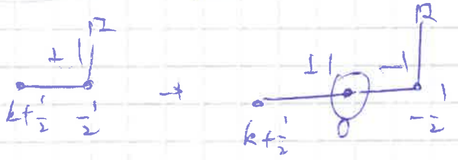
$(ST)^3 = 1$

$S^2 = \cdot e$

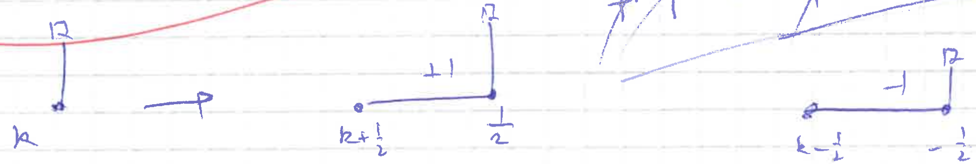
$S^{-1} = \begin{bmatrix} 0 & 1 \\ -1 & 0 \end{bmatrix}$

$T^{-\frac{1}{2}}$ $T^{\frac{1}{2}} S T^{\frac{1}{2}}$

$T^{-\frac{1}{2}} S T^{-\frac{1}{2}}$



$T^k T = T^k T^{-\frac{1}{2}} S T^{\frac{1}{2}} \cancel{T}$



$T^{-\frac{1}{2}} \quad T^{\frac{1}{2}} S T$

$T^{k+\frac{1}{2}}$ $T^{k+\frac{1}{2}} S T_1$

$T^{\frac{1}{2}} S T^{\frac{1}{2}}$

$\boxed{T^{\frac{1}{2}} S T = S^{-1}}$

$ST = (-)\ TS\ TS\ TS$

$ST = \begin{bmatrix} -1 & -1 \\ 1 & 0 \end{bmatrix}$

$TS = \begin{bmatrix} 0 & -1 \\ 1 & -1 \end{bmatrix}$

$\boxed{TST}$

$(ST)^2$ S^{-1}

$T^{\frac{1}{2}} = T^{\frac{1}{2}} S T^{-\frac{1}{2}} S T^{-1} = (-) T S T S$

$\boxed{T^{\frac{1}{2}} = S^{-1}}$

$\boxed{S T^{-1} S = TST}$

$\boxed{STS = T^{-1} S^{-1} T^{-1}}$

$T^{-\frac{1}{2}}$

$ST =$

$(T^{\frac{1}{2}})^2 = T$

$T^{\frac{1}{2}} = \begin{bmatrix} -1 & 0 \\ -\frac{1}{2} & -1 \end{bmatrix}$

$T^{\frac{1}{2}} = \begin{bmatrix} 1 & 0 \\ \frac{1}{2} & 1 \end{bmatrix}$

$T = \begin{bmatrix} 1 & 0 \\ 1 & 1 \end{bmatrix}$

$T^{k_1} (S T^{-1} S) T^{k_2} \Longleftrightarrow T^{k_1} (T S T) T^{k_2}$

$T \boxed{(S T^{-1} S)} T^k \longrightarrow T^{k_1} (T^{-1} S^{-1} T^{-1}) T^{k_2}$

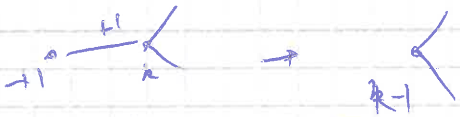
$T^{\frac{1}{2}} \to T^{\frac{1}{2}} S T$

$TST^{-1}STS^{-1}$

$T^{k_1} S T^{-1} = T^{k_1+1}$

$TSTST = S^{-1}$

$T.S$



$\boxed{S T^{-1} = TS}$

$S T T^{k}$ $(S T^{-1} S) = T^{k+1} S$

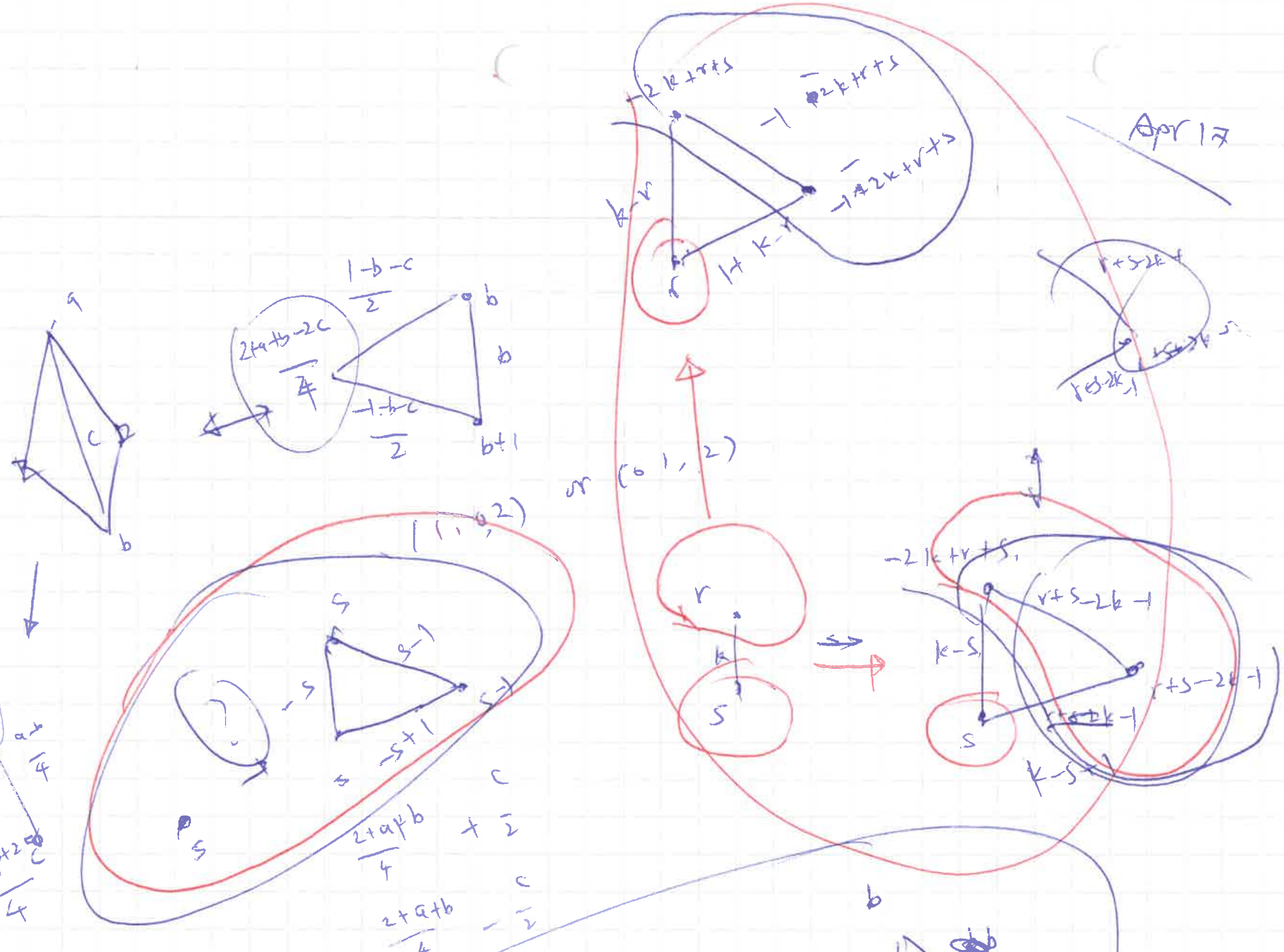
$ST^{-1} = TS$

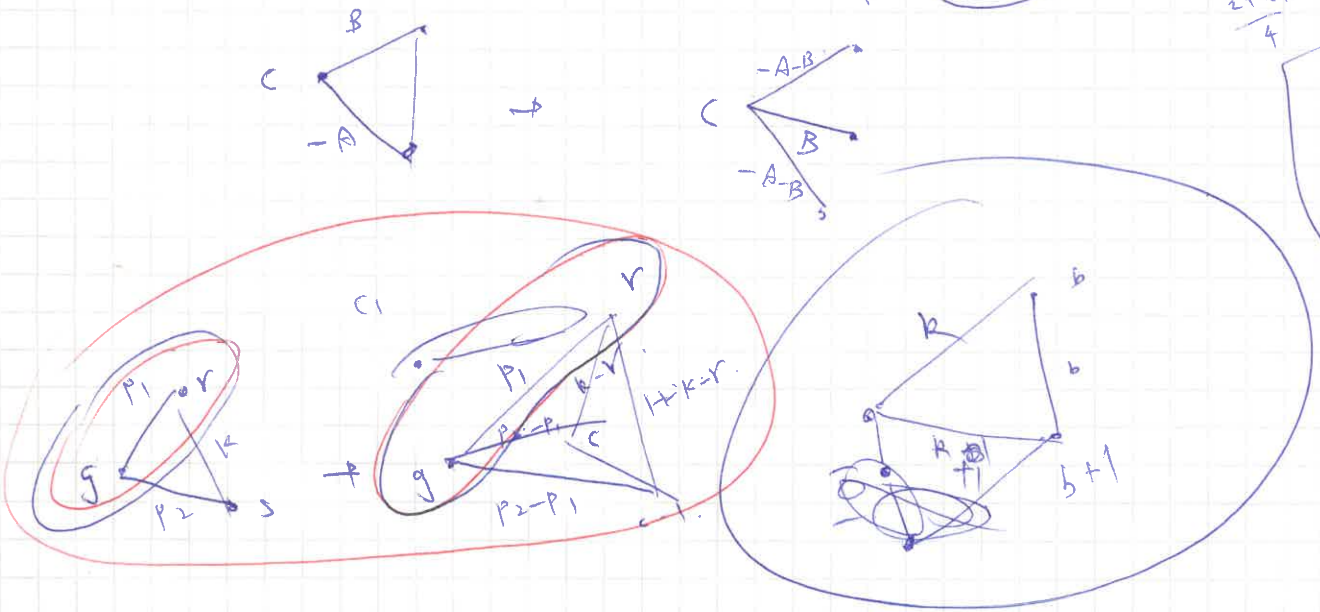
Apr 17

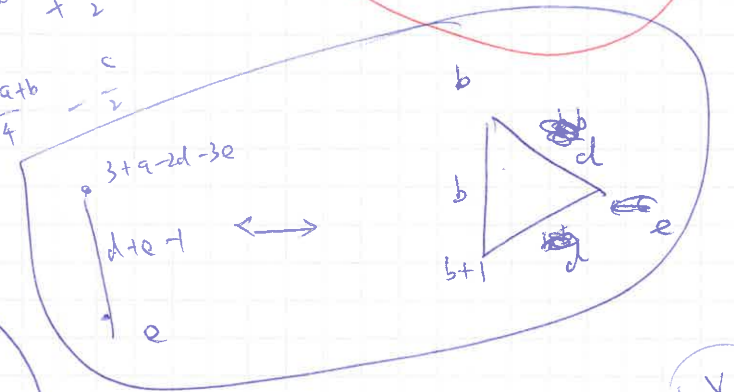
$$A = \frac{b_1 + a_1}{2}$$

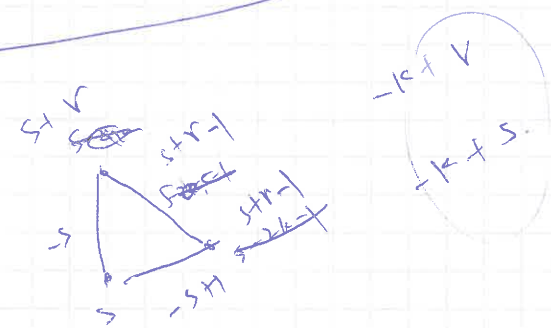
$$B = \frac{b_1 - a_1}{2}, \quad -A = \frac{-b_1 - a_1}{2}$$

$$\begin{cases} B + A = b_1 \\ -B + A = a_1 \end{cases}$$

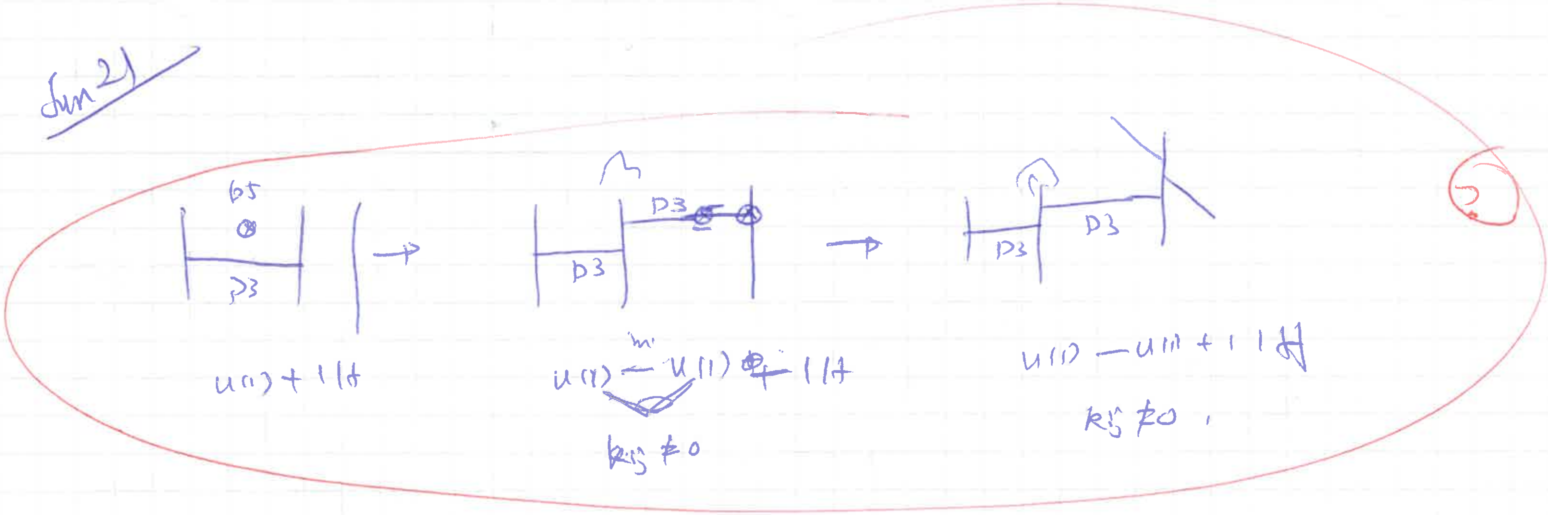








dim 2)



Apr 14

thu

How to understand ST- enhancement ~~of D5~~ the 5 brane using string junctions ?

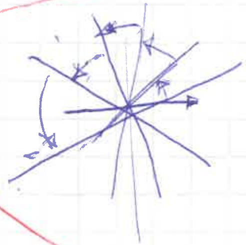
$$\frac{d^2 y}{y\, dx^2} = -a.$$

$$y \, d\left(\frac{dy}{dx}\right) / dx$$

$$y \frac{dy'}{dx} = -y$$

$$y'' - a y = 0$$

Is it possible to add param ?

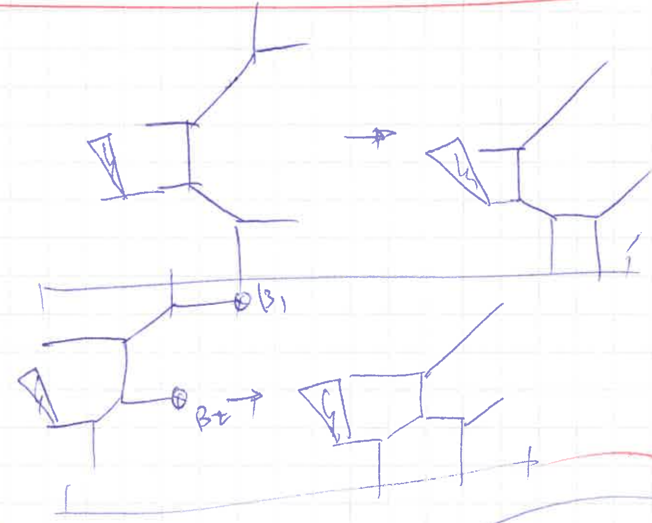


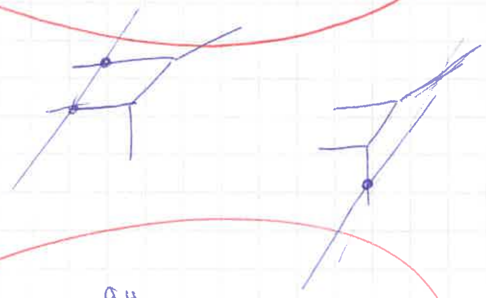
~~What~~

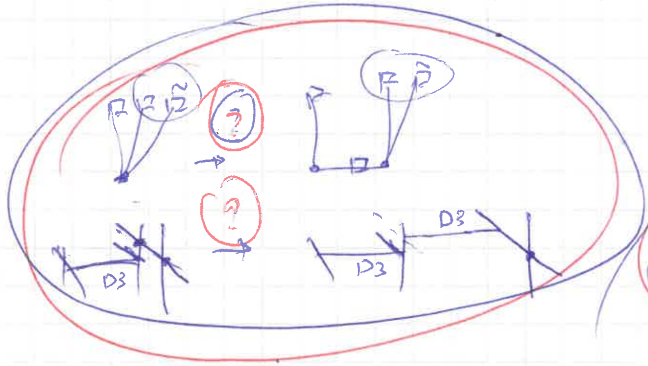
How to visualize mixed CS levels ?

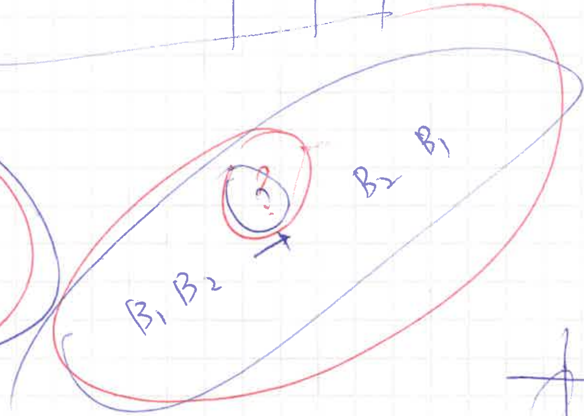
$k_{ij} A_i \wedge dA_j$.

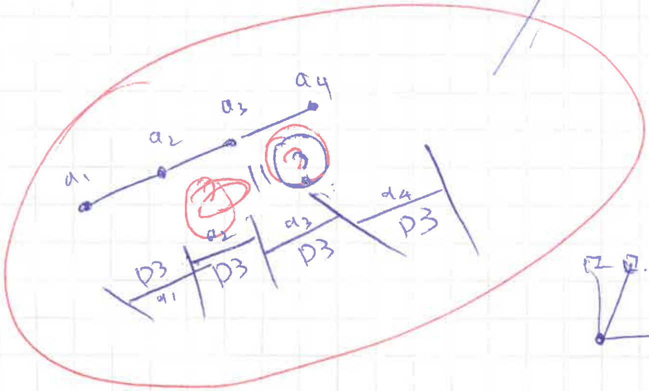
~~$A \wedge A$~~

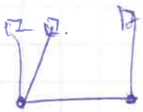


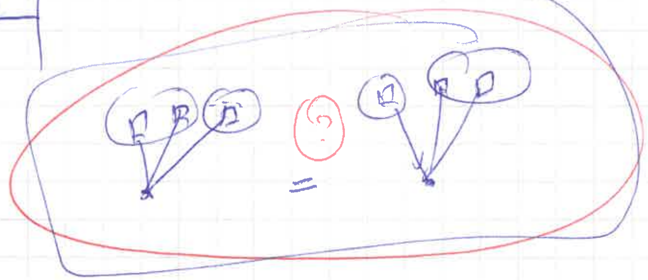


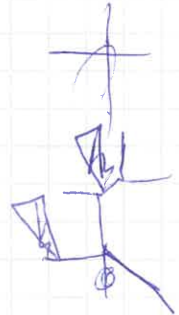












Jun / 5

$$q^{\frac12}\beta_j^{-1} = \cancel{\tilde{x}}\,x \qquad \cancel{q^{-\frac12} = q^{-\frac12}\beta_j}$$

$$q\,\beta_j^{-1} = \tilde{\beta}_j\,q$$

$$\boxed{\frac{(\beta_j\,;\,q^{-1})_\infty}{(\beta_j^{-1}\,;\,q)_\infty}} \quad (\beta_j^{-1};q)_n \quad (\beta_j^{-1};q) = (\beta_j;q)_\infty = \boxed{\frac{(q\beta_j^{-1};q)_\infty}{(q\beta_j;q)_\infty}} = PE\left[\frac{q(\beta_j - q\beta_j^{-1})}{1-q}\right]$$

$$\frac{\cancel{M(qz)}}{\cancel{M(z)}} \cdot \frac{M(z)}{M(qz)}$$

$$PE\left[-\frac{\beta_j - \beta_j^{-1}}{1-q}\right] \qquad (\beta_j;q^{-1})_\infty$$

$$\frac{(\beta_j;q)_\infty}{(\alpha_i;q)_\infty} \xrightarrow{?} \frac{(\beta_j^{-1};q^{-1})_\infty}{(\alpha_i^{-1};q^{-1})_\infty}$$

$$\Big\downarrow\ q \to q^{-1}$$

$$q\,\beta_j = \tilde{\beta}_j$$

$$\frac{(\beta_j;q^{-1})_\infty}{(\alpha_i;q^{-1})_\infty} = \frac{(q\alpha_i;q)_\infty}{(q\beta_j;q)_\infty} = \frac{\theta(-q^{\frac12}\alpha_i)\,(\beta_j^{-1};q)_\infty}{(\alpha_i^{-1};q)_\infty\,\theta(-q^{\frac12}\beta_j)}$$

$$q\,\beta_j = \tilde{\beta}$$

$$= \frac{(q^{-1}\alpha_i^{-1};q)_\infty}{(q^{-1}\beta_j^{-1};q)_\infty}\,\frac{\theta(-q^{\frac12}\alpha_i)}{\theta(-q^{\frac12}\beta_j)}$$

$$\alpha_i = q^{-\frac12}\tilde{\alpha}_i$$

$$\tilde{\alpha}_i = q^{\frac12}\alpha_i$$

$$\theta(-q^{-\frac12}x^{-1}) = (x^{-1};q)_\infty(qx;q)_\infty =$$

$$\alpha_i = q^{\frac12}\tilde{\alpha}_i$$

$$\theta(-q^{\frac12}x)$$

$$q^{\frac12}\tilde{\alpha}_i = q^{\frac12}\alpha_i$$

$$q^{\frac12}\alpha_i$$

$$q^{-\frac12}$$

$$\beta_j = \tilde{\beta}\,q^{-1}$$

$$q^{-1}$$

$$\tilde{\beta} = \beta\cdot q$$

$$\frac{1}{(q\beta;q)_\infty(\beta^{-1};q)_\infty} = \frac{1}{\theta(-q^{-\frac12}\beta^{-1})} = \frac{1}{\theta(-q^{\frac12}\beta)}$$

Apr 22

$\pm 2J\,2\,2i \quad + \frac{y^2}{2}$

$STST.$

$(-1)\ T^{-1}S$

$\boxed{T^{-1}S^{-1}}$

(ST)

$X = \delta\, T S^{-1}$

$X S^{-1} = T^{-1}S^{-1}$

$S(TST) = \boxed{SS}\,T^{-1}S = -T^{-1}S$

$\boxed{X = T^{-1}S^{-1}} = (ST)^2 = STST$

$\boxed{\tan\theta = \pm 1}$

$\boxed{\theta = \pm\frac{\pi}{4}}$

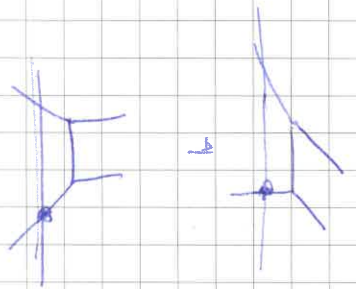
S.O.Z.D

$+1 \quad \leftrightarrow \quad -1$

$XYZ =$

HW

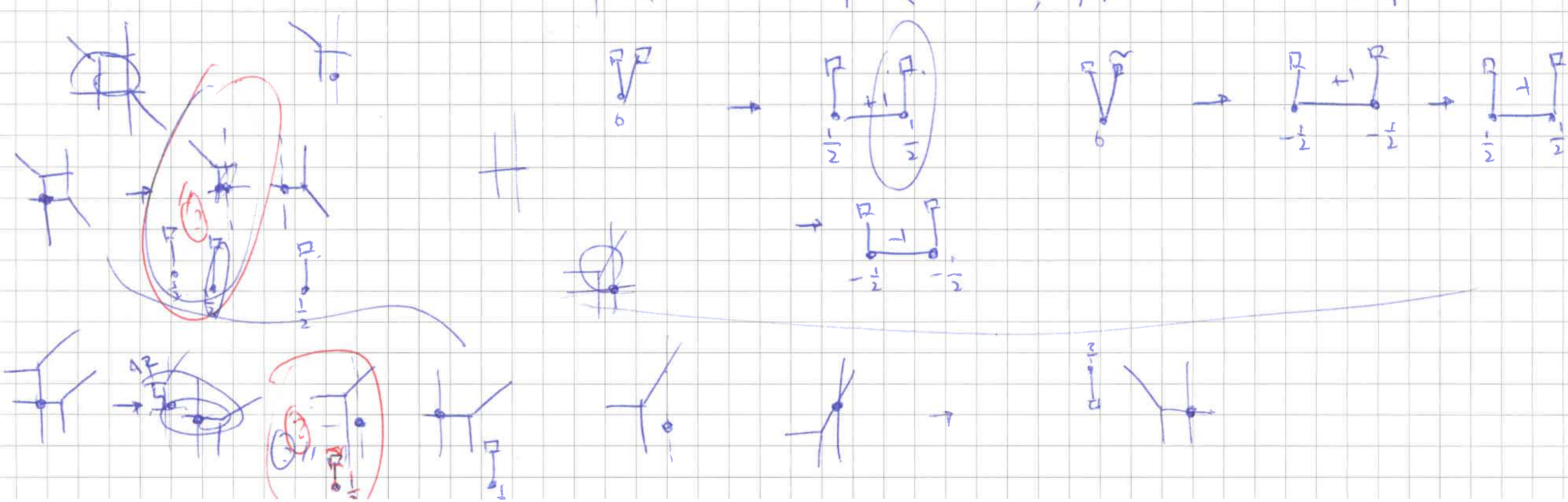
May 27



$$H \quad \begin{bmatrix} 0 & 1 \\ 1 & 1 \end{bmatrix} \to \begin{bmatrix} -1 & -1 \\ -1 & 0 \end{bmatrix}$$

$$AP \quad \cancel{\begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix} \to \begin{bmatrix} 1 & -1 \\ -1 & 1 \end{bmatrix}}$$

$$(\alpha;\varepsilon)_n = (\alpha^{-1};\varepsilon^{-1})_n \, (-\sqrt{\varepsilon})^{n^2} \, (\sqrt{\varepsilon}\,\alpha^{-1})^{-n} \qquad (\alpha/\sqrt{\varepsilon})^n$$



$$I = \oint \nabla_\mu \nabla_\nu e_\rho - \nabla_\nu \nabla_\mu e_\rho$$

$$= \nabla_\mu(\Gamma^{\iota}_{\nu\rho}\, e_\iota) - \nabla_\nu(\Gamma^{\iota}_{\mu\rho}\, e_\iota)$$

$$= (\nabla_\mu \Gamma^{\iota}_{\nu\rho})e_\iota + \Gamma^{\iota}_{\nu\rho} \nabla_\mu e_\iota$$

$$\nabla_{[X,Y]} Z = \nabla_{XY} - {}_{YX} Z$$

$$- (\nabla_\nu \Gamma^{\iota}_{\mu\rho})e_\iota + \Gamma^{\iota}_{\mu\rho} \nabla_\nu e_\iota \qquad =$$

$$= \Big(\partial_\mu \Gamma^{\iota}_{\nu\rho}\, e_\iota + \Gamma^{\iota}_{\nu\rho} \Gamma^{\rho}_{\mu\iota}\, e_\rho$$

$$- \partial_\nu \Gamma^{\iota}_{\mu\rho}\, e_\iota + \Gamma^{\iota}_{\mu\rho} \Gamma^{\rho}_{\nu\iota}\, e_\rho\Big) \cancel{f^\sigma}$$

$$= \partial_\mu \Gamma^{\sigma}_{\nu\rho} - \partial_\nu \Gamma^{\sigma}_{\mu\rho} + \Gamma^{\lambda}_{\nu\rho} \Gamma^{\sigma}$$

$\cancel{\nabla}\ T \qquad \cancel{X^\nu \nabla_\nu}\ ($

$$\nabla_X(\nabla_X S)$$

$$= X^\nu \nabla_\nu (X^\rho \nabla_\rho S)$$

$$X(Y)$$

$$= \cancel{(\nabla_X X^\rho}\, \nabla_\rho S +$$

$$= X^\nu X^\rho\, \nabla_\nu \nabla_\rho S$$

$$X^\nu = \frac{dx^\nu}{dt}.$$

$$= \cancel{\nabla_X} =$$

$$\mathrm{tr} \log A = \log \det A.$$

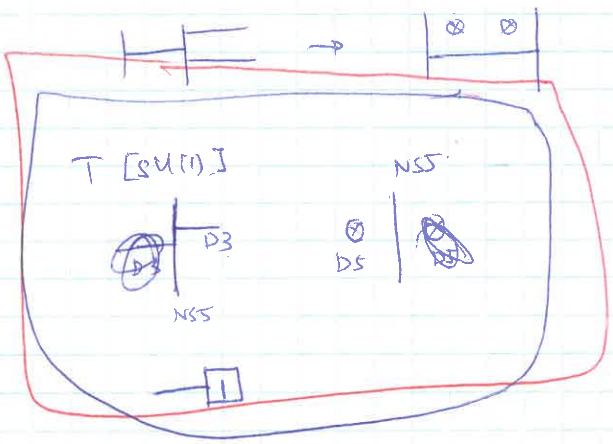
$$g^{\mu\nu} G_{\mu\nu} = R - \frac{1}{2} R\, \cancel{g_{\mu\nu} g^{\mu\nu}} = 0.$$

$$\frac{1}{2} R = 0$$

Mar 20

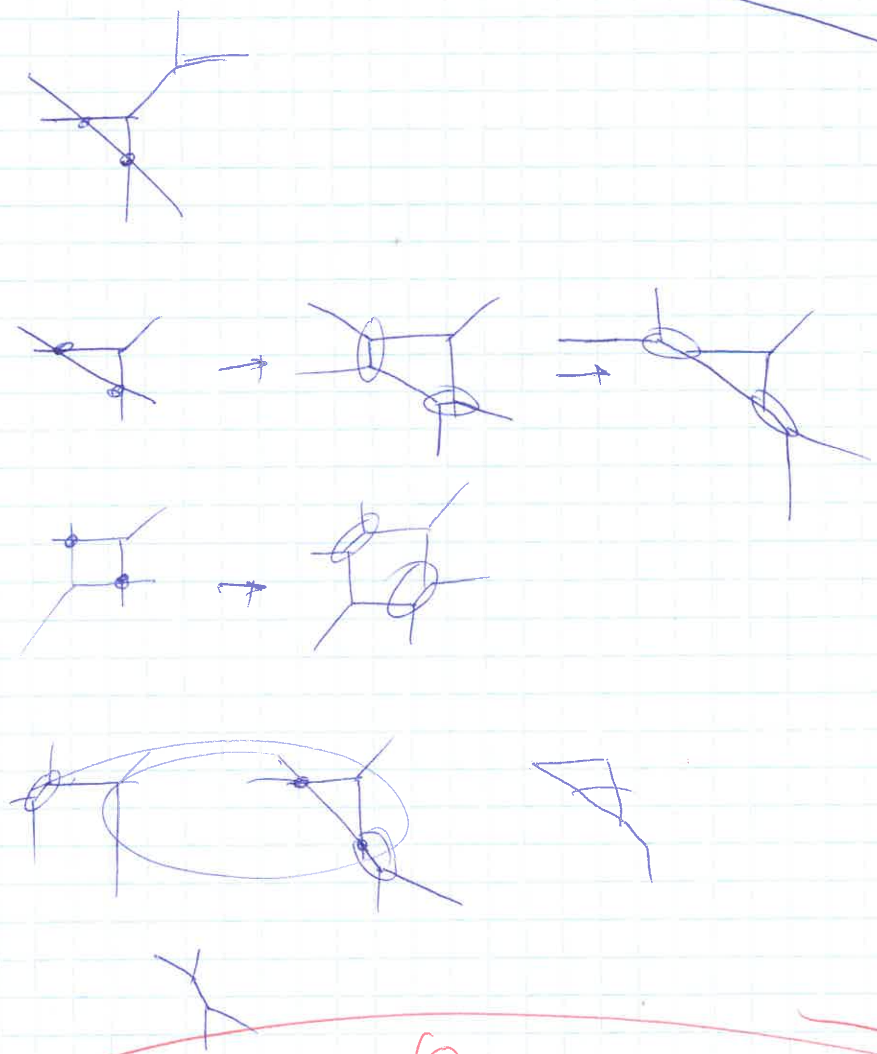
~~T [SU(1)]~~

T [SU(2)]



(1) What is the gluing use T[G]. for brane webs ?

Why the Hopf link ~~ratio~~ gives rise to T[SU(2)] ~~for~~ theory for gluing? ?



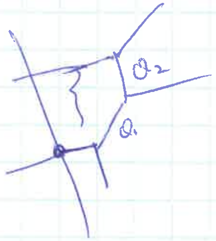
(2) mutation ⇄ unlinking / linking

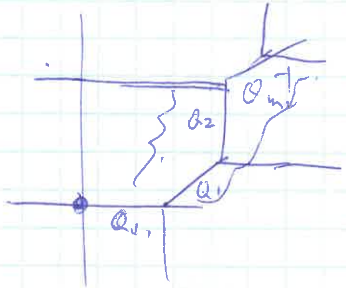
Ma 23

10

$$\frac{M(Q;t,q)}{m(Q;t,q)} = (Qq, q)_\infty$$

$$\frac{M(Q;t,q)}{M(qQ,t,q)} = (Qq,t)_\infty$$





$$\frac{(Q_1Q_2, q)_\infty}{\left(\frac{Q_1Q_2}{Q_{m_2}}, q\right)_\infty} \cdot \frac{\left(\frac{Q_1Q_2}{Q_{m_1}}, q\right)_n}{(Q_1Q_2, q)_n}$$

(Q_1Q_2)

$M\left(\quad t, q\right)$

$M\left[\frac{Q_1Q_2}{Q_{m_2}}\right]$

$$\frac{Q_1Q_2Q_{m_1}}{Q_{m_2}}$$

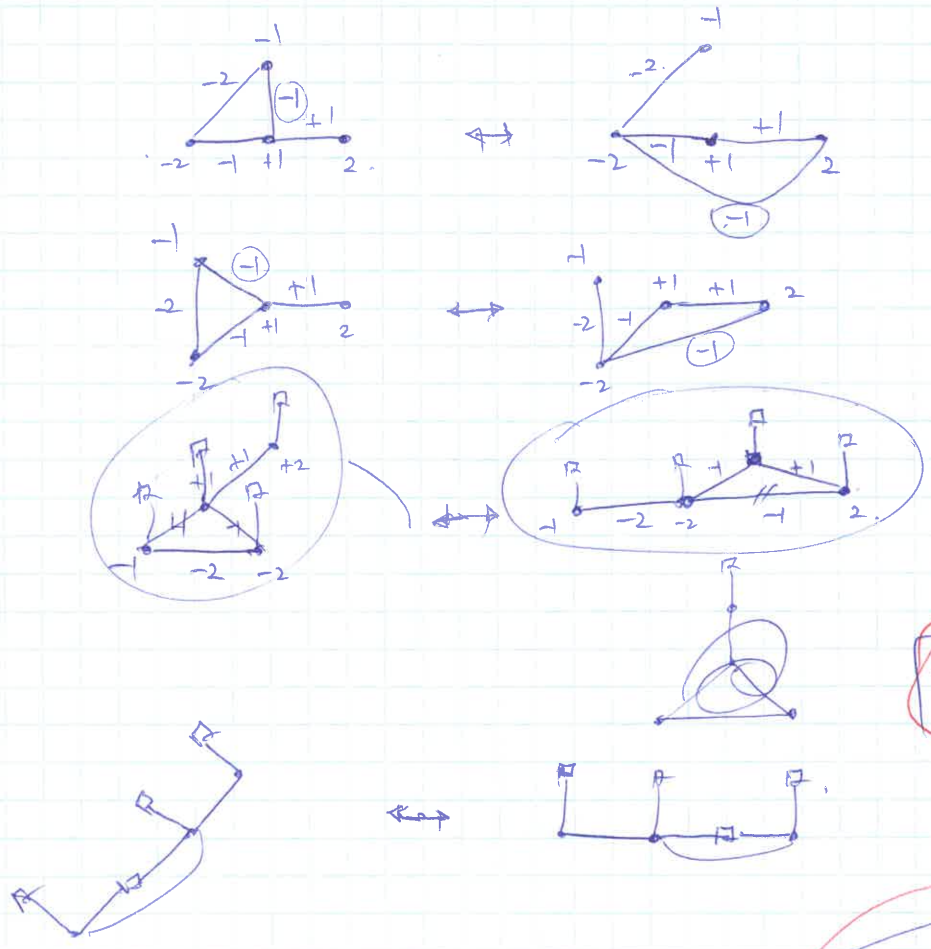
$$\frac{M\left(\frac{Q_1Q_2}{q}\right)_q}{M\left[\left(\frac{Q_1Q_2}{q}\right)q\right]} = \frac{M\left[\left(\frac{Q_1Q_2}{q}\right)\right]}{\quad} =$$

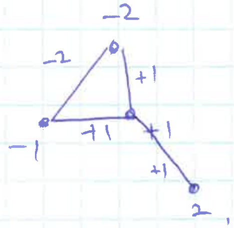
$M\left(\frac{Q_1Q_2}{q}\right)$

~~Mar 20~~ ~~Mar 19~~

$\hat{Z}_2^{u(1)} \quad (m_1, m_2 ; \eta)$

$$\begin{bmatrix} -2 & -2 & -1 & 0 \\ -2 & -1 & -1 & 0 \\ -1 & +1 & 1 & 1 \\ 0 & 0 & 1 & 2 \end{bmatrix} \longleftrightarrow \begin{bmatrix} -2 & -2 & -1 & -1 \\ -2 & -1 & 0 & 0 \\ -1 & 0 & 1 & 1 \\ -1 & 0 & 1 & 2 \end{bmatrix}$$

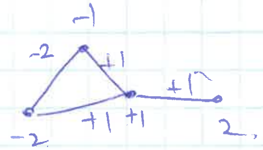




$e^{x_1 x_2} - e^{-x_1 x_2}$

$x_1 = m_1 - m_2$

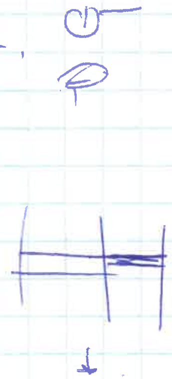
$x_2 = \eta$



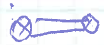
$e^{2\pi i m_1 \eta} - e^{2\pi i m_2 \eta}$

$e \quad = e^{2\pi i}$

~~sinh~~



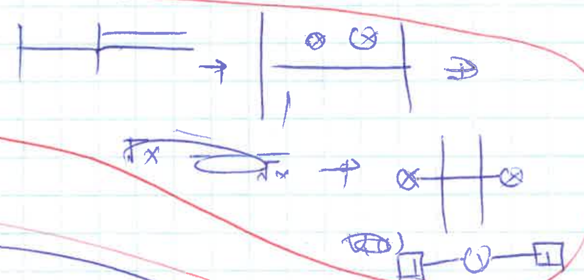
$s_1^{\frac{1}{2}} \, x_2^{-}$



T[SU(2)]

$$\frac{s_1^{\frac{1}{2}}}{s_2^{\frac{1}{2}}} - \frac{s_2^{\frac{1}{2}}}{s_1^{\frac{1}{2}}} = \frac{s_1^{-\frac{1}{2}}}{s_2^{\frac{1}{2}}}\left(s_1 - \frac{s}{s_1}\right)$$

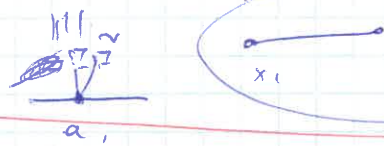
T[SU(2)]



$$\frac{s_1 - s_2}{s_2^{\frac{1}{2}} s_1^{\frac{1}{2}}}$$

$e^{\frac{a}{2}x^2} \sinh x$

|||



$= e^{x_1 x_2} - e^{-x_1 x_2}$

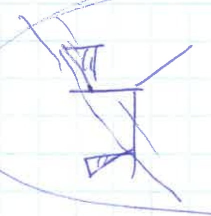
?

20 Mar ~~28~~

S-duality

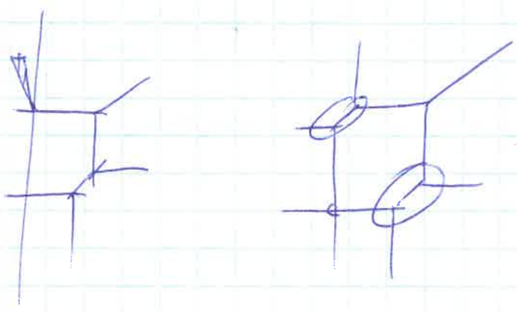
a_1 —— a_2 $= S^2 \setminus$ Hopf link $= T[SU(2)] =$ ①—[2] $=$ [1]—①—[1]

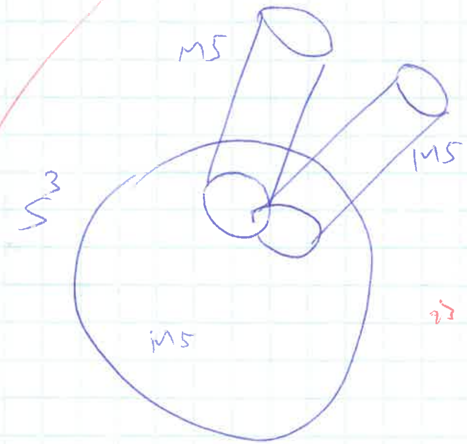
~~$T[SU(2)] \longleftrightarrow X\ Y\ Z$~~

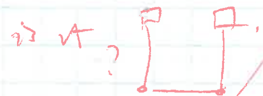


Z is it Hopf link?

$$C_{x m \phi} = q^{\frac{k(x)}{2}} W_{x+m}(\Sigma)$$

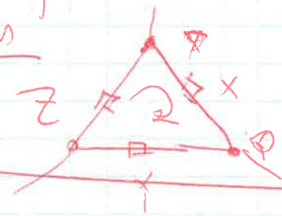


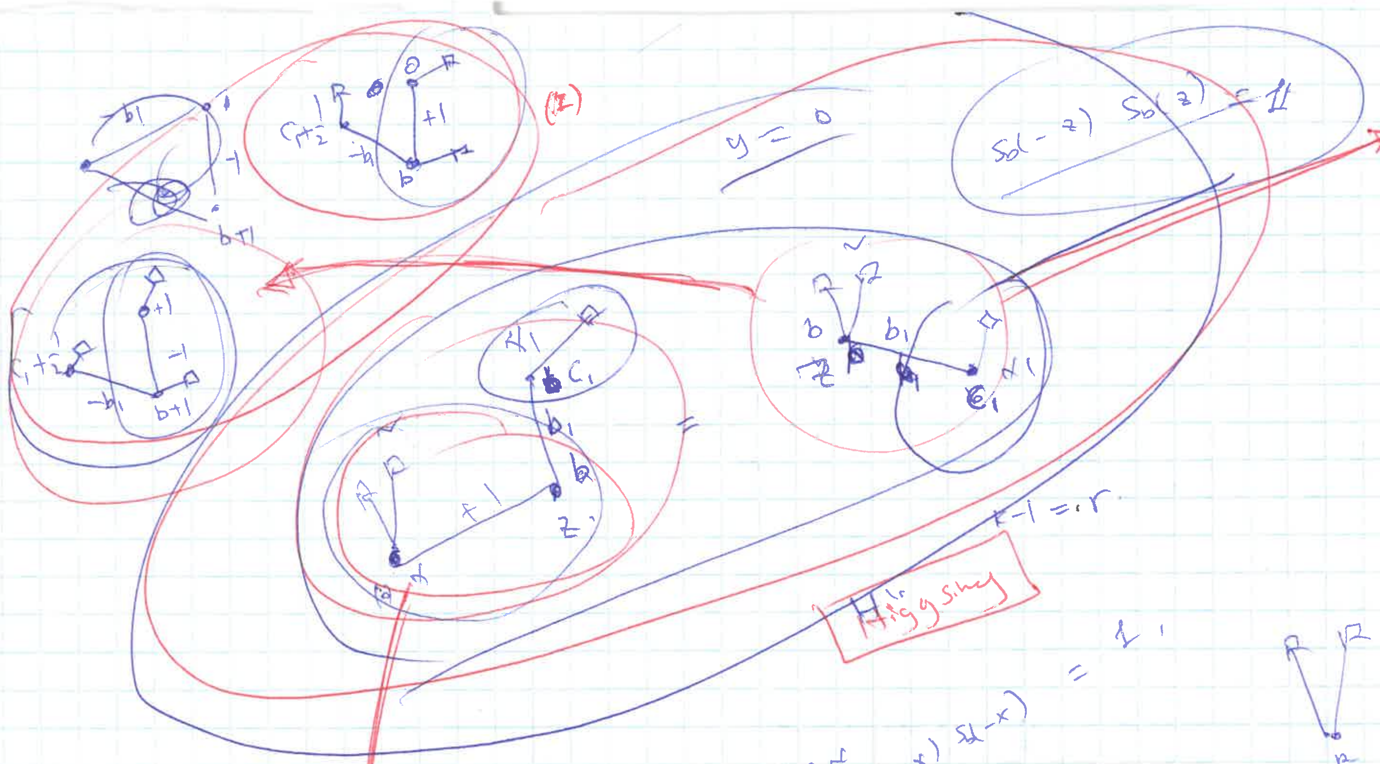


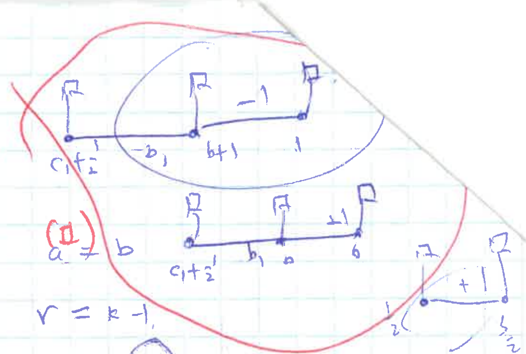


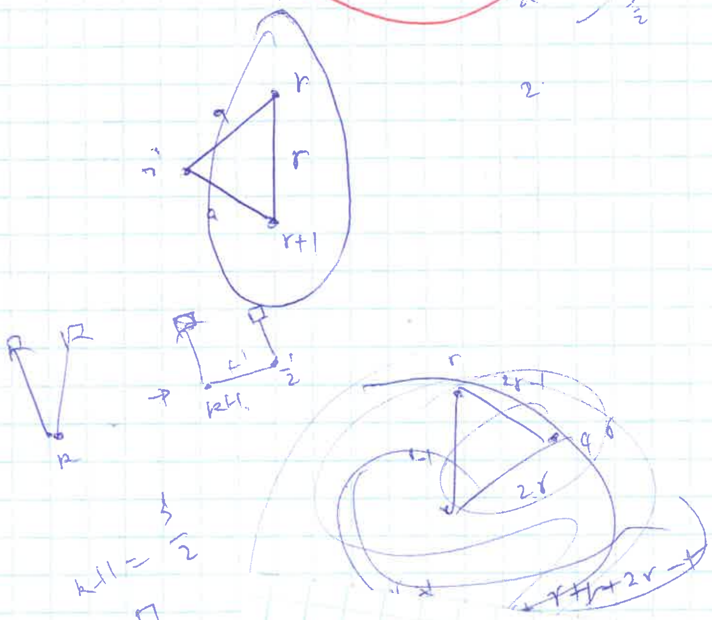
How to introduce ~~sp~~ W, theory triangle ?

or understand









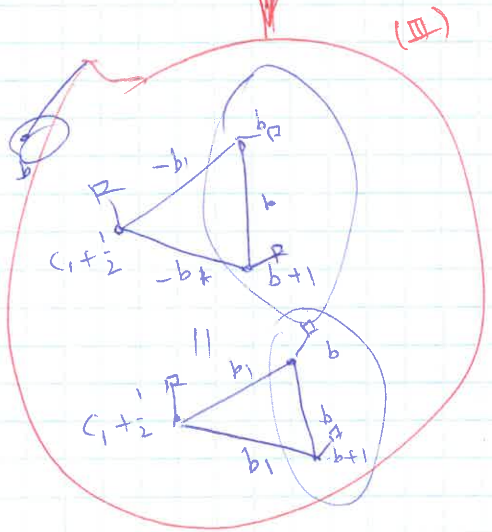
$$= 1$$

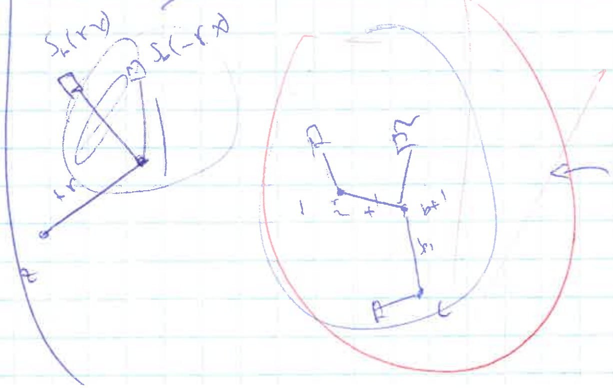
$$\oint dx\, e^{-2\pi i z x} S_0(x) S_0(-x)$$

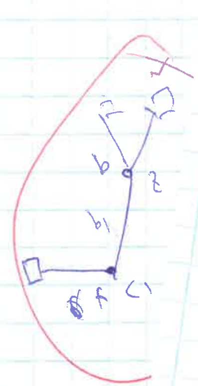
$$x \to rx$$

$$\oint dx\, e^{-2\pi i z r x} S_0(rx) S_0(rx)$$

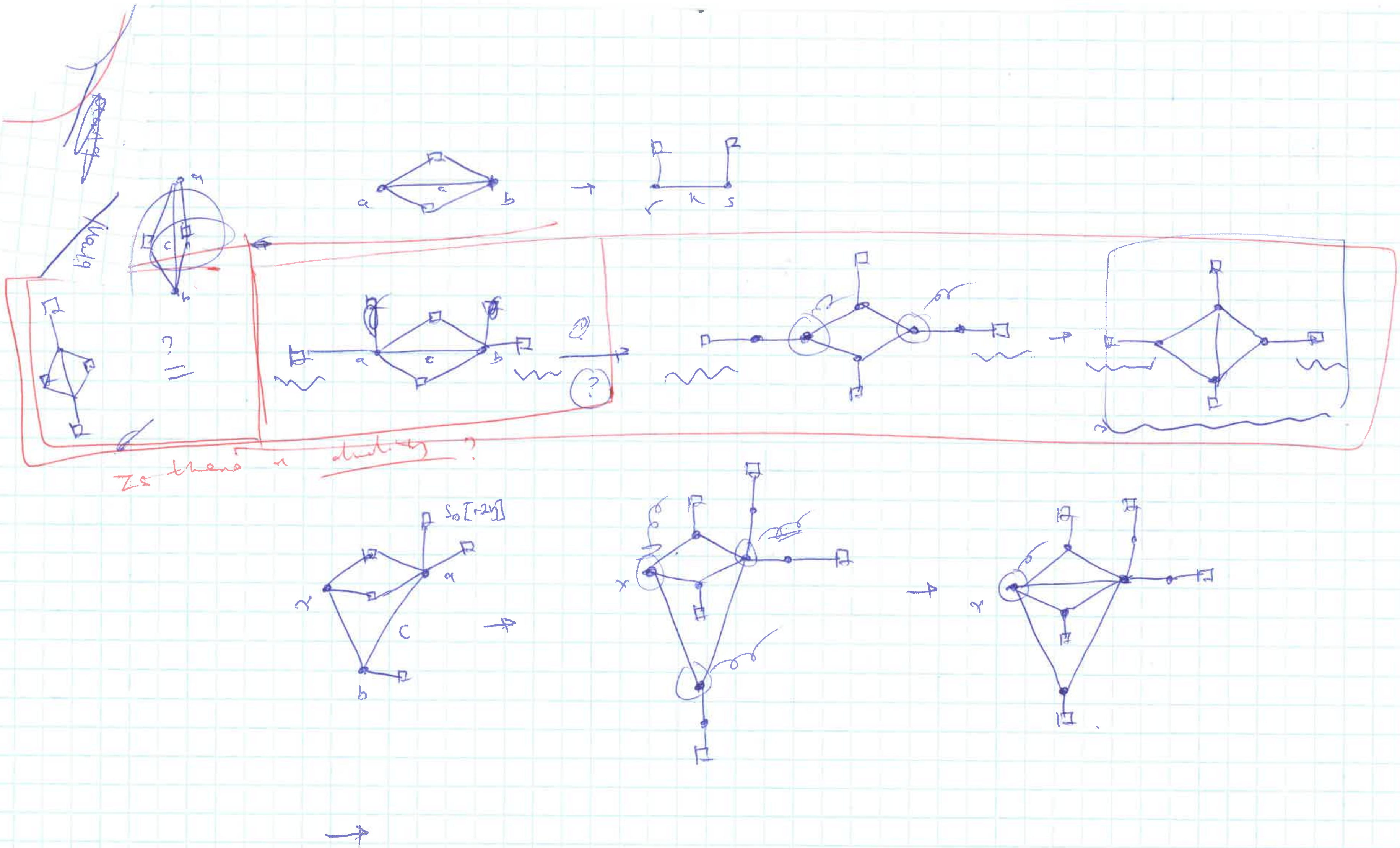
$$k+1 = \frac{3}{2}$$







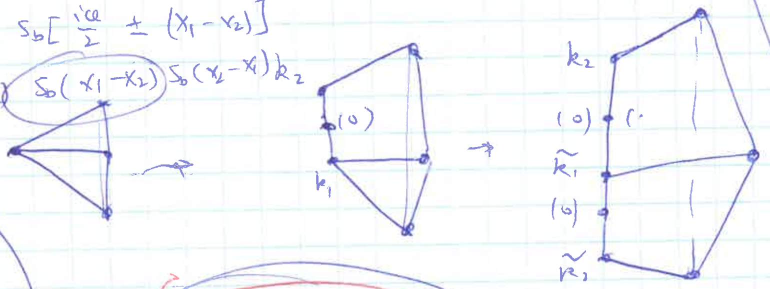
Mar 14

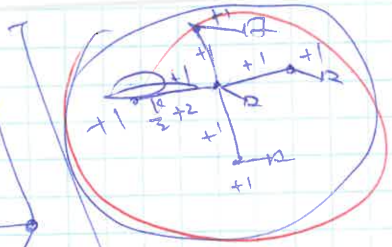


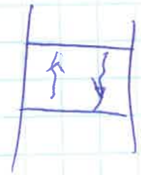
Nov 18

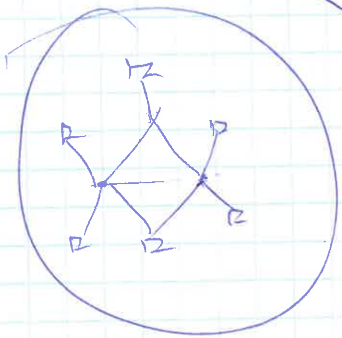
$S_b[\frac{iQ}{2} \pm (x_1+x_2)]$ $S_b[\frac{iQ}{2} \pm (x_1-x_2)]$

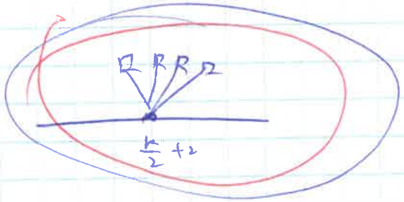
$S_b(\frac{iQ}{2}+x_1+x_2)\, S_b(-x_1-x_2)\, S_b(x_1-x_2)\, S_b(x_2-x_1)\, k_2$

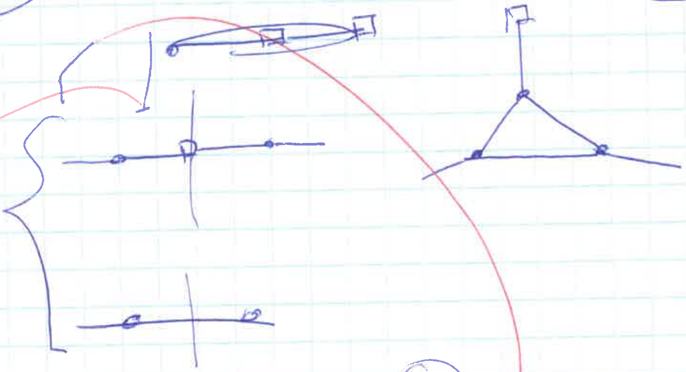




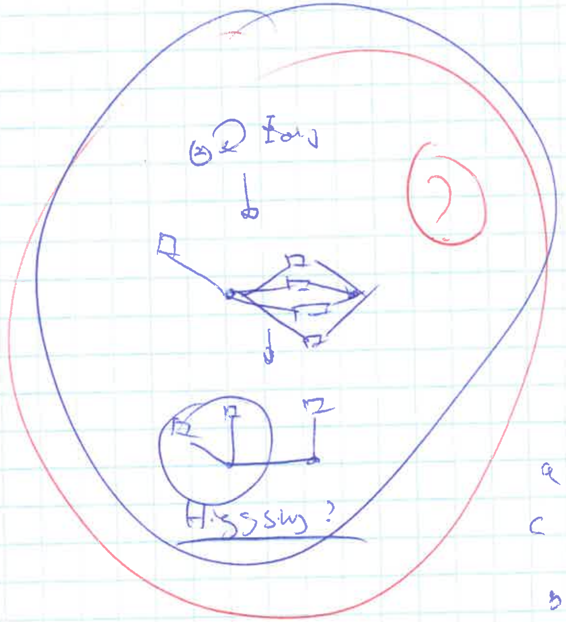


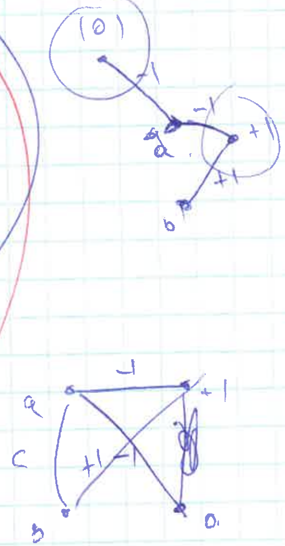






two kinds of gluing ?

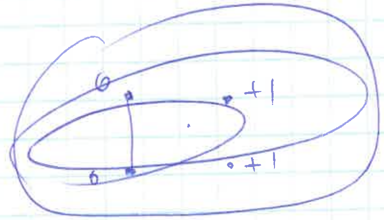


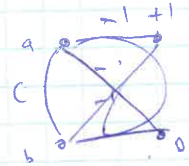


U(2)

$\int dx_1 \int dx_2\, 4 \sinh 2\pi b(x_1-x_2) \sinh 2\pi b^{-1}(x_1-x_2)$

$$\boxed{S_b(\frac{iQ}{2}+x) = \frac{S_b(\frac{iQ}{2}+x-ib)}{2i\sinh 2\pi b x}}$$





$\frac{iQ}{2}+x-iQ$

$S_b(\frac{iQ}{2}+x)$ $S_b(\frac{iQ}{2}+x-ib)$

$x \to x+ib$

$\frac{iQ}{2}-x\ \boxed{-ib-iQ}$

Mar 17

$$(x, q)_{a+b} = (x, q)_a \, (x q^a, q)_b$$

$$(x, q)_{n-m} = (x q^{-m}, q)_n \, (x q^{-m}, q)_m^{-1}$$

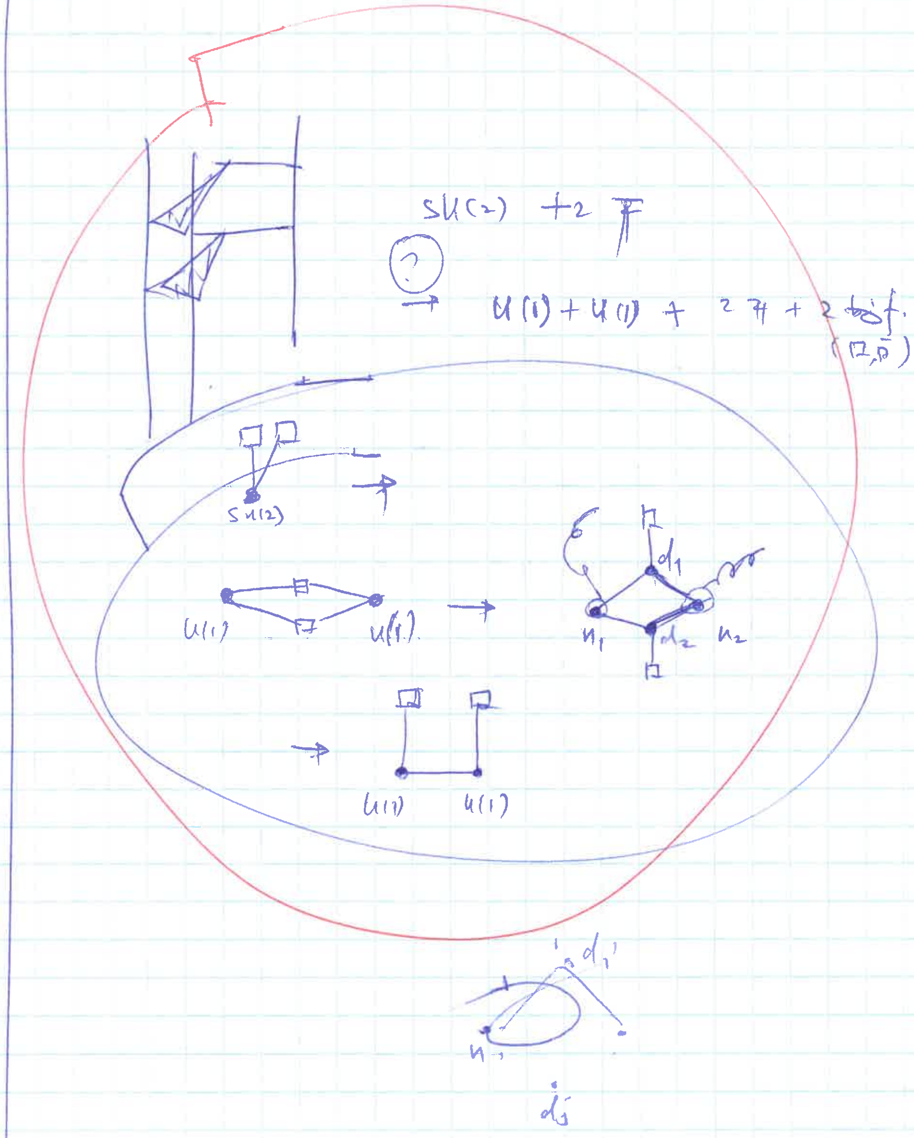
$$S_b\left(z + \frac{iQ}{2}\right) = \frac{1}{\sqrt{q}} \; PE\left[\frac{z}{1-q}\right] PE\left[\frac{\tilde{z}}{1-\tilde{q}}\right]$$

$$S_b\left(\cancel{x+y} + \frac{iQ}{2}\right) = \cancel{\to}\frac{1}{\sqrt{q}} \; PE\left[\frac{xy}{1-q}\right] = \frac{\quad}{(xy, q)}$$

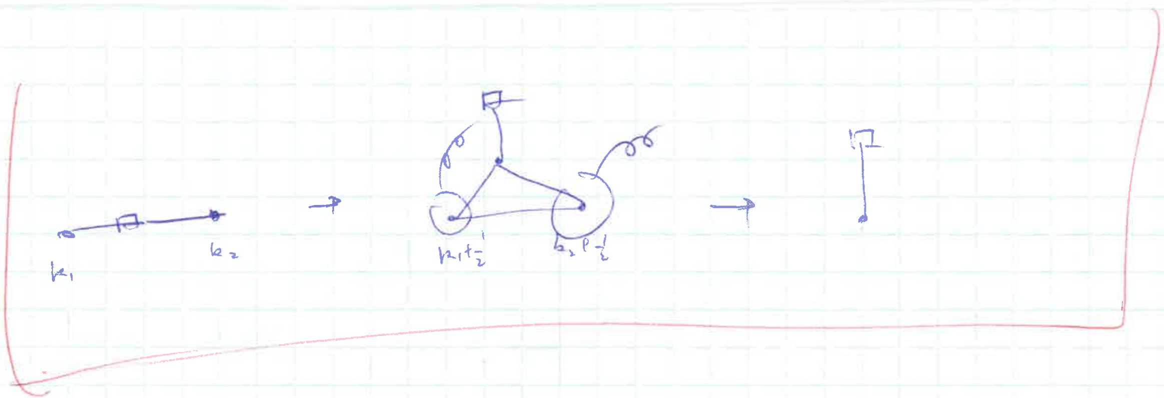
$$x_1 - x_2 = -ibm - \frac{in}{b}$$

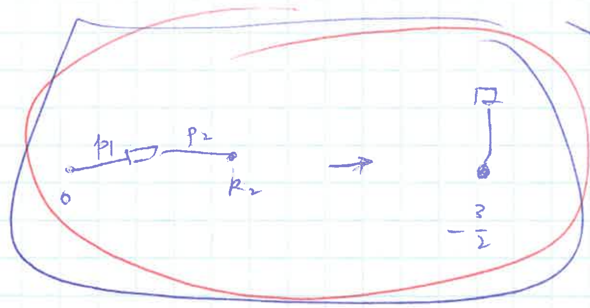
$$e^{2\pi i b Q} = q.$$

$$2 m i b + Q.$$



Nov 15





20 + 10 } coffee
30 + 10 } tissue
+ 15 } beer
25 + 10 } chicken
+ 10 } towel paper

$30 + 25 + 55$

$-r_1 \quad + r_2$

$\left(\frac{y_3}{y_1} \frac{1}{5}, \frac{y_3}{y_1} \right) \to \left(\frac{y_1}{y_2} \frac{1}{5}, \frac{y_1}{y_2} \right)$

$\frac{y}{y}$

$r_1 \quad r_0 \to -r_2$

$\boxed{r_2 \cdot r_2 = -1}$

$r_1 \cdot r_2 = 1,$

$(r_1 + r_2) \cdot (r_1 + r_2)$

$= r_1 r_1 + r_2 r_2 + \cancel{r_1 r_2 + r_2 r_1}$

$= k + 1 + 1$

$r_1 \leftarrow r_2$

$r_1 \cdot r_1 = k$

$r_2 \cdot r_2 =$

$r_1 \cdot r_2 = 1$

$\cancel{(r_1 - r_2)(r_1 - r_2)}$

$\cancel{= r_1^2 - r_2 r_1 - r_1}$

$r_{-2} \to \frac{-r_2}{}$

$r_1 \to r_1 + r_2$

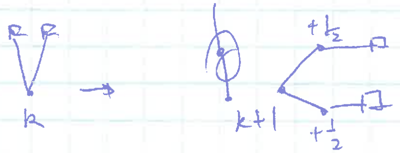
k

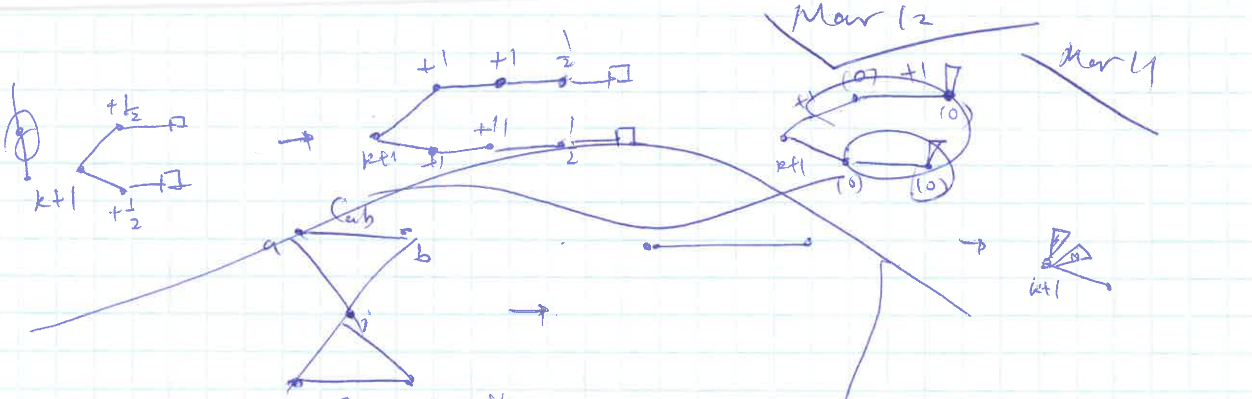
Mar 14

Mar 12

Mar 14

$\Sigma(2, 3, 6r+1)$

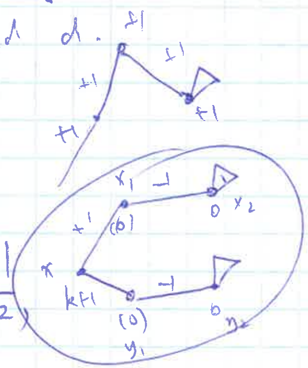




$\frac{1}{2} - \frac{1}{k+1}$ $\quad \frac{k+1}{k+1}$

$$\boxed{M\left(b,\ \frac{a_1}{b_1},\ \frac{a_2}{b_2},\ \frac{a_3}{b_3}\right) = \Sigma(b_1, b_2, b_3)}$$

$$\boxed{b + \sum_{i=1}^{3} \frac{a_i}{b_i} = -\frac{1}{b_1 b_2 b_3}}$$



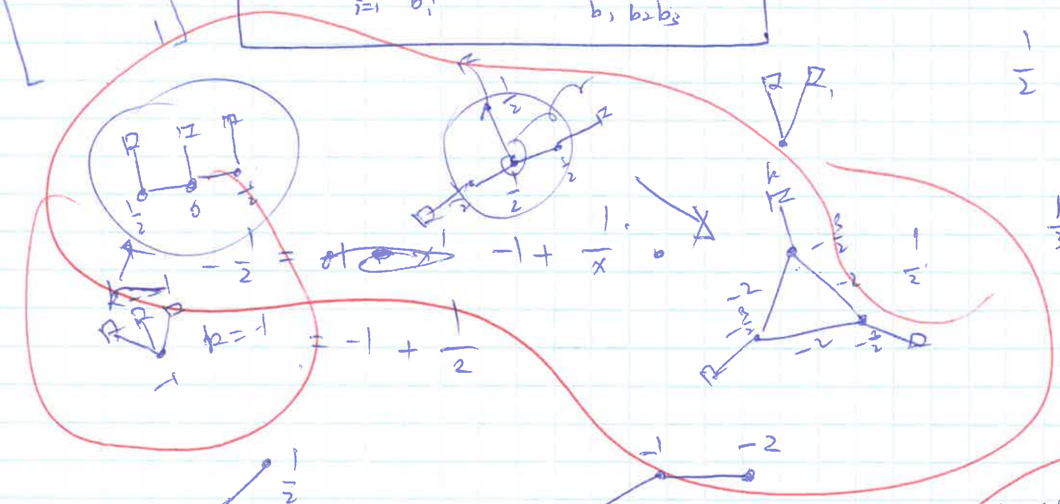
$\frac{1}{2} = 1 + \frac{1}{(-2)}$

$y \to y + \frac{i\alpha}{2}$

$-y \to -y - \frac{i\alpha}{2}$

$\frac{i\alpha}{2} - 2y + i\alpha$

$-\frac{i\alpha}{2} - 2w$

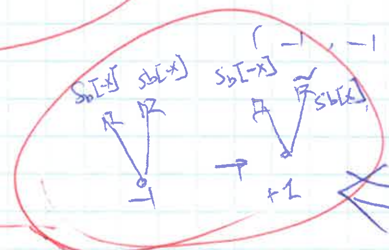


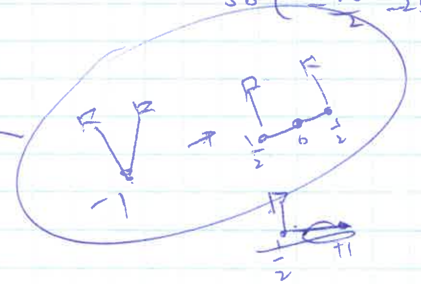
$$\frac{1}{3} = 1 - \frac{1}{\frac{3}{2}} = 1 - \frac{1}{1 + \frac{1}{(-2)}}$$

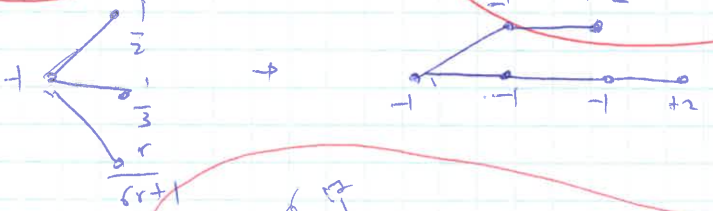
$$\int dz\, S_b\left(\frac{i\alpha}{2} + y - z\right) S_b\left(\frac{i\alpha}{2} + y + z\right)$$

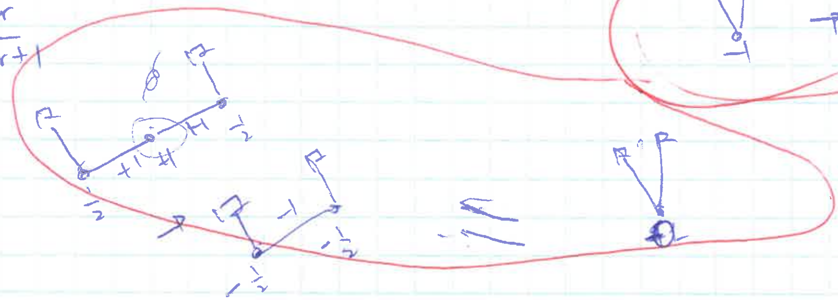
$S_b\left(-\frac{i\alpha}{2} - 2y\right)$

$(-1, -1, +2)$





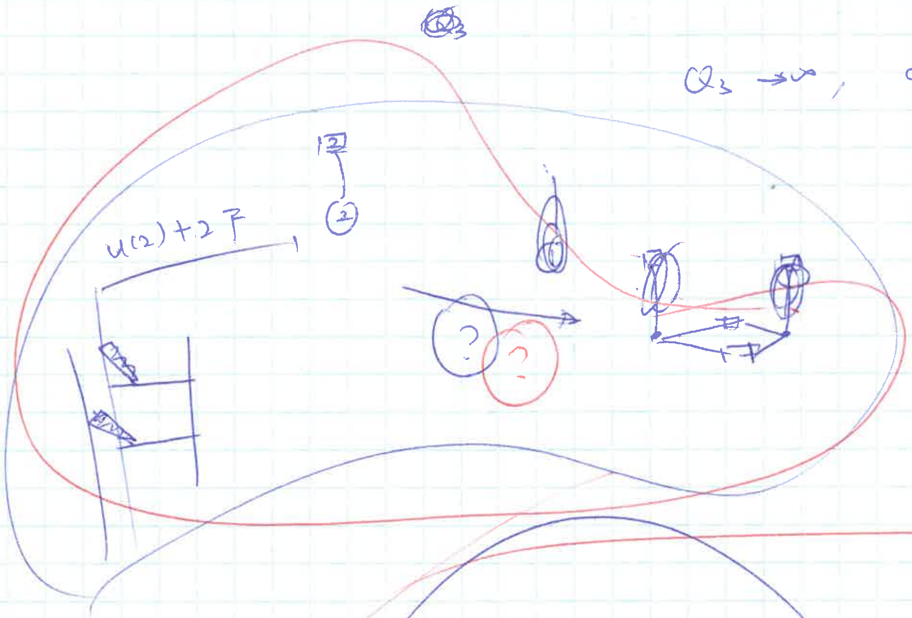


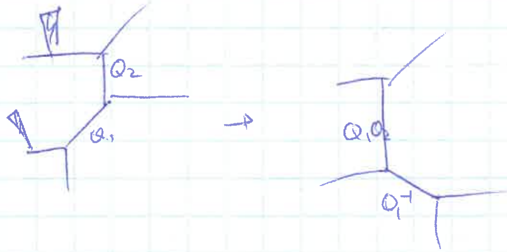


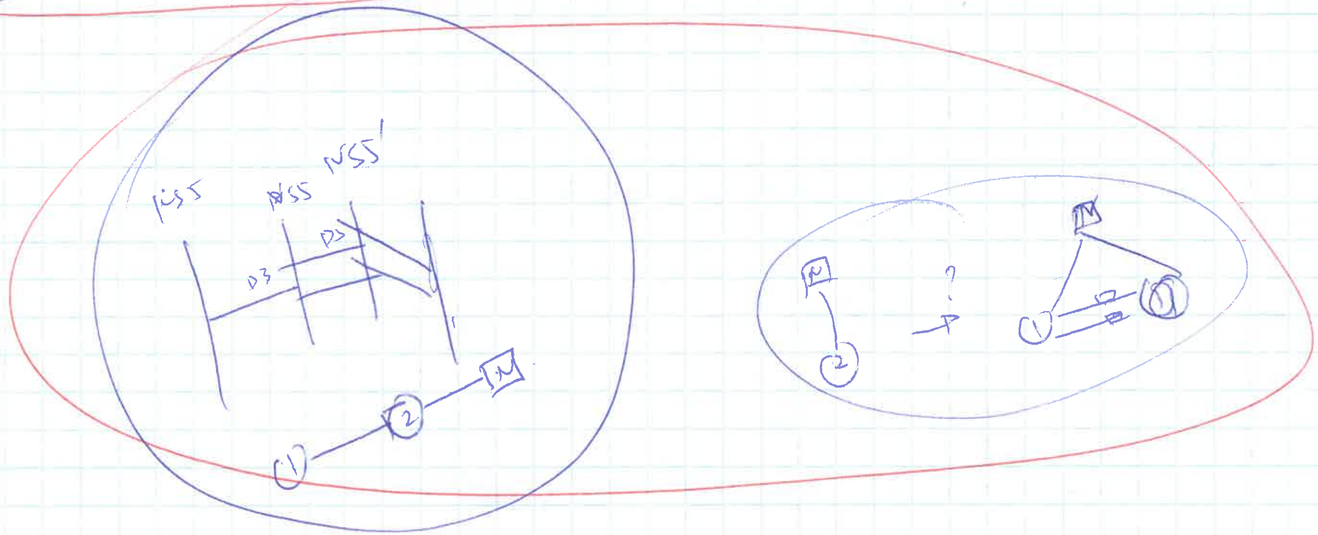
$+1$

Mar 14

$Q_3 \to \infty$, $Q_1 \to 0$

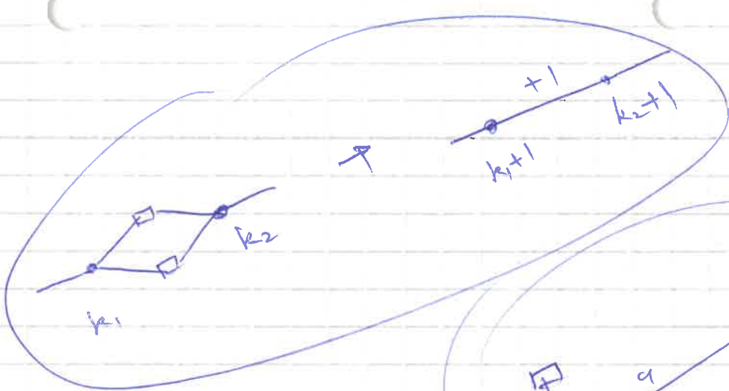


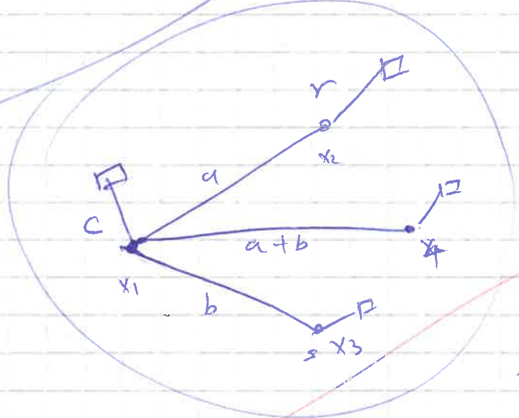


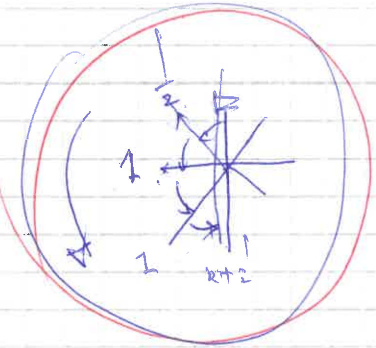


Memo

$\begin{vmatrix}1&0\\0&1\end{vmatrix}$



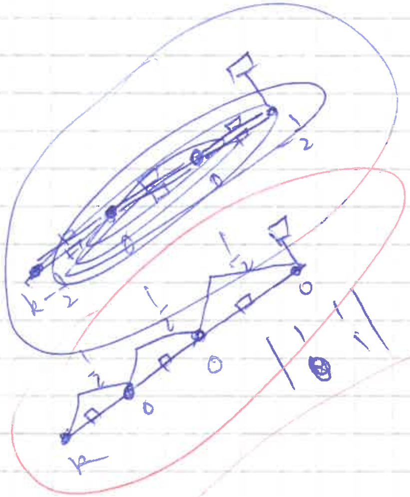


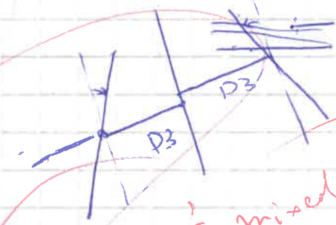


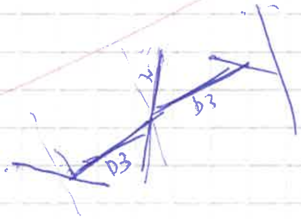
$(-\sqrt{q})^{[2ad_1d_2+2bd_1d_3+2(a+b)d_1d_4]}$

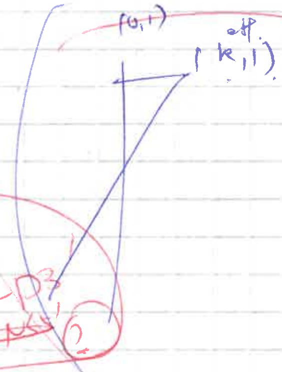
$x_1^{d_1}\,x_2^{d_2}\,x_3^{d_3}\,x_4^{d_4}$

$(q^{-1})^{d_4}\,x_2^{d_4}\,x_3^{d_4}$



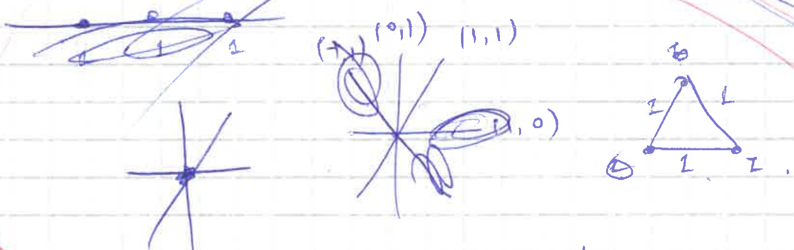






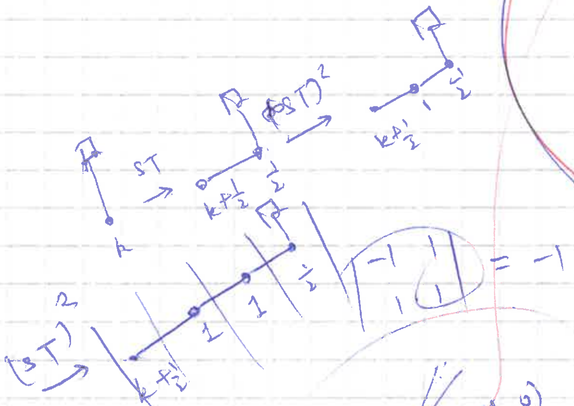
Is there $\frac{1}{2}$ mixed CS level between D3-D3, ~~NS5-NS5~~ ?

$\begin{vmatrix}k^{e+1}&1\\0&1\end{vmatrix}=k^{e+1}$

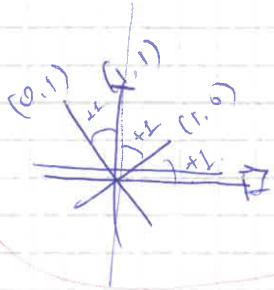


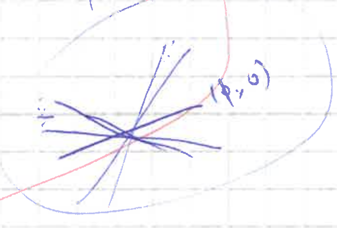
$\begin{vmatrix}1&0\\0&1\end{vmatrix}=1,\quad \begin{vmatrix}1&0\\1&1\end{vmatrix}=1,\quad \begin{vmatrix}1&1\\0&1\end{vmatrix}=1$

$\begin{vmatrix}1&1\\1&0\end{vmatrix}$



$\begin{vmatrix}-1&1\\1&1\end{vmatrix}=-1$





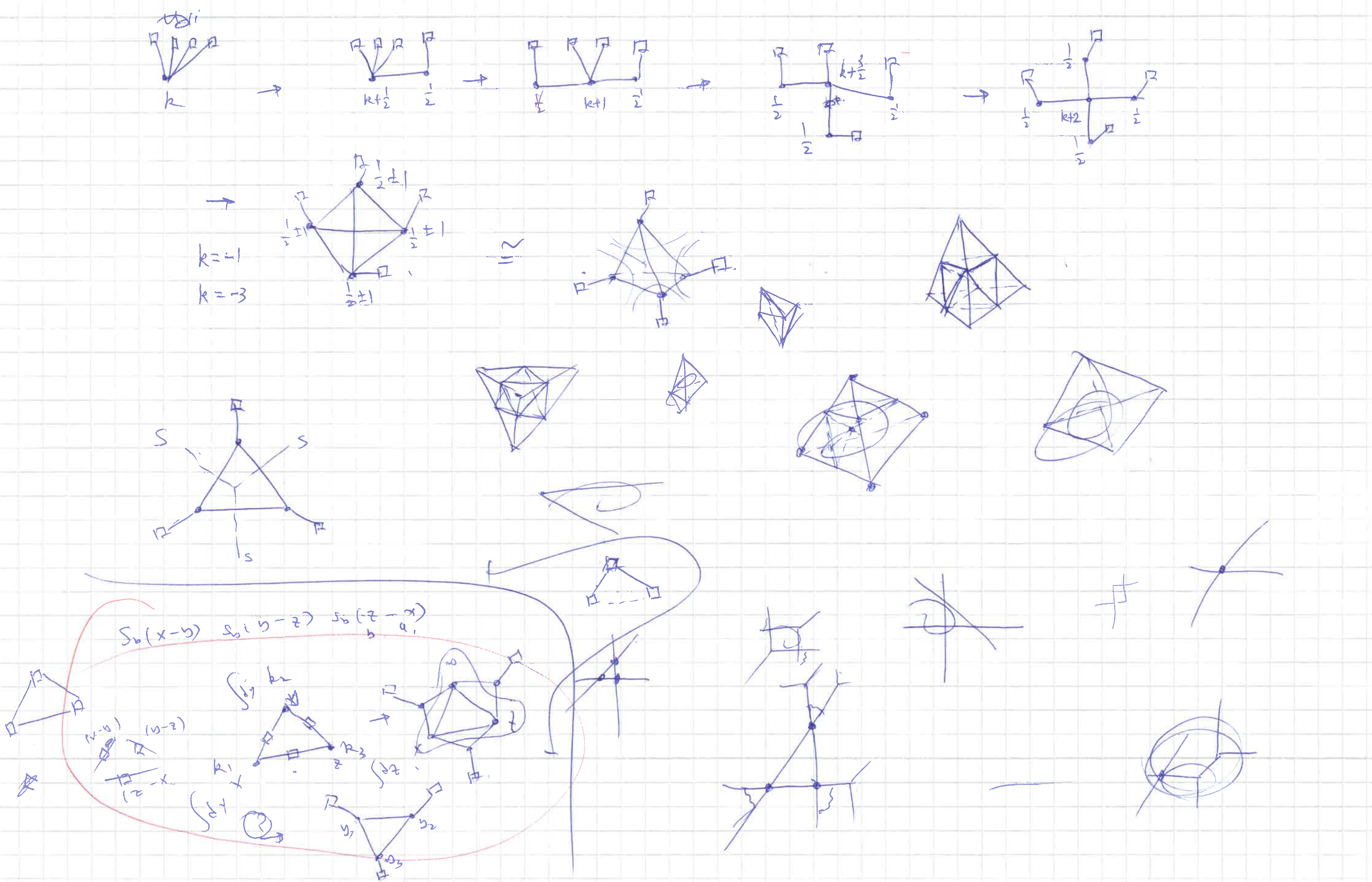
$\begin{vmatrix}1&0\\*&1\end{vmatrix}$

$x_2^{d_2+d_4}\qquad x_3^{d_3+d_4}$

$d_2\to d_2+d_4\qquad d_3\to d_3-d_4$

$2ad_1(d_2-d_4)+2bd_1(d_3-d_4)$

$2ad_1d_2-2ad_1d_4+2bd_1d_3-2bd_1d_4$



k
k+1/2
1/2
k+1
k+3/2
k+2
1/2 ± 1
k = -1
k = -3
S
s
S_b(x-y)
S_b(y-z)
S_b(z-x)
k_1
k_2
k_3
y_1
y_2
y_3