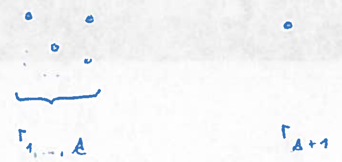
Notation and gauge is taken from P. Naidon J. Phys. B: At. Mol. Opt. Phys. 49 (2016) 034002

Consider



single → cl. coord.

$$\bar{r}_i = r_i - R_{A,B}$$

here: $|A| = A$ and $|B| = 1$

i.e. A particles in spatially sym. state and 1 particle whose internal state matches that of particle A;

$\rightsquigarrow V_{A,A+1} \approx 0$; $\hat{\mathcal{A}} = \mathbb{1} - \hat{P}(A \leftrightarrow A+1)$

$\bar{r}_{A+1} = 0$ and $r_{A+1} = R_B$

$R_A = \frac{r_1 + \ldots + r_A}{A}$, $R = R_A - R_B$

"Freeze" A-body fragment $\rightsquigarrow$ dynamical eq. for the motion of particle $A+1$ relative to the A-body core is given by

$$\langle \phi_A \phi_B | \left(\hat{T}_R + \hat{V}_{AB} - E + e_A + e_B \right) \hat{\mathcal{A}} \left[\phi_A \phi_B \psi \right] \rangle = 0 \qquad \text{Naidon Eq. (15)} = (\mathrm{I})$$

↑ avg. wrt. $\bar{r}_{1,\ldots,A-1}$

note $\bar{r}_A = -(\bar{r}_1 + \ldots + \bar{r}_{A-1})$ is a dependent "variable";

R_{cm} was removed, and the dep. on R is the one of interest;

note that $\bar{r}_A$ has to be considered!

now: $\phi_B = \mathbb{1}$; $e_B = 0$

$$\phi_A \equiv (a)^{\frac{A}{4}} e^{-\frac{a}{2}\sum_{i=1}^{A} \bar{r}_i^2} = a^{A/4} e^{-\frac{a}{2}\left(\bar{r}_1^2 + \ldots + \bar{r}_{A-1}^2 + \overbrace{(\bar{r}_1 + \ldots + \bar{r}_{A-1})^2}\right)}$$

$$\hat{V}_{AB} = C_\Lambda \sum_{i \in A} \delta^\Lambda(r_i - r_{A+1}) + D_\Lambda \left[\sum_{i,j \in A} \delta^\Lambda(r_i - r_{A+1}) \delta^\Lambda(r_j - r_{A+1}) + \delta^\Lambda(r_i - r_{A+1}) \delta^\Lambda(r_i - r_j) \right]$$

↑

"inter-fragment" part of the interaction using $\delta^\Lambda(r_A - r_{A+1}) \approx 0$

in cl. coord.

$$\hat{=} C_\Lambda \sum_{i \in A} \delta^\Lambda(\bar{r}_i - R) + D_\Lambda \sum_{\substack{i,j \in A \\ i \neq j}} \left[\delta^\Lambda(\bar{r}_i - R) \delta^\Lambda(\bar{r}_j - R) + \delta^\Lambda(\bar{r}_i - R) \delta^\Lambda(\bar{r}_i - \bar{r}_j) \right]$$

N

Let me demonstrate the contribution of $C_\lambda \delta^\lambda(\bar r_1 - R)$ to the equation of motion, and how we can derive analytical expression for ~~des~~ the dependence of the fragment-effective interaction on $\{\lambda, a, A, C_\lambda, D_\lambda, ?\}$:

no! The interaction does not contain λ Parameter counts!

$$\frac{A}{2}\int e^{-\frac{a}{2}\sum_{i\le A}\bar r_i^2}\, C_\lambda\, e^{-\frac{\lambda^2}{4}(\bar r_1 - R')^2}\left(\mathbb{1} - \hat P_{A,A+1}\right) \underbrace{e^{-\frac{a}{2}\left[\sum_{i<A}\bar r_i^2 + \left(\sum_{i<A}\bar r_i\right)^2\right]}}_{\neq f(\bar r_A, \bar r_{A+1})} \psi(R')\,\delta(R-R')\, d(\bar r_{1,\dots,A-1}, R')$$

$V_{\text{Direct}}^{(\text{LO}')}$

$\Rightarrow$ P acts on $\delta(R-R')$ only!

$$\hat V_{EX} \doteq -C_\lambda a^{\frac{A}{2}}\int e^{-a\sum_{i\le A}\bar r_i^2}\,\hat P_{A,A+1}\left[\delta\left(\frac{\sum_{i\le A} r_i}{A} - r_{A+1}\right) - R'\right] e^{-\frac{\lambda^2}{4}(\bar r_1 - R')^2}\psi(R')\, d(\bar r_{\dots}, R')$$

note for $A=1$, $\bar r_A = 0$ and we get $\delta(R+R') \Rightarrow \psi(R) \to \psi(-R)$

$$\doteq -\left(\frac{A+1}{A}\right)^{-1} C_\lambda a^{\frac{A}{2}}\int e^{-a\sum(\dots) - \frac{\lambda^2}{4}(\bar r_1 - R')^2}\,\underbrace{\delta\left(\frac{R}{A+1} + \frac{A}{A+1}R' - \bar r_A\right)}_{\frac{1}{2\pi}\int ds\, e^{is(\dots)}}\psi(R')\, d(\bar r_{i<A}, R')$$

for 1-d, only e.g. cartesian x coord.

$$\doteq -\left(\frac{A+1}{A}\right)^{-1} C_\lambda (2\pi)^{-1} a^{\frac{A}{2}}\int d\bar r_{i<A}\, ds\, dR'\; e^{-\frac{1}{2}\bar r^T \mathbb{A}\,\bar r + \mathbb{B}\cdot\bar r - \frac{\lambda^2}{4}R^2 + is\frac{R}{A+1} + is\frac{A}{A+1}R'}\,\psi(R')$$

$$\mathbb{A} = \begin{pmatrix} 4a + \frac{\lambda^2}{2} & 2a & \cdots & 2a \\ 2a & 4a & & \\ \vdots & & \ddots & \\ 2a & & 2a & 4a \end{pmatrix} = M(A-1 \times A-1)$$

note that this matrix is not unique but is chosen symmetric in order to use generalized Gaussian-integral formula;

$$\mathbb{B} = \begin{pmatrix} \frac{\lambda^2}{2}R - is \\ -is \\ \vdots \\ -is \end{pmatrix} = M(A-1, 1)$$

$$\doteq -\left|\frac{A+1}{A}\right|^{-1}\frac{C_\lambda}{2\pi}\, a^{\frac{A}{2}}\,\frac{(2\pi)^{A/2}}{\sqrt{\det \mathbb{A}}}\int dR'\, ds\; e^{\frac{1}{2}\mathbb{B}^T\mathbb{A}^{-1}\mathbb{B} + is\left(\frac{R}{A+1} + \frac{A}{A+1}R'\right) - \frac{\lambda^2}{4}R^2}\,\psi(R')$$

$$\doteq -\left|\frac{A+1}{A}\right|^{-1}\frac{C_\lambda}{2\pi}\, a^{\frac{A}{2}}\,\frac{(2\pi)^{A/2}}{\sqrt{|\mathbb{A}|}}\, e^{-\frac{\lambda^2}{4}R^2}\int dR'\, ds\; e^{-\frac{1}{2}s^2 A_s + s B_s}\,\psi(R')\cdot e^{+C_0 R^2}$$

$$A_s = \frac{2(A-1) + \frac{\lambda^2}{2a}(A-2)}{4Aa + (A-1)\lambda^2}\;;\quad B_s = i\left(\frac{-R\lambda^2}{4aA + (A-1)\lambda^2} + \frac{R}{A+1} + \frac{A}{A+1}R'\right)$$

$$C_0 = \frac{(A-1)\lambda^4}{16Aa + 4(A-1)\lambda^2}$$

$\square$

$$\overset{\text{II}}{=} -\frac{A+1}{A} C_1 (2\pi)^{\frac{A-1}{2}} \underbrace{\left((A-1)2^{A-2} a^{-2} + (A-2)\, 2^{A-4} \frac{\Lambda^2}{a^3}\right)^{-\frac{1}{2}}}_{f_1(A,a,\Lambda)} \int e^{\left(-\frac{\Lambda^2}{4}\cancel{+c}\right)R^2 + \frac{1}{2} B_s \cdot A_s^{-1} \cdot B_s} \psi(R')\, dR' \qquad (\text{II})$$

with
$$\frac{1}{2} B_s A_s^{-1} B_s = \underbrace{\frac{\left(4aA + (A-1)\Lambda^2\right)\left(\frac{A}{A+1} R' + \frac{R}{A+1} + \frac{R\Lambda^2}{4aA + (A-1)\Lambda^2}\right)^2}{2\left(2(A-1) + \frac{(A-2)}{2}\frac{\Lambda^2}{a}\right)}}_{f_2(A,a,\Lambda,R,R')}$$

The dependence of A_s, B_s, $f_{1,2}$ has been conjectured from 6 staring for a day on

A	A_s	B_s	f_1	f_2
3				
4				
5				
6				
7				

Unit consistency: $[f_1] = [a]$ b/c $[\Lambda^2] = [a]$
$= fm^{-2} = MeV^2$

One obtains Eq. II for each cartesian dimension which yields the final, vectorial form

$$V_{EX}(\underline{R}, \cancel{A}) = \int d^4 R' \, (-C_1) \left(\frac{A+1}{A}\right)^4 (2\pi)^{\frac{4}{2}(A-1)} \left[(A-1)2^{\cancel{A}-2} a^{-2} + (A-2)2^{\cancel{A}-4} \frac{\Lambda^2}{a^3}\right]^{-\frac{4}{2}} e^{\left(-\frac{\Lambda^2}{4}\cancel{+c}\right)\underline{R}^2 + f_2(A,a,\Lambda,\underline{R},\underline{R}')} \psi(\underline{R}')$$

Next: i, $\delta(\bar{r}_1 - R) \leftrightarrow \delta^1(\bar{r}_1 - R)\,\delta^1(\bar{r}_2 - R)$ i.e. derive $f_{1,2}$ for 3NI

ii, derive reasonable limits of $f_{1,2}$ and thereby for V_{EX}:

$$\lim_{\substack{A \gg 1 \\ \Lambda \gg a}} f_{1,2} = ?$$

note: System size $\propto a^{-\frac{1}{2}}$ => ~~max~~ cutoff momenta only $> \sqrt{a}$.

iii, $\langle \phi_A | \hat{r}_R \, \hat{A}[\phi_A \psi] \rangle = ?$

V_{Direct}

$\mathcal{A}$ retains its shape and filling and $\mathcal{B} = \begin{pmatrix} \frac{\lambda^2}{2} R \\ \vdots \end{pmatrix}$; $\delta(R-R')$ remains,

and we obtain in 1-dim. cartesian coords.:

$$V_D(R) = +C_\lambda^V \left(\frac{A+1}{A}\right)^{-1} a^{\frac{A}{2}} \underbrace{|\mathcal{A}_V|^{-\frac{1}{2}}}_{= \frac{a}{\sqrt{2^{A-1} A \cdot a + 2^{A-3}(A-1)\lambda^2}}} (2\pi)^{\frac{A}{2}-1} e^{-\frac{\lambda^2}{4} R^2} \, \psi(R) \cdot \underbrace{e^{\frac{1}{2}\mathcal{B}_V^T \mathcal{A}_V^{-1} \mathcal{B}_V}}$$

$= \frac{\lambda^2}{2}$ for 3N1

V_2: $\frac{A-1}{16 Aa + 4(A-1)\lambda^2} \lambda^4 R^2 \to \frac{\lambda^2}{4} R^2$

V_{3a}: $\frac{A-2}{8 \cdot Aa + 2(A-2)\lambda^2} \lambda^4 R^2 \to \frac{\lambda^2}{2} R^2$

V_{3b}: $\frac{(A-1)a\lambda^4 R^2}{16Aa^2 + 4(3A-5)a\lambda^2 + (A-2)\lambda^4} + \frac{\frac{1}{4}(A-2)\lambda^6 R^2}{64Aa^2 + 16(3A-5)a\lambda^2 + 4(A-2)\lambda^4}$

V_{3N1}

we consider generic cases ($i=1$; $i,j=1,2$ for this case)

$$\underbrace{D_\lambda e^{-\frac{\lambda^2}{4}(\bar{r}_1 - R)^2 - \frac{\lambda^2}{4}(\bar{r}_2 - R)^2}}_{\text{type-a}} \quad \text{and} \quad \overbrace{D_\lambda e^{-\frac{\lambda^2}{4}(\bar{r}_1 - R)^2 - \underbrace{\frac{\lambda^2}{4}(\bar{r}_1 - \bar{r}_2)^2}_{= -\frac{\lambda^2}{4}(\bar{r}_1^2 + \bar{r}_2^2) + \underbrace{\frac{\lambda^2}{2}\bar{r}_1 \cdot \bar{r}_2}_{\text{goes into } \mathcal{A}}}}}^{\text{type-b}}$$

$$\mathcal{A} = \begin{pmatrix} 4a + \frac{\lambda^2}{2} & & 2a & \\ & 4a + \frac{\lambda^2}{2} & & \\ & & 4a & \\ 2a & & & 4a \end{pmatrix}, \quad \mathcal{B} = \begin{pmatrix} \frac{\lambda^2}{2}R - is \\ \boxed{\frac{\lambda^2}{2}R - is} \\ -is \\ \vdots \\ -is \end{pmatrix} ; \quad e^{-\frac{\lambda^2}{2}R^2}$$

and $$\mathcal{A} = \begin{pmatrix} 4a + \frac{\lambda^2}{2} & \boxed{\frac{1}{2}\lambda^2 + 2a} & 2a & \\ \boxed{\frac{1}{2}\lambda^2 + 2a} & 4a + \frac{\lambda^2}{2} & & \\ & & 4a & \\ 2a & & & \ddots \end{pmatrix}, \quad \mathcal{B} = \begin{pmatrix} \frac{\lambda^2}{2}R - is \\ -is \\ \vdots \\ -is \end{pmatrix} ; \quad e^{-\frac{\lambda^2}{4}R^2}$$

From here on, the evaluation proceeds as for V_{2N1}:

1, Integrate over internal coordinates

$$\Rightarrow \hat{V}_{EX}(3N1_{a,b}) = -\underbrace{\frac{A}{A+1}}_{\text{from } \hat{P}_{A,A+1}\delta(R-R')} \underbrace{(2\pi)^{\frac{A}{2}-1}}_{\int d\bar{r}} \underbrace{(\det \mathcal{A})^{-1/2}}_{\int d\bar{r}} D_\lambda \, e^{-\frac{\lambda^2}{2}R^2} \int dR' ds \, e^{\frac{1}{2}\mathcal{B}^T \mathcal{A}^{-1} \mathcal{B} + is\left(\frac{R}{A+1} + \frac{A}{A+1}R'\right)}$$

$\delta = \int e^{\dots}$

2, $\frac{1}{2}\mathcal{B}^T \mathcal{A}^{-1} \mathcal{B} + is\left(\frac{R}{A+1} + \frac{A}{A+1}R'\right) \equiv \underbrace{K_2 s^2 + K_1 s + K_0}_{\text{? find } (A, a, \lambda) \text{ dependence!}}$

	K_0	K_1	K_2
$V_{2\text{-body}}$	$+\dfrac{(A-1)a\Lambda^4 R^2}{16(Aa^2)+4(A-1)a\Lambda^2}$	$-i\left(\dfrac{4a\Lambda^2}{16Aa^2+4(A-1)a\Lambda^2}-\dfrac{1}{A+1}\right)R+i\dfrac{A}{A+1}R'$	$\dfrac{-4(A-1)a-(A-2)\Lambda^2}{16Aa^2+4(A-1)a\Lambda^2}$
$V_{3\ \text{type-a}}$	$+\dfrac{2(A-2)a\Lambda^4 R^2}{16Aa^2+4(A-2)a\Lambda^2}$	$-i\left(\dfrac{8a\Lambda^2}{16Aa^2+4(A-2)a\Lambda^2}-\dfrac{1}{A+1}\right)R+i\dfrac{A}{A+1}R'$	$-\dfrac{4(A-1)a+(A-3)\Lambda^2}{16Aa^2+4(A-2)a\Lambda^2}$
$V_{3\ \text{type-b}}$	$+\dfrac{(A-1)a\Lambda^4+(A-2)\frac{\Lambda^6}{4}}{16Aa^2+(12A-20)a\Lambda^2+(A-2)\Lambda^4}R^2$	$-i\left(\dfrac{4a\Lambda^2}{16Aa^2+(12A-20)a\Lambda^2+(A-2)\Lambda^4}-\dfrac{1}{A+1}\right)R+i\dfrac{A}{A+1}R'$	$-\dfrac{4(A-1)a+(3A-8)\Lambda^2+(A-3)\frac{\Lambda^2}{4a}}{16Aa^2+(12A-20)a\Lambda^2+(A-2)\Lambda^2}$

3, evaluate $\displaystyle\int d\cancel{R}s\, e^{K_2 s^2+K_1 s+K_0} = e^{K_0}\sqrt{\frac{2\pi}{2K_2}}\, e^{\frac{1}{2}K_1^2\cdot K_2^{-1}\cdot 2}$

$$= \begin{cases}
V_{2N}: \quad \underbrace{\sqrt{\pi}\cdot\sqrt{\dfrac{16Aa^2+4(A-1)a\Lambda^2}{4(A-1)a+(A-2)\Lambda^2}}}_{\equiv F_1}\, e^{F_2}\,; \quad F_2 := +\dfrac{(A-1)\Lambda^4}{16Aa+(4(A-1))\Lambda^2}R^2 - \dfrac{(16Aa^2+4(A-1)a\Lambda^2)\left(\frac{A}{A+1}R'+\frac{R}{A+1}-\frac{4a\Lambda^2 R}{16Aa^2+4(A-1)a\Lambda^2}\right)^2}{4(A-1)a+(A-2)\Lambda^2} \\
\text{lim } \frac{\Lambda^2}{a}\gg 1 \qquad 2\sqrt{\frac{A-1}{A-2}a} \\
V_{3N\,a}: \quad \sqrt{\pi}\cdot\sqrt{\dfrac{16Aa^2+4(A-2)a\Lambda^2}{4(A-1)a+(A-3)\Lambda^2}}\, e^{F_2}\,; \quad F_2 := +\dfrac{2(A-2)\Lambda^4}{16Aa+4(A-2)\Lambda^2}R^2 - \dfrac{(16Aa^2+4(A-2)a\Lambda^2)\left(\frac{A}{A+1}R'+\frac{R}{A+1}-\frac{8a\Lambda^2 R}{16Aa^2+4(A-2)a\Lambda^2}\right)^2}{4(A-1)a+(A-3)\Lambda^2} \\
\qquad 2\sqrt{\frac{(A-2)}{(A-3)}a} \\
V_{3N\,b}: \quad \sqrt{\pi}\sqrt{\dfrac{16Aa^2+(3A-5)\cdot 4a\Lambda^2+(A-2)\Lambda^4}{4(A-1)\cdot a+(3A-8)\Lambda^2+\frac{(A-3)}{4}\frac{\Lambda^4}{a}}}\, e^{F_2} \\
\qquad 2\sqrt{\frac{A-2}{A-3}a} \\
F_2 = +\dfrac{\left((A-1)a\Lambda^4+\frac{(A-2)}{4}\Lambda^6\right)R^2}{16Aa^2+4(3A-5)a\Lambda^2+(A-2)\Lambda^4} - \dfrac{(16Aa^2+4(3A-5)a\Lambda^2+(A-2)\Lambda^4)\left(\frac{A}{A+1}R'+\frac{R}{A+1}-\frac{4a\Lambda^2 R}{16Aa^2+4(3A-5)a\Lambda^2+\ldots}\right)}{4(A-1)a+(3A-8)\Lambda^2+\frac{(A-3)}{4}\frac{\Lambda^2}{a}}
\end{cases}$$

1

V_2 V_{3A} V_{3B}

$$\frac{a^{\frac{A}{2}}}{\sqrt{\det A}}$$

$$\frac{\sqrt{a}}{\sqrt{A \cdot 2^{A-1} + (A-1)A 2^{A-3}\frac{\lambda^2}{a}}}$$

$$\frac{\sqrt{a}}{\sqrt{A \cdot 2^{A-1} + (A-1)2^{A-2}\frac{\lambda^2}{a} + \frac{1}{4}(A-2)2^{A-3}\lambda^4/a^2}}$$

$$\frac{\sqrt{a}}{\sqrt{A \cdot 2^{A-1} + \left[(A-1)2^{A-3} + (A-2)2^{A-2}\right]\frac{\lambda^2}{a} + \frac{(A-2)}{4}2^{A-3}\frac{\lambda^4}{a^2}}}$$

$\lim \frac{\lambda^2}{a} \gg 1$

$$\frac{a}{\lambda}\frac{1}{\sqrt{(A-1)2^{A-3}}}$$

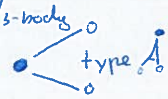
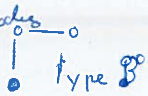
$$\frac{a^{3/2}}{\lambda^2}\frac{1}{\sqrt{(A-2)2^{A-5}}}$$

$$\frac{a^{3/2}}{\lambda^2}\frac{1}{\sqrt{(A-2)2^{A-5}}}$$

$$F_2 = c_1 R^2 + c_2 (a_1 R' + a_2 R)^2$$

$$= c_1 R^2 + c_2 a_1^2 R'^2 + c_2 a_2^2 R^2 + 2 a_1 a_2 c_2 R' R$$

$$= (c_1 + c_2 a_2) R^2 + c_2 a_1^2 R'^2 + 2 a_1 a_2 c_2 R' R$$

	c_1	c_2	a_1	a_2
$V_{2\text{-body}}$ 	$-\frac{\Lambda^2}{4} + \frac{(A-1)\Lambda^4}{16Aa + 4(A-1)\Lambda^2}$	$-\frac{16Aa^2 + 4(A-1)a\Lambda^2}{4(A-1)a + (A-2)\Lambda^2}$	$\frac{A}{A+1}$	$\frac{1}{A+1} - \frac{4\Lambda^2}{16Aa + 4(A-1)\Lambda^2}$
$\frac{\Lambda^2}{a} \gg 1$	$-\frac{\Lambda^2}{4} + \frac{\Lambda^2}{4} = 0$	$-4\frac{(A-1)}{(A-2)}a$	$\frac{A}{A+1}$	$\frac{A}{A+1} - \frac{A}{A-1} < 0$
$V_{3\text{-body}}$ type A 	$-\frac{\Lambda^2}{2} + \frac{2(A-2)\Lambda^4}{16Aa + 4(A-2)\Lambda^2}$	$-\frac{16Aa^2 + 4(A-2)a\Lambda^2}{4(A-1)a + (A-3)\Lambda^2}$	$\frac{A}{A+1}$	$\frac{1}{A+1} - \frac{8\Lambda^2}{16Aa + 4(A-2)\Lambda^2}$
	0	$-4\frac{(A-2)}{(A-3)}a$	$\frac{A}{A+1}$	$\frac{A}{A+1} - \frac{2}{(A-2)} < 0$
$V_{3\text{-body}}$ type B 	$-\frac{\Lambda^2}{4} + \frac{(A-1)a\Lambda^4 + \frac{(A-2)}{4}\Lambda^6}{16Aa^2 + 4(3A-5)a\Lambda^2 + (A-2)\Lambda^4}$	$-\frac{16Aa^2 + 4(3A-5)a\Lambda^2 + (A-2)\Lambda^4}{4(A-1)a + (3A-8)\Lambda^2 + \frac{(A-3)}{4}\frac{\Lambda^4}{a}}$	$\frac{A}{A+1}$	$\frac{1}{A+1} - \frac{4\Lambda^2}{16Aa + 4(3A-5)\Lambda^2 + (A-2)\Lambda^4}$
	0	$-4\frac{(A-2)}{(A-3)}a$	$\frac{A}{A+1}$	$\frac{A}{A+1} - \frac{4}{(A-2)\Lambda^2/a} \gtrless 0$

The generic form in 3D for $v \in \{V_{2N1}, V_{3N1_A}, V_{3N1_B}\}$ is thus

$$\hat{V}_{EV}(v) = -\frac{A}{A+1} F_1^3 \left(\frac{(2\pi)^{\frac{A}{2}-1} a^{\frac{A}{2}}}{\sqrt{\det A_v}} \right)^3 \cdot LEC(\Lambda) \left| \sum_{\substack{\text{int.}\\ \text{pairs/}\\ \text{triplets}}} \right| (A) \int d^{(3)}\underline{R}' \, e^{(c_1^v + c_2^v a_2^v)\underline{R}^2 + c_2^v a_1^v \underline{R}'^2 + 2 a_1^v a_2^v c_2^v \underline{R}' \cdot \underline{R}} \, \Psi(\underline{R}'$$

$\sqrt{\pi}$

$\frac{\Lambda^2}{a} \gg 1$

V_2 $\quad 2\sqrt{\frac{A-1}{A-2}a}\,(2\pi)^{\frac{A}{2}-1}\frac{a}{\Lambda}\frac{A}{\sqrt{(A-1)2^{A-3}}}$ $\quad (A-1)$ $\quad -4\frac{A-1}{A-2}\left(\frac{A}{A+1} - \frac{A}{A-1}\right)$ $\quad 4\frac{(A-1)}{(A-2)}\left(\frac{A}{A+1}\right)$ $\quad -8\frac{(A-1)}{(A-2)}\left(\frac{A}{A+1}\right)\left(\frac{A}{A\ldots}\right.$

V_{3_A} $\quad 2\sqrt{\frac{A-2}{A-3}a}\,\underbrace{(2\pi)^{\frac{A}{2}-1}\frac{a^{3/2}}{\Lambda^2}\frac{A}{\sqrt{(A-2)2^{A-5}}}}$ $\quad (A-1)(A-2)$

V_{3_B} $\quad 2\sqrt{\frac{A-2}{A-3}a}$ $\quad (A-1)^2$