

PG No. 22 C_{3h} 6 [hexagonal] (axial, internal polar quadrupole)

* Harmonics for rank 0

* Harmonics for rank 1

$$\vec{\mathbb{G}}_1^{(2,1)}[q](A')$$

** symmetry

z

** expression

$$\frac{\sqrt{30}Q_vxy}{5} - \frac{\sqrt{30}Q_{xy}(x-y)(x+y)}{10} + \frac{\sqrt{30}Q_{xz}yz}{10} - \frac{\sqrt{30}Q_{yz}xz}{10}$$

$$\vec{\mathbb{G}}_{1,1}^{(2,1)}[q](E''), \vec{\mathbb{G}}_{1,2}^{(2,1)}[q](E'')$$

** symmetry

x

y

** expression

$$-\frac{3\sqrt{10}Q_uyz}{10} - \frac{\sqrt{30}Q_vyz}{10} + \frac{\sqrt{30}Q_{xy}xz}{10} - \frac{\sqrt{30}Q_{xz}xy}{10} - \frac{\sqrt{30}Q_{yz}(y-z)(y+z)}{10}$$

$$\frac{3\sqrt{10}Q_uxz}{10} - \frac{\sqrt{30}Q_vxz}{10} - \frac{\sqrt{30}Q_{xy}yz}{10} + \frac{\sqrt{30}Q_{xz}(x-z)(x+z)}{10} + \frac{\sqrt{30}Q_{yz}xy}{10}$$

* Harmonics for rank 2

$$\vec{\mathbb{G}}_2^{(2,-1)}[q](A'')$$

** symmetry

$$-\frac{x^2}{2} - \frac{y^2}{2} + z^2$$

** expression

$$\frac{\sqrt{2}Q_{xz}y}{2} - \frac{\sqrt{2}Q_{yz}x}{2}$$

$$\vec{\mathbb{G}}_2^{(2,1)}[q](A'')$$

** symmetry

$$-\frac{x^2}{2} - \frac{y^2}{2} + z^2$$

** expression

$$\frac{5\sqrt{42}Q_vxyz}{14} - \frac{5\sqrt{42}Q_{xy}z(x-y)(x+y)}{28} - \frac{\sqrt{42}Q_{xz}y(x^2+y^2-4z^2)}{28} + \frac{\sqrt{42}Q_{yz}x(x^2+y^2-4z^2)}{28}$$

$$\vec{\mathbb{G}}_{2,1}^{(2,-1)}[q](E'), \vec{\mathbb{G}}_{2,2}^{(2,-1)}[q](E')$$

** symmetry

$\sqrt{3}yz$

$-\sqrt{3}xz$

** expression

$$\frac{\sqrt{2}Q_ux}{2} + \frac{\sqrt{6}Q_vx}{6} + \frac{\sqrt{6}Q_{xy}y}{6} - \frac{\sqrt{6}Q_{xz}z}{6}$$

$$\frac{\sqrt{2}Q_uy}{2} - \frac{\sqrt{6}Q_vy}{6} + \frac{\sqrt{6}Q_{xy}x}{6} - \frac{\sqrt{6}Q_{yz}z}{6}$$

$$\vec{\mathbb{G}}_{2,1}^{(2,1)}[q](E'), \vec{\mathbb{G}}_{2,2}^{(2,1)}[q](E')$$

** symmetry

$\sqrt{3}yz$

$-\sqrt{3}xz$

** expression

$$-\frac{\sqrt{42}Q_ux(x^2+y^2-4z^2)}{28} - \frac{\sqrt{14}Q_vx(x^2-9y^2+6z^2)}{28} - \frac{\sqrt{14}Q_{xy}y(3x^2-2y^2+3z^2)}{14} + \frac{\sqrt{14}Q_{xz}z(3x^2+3y^2-2z^2)}{14}$$

$$-\frac{\sqrt{42}Q_{uy}\left(x^2+y^2-4z^2\right)}{28}-\frac{\sqrt{14}Q_vy\left(9x^2-y^2-6z^2\right)}{28}+\frac{\sqrt{14}Q_{xy}x\left(2x^2-3y^2-3z^2\right)}{14}+\frac{\sqrt{14}Q_{yz}z\left(3x^2+3y^2-2z^2\right)}{14}$$

$\tilde{\mathbb{G}}_{2,1}^{(2,-1)}[q](E'')$, $\tilde{\mathbb{G}}_{2,2}^{(2,-1)}[q](E'')$

** symmetry

$$\frac{\sqrt{3}(x-y)(x+y)}{2}$$

$$-\sqrt{3}xy$$

** expression

$$\frac{\sqrt{6}Q_{xy}z}{3}-\frac{\sqrt{6}Q_{xz}y}{6}-\frac{\sqrt{6}Q_{yz}x}{6}$$

$$\frac{\sqrt{6}Q_vz}{3}-\frac{\sqrt{6}Q_{xz}x}{6}+\frac{\sqrt{6}Q_{yz}y}{6}$$

$\tilde{\mathbb{G}}_{2,1}^{(2,1)}[q](E'')$, $\tilde{\mathbb{G}}_{2,2}^{(2,1)}[q](E'')$

** symmetry

$$\frac{\sqrt{3}(x-y)(x+y)}{2}$$

$$-\sqrt{3}xy$$

** expression

$$-\frac{5\sqrt{42}Q_uxyz}{14}+\frac{\sqrt{14}Q_{xy}z\left(3x^2+3y^2-2z^2\right)}{28}-\frac{\sqrt{14}Q_{xz}y\left(9x^2-y^2-6z^2\right)}{28}+\frac{\sqrt{14}Q_{yz}x\left(x^2-9y^2+6z^2\right)}{28}$$

$$-\frac{5\sqrt{42}Q_uz(x-y)(x+y)}{28}+\frac{\sqrt{14}Q_vz\left(3x^2+3y^2-2z^2\right)}{28}-\frac{\sqrt{14}Q_{xz}x\left(2x^2-3y^2-3z^2\right)}{14}-\frac{\sqrt{14}Q_{yz}y\left(3x^2-2y^2+3z^2\right)}{14}$$

* Harmonics for rank 3

$\tilde{\mathbb{G}}_3^{(2,-1)}[q](A')$

** symmetry

$$-\frac{z\left(3x^2+3y^2-2z^2\right)}{2}$$

** expression

$$-\frac{\sqrt{30}Q_vxy}{10}+\frac{\sqrt{30}Q_{xy}(x-y)(x+y)}{20}+\frac{\sqrt{30}Q_{xz}yz}{5}-\frac{\sqrt{30}Q_{yz}xz}{5}$$

$\tilde{\mathbb{G}}_3^{(2,1)}[q](A')$

** symmetry

$$-\frac{z\left(3x^2+3y^2-2z^2\right)}{2}$$

** expression

$$-\frac{\sqrt{15}Q_vxy\left(x^2+y^2-6z^2\right)}{6}+\frac{\sqrt{15}Q_{xy}(x-y)(x+y)\left(x^2+y^2-6z^2\right)}{12}-\frac{\sqrt{15}Q_{xz}yz\left(3x^2+3y^2-4z^2\right)}{12}+\frac{\sqrt{15}Q_{yz}xz\left(3x^2+3y^2-4z^2\right)}{12}$$

$\tilde{\mathbb{G}}_3^{(2,-1)}[q](A'',1)$

** symmetry

$$\frac{\sqrt{10}y\left(3x^2-y^2\right)}{4}$$

** expression

$$-\frac{\sqrt{3}Q_vxz}{2}+\frac{\sqrt{3}Q_{xy}yz}{2}+\frac{\sqrt{3}Q_{xz}(x-y)(x+y)}{4}-\frac{\sqrt{3}Q_{yz}xy}{2}$$

$\tilde{\mathbb{G}}_3^{(2,-1)}[q](A'',2)$

** symmetry

$$\frac{\sqrt{10}x\left(x^2-3y^2\right)}{4}$$

** expression

$$\frac{\sqrt{3}Q_vyz}{2}+\frac{\sqrt{3}Q_{xy}xz}{2}-\frac{\sqrt{3}Q_{xz}xy}{2}-\frac{\sqrt{3}Q_{yz}(x-y)(x+y)}{4}$$

$$\vec{\mathbb{G}}_3^{(2,1)}[q](A'', 1)$$

** symmetry

$$\frac{\sqrt{10}y(3x^2 - y^2)}{4}$$

** expression

$$\begin{aligned} & \frac{7\sqrt{2}Q_{uxz}(x^2 - 3y^2)}{8} - \frac{\sqrt{6}Q_{vxz}(3x^2 + 3y^2 - 4z^2)}{24} + \frac{\sqrt{6}Q_{xyyz}(3x^2 + 3y^2 - 4z^2)}{24} \\ & + \frac{\sqrt{6}Q_{xz}(5x^4 - 21x^2y^2 - 9x^2z^2 + 2y^4 + 9y^2z^2)}{24} + \frac{\sqrt{6}Q_{yz}xy(11x^2 - 17y^2 + 18z^2)}{24} \end{aligned}$$

$$\vec{\mathbb{G}}_3^{(2,1)}[q](A'', 2)$$

** symmetry

$$\frac{\sqrt{10}x(x^2 - 3y^2)}{4}$$

** expression

$$\begin{aligned} & -\frac{7\sqrt{2}Q_{uyz}(3x^2 - y^2)}{8} + \frac{\sqrt{6}Q_{vyz}(3x^2 + 3y^2 - 4z^2)}{24} + \frac{\sqrt{6}Q_{xyxz}(3x^2 + 3y^2 - 4z^2)}{24} \\ & - \frac{\sqrt{6}Q_{xz}xy(17x^2 - 11y^2 - 18z^2)}{24} + \frac{\sqrt{6}Q_{yz}(2x^4 - 21x^2y^2 + 9x^2z^2 + 5y^4 - 9y^2z^2)}{24} \end{aligned}$$

$$\vec{\mathbb{G}}_{3,1}^{(2,-1)}[q](E'), \vec{\mathbb{G}}_{3,2}^{(2,-1)}[q](E')$$

** symmetry

$$\sqrt{15}xyz$$

$$\frac{\sqrt{15}z(x - y)(x + y)}{2}$$

** expression

$$\frac{\sqrt{6}Q_u(x - y)(x + y)}{4} + \frac{\sqrt{2}Q_v(x^2 + y^2 - 2z^2)}{4}$$

$$-\frac{\sqrt{6}Q_uxy}{2} - \frac{\sqrt{2}Q_{xy}(x^2 + y^2 - 2z^2)}{4}$$

$$\vec{\mathbb{G}}_{3,1}^{(2,1)}[q](E'), \vec{\mathbb{G}}_{3,2}^{(2,1)}[q](E')$$

** symmetry

$$\sqrt{15}xyz$$

$$\frac{\sqrt{15}z(x - y)(x + y)}{2}$$

** expression

$$\begin{aligned} & -\frac{\sqrt{3}Q_u(x - y)(x + y)(x^2 + y^2 - 6z^2)}{6} - \frac{Q_v(x^4 - 12x^2y^2 + 6x^2z^2 + y^4 + 6y^2z^2 - 2z^4)}{6} \\ & - \frac{7Q_{xy}xy(x - y)(x + y)}{6} + \frac{7Q_{xz}xz(x - z)(x + z)}{6} - \frac{7Q_{yz}yz(y - z)(y + z)}{6} \end{aligned}$$

$$\begin{aligned} & \frac{\sqrt{3}Q_uxy(x^2 + y^2 - 6z^2)}{3} + \frac{7Q_vxy(x - y)(x + y)}{6} - \frac{Q_{xy}(5x^4 - 18x^2y^2 - 12x^2z^2 + 5y^4 - 12y^2z^2 + 4z^4)}{12} \\ & - \frac{7Q_{xz}yz(3x^2 + y^2 - 2z^2)}{12} - \frac{7Q_{yz}xz(x^2 + 3y^2 - 2z^2)}{12} \end{aligned}$$

$$\vec{\mathbb{G}}_{3,1}^{(2,-1)}[q](E''), \vec{\mathbb{G}}_{3,2}^{(2,-1)}[q](E'')$$

** symmetry

$$-\frac{\sqrt{6}x(x^2 + y^2 - 4z^2)}{4}$$

$$-\frac{\sqrt{6}y(x^2 + y^2 - 4z^2)}{4}$$

** expression

$$-\frac{\sqrt{15}Q_{uyz}}{5} + \frac{3\sqrt{5}Q_{vyz}}{10} - \frac{3\sqrt{5}Q_{xyxz}}{10} + \frac{3\sqrt{5}Q_{xz}xy}{10} - \frac{\sqrt{5}Q_{yz}(5x^2 - y^2 - 4z^2)}{20}$$

$$\frac{\sqrt{15}Q_{uxz}}{5} + \frac{3\sqrt{5}Q_{vzx}}{10} + \frac{3\sqrt{5}Q_{xyy}}{10} - \frac{\sqrt{5}Q_{xz}(x^2 - 5y^2 + 4z^2)}{20} - \frac{3\sqrt{5}Q_{yz}xy}{10}$$

$\tilde{\mathbb{G}}_{3,1}^{(2,1)}[q](E'')$, $\tilde{\mathbb{G}}_{3,2}^{(2,1)}[q](E'')$

** symmetry

$$-\frac{\sqrt{6}x(x^2 + y^2 - 4z^2)}{4}$$

$$-\frac{\sqrt{6}y(x^2 + y^2 - 4z^2)}{4}$$

** expression

$$\begin{aligned} & \frac{\sqrt{30}Q_{uyz}(3x^2 + 3y^2 - 4z^2)}{24} + \frac{\sqrt{10}Q_{vyz}(27x^2 - y^2 - 8z^2)}{24} - \frac{\sqrt{10}Q_{xyx}(13x^2 - 15y^2 - 8z^2)}{24} \\ & - \frac{\sqrt{10}Q_{xz}xy(x^2 + y^2 - 6z^2)}{24} + \frac{\sqrt{10}Q_{yz}(2x^4 + 3x^2y^2 - 15x^2z^2 + y^4 - 9y^2z^2 + 4z^4)}{24} \end{aligned}$$

$$\begin{aligned} & - \frac{\sqrt{30}Q_{uxz}(3x^2 + 3y^2 - 4z^2)}{24} - \frac{\sqrt{10}Q_{vxz}(x^2 - 27y^2 + 8z^2)}{24} - \frac{\sqrt{10}Q_{xyy}(15x^2 - 13y^2 + 8z^2)}{24} \\ & - \frac{\sqrt{10}Q_{xz}(x^4 + 3x^2y^2 - 9x^2z^2 + 2y^4 - 15y^2z^2 + 4z^4)}{24} + \frac{\sqrt{10}Q_{yz}xy(x^2 + y^2 - 6z^2)}{24} \end{aligned}$$

* Harmonics for rank 4

$\tilde{\mathbb{G}}_4^{(2,-1)}[q](A', 1)$

** symmetry

$$\frac{\sqrt{70}xz(x^2 - 3y^2)}{4}$$

** expression

$$-\frac{3\sqrt{2}Q_{uy}(3x^2 - y^2)}{8} - \frac{\sqrt{6}Q_{vy}(x^2 + y^2 - 4z^2)}{8} - \frac{\sqrt{6}Q_{xy}x(x^2 + y^2 - 4z^2)}{8} - \frac{\sqrt{6}Q_{xz}xyz}{4} - \frac{\sqrt{6}Q_{yz}z(x - y)(x + y)}{8}$$

$\tilde{\mathbb{G}}_4^{(2,-1)}[q](A', 2)$

** symmetry

$$\frac{\sqrt{70}yz(3x^2 - y^2)}{4}$$

** expression

$$\frac{3\sqrt{2}Q_{ux}(x^2 - 3y^2)}{8} + \frac{\sqrt{6}Q_{vx}(x^2 + y^2 - 4z^2)}{8} - \frac{\sqrt{6}Q_{xy}y(x^2 + y^2 - 4z^2)}{8} + \frac{\sqrt{6}Q_{xz}z(x - y)(x + y)}{8} - \frac{\sqrt{6}Q_{yz}xyz}{4}$$

$\tilde{\mathbb{G}}_4^{(2,1)}[q](A', 1)$

** symmetry

$$\frac{\sqrt{70}xz(x^2 - 3y^2)}{4}$$

** expression

$$\begin{aligned} & \frac{3\sqrt{77}Q_{uy}(3x^2 - y^2)(x^2 + y^2 - 8z^2)}{88} + \frac{\sqrt{231}Q_{vy}(7x^4 - 16x^2y^2 + 6x^2z^2 + y^4 + 6y^2z^2 - 4z^4)}{88} \\ & - \frac{\sqrt{231}Q_{xy}x(x^4 - 7x^2y^2 - 3x^2z^2 + 4y^4 - 3y^2z^2 + 2z^4)}{44} - \frac{\sqrt{231}Q_{xz}xyz(11x^2 - y^2 - 10z^2)}{44} - \frac{\sqrt{231}Q_{yz}z(x^4 + 9x^2y^2 - 5x^2z^2 - 4y^4 + 5y^2z^2)}{44} \end{aligned}$$

$\tilde{\mathbb{G}}_4^{(2,1)}[q](A', 2)$

** symmetry

$$\frac{\sqrt{70}yz(3x^2 - y^2)}{4}$$

** expression

$$\begin{aligned} & - \frac{3\sqrt{77}Q_{ux}(x^2 - 3y^2)(x^2 + y^2 - 8z^2)}{88} - \frac{\sqrt{231}Q_{vx}(x^4 - 16x^2y^2 + 6x^2z^2 + 7y^4 + 6y^2z^2 - 4z^4)}{88} \\ & - \frac{\sqrt{231}Q_{xy}y(4x^4 - 7x^2y^2 - 3x^2z^2 + y^4 - 3y^2z^2 + 2z^4)}{44} + \frac{\sqrt{231}Q_{xz}z(4x^4 - 9x^2y^2 - 5x^2z^2 - y^4 + 5y^2z^2)}{44} + \frac{\sqrt{231}Q_{yz}xyz(x^2 - 11y^2 + 10z^2)}{44} \end{aligned}$$

$\tilde{\mathbb{G}}_4^{(2,-1)}[q](A'')$

** symmetry

$$\frac{3x^4}{8} + \frac{3x^2y^2}{4} - 3x^2z^2 + \frac{3y^4}{8} - 3y^2z^2 + z^4$$

** expression

$$-\frac{\sqrt{105}Q_vxyz}{7} + \frac{\sqrt{105}Q_{xy}z(x-y)(x+y)}{14} - \frac{\sqrt{105}Q_{xz}y(x^2+y^2-4z^2)}{28} + \frac{\sqrt{105}Q_{yz}x(x^2+y^2-4z^2)}{28}$$

$\tilde{\mathbb{G}}_4^{(2,1)}[q](A'')$

** symmetry

$$\frac{3x^4}{8} + \frac{3x^2y^2}{4} - 3x^2z^2 + \frac{3y^4}{8} - 3y^2z^2 + z^4$$

** expression

$$\begin{aligned} & \frac{7\sqrt{330}Q_vxyz(x^2+y^2-2z^2)}{44} + \frac{7\sqrt{330}Q_{xy}z(x-y)(x+y)(x^2+y^2-2z^2)}{88} \\ & + \frac{\sqrt{330}Q_{xz}y(x^4+2x^2y^2-12x^2z^2+y^4-12y^2z^2+8z^4)}{88} - \frac{\sqrt{330}Q_{yz}x(x^4+2x^2y^2-12x^2z^2+y^4-12y^2z^2+8z^4)}{88} \end{aligned}$$

$\tilde{\mathbb{G}}_{4,1}^{(2,-1)}[q](E'), \tilde{\mathbb{G}}_{4,2}^{(2,-1)}[q](E')$

** symmetry

$$-\frac{\sqrt{10}yz(3x^2+3y^2-4z^2)}{4}$$

$$\frac{\sqrt{10}xz(3x^2+3y^2-4z^2)}{4}$$

** expression

$$\begin{aligned} & -\frac{3\sqrt{14}Qux(x^2+y^2-4z^2)}{56} - \frac{\sqrt{42}Q_vx(x^2+5y^2-8z^2)}{56} + \frac{\sqrt{42}Q_{xy}y(x^2-3y^2+8z^2)}{56} - \frac{\sqrt{42}Q_{xz}z(x^2-13y^2+4z^2)}{56} - \frac{\sqrt{42}Q_{yz}xyz}{4} \\ & - \frac{3\sqrt{14}Q_uy(x^2+y^2-4z^2)}{56} + \frac{\sqrt{42}Q_vy(5x^2+y^2-8z^2)}{56} - \frac{\sqrt{42}Q_{xy}x(3x^2-y^2-8z^2)}{56} - \frac{\sqrt{42}Q_{xz}xyz}{4} + \frac{\sqrt{42}Q_{yz}z(13x^2-y^2-4z^2)}{56} \end{aligned}$$

$\tilde{\mathbb{G}}_{4,1}^{(2,1)}[q](E'), \tilde{\mathbb{G}}_{4,2}^{(2,1)}[q](E')$

** symmetry

$$-\frac{\sqrt{10}yz(3x^2+3y^2-4z^2)}{4}$$

$$\frac{\sqrt{10}xz(3x^2+3y^2-4z^2)}{4}$$

** expression

$$\begin{aligned} & \frac{3\sqrt{11}Qux(x^4+2x^2y^2-12x^2z^2+y^4-12y^2z^2+8z^4)}{88} + \frac{\sqrt{33}Q_vx(x^4-12x^2y^2+2x^2z^2-13y^4+114y^2z^2-20z^4)}{88} \\ & + \frac{\sqrt{33}Q_{xy}y(4x^4+x^2y^2-27x^2z^2-3y^4+29y^2z^2-10z^4)}{44} \\ & - \frac{\sqrt{33}Q_{xz}z(4x^4+15x^2y^2-13x^2z^2+11y^4-27y^2z^2+4z^4)}{44} + \frac{7\sqrt{33}Q_{yz}xyz(x^2+y^2-2z^2)}{44} \end{aligned}$$

$$\begin{aligned} & \frac{3\sqrt{11}Q_uy(x^4+2x^2y^2-12x^2z^2+y^4-12y^2z^2+8z^4)}{88} + \frac{\sqrt{33}Q_vy(13x^4+12x^2y^2-114x^2z^2-y^4-2y^2z^2+20z^4)}{88} \\ & - \frac{\sqrt{33}Q_{xy}x(3x^4-x^2y^2-29x^2z^2-4y^4+27y^2z^2+10z^4)}{44} + \frac{7\sqrt{33}Q_{xz}xyz(x^2+y^2-2z^2)}{44} \\ & - \frac{\sqrt{33}Q_{yz}z(11x^4+15x^2y^2-27x^2z^2+4y^4-13y^2z^2+4z^4)}{44} \end{aligned}$$

$\tilde{\mathbb{G}}_{4,1}^{(2,-1)}[q](E'', 1), \tilde{\mathbb{G}}_{4,2}^{(2,-1)}[q](E'', 1)$

** symmetry

$$\frac{\sqrt{35}(x^2-2xy-y^2)(x^2+2xy-y^2)}{8}$$

$$\frac{\sqrt{35}xy(x-y)(x+y)}{2}$$

** expression

$$\sqrt{3}Q_vxyz + \frac{\sqrt{3}Q_{xy}z(x-y)(x+y)}{2} - \frac{\sqrt{3}Q_{xz}y(3x^2-y^2)}{4} - \frac{\sqrt{3}Q_{yz}x(x^2-3y^2)}{4}$$

$$-\frac{\sqrt{3}Q_vz(x-y)(x+y)}{2} + \sqrt{3}Q_{xy}xyz + \frac{\sqrt{3}Q_{xz}x(x^2-3y^2)}{4} - \frac{\sqrt{3}Q_{yz}y(3x^2-y^2)}{4}$$

$$\vec{\mathbb{G}}_{4,1}^{(2,-1)}[q](E'', 2), \vec{\mathbb{G}}_{4,2}^{(2,-1)}[q](E'', 2)$$

** symmetry

$$-\frac{\sqrt{5}(x-y)(x+y)(x^2+y^2-6z^2)}{4}$$

$$\frac{\sqrt{5}xy(x^2+y^2-6z^2)}{2}$$

** expression

$$-\frac{6\sqrt{7}Q_uxyz}{7} - \frac{\sqrt{21}Q_{xy}z(3x^2+3y^2-2z^2)}{14} + \frac{\sqrt{21}Q_{xz}y(2x^2-y^2+z^2)}{14} - \frac{\sqrt{21}Q_{yz}x(x^2-2y^2-z^2)}{14}$$

$$-\frac{3\sqrt{7}Q_uz(x-y)(x+y)}{7} - \frac{\sqrt{21}Q_vz(3x^2+3y^2-2z^2)}{14} + \frac{\sqrt{21}Q_{xz}x(x^2-5y^2+2z^2)}{28} + \frac{\sqrt{21}Q_{yz}y(5x^2-y^2-2z^2)}{28}$$

$$\vec{\mathbb{G}}_{4,1}^{(2,1)}[q](E'', 1), \vec{\mathbb{G}}_{4,2}^{(2,1)}[q](E'', 1)$$

** symmetry

$$\frac{\sqrt{35}(x^2-2xy-y^2)(x^2+2xy-y^2)}{8}$$

$$\frac{\sqrt{35}xy(x-y)(x+y)}{2}$$

** expression

$$-\frac{9\sqrt{154}Q_uxyz(x-y)(x+y)}{22} + \frac{\sqrt{462}Q_vxyz(x^2+y^2-2z^2)}{44} + \frac{\sqrt{462}Q_{xy}z(x-y)(x+y)(x^2+y^2-2z^2)}{88}$$

$$-\frac{\sqrt{462}Q_{xz}y(9x^4-14x^2y^2-12x^2z^2+y^4+4y^2z^2)}{88} + \frac{\sqrt{462}Q_{yz}x(x^4-14x^2y^2+4x^2z^2+9y^4-12y^2z^2)}{88}$$

$$-\frac{9\sqrt{154}Q_uz(x^2-2xy-y^2)(x^2+2xy-y^2)}{88} - \frac{\sqrt{462}Q_vz(x-y)(x+y)(x^2+y^2-2z^2)}{88} + \frac{\sqrt{462}Q_{xy}xyz(x^2+y^2-2z^2)}{44}$$

$$+ \frac{\sqrt{462}Q_{xz}x(x^4-8x^2y^2-2x^2z^2+3y^4+6y^2z^2)}{44} + \frac{\sqrt{462}Q_{yz}y(3x^4-8x^2y^2+6x^2z^2+y^4-2y^2z^2)}{44}$$

$$\vec{\mathbb{G}}_{4,1}^{(2,1)}[q](E'', 2), \vec{\mathbb{G}}_{4,2}^{(2,1)}[q](E'', 2)$$

** symmetry

$$-\frac{\sqrt{5}(x-y)(x+y)(x^2+y^2-6z^2)}{4}$$

$$\frac{\sqrt{5}xy(x^2+y^2-6z^2)}{2}$$

** expression

$$-\frac{21\sqrt{22}Q_uxyz(x^2+y^2-2z^2)}{44} + \frac{21\sqrt{66}Q_vxyz(x-y)(x+y)}{44} - \frac{\sqrt{66}Q_{xy}z(9x^4-24x^2y^2-10x^2z^2+9y^4-10y^2z^2+2z^4)}{44}$$

$$+ \frac{\sqrt{66}Q_{xz}y(x^4+2x^2y^2-12x^2z^2+y^4-12y^2z^2+8z^4)}{44} + \frac{\sqrt{66}Q_{yz}x(x^4+2x^2y^2-12x^2z^2+y^4-12y^2z^2+8z^4)}{44}$$

$$-\frac{21\sqrt{22}Q_uz(x-y)(x+y)(x^2+y^2-2z^2)}{88} + \frac{\sqrt{66}Q_vz(3x^4-78x^2y^2+20x^2z^2+3y^4+20y^2z^2-4z^4)}{88} + \frac{21\sqrt{66}Q_{xy}xyz(x-y)(x+y)}{44}$$

$$+ \frac{\sqrt{66}Q_{xz}x(x^4+2x^2y^2-12x^2z^2+y^4-12y^2z^2+8z^4)}{44} - \frac{\sqrt{66}Q_{yz}y(x^4+2x^2y^2-12x^2z^2+y^4-12y^2z^2+8z^4)}{44}$$