Restricted to brief perdse for research, reviews, or senotarry d	July	010,	e with required quotation reference. ISBN 15. 770-07
– II The Geometry of Physics – 6. The Natural Space of Physics – 6.2. The Geometric Algebra of Natural Space –	G	R	- 6.3.2. The Even and the Odd Geometric Algebra - 6.2.5.7 Commutator Product of Multivectors
	0	$\mathbf{O}$	
	ne	S	6.3 The 2-space Structure <i>Quality</i> Described by Multivectors
	tt		A general arbitrary 3-multivector is constructed from four <i>primary qualities</i>
	ic.	H	nag-0 + nag-1 + nag-2 + nag-3. The approach tries to add these different a
		0	A classical space solid object we have the tradition to define in a Euclidean
	7	h	$(V_3, \mathbb{R}) \sim \mathbb{R}_1^3$ fixed to a standard <i>orthonormal dextral basis</i> { $\sigma_1, \sigma_2, \sigma_3$ } of the
	iti	$\frown$	All 1-vectors in this Euclidean vector space possess the <i>primary qualities of</i>
	$q_{l}$	$\mathbf{H}$	This basis implies the transversal bivector basis $\{i_1, i_2, i_3\} = \{\sigma_3 \sigma_2, \sigma_1 \sigma_3, \sigma_2, \sigma_3 \sigma_2, \sigma_3 \sigma_3, \sigma_3, \sigma_3, \sigma_3, \sigma_3, \sigma_3, \sigma_3,$
	le		as a generator of all planes possessing <i>pqg-2 quality</i> . On top of that we have
	0	4	pseudoscalar unit $i \coloneqq \sigma_3 \sigma_2 \sigma_1$ generating the chiral volume possessing pqg
			In all, we expand a multivector form from the geometric algebra $\mathcal{G}_3 = \mathcal{G}_3(\mathbb{R})$
	u u	C	(6.59) $A = \alpha + \underbrace{x_1 \sigma_1 + x_2 \sigma_2 + x_3 \sigma_3}_{I_1 I_2 I_2 I_3 I_3} + \underbrace{\beta_1 \mathbf{i}_1 + \beta_2 \mathbf{i}_2 + \beta_3 \mathbf{i}_3}_{I_2 I_3 I_3 I_3} + v\mathbf{i}$
	re	2	$A = \langle A \rangle_0 + \qquad \langle A \rangle_1 \qquad + \qquad \langle A \rangle_2 \qquad + \langle A \rangle_3$
			Refer to: $(5.59)$ $(6.29)$ $(6.32), (6.33), (6.36)$ $(6.15)$ in $6.2.2$
	Mc		We have separated the multivector concept into four different <i>primary quali</i>
	utl	<b>—</b> .	$(6.60) \qquad \langle A \rangle_0 = \alpha, \qquad \qquad pqg-0, \text{ scalar}$
	ie	$\mathbf{O}$	(6.61) $\langle A \rangle_1 = \mathbf{a} = x_1 \sigma_1 + x_2 \sigma_2 + x_3 \sigma_3,$ pqg-1, 1-
	m	$\square$ .	(6.62) $\langle A \rangle_2 = \mathbf{b}\mathbf{i} = (\beta_1 \mathbf{\sigma}_1 + \beta_2 \mathbf{\sigma}_2 + \beta_3 \mathbf{\sigma}_3)\mathbf{i} = \beta_1 \mathbf{i}_1 + \beta_2 \mathbf{i}_2 + \beta_3 \mathbf{i}_3, pgg-2, \text{ bin}$
	ati	$\frown$	$(6.63) \qquad (A)_{a} = vi$
	ic.	Ĭ	(0.05) $(173 - 00)$ $(173 - 00)$ $(173 - 00)$
	$ \mathcal{I} $		<b>primary qualities of grades</b> we call it $G_{-}(\mathbb{R}) = G(V_{-}, \mathbb{R})$ over a Euclidean x
	R		with which we try to describe the <i>local topological form structure</i> of the phy
	ea.	D	This linear addition structure for multivectors over a real field $\mathbb{R}$ we express
	NS C	$\boldsymbol{\triangleleft}$	$(6.64)  A = \alpha + \mathbf{a} + \mathbf{b}\mathbf{i} + v\mathbf{i}$
	nc	$\mathbf{S}$	The linear algebra $G_2 = G_2(\mathbb{R})$ has more dimension from the different grade
	in	$\overline{\mathbf{O}}$	(6.65) $\dim(G_2) = 1 + 3 + 3 + 1 = 8.$ In generell, $\dim(G_n) =$
	00	Ň	The mixed basis for the whole linear algebra $G_2$ is $\{1, \sigma_1, \sigma_2, \sigma_3, \sigma_2, \sigma_3, \sigma_4, \sigma_5, \sigma_5, \sigma_5, \sigma_5, \sigma_5, \sigma_5, \sigma_5, \sigma_5$
			6.3.2. The Even and the Odd Geometric Algebra
			When we split this algebra in even $\mathcal{G}_3^+$ and odd $\mathcal{G}_3^-$ , so $\mathcal{G}_3 = \mathcal{G}_3^- + \mathcal{G}_3^+$ , we we
			(6.66) $A = \langle A \rangle^+ + \langle A \rangle^- = \langle A \rangle^+_{0,2} + \langle A \rangle^{1,3} = \alpha + \mathbf{b}\mathbf{i} + \mathbf{a} + v\mathbf{i},$
		Θ	where the even algebra $\mathcal{G}_3^+$ is a <i>closed</i> multiplication spinor algebra, while $\mathcal{G}$
	it		The spinor multivector subject can be expressed as a 1-rotor multiplied with
		$\mathbf{S}$	(6.67) $\langle A \rangle^+ = \langle A \rangle_{0,2}^+ = \langle A \rangle_0 + \langle A \rangle_2 = \alpha + \mathbf{b}\mathbf{i} = \mathbf{r} \cdot \mathbf{u} + \mathbf{r} \wedge \mathbf{u} = \mathbf{r} \mathbf{u} = \rho U =$
			as in $(5.163)$ origin in $(5.97)$ , where the rotation is in the plane of the bivector
		r	You may define two object 1-vectors whose product spinor <b>ru</b> determines the
		E	dilation $\rho =  \mathbf{r}\mathbf{u} $ . (We prefer to choose $ \mathbf{u}  = 1$ so that $\rho =  \mathbf{r} $ if it is possible.)
		F	If you determine the 1-vector $\mathbf{b} = -i(\mathbf{r} \wedge \mathbf{u})$ as an object it will represent the
	2		This rotation axis has a transversal plane <i>direction</i> in which $\mathbf{r}$ and $\mathbf{u}$ exist.
	$ \breve{2} $	$\supset$	The odd algebra $\mathcal{G}_3^-(\mathbb{R})$ part substance of 3-space gives us subjects $\langle A \rangle_{1,3}^-$
	$\mathbf{O}$	B	The geometric 1-vector can give us a straight rectilinear translation as in $\S4$ .
	<b>i</b>		by the subject $\mathbf{l} = \mathbf{a}$ , or by the 1-vector object $\mathbf{a}$ representing a pige-1 direct.
	N	Ĩ	a chiral-diracted volume of a solid spatial antity object as a chiral quality i
		õ	<sup>297</sup> I think that there could be a little problem here; if we find <b>r</b> and <b>u</b> colinear $\mathbf{r} \wedge \mathbf{u} = 0 \Leftrightarrow \mathbf{b} = 0$ then the
		n	and by that, does a pure scalar spinor gives any sense, even if it has a final magnitude $ \mathbf{ru}  > 0$ ? Oscill
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mutator Product of Multivectors in Geometric Algebra -

## by Multivectors

rom four <i>primary qualities of grades</i>				
ries to add these different qualities together.				
on to define in a Euclidean vector space				
ral basis $\{\sigma_1, \sigma_2, \sigma_3\}$ of three 1-vector objects.				
ess the <i>primary qualities of first grade</i> ( <i>pqg-1</i> ).				
$i_1, i_2, i_3$ = { $\sigma_3 \sigma_2, \sigma_1 \sigma_3, \sigma_2 \sigma_1$ }, (6.31), (6.34)				
<i>lity</i> . On top of that we have trivector chiral				
iral volume possessing <i>pqg-3 quality</i> .				
prometric algebra $\mathcal{G}_3 = \mathcal{G}_3(\mathbb{R}) = \mathcal{G}(V_3, \mathbb{R})$ as				
$\mathbf{i}_2 + \boldsymbol{\beta}_3 \mathbf{i}_3 + v \mathbf{i}$				
$A_{2} + \langle A \rangle_{3}$				
33), (6.36)   (6.15) in 6.2.2				
our different primary quality grades				
$pqg$ -0, scalar, $\dim(\mathbb{R}) = 1$ ,				
$pqg$ -1, 1-vector, dim $(V_3) = 3$ ,				
$+ \beta_2 i_2 + \beta_3 i_3$ , <i>pqg</i> -2, bivector, dim( $V_3$ ) = 3,				
e pseudoscalar, $pqg$ -3, trivector, dim( $\mathbb{R}$ ) = 1.				
gebra has a linear addition structure of multiple				
$\mathcal{K}(V_3, \mathbb{R})$ over a Euclidean vector space $V_3$ ,				
al form structure of the physical 3-space.				
er a real field $\mathbb R$ we express				
on from the different grade qualities, in all				
In generell, dim $(\mathcal{G}_n) = \sum_{r=0}^n \binom{n}{r} = 2^n$				
$s \{1, \sigma_1, \sigma_2, \sigma_3, \sigma_3\sigma_2, \sigma_1\sigma_3, \sigma_2\sigma_1, \sigma_3\sigma_2\sigma_1\}.$				
$\overline{G}_3$ , so $G_3 = \overline{G}_3 + \overline{G}_3^+$ , we write the multivector				

ion spinor algebra, while  $\mathcal{G}_3^-$  is open, not closed. as a 1-rotor multiplied with a real dilation factor

 $\mathbf{r} \cdot \mathbf{u} + \mathbf{r} \wedge \mathbf{u} = \mathbf{r} \mathbf{u} = \rho U = \rho e^{i\theta} \in \mathcal{G}_3^+(\mathbb{R}),$ 

s in the plane of the bivector  $\mathbf{b}\mathbf{i} = \mathbf{r} \wedge \mathbf{u}$ . uct spinor **ru** determines the rotation, and that  $\rho = |\mathbf{r}|$  if it is possible.)<sup>297</sup> object it will represent the rotation axis for  $\langle A \rangle^+$ . *n* in which **r** and **u** exist.

pace gives us subjects  $\langle A \rangle_{1,3}^- = \mathbf{a} + v \mathbf{i}$ . tilinear translation as in §4.4.2.13 and § 5.3.7.2 representing a *pqg-*1 *direction* and a straight The new pqg-3 subject vi gives us object, as a *chiral quality pqg-*3.

inear  $\mathbf{r} \wedge \mathbf{u} = 0 \Leftrightarrow \mathbf{b} = 0$  then the spinor is a pure scalar  $\mathbf{r} \cdot \mathbf{u}$ final magnitude |ru| >0? Oscillations will resolve this.

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