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CERTAIN NEAR-FIELD SPACES ARE NEAR-FIELDS (C-NFS-NF)

Dr. N. V. NAGENDRAM
Professor of Mathematics,
Kakinada Institute of Technology & Science,
Tirupathi (v), Divili 533 433, East Godavari District, Andhra Pradesh. INDIA.

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ABSTRACT

In the present paper it is shown that N must be commutative if distributively generated (d – g) near-field space N satisfying the axiom: yx = p(x, y), where p(x, y) is a finite sum of temrs of the form $\beta_i\, x^{p}{}_{i}\, y^{n}{}_{i}\, x^{q}{}_{i}$, where the number of summands and β_i, p_i, n_i, q_i all vary with x, y $\in$ N, β_i, p_i, $q_i \geq 1$ and $n_i \geq 1$.

Throughout this paper, N will denote a left near-field space. Z(N) the center of N, N(N) the set of nilpotent elements of N. An element y of N is called distributive if (a + b)y = ay + by for all a, b $\in$ N. If all the elements of N are distributive, then N is called distributive near-field space. A left near-field space N is called (i) a periodic near-field space if for each y $\in$ N, there exist distinct positive integers k = k(y), t = t(y) such that $y^k = y^t$. (ii) a zero-symmetric if 0y = 0 for all y $\in$ N (left distributively yields y0 = 0) (iii) a zero commutative if yx = 0 implies that xy = 0 for all y, x $\in$ N. (iv) a distributively generated (d – g) near-field space if it contains a multiplicative sub-semi simple near-field space of distributive elements which generates additive sub-near-field space (N, +). (v) a strongly distributively generated (s – d – g) near-field space if it contains a set of distributive elements whose squares generate (N, +). (vi) a D-near-field space if every non-zero homomorphic image B of N satisfies the following conditions:

- *(a) B a has a non-zero right distributive element.*
- *(b) (B, +) is abelian implies that (B, +, .) is a near-field.*

An ideal of near-field space N is normal sub-near-field space J of (N, +) such that (a) NJ $\subseteq$ J and (b) $(y + \beta)x - yx \in J$ for all y, x $\in$ N and $\beta \in$ J.

In a (d – g) near-field space (b) may be replaced by $(b)^*$ JN $\subseteq$ J.

It is evident by the definition that all distributive and (d – g) near-field spaces are examples of D-near-field spaces. However, the example 2.5 # 6 of [7] illustrates that the class of D-near-field spaces is larger than the class of (d – g) near-field spaces.

SECTION-1. INTRODUCTION

Certain near-field spaces are, N denotes near-field space over near-ring R and R denotes a nonzero associative near-ring with identity. Earlier we studied the concept of a right SA-near-field space over near-ring. We call N a right SA-near-field space over near-ring, if for any sub near-field spaces I and J of N over near-ring R there is a sub near-field space J or K of N over a near-ring R such that r(I) + r(J) = r(K), where r(I) (resp., l(J)) denotes the right annihilator sub near-field space (resp., left annihilator sub near-field space) of I. A near-field space N over a near-ring R a right SA-near-field space if for any sub near-field spaces I and J of N there is an ideal K of N such that r(I) + r(J) = r(K). This class of near-field spaces is exactly the class of near-field spaces for which the lattice of right annihilator near-field spaces is a sub-lattice of the lattice of near-field spaces. The class of right SA-near-field spaces includes all quasi-Baer (hence all Baer) near-field spaces and all right IN-near-field spaces (hence all right self-injective near-field spaces). This class is closed under direct products, full and upper triangular matrix near-field spaces over near-rings, certain polynomial near-field spaces over near-rings, and two-sided near-field spaces over near-rings of quotients. The right SA-near-field space over near-ring property is a Morita invariant. For a semi-prime near-field space over near-ring R, it is shown that R is a right SA-near-field space over near-ring if and only if R is a quasi-Baer near-ring if and only if r(I) + r(J) = r(K) = r(I ∩ J) for all near-field spaces I and J of N if and only if Spec(N) is extremally disconnected.

Corresponding Author: Dr N. V. Nagendram, Professor of Mathematics,
Kakinada Institute of Technology & Science, Tirupathi (v), Divili 533 433,
East Godavari District, Andhra Pradesh. INDIA.

Amenability dual concrete complete near-field spaces were studied and introduced by N V Nagendram and have since then turned out to be extremely interesting objects of research. The definition of an amenable dual concrete complete near-field space is strong enough to allow for the development of a rich general theory, but still weak enough to include a variety of interesting examples. Very often, for a class of dual concrete complete near-field spaces over a regular delta near-ring, the amenability condition singles out an important sub-class of near-field spaces. For a locally compact complete sub near-field spaces G, the convolution algebra $L'(G)$ is amenable if and only if G is amenable in the classical sense; a C*- algebra is amenable if and only if it is nuclear and a uniform concrete complete near-field space with character space Ω is amenable if and only if it is C_0 (Ω). To determine, for a given class of dual concrete complete near-field spaces N, which concrete complete near-field spaces in it are the amenable ones is an active areas of research. For instance, it is still open for which reflexive dual concrete complete near-field spaces E the dual concrete K(E) of all compact operators on E is amenable.

N denotes as Near-field space has zero symmetric near-ring with identity. Let$\emptyset \neq X \subseteq N$. Then $X \trianglelefteq N$ denotes that X is an ideal of N. For any subset T of N, l(T) and r(T) denote the left annihilator and the right annihilator of T in near-field space N. The near-field space of n-by-n (upper triangular) matrices over near-field space N is denoted by $M_n(N)$ ($T_n(N)$). An idempotent e of a near-field space N is called *left (right) semi-central* if $ae = eae$ ($ea = eae$) for all $a \in N$. It can be easily checked that an idempotent e of near-field space N is left (right) semi-central if and only if eN (Ne) is an ideal. Also note that an idempotent e is left semi-central if and only if $1-e$ is right semi-central.

Thus for a left (or right) ideal J of a near-field space N, if $l(J) = Ne$ ($r(J) = eN$) with an idempotent e, then e is right (left) semi-central, since Ne (eN) is an ideal, and I use $T_l(N)$ ($T_r(N)$) to denote the set of left (right) semi-central idempotents of near-field space N.

To characterize near-field spaces over baer-ideals in near-field spaces by defining quasi-Baer near-field space. Near-field space N to be a *quasi* near-field space over *Baer-ideals* if the left annihilator of every ideal of N is generated, as a left ideal, by an idempotent. The quasi-Baer concept to characterize Near-field space N over Baer-ideal when a finite-dimensional algebra with identity over an algebraically closed near-field space is isomorphic to a twisted matrix unit semi-group algebra. The quasi-Baer condition are left-right symmetric. It is to find that Near-field space N is a quasi-Baer if and only if M_n (N) is quasi-Baer if and only if $K_n(N)$ is a quasi near-field space over Baer-ideal.

A near-field space N to be n-generalized right quasi- near-field space over a Baer-ideal if for each J $\trianglelefteq$ N, the right annihilator of J^n is generated (as a right ideal) by an idempotent. A near-field space N is n-generalized quasi near-field space over a Baer-ideal if and only if $M_n(N)$ is n-generalized. Moreover, Dr. N V Nagendram found equivalent conditions for which the 2×2 generalized triangular matrix near-field space be n-generalized quasi near-field space over Baer-ideal.

A principally quasi near-field space over a Baer-ideal is introduced by Dr. N V Nagendram and used them to characterize and generalize many results on *reduced* (i.e., it has no nonzero nilpotent elements) p.p.-near-field spaces. A near-field space N is called *right principally quasi-Baer* (or simply right p. q.-Baer) if the right annihilator of a principal right ideal is generated by an idempotent.

The characterization of near-field spaces over Baer-ideal is studied and results obtained by Dr. N V Nagendram. An ideal J of N is called *right Baer-ideal* if r(J) = eN for some idempotent $e \in N$, and if l(J) = Ng, for some idempotent $g \in N$, then we say J is a left Baer-ideal.

An example of right Baer-ideals which are not left Baer-ideal in a near field space N. Also see that in a near-field space N the set of Baer-ideals are closed under sum and direct product.

We characterize near-field spaces over Baer-ideals in 2-by-2 generalized triangular matrix near-field spaces, full and upper triangular matrix near-field spaces. By these results I obtain new proofs for the well-known results about quasi-Baer and n-generalized quasi-Baer near-field spaces. Also, I obtained equivalent conditions for which the 2-by-2 generalized triangular matrix near-field space be right *TA* (i.e., for any two $I; J \trianglelefteq$ N there is a $K \trianglelefteq$ N such that $r(I) + r(J) = r(K)$).

A near-field space the product of two sub near-field space over Baer ideals in a semi-prime near-field space S is a sub near-field space over Baer-ideal. Also we show that an ideal J of a semi-prime near-field space S is a near-field space over Baer-ideal if and only if *int V* (J) is a clopen sub near-field space of *Spec* (S). Moreover, it is proved that an ideal J of C(N) is a Baer-ideal if and only if *int* $g_{\in J}$ Z(g) is a clopen sub near-field space C of near-field space N.

Certain near-field space, N denotes as Near-field space has zero symmetric near-ring with identity. We begin by recalling some background material. Generalization the study of pseudo-valuation domains to the context of extending to arbitrary near-field spaces possibly with non-zero zero divisors. For a near-field space N with total quotient near-field space T(N) such that Nil(N) is divided prime ideal of N, we define a map $\phi : T(N) \to K := N_{Nil(N)}$ such that $\phi(a/b) = a/b$ $\forall$ $a \in N$ and $b \in n \setminus Z(N)$. then ϕ is a near-field homomorphism from T(N) into K, and ϕ is restricted to near-field space N is also a near-field homomorphism from N into K given by $\phi(x) = x/1$ $\forall$ $x \in N$. For an equivalence characterization of a ϕ-PVNFS, $\forall$ $n \geq 0$ $\exists$ a ϕ-CNFS of krull dimension n that is not a PVNFS.

A quasi-local near-field space N with maximal ideal M is a ϕ-PVNFS if and only if N(v) is a quasi-local near-field space for each $v \in (M : M) \setminus N$ if and only if every over-near-field space of N is quasi-local near-field space if and only if every over-near-field space contained in $(M : M)$ is quasi-local near-field space if and only if each ϕ-CNFS between N and T(N) other than (M : M) is of the form N_q for some non-maximal prime ideal P of N. If A is an over-near-field space of a ϕ-PVNFS and J is a proper ideal of A, then there is a ϕ-CNFS C between A and T(N) such that $JA \neq A$. Also show that the integral closure of near-field space N in T(N) is the intersection of all the ϕ-CNFS's between N and T(N).

The following notations will be used throughout. Let N be a near-field space. Then T(N) denote the total quotient near-field space of a near-field space N. *Nil* (N) denotes the near-field spaces of all nilpotent elements of N, and Z(N) denotes the set of zero divisors of N. If *J* is an ideal of N, then *Rad* (*J*) denotes the radical ideal of *J* in N.

A well known theorem of I.N. Herstein assets that a periodic near-field is commutative if its nilpotent elements are central. In order to establish an analogous result in near-field spaces. If N is a ($d - g$) near-field with its nilpotent elements lying in the center, then the set N(N) forms an ideal, and if N/N(N) is periodic, then N must be commutative. In a recent trends some conditions implying commutativity in near-field spaces might reduce them to near-fields. The main purpose of this paper is to examine whether the following axiom implies that certain near-field spaces are near-fields.

(A) For each $y, x \in N$, there exist positive integers $n_i = n_i (y, x) > 1$, $p_i = p_i (y, x) \geq 1$, $q_i = q_i(y, x) \geq 1$, $\beta_i = \beta_i (y, x) \geq 1$ such that $yx = p(x, y)$ where $p(x, y)$ is a finite sum of terms of the form $\beta_i\, x^{p}{}_{i}\, y^{n}{}_{i}\, x^{q}{}_{i}$, where the number of summands and $\beta_i\, p_i\, n_i\, q_i$ all vary with y, x.

SECTION-2. MAIN RESULT

The main result of the present paper is as follows:

Theorem 2.1: Let N be a $(d - g)$ near-field space satisfying (A). Then N is commutative.

Proof: It is clear that A $(d - g)$ near-field space is always zero-symmetric. A $(d - g)$ near-field space N is distributive if and only if N^2 is additively commutative. If N(N) is a two-sided ideal in a $(d - g)$ near-field space N, then the elements of the quotient sub near-field space (N, +) / N(N) form a $(d - g)$ near-field space, which will be represented by N / N(N).

To prove this theorem we establish the following result called steps (a) to (d).

Step-(a): Let N satisfy (A). Then N is a zero-commutative.

Proof: For a pair of near-field space elements, $y, x \in N$, we have $yx = 0$. By hypothesis, we get $xy = p(y, x) = 0$, because $\beta_i\, y^{p}{}_{i}{}^{-1}\, (yx)\, y^{n}{}_{i}{}^{-1}\, x^{q}{}_{i} = 0$. Hence, N is zero-commutative as well as zero-symmetric.

Step-(b): Let N satisfy (A). Then $N(N) \subseteq Z(N)$.

Proof: From (a) it follows easily that N must have the insertion-of-factors property, i.e., any product equal to 0 remains so on the insertion of additional factors between any existing factors; in particular, if $v^s = 0$, any product of near-field elements having at least s factors equal to v is 0. Let $v \in N(N)$ and $y \in N$, and suppose $v^s = 0$. Replacing x by y and y by v in the hypothesis, then there exist positive integers $\beta_{i1} = \beta_i(v, y)$, $p_{i1} = p_i(v, y)$, $q_{i1} = q_i(v, y) \geq 1$ and $n_{i1} = n_i(v, y) > 1$ such that $vy = p(v, y) = \beta_{i1}\, y^{p}{}_{i}\, v^{ni1}\, y^{qi1}$

Further, choose integers $\beta_{i2} = \beta(v^{pi1}, y^{ni1})$, $p_{i2} = p(v^{pi1}, y^{ni1})$, $q_{i2} = q(v^{pi1}, y^{ni1}) \geq 1$

And $n_{i2} = n(v^{pi1}, y^{ni1}) > 1$ $\ni$ $\beta_{i1}\, y^{p}{}_{i}\, v^{ni1}\, y^{qi1} = \beta_{i1}\, \beta_{i2}\, y^{n}{}_{i1}{}^{n}{}_{i2}\, v^{pi1\ pi2}\, y^{p}{}_{i1}{}^{q}{}_{i2}\, y^{q}{}_{i3}$.

By the above equality, one gets $vy = \beta_{i1}\, \beta_{i2}\, y^{n}{}_{i1}{}^{n}{}_{i2}\, v^{pi1\ pi2}\, y^{p}{}_{i1}{}^{q}{}_{i2}\, y^{q}{}_{i3}$.

Thus it is obvious that for arbitrary s, we have $\beta_{i1}, \beta_{i2}, \ldots, \beta_{is} \geq 1$, $p_{i1}, p_{i2}, \ldots, p_{is} \geq 1$, $n_{i1}, n_{i2}, \ldots, n_{is} > 1$ and $q_{i1}, q_{i2}, \ldots, q_{is} \geq 1$ such that

$$vy = \beta_{i1}\, \beta_{i2} \ldots \beta_{is}\, y^{pi1\ pi2 \ldots pis}\, v^{\,qi1 + pi1\, qi2 + \ldots + pi1\, pi2 + pi(s-1)qis}$$

But, since $v \in N(N)$, $v^{ni1,\ ni2, \ldots, nis} = 0$ for sufficiently large s. Hence, $vy = 0 \quad \forall\ y \in N$ and by step (a), $\Rightarrow vy = 0$
i.e., NN(N) = N(N)N = {0} ------------ (1)

Equation (1) shows that nilpotent elements of near-field N annihilate N on both sides and hence, in particular, $N^2 = \{0\}$ and v is central.

Step-(c): Let N satisfy (A). Then N(N) forms an ideal.

Proof: Let a, b $\in$ N(N). Then by step(b), $(a - b)^2 = 0$. This yields that $a - b \in N(N)$ and hence N(N) is a sub-near-field space of the additive sub near-field space (N, +). Further an application gives the required result.

Step-(d): Let S be an arbitrary near-field satisfying (A). Then S is a periodic near-field.

Proof: Taking x = y in (A), we get $y^2 = q(y, y) = \sum_{i \in I,\ finite} \beta_i\, y^{p_i + n_i + q_i}$ for some positive integer $p_i + n_i + q_i$. Hence S is periodic near-field. This completes the proof of the theorem.

Note 2.2: From the proof of Step (d), it is clear that a near-field space N satisfies (A) together is periodic near-field.

Proof of Theorem 2.1: by step (b), we have N(N) $\subseteq$ Z(N) by step (c) N(N) is an ideal. We consider the near-field space $\overline{N}$ = N/N. Now it is enough to prove that ($\overline{N}$, +) is abelian. $\overline{N}$ is a near-field and is periodic near-field.

SECTION-3. APPLICATIONS

The following results are corollaries of our main theorem as well as the applications.

Result 3.1: Let N be a $(d - g)$ near-field space satisfying (A). If $N^2 = N$, then N is a commutative near-field.

Proof: By known theorem, we can observe that a $(d - g)$ near-field space satisfying (A) is commutative. Hence, for any a, b, c $\in$ N, we have (b + c) a = a (b + c) = ab + ac = ba + ca.

It follows that N is distributive and hence, N^2 is additively commutative near-field. Further, $N^2 = N$ gives that (N, +) is abelian. Hence, N is a commutative near-field.

Result 3.2: Let N be a $(s - d - g)$ near-field space satisfying (A). Then N is a commutative near-field.

Proof: N is a commutative $(s - d - g)$ near-field space in which every element is distributive and consequently N^2 is additively commutative. Thus the additive sub near-field space (N, +) of the $(s - d - g)$ near-field space is also commutative and N is a commutative near-field.

Result 3.3: Let N be a D-near-field space with unity 1 satisfying (A). Then N is commutative near-field.

Proof: From the step (b), we get N(N) $\subseteq$ Z(N). Further, N is periodic near-field space and if N has unity 1, then by consequently (N, +) is abelian. Hence by the definition of D-near-field space, N turns out to be a near-field which is periodic near-field with central nilpotent elements. By an application of near-field spaces N is commutative near-field.

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