

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

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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 terms 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 $x, y \in N, \beta_i, p_i, q_i \geq 1$ 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 has a non-zero right distributive element.
- (b) $(B, +)$ is abelian implies that $(B, +, \cdot)$ 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 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 $r(I) + r(J) = r(K) = r(I \cap J)$ for all near-field spaces I and J of N if and only if $\text{Spec}(N)$ is extremally disconnected.

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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 $C_0(\Omega)$. 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 $\text{int } V(J)$ is a clopen sub near-field space of $\text{Spec}(S)$. Moreover, it is proved that an ideal J of $C(N)$ is a Baer-ideal if and only if $\text{int } g_{eJ} Z(g)$ 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 $\phi : T(N) \rightarrow K := N_{Nil(N)}$ 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 asserts 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 $vy = p(v, y) = \beta_{i1} y^{p_{i1}} v^{n_{i1}} y^{q_{i1}}$

Further, choose integers $\beta_{i2} = \beta(v^{p_{i1}}, y^{n_{i1}}), p_{i2} = p(v^{p_{i1}}, y^{n_{i1}}), q_{i2} = q(v^{p_{i1}}, y^{n_{i1}}) \geq 1$

And $n_{i2} = n(v^{p_{i1}}, y^{n_{i1}}) > 1 \ni \beta_{i1} y^{p_{i1}} v^{n_{i1}} y^{q_{i1}} = \beta_{i1} \beta_{i2} y^{n_{i1} n_{i2}} v^{p_{i1} p_{i2}} y^{p_{i1} q_{i2}} y^{q_{i3}}$.

By the above equality, one gets $vy = \beta_{i1} \beta_{i2} y^{n_{i1} n_{i2}} v^{p_{i1} p_{i2}} y^{p_{i1} q_{i2}} y^{q_{i3}}$.

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

$$vy = \beta_{i1} \beta_{i2} \dots \beta_{is} y^{p_{i1} p_{i2} \dots p_{is} q_{i1} + p_{i1} q_{i2} + \dots + p_{i1} p_{i2} + p_{i(s-1)} q_{is}}$$

But, since $v \in N(N), v^{n_{i1}, n_{i2}, \dots, n_{is}} = 0$ 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 $y^2 = q(y, y) = \sum_{i \in I, \text{finite}} \beta_i y^{p_i + n_i + q_i}$ 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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