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Γ-SEMI SUB NEAR-FIELD SPACES OF A Γ-NEAR-FIELD SPACE OVER NEAR-FIELD PART I

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ABSTRACT

In this paper we introduce the semi sub near-field spaces in Γ-near- field space over a near-field (PART I), and we three Smt. Thurumella Madhavi Latha, Dr. T V Pradeep Kumar and Dr. N V Nagendram together investigate the related properties of generalization of a semi sub near-field spaces in Γ-near-filed space over a near-field.

Keywords: *Γ-near-field space; Γ-Semi sub near-field space of Γ-near-field space; Semi near-field space of Γ-near-field space.*

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SECTION 1: INTRODUCTION

In this paper, Part I consisting two important sections we introduce the semi sub near-field spaces in Γ-near- field space over a near-field, and we three Smt. Thurumella Madhavi Latha, Dr. T V Pradeep Kumar and Dr. N V Nagendram together investigate the related properties of generalization of a semi sub near-field spaces in Γ-near- field space over a near-field.

As a generalization of a semi sub near-field spaces in Γ-near- field space over a near-field, introduced the notion of semi sub near-field spaces in Γ-near- field space over a near-field, extended many classical notions of semi sub near-field spaces in Γ-near- field space over a near-field. In this chapter we develop the algebraic theory of semi sub near-field spaces in Γ-near- field space over a near-field.

The notion of a semi sub near-field spaces in Γ-near- field space over a near-field is introduced and some examples are given. Further the terms; commutative semi sub near-field spaces in Γ-near- field space, quasi commutative semi sub near-field spaces in Γ-near- field space, normal semi sub near-field spaces in Γ-near- field space, left pseudo commutative semi sub near-field spaces in Γ-near- field space, right pseudo commutative semi sub near-field spaces in Γ-near-filed space are introduced. It is proved that (1) if S is a commutative semi sub near-field spaces in Γ-near- field space then S is a quasi commutative semi sub near-field spaces in Γ-near- field space, (2) if S is a quasi commutative semi sub near-field spaces in Γ-near- field space then S is a normal semi sub near-field spaces in Γ-near- field space, (3) if S is a commutative semi sub near-field spaces in Γ-near- field space, then S is both a left pseudo commutative and a right pseudo commutative semi sub near-field spaces in Γ-near- field space over a near-field. Further the terms; left identity, right identity, identity, left zero, right zero, zero of a semi sub near-field spaces in Γ-near- field space over a near-field are introduced. It is proved that if a is a left identity and b is a right identity of a semi sub near- field spaces in Γ-near- field space, then a = b. It is also proved that any Γ-semi sub near- field spaces in Γ-near-filed space has at most one identity. It is proved that if a is a left zero and b is a right zero of a semi sub near-field spaces in Γ-near- field space, then a = b and also it is proved that any Γ-semi sub near-field spaces in Γ-near-filed space over a near-field has at most one zero element.

SECTION 2: PRELIMINARIES

In section 2, the terms; Γ-semi sub near-field space, Γ-semi sub near- field space generated by a sub near-field space, cyclic Γ-semi sub near- field space of a Γ-semi near-field space and cyclic Γ-semi near-field space are introduced. It is proved that (1) the non-empty intersection of any two Γ-semi sub near-field spaces of a Γ-semi near-field space T is a Γ-semi near-field space of T, (2) the nonempty intersection of any family of Γ-semi sub near-field spaces of a Γ-semi near-field space T is a Γ-semi near-field space of T. It is also proved that if B is a non-empty subset of a Γ-semi near-field space T, then the Γ-semi sub near-field space of T generated by B is the Inter-section of all Γ-semi sub near-field spaces of T containing B.

2.1. Γ-Semi Sub Near-Field Space Of Γ- Near-Field Space Over A Near-Field.

In this section, the notion of a Γ-semi sub near-field space is introduced and some examples are given. Further the terms commutative Γ-semi sub near-field space, quasi commutative Γ-semi sub near-field space, normal Γ-semi sub near-field space, left pseudo commutative Γ-semi sub near-field space, right pseudo commutative Γ-semi sub near-field space are introduced. It is proved that (1) if S is a commutative Γ-semi sub near-field space then S is a quasi commutative Γ-semi sub near-field space, (2) if S is a quasi commutative Γ-semi sub near-field space then S is a normal Γ-semi sub near-field space, (3) if S is a commutative Γ-semi sub near-field space, then S is both a left pseudo commutative and a right pseudo commutative Γ-semi sub near-field space. Further the terms; left identity, right identity, identity, left zero, right zero, zero of a Γ-semi sub near-field space are introduced.

It is proved that if a is a left identity and b is a right identity of a Γ-semi sub near-field space S, then a = b. It is also proved that any Γ-semi sub near-field space S has at most one identity. It is proved that if a is a left zero and b is a right zero of a Γ-semi sub near-field space S, then a = b and it is also proved that any Γ-semi sub near-field space S has at most one zero element.

We now introduce the notion of a Γ-semi sub near-field space of Γ-near-field space over a near-field.

Definition 2.1: Γ-semi sub near-field space. Let S and Γ be two non-empty sets. Then S is called a Γ-semi sub near-field space if there exist a mapping from $S \times \Gamma \times S \to S$ which maps $(a, \alpha, b) \to a\alpha b$ satisfying the condition:
$(a\gamma b)\mu c = a\gamma(b\mu c)$ for all a, b, c $\in$ S and $\gamma, \mu \in \Gamma$.

Note 2.2: Let S be a Γ-semi sub near-field space. If M and L are two sub near field spaces of S, we shall denote the set $\{a\gamma b : a \in M, b \in L \text{ and } \gamma \in \Gamma\}$ by MΓL.

In the following some examples of Γ-semi sub near-field spaces are given.

Example 2.3: Let S be the set of all non-positive integers and Γ be the set of all non-positive even integers. If $a\alpha b$ denote as usual multiplication of integers for a, b ∈ S and α ∈ Γ, then S is a Γ-semi sub near-field space.

Example 2.4: Let Q be the set of rational numbers and Γ = K be the set of natural numbers. Define a mapping from $Q \times \Gamma \times Q$ to Q by $a\alpha b$ = usual product of a, α, b; for a, b ∈ Q, α ∈ Γ. Then Q is a Γ-semi sub near-field space.

Example: 2.5: Let S = {5n + 4: n is a positive integer} and Γ = {5n + 1: n is a positive integer}. Then S is a Γ-semi sub near-field space with the operation defined by $a\alpha b = a + \alpha + b$ where a, b ∈ S, α ∈ Γ and + is the usual addition of integers.

Example 2.6: Let S be the set of all integers of the form 4n+1 where n is an integer and Γ denote the set of all integers of the form 4n+3. If $a\gamma b$ is $a + \gamma + b$, for all a, b ∈ S and γ ∈ Γ, then S is a Γ-semi sub near-field space.

Example 2.7: Let S = {{ϕ}, {a}, {b}, {c}, {a, b}, {b, c}, {a, c}, {a, b, c}} and Γ = {{ϕ}, {a}, {a, b, c}}. If for all A, C ∈ S and B ∈ Γ, ABC = A ∩ B ∩ C, then S is a Γ-semi sub near-field space.

Example 2.8: Let S = {ϕ}, {a}, {b}, {c}, {a, b}, {b, c}, {a, c}, {a, b, c}} and Γ = {{a, b, c}}. If for all A, C ∈ S and B ∈ Γ, ABC = A ∩ B ∩ C, then S is a Γ-semi sub near-field space.

Example 2.9: Let S be the set of all 2 × 3 matrices over Q, the set of rational numbers and Γ be the set of all 3 × 2 matrices over Q. Define AαB = usual matrix product of A, α, B; for all A, B ∈ S and for all α ∈ Γ. Then S is a Γ-semi sub near-field space. Note that S is not a semi sub near-field space.

Example 2.10: Let S = {- *i*, 0, *i*} and Γ = S. Then S is a Γ-semigroup under the multiplication of complex numbers, while S is not a semigroup under multiplication of complex numbers.

Example 2.11: Let S be a Γ-semi sub near-field space and α a fixed element in Γ. We define $ab = a\alpha b$ for all $a, b \in$ S. We can show that (S, .) is a Γ- semi sub near-field space and we denote this Γ-semi sub near-field space by Sα .

Example 2.12: Let S be a semi sub near-field space and Γ be a mapping and also a non-empty sub near-field space. Define a mapping from S × Γ × S → S as $a\alpha b = ab$, for all $a, b \in$ S and $\alpha \in \Gamma$. Then S is a Γ-semi sub near-field space.

Verification: Let $a, b, c \in$ S and $\alpha, \ \beta \in \Gamma$. Then $(a\alpha b)\beta c = (ab)\beta c = (ab)c = a(bc) = a\alpha(bc) = a\alpha(b\beta c)$. Therefore S is a Γ-semi sub near-field space.

Note 2.13: Every semi sub near-field space can be considered to be a Γ-semi sub near-field space. Thus the class of all Γ-semi sub near-field spaces includes the class of all Γ-semi sub near-field spaces.

Example 2.14: Free Γ-Semi sub near-field space. Let X and Γ be two non-empty Γ-semi sub near-field spaces. A sequence of elements $\alpha_1\alpha_1\alpha_2\alpha_2 \ldots\ldots \alpha_{n-1}\,\alpha_{n-1}\alpha_n$ where $\alpha_1,\alpha_2,\alpha_3,\ldots\ldots\ldots\alpha_n \in$ X and $\alpha_1,\alpha_2,\alpha_3, \ldots\ldots,\alpha_n \in \Gamma$ is called a word over the alphabet X relative to Γ. The set S of all words with the operation defined from S × Γ × S to S as $(a_1\alpha_1a_2\alpha_2 .... a_{n-1}\alpha_{n-1}a_n)\ \gamma(b_1\beta_1b_2\beta_2 \ldots b_{m-1}\beta_{m-1}b_m) = a_1\alpha_1a_2\alpha_2 \ldots a_{n-1}\alpha_{n-1}a_n\ \gamma b_1\beta_1b_2\beta_2 \ldots\ldots b_{m-1}\beta_{m-1}b_m$ is a Γ-semi sub near-field space. This Γ-semi sub near-field space is called free Γ-semi sub near-field space over the alphabet X relative to Γ.

In the following we introduce the notion of a commutative Γ-semi sub near-field space.

Definition 2.15: Commutative Γ-semi sub near-field space. A Γ-semi sub near-field space S is said to be commutative provided $a\gamma b = b\gamma a$ for all $a, b \in S$ and $\gamma \in \Gamma$.

Note 2.16: If S is a commutative Γ-semi sub near-field space then $a\,\Gamma b = b\,\Gamma a$ for all $a, b \in S$.

Note 2.17: Let S be a Γ-semi sub near-field space and $a, b \in$ S and $\alpha \in \Gamma$. Then $a\alpha a\alpha b$ is denoted by $(a\alpha)^2b$ and consequently $a\ \alpha\, a\ \alpha\, a\ \alpha\ldots..(n\ terms)b$ is denoted by $(a\alpha)^n b$.

In the following we introduce a quasi commutative Γ-semi sub near-field space.

Definition 2.18: Quasi commutative sub near-field space. A Γ-semi sub near-field space S is said to be quasi commutative provided for each $a,b \in$S, there exists a natural number n such that $a\gamma\ b\ \gamma\ (b\gamma\ )n\ a\ \ \forall\gamma \in\Gamma$.

Note 2.19: If a Γ-semi sub near-field space S is quasi commutative then for each $a, b \in$ S, there exists a natural number n such that, $a\Gamma b = (b\Gamma)na$.

Theorem 2.20: If S is a commutative Γ-semi sub near-field space then S is a quasi commutative Γ-semi sub near-field space.

Proof: Suppose that S is a commutative Γ-semi sub near-field space. Let $a, b \in S$. Now $a\alpha b = b\alpha a \Rightarrow a\alpha b = (b\alpha\,)^1 a$. Therefore S is a quasi commutative Γ-semi sub near-field space.

In the following we introduce the notion of a normal Γ-semi sub near-field space.

Definition 2.21: Normal Γ-semi sub near-field space. A Γ-semi sub near-field space S is said to be *normal* Γ-semi sub near-field space provided $a\alpha$S = S$\alpha a\ \forall\,\alpha \in\Gamma$ and $\forall a\in S$.

Note 2.22: If a Γ-semi sub near-field space S is normal *Γ*-semi sub near-field space then $a\Gamma$S = SΓa for all $a \in$ S.

Theorem 2.23: If S is a quasi commutative Γ-semi sub near-field space then S is a normal Γ-semi sub near-field space.

Proof: Let S be a commutative Γ-semi sub near-field space. By theorem 2.20, S is a quasi commutative Γ-semi sub near-field space. By theorem 2.23, S is a normal Γ-semi sub near-field space. Therefore every commutative Γ-semi sub near-field space is a normal Γ-semi sub near-field space.

In the following we are introducing left pseudo commutative Γ-semi sub near-field space and right pseudo commutative Γ-semi sub near-field space.

Definition 2.23: Left pseudo Commutative Γ-semi sub near-field space. A Γ-semi sub near-field space S is said to be left pseudo commutative provided $a\Gamma b\Gamma c = b\Gamma a\Gamma c$ for all $a, b, c \in$ S.

Definition 2.24: Pseudo Commutative Γ-semi sub near-field space. A Γ-semi sub near-field space S is said to be right pseudo commutative provided $a\Gamma b\Gamma c = a\Gamma c\Gamma b$ for all $a, b, c \in S$.

Theorem 2.25: If S is a commutative Γ-semigroup, then S is both a left pseudo commutative Γ-semi sub near-field space and a right pseudo commutative Γ-semi sub near-field space.

Proof: Suppose that S is commutative Γ-semi sub near-field space. Then $a\Gamma b\Gamma c = (a\Gamma b)\Gamma c = (b\Gamma a)\Gamma c = b\Gamma a\Gamma c$. Therefore S is a left pseudo commutative Γ-semi sub near-field space. Again $a\Gamma b\Gamma c = a\Gamma(b\Gamma c) = a\Gamma(c\Gamma b) = a\Gamma c\Gamma b$. Therefore S is a right pseudo commutative Γ-semi sub near-field space. This completes the proof of the theorem.

Note 2.26: The converse of the above theorem is not true. i.e., if S is a left and right pseudo commutative Γ-semi sub near-field space then S need not be a commutative Γ-semi sub near-field space.

Example 2.27: Let $S = \{a, b, c\}$ and $\Gamma = \{x, y, z\}$. Define a binary operation **'.'** In S as shown in the following table:

.	*a*	*b*	*c*
a	*a*	*a*	*a*
b	*a*	*a*	*a*
c	*a*	*b*	*c*

Define a mapping S × Γ × S → S by $a\alpha b = ab$ for all $a, b \in$ S and $\alpha \in \Gamma$. It is easy to see that S is a Γ-semi sub near-field space. Now S is a left and right pseudo commutative Γ-semi sub near-field space. But S is not a commutative Γ-semi sub near-field space.

In the following we are introducing left identity, right identity and identity of a Γ-semi sub near-field space of Γ-semi sub near-field space.

Definition 2.28: Left identity. An element **'α'** of a Γ-semi sub near-field space S is said to be a left identity of S provided $a\alpha s = s$ for all $s \in S$ and $\alpha \in \Gamma$.

Definition 2.29: R*ight* identity. An element 'α' of a Γ-semi sub near-field space S is said to be a *right identity* of S provided $s\alpha a = s$ for all $s \in S$ and $\alpha \in \Gamma$.

Definition 2.30: Identity. An element 'α' of a Γ-semi sub near-field space S is said to be a two sided identity or an identity provided it is both a left identity and a right identity of S.

Theorem 2.31: If a is a left identity and b is a right identity of a Γ-semi sub near-field space S, then $a = b$.

***Proof*:** Since a is a left identity of S, $a\alpha s = s$ for all $s \in$ S and $\alpha \in \Gamma$ and hence $a\alpha b = b$ for all $\alpha \in \Gamma$. Since b is a right identity of S, $s\alpha b = s$ for all $s \in$ S and $\alpha \in \Gamma$ and hence $a\alpha b = a$ for all $\alpha \in \Gamma$. Now $a = a\alpha b = b$.

Theorem 2.32: Any Γ-semi sub near-field space S has at most one identity.

Proof: Let a, b be two identity elements of the Γ-semi sub near-field space S. Now a can be considered as a left identity and b can be considered as a right identity of S. By theorem 2.31, $a = b$. Then S has at most one identity. This completes the proof of the theorem.

Note 2.33: The identity (if exists) of a Γ-semi sub near-field space is usually denoted by 1.

Definition 2.34: Γ-monoid sub near-field space. A Γ-semi sub near-field space S with identity is called a Γ-monoid sub near-field space.

In the following we are introducing left zero, right zero and zero of a Γ-semi sub near-field space.

Definition 2.35: left zero sub near-field space. An element a of a Γ-semi sub near-field space S is said to be a left zero sub near-field space of S provided $a\alpha s = a$ for all $s \in$ S and $\alpha \in \Gamma$.

Definition 2.36: right zero sub near-field space. An element *a* of a Γ-semi sub near-field space S is said to be a right zero sub near-field space of S provided $s\alpha a = a$ for all $s \in$ S and $\alpha \in \Gamma$.

Definition 2.37: Two sided zero sub near-field space or zero sub near-field space. An element *a* of a Γ-semi sub near-field space S is said to be a two sided zero sub near-field space or zero sub near-field space provided it is both a left zero and a right zero of S.

We are now introducing left zero Γ-semi sub near-field space, right zero Γ-semi sub near-field space and zero Γ-semi sub near-field space.

Definition 2.38: left zero Γ-semi sub near-field space. A Γ-semi sub near-field space in which every element is a left zero is called a left zero Γ-semi sub near-field space.

Definition 2.39: right zero Γ-semi sub near-field space. A Γ-semi sub near-field space in which every element is a right zero is called a right zero Γ-semi sub near-field space.

Definition 2.40: zero Γ-semi sub near-field space or a **null Γ-semi sub near-field space.** A Γ-semi sub near-field space with 0 in which the product of any two elements equals to 0 is called a zero Γ-semi sub near-field space or a null Γ-semi sub near-field space.

Theorem 2.41: If a is a left zero and b is a right zero of a Γ-semi sub near-field space S, then a = b.

Proof: Since a is a left zero of S, aαs = a for all s ∈ S, α ∈ Γ and so aαb = a for all α ∈ Γ. Since b is a right zero of S, sαb = b for all s ∈ S and α ∈ Γ and hence aαb = b for all α ∈ Γ. Now a = aαb = b.

Theorem 2.42: Any Γ-semi sub near-field space S has at most one zero element (i.e. zero Γ-semi sub near-field space or a null Γ-semi sub near-field space).

Proof: Let a, b be two zeros of the Γ-semi sub near-field space S. Now a can be considered as a left zero and b can be considered as a right zero. By theorem 2.41, a = b. Thus S has at most one zero.

Note 2.43: The zero (if exists) of a Γ-semi sub near-field space is usually denoted by 0.

Notation 2.44: Let S be a Γ-semi sub near-field space. If S has an identity, let S^1 = S and if S does not have an identity, let S1 be the Γ-semi sub near-field space S with an identity adjoined usually denoted by the symbol 1. Similarly if S has a zero, let S0 = S and if S does not have a zero, let S0 be the Γ-semi sub near-field space S with zero adjoined usually denoted by the symbol 0.

SECTION 3: MAIN RESULTS

In this section, Following terms left Γ-sub near-field space, right Γ- sub near-field space, Γ- sub near-field space, proper Γ- sub near-field space, trivial Γ- sub near-field space, maximal left Γ- sub near-field space, maximal right Γ- sub near-field space, maximal Γ- sub near-field space, Γ- sub near-field space generated by a sub near field space B, principal left Γ- sub near-field space, principal right Γ- sub near-field space, principal Γ- sub near-field space of a Γ-sub near-field space over a near-field are introduced. Also left duo Γ-semi sub near-field space, right duo Γ-semi sub near-field space, duo Γ-semi sub near-field space, left simple Γ-semi sub near-field space, right simple Γ-semi sub near-field space and simple Γ-semi sub near-field space are introduced. It is proved that (1) the nonempty intersection of two left Γ- sub near-field spaces of a Γ-semi sub near-field space T is a left Γ- sub near-field space of T, (2) the nonempty intersection of any family of left Γ - sub near-field spaces of a Γ-semi sub near-field space T is a left Γ - sub near-field space of T, (3) the union of two left Γ - sub near-field spaces of a Γ –semi sub near-field space T is a left Γ - sub near-field space of T and (4) the union of any family of left Γ- sub near-field spaces of a Γ –semi sub near-field space T is a left Γ - sub near-field space of T. It is also proved that (1) the nonempty intersection of two right Γ- sub near-field spaces of a Γ-semi sub near-field space T is a right Γ- sub near-field space of T, (2) the nonempty intersection of any family of right Γ - sub near-field spaces of a Γ –semi sub near-field space T is a right Γ - sub near-field space of T, (3) the union of two right Γ - sub near-field spaces of a Γ –semi sub near-field space T is a right Γ - sub near-field space of T and (4) the union of any family of right Γ - sub near-field spaces of a Γ –semi sub near-field space T is a right Γ- sub near-field space of T. Further it is proved that (1) the nonempty intersection of two Γ- sub near-field spaces of a Γ-semi sub near-field space T is a Γ- sub near-field space of T, (2) the nonempty intersection of any family of Γ- sub near-field spaces of a Γ-semi sub near-field space T is a Γ- sub near-field space of T, (3) the union of two Γ- sub near-field spaces of a Γ-semi sub near-field space T is a Γ - sub near-field space of T and (4) the union of any family of Γ- sub near-field spaces of a Γ-semi sub near-field space T is a Γ- sub near-field space of T.

It is proved that if T is a Γ-semi sub near-field space and $a \in$ T then (i) L(a) = a∪T Γa, (ii) N(a) = a∪a ΓS, (iii) J(a) = a ∪ aΓT ∪ TΓa ∪ TΓaΓT. It is proved that a Γ- semi sub near-field space T is a duo Γ- semi sub near-field space if and only if x Γ $S^1 = S^1$ Γx for all $x \in$ T. Further it is also proved that every normal Γ- semi sub near-field space is a duo Γ-semi sub near-field space. It is proved that (1) a Γ –semi sub near-field space T is a left simple Γ –semi sub near-field space if and only if T Γa = T for all $a \in$ T, (2) a Γ –semi sub near-field space T is a right simple Γ –semi sub near-field space if and only if a Γ T = T for all $a \in$ T, (3) a Γ –semi sub near-field space T is a simple Γ –semi sub near-field space if and only if TΓaΓT = T for all $a \in$ T.

3.1. Γ-semi sub normal near-field space of Γ-semi sub near-field space over near-field

The term Γ-semi sub normal near-field space plays a special role in the theory of Γ-semi sub near-field spaces. In this section, the terms; Γ-semi sub normal near-field space, Γ- semi sub normal near-field space generated by a sub near-field space, cyclic Γ- semi sub normal near-field space of a Γ-semi sub near-field space and cyclic Γ-semi sub near-field space are introduced. It is proved that (1) the nonempty intersection of two Γ- semi sub normal near-field spaces of a Γ-semi sub near-field space S is a Γ- semi sub normal near-field space of S, (2) the non-empty intersection of any family of Γ- semi sub normal near-field space of a Γ-semi sub near-field space S is a Γ- semi sub normal near-field space of S. It is also proved that if A is a nonempty Γ- semi sub near-field space of a Γ-semi sub near-field space S, then the Γ-semi sub normal near-field space of S generated by A is the intersection of all Γ- semi sub normal near-field spaces of S containing A.

Definition 3.2: Let S be a Γ-semi sub normal near-field space. A non-empty subset T of S is said to be a Γ- semi sub normal near-field space of S if $a\gamma b \in$ T, for all $a, b \in$ T and $\gamma \in \Gamma$.

Note 3.3: A non-empty Γ-semi sub near-field space T of a Γ-semi sub normal near-field space S is a Γ-semi sub normal near-field space of S iff TΓT ⊆ T.

Example 3.4: Let S = [0, 1] and Γ = {1/n: n is a positive integer}. Then S is a Γ-semi sub near-field space under the usual multiplication. Let T = [0, 1/2]. Now T is a non-empty Γ-semi sub near-field space of S and $a\gamma b \in$ T, for all $a, b \in$ T and $\gamma \in \Gamma$. Then T is a -semi sub near-field space of S.

Theorem 3.5: The nonempty intersection of two Γ-semi sub near-field spaces of a Γ-semi sub near-field space S is a Γ-semi sub near-field space of S.

Proof: Let T_1, T_2 be two Γ-semi sub near-field spaces of S. Let $a, b \in T_1 \cap T_2$ and $\gamma \in \Gamma$.
$a, b \in T_1 \cap T_2 \Rightarrow a, b \in T_1$ and $a, b \in T_2$
$a, b \in T_1$, $\gamma \in \Gamma$, T_1 is a Γ-semi sub near-field space of S ⇒ $a\gamma b \in T_1$.
$a, b \in T_2$, $\gamma \in \Gamma$, T2 is a Γ-semi sub near-field space of S ⇒ $a\gamma b \in T_2$.
$a\gamma b \in T_1$, $a\gamma b \in$ T2⇒ $a\gamma b \in T_1 \cap T_2$. Therefore $T_1 \cap T_2$ is a Γ-semi sub near-field space of S. This completes the proof of the theorem.

Theorem 3.6: The nonempty intersection of any family of Γ-semi sub near-field spaces of a Γ-semi sub near-field space S is a Γ-semi sub near-field space of S.

Proof: Let $\{T_\alpha\}_{\alpha \in \Delta}$ be a family of Γ-semi sub near-field spaces of S and let $T = \bigcap_{\alpha \in \Delta} T_\alpha$.
Let $a, b \in$ T and $\gamma \in \Gamma$.
$a, b \in T \Rightarrow a, b \in \bigcap_{\alpha \in \Delta} T_\alpha$.
$\Rightarrow a, b \in T_\alpha$ for all $\alpha \in \Delta$.
$a, b \in T_\alpha$, $\gamma \in \Gamma$, T_α is a Γ-semi sub near-field space of S ⇒ $a\gamma b \in T_\alpha$.
$a\gamma b \in T_\alpha$ for all $\alpha \in \Delta \Rightarrow a\gamma b \in T_\alpha$
$\forall \alpha \in \Delta \Rightarrow a\gamma b \in T$.

Therefore T is a Γ-semi sub near-field space of S. This completes the proof of the theorem.

In the following we are introducing a Γ-semi sub near-field space which is generated by a sub near-field space and a cyclic Γ-semi sub near-field space of Γ-semi near-field space over a near-field. This completes the proof of the theorem.

Definition 3.7: Γ-semi sub near-field space of S generated by A. Let S be a Γ-semi sub near-field space and A be a non-empty sub near-field space of S. The smallest Γ-semi sub near-field space of S containing A is called a Γ-semi sub near-field space of S generated by A. It is denoted by < A >.

Theorem 3.8: Let S be a Γ-semi sub near-field space and A be a nonempty sub near-field space of S. Then $< A > = \{a_1\ \alpha_1\ a_2\ \alpha_2 \ldots\ldots a_{n-1}\ \alpha_{n-1}\ a_n : n \in N, a_1, a_2, \ldots, a_n \in A, \alpha_1, \alpha_2, \ldots, \alpha_{n-1} \in \Gamma\}$.

Proof: Let $T = \{a_1\ \alpha_1\ a_2\ \alpha_2 \ldots a_{n-1}\ \alpha_{n-1}\ a_n : n \in N, a_1, a_2, \ldots a_n \in A, \alpha_1, \alpha_2, \ldots, \alpha_{n-1} \in \Gamma\}$.
Let $a, b \in T$ and $\gamma \in \Gamma$.

$a \in T \Rightarrow a = a_1\ \alpha_1\ a_2\ \alpha_2 \ldots\ldots a_{m-1}\ \alpha_{m-1} a_m$ where $a_1, a_2, \ldots a_m \in A, \alpha_1, \alpha_2, \ldots, \alpha_{m-1} \in \Gamma$.

$b \in T \Rightarrow b = b_1\ \beta_1\ b_2\ \beta_2 \ldots\ldots b_{n-1}\ \beta_{n-1}\ b_n$ where $b_1, b_2, \ldots b_n \in A, \beta_1, \beta_2, \ldots, \beta_{n-1} \in \Gamma$.

Now $a\gamma b = (a_1\ \alpha_1\ a_2\ \alpha_2 \ldots\ldots a_{m-1}\ \alpha_{m-1} a_m)\ \gamma\ (b_1\ \beta_1\ b_2\ \beta_2 \ldots\ldots b_{n-1}\ \beta_{n-1}\ b_n) \in T$.

Therefore T is a Γ- semi sub near-field space of S.

Let K be a Γ- semi sub near-field space of S such that $A \subseteq K$.

Let $a \in T$. Then $a = a_1\ \alpha_1\ a_2\ \alpha_2 \ldots\ldots a_{n-1}\ \alpha_{n-1} a_n$ where $a_1, a_2, \ldots a_n \in A, \alpha_1, \alpha_2, \ldots, \alpha_{m-1} \in \Gamma$
$a_1, a_2, \ldots a_n \in A, A \subseteq K \Rightarrow a_1, a_2, \ldots a_n \in K$.

$a_1, a_2, \ldots a_n \in K, \alpha_1, \alpha_2, \ldots, \alpha_{n-1} \in \Gamma$, K is a Γ- semi sub near-field space of sub near-field space over near-field.

$\Rightarrow a_1\ \alpha_1\ a_2\ \alpha_2 \ldots\ldots a_{n-1}\ \alpha_{n-1} a_n \in K \Rightarrow a \in K$. Therefore, $T \subseteq K$.

So T is the smallest Γ- semi sub near-field space S of sub near-field space over near-field containing A. Hence $< A > = T$.

Theorem 3.9: Let S be a Γ- semi sub near-field space and A be a non-empty sub near-field space of S. Then < A > = The intersection of all Γ- semi sub near-field spaces of S containing A.

Proof: Let Δ be the set of all Γ- semi sub near-field spaces of S containing A.

Since S is a Γ- semi sub near-field space of S containing A, $S \in \Delta$. So $\Delta \neq \emptyset$.

Let $T^* = \bigcap_{T \in \Delta} T$. Since $A \subseteq T$ for all $T \in \Delta$, $A \subseteq T^*$.
By theorem 3.4, T^* is a Γ- semi sub near-field space of S.

Since $T^* \subseteq T$ for all $T \in \Delta$, T^* is the smallest Γ- semi sub near-field space of S containing A. Therefore $T^* = < A >$. This completes the proof of the theorem.

Definition 3.10: cyclic Γ-semi sub near-field space. Let S be a Γ-semi sub near-field space of Γ-sub near-field space over a near-field space. A Γ-semi sub near-field space T of S is said to be cyclic Γ-semi sub near-field space of S if T is generated by a single element sub near-field space of S.

Note 3.11: Let T be a Γ-semi sub near-field space of Γ-semi sub near-field space S. Then T is cyclic iff $T = \bigcup_{n \in N} (a\Gamma)^{n-1} a$, for some $a \in S$.

Definition 3.12: cyclic Γ- semi sub near-field space. A Γ-semi sub near-field space S is said to be a cyclic Γ- semi sub near-field space if S is a cyclic Γ- semi sub near-field space of S itself.

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