

## TORSION UNITS IN INTEGRAL GROUP RINGS

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(Communicated by Ronald M. Solomon)

**ABSTRACT.** Let  $G = \langle a \rangle \rtimes X$  where  $\langle a \rangle$  is a cyclic group of order  $n$ ,  $X$  is an abelian group of order  $m$ , and  $(n, m) = 1$ . We prove that if  $\mathbb{Z}G$  is the integral group ring of  $G$  and  $H$  is a finite group of units of augmentation one of  $\mathbb{Z}G$ , then there exists a rational unit  $\gamma$  such that  $H^\gamma \subseteq G$ .

Let  $G$  be a finite group,  $\mathbb{Z}G$  the integral group ring of  $G$ , and  $U_1\mathbb{Z}G$  the group of units of augmentation one in  $\mathbb{Z}G$ . It has been conjectured by Zassenhaus that if  $H$  is a finite subgroup of  $U_1\mathbb{Z}G$ , then  $H$  is conjugate to a subgroup of  $G$  by a rational unit, i.e., there exists  $\gamma \in U\mathbb{Q}G$  such that  $H^\gamma \subseteq G$ .

This conjecture has been confirmed by Weiss in [8] for  $p$ -groups. In this note we shall prove this conjecture for a certain class of metabelian groups. More precisely, we will establish the following result:

**Theorem.** *Let  $G$  be a split extension  $\langle a \rangle \rtimes X$ , where  $\langle a \rangle$  is a cyclic group of order  $n$ ,  $X$  is an abelian group of order  $m$ , and  $(n, m) = 1$ . If  $H \subseteq U_1\mathbb{Z}G$  is a finite group, then there exists  $\gamma \in U\mathbb{Q}G$  such that  $H^\gamma \subseteq G$ .*

Before proceeding to the proof of the theorem we record some useful facts that will be needed.

If  $N$  is a normal subgroup of  $G$ , let us denote by  $\Delta(G, N)$  the kernel of the natural map  $\mathbb{Z}G \rightarrow \mathbb{Z}(G/N)$ . Also we briefly write  $u \sim g$  to indicate that  $u$  is conjugate in  $\mathbb{Q}G$  to  $g$ .

**Lemma 1.** *Let  $G = A \rtimes X$ , where  $A$  is an abelian normal  $p$ -group and  $X$  is any group with  $(|A|, |X|) = 1$ . Let  $u \in U_1\mathbb{Z}G$  be a unit of the form  $u = vw$ , where  $v \in U(1 + \Delta(G, A))$ ,  $w \in U_1\mathbb{Z}X$ . If  $u$  has finite order not divisible by  $p$ , then  $u \sim w$ .*

*Proof.* See [3, Lemma 2].

**Lemma 2.** *Let  $G = \langle a \rangle \rtimes X$ , where  $o(a) = n$ ,  $|X| = m$ , and  $(n, m) = 1$ . If an element  $a^i x$  of  $G$ , where  $x \in X$ , is of order divisible by all primes dividing  $n$ , then  $x$  is central in  $G$ .*

*Proof.* It is a consequence of [4, Lemma 2.3].

**Lemma 3.** *Let  $G$  be a split extension  $\langle a \rangle \rtimes X$ , where  $\langle a \rangle$  is a cyclic group of order  $n$ ,  $X$  is an abelian group of order  $m$ , and  $(n, m) = 1$ . If  $G_0$  is a*

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# Units In Integral Group Rings

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