TRANSITIVE STEINER AND KIRKMAN TRIPLE SYSTEMS OF ORDER 27

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ABSTRACT. There are 71 Steiner triple systems of order 27 whose automorphism groups are point-transitive, and there are 248 transitive Kirkman triple systems of order 27. Computational methods used to find these designs are outlined. The designs and some of their properties are presented.

1. STEINER TRIPLE SYSTEMS AND THEIR GROUPS

A *Steiner triple system* of order v , briefly $\text{STS}(v)$, is a pair $(V, \mathcal{B})$ where V is a set of v elements and $\mathcal{B}$ is a set of 3-element subsets of V , with the property that every 2-subset of V appears in exactly one subset of $\mathcal{B}$. Sets in $\mathcal{B}$ are *triples*. An *automorphism* of an $\text{STS}(v)$ is a permutation on V that maps each triple in $\mathcal{B}$ to a triple of $\mathcal{B}$, and the *automorphism group* is the group of all automorphisms of the STS. The STS is *transitive* if the automorphism group acts transitively on V ; it is *cyclic* when the group contains Z_v as a subgroup, and *abelian* if there is an abelian subgroup of the automorphism group that acts transitively on V .

Steiner triple systems with large automorphism groups, and in particular transitive STS, are studied in large part because they yield examples of Steiner triple systems with interesting “regularity.” There is an extensive literature on cyclic STS [2], but for the closely related case of transitive STS, especially nonabelian STS, little is known.

Transitive STS of order 21 have been constructively enumerated [5]; there are seven cyclic designs and three other transitive ones. Subsequently, Tonchev [8] constructively enumerated the transitive $\text{STS}(25)$; there are three over $Z_5 \times Z_5$, in addition to the twelve over Z_{25} known since the 1930s [1].

For order 27, there are five possible automorphism groups to be considered. Three are the abelian groups $Z_3 \times Z_3 \times Z_3$, $Z_9 \times Z_3$, and Z_{27} . In addition, there are two nonabelian groups [3]. The first of these has all group elements of order 3, while the second has Z_9 as a subgroup. Every transitive $\text{STS}(27)$ has (at least) one of these contained in its automorphism group. Cyclic $\text{STS}(27)$ ’s have been generated previously [1], as have the “1-rotational” $\text{STS}(27)$ ’s [7].

In this paper, we exhibit all transitive $\text{STS}(27)$ ’s. There are eight cyclic ones [1]; we find that there are 71 transitive $\text{STS}(27)$ ’s in total. In addition to presenting these designs, we give an extensive computational analysis of them.

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We list numbers of subdesigns, group orders, and whether or not the design is resolvable.

A *parallel class* in an STS is a spanning set of pairwise disjoint triples. A *resolution* is a partition of the triples of the STS into parallel classes. A Steiner triple system along with a resolution of it is a *Kirkman triple system*, or KTS. An automorphism of the STS is also an automorphism of a Kirkman triple system that it supports, *provided* the automorphism preserves the parallel classes of the resolution. In general, a Steiner triple system that is transitive can be resolvable in many ways; some Kirkman triple systems so arising may be transitive, while others are not. For a transitive STS, a *transitive resolution* (under a group Γ) is a resolution whose parallel classes are preserved under the action of Γ . A *transitive KTS* is a Kirkman triple system whose automorphism group acts transitively on elements (and, of course, preserves the resolution).

We examine all resolutions of the transitive STS(27) that are preserved by one of the groups acting transitively on 27 elements; we establish that there are precisely 248 nonisomorphic transitive Kirkman triple systems of order 27. We exhibit a compact representation of each, along with its group order.

Janko and van Trung [4] have previously found all 661 “2-rotational” KTS(27)’s, each necessarily having group order divisible by 13. Only one of their designs is also transitive as a Kirkman triple system, and hence 247 of the designs we exhibit appear to be previously unpublished.

Before presenting the catalogues of designs, we outline the computational methods used. Let Γ be one of the five groups of order 27, presented as a transitive permutation group on V , a set of 27 elements. The action of Γ partitions the 3-subsets of V into orbits $T_1, \dots, T_t$, and partitions the pairs into orbits $P_1, \dots, P_p$. Now form a matrix $A = A_{23}(\Gamma)$, whose (i, j) entry is the number of times a fixed pair in orbit P_i appears in triples of orbit T_j . Let U be a 0, 1-solution to the matrix equation $AU = \underline{1}$. Then U is the characteristic vector of a Steiner triple system whose automorphism group contains Γ .

Solutions of this matrix equation are in one-to-one correspondence with distinct STS(27)’s whose automorphism group contains Γ . Hence all such STS(27)’s can be found by solving a binary knapsack problem. However, we are interested only in nonisomorphic solutions. Applying a permutation π in the normalizer of Γ in Sym_{27} (the symmetric group on 27 symbols) carries an STS to an isomorphic, but possibly distinct, STS. Using the normalizer of Γ to eliminate duplicates in the search for the solutions to the matrix equation substantially reduces the number of solutions to be examined. Finally, we find one representative of each isomorphism type, and its automorphism group, using the graph isomorphism program “nauty” of McKay [6].

Parallel classes are found as follows. Form a 117-vertex block nonintersection graph, having a vertex representing each block, and two vertices adjacent when the corresponding blocks are disjoint. A parallel class is a 9-clique in this graph. Each parallel class generates an orbit of parallel classes under the action of Γ . Such an orbit may have all parallel classes having no triples in common (*a type-1 class*), or two parallel classes of the orbit may share a triple (*a type-2 class*). A transitive resolution contains only type-1 classes. To check resolvability (not necessarily transitive), form a graph whose vertices are the parallel classes, and make two vertices adjacent if the corresponding parallel classes have no common triple. A resolution is a 13-clique in this graph. In a typical case, the graph has

thousands of vertices (parallel classes), and so we did not find all resolutions, but verified the existence or nonexistence of one.

Finding transitive resolutions is an easier matter. One first eliminates all type-2 classes. Then the remaining parallel classes fall into orbits under Γ . We form a graph whose vertices are the orbits of parallel classes, where each vertex has a *weight* equal to the number of parallel classes in the orbit. Two vertices are adjacent if no parallel class in the orbit represented by one vertex shares a triple with a parallel class of the orbit represented by the second vertex. Then a transitive resolution (that is, a transitive Kirkman triple system) is a clique of *weight* 13 in this graph.

Finally, determining the nonisomorphic transitive Kirkman triple systems was again performed by nauty. The success of the approach here rests on the effective solution of two difficult problems: an integer knapsack problem, and a clique problem. These are the same problem in disguise; the approach used is a heuristic method that quickly prunes the number of cases to be considered.

To determine the solutions of the binary knapsack problem $AU = J$, we use an algorithm called SYNTH. At present, SYNTH is ideally suited for problems in which A has several thousand columns but fewer than 100 rows, and determines all possible solutions. In this recursive algorithm, a column X of A which has a 1 in the first row is selected. All rows in which X has a 1 are marked for deletion, and so are all columns of A that are not orthogonal to X (that is, those that have nonzero inner product with column X). A *synthem* is a pair of binary vectors indicating which rows are active (not marked for deletion), and which columns are active. Synthem are used to pass information about these “conceptual” differences recursively to the main function in SYNTH. The synthem passed is then used to prune the possible solution space. This pruning process conceptually yields submatrix A' of A (without actually incurring the overhead of carrying out the deletions physically), and the algorithm recursively determines all solutions to subproblem $A'U' = J'$. The above deletions are relative only to the subproblem indicated by the synthem. The algorithm proceeds to select the second column X of A with a 1 in A 's first row, and the process continues until all 1's in row one of A have been considered.

2. TRANSITIVE STS OF ORDER 27

In this section, we exhibit all 71 transitive Steiner triple systems of order 27. We report nonisomorphic solutions for each of the five groups; some designs are represented over more than one of the groups, but we assign each isomorphism type of design a unique number that is used throughout. When a design has a presentation over more than one group, we give a presentation of it over each relevant group.

For each design, the number of subdesigns has been determined; none has a subdesign of order 7 or 13, and the only admissible order for a subdesign is 9. We report the number of subdesigns for each design under column “S.”

It is an easy exercise to see that each design has a parallel class, since there is some orbit of nine triples in each solution. However, not all of the designs are resolvable. Under the column “Res,” we report on resolvability of each design as follows. “N” indicates that the design has no resolution at all. “R” indicates that it is resolvable but has no transitive resolution under the action of the

group. “T” indicates that it has a transitive resolution, and the accompanying number is the number of such resolutions under the action of the group. In the case of design 50, the design has a unique resolution, and this resolution is transitive.

We have also computed the number of parallel classes in each design; this ranges from 478 (design 44) to 17641 (design 1). Design 1 is of course the affine geometry; hence, the fact that it maximizes the number of parallel classes, resolutions, transitive resolutions, and subdesigns, comes as no surprise.

Finally, we have also computed cycle structures [2] for each design. Design 1 has a 2-transitive automorphism group, and hence its cycle structure must be the same for all pairs of elements (i.e., it is *uniform*). Remarkably, design 2 is also uniform and has the same cycle structures as design 1. None of the remaining 69 are uniform, although designs 3 and 6 have only two different cycle structures.

For compactness, we list the designs with element set $\{a, b, \dots, y, z, A\}$, listing a block $\{a, b, c\}$ as abc . We only list orbit representatives for each design. To obtain the full set of 117 blocks, one applies the group generated by the generators given in each case to find the orbits of the representative triples; their union is the block set of the design.

2.1. The nonabelian group of exponent three. We present here the results for the nonabelian group of order 27 having all group elements of order 3. We use the set of three generators:

$$\begin{aligned} &bcaxutmpj kirngfwsAyovehzqdl \\ &drhealpicfmjxAzqgsbwtnukoyv \\ &ftoljgazyqspbcndewumkixrvAh \end{aligned}$$

There are forty nonisomorphic Steiner triple systems carried by this group; we present them here in compact form:

No.	Order	S	Res	Orbit Representatives
1	303264	39	T 729	$abcadeafgahu aixajp akAalqamo ant arv asz awy$
2	11664	12	T 567	$abcadeafgahk aixajp alqamo ant arv awy$
3	486	3	R	$abcadeafh aixajp alqamo ant arv asz awy$
4	432	3	T 15	$abcadeafgahi akAalv amo ant awy$
5	162	3	T 27	$abcadeafgahi akAalqamo ant arv asz awy$
6	162	3	R	$abcadeafhairajp alqamo ant asz$
7	81	3	T 21	$abcadeafgahk ai jalqamo arv awy$
8	81	0	T 6	$abcadeafgahi akmanw arv$
9	81	0	T 3	$abcadeafgahjain akyas z$
10	54	3	R	$abcadeafh ai jalqamo arv asz awy$

11 54 3 R *abc ade afh ain ajp amo arv asz awy*
 12 54 0 T9 *abc ade afg ahi akn alv amo*
 13 54 3 T5 *abc ade afg ahk ai j alr awy*
 14 54 3 R *abc ade afh ain ajm arv asz*
 15 54 3 T3 *abc ade afh aix ajv aln asz*
 16 54 3 R *abc ade afi ahl ajs akA awy*
 17 27 0 T5 *abc ade afg ahi akm ant arv asz awy*
 18 27 0 T5 *abc ade afg ahi akA alq amo ans awy*
 19 27 0 R *abc ade afh aim ajp alq ant arv awy*
 20 27 0 T3 *abc ade afg ahi akl amo ans*
 21 27 0 T2 *abc ade afg ahi akm ans awy*
 22 27 0 T3 *abc ade afg ahi akn alq amz*
 23 27 0 T1 *abc ade afg ahi akn alr asz*
 24 27 0 T2 *abc ade afg ahj aiq akn asz*
 25 27 0 T1 *abc ade afh ai j alq amz awy*
 26 27 3 R *abc ade afh ai j alr asz awy*
 27 27 0 R *abc ade afh ai j alv amo awy*
 28 27 0 T1 *abc ade afh aim ajp aln arv*
 29 27 0 T1 *abc ade afh aim ajt alq awy*
 30 27 0 R *abc ade afh ain ajp amz awy*
 31 27 0 R *abc ade afh aiq ajw ant arv*
 32 27 0 R *abc ade afh air ajn alq amo*
 33 27 0 T2 *abc ade afh air ajp alt amo*
 34 27 0 T1 *abc ade afh aix ajm alt arv*
 35 27 0 T1 *abc ade afh aix ajm alv ant*
 36 27 0 T2 *abc adf ahm akl ans*
 37 27 0 T3 *abc adf ahq aik amz*
 38 27 0 T1 *abc adf aht aim akl*
 39 27 0 T2 *abc adf ahv aim akn*
 40 27 0 T1 *abc adf ahx akl amz*

2.2. The nonabelian group of exponent nine. In this subsection, we treat the cases for the nonabelian group having a subgroup isomorphic to Z_9 , having generators:

$$\begin{aligned}
 & dulefghijkamnoprscAvwxzytb \\
 & bcaxAwtvzuygkfjeidhlosnrmqp
 \end{aligned}$$

This group carries 18 nonisomorphic triple systems, as follows:

No.	Order	S	Res	Orbit	Representatives
1	303264	39	T 39	<i>abc ady aeu a fi agv anz aqw</i>	
2	11664	12	T 9	<i>abn adA aex a fi agy</i>	
3	486	3	R	<i>abf adA aex agy aqw</i>	
41	81	0	T 5	<i>abl adw aeu a fi agn</i>	
42	27	0	R	<i>abl adf ags amA anz</i>	
43	27	0	T 2	<i>abl adg aex amA anz</i>	
44	27	0	T 1	<i>abl adi aex amz aqw</i>	
45	27	0	R	<i>abl adi aex amA anz</i>	
46	27	0	R	<i>abl adj ags amz aqw</i>	
47	27	0	T 1	<i>abl adj ags amA anz</i>	
48	27	0	N	<i>abl ads aeh amw anz</i>	
49	27	0	T 1	<i>abl ads aei amw anz</i>	
50	27	0	T 1	<i>abl adv aeh anz aqA</i>	
51	27	0	T 2	<i>abl adv aei anz aqA</i>	
52	27	0	T 3	<i>abl adv aez a fi agw</i>	
53	27	0	T 5	<i>abl adw aez a fi agm</i>	
54	27	0	T 4	<i>abl adx aeo a fi agr</i>	
55	27	0	T 4	<i>abl adx aeu a fi agz</i>	

2.3. The group $Z_3 \times Z_3 \times Z_3$. For the elementary abelian group Z_3^3 , we use the three generators:

bcaefdhigkljnomqrptuswxvzAy
defghiabcmnopqrjklvwxyzAstu
jklmnopqrstuvwxyzAabcdefghi

This group carries five nonisomorphic triple systems, all of which are carried as well by at least one of the groups already handled.

No.	Order	S	Res	Orbit	Representatives
1	303264	39	T 81	<i>abc adh ajt amA apx</i>	
2	11664	12	T 99	<i>abc adh ajv akx alw</i>	
3	486	3	T 81	<i>abc adg aei afj akw alA aoz</i>	
6	162	3	T 81	<i>abc adh ajv akx alz</i>	
41	81	0	T 29	<i>abc adg aej afm alv aoz aqx</i>	

2.4. **The group $Z_9 \times Z_3$.** Here we give solutions for the abelian group $Z_9 \times Z_3$, with generators:

$$\begin{aligned} &dlmefghijkanuopqrstbvwxyzAc \\ &bcalnopqrstmduvwxyzAefghijk \end{aligned}$$

This group carries 15 nonisomorphic triple systems, as follows:

No.	Order	S	Res	Orbit	Representatives
1	303264	39	T 27		<i>abc adq ael a fi agn aoy arv</i>
2	11664	12	T 9		<i>adv adt aep a fi agq</i>
3	486	3	R		<i>abf adA aew agx aoy</i>
5	162	3	T 9		<i>abc adq ael a fi agu aoy arv</i>
7	81	3	T 3		<i>abv adq ael a fi agu</i>
8	81	0	T 3		<i>abm adr aep a fi agy</i>
9	81	0	T 3		<i>abm adr aez a fi agy</i>
56	54	3	R		<i>abf adt aep agA aoy</i>
57	54	3	R		<i>abf adt aez agA aoy</i>
58	27	0	T 2		<i>abm adg aes anx arv</i>
59	27	0	T 1		<i>abm adi aep aoy aqy</i>
60	27	0	T 2		<i>abm adi aes anx arv</i>
61	27	0	T 1		<i>abm adi aes any arv</i>
62	27	0	T 5		<i>abm adr aep a fi ags</i>
63	27	0	T 5		<i>abm adr aez a fi ags</i>

2.5. **The group Z_{27} .** The cyclic designs have been known for over fifty years [1]. We include them here for completeness, using the generator:

$$bcdefghijklmnopqrstuvwxyzAa$$

There are eight nonisomorphic cyclic STS(27) :

No.	Order	S	Res	Orbit	Representatives
64	27	0	N		<i>abd ael a fp ago ajs</i>
65	27	0	N		<i>abd ael a fp agt ajs</i>
66	27	0	R		<i>abd ael a fr ago ajs</i>
67	27	0	T 2		<i>abd ael a fr agt ajs</i>
68	27	0	T 2		<i>abd aeo a fl ahp ajs</i>
69	27	0	N		<i>abd aeo a fl aht ajs</i>
70	27	0	N		<i>abd aer a fv ahp ajs</i>
71	27	0	R		<i>abd aer a fv aht ajs</i>

3. TRANSITIVE KIRKMAN TRIPLE SYSTEMS

Forty-nine of the Steiner triple systems exhibited in §2 can be resolved in such a way that the Kirkman triple system is also transitive. In the appendix

(Supplement section at the end of this issue), we exhibit all nonisomorphic transitive Kirkman triple systems of order 27. There are 248 altogether. Hence we resort to a compact representation of the systems.

We list only those parallel classes that suffice to generate the thirteen parallel classes under the action of the groups (as given in §2). Each required parallel class is also listed in a compressed manner. Any automorphism of order 3 on the Kirkman system must either fix a parallel class, or must move the entire parallel class. If it fixes the parallel class, it may either fix the blocks of the parallel class, or permute them within the parallel class. In general, for each parallel class, some subgroup of the group of order 27 acting on the design fixes that parallel class. Hence it suffices to prescribe orbit representatives of the blocks in the parallel class in its stabilizing subgroup.

Each parallel class can therefore be succinctly described using the generators from §2 to specify the stabilizer of the parallel class, and listing orbit representatives for the parallel class under this subgroup. We specify the stabilizer of the parallel class by specifying a *subgroup code*, which is an integer from $\{0, \dots, 7\}$. It is interpreted as follows. For the two groups having all elements of order 3, let π_1, π_2, π_3 be the three generators (in the same order) as given in §2. For the two groups requiring two generators, let π_2, π_3 be the two generators as given in §2, and let $\pi_1 = \pi_2^3$. For Z_{27} , let π_3 be the generator given in §2, $\pi_2 = \pi_3^3$ and $\pi_1 = \pi_3^9$. It is *important* to remark that an automorphism of order 9 may move a parallel class, while the cube of the same automorphism fixes it; hence, we require these redundant generators in specifying the stabilizer of each parallel class.

Now with permutations chosen in this way, write the subgroup code as a 3-bit binary number $b_3b_2b_1$; the stabilizer is found by generating the minimal subgroup containing $\pi_1^{b_1}, \pi_2^{b_2}$, and $\pi_3^{b_3}$. Each parallel class is written as a subgroup code, followed by orbit representatives for the parallel classes; parallel classes are separated in the listing by colons.

Therefore, to recover the entire resolution, one first finds the stabilizer for each parallel class in turn, and applies all permutations in the stabilizer to reconstruct the parallel class. Then one applies the action of the entire group to find all thirteen parallel classes.

We give an example of the process here. Over the second nonabelian group, the following is a compact representation of a Kirkman triple system: $4adv\,egj\,fmz : 6anz : 2fnu$. There are three orbits of parallel classes. To recover the orbit representatives for all parallel classes, apply the second generator to adv, egj, fmz , both generators to anz , and the first generator to fnu . This yields the three parallel classes:

$$\begin{array}{l} adv\,bxs\,chr\,egj\,tuA\,lop\,fmz\,kqw\,iny \\ anz\,dot\,epA\,bfq\,gru\,hsv\,ciw\,jlx\,kmy \\ fnu\,gov\,hpw\,iqx\,jry\,ksz\,act\,dIA\,bem \end{array}$$

Now apply both generators to produce all parallel classes in the orbits of these three. The orbit lengths obtained are 9, 1, and 3 for the three parallel classes given:

adv bxs chr egj tuA lop fmz kqw iny
 dew cuy ils fhk bvA mpq gnt arx joz
 efx lvz cjm agi buw nqr hoA dsy kpt
 fgy mtw kln dhj uvx ors bip cez aqA
 ghz nxA amo eik vwy cps jqu flt bdr
 hit boy dnp afj wxz clq kru gmA esu
 iJA puz eoq dgk txy lmr asw bhn cfw
 bjk qtv fpr aeh yzA mns cdx iou glw
 aku rWA gqs dfi btz cno ely jpv hmx

anz dot epA bfq gru hsv ciw jlX kmy

fnu gov hpw iqx jry ksz act dLA bem
 fow jst env irz dmU hqy abl gpx cKA
 jnw hlu fsA dqz kox imv bcg ert apy

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Supplement to TRANSITIVE STEINER AND KIRKMAN TRIPLE SYSTEMS OF ORDER 27

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Transitive Kirkman Triple Systems of Order 27

See §3 of that paper for instructions in reading the following tables.

1. The nonabelian group of exponent three

This group carries 146 nonisomorphic transitive Kirkman triple systems. We list them next, giving the number of the underlying transitive *STS* in the lists of §2, and the order of the automorphism group of the Kirkman triple system.

No.	STS	Order	Representation
1	1	303264	6 alq bux chi:5 amo dhr euv:4 cjr dit asz:4 clu etz aix:7 cno dlp
2	1	11664	7 ajp:7 amo:7 ant:7 cjr dmv:7 clu:7 cno dlp:7 cps:7 cyA dgj:7 fjl:7 fkz:7 fuA:7 juy:7 los
3	1	3888	6 afg brs chi:5 amo dhr euv:4 cjr dit asz:4 clu etz aix:7 fjl
4	1	3888	7 ajp:5 amo dwA eis:4 arv bhq cdk:7 cjr dmv:7 cno dlp:7 cyA dgj:7 fjl:7 fkz:7 fuA
5	2	3888	7 ajp:5 amo dhr euv:4 arv bhq cdk:6 cju:7 cno dlp:7 cyA dgj:7 fjl
6	1	2916	7 ajp:5 amo dhr euv:4 cjr dit asz:4 clu etz aix:7 cno dlp:7 cyA dgj:7 fjl
7	1	2916	7 ajp:5 amo dhr euv:7 cjr dmv:7 clu:7 cno dlp:7 cps:7 cyA dgj:7 fjl:7 fkz:7 fuA:7 los
8	1	2916	7 ajp:5 amo dwA eis:4 arv bhq cdk:7 cno dlp:4 cqx dit akA:7 cyA dgj:7 fjl
9	1	1944	7 ajp:5 amo dhr euv:4 arv bhq cdk:4 cjr dit asz:7 cno dlp:7 cyA dgj:7 fjl
10	1	1944	7 ajp:5 amo dhr euv:4 cjr dit asz:7 clu:7 cno dlp:7 cps:7 cyA dgj:7 fjl:7 los
11	2	1944	7 ajp:5 amo dhr euv:4 asA bip cex:7 clu:7 cno dlp:7 cps:7 cyA dgj:7 fjl:7 los
12	1	972	6 afg brs chi:5 amo dwA eis:4 arv bhq cdk:4 cqx dit akA:7 fjl
13	1	972	6 afg brs chi:7 amo:7 ant:7 cjr dmv:7 clu:7 cps:7 fjl:7 fkz:7 fuA:7 juy:7 los
14	1	972	6 afg bux chi:5 amo dhr euv:4 cjr dit asz:4 clu etz aix:7 cyA dgj
15	1	972	6 afg bux chi:5 amo dwA eis:4 arv bhq cdk:4 cqx dit akA:7 cyA dgj
16	1	972	6 afg bux chi:7 amo:7 ant:7 cjr dmv:7 clu:7 cps:7 cyA dgj:7 fkz:7 fuA:7 juy:7 los
17	1	972	7 ajp:5 amo dhr euv:4 arv bhq cdk:7 cjr dmv:7 cno dlp:7 cyA dgj:7 fjl:7 fkz:7 fuA
18	2	972	7 ajp:5 amo dhr euv:5 cju dty:4 clu etz aix:7 cno dlp:7 cyA dgj:7 fjl
19	2	972	7 ajp:5 amo dwA eis:4 arv bhq cdk:5 cju dty:7 cno dlp:7 cyA dgj:7 fjl
20	2	486	7 ajp:5 amo dhr euv:4 arv bhq cdk:4 asA bip cex:7 cno dlp:7 cyA dgj:7 fjl
21	2	486	7 ajp:5 amo dhr euv:4 asA bip cex:4 clu etz aix:7 cno dlp:7 cyA dgj:7 fjl
22	4	432	7 akA:5 amo dlp euv:5 ckw dqt:5 clq:7 cps:7 fjl:7 juy

23	4	432	7 akA:5 amo dWA eis:5 ckw dqt:5 clq:7 cno dlp:7 cps:7 flj	65	2	162	6 afg brs chi:7 amo:7 ant:6 cjuw:7 clu:7 cps:7 flj:7 juy:7 los
24	1	324	6 afg brs chi:5 amo dhr euw:4 arv bhq cdk:4 cjr dit asz:7 flj	66	5	162	7 akA:5 amo dhr euw:5 ckw dqt:7 clu:7 cno dlp:7 cps:7 cyA dgi:7 flj:7
25	1	324	6 afg brs chi:5 amo dhr euw:4 arv bhq cdk:4 cqr dit akA:7 flj	67	5	162	7 akA:5 amo dWA eis:5 ckw dqt:7 clu:7 cno dlp:7 cps:7 cyA dgi:7 flj:7
26	1	324	6 afg brs chi:5 amo dhr euw:4 cjr dit asz:7 clu:7 cps:7 flj:7 los	68	5	162	fuA
27	1	324	6 afg brs chi:5 amo dhr euw:7 cjr dmv:7 clu:7 cps:7 flj:7 flz:7 fuA:7 los	69	4	108	7 akA:7 juy
28	1	324	6 afg brs chi:5 amo dWA eis:4 arv bhq cdk:7 cjr dmv:7 flj:7 flz:7 fuA:7 los	70	4	108	7 akA:5 amo dhr euw:5 ckw dqt:5 clq:7 cno dlp:7 cps:7 flj
29	1	324	6 afg brs chi:5 amo dWA eis:7 cjr dmv:7 clu:7 cps:7 flj:7 flz:7 fuA:7 los	71	4	108	7 akA:5 amo dWA ejq:5 ckw dqt:5 clq:7 cps:7 flj:7 juy
30	1	324	6 afg bux chi:5 amo dhr euw:4 arv bhq cdk:4 cjr dit asz:7 cyA dgi	72	8	81	7 akA:7 amo:7 ant:5 ckw dqt:5 clq:7 cno dlp:7 cps:7 flj:7 juy
31	1	324	6 afg bux chi:5 amo dhr euw:4 arv bhq cdk:4 cqr dit akA:7 cyA dgi	73	8	81	4 aLA bqy ckw:7 clu:7 cno dlp:7 flj:7 juy
32	1	324	6 afg bux chi:5 amo dhr euw:4 cjr dit asz:7 clu:7 cps:7 cyA dgi:7 los	74	8	81	4 anw bip hav:7 clu:7 cno dlp:7 flj:7 juy
33	1	324	6 afg bux chi:5 amo dhr euw:7 cjr dmv:7 clu:7 cps:7 cyA dgi:7 flz:7 fuA:7 los	75	9	81	5 ahi:6 anw bqy:4 aoq bhr hav:7 clu:7 cno dlp:7 flj:7 juy
34	1	324	6 afg bux chi:5 amo dWA eis:4 arv bhq cdk:7 cjr dmv:7 cyA dgi:7 flz:7 fuA	76	9	81	4 ain bkp exz:7 cno dlp:7 fuA:7 gpq:7 juy
35	1	324	6 afg bux chi:5 amo dWA eis:7 cjr dmv:7 clu:7 cps:7 cyA dgi:7 flz:7 fuA:7 los	77	9	81	4 ain brz djk:6 aow biq:5 aru:7 cno dlp:7 fuA:7 gpq:7 juy
36	4	216	7 akA:5 amo dhr ejq:7 ant:5 ckw dqt:5 clq:7 cps:7 flj	78	4	54	4 aow btp ehv:7 cno dlp:7 fuA:7 gpq:7 juy
37	1	162	6 afg brs chi:5 amo dhr euw:4 arv bhq cdk:7 cjr dmv:7 flj:7 flz:7 fuA	79	4	54	0 ahi byA cfm dqt eop gtx jsv lwz aru:7 akA:7 cno dlp:7 cps:7 flj
38	1	162	6 afg bux chi:5 amo dhr euw:4 arv bhq cdk:7 cjr dmv:7 cyA dgi:7 flz:7 fuA	80	5	54	7 akA:5 amo dhr ejq:7 ant:5 ckw dqt:7 clu:7 cps:7 cyA dgi:7 flj:7 fuA
39	2	162	6 afg brs chi:5 amo dhr euw:4 arv bhq cdk:4 asA bip cex:7 flj	81	5	54	7 akA:5 amo dhr euw:5 ckw dqt:4 clu ejq awy bmt hzA:7 cyA dgi:7 flj:7 fuA
40	2	162	6 afg brs chi:5 amo dhr euw:4 arv bhq cdk:5 cjuw dty:7 flj	82	5	54	7 akA:5 amo dhr euw:5 ckw dqt:4 clu etz afg ivy rwx:7 cyA dgi:7 flj:7 fuA
41	2	162	6 afg brs chi:5 amo dhr euw:4 arv bhq cdk:6 cjuw dty:7 flj	83	5	54	7 akA:5 amo dlp eis:7 ant:5 ckw dqt:7 clu:7 cps:7 cyA dgi:7 flj:7 fuA
42	2	162	6 afg brs chi:5 amo dhr euw:4 asA bip cex:7 clu:7 cps:7 flj:7 los	84	5	54	7 akA:5 amo dWA eis:5 ckw dqt:4 clu ejq awy bmt hzA:7 cyA dgi:7 flj:7 fuA
43	2	162	6 afg brs chi:5 amo dhr euw:4 asA bip cex:7 clu:7 cps:7 flj:7 los	85	5	54	7 akA:5 amo dWA eis:5 ckw dqt:4 clu etz afg ivy rwx:7 cyA dgi:7 flj:7 fuA
44	2	162	6 afg brs chi:5 amo dhr euw:5 cjuw dty:4 clu etz aix:7 flj	86	5	54	7 akA:7 amo:7 ant:5 ckw dqt:4 clu ejq awy bmt hzA:7 cyA dgi:7 flj:7 fuA
45	2	162	6 afg brs chi:5 amo dhr euw:5 cjuw dty:7 clu:7 cps:7 flj:7 los	87	5	54	7 akA:7 juy
46	2	162	6 afg brs chi:5 amo dhr euw:6 cjuw dty:4 clu etz aix:7 flj	88	12	54	7 akA:7 amo:7 ant:5 ckw dqt:4 clu etz afg ivy rwx:7 cyA dgi:7 flj:7 fuA
47	2	162	6 afg brs chi:5 amo dhr euw:6 cjuw:7 clu:7 cps:7 flj:7 los	89	12	54	6 akn bhl:5 amo dhr ejq:5 ckw dqt:5 clq:7 flj
48	2	162	6 afg brs chi:5 amo dWA eis:4 arv bhq cdk:4 asA bip cex:7 flj	90	12	54	6 akn bhl:5 amo dlp eis:5 ckw dqt:5 clq:7 flj
49	2	162	6 afg brs chi:5 amo dWA eis:4 arv bhq cdk:6 cjuw dty:7 flj	91	13	54	6 akn bhl:7 amo:5 ckw dqt:5 clq:7 cno dlp:7 flj:7 juy
50	2	162	6 afg brs chi:5 amo dWA eis:4 arv bhq cdk:4 clu etz aix:7 flj	92	13	54	4 aij boz dkw:4 aov brA djs:4 asA bip cex:7 cno dlp:7 cps:7 flj:7 juy
51	2	162	6 afg brs chi:5 amo dWA eis:4 asA bip cex:7 clu:7 cps:7 flj:7 los	93	13	54	4 aij boz dkw:4 aov brA djs:5 cjuw dty:7 cno dlp:7 cps:7 flj:7 juy
52	2	162	6 afg brs chi:5 amo dWA eis:5 cjuw dty:4 clu etz aix:7 flj	94	15	54	4 aij boz dkw:4 aov brA djs:6 cjuw:7 cno dlp:7 cps:7 flj:7 juy
53	2	162	6 afg brs chi:5 amo dWA eis:5 cjuw dty:7 clu:7 cps:7 flj:7 los	95	15	54	0 aju bgr cfp dli enx hzA koy mqu ntz:7 flj:7 fuA:7 juy:7 los
54	2	162	6 afg brs chi:5 amo dWA eis:5 cjuw dty:4 clu etz aix:7 flj	96	15	54	0 aju bfw cgl dJA enq hvx ity moz ps:7 flj:7 fuA:7 juy:7 los
55	2	162	6 afg brs chi:5 amo dWA eis:6 cjuw:4 clu etz aix:7 flj	97	15	54	0 aju bgr cfp dse eLA hiw joq mvy ntz:7 flj:7 fuA:7 juy:7 los
56	2	162	6 afg brs chi:5 amo dWA eis:6 cjuw:7 clu:7 cps:7 flj:7 los	98	7	27	0 aij ber cgt dWA fip hmu kvq loy nsz:7 akA:7 cno dlp:7 cps:7 flj
57	2	162	6 afg brs chi:7 amo:7 ant:4 arv bhq cdk:4 asA bip cex:7 flj:7 juy	99	7	27	4 aij boz dkw:5 amo dhr ejq:4 asA bip cex:7 clu:7 cps:7 cyA dgi:7 flj
58	2	162	6 afg brs chi:7 amo:7 ant:4 arv bhq cdk:6 cjuw dty:7 flj:7 juy	100	7	27	4 aij boz dkw:5 amo dhr ejq:5 cjuw dty:7 clu:7 cps:7 cyA dgi:7 flj
59	2	162	6 afg brs chi:7 amo:7 ant:4 asA bip cex:4 clu etz aix:7 juy	101	7	27	4 aij boz dkw:5 amo dhr ejq:6 cjuw:7 clu:7 cps:7 cyA dgi:7 flj
60	2	162	6 afg brs chi:7 amo:7 ant:4 asA bip cex:4 clu etz aix:7 juy	102	7	27	4 aij boz dkw:5 amo dlp eis:4 asA bip cex:7 clu:7 cps:7 cyA dgi:7 flj
61	2	162	6 afg brs chi:7 amo:7 ant:4 asA bip cex:7 clu:7 cps:7 flj:7 juy:7 los				
62	2	162	6 afg brs chi:7 amo:7 ant:5 cjuw dty:4 clu etz aix:7 flj:7 juy				
63	2	162	6 afg brs chi:7 amo:7 ant:5 cjuw dty:7 clu:7 cps:7 flj:7 juy:7 los				
64	2	162	6 afg brs chi:7 amo:7 ant:6 cjuw:4 clu etz aix:7 flj:7 juy				

2. The nonabelian group of exponent nine

The nonabelian group having Z_9 as a subgroup carries 43 nonisomorphic Kirkman triple systems; we list the 32 that are not also carried by the first nonabelian group:

No.	STS	Order	Representation
147	2	486	5 ajv:5 akt:5 cjs eit:6 cnq dgi:1 fnz glu hsy
148	1	324	0 aeu bin chl dot fty gmq ksa pxz rvw:5 ckr:6 cnq dgi
149	2	243	1 adA bmt cho:6 cnq dgi:1 fnz glu hsy
150	41	81	1 adw chm ltv:5 aeu:1 agn bhv lmx:6 cnq dgi:2 fnu
151	41	81	5 aeu:0 agn bqr chm dIA efy iuw jst kox pvz:6 cnq dgi
152	41	81	5 aeu:1 agn bqr ert:6 cnq dgi
153	41	81	5 aeu:1 aeq bhv dmu:6 cnq dgi
154	41	81	5 aeu:4 akv dIA fjq:6 cnq dgi
155	43	27	4 amA dij flt:6 anz:2 fnu
156	43	27	6 anz:2 aqr:4 ckA dij flt
157	44	27	4 amz dej flt:6 aqr:2 fnu
158	47	27	6 anz:4 aqr dwy egh:2 fnu
159	49	27	2 amw:6 anz:0 cmx dfj env apy biu gwA hio ksz lqr
160	50	27	4 adv egi fmz:6 anz:2 fnu
161	51	27	0 aei bvw chr dIA fgy jst kox mng puz:6 anz:2 arx bhn
162	51	27	6 anz:2 arx bhn:4 cjm dgi env
163	52	27	1 agw chr mxy:6 cnq dgi:2 fnu
164	52	27	1 ahA bex cdo:6 cnq dgi:2 fnu
165	52	27	5 adv:1 ans bru dky:1 aqr bpv dhx:6 cnq dgi:2 fnu
166	53	27	0 agm bij cfr dky elp hzz noA qtw suv:6 cnq dgi:2 fnu
167	53	27	1 adw chm ltv:0 agm bfh cip dIA euw jst kox nyz qrv:6 cnq dgi
168	53	27	1 adw chm ltv:1 ans bdv ert:6 cnq dgi
169	53	27	1 adw chm ltv:1 ans bkt dIA:6 cnq dgi
170	53	27	1 adw chm ltv:1 ans bru dky:5 ely dis euw:6 cnq dgi:2 fnu
171	54	27	1 adx bos ckA:1 clx dhs azA:6 cnq dgi
172	54	27	1 ajm brx ckA:1 clx dhs azA:6 cnq dgi
173	54	27	4 auv dIA fjq:6 cnq dgi:1 cvz els fgt
174	54	27	5 auv:1 clx dhs azA:6 cnq dgi:1 cvz els fgt:2 fnu
175	55	27	1 adx boA chs:6 cnq dgi:2 fnu
176	55	27	1 agz chs lrv:4 akw dIA hjz:6 cnq dgi
177	55	27	1 agz chs lrv:5 cjp:6 cnq dgi:1 cvz els fgt:2 fnu
178	55	27	1 ahv bpu cdr:6 cnq dgi:2 fnu

103	7	27	4 ajb boz dkw:5 amo dlp eis:6 cjuw:7 clu:7 cps:7 cyA dgi:7 flj
104	7	27	4 ajb boz dkw:7 amo:4 asA bip cex:7 clu:7 cno dlp:7 cps:7 cyA dgi:7 flj:7 juy
105	8	27	0 ahi bvw egi dmx eou fqr kyA lnt psz:7 clu:7 cno dlp:7 flj:7 juy
106	12	27	0 alv bkz cfs dmA eop ghj itx nru qwy:5 amo dhr ejq:7 flj
107	12	27	0 alv bkz cfs dmA eop ghj itx nru qwy:5 amo dhr eis:7 flj
108	12	27	0 alv bkz cfs dmA eop ghj itx nru qwy:7 amo:7 cno dlp:7 flj:7 juy
109	13	27	0 alk bos cgy dqA emu fpw ilt jnx rsv:7 cno dlp:7 cps:7 flj:7 juy
110	17	27	5 ahi:5 ant dhr ejq:4 aoq blr hav:7 clu:7 cps:7 flj:7 fuA
111	17	27	5 ahi:5 ant dlp eis:4 aoq blr hav:7 clu:7 cps:7 flj:7 fuA
112	17	27	5 ahi:7 ant:4 aoq blr hav:4 clu etz afg ivy jwx:7 flj:7 fuA:7 juy
113	17	27	5 ahi:7 ant:4 aoq blr hav:7 clu:7 cno dlp:7 cps:7 flj:7 fuA:7 juy
114	17	27	5 ahi:7 ant:4 aoq blr hav:7 clu:7 cno dlp:7 cps:7 flj:7 fuA:7 juy
115	18	27	7 akA:5 amo dhr ejq:5 ckw dqt:6 clx:7 cps:7 cyA dgi:7 flj
116	18	27	7 akA:5 amo dlp eis:5 ckw dqt:6 clx:7 cps:7 cyA dgi:7 flj
117	18	27	7 akA:7 amo:5 ckw dqt:6 clx:8 cno dgi bux:7 cps:7 juy
118	18	27	7 akA:7 amo:5 ckw dqt:6 clx:7 cno dlp:7 cps:7 cyA dgi:7 flj:7 juy
119	18	27	7 akA:7 amo:5 ckw dqt:6 clx:7 cps:6 cvz dgi bmt:7 juy
120	20	27	5 aki:5 amo dhr ejq:5 ckw dqt:6 clx:7 flj
121	20	27	5 aki:5 amo dlp eis:5 ckw dqt:6 clx:7 flj
122	20	27	5 aki:7 amo:5 ckw dqt:6 clx:7 cno dlp:7 flj:7 juy
123	21	27	0 ajx bin cfu dqt erv glu how kyA mps:7 cno dlp:7 cps:7 flj:7 juy
124	21	27	5 ahi:4 aoq blr hav:6 clx:7 cno dlp:7 cps:7 flj:7 juy
125	22	27	6 akn bhl:5 ckw dqt:6 clt erA:6 cno dgi bux:7 juy
126	22	27	6 akn bhl:5 ckw dqt:6 clt erA:6 cvz dgi bmt:7 juy
127	22	27	6 akn bhl:5 ckw dqt:6 clt erA:7 cno dlp:7 cyA dgi:7 flj:7 juy
128	23	27	6 akn bhl:4 aov brA djs:5 ckw dqt:7 cno dlp:7 flj:7 fuA:7 juy
129	24	27	1 ahj dmA efy:7 cno dlp:7 fuA:7 gpq:7 juy
130	24	27	5 ahj:6 akn bhl:4 cky djs amx:7 cno dlp:7 fuA:7 gpq:7 juy
131	25	27	0 agA bpt cik das emu fgy hjw lrv nox:7 cps:7 cyA dgi:7 flj:7 juy
132	28	27	0 ahi bqe cgt dIA ewx ipu lor mvy ntz:7 ajp:7 clu:7 flj:7 juy
133	29	27	2 am bwA fgz:7 cps:7 cyA dgi:7 gpq:7 juy
134	33	27	0 air bpe cjt dpv fgr hbx lou mqA ntz:7 ajp:7 amo:7 flj:7 juy
135	33	27	7 ajp:2 aku bqs cFA:7 amo:7 flj:7 juy
136	34	27	0 anz blm cgt ddx epr hA joq kwy tuv:7 clu:7 flj:7 juy:7 los
137	35	27	7 ant:0 ars bfg cgt djn ewx htv kZA lpy mou:7 flj:7 juy:7 los
138	36	27	0 ayA b'jv chn dix eqg fps krx lmo tuz:6 clx:7 fot
139	36	27	6 sox bjv:0 ayA btx chn djm erv fgl ikp ouw qsz:7 fot
140	37	27	0 acj bmw egx dKA fu hyz lrv npt oqs:5 csA dgi etw:7 juy
141	37	27	0 alk btx cfr dww eqg hyz jns luA mop:5 csA dgi etw:7 juy
142	37	27	0 sav blo cgx dKA emu fjq hyz ipw mrt:5 csA dgi etw:7 juy
143	38	27	0 aqr btx chn dov ery fgl jsz kMA:6 clm:7 fot
144	39	27	0 alu bgi cfs dpq ent hjo krx mxy vZA:6 cqt dky:7 fot
145	39	27	1 agp djt ery:6 akn bhl:7 fot
146	40	27	0 aki bmw egx dpq erA fhv toy jns tuz:6 am bps:7 fot

3. The group $Z_3 \times Z_3 \times Z_3$

The elementary abelian group Z_3^3 carries 63 nonisomorphic Kirkman triple systems, of which 47 are not isomorphic to those listed earlier:

No.	STS	Order	Representation
179	2	81	0 ams bpA cju dlt eoy frx gqu hlx inv:7 jkl:5 jmq
180	2	54	3 akx:2 aot bpA ckv:2 clx djs eqw:7 jkl:5 jmq
181	2	54	3 akx:6 aow bpu:3 clx dmy:7 jkl:5 jmq
182	3	54	2 afj btv kra:0 ary bms cju dpx eoa fku gqt hmw ilz:0 ckz ddy ems apt bow flv grx hnA iju:7 cny ddt:3 jkl svy aei
183	3	54	2 afj btv kra:0 ary bms cju dpx eoa fku gqt hmw ilz:0 ckz ddy ems apt bow flv grx hnA iju:7 cny ddt:3 jkl svA adg
184	3	54	2 afj btv kra:0 ary bms cju dpx eoa fku gqt hmw ilz:0 ckz ddy ems apt bow flv grx hnA iju:7 cny ddt:7 jkl:7 jmp:7 jnr
185	3	54	2 afj btv kra:3 akw:3 ckz dou:7 cny ddt:3 jkl svy aei
186	3	54	2 afj btv kra:3 akw:3 ckz dou:7 cny ddt:3 jkl svA adg
187	3	54	2 afj btv kra:3 akw:3 ckz dou:7 cny ddt:7 jkl:7 jmp:7 jnr
188	3	54	2 afj btv kra:4 amu bps eoa:4 ckz djw fPA:7 cny ddt:3 jkl svy aei
189	3	54	2 afj btv kra:4 amu bps eoa:4 ckz djw fPA:7 cny ddt:3 jkl svA adg
190	3	54	2 afj btv kra:4 amu bps eoa:4 ckz djw fPA:7 cny ddt:7 jkl:7 jmp:7 jnr
191	6	54	3 akx:3 alx:3 clx dmy:7 jkl:5 jmq
192	6	54	3 alx:2 aqA bos cju:2 clx dpv ekt:7 jkl:5 jmq
193	6	54	3 alx:6 auu bry:2 clx djs eqw:7 jkl:5 jmq
194	2	27	3 akx:2 aot bpA ckv:2 clx dpv ekt:7 jkl:5 jmq
195	2	27	3 akx:3 alx:2 clx djs eqw:7 jkl:5 jmq
196	2	27	6 auu bry:2 aot bpA ckv:2 clx djs eqw:7 jkl:5 jmq
197	3	27	2 afj btv kra:3 akw:0 ckz ddy ems apt bow flv grx hnA iju:7 cny ddt:3 jkl svy aei
198	3	27	2 afj btv kra:3 akw:0 ckz ddy ems apt bow flv grx hnA iju:7 cny ddt:3 jkl svA adg
199	3	27	2 afj btv kra:3 akw:0 ckz ddy ems apt bow flv grx hnA iju:7 cny ddt:7 jkl:7 jmp:7 jnr
200	3	27	2 afj btv kra:3 akw:4 ckz djw fPA:7 cny ddt:3 jkl svy aei
201	3	27	2 afj btv kra:3 akw:4 ckz djw fPA:7 cny ddt:3 jkl svA adg
202	3	27	2 afj btv kra:3 akw:4 ckz djw fPA:7 cny ddt:7 jkl:7 jmp:7 jnr
203	3	27	2 afj btv kra:4 amu bps eoa:0 ckz ddy ems apt bow flv grx hnA iju:7 cny ddt:3 jkl svy aei
204	3	27	2 afj btv kra:4 amu bps eoa:0 ckz ddy ems apt bow flv grx hnA iju:7 cny ddt:3 jkl svA adg
205	3	27	2 afj btv kra:4 amu bps eoa:0 ckz ddy ems apt bow flv grx hnA iju:7 cny ddt:7 jkl:7 jmp:7 jnr
206	6	27	3 akx:2 art bmx cky:2 clx djs eqw:7 jkl:5 jmq
207	6	27	3 akx:2 art bmx cky:2 clx dpv ekt:7 jkl:5 jmq
208	6	27	3 akx:3 alx:2 clx djs eqw:7 jkl:5 jmq
209	6	27	3 akx:3 alx:2 clx dpv ekt:7 jkl:5 jmq
210	6	27	3 akx:6 aow bpu:2 clx djs eqw:7 jkl:5 jmq
211	6	27	3 akx:6 aow bpu:2 clx dpv ekt:7 jkl:5 jmq
212	6	27	3 akx:6 aow bpu:3 clx dmy:7 jkl:5 jmq
213	6	27	3 alx:6 auu bry:2 clx dpv ekt:7 jkl:5 jmq
214	6	27	6 auu bry:2 art bmx cky:2 clx dpv ekt:7 jkl:5 jmq
215	6	27	6 auu bry:6 aow bpu:2 clx djs eqw:7 jkl:5 jmq
216	6	27	6 auu bry:6 aow bpu:2 clx dpv ekt:7 jkl:5 jmq
217	6	27	6 aow bpu:2 aqA bos cju:2 clx dpv ekt:7 jkl:5 jmq
218	41	27	0 aej btx chq dvz fgo isA kpy lmu nrw:1 ahh dsx mry:0 ckx dju emz ant bty fgv grs hIA iow:7 cny ddt:7 cpw dKA:7 jmp:7 mno stu
219	41	27	0 aej btx chq dvz fgo isA kpy lmu nrw:1 ahh dsx mry:3 ckx ddy:7 cny drt:7 cpw dKA:7 jmp:7 mno stu
220	41	27	0 aej btx chq dvz fgo isA kpy lmu nrw:1 ahh dsx mry:4 ckx dqw apA:7 cny ddt:7 cpw dKA:7 jmp:7 mno stu
221	41	27	0 aej btx chq dvz fgo isA kpy lmu nrw:2 afm bsz kru:0 ckx dju emz ant bgy fgv grs hIA iow:7 cny ddt:7 cpw dKA:7 jmp:7 mno stu
222	41	27	0 aej btx chq dvz fgo isA kpy lmu nrw:2 afm bsz kru:3 ckx ddy:7 cny drt:7 cpw dKA:7 jmp:7 mno stu
223	41	27	0 aej btx chq dvz fgo isA kpy lmu nrw:2 afm bsz kru:4 ckx dqw apA:7 cny ddt:7 cpw dKA:7 jmp:7 mno stu
224	41	27	2 afm bsz kru:1 air dvz jns:4 ckx dqw apA:7 cny ddt:7 cpw dKA:7 jmp:7 mno stu
225	41	27	2 afm bsz kru:2 air btx jns:4 ckx dqw apA:7 cny ddt:7 cpw dKA:7 jmp:7 mno stu

4. The group $Z_9 \times Z_3$

$Z_9 \times Z_3$ carries 41 nonisomorphic transitive Kirkman triple systems, of which 19 are nonisomorphic to previous systems:

No.	STS	Order	Representation
226	5	54	5 adq:5 aoy dgj enu:6 cio dsw:5 ckz dfn:5 cnw diA
227	5	54	5 adq:5 aoy dgj etx:5 ckz dfn:5 cnw diA:6 foy
228	7	27	5 adq:5 ckz dfn:5 cnw diA:6 cvy dgi:1 foy glm hitx
229	58	27	2 anx:6 arv:0 cju env fhl adg bKA iqx myz ops rtw
230	58	27	4 aqj dPA efi:6 arv:2 fnu
231	59	27	4 aep dtx fji:6 aoy:2 fnu
232	60	27	0 ahh biw cfs doy elm gpx jtz nqr uvA:5 aqj:6 arv
233	60	27	5 aqj:6 arv:0 atA biw cfs doy env gkj hrx lpq muz
234	61	27	4 aqj dpy ekt:6 arv:2 fnu
235	62	27	0 auy bqv cez dmn flr git hpw jsA lox:1 cop dwx ekt:6 cvy dgi
236	62	27	1 ags bnw chA:6 cvy dgi:2 fnu
237	62	27	1 ags btx cez:6 cvy dgi:2 fnu
238	62	27	4 adr ewA fls:6 cvy dgi:2 fnu
239	62	27	5 aep:1 auy bpz dht:1 cop dwx ekt:6 cvy dgi:2 fnu

240	63	27	0 auy bqy ceg dmn flr hpw ilt jsA oxz:1 cop dwx eft:6 cvy dgj
241	63	27	1 aho cjw lqA:1 cop dwx eft:5 cqz dFA epr:6 cvy dgj:2 fnu
242	63	27	1 anp bkA cjw:1 cop dwx eft:6 cvy dgj
243	63	27	1 atA bhs cjw:1 cop dwx eft:6 cvy dgj
244	63	27	4 ags dFA exy:6 cvy dgj:2 fnu

5. The group Z_{27}

Z_{27} carries only four transitive Kirkman triple systems:

No.	STS	Order	Representation
245	67	27	2 ahx:1 akp civ efh:4 clu
246	67	27	2 ahx:1 ayz bnx civ:4 clu
247	68	27	1 aiu bgm efh:2 akx:4 clu
248	68	27	2 akx:1 amt cij efh:4 clu