

Cambridge University Press

978-0-521-62349-0 - Geometry of Sporadic Groups II: Representations and Amalgams

A. A. Ivanov and S. V. Shpectorov

[Table of Contents](#)[More information](#)

# Contents

<i>Preface</i>	<i>page</i> ix
1      Preliminaries	1
1.1   Geometries and diagrams	1
1.2   Coverings of geometries	3
1.3   Amalgams of groups	5
1.4   Simple connectedness via universal completion	7
1.5   Representations of geometries	11
 Part I. Representations	 17
2      General features	19
2.1   Terminology and notation	19
2.2   Collinearity graph	22
2.3   Geometric hyperplanes	24
2.4   Odd order subgroups	27
2.5   Cayley graphs	32
2.6   Higher ranks	34
2.7 <i>c</i> -extensions	35
2.8   Non-split extensions	40
 3      Classical geometries	 43
3.1   Linear groups	43
3.2   The Grassmannian	45
3.3 $\mathcal{P}_e^1$ is uniserial	47
3.4 $\mathcal{G}(S_4(2))$	50
3.5   Symplectic groups	51
3.6   Orthogonal groups	55
3.7   Brouwer's conjecture	56
3.8 $\mathcal{G}(3 \cdot S_4(2))$	64

Cambridge University Press

978-0-521-62349-0 - Geometry of Sporadic Groups II: Representations and Amalgams

A. A. Ivanov and S. V. Shpectorov

Table of Contents

[More information](#)

vi

*Contents*

3.9	$\mathcal{G}(Alt_5)$	66
3.10	$\mathcal{G}(3^{\frac{10}{2}12} \cdot S_{2n}(2))$	68
4	Mathieu groups and Held group	76
4.1	$\mathcal{G}(M_{23})$	76
4.2	$\mathcal{G}(M_{22})$	77
4.3	$\mathcal{G}(M_{24})$	81
4.4	$\mathcal{G}(3 \cdot M_{22})$	82
4.5	$\mathcal{D}(M_{22})$	88
4.6	$\mathcal{G}(He)$	92
5	Conway groups	93
5.1	Leech lattice	93
5.2	$\mathcal{G}(Co_2)$	97
5.3	$\mathcal{G}(Co_1)$	99
5.4	Abelianization	101
5.5	$\mathcal{G}(3^{23} \cdot Co_2)$	103
5.6	$\mathcal{G}(3 \cdot U_4(3))$	108
6	Involution geometries	111
6.1	General methods	111
6.2	$\mathcal{I}(Alt_7)$	115
6.3	$\mathcal{I}(M_{22})$	117
6.4	$\mathcal{I}(U_4(3))$	120
6.5	$\mathcal{I}(Co_2, 2B)$	122
6.6	$\mathcal{I}(Co_1, 2A)$	125
7	Large sporadics	128
7.1	Existence of the representations	128
7.2	A reduction via simple connectedness	131
7.3	The structure of $N(p)$	134
7.4	Identifying $R_1(p)$	141
7.5	$R_1(p)$ is normal in $R[p]$	146
7.6	$R[p]$ is isomorphic to $\tilde{G}(p)$	151
7.7	Generation of $\tilde{G}(p) \cap \tilde{G}(q)$	153
7.8	Reconstructing the rank 3 amalgam	155
7.9	$\mathcal{G}(3^{4371} \cdot BM)$	159
	Part II. Amalgams	161
8	Method of group amalgams	163
8.1	General strategy	163
8.2	Some cohomologies	165

Cambridge University Press

978-0-521-62349-0 - Geometry of Sporadic Groups II: Representations and Amalgams

A. A. Ivanov and S. V. Shpectorov

Table of Contents

[More information](#)

	<i>Contents</i>	vii
8.3 Goldschmidt's theorem	170	
8.4 Factor amalgams	173	
8.5 $L_3(2)$ -lemma	175	
8.6 Two parabolics are sufficient	178	
9 Action on the derived graph	180	
9.1 A graph theoretical setup	180	
9.2 Normal series of the vertex stabilizer	183	
9.3 Condition $(*_i)$	187	
9.4 Normal series of the point stabilizer	191	
9.5 Pushing up	196	
10 Shapes of amalgams	198	
10.1 The setting	198	
10.2 Rank three case	200	
10.3 Rank four case	204	
10.4 Rank five case	209	
10.5 Rank six case	211	
10.6 The symplectic shape	211	
10.7 Summary	213	
11 Amalgams for $P$ -geometries	215	
11.1 $M_{22}$ -shape	215	
11.2 Aut $M_{22}$ -shape	217	
11.3 $M_{23}$ -shape	219	
11.4 $Co_2$ -shape	221	
11.5 $J_4$ -shape	227	
11.6 Truncated $J_4$ -shape	233	
11.7 $BM$ -shape	234	
12 Amalgams for $T$ -geometries	242	
12.1 $Alt_7$ -shape	242	
12.2 $S_6(2)$ -shape	243	
12.3 $M_{24}$ -shape	246	
12.4 Truncated $M_{24}$ -shape	248	
12.5 The completion of $\mathcal{A}_f$	253	
12.6 $Co_1$ -shape	256	
12.7 $M$ -shape	261	
12.8 $S_{2n}(2)$ -shape, $n \geq 4$	261	
<i>Concluding Remarks</i>	269	

Cambridge University Press

978-0-521-62349-0 - Geometry of Sporadic Groups II: Representations and Amalgams

A. A. Ivanov and S. V. Shpectorov

Table of Contents

[More information](#)

viii

*Contents*

13	Further developments	271
13.1	Group-free characterizations	271
13.2	Locally projective graphs	275
<i>References</i>		278
<i>Index</i>		285