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T^n-ACTIONS ON SIMPLY CONNECTED $(n+2)$-MANIFOLDS

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In this paper we show that, for each $n \geqq 2$, there is a unique, closed, compact, connected, simply connected $(n+2)$-manifold, M_{n+2}, admitting an action of T^n satisfying the following condition: there are exactly n T^1-stability groups $T_1, \cdots, T_n$ with each $F(T_i, M_{n+2})$ connected. In this case we have $T^n \cong T_1 \times \cdots \times T_n$. Any other action (T^n, M^{n+2}), M^{n+2} simply connected, can be obtained from an action (T^n, M_{n+2}) by equivariantly replacing copies of $D^4 \times T^{n-2}$ with copies of $S^3 \times D^2 \times T^{n-3}$. As an application, we classify all actions of T^n on simply connected $(n+2)$-manifolds for $n = 3, 4$.

Several results have been obtained about T^n-actions on $(n+2)$-manifolds. Orlik and Raymond have obtained various classification theorems for the cases $n = 1, 2$ (see [11], [12] and [14]). Various general results have been obtained in [4] and [5] for $n > 2$. This paper is a continuation of the work done in [4]. We also obtain classification theorems similar to those of [12] for $n = 3, 4$.

In [4] it was shown that, for each n, there exist actions of T^n on simply connected $(n+2)$-manifolds. Here we prove the following.

THEOREM. *For each n, there is a unique closed, compact, connected, simply connected $(n+2)$-manifold M_{n+2} admitting an action of T^n satisfying the following conditions*:

(i) *There are exactly n T^1-stability groups $T_1, \cdots, T_n$.*

(ii) *Each $F(T_i, M_{n+2})$ is connected.*

Furthermore, $T^n \cong T_1 \times \cdots \times T_n$.

We then show that any action (T^n, M^{n+2}), M^{n+2} a closed, compact, connected, simply connected $(n+2)$-manifold, can be obtained from an action (T^n, M_{n+2}) by equivariantly replacing copies of $D^4 \times T^{n-2}$ with copies of $S^3 \times D^2 \times T^{n-3}$.

The above results are applied to two specific cases. We show that if T^3 acts on a simply connected 5-manifold, M, then M is $M_5 = S^5$ or a connected sum of copies of $S^2 \times S^3$. For T^4-actions on simply connected 6-manifolds, M, we show that M is $M_6 = S^3 \times S^3$ or M is a connected sum of copies of $S^2 \times S^4$ and $S^3 \times S^3$.

1. Preliminaries. We shall use standard terminology and notation throughout (e.g. see [2]). Unless otherwise stated, all mani-