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Odd-dimensional analogue of the Euler characteristic

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When compact manifolds X and Y are both even dimensional, their Euler characteristics obey the Kunneth formula $\chi(X \times Y) = \chi(X)\chi(Y)$ .In terms of the Betti numbers of $b_p(X)$, $\chi(X) = \Sigma_p (-1)^p b_p(X)$, implying that $\chi(X) = 0$ when X is odd dimensional. We seek a linear combination of Betti numbers, called ρ, that obeys an analogous formula $\rho(X \times Y) = \chi(X)\rho(Y)$ when Y is odd dimensional. The unique solution is $\rho(Y) = -\Sigma_p (-1)^p p\, b_p(Y)$. Physical applications include: (1) $\rho \longrightarrow (-1)^m \rho$ under a generalized mirror map in $d = 2m+1$ dimensions, in analogy with $\chi \longrightarrow (-1)^m \chi$ in $d = 2m$; (2) ρ appears naturally in compactifications of M-theory. For example, the 4-dimensional Weyl anomaly for M-theory on $X^4 \times Y^7$ is given by $\chi(X^4)\rho(Y^7) = \rho(X^4 \times Y^7)$ and hence vanishes when Y^7 is self-mirror. Since, in particular, $\rho(Y \times S^1) = \chi(Y)$, this is consistent with the corresponding anomaly for Type IIA on $X^4 \times Y^6$, given by $\chi(X^4)\chi(Y^6) = \chi(X^4 \times Y^6)$, which vanishes when Y^6 is self-mirror; (3) In the partition function of p-form gauge fields, ρ appears in odd dimensions as χ does in even.

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