

# Small resolutions of SU(5)-models in F-theory

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We provide an explicit desingularization and study the resulting fiber geometry of elliptically fibered fourfolds defined by Weierstrass models admitting a split  $A_4$  singularity over a divisor of the discriminant locus. Such varieties are used to geometrically engineer SU(5) Grand Unified Theories in F-theory. The desingularization is given by a small resolution of singularities. The  $I_5$  fiber naturally appears after resolving the singularities in codimension-one in the base. The remaining higher codimension singularities are then beautifully described by a four dimensional affine binomial variety which leads to six different small resolutions of the the elliptically fibered fourfold. These six small resolutions define distinct fourfolds connected to each other by a network of flop transitions forming a dihedral group. The location of these exotic fibers in the base is mapped to conifold points of the threefolds that defines the type IIB orientifold limit of the F-theory. The full resolution have interesting properties, specially for fibers in codimension three: the rank of the singular fiber does not necessary increase and the fibers are not necessary in the list of Kodaira and some are not even (extended) Dynkin diagram.

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