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CW-Spheres from Meet-Distributive Lattices

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Meet-distributive lattices are to convex closure what geometric lattices are to linear or affine span. In the latter case, when the underlying matroid is orientable, there is an associated Eulerian poset of faces of the corresponding arrangement of (pseudo) hyperplanes, whose enumerative information can be obtained directly from the geometric lattice, as shown in the classical work of Zaslavsky.

We show that this continues to hold for abstract convex closures: for each one there is a regular CW-sphere whose enumerative information can be read in the same way from the underlying meet-distributive lattice of closed sets. In both cases, the transfer of information from lattice to sphere is accomplished by changing descents to peaks in an edge-labeling of the lattice.