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Einstein Telescope tunnel structures

We propose to replace the large underground halls with a short tunnel section above the main one, connected by vertical wells that host the seismic attenuation chains. This solution has substantial advantages in terms of physics performance, engineering, safety and even cost.

By placing the heads of the seismic attenuation chains on the bedrock of the upper tunnel it removes them from the test mass level, thus allowing easier access. The bedrock stability eliminates the tilt noise amplification effect of tall support structures, resulting in better noise attenuation. Side access from floors anchored to the walls of the well makes implementation and maintenance of components easier and safer and eliminates the need of both overhead cranes and tall vertical access structures. The absence of overhead crane leaves space for longer pendulums even if the two tunnels are kept within the profile of the present hall design, which drive seismic attenuation to lower frequency. The residual seismic noise can be pushed farther away from the sensitivity curve with even longer pendulums if a larger vertical separation between the two tunnels is chosen, at no significant cost. Using the bedrock in the wells as reference, the pendulums residual speed can be damped below the Peterson's model, with large reduction of the required lock actuation authority and greatly eases the interferometer lock acquisition. From the mining engineering point of view, the much smaller radius of the excavations reduces the hydrostatic stress that integrates along the walls and the thickness of required reinforcements. This, together with the smaller excavated volume, significantly reduces costs.

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