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Internally shielded beam transport and support system

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Due to environmental concerns, the Advanced Photon Source has a policy that disallows any exposed lead within the facility. This creates a real problem for the beam transport system, not so much for the pipe but for the flexible coupling (bellows) sections.

A complete internally shielded X-ray transport system, consisting of long transport lines joined by flexible coupling sections, has been designed for CARS Sector 14 to operate either at high vacuum or as a helium flight tube. It can effectively shield against air scattering of wiggler or undulator white beam with proper placement of apertures, collimators, and masks for direct beam control. The system makes use of male and female style fittings that create a labyrinth allowing for continuous shielding through the flexible coupling sections. These parts are precision machined from a ternary hypereutectic lead alloy (cast under 15 inches of head pressure to assure a pin hole free casting) then pressed into either end (rotatable vacuum flanges) of the bellows assembly. The transport pipe itself consists of a four part construction using a stepped transition ring (Z-ring) to connect an inner tube to the vacuum flange and also to a protective and supportive outer tube. The inner tube is wrapped with 1/16" pure lead sheet to a pre-determined thickness following the shape of the stepped transition ring for continuous shielding.

This design has been prototyped and radiation tested.