Subject: Re: Huygen's Principle...
Posted by Bill Fitzmaurice on Sat, 07 Aug 2004 13:13:23 GMT
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The main principle Huygens is famous for, at least as far as folded horns is concerned, is the topology of a 45 degree reflector, as you state. Intuitively one would have the reflector placed so as not to constrict the pathway through the bend; Huygens made the reflector surface longer, so that a wave would see a 45 degree reflector across its entire front, and no reflective surface at 0 degrees that would send part of the wave back from whence it came, again as you note. This results in a constriction of the pathway at the bend but he showed, correctly, that any destructive action caused by that constriction was more than overshadowed by the improved passage efficiency of the wave. However, what Huygens did not address was the question of using a reflector versus a rounded bend. With a flat reflector segments of the incoming wave intersect with segments of the outgoing wave at various degrees of phase, with attendant dips and peaks in response; at higher frequencies the dips outwiegh the peaks to the point of serving as a low pass filter. Huygens made the flat reflector work as well as possible. However, a rounded bend, and not just a rounded bend but one with a rounded inner corner of relatively wide radius compared to the wavelength being passed, ideally allows the wave to pass without being reflected at all. If there are no reflections there are no interactions between an incoming and outgoing wave. This is what is seen in your vacuum duct analogy. The rounded pathway is not perfect by any means. It suffers limitations because the relationship between wavelength and bend radius is an inverse one; the higher the frequency the larger the bend radius required to pass the wave. Once the horn gets to a size adequate to pass a 5kHz wave without attenuation, for instance, the horn mouth is so large that the off-axis response is drooping anyway. Still, it is a better method of allowing high frequency waves to pass through a bend than a flat reflector, with the additional benefit of working just as well in a 180 degree bend as in a 90 degree bend.