Transient Vacuum and High Pressure Generation by Focused Acoustic Waves

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Introduction:
Amplitude of acoustic waves can be magnified by conical or concave waveguides, like in ear trumpets or fjords (surface waves). The simplest way realizing a capable device is a conical waveguide with a target to be treated in the top of the cone, and a spherical actor or acoustic exciter on the other end. The acoustic amplitude is magnified, respectively compressed by the ratio of the local cross section of the waveguide. The amplitude magnification can be approximatively estimated by the conservation of pressure and wave energy. This can induce very low (vacuum) or very high pressures and temperatures in the acoustic focus.

Results:
Simulations on frequency domain and on transient wave equation confirmed the assumption of pressure amplitude amplification very well.

Computational Methods:
The simulations were performed with Comsol pressure acoustics (frequency domain) and Mathematical PDE (transient wave equation)

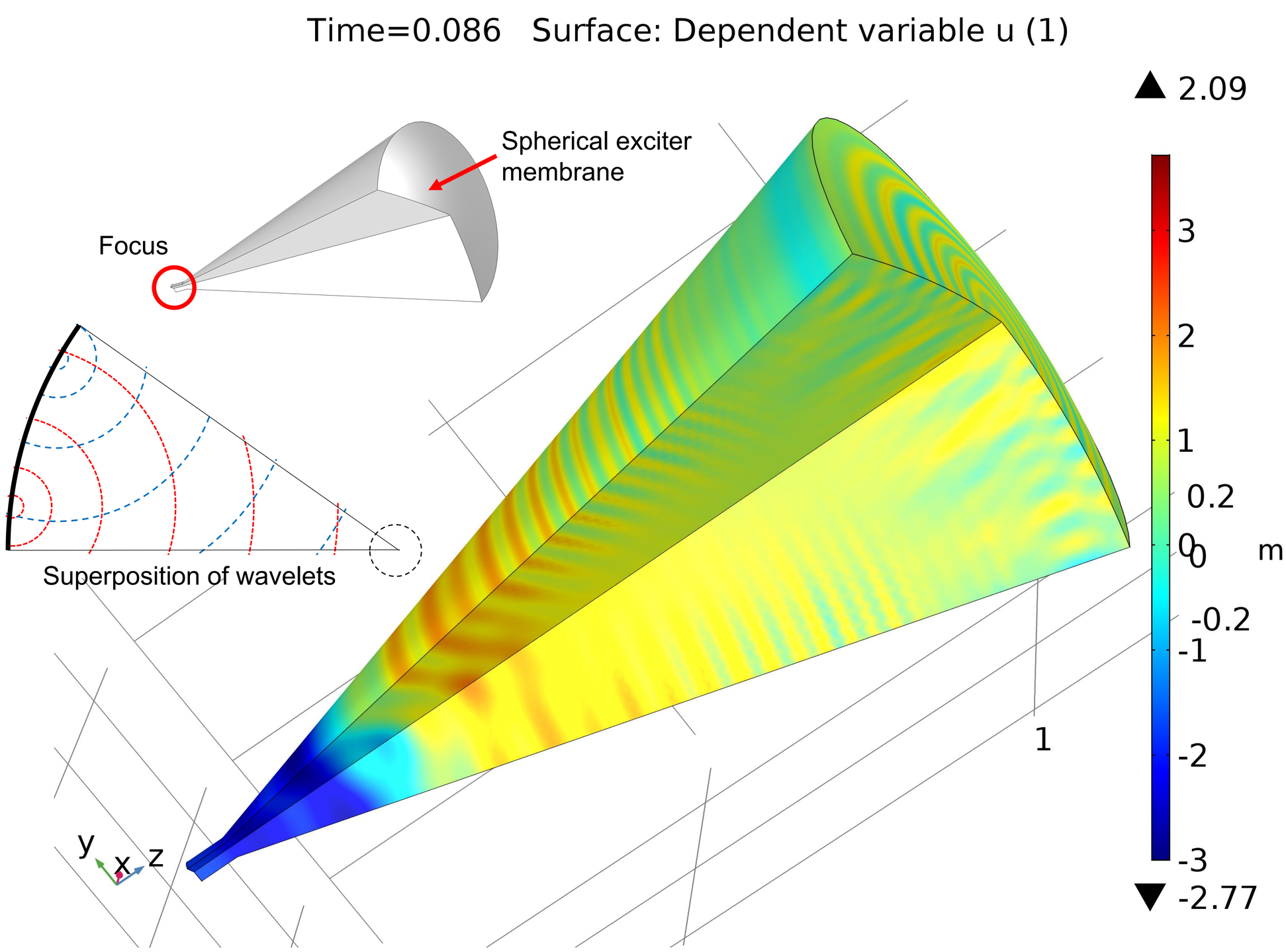

Figure 1. Transient simulation of a traveling focused wave front. There is a transient vacuum in the cone‘s focus

Conclusions:
Commercial use of this technology can improve or provide pseudo-continuous low-pressure plasma applications, like Plasma Chemical Vapor Deposition (PCVD) or high-presssure-high-temperature applications like surface recrystallization or transformation of elements modifications (i.e. graphite – diamond). High-pressure and high temperature shockwaves also can induce fast non-equilibrium chemical reactions.

References:
1. Optima pharma patent application at the German Patent and Trademark Office DPMA, Patent pending : DE 10 2013 204 353 A1 , 2014.09.18