

Energy transference at hypersonic velocities

[Environment](#), [Nature](#)



I'm pretty sure we have had this discussion before so I've got one of my old copycats from a previous thread. Force travels through solid objects at roughly the speed of sound in that object, if you force a piece of an object to move at greater than the speed of sound through that medium it will simply tear whatever is holding it together without transmitting force to the surrounding structure. This gives a kind of hole punch effect. If the projectile is moving faster than the speed of sound in the target. The maximum known speed of sound is about 1 km/s in diamond, given that a dreaded shot moves at about 4 km/s it is safe to assume that armor isn't going to do it. Given the momentum behind the small slug it should remain above the speed of sound in diamond until $(\text{kg} \cdot \text{km/s} / \text{km/s})$ the total mass of matter it has punched through reaches 5.3 tones.

Second, things heat up when they are compressed as given by the perfect gas law (at these energy densities it is close enough for our purposes despite everything being solid) so when the projectile gets compressed it heats up, if it heats up to the correct level it melts, vaporizes and turns into plasma, that depends on the energy densities present (FUSION). So when a solid slug hits the armor the first thing which will happen is that the slug punches a hole clean through the armor, no ifs, no buts.

Then the pressure wave begins to propagate through both the armor chunk which has been torn out and the projectile, the amount of pressure in this wave is so immensely huge that the matter instantly becomes plasma shortly followed by becoming an angular fireball. The only question left is how far does the projectile reach inside the ship until you can stop modeling it as a projectile and have to start modeling it as a nuke. The irony here is that

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armor essentially contains the fireball inside the vessel instead of keeping it on the outside. This is also why whippier shields are effective, the small layer of matter makes a hyper velocity impact undergo the pressure induced explosion and become a far less damaging gas which is then repelled by the actual armor of the vessel. Than weapons are a whole different ballgame. Nationally what comes out of a Than weapon can be considered a mass driver slug (the fact that it is molten doesn't matter, the impact velocity is so far beyond the speed of sound in the target and projectile that it's irrelevant) but in this case instead of being a CACM long cylinder or even a Javelin it is a long thin wire which probably only has a cross section measured in tenths of millimeters and a length in the hundreds of meters. ND punches a hole, the pressure wave propagates back through the projectile, as the pressure wave passes it explodes with the force of a nuclear weapon. So far normal. BUT because the projectile is so long and traveling orders of magnitude faster than its speed of sound, once the front end explodes it leaves relatively clear (exploded) space for the next section of the projectile to pass through and strike deeper into the target, just like a pulsed laser or a multiple impact kinetic weapon like metal storm. This happens over and over and over again, the end effect is that a Than weapon will punch clean through a ship and out the other side which leaves a nice neat little hole.