Prospective Acquisition: a Novel Application for Superluminal Photons in MRI

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Introduction

Recent measurements of the neutrino velocity with the OPERA detector [1] spiked the interest of applications for particles with superluminal velocities. These particles have untapped potential in many fields [2]. Here we present a study that used superluminal photons to increase efficiency of clinical MR scans; however this technique needs to overcome some growing pains before widespread use is warranted.

Materials and Methods

We generated photons at 63.25 Mhz inside Schwarzschild bubbles [3,4] travelling towards the scanner (Fig. 1). When the photons exited the Alcubierre space in forward direction, they had superluminal speed. The photons were directed into the scanner bore at times when excitation was required, replacing the regular excitation pulses generated by the commercial scanner. According to Einstein's principles of stimulated emission, the coherent photons emitted therefore exhibited the same properties, phase, velocity etc. of the incoming wave, meaning the resonant photons also were superluminal. Our Schwarzschild bubble generator (SBG) was tuned so that data sampling takes place exactly 8h before the photons leave the collimator.

89 patients were enrolled in the study (42 male, 44 female, 3 other (1 hermaphrodite, 2 transgender), total 44 1/2m, 46 1/2f). Standard clinical protocols were used according to patient diagnosis, only RF excitation and acquisition deviated in the above described manner from standard clinical imaging.

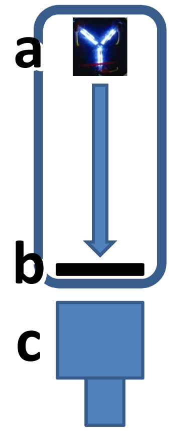

Fig. 1: Diagram of the experimental setup: In the top part of the image the SBG can be seen with the flux generator (a), the constant stream of Schwarzschild bubbles indicated by the arrow then travels towards the magnet, emanating photons at the resonance frequency in forward direction and evaporate before reaching the wall of the vacuum chamber due to Hawkings radiation. A shutter mechanism (b) is located at the collimator of the SBG (towards the magnet) that is synchronized with the pulse sequence to allow for synchronous RF excitation. The MR magnet (c) is a commercially available unit with only minor modifications to allow for external RF excitation and prospective acquisition.

Results and Discussion

Reports of all patients were obtained before patient registration. A typical image can be seen in Figure 2. Imaging data was also obtained - but excluded from the study - from one patient who canceled on short notice, this case seems to indicate that McFly paradoxes [5] are possible if the probability waves are high enough for an event to occur. However it may also be shine-through from a parallel universe [6].

Another interesting and initially puzzling case was one, where the patient came in for an evaluation of the optical nerve, and the radiologist dictated a massive hematoma in the right temporal area, however the patient was fine when he showed up. Only when the actual exam was started the mystery was solved, as the patient bumped his head when he slipped while taking off his shoes prior to the exam. The patient was kept for observation for a day after the MRI was completed but showed no further complications.

In summary we could show that superluminal MRI is feasible, the modifications to the scanner are minimal, only prospective acquisition and synchronization between the pulse sequence and the stand-alone SBG to triggers RF excitation is needed. Our technique can be used for faster and more efficient scanning. Our current practice is to read the report by day and having the actual MR exam the following night, this way the patient can take the report along and scanner utilization can be optimized.

We observed, however, effects of the time-space continuum that are not clearly understood, see the example above. In another recent case, a tech cancelled an exam that showed massive metal artifacts in the brain, the patient then reportedly went to the beach that day, however there it is conceivable that patients in such cases hold the hospital liable for hypothetical harm, since the images can be interpreted as evidence of neglect.

The technique currently has several limitations: Currently no local excitation coils can be used. Also, the delay between acquisition and excitation cannot easily be changed but requires lengthy retuning of the SBG. In addition, as pointed out earlier, paradoxes or apparent paradoxes might be observed. However, these shortcomings do not diminish the general utility of our new acquisition strategy.

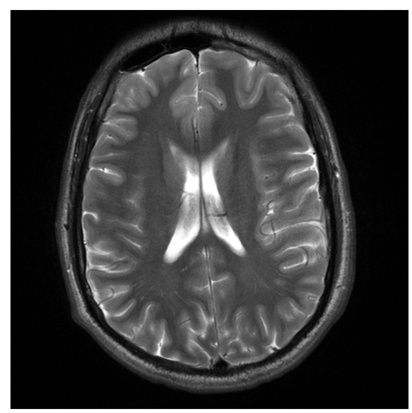

Fig. 2: Typical image quality obtained with superluminal excitation and prospective acquisition. T2 weighted TSE: TE=85ms, TR=5s, TAQ: -7h57min.

References [1] OPERA Collaborators, arXiv:1109.4897v1; 2011. [2] http://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/20110015936_2011016932.pdf. [3] M. Alcubierre, Class.Quant.Grav. 11:L73-L77,1994. [4] C. Van den Broeck, Class.Quant.Grav. 16: 3973-3979, 1999. [5] G. Gipe, B. Gale, R. Zemeckis, Back to the Future: A Novel, Berkley, 1985. [6] B.S. DeWitt, Physics Today:24:30-40,1970.