Why a Double Slit Experiment Can't Detect Our Motion through Space.

There have been many attempts to detect our motion through space using a one-way speed of light experiment, but these experiments always fail due to the inability to synchronize the clocks used to detect the propagation time. Another idea has been to attempt to measure the one-way speed of light indirectly, by detecting a wavelength change or some other parameter. In a one-way light propagation experiment, one might expect that if a preferred frame for the speed of light exists, this would alter the wavelength in the "into the wind" and "against the wind" directions, which could lead to a measurable effect. We will consider herein the situation with a double slit experiment, where the beams propagate from a source to a screen one-way, and explain why no change in the wavelength would be detectable.

We will consider a classic Doppler effect with sound waves to illustrate our point:

In our example, we have 3 police cars, labelled 1, 2 and 3. Police care #2 has it's siren blaring. Police car #1 is behind #2 by 15 meters, and #3 is ahead of #2 by 15 meters. These three cars are all proceeding to the right at the same velocity. Cars #1 and #3 also have screens attached to them. A fourth police car is directly above police car #2 , also with its siren going, and is keeping pace with #2.

As can be seen from the picture, sound waves are emitted from car #2 and #4, which are Doppler shifted due to the motion of the cars with respect to the air. In the forward direction, the wavelengths are compressed, and in the rear direction, they are expanded. These sound waves meet and form an interference pattern in the air as illustrated by the blue concentric lines. If we draw red lines through the points of constructive interference, we find that due to the shorter wavelengths ahead of the cars, the lines of constructive interference are compressed, such that for the same distance in air, the distance between the n=0 and n=1 fringes are smaller than the stationary condition. Conversely, in the reverse direction, the larger wavelength expands the interference pattern, and the distance between the n=0 and n=1 fringes is larger for the same distance in air.

However, we can see that in the time that the waves are being emitted, car #1 is rapidly approaching the interference pattern, whereas car #3 is receding from it. A quick calculation shows that:

If:	speed of sound is 343 m/s	Distance between each car is 15 meters
	Speed of cars is 200 km/s	Distance from car 2 to 4 (slit) is 8 meters

Then for wavelengths of sound that are much smaller than the slit distance, the forward interference pattern reaches the screen on car #3 at 23.75 meters from where car #2 started, and the reverse interference fringes meet the #1 screen 6.25 meters behind where car #2 started. As it turns out***, the distance approached by car#1 and the distance receded by car #3 exactly balances the difference in the expansion rate of the interference fringes, such that when the strike their respective screens, they are spaced by the same amount as if the cars were stationary.***

What this shows then is that regardless of the motion of the cars with respect to the air, the sound waves interference will look the same to the car behind and the car forward, as long as all the cars are co-moving at the same speed. Further, the pitch of the sound will appear to be the same for the moving cars as well, since there is no Doppler effect detectable between co-moving sources and receivers. So in other words, using the information available to the drivers of the cars from the waves (pitch, interference pattern, etc.) there is no evidence that they are moving. The difference in the sound wave velocity in their frame of reference is undetectable based on the tests they have performed.

This is exactly the same problem as the hypothetical scenario of a preferred frame for the speed of light. If light were a wave moving through an aether, similar to our sound wave moving through the air, our co-moving sources and observers can't detect that we are moving relative to this frame for the same reasons. In a double slit experiment, our two police cars #2 and #4 are like our slits that emit light that interferes in the preferred frame, but the motion of the screens with respect to the preferred frame cancel out the fringe divergence expected from the wavelength difference in the forward and reverse directions.