## 5.7 Photorefractively Squeezed Light

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Squeezed light is of fundamental interest in quantum optics and may see practical applications in optical communications, and in precise length measurements via interferometry.

In our set up a pump wave (1) interferes at a small crossing angle (approximately 1.3 degrees) with a weaker probe wave (3) in the crystal. The contrast of this grating and its position along the direction of the grating vector, should fluctuate slightly in response to quantum (and other, more mundane) fluctuations in the amplitudes and phases of beams 1 and 3. And because beam 3 is weaker (usually by a factor of 20 in intensity) its fluctuations should be relatively larger and should have a greater effect on the position and contrast of the grating than those of beam 1. To "read" the grating, we direct another strong pump wave, beam 2, onto the grating from the same side as beam 3. Beam 2 reflects off the grating to produce beam 4, which is the phase conjugate of beam 3 in the sense the phases of beams 3 and 4 become negatively correlated. On the other hand, if beam 3 fluctuates in amplitude, say, by getting momentarily stronger, the grating contrast momentarily increases and beam 4 gets momentarily stronger. As a result, the amplitude fluctuations of beams 3 and 4 are positively correlated. Because the fluctuations occur on all time scales, some fluctuations in the amplitude and phase of beam 3 should last long enough for the grating to respond and produce correlated amplitude fluctuations and anticorrelated phase fluctuations in beam 4.

Next, the beams 3 and 4 interfere after a beamsplitter to produce beam 5, which is squeezed. One can understand from a purely classical argument why a linear combination of beams 3 and 4 produces squeezing. For example, suppose beams 3 and 4 combine in phase to produce beam 5. Then their amplitude fluctuations should tend to add and their phase fluctuations should tend to cancel, thus squeezing the phase of beam 5 and antisqueezing its amplitude. On the other hand, suppose beams 3 and 4 combine $\pi$ out of phase to produce beam 5. Then their amplitude fluctuations tend to cancel and their phase fluctuations tend to add. In this case some of the "in phase" noise is squeezed into the other quadrature.

Preliminary measurements have been performed in our laboratory with the result of identifying the experimental problems and suggesting possible solutions. The project will be continued at Bucknell University.

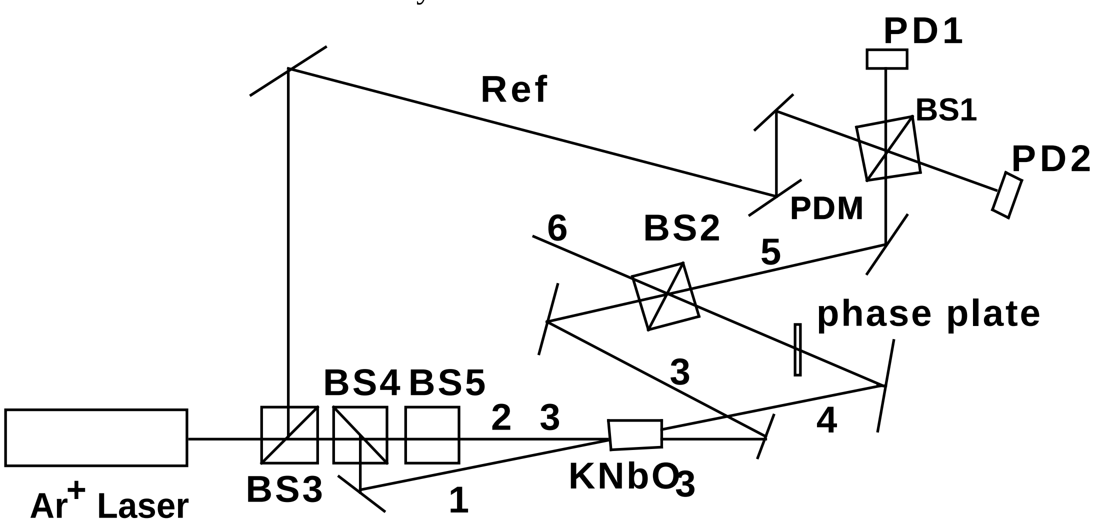


Fig. 5 Experimental set–up to photorefractively squeez light