We present a magnetometric sensor scheme, which uses a single laser for optical pumping, magnetic resonance (MR) excitation, and MR probing. MR is excited by the modulation of circularly polarized component of the beam, and detection is achieved in a quantum nondestructive manner by the linearly polarized component. This allows us to significantly simplify the Bell-Bloom scheme [1], while retaining its sensitivity [2].

A single beam is tuned to a frequency close to the \( F = \frac{1}{2} \leftrightarrow F' = \frac{1}{2} \) transitions of the \( S_{1/2} \) state of an alkali metal (in our work, we use Cs); this beam depletes the \( F = \frac{1}{2} \) level, and populates and strongly polarizes the \( F = \frac{3}{2} \) level, forming the stretched state. Therefore the \( \pi \)-component of the beam, which we use for probe, mainly detects the MR at a level from which it is detuned by \(~9\) GHz. This provides the appropriate conditions for nondestructive quantum detection; thus, we achieve near-optimal conditions for both pumping and probing. Fig.1 shows a version that uses high duty cycle pulse pumping, which makes it possible to further reduce the MR width.

References