A Prototype Instrument for Measuring SO_2 Using Laser Induced Fluorescence

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Sulfur dioxide (SO_2) is an Environmental Protection Agency (EPA) criteria air pollutant, and a dominant precursor to particulate matter both in the troposphere and in the stratosphere. Intentional releases of SO_2 in the stratosphere are being discussed as a potential climate mitigation strategy for the future. Measurements of SO_2 at ambient levels are challenging. Commercial fluorescence instrumentation lacks the precision for use in locations other than those that are highly polluted. At the same time, in polluted regions this measurement technique is affected by interferences from nitric oxide and aromatic compounds. Chemical ionization mass spectrometer (CIMS) techniques have been used to measure SO_2, but achieving the precision required for background measurements is still challenging. CIMS also has large space/weight/power requirements, and can be subject to complex ionization chemistry and chemical interferences (e.g. water). For these reasons, development of new SO_2 instrumentation with high precision and accuracy and capable of being operated on aircraft is desired.

We have constructed a custom fiber based tunable UV (217 nm) laser and used it to sensitively detect SO_2 using a prototype laser induced fluorescence instrument (LIF). The fiber laser approach has space/weight/power/complexity requirements that are all significant improvements over the previous dye laser approaches to the SO_2 LIF measurement technique, and will yield an aircraft deployable instrument. Here we will describe the instrument, and present initial measurement results and plans for aircraft testing.

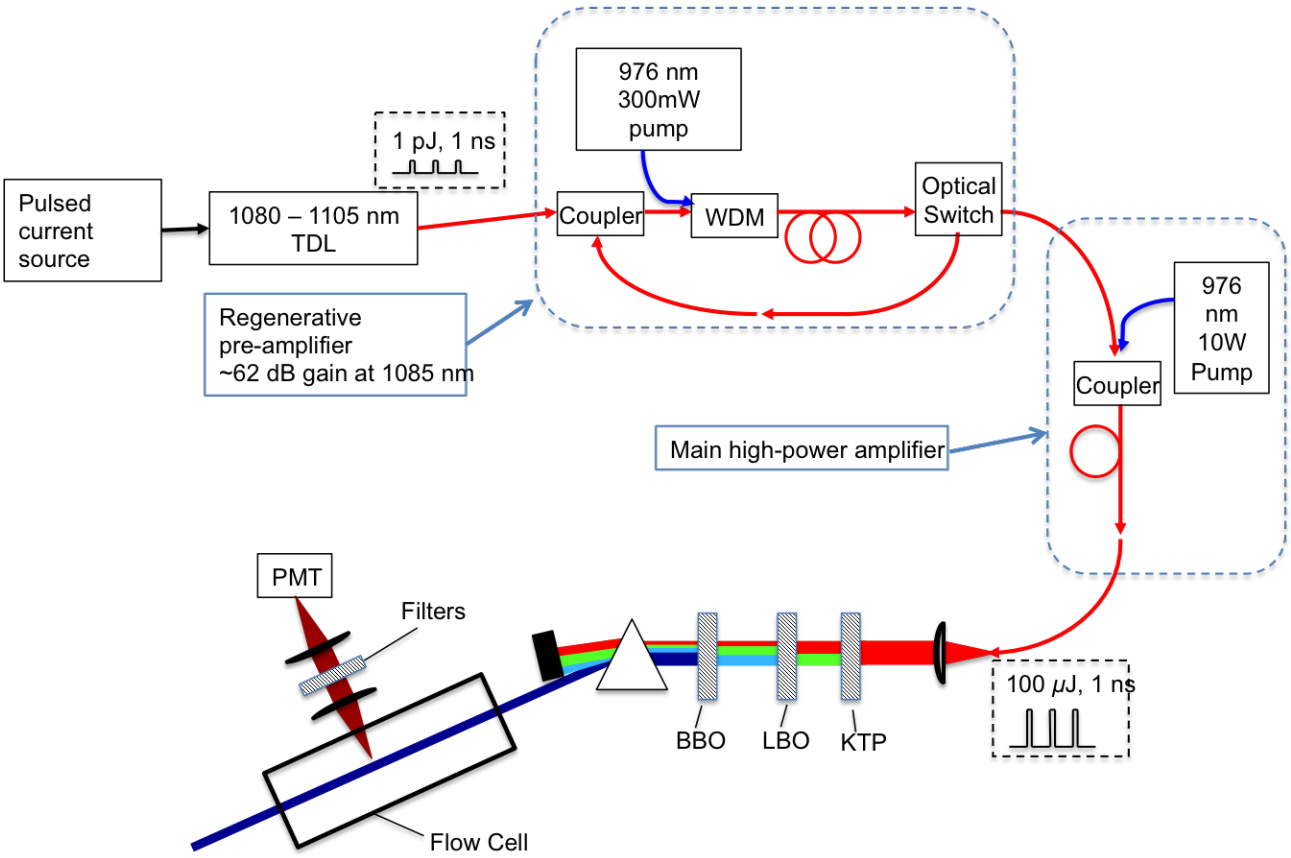

Figure 1. LIF instrument schematic