# Triple flames and flame stabilization

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## 1. Motivation and objectives

It is now well established that when turbulent jet flames are lifted, combustion begins, i.e., the flame is stabilized, at an axial station where the fuel and air are partially pre-mixed. One might expect, therefore, that the beginning of the combustion zone would be a triple flame. Such flames are described by G. R. Ruetsch, 1994. However, the recent experiments of Schefer *et al.* 1994a,b, together with the earlier work of Seitzman *et al.* 1990, provide data that are, so far, difficult to reconcile with the presence of triple flames. In particular, laser images of CH and OH, marking combustion zones, do not exhibit shapes typical of triple flames, and, more significantly, the lifted flame appears to have a propagation speed that is an order of magnitude higher than the laminar flame speed. The speed of triple flames studied thus far exceeds the laminar value by a factor less than two. The objective of the present task is the resolution of this apparent conflict between the experiments and the triple flame characteristics, and the clarification of the mechanisms controlling flame stability.

## 2. Accomplishments

So far, several possible explanations of the difficulty have been identified and are being investigated. These include:

(1) The resolution achieved in the experiments: is it sufficient to exhibit the structure of a triple flame?

(2) Is the flow field in the neighborhood of the stabilization point sufficiently close to that for which triple flames are known to exist?

(3) Can triple flames be generated that have higher propagation speeds?

(4) Does the unsteadiness of the laboratory flames introduce an essential new element into the problem?

(5) Are flame ignition limits essential in the calculation of triple flames that more closely resemble lifted flames?

Investigation of these points is underway.

## 3. Future work

The work on this project is in collaboration with G. R. Ruetsch, who is investigating structure of triple flames by direct numerical solution of the appropriate equations. Dr. Robert Schefer of the Combustion Research Facility, Sandia National Laboratories, Livermore, has generously agreed to provide more detailed data concerning his lifted flames and to discuss his plans for further experiments in this area.

Analysis of the results from these two projects should lead to a conclusion concerning the relevance of triple flames to the subject of flame stabilization.

## REFERENCES

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