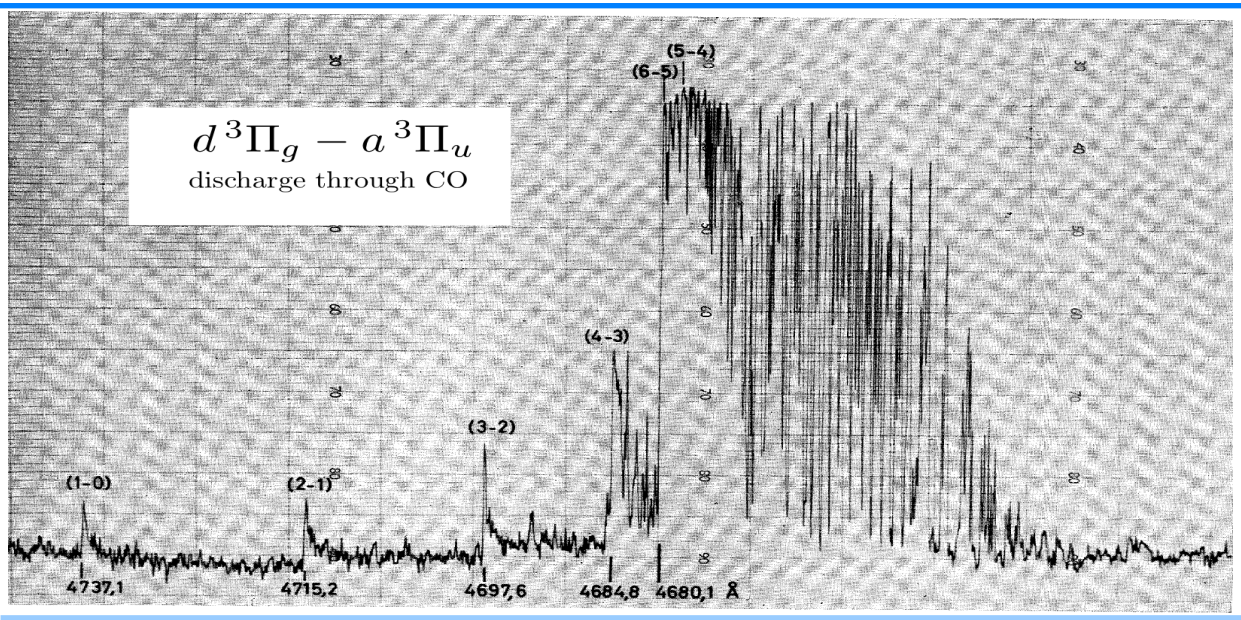
Shedding light on a dark state: The energetically lowest high-spin state of C_2

Introduction

- The C_2 chemistry is still unclear and its role in soot formation is not well established
- The visible spectrum (400-600 nm) of dicarbon is widely used in combustion and astronomy studies to characterize and test chemical mechanisms
- The molecule is often produced in emissive states from hydrocarbons that are irradiated or undergo exothermic reactions
- Spectroscopically dark states can be dynamically active and they can play an important role in energy flow processes governing intra and intermolcular redistribution

High-pressure bands

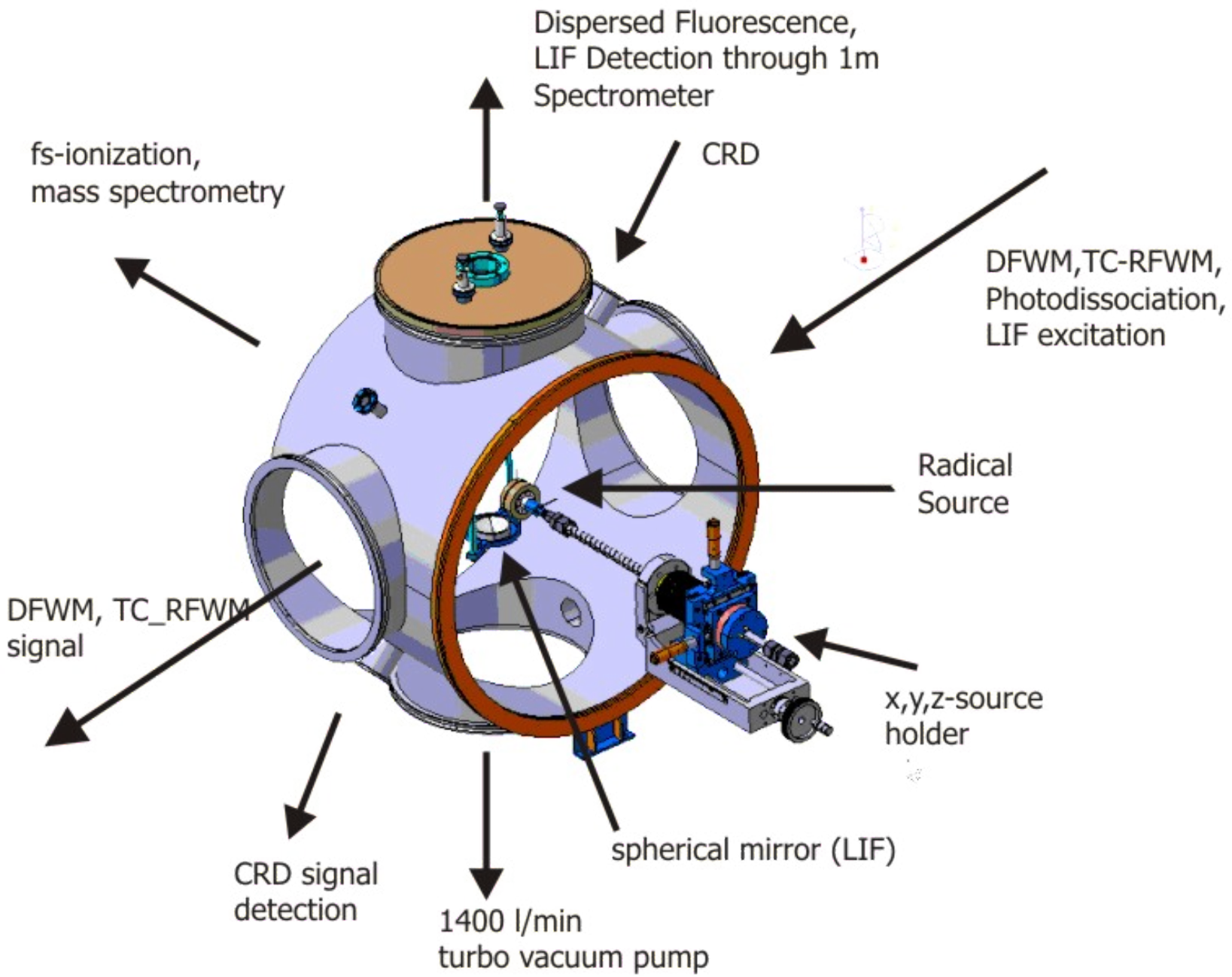


Example:

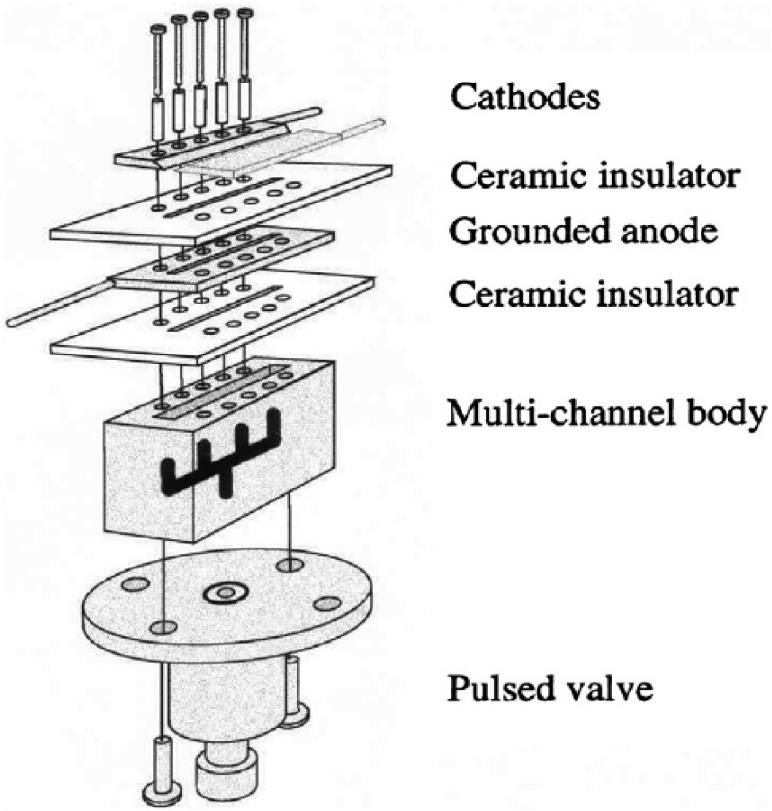
Dramatic increase in emission from v'=6

- 'High pressure' bands are observed since 1910
- In different environments: discharge, fast flow reactor, Na+CCl_4, laser carbon plasma etc.
- Origin is unclear, a 'dark' state is suspected
- This work: First experimental observation and characterization of the energetically lowest high-spin (dark) state of C_2: $^5\Pi_g$
- Method: Deperturbation studies by high-sensitive, double-resonant four-wave mixing in combination with a molecular beam/discharge source assembly

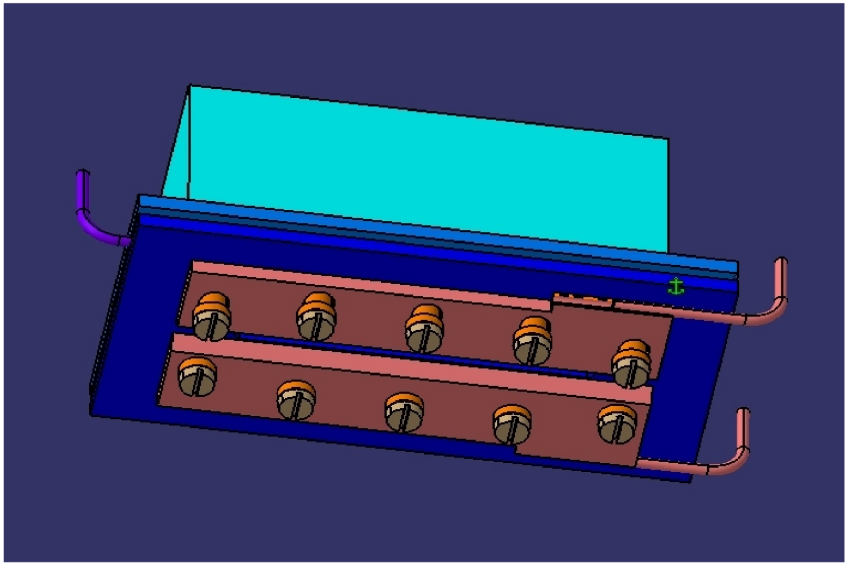
Molecular beam apparatus

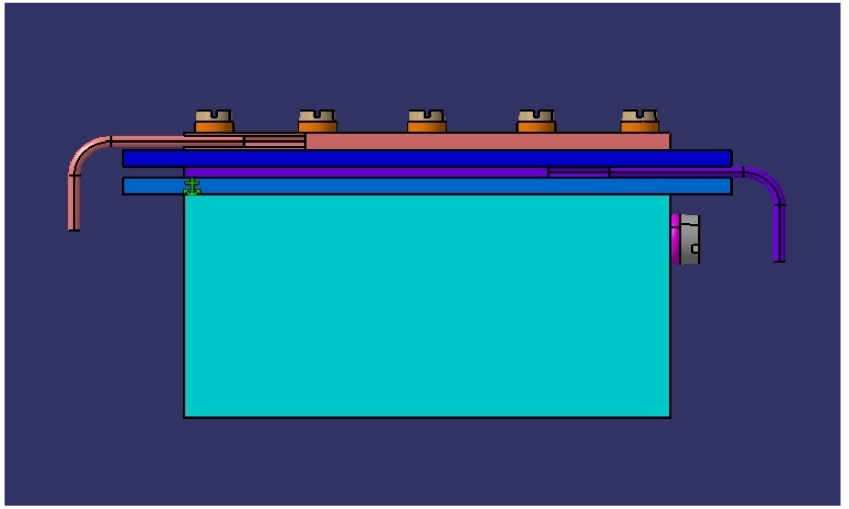


Discharge/Slit-Source

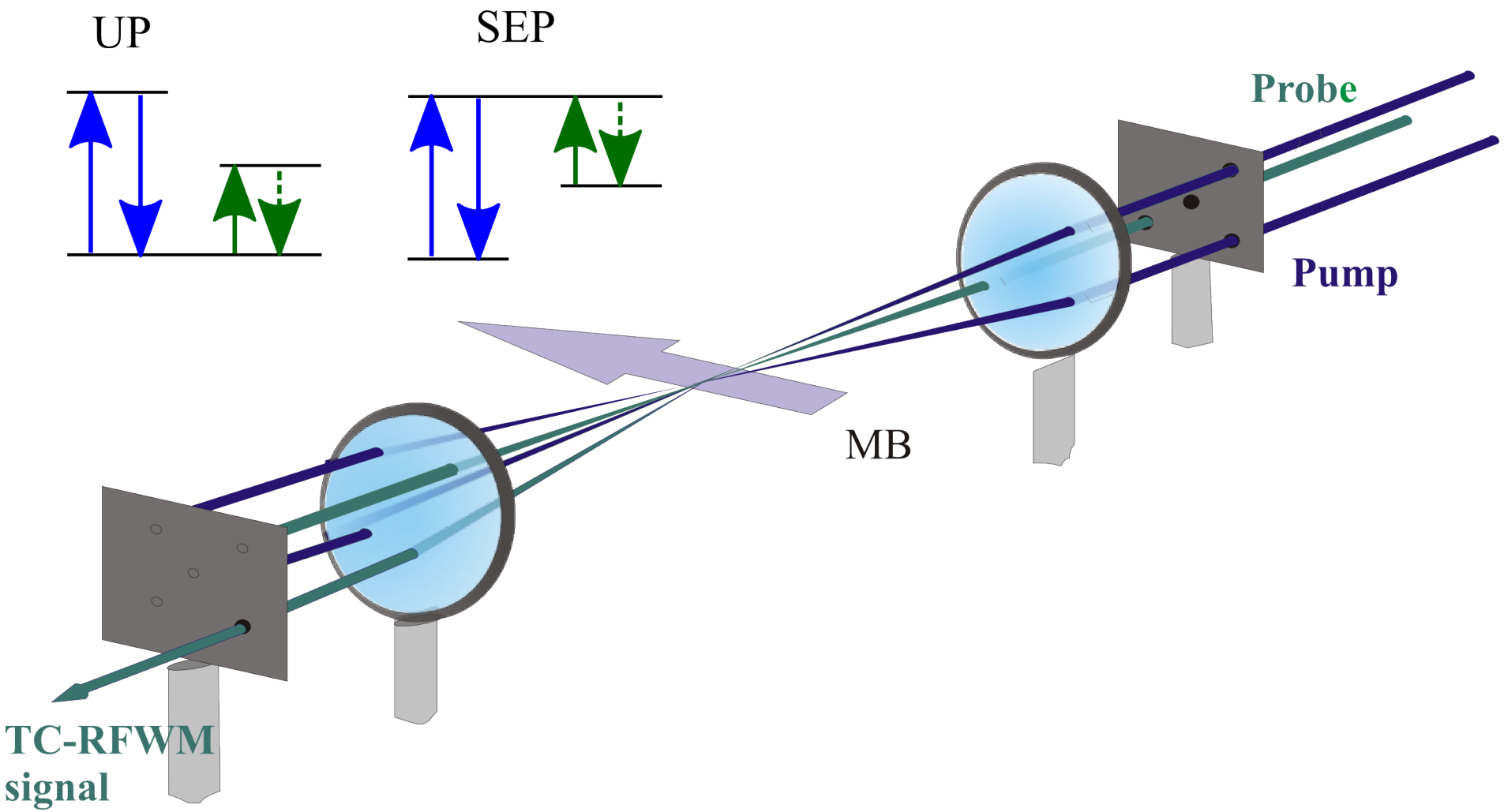


Linnartz, Physica Scripta 69(2004) C37

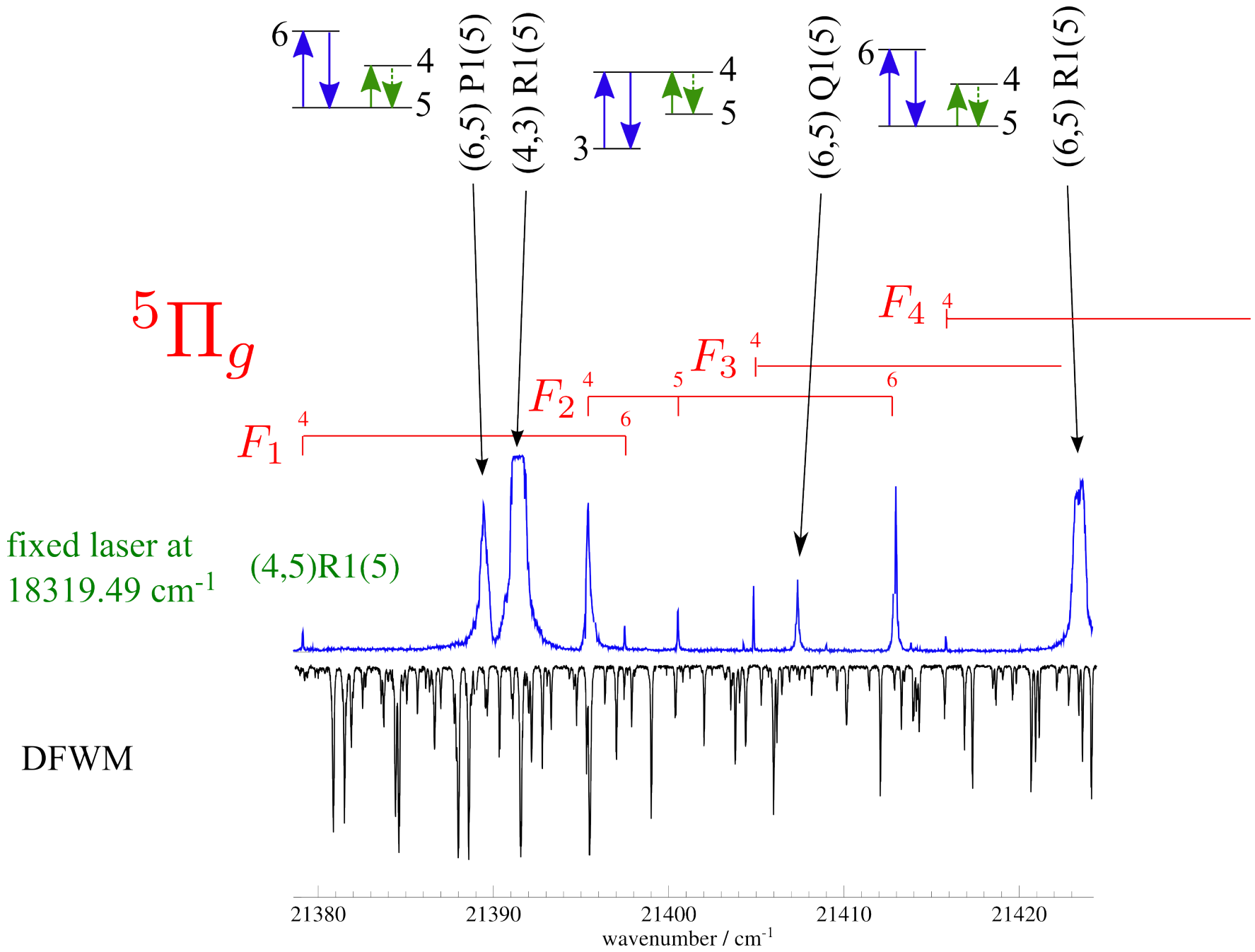




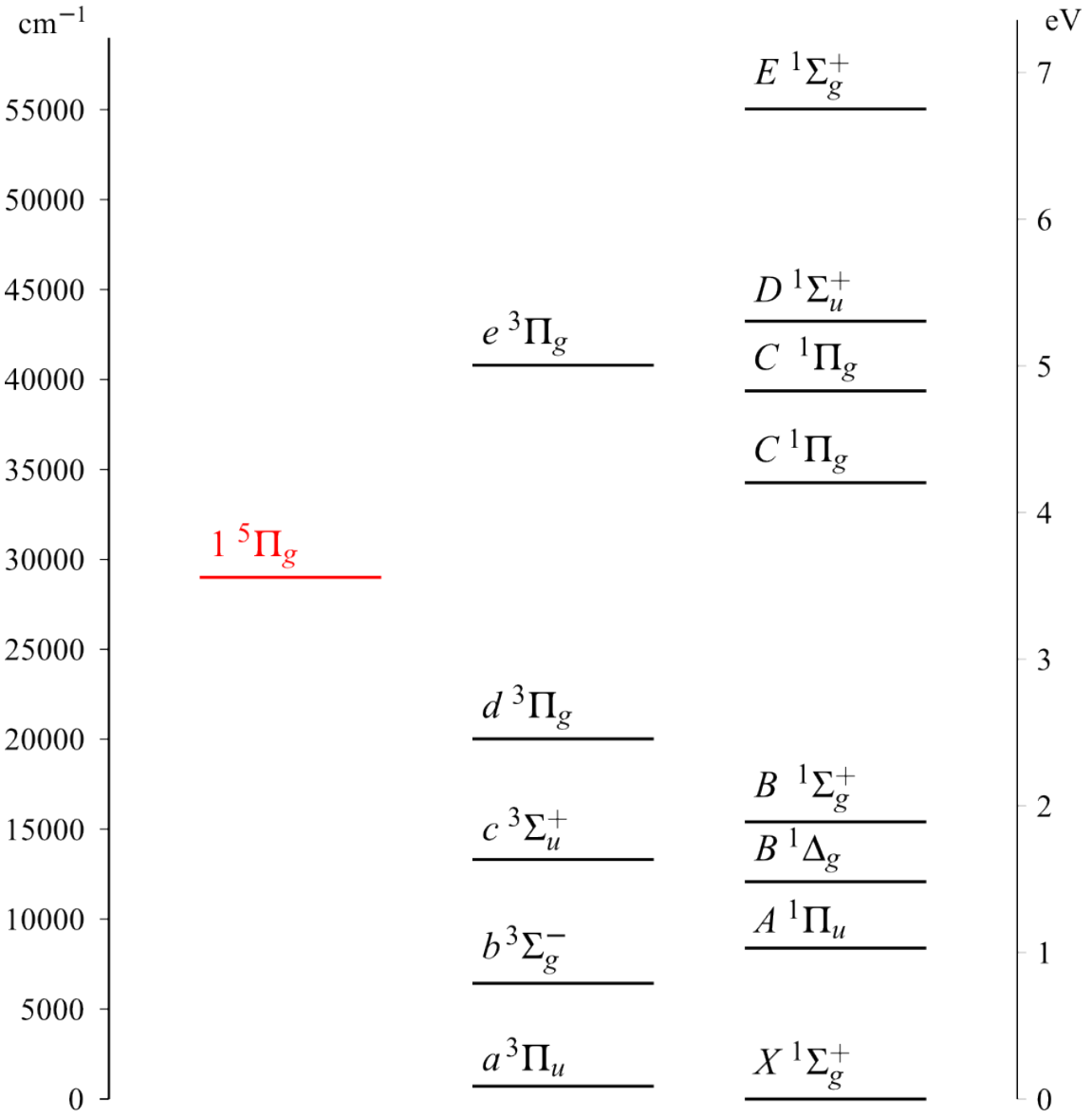
TC-RFWM setup



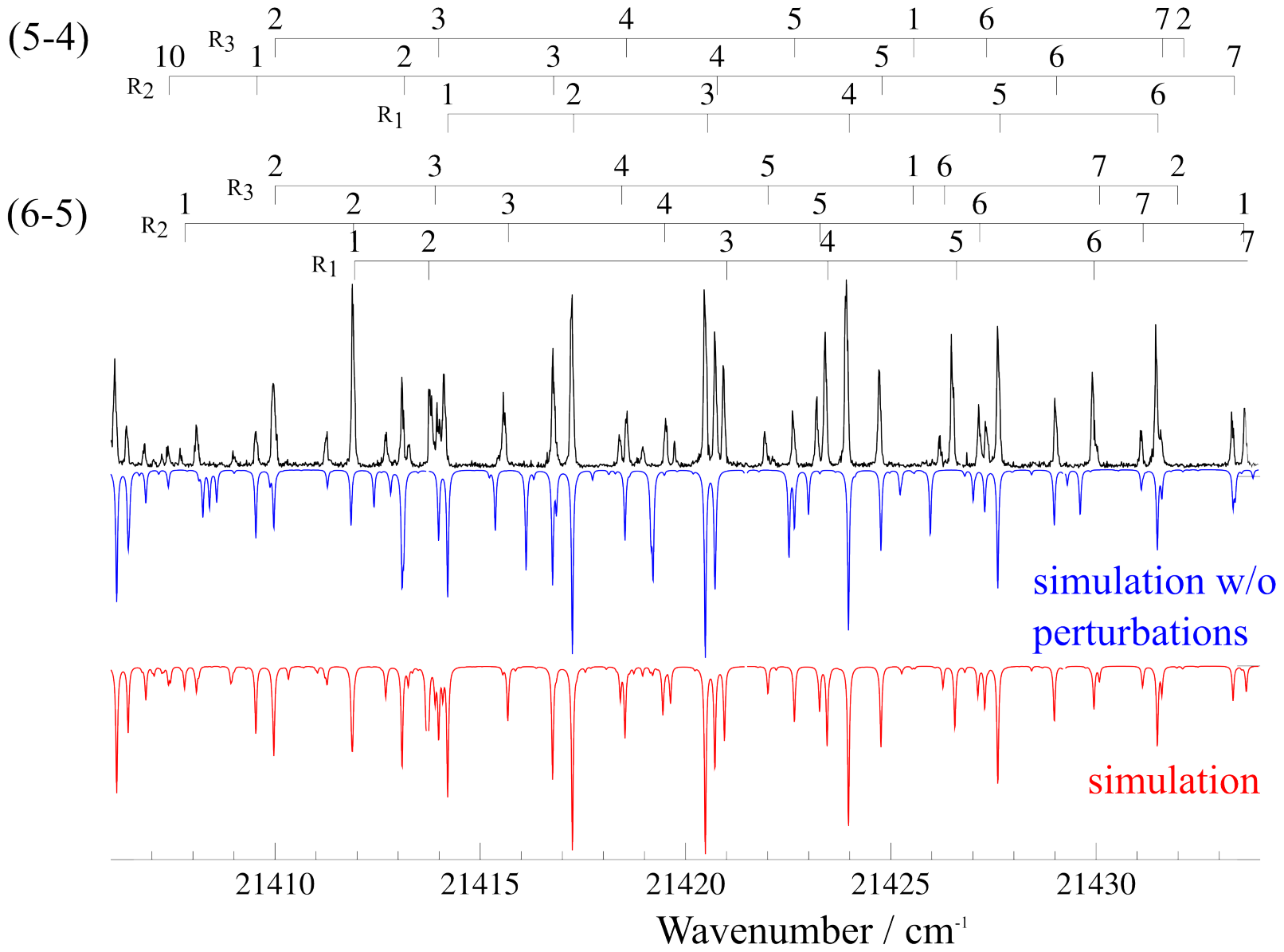
Perturbed transitions/dark states



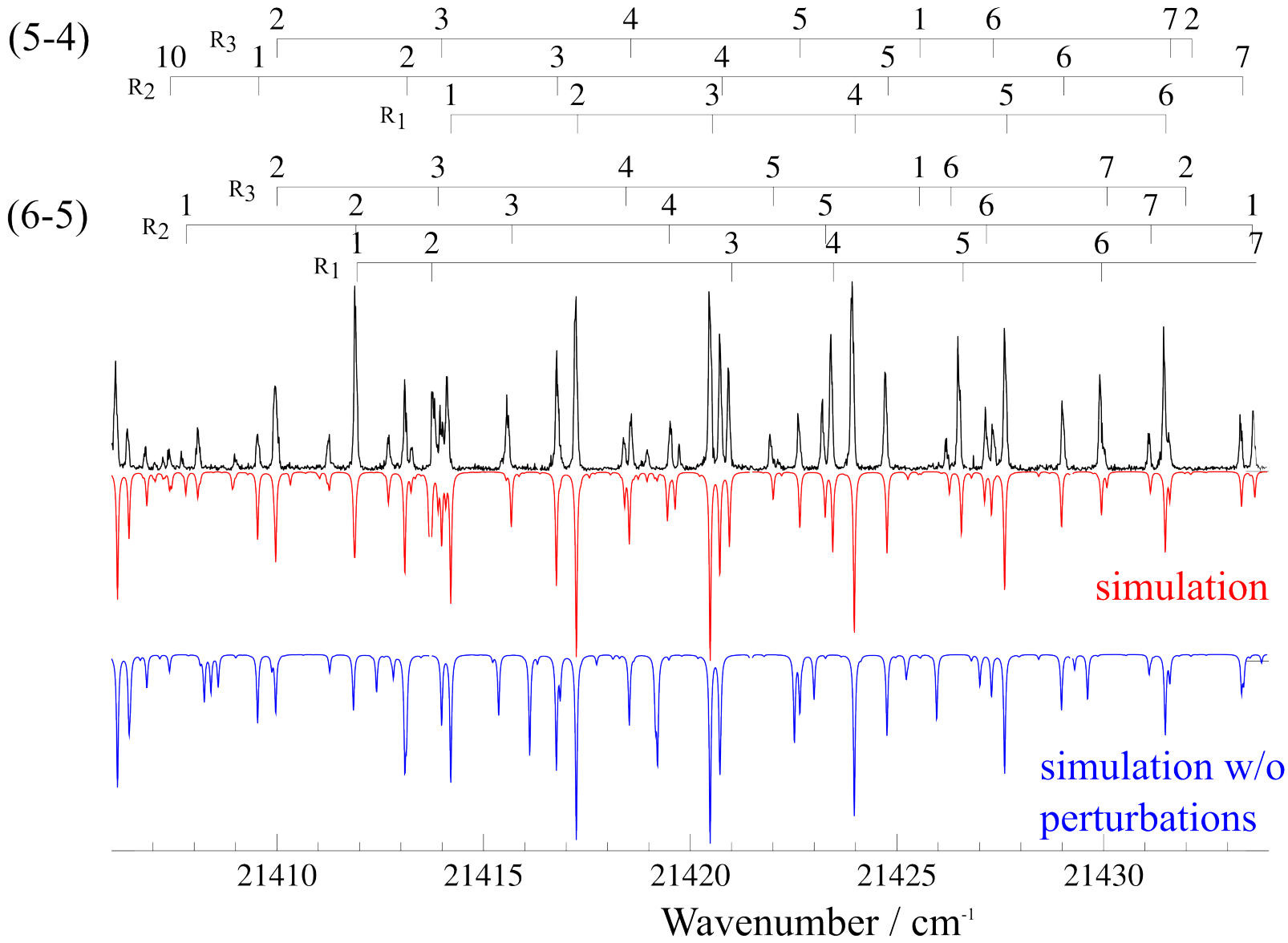
First experimental observation of a high-spin state of C_2



Deperturbed spectrum



Deperturbed spectrum



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