**Please describe your findings in an easy to understand way for a broad scientific audience?**

We have answered with our publication two fundamental questions in the controversial discussion on C2:

a) What is the bond multiplicity of C2? Answer: 2.8 based on Mayer bond orders (which are broadly accepted) and using the the best methods we have available currently (mutireference coupled cluster methods)

b) What is the intrinsic strength of C2? Answer: 2.4 according to a multireference coupled cluster description of the C2 stretching force constant.

Other researchers claim that C2 is a molecule with a quadruple bond. We cannot confirm this. It has unusual bonding in so far as its bonding is based on a pi-double bond augmented with some weak sigma bonding. But neither the bond multiplicity (measured by the bond order) nor the intrinsic bond strength support a bonding model based on a quadruple bond.

**What initiated your interest in C2?/Why is it important to know?**

C2 plays an important role in the catalyzed formation of fullerenes and carbonanotubes and is a frequent intermediate in combustion processes: The blue glow of hydrocarbon flames of Bunsen burners and gas hops results from C2.

Apart from this it has the peculiar property that its first excited state is just 2 kcal/mol above the ground state.

What bonding properties lead to its high reactivity and why have we failed to describe such a simple molecule in a way that its bonding is still controversially discussed? Applied quantum chemistry has been successfully used for the last 50 years and the bonding of diatomic molecules such as C2 should be solved in the past and no longer be a problem in the year 2016.

**Why do you think is this topic discussed controversially?**

Different aspects of chemical bonding are described in three following ways: i) By focusing on the bond multiplicity that is quantitatively assessed by the bond order. ii) By focusing on the bond dissociation energy that is a reaction parameter and reflects the ease of breaking a specific bond in a molecule and depends on both the strength of a bond **and all additional electronic effects increasing the stability of the reaction fragments**. iii) By focusing on the intrinsic strength of a bond which is reflected by its local stretching force constant.

A) C2 is discussed controversial because the three quantities ( bond multiplicity, bond dissociation energy, and intrinsic bond strength) are often used indiscriminately in the discussion without realizing hat different quantities are compared.

B) When carrying out highly accurate descriptions of C2, methods are used for which an accurate and generally accepted analysis of bond multiplicity, bond dissociation energy, or intrinsic bond strength are not available. This opens up the possibility of individual interpretations.

We avoided problems A) and B) by clearly distinguishing between the three quantities and by using established highly accurate methods for which a quantity such as the bond order or the local stretching force constant are well-defined.

We believe that discussions such as that one on the bonding in C2 help to improve and/or develop generally accepted analysis methods for which this has not been done so far.