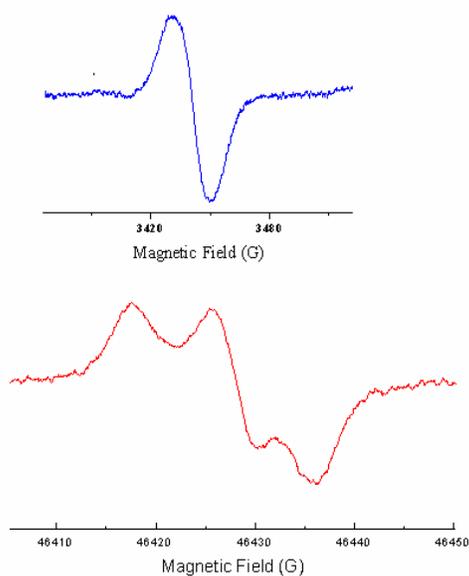


## The Electronic Structure of the Primary Chlorophyll Electron Donor in Green Plant Photosystem I

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New data reveal the electronic structure of the primary electron donor (of green plant photosystem I) that is involved in the ultimate photosynthetic oxygen production. The initial step in photosynthetic energy conversion is the absorption of light (excitation) by a chlorophyll pigment (known as  $P_{700}$ ) that is contained in a protein. Rapid electron transfer from  $P_{700}^*$  (\* indicates excited state) to nearby pigment molecules converts the trapped energy into a form in which it can drive the chemical reactions that change carbon dioxide into sugar. The electron transfer steps transform  $P_{700}^*$  into a species having one unpaired electron ( $P_{700}^{+\bullet}$ ). Much is known about the general features of these reactions. However, important details about the electronic structure of  $P_{700}^{+\bullet}$  and  $P_{700}^*$  remain controversial. In particular, there is uncertainty whether  $P_{700}^{+\bullet}$  consists of one or two chlorophyll molecules. We have obtained new data that shows that the electronic structure of  $P_{700}^{+\bullet}$  is different from that of monomeric chlorophyll *a*. This new information was revealed by studying the electron paramagnetic resonance spectra of  $P_{700}^{+\bullet}$  and  $TP_{700}^*$  (excited triplet state of  $P_{700}$ ) with high frequency (D-band) electron paramagnetic resonance (EPR) spectroscopy on deuterated photosynthetic proteins and pigments. The figure shows the enhanced spectral resolution obtained with high-frequency EPR compared to the spectra obtained previously with the more conventional lower frequency (X-band) EPR.



High-frequency EPR spectrum of the primary donor  $P_{700}^{+\bullet}$  cation radical in photosynthetic protein (bottom) demonstrate the increase of the spectral resolution compared to the conventional X-band EPR spectroscopy (top).