The structure of the simple, fundamental ethyl cation has finally been ascertained. Computational studies had long suggested the non-classical structure 1 for this cation. The classical structure 2 is a transition state for scrambling the protons. The MP2/6-311G(2d,p) geometries of both structures are shown in Figure 1.

Figure 1. MP2/6-311G(2d,f) structures of 1, 2, 1·Ar(C\textsubscript{2v}) and 1·Ar(C\textsubscript{s}).
Dopfer\textsuperscript{1} has now obtained IR spectrum of ethyl cation by single-photon IR photodissociation spectroscopy through the reaction

\[
\text{C}_2\text{H}_5^+ \cdot \text{Ar} + h\nu \rightarrow \text{C}_2\text{H}_5^+ + \text{Ar}
\]

Two structures of the ethyl cation associated with Ar were optimized at MP2/6-311G(2df,2pd). (The MP2/6-311G(2d,p) structures are shown in Figure 1.) Both of their computed IR spectra have stretches at nearly identical wavenumbers as for ethyl cation \textit{\textsuperscript{1} itself}. The experimental IR spectra has absorptions at 3317 and 3037 cm\textsuperscript{-1}, very close to the computed frequencies for \textit{\textsuperscript{1}Ar}(C\textsubscript{2v}). This provides strong experimental evidence that ethyl cation is in fact a non-classical ion.

\textbf{Source: http://comporgchem.com/blog/?p=60}