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Predicting and interpreting a doubly charged scalar candidate at the LHC

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Several indications for neutral scalars are observed at the LHC. One of them, a broad resonance peaked at about 650 GeV which we call H(650), was obtained by an outsider combining published histograms from ATLAS and CMS on ZZ $\rightarrow 4\ell$ searches, and this combination shows a local significance close to 4 s.d. Since then, CMS has reported two other indications at the same mass, with similar local significances: H $\rightarrow$WW $\rightarrow \ell\nu\ell\nu$ and H$\rightarrow$bbh125 where h125 $\rightarrow$??. ATLAS has completed its analysis of ZZ$\rightarrow 4\ell$ from which we infer an indication for H(650) with 3.5 s.d. significance. Assuming that the mass is already known from the former set, and combining these three results, one gets a global statistical significance of about 6 s.d. H(650) has a coupling to WW similar to h(125) and therefore we argue that a sum rule (SR) required by unitarity for WW implies that there should be a compensating effect from a doubly charged scalar H++, with a large coupling to W+W+. We therefore predict that this mode should become visible through the vector boson fusion process W+W+->H++, naturally provided by LHC. A recent indication for H++(450)->W+W+ from ATLAS allows a model independent interpretation of this result through the SR constraint which gives BR(H++->W+W+)~10%, implying the occurrence of additional modes H'+W+ and H'+H'+ from one or several light H'+ with masses below mH++ - mW or MH++/2, that is mH'+ < 370 GeV or 225 GeV. A similar analysis is provided for H+(375)->ZW, indicated by ATLAS and CMS. Both channels suggest a scalar field content similar to the Georgi Machacek model with triplets, at variance with the models usually considered.

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