From the discovery of direct-single-$e^{\pm}$ from charm in 1974 to a fundamental test of the Higgs Yukawa coupling in Heavy Ion Collisions[1] MICHAEL TANNENBAUM, Brookhaven National Laboratory — Searches for the intermediate boson, $W^{\pm}$, the heavy quantum of the Weak Interaction, via its semi-leptonic decay, $W \to e + \nu$, in the 1970's instead discovered unexpectedly large hadron production at high p_T, notably π^0, which provided a huge background of $e^{\pm}$ from internal and external conversions. Methods developed at the CERN ISR led to the discovery of direct-single-$e^{\pm}$ in 1974, later determined to be from the semi-leptonic decay of charm which had not yet been discovered. The same methods—i) $\geq 10^5$ charged hadron rejection; ii) minimum of material in the aperture to avoid external conversions; iii) zero magnetic field on the axis to avoid de-correlating conversion pairs; iv) precision measurement of π^0 and η, the predominant background source; v) precision background determination in the direct-single-$e^{\pm}$ signal channel by adding external converter—were used at RHIC to make precision measurements of heavy quark production in p-p and Au+Au collisions, leading to the puzzle of apparent equal suppression of light and heavy quarks in the QGP. If the Higgs mechanism gives mass to gauge bosons but not to fermions, then a proposal that all 6 quarks are nearly massless in a QGP, which would resolve the puzzle, can not be excluded. This proposal can be tested with future measurements.

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