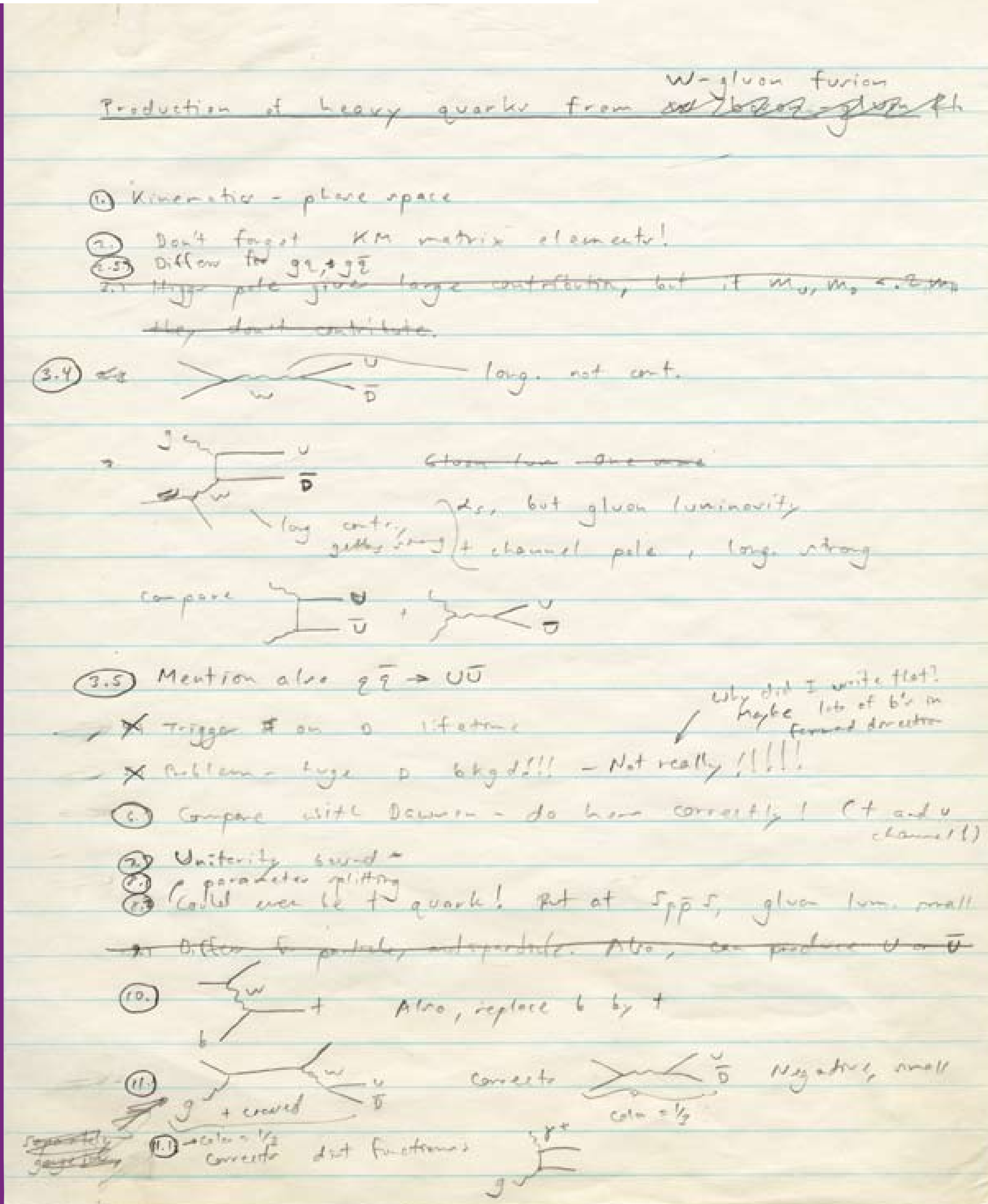
logbook: single top production


Production of heavy quarks from W-gluon fusion

(1.) Kinematics - phase space
(2.) Don't forget KM matrix elements!
(2.5) Differ for qq, $q\bar{q}$
~~(3.) Higgs pole gives large contribution, but if M_U, M_D < ... they don't contribute.~~
(3.4) long. not cont.
~~Gluon fus...~~
ds, but gluon luminosity
long contr. ... t channel pole, long. strong
compare
(3.5) Mention also $q\bar{q} \to U\bar{U}$
~~Trigger # on D lifetime~~ — Why did I write that? Maybe lots of b's in forward direction
~~Problem - large D bkgd!!!~~ - Not really !!!!
(6.) Compare with Dawson - do her correctly! (t and u channel!)
(7.) Unitarity bound
(8.) parameter splitting
(9.) Could even be t quark! But at $Sp\bar{p}S$, gluon lum. small
~~Differ for particle, antiparticle. Also, can produce U or $\bar{U}$~~
(10.) Also, replace b by t
(11.) + crossed — Corrects — Negative, small — Color = 1/3
(11.1) Color = 1/3 corrects dist functions — Separately gauge inv.

Document courtesy of Scott Willenbrock

In 1985, ten years before scientists at Fermilab discovered the top quark, Scott Willenbrock was a graduate student at the University of Texas at Austin. He and Duane Dicus were wondering how likely it would be for a particle collider such as the Fermilab Tevatron to produce a single heavy quark. Willenbrock remembers that the eureka moment came when he was sitting in a UTexas shuttle bus on his way home. There he realized that a subatomic process called "*W*-gluon fusion" could lead to a single heavy quark. To outline the calculation, Willenbrock made this to-do list and included the remark, "Could even be *t* quark!"

"Back then we were thinking about a hypothetical fourth generation of quarks [labeled U,D in the list]," says Willenbrock, now a professor at the University of Illinois at Urbana-Champaign. "Physicists had no idea how heavy the [third-generation] top was, and we didn't know whether this calculation would be relevant to the top."

In 1995, the CDF and DZero experiments at Fermilab observed top quarks for the first time, produced in pairs via the strong nuclear force. The particle was so heavy that scientists began to search for single top quark production as well. In December 2006, about twenty-one years after Dicus and Willenbrock published their predictions, the DZero collaboration reported the first evidence for single top production at the Tevatron.

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