Physics 686 **Homework 5** **Due March 24, 2004**

<u>Problem 1.</u> Consider the limit that the gauginos of the MSSM are massive, but unmixed states. (This is actually not a bad approximation in many models.) Also suppose that the squarks and sleptons are massive but unmixed (this is usually not a bad approximation either, except for the stops, sbottoms, and staus). Draw *all* tree-level partonic Feynman diagrams for each of the following processes at the Tevatron, or an e^+e^- collider. (Note that the *parton-level* diagrams would be the same for the LHC as for the Tevatron.) Take into account all interactions of gauge-coupling strength, but ignore superpotential couplings. You may want to start by drawing all of the relevant Feynman rules. Do not try to compute cross-sections for any of these processes, but label each interaction vertex by the corresponding gauge couplings, and each internal and external line by the corresponding particle(s).

(a)	$p\overline{p} \to \tilde{W}^+\tilde{W}^-$	(b)	$p\overline{p} \to \tilde{W}^+\tilde{W}^0$
(c)	$p\overline{p} \to \tilde{W}^0\tilde{B}^0$	(d)	$p\overline{p} \to \tilde{W}^+\tilde{B}^0$
(e)	$p\overline{p} \to \tilde{B}^0\tilde{B}^0$	(f)	$e^+e^- \to \tilde{W}^+\tilde{W}^-$
(g)	$e^+e^- \to \tilde{W}^0\tilde{W}^0$	(h)	$e^+e^- \to \tilde{B}^0\tilde{B}^0$
(i)	$p\overline{p} \to \tilde{g}\tilde{g}$	(j)	$p\overline{p} \to \tilde{u}_L\tilde{u}_L^*$
(k)	$p\overline{p} \to \tilde{u}_L\tilde{d}_L^*$	(l)	$p\overline{p} \to \tilde{u}_L\tilde{u}_R^*$
(m)	$p\overline{p} \to \tilde{u}_L\tilde{d}_R^*$	(n)	$p\overline{p} \to \tilde{e}_L\tilde{e}_L^*$
(o)	$p\overline{p} \to \tilde{e}_R\tilde{e}_R^*$	(p)	$p\overline{p} \to \tilde{\nu}_e\tilde{\nu}_e^*$
(q)	$e^+e^- \to \tilde{u}_L\tilde{u}_L^*$	(r)	$e^+e^- \to \tilde{u}_L\tilde{u}_R^*$
(s)	$e^+e^- \to \tilde{e}_L\tilde{e}_L^*$	(t)	$e^+e^- \to \tilde{e}_R\tilde{e}_R^*$
(u)	$e^+e^- \to \tilde{\nu}_e\tilde{\nu}_e^*$	(v)	$p\overline{p} \to \tilde{u}_L\tilde{g}$
(w)	$p\overline{p} \to \tilde{W}^+\tilde{g}$	(x)	$e^+e^- \to \tilde{g}\tilde{g}$

[Hint: exactly two of the processes above have NO tree-level contribution, within the stated approximation.]

(y) There is a proposal to run a linear collider in a mode where it collides electrons (rather than e^+e^-). What are all the possible tree-level processes $e^-e^- \to X$, where X consists of two superpartners, using the same assumptions as above?