MONOPOLES, SUPERSYMMETRY, COMPOSITENESS, etc., SEARCHES FOR

Magnetic Monopole Searches

Isolated candidate events have not been confirmed. Most experiments obtain negative results.

Supersymmetric Particle Searches

Limits are based on the Minimal Supersymmetric Standard Model.

Assumptions include: 1) $\widetilde{\chi}_1^0$ (or $\widetilde{\gamma}$) is lightest supersymmetric particle; 2) R-parity is conserved; 3) $m_{\widetilde{f}_L} = m_{\widetilde{f}_R}$, and all scalar quarks (except $\widetilde{t}_L$ and $\widetilde{t}_R$) are degenerate in mass.

See the Particle Listings for a Note giving details of supersymmetry.

$\widetilde{\chi}_i^0$ — neutralinos (mixtures of $\widetilde{\gamma}$, $\widetilde{Z}^0$, and $\widetilde{H}_i^0$)

Mass $m_{\widetilde{\gamma}} > 15$ GeV, CL = 90% [if $m_{\widetilde{f}} = 100$ GeV (from cosmology)]

Mass $m_{\widetilde{\chi}_1^0} > 23$ GeV, CL = 95% [$\tan\beta > 3$]

Mass $m_{\widetilde{\chi}_2^0} > 52$ GeV, CL = 95% [$\tan\beta > 3$]

Mass $m_{\widetilde{\chi}_3^0} > 84$ GeV, CL = 95% [$\tan\beta > 3$]

Mass $m_{\widetilde{\chi}_4^0} > 127$ GeV, CL = 95% [$\tan\beta > 3$]

$\widetilde{\chi}_i^\pm$ — charginos (mixtures of $\widetilde{W}^\pm$ and $\widetilde{H}_i^\pm$)

Mass $m_{\widetilde{\chi}_1^\pm} > 45$ GeV, CL = 95% [all $m_{\widetilde{\chi}_1^0}$]

Mass $m_{\widetilde{\chi}_2^\pm} > 99$ GeV, CL = 95% [GUT relations assumed]

$\widetilde{\nu}$ — scalar neutrino (sneutrino)

Mass $m > 37.1$ GeV, CL = 95% [one flavor]

Mass $m > 41.8$ GeV, CL = 95% [three degenerate flavors]

$\widetilde{e}$ — scalar electron (selectron)

Mass $m > 65$ GeV, CL = 95% [if $m_{\widetilde{\gamma}} = 0$]

Mass $m > 50$ GeV, CL = 95% [if $m_{\widetilde{\gamma}} < 5$ GeV]

Mass $m > 45$ GeV, CL = 95% [if $m_{\widetilde{\chi}_1^0} < 41$ GeV]

$\widetilde{\mu}$ — scalar muon (smuon)

Mass $m >$ 45 GeV, CL = 95% [if $m_{\widetilde{\chi}^0_1} < 41$ GeV]

$\widetilde{\tau}$ — scalar tau (stau)

Mass $m >$ 45 GeV, CL = 95% [if $m_{\widetilde{\chi}^0_1} < 38$ GeV]

$\widetilde{q}$ — scalar quark (squark)

These limits include the effects of cascade decays, evaluated assuming a fixed value of the parameters μ and $\tan\beta$. The limits are weakly sensitive to these parameters over much of parameter space. Limits assume GUT relations between gaugino masses and the gauge coupling; in particular that for $|\mu|$ not small, $m_{\widetilde{\chi}^0_1} \approx m_{\widetilde{g}}/6$.

Mass $m >$ 176 GeV, CL = 95% [any $m_{\widetilde{g}}$ <300 GeV, $\mu = -250$ GeV, $\tan\beta = 2$]

Mass $m >$ 224 GeV, CL = 95% [$m_{\widetilde{g}} \leq m_{\widetilde{q}}$, $\mu = -400$ GeV, $\tan\beta = 4$]

$\widetilde{g}$ — gluino

There is some controversy about a low-mass window ($1 \lesssim m_{\widetilde{g}} \lesssim 4$ GeV). Several experiments cast doubt on the existence of this window.

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Mass $m >$ 154 GeV, CL = 95% [$m_{\widetilde{g}} \leq m_{\widetilde{q}}$, $\mu = -400$ GeV, $\tan\beta = 4$]

Mass $m >$ 212 GeV, CL = 95% [$m_{\widetilde{g}} \geq m_{\widetilde{q}}$, $\mu = -250$ GeV, $\tan\beta = 2$]

Quark and Lepton Compositeness, Searches for

Scale Limits Λ for Contact Interactions (the lowest dimensional interactions with four fermions)

If the Lagrangian has the form

$$\pm \frac{g^2}{2\Lambda^2}\, \overline{\psi}_L \gamma_\mu \psi_L \overline{\psi}_L \gamma^\mu \psi_L$$

(with $g^2/4\pi$ set equal to 1), then we define $\Lambda \equiv \Lambda^{\pm}_{LL}$. For the full definitions and for other forms, see the Note in the Listings on Searches for Quark and Lepton Compositeness in the full *Review* and the original literature.

$\Lambda^{+}_{LL}(eeee)$	$>$	1.6 TeV, CL = 95%
$\Lambda^{-}_{LL}(eeee)$	$>$	3.6 TeV, CL = 95%
$\Lambda^{+}_{LL}(ee\mu\mu)$	$>$	2.6 TeV, CL = 95%
$\Lambda^{-}_{LL}(ee\mu\mu)$	$>$	1.9 TeV, CL = 95%
$\Lambda^{+}_{LL}(ee\tau\tau)$	$>$	1.9 TeV, CL = 95%
$\Lambda^{-}_{LL}(ee\tau\tau)$	$>$	2.9 TeV, CL = 95%
$\Lambda^{+}_{LL}(\ell\ell\ell\ell)$	$>$	3.5 TeV, CL = 95%
$\Lambda^{-}_{LL}(\ell\ell\ell\ell)$	$>$	2.8 TeV, CL = 95%
$\Lambda^{+}_{LL}(eeqq)$	$>$	2.3 TeV, CL = 95%
$\Lambda^{-}_{LL}(eeqq)$	$>$	2.2 TeV, CL = 95%
$\Lambda^{+}_{LL}(\mu\mu qq)$	$>$	1.4 TeV, CL = 95%
$\Lambda^{-}_{LL}(\mu\mu qq)$	$>$	1.6 TeV, CL = 95%
$\Lambda^{\pm}_{LR}(\nu_\mu \nu_e \mu e)$	$>$	3.1 TeV, CL = 90%
$\Lambda^{\pm}_{LL}(qqqq)$	$>$	1.4 TeV, CL = 95%

Recent CDF measurements of the inclusive jet cross section in $p\overline{p}$ collisions could be interpreted as tentative evidence for a four-quark contact interaction with $\Lambda^{\pm}_{LL}\,(qqqq) \sim 1.6$ TeV. However, CDF notes that uncertainty in the parton distribution functions, higher-order QCD corrections, and detector calibration may possibly account for the effect.

Excited Leptons

The limits from $\ell^{*+}\,\ell^{*-}$ do not depend on λ (where λ is the $\ell\,\ell^*$ transition coupling). The λ-dependent limits assume chiral coupling, except for the third limit for e^* which is for nonchiral coupling. For chiral coupling, this limit corresponds to $\lambda_\gamma = \sqrt{2}$.

$e^{*\pm}$ — excited electron

Mass $m >$ 46.1 GeV, CL = 95% (from $e^{*+}\,e^{*-}$)
Mass $m >$ 91 GeV, CL = 95% (if $\lambda_Z > 1$)
Mass $m >$ 146 GeV, CL = 95% (if $\lambda_\gamma = 1$)

$\mu^{*\pm}$ — excited muon

Mass $m >$ 46.1 GeV, CL = 95% (from $\mu^{*+}\,\mu^{*-}$)
Mass $m >$ 91 GeV, CL = 95% (if $\lambda_Z > 1$)

$\tau^{*\pm}$ — excited tau

Mass $m >$ 46.0 GeV, CL = 95% (from $\tau^{*+}\,\tau^{*-}$)
Mass $m >$ 90 GeV, CL = 95% (if $\lambda_Z > 0.18$)

ν^* — excited neutrino

Mass $m >$ 47 GeV, CL = 95% (from $\nu^*\,\overline{\nu}^*$)
Mass $m >$ 91 GeV, CL = 95% (if $\lambda_Z > 1$)

q^* — excited quark

Mass $m >$ 45.6 GeV, CL = 95% (from $q^*\,\overline{q}^*$)
Mass $m >$ 88 GeV, CL = 95% (if $\lambda_Z > 1$)
Mass $m >$ 570 GeV, CL = 95% ($p\,\overline{p} \rightarrow\ q^*\,X$)

Color Sextet and Octet Particles

Color Sextet Quarks (q_6)

Mass $m >$ 84 GeV, CL = 95% (Stable q_6)

Color Octet Charged Leptons (ℓ_8)

Mass $m >$ 86 GeV, CL = 95% (Stable ℓ_8)

Color Octet Neutrinos (ν_8)

Mass $m >$ 110 GeV, CL = 90% ($\nu_8 \rightarrow\ \nu\,g$)