SEARCHES FOR MONOPOLES, SUPERSYMMETRY, TECHNICOLOR, COMPOSITENESS, etc.

Magnetic Monopole Searches

Isolated supermassive monopole candidate events have not been confirmed. The most sensitive experiments obtain negative results.

Best cosmic-ray supermassive monopole flux limit:

$< 1.0 \times 10^{-15}$ cm^{-2}sr^{-1}s^{-1} for $1.1 \times 10^{-4} < \beta < 0.1$

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) With the excepton of $\widetilde{t}$ and $\widetilde{b}$, all scalar quarks are assumed to be degenerate in mass and $m_{\widetilde{q}_R} = m_{\widetilde{q}_L}$. 4) Limits for sleptons refer to the $\widetilde{\ell}_R$ states.

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 $m_{\widetilde{\chi}_1^0} > 32.5$ GeV, CL = 95%
[$\tan\beta > 0.7$, $m_{\widetilde{\chi}_2^0} - m_{\widetilde{\chi}_1^0} > 5$ GeV]

Mass $m_{\widetilde{\chi}_2^0} > 55.9$ GeV, CL = 95%
[$\tan\beta > 1.5$, $m_{\widetilde{\chi}_2^0} - m_{\widetilde{\chi}_1^0} > 10$ GeV]

Mass $m_{\widetilde{\chi}_3^0} > 106.6$ GeV, CL = 95%
[$\tan\beta > 1.5$, $m_{\widetilde{\chi}_2^0} - m_{\widetilde{\chi}_1^0} > 10$ GeV]

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

Mass $m_{\widetilde{\chi}_1^\pm} > 67.7$ GeV, CL = 95%
[$\tan\beta > 0.7$, $m_{\widetilde{\chi}_1^\pm} - m_{\widetilde{\chi}_1^0} > 3$ GeV]

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

Mass $m >$ 87.1 GeV, CL = 95% [$m_{\widetilde{e}_R} - m_{\widetilde{\chi}_1^0} > 5$ GeV]

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

Mass $m >$ 82.3 GeV, CL = 95% [$m_{\widetilde{\mu}_R} - m_{\widetilde{\chi}_1^0} > 3$ GeV]

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

Mass $m >$ 81.0 GeV, CL = 95% [$m_{\widetilde{\tau}_R} - m_{\widetilde{\chi}_1^0} > 8$ 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.

Mass $m >$ 250 GeV, CL = 95% [$\tan\beta = 2$, $\mu < 0$, $A = 0$]

$\widetilde{b}$ — scalar bottom (sbottom)

Mass m none 40–75 GeV, CL = 95%
[$\widetilde{b} \to b\widetilde{\chi}_1^0$, all θ_b, $m_{\widetilde{b}} - m_{\widetilde{\chi}_1^0} > 10$ GeV]

$\widetilde{t}$ — scalar top (stop)

Mass $m >$ 86.4 GeV, CL = 95%
[$\widetilde{t} \to t\widetilde{\chi}_1^0$, all θ_t, $m_{\widetilde{t}} - m_{\widetilde{\chi}_1^0} > 5$ GeV]

$\widetilde{g}$ — gluino

There is some controversy on whether gluinos in a low-mass window ($1 \lesssim m_{\widetilde{g}} \lesssim 5$ GeV) are excluded or not. See the Supersymmetry Listings for details.

The limits summarised here refere to the high-mass region ($m_{\widetilde{g}} \gtrsim 5$ GeV), and 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,

Mass $m >$ 190 GeV, CL = 95% [$\tan\beta = 2$, $\mu < 0$, $A = 0$]
Mass $m >$ 260 GeV, CL = 95% [$m_{\widetilde{q}} = m_{\widetilde{g}}$, $\tan\beta = 2$, $\mu < 0$, $A = 0$]

Technicolor

Searches for a color-octet techni-ρ constrain its mass to be greater than 260 to 480 GeV, depending on allowed decay channels. Similar bounds exist on the color-octet techni-ω.

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.

$\Lambda^{+}_{LL}(e\,e\,e\,e)$	$>$ 3.5 TeV, CL = 95%
$\Lambda^{-}_{LL}(e\,e\,e\,e)$	$>$ 3.8 TeV, CL = 95%
$\Lambda^{+}_{LL}(e\,e\,\mu\,\mu)$	$>$ 4.5 TeV, CL = 95%
$\Lambda^{-}_{LL}(e\,e\,\mu\,\mu)$	$>$ 4.7 TeV, CL = 95%
$\Lambda^{+}_{LL}(e\,e\,\tau\,\tau)$	$>$ 3.9 TeV, CL = 95%
$\Lambda^{-}_{LL}(e\,e\,\tau\,\tau)$	$>$ 4.0 TeV, CL = 95%
$\Lambda^{+}_{LL}(\ell\ell\ell\ell)$	$>$ 5.3 TeV, CL = 95%
$\Lambda^{-}_{LL}(\ell\ell\ell\ell)$	$>$ 5.5 TeV, CL = 95%
$\Lambda^{+}_{LL}(e\,e\,q\,q)$	$>$ 5.4 TeV, CL = 95%
$\Lambda^{-}_{LL}(e\,e\,q\,q)$	$>$ 6.2 TeV, CL = 95%
$\Lambda^{+}_{LL}(e\,e\,b\,b)$	$>$ 5.6 TeV, CL = 95%
$\Lambda^{-}_{LL}(e\,e\,b\,b)$	$>$ 4.9 TeV, CL = 95%
$\Lambda^{+}_{LL}(\mu\,\mu\,q\,q)$	$>$ 2.9 TeV, CL = 95%
$\Lambda^{-}_{LL}(\mu\,\mu\,q\,q)$	$>$ 4.2 TeV, CL = 95%
$\Lambda^{\pm}_{LR}(\nu_\mu\,\nu_e\,\mu\,e)$	$>$ 3.1 TeV, CL = 90%
$\Lambda^{+}_{LL}(q\,q\,q\,q)$	$>$ 2.7 TeV, CL = 95%
$\Lambda^{-}_{LL}(q\,q\,q\,q)$	$>$ 2.4 TeV, CL = 95%
$\Lambda^{+}_{LL}(\nu\,\nu\,q\,q)$	$>$ 5.0 TeV, CL = 95%
$\Lambda^{-}_{LL}(\nu\,\nu\,q\,q)$	$>$ 5.4 TeV, CL = 95%

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 $m >$ 90.7 GeV, CL = 95% (from $e^{*+}e^{*-}$)
Mass $m =$ none 30–200 GeV, CL = 95% (from $e p \rightarrow e^* X$)
Mass $m >$ 91 GeV, CL = 95% (if $\lambda_Z > 1$)
Mass $m >$ 306 GeV, CL = 95% (if $\lambda_\gamma = 1$)

$\mu^{*\pm}$ — excited muon

Mass $m >$ 90.7 GeV, CL = 95% (from $\mu^{*+}\mu^{*-}$)
Mass $m >$ 91 GeV, CL = 95% (if $\lambda_Z > 1$)

$\tau^{*\pm}$ — excited tau

Mass $m >$ 89.7 GeV, CL = 95% (from $\tau^{*+}\tau^{*-}$)
Mass $m >$ 90 GeV, CL = 95% (if $\lambda_Z > 0.18$)

ν^* — excited neutrino

Mass $m >$ 90.0 GeV, CL = 95% (from $\nu^*\overline{\nu}^*$)
Mass $m >$ 91 GeV, CL = 95% (if $\lambda_Z > 1$)
Mass $m =$ none 40–96 GeV, CL = 95% (from $e p \rightarrow \nu^* X$)

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% ($\nu_8 \rightarrow \nu g$)