

Dark matter

Niklas Pietsch

DESY SUSY Meeting, 22nd March 2010



Neutralino as dark matter candidate¹

Motivation: Estimating the contribution of neutralinos to dark matter from LHC data

- R-parity conservation
 - ⇒ Pairwise production and annihilation of sparticles
 - ⇒ Lightest supersymmetric particle (LSP) is stable
- In many models: Lightest neutralino $\tilde{\chi}_1^0$ is LSP

⇒ $\tilde{\chi}_1^0$ is good candidate for dark matter

¹ “Supersymmetrie: Parameterbestimmung”, T 52.3, T 52.4

Neutralino as dark matter candidate

- Cross-section for annihilation of WIMPs
 - proportional to $\frac{1}{\text{DM density}}$
 - well known
- Annihilation of neutralinos
 - $\tilde{\chi}_1^0 \tilde{\chi}_1^0 \longrightarrow f \bar{f}$ via A^0 or Z
 - Cross-section depends on m_{A^0} and $\tan \beta$

⇒ Measuring m_{A^0} and $\tan \beta$ to determine the contribution of neutralinos to dark matter

or

⇒ Assuming that dark matter is totally made up of $\tilde{\chi}_1^0$ to introduce their annihilation cross-section as constraint for SUSY searches

Neutralino as dark matter candidate

Analysis:

- Vary $\tan \beta$ and A_0 for given m_0 and $m_{1/2}$ (and given sign $\mu = +$ (?))
- Studie which scenarios match to the hypothesis that dark matter is totally made up of neutralinos

Result:

For many points in the $m_0 - m_{1/2}$ plane values for $\tan \beta$ and A^0 (?) can be found such that the hypothesis may be true

Kaluza-Klein-excitations as dark matter candidates²

- Models with infinite extra dimensions (ED)
 - States in ED are quantized
 - SM particles excited to these states are called Kaluza-Klein-particles (KK-particle)
 - ED not visible
 - ⇒ Momentum of KK-particle in ED shows up as additional mass

⇒ Lightest KK-particle is good candidate for dark matter

→ Why is it stable?

² "Hauptvorträge", T 4.1, "Eingeladene Vorträge", T 7.4

Kaluza-Klein-excitations as dark matter candidates

- Significant excess in the cosmic-ray positron fraction observed by PAMELA experiment may be explained by
 - Extra dimensions:
 - Annihilation of lightest KK-particles (KK-photons)
 - ⇒ BUT: Cross-section consistent with the dark matter observed relic abundance (?) is too small to explain excess and requires to introduce "boost" factors
 - Many other explanations (e.g. decaying dark matter, pulsars)

⇒ Models are "tuned" to explain excess, but are not motivated by a fundamental principle like SUSY