The XENON program and DARWIN

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Outline

1. Xenon as detector medium
2. XENON100 results
3. Progress on XENON1T
4. DARWIN future facility
### Xenon as detection medium

**WIMP Scattering Rates**

- **18 evts/100-kg/year**
  - \(E_{th}=5\) keVr

- **8 evts/100-kg/year**
  - \(E_{th}=15\) keVr

\[M_X = 100\ \text{GeV}, \sigma_{X-p} = 10^{-45}\ \text{cm}^2\]

- **Self-shielding**
  - \(\rightarrow\) High stopping power

- **178 nm UV photons**
  - \(\rightarrow\) No wavelength-shifter

- **Simple cryogenics**
  - \(\sim 180\ K = -93^\circ\)

- **High atomic mass** \(A \sim 131\)

- **\(^{129}\text{Xe}\) and \(^{131}\text{Xe}\)**
  - \(\rightarrow\) spin-dep. interactions
Two phase noble gas TPC

- Scintillation signal (S1)
- Proportional signal (S2)

→ Electronic/nuclear recoil discrimination
The XENON program

- **XENON10**: 15 kg active volume
- **XENON100**: 62 kg active volume
  - New results coming!!
- Currently running
- **XENON1T**: 1T fiducial volume
  - planning/construction in 2012

- Laboratori Nazionali del Gran Sasso (Italy)
- ~ 3 650 m.w.e. shielding
XENON100 data taking

100.9 d results in 2011

Several improvements:
- Lower $^{85}\text{Kr}$ concentration
- Improved purity and lower trigger threshold

New run 224.6 live days
→ Party after unblinding  
... and back to work on XENON1T
XENON1T

1 ton fiducial mass (total ~3 ton)
1m drift length
100x less background than XENON100
Shielding: water Cherenkov muon veto
Low radioactivity PMTs

Fully funded!
Timeline goal: data taking by 2015
XENON1T in Hall B @ LNGS

- Start of construction: Autumn 2012
- Schedule is revised monthly

WP structure established
Some improvements and challenges

- **Water shield** to reduce the background: muon veto
  - Optimization for high light collection
- Reduction of **Kr and Rn intrinsic contaminations**
  - Development of krypton- and radon-removal towers
- **Low radioactivity**: Screening of all detector materials

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Active muon veto

Radon screening facility

Gamma screening facility
Some improvements and challenges II

- **Drifting electrons thought 1 m LXe**
  - Fast xenon recirculation being tested on a demonstrator

- **HV feedthrough tested up to 110 kV**

- **New High Pressure Recovering System (RestoX)**
XENON1T inner TPC

- Design baseline as in XENON100
  - Teflon as reflector
  - Two low-radioactivity PMT arrays
  - Copper field-shaping rings

- Materials with low neutron background
Light simulations for XENON1T:

- good light collection for S2 signals
- \((x,y)\) position resolution of \(\sim 6\) cm

HV tests with 3 PMTs
R11410 tests at UZH

Stable operation in LXe over 5 months

- Blue LED for SPE
- PMT @ –1 600 V
- T = 171 K
- P = 1.4 bar
DARWIN future facility

- R&D and design study for a noble liquid facility in Europe
- LAr and LXe communities involved

http://darwin.physik.uzh.ch/
DARWIN physics

- Measurement of dark matter properties
  - Ultimate WIMP limit at around $10^{-48}$ cm$^2$
- Real time measurement of pp-neutrinos
  - with $\sim 10$ t of LXe about 4 000 neutrinos per year
Summary

- **XENON100** is running successfully
  - New results based on $\sim 224.6$ live days coming soon!
- **XENON1T** will start construction this year
- **DARWIN**: ultimate measurement of DM properties