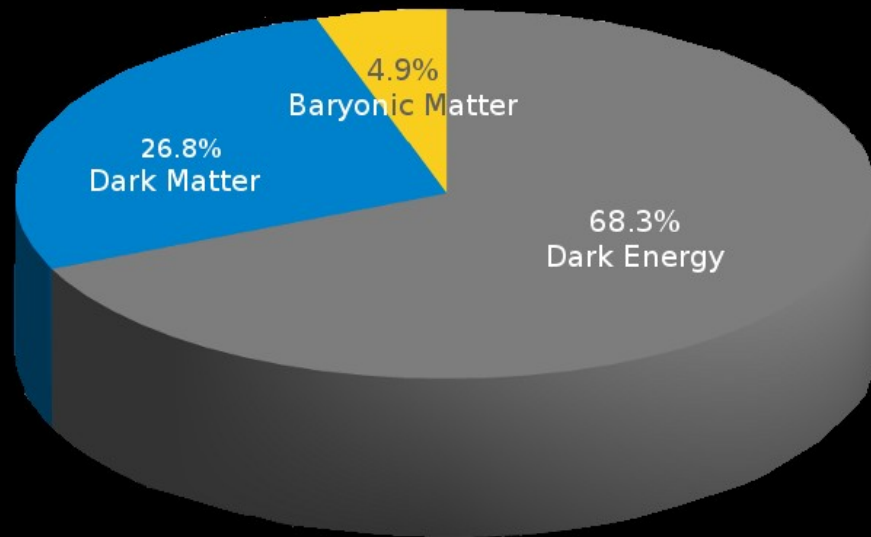


Experimental Astroparticle Physics

Searching for Dark Matter

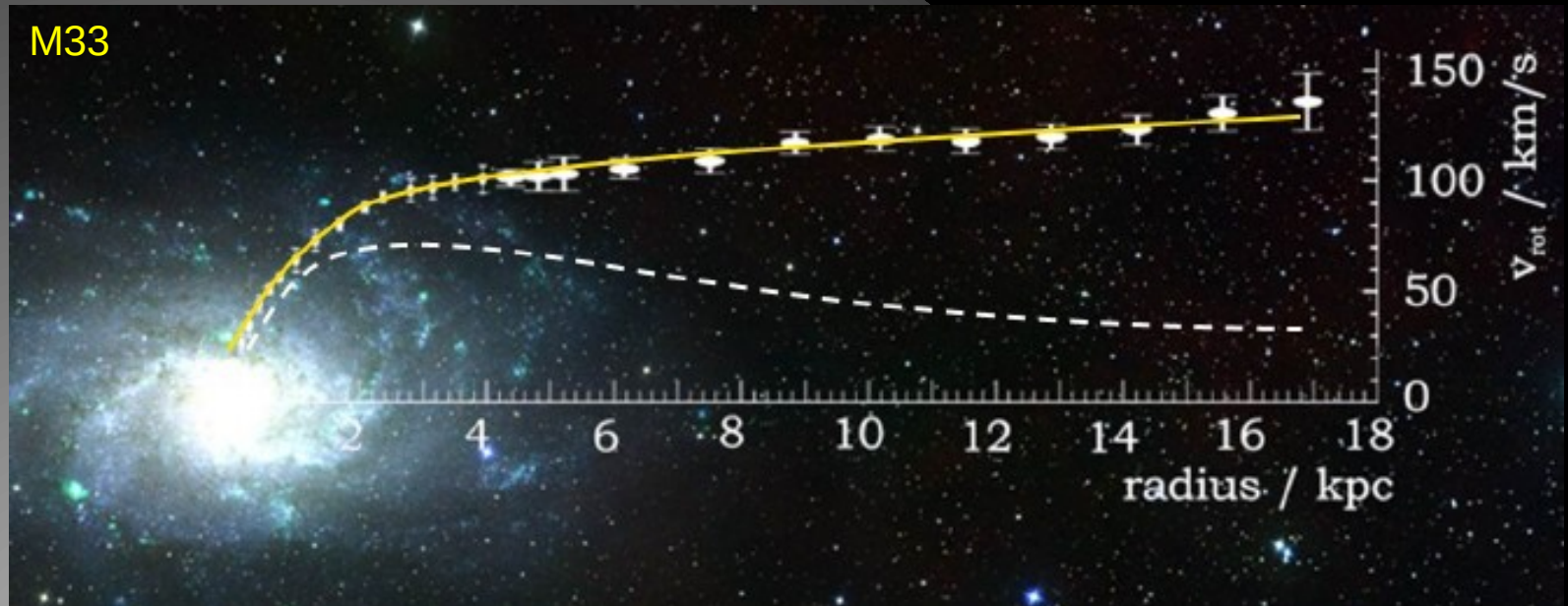


**95% of the
Universe
is dark!**

**Dark Matter
Flux in Freiburg:
 $\Phi \approx 10^5 \text{ cm}^{-2} \text{ s}^{-1}$**

Galactic Rotation Curves

Measurement: flat rotation profile... far beyond visible stars



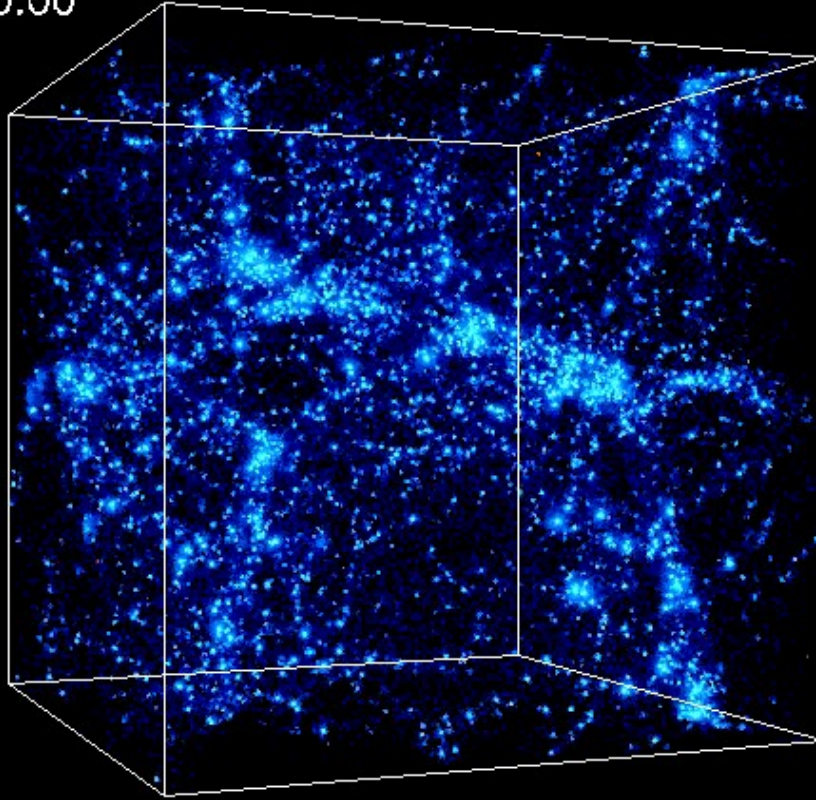
Galaxy embedded
in „halo“ made of
dark matter



Dark Matter shapes the Universe

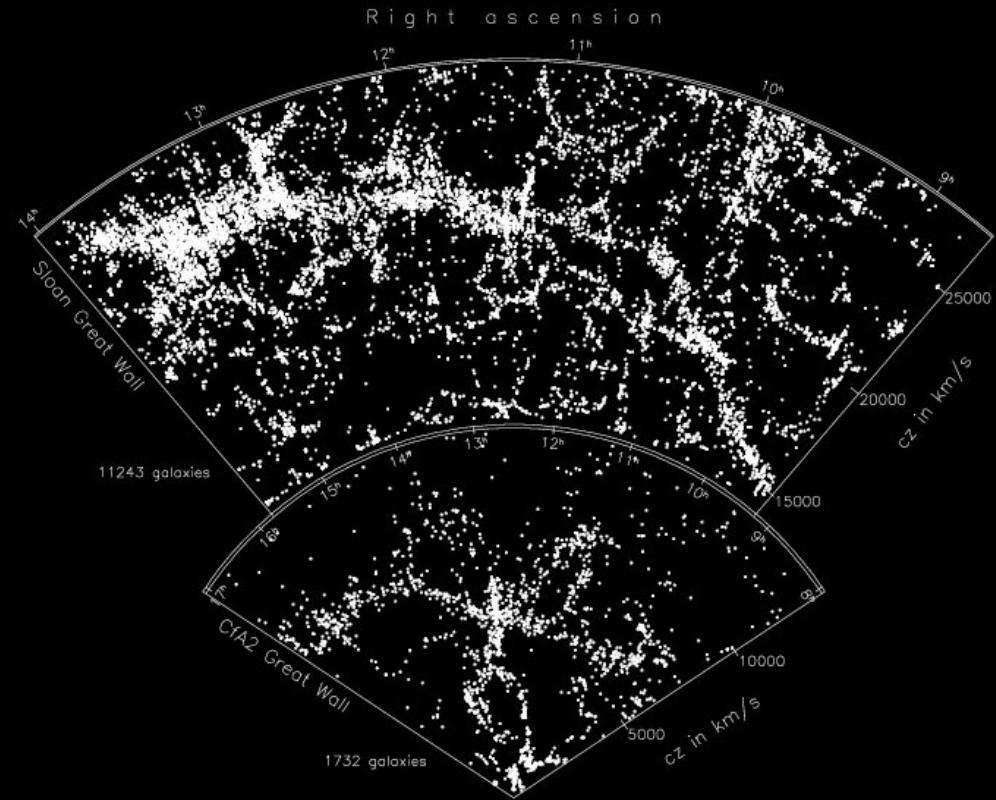
now

$Z = 0.00$



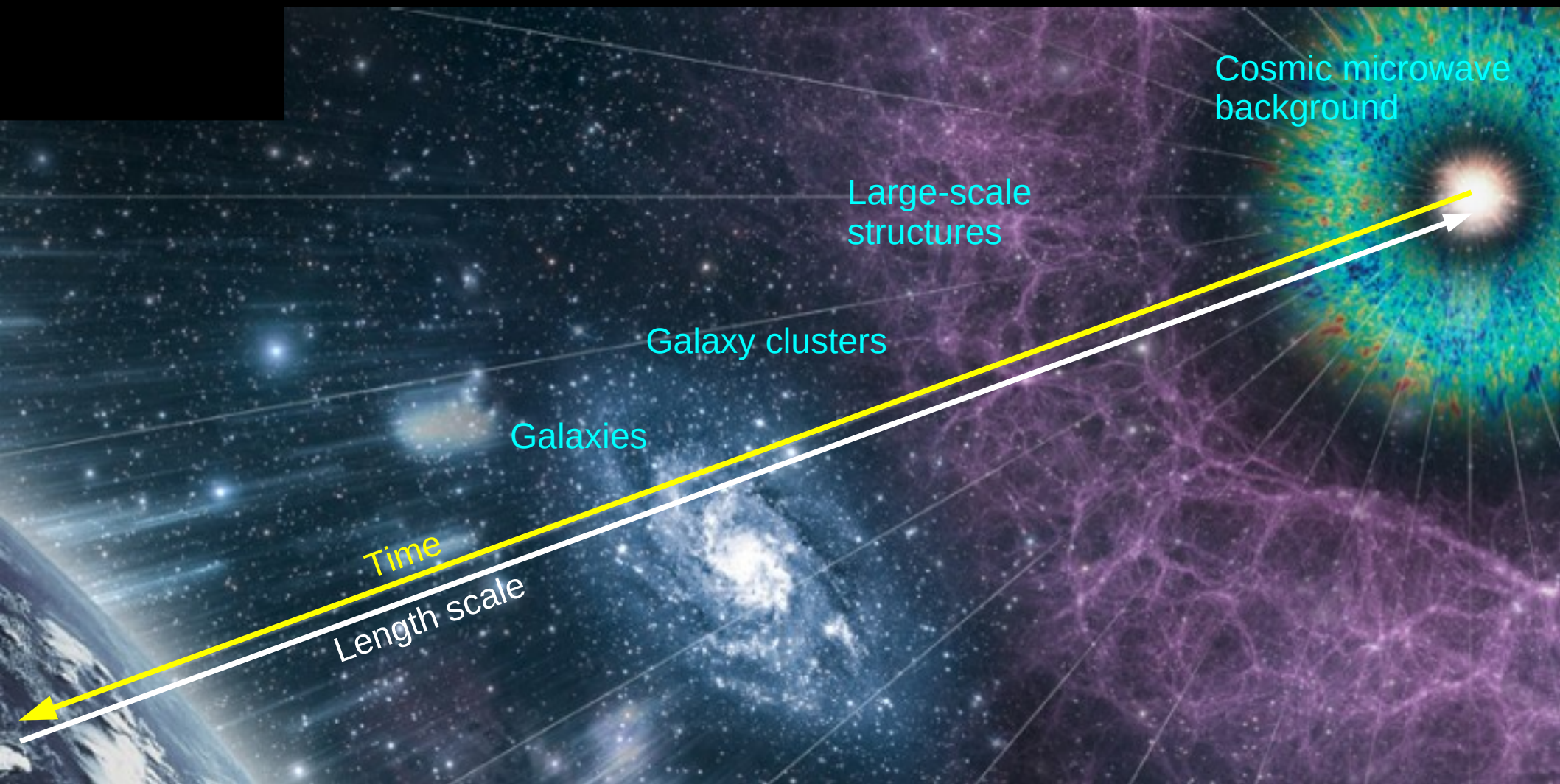
<http://cosmicweb.uchicago.edu>

Simulation



Observation (SDSS)

Evidence for DM at all Scales

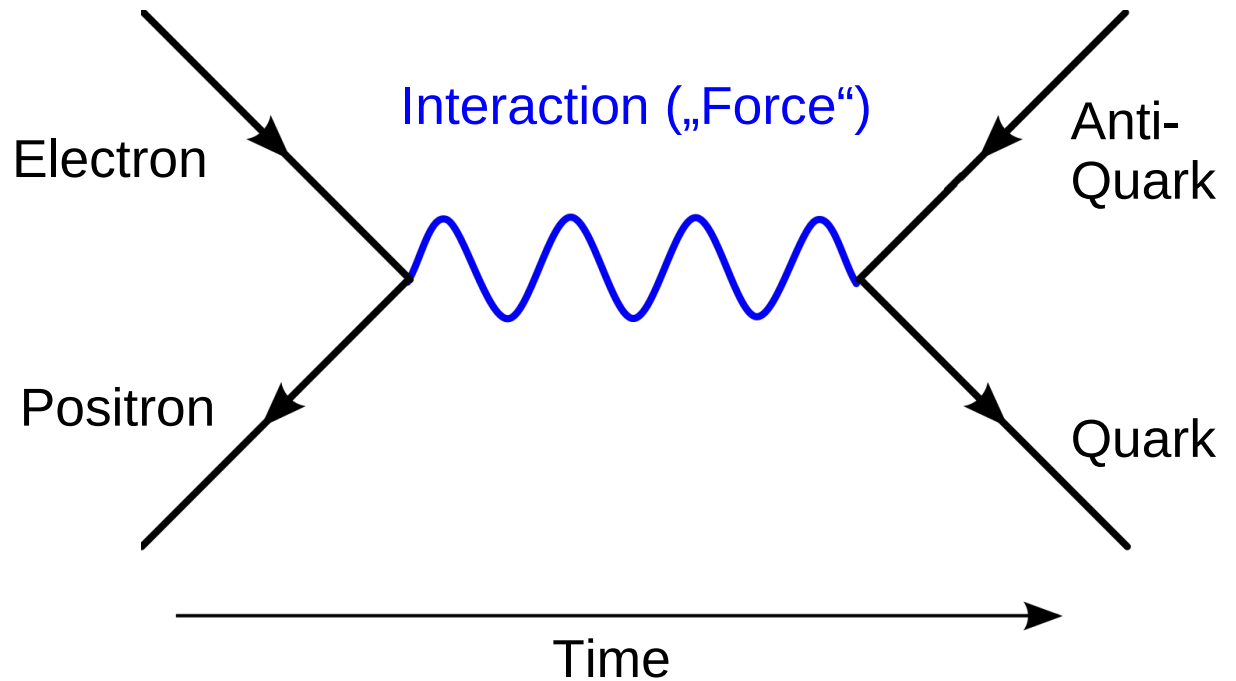
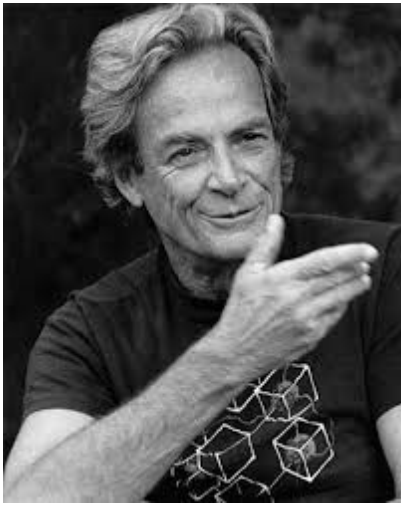


<http://www.cosmology.ethz.ch>

Theories for Dark Matter

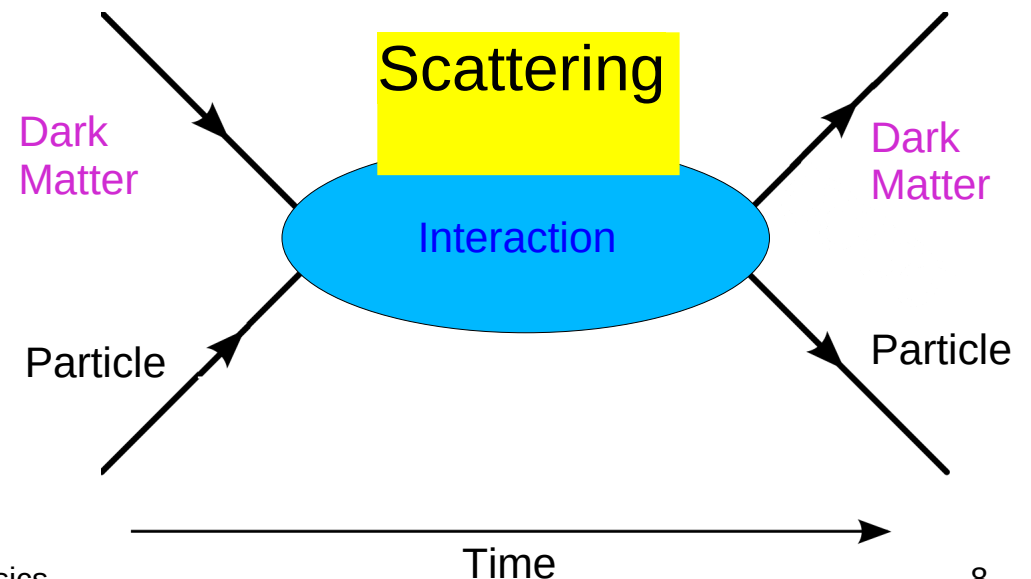
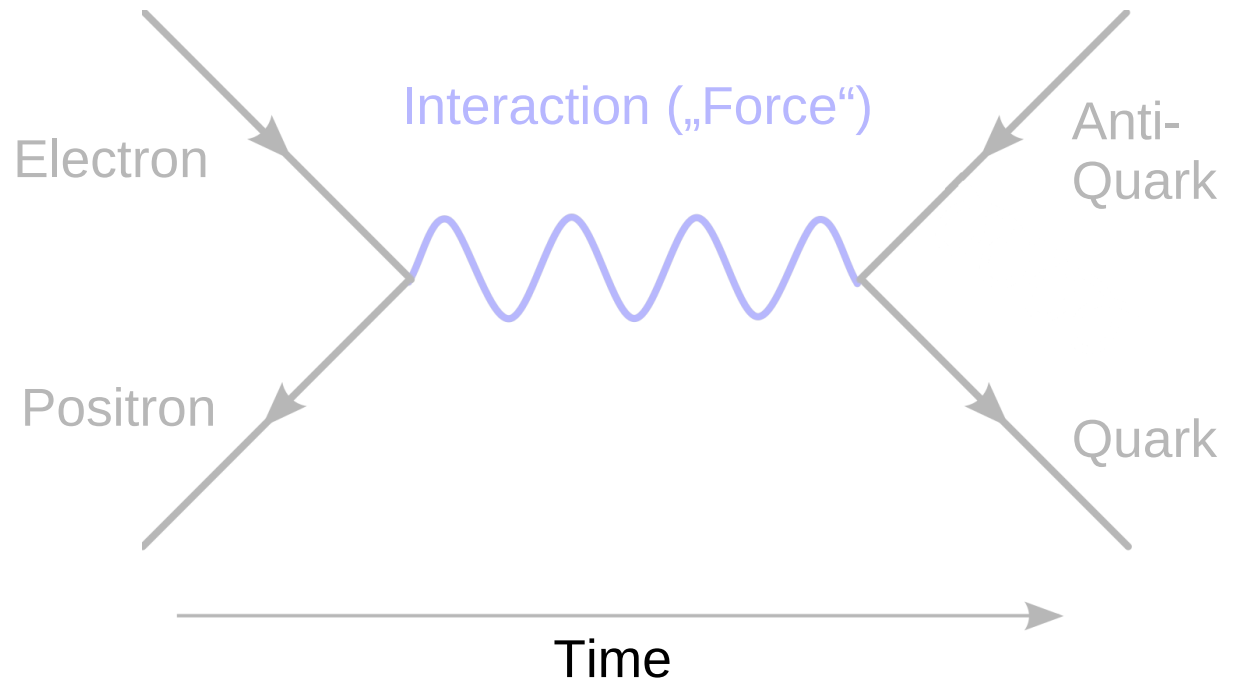


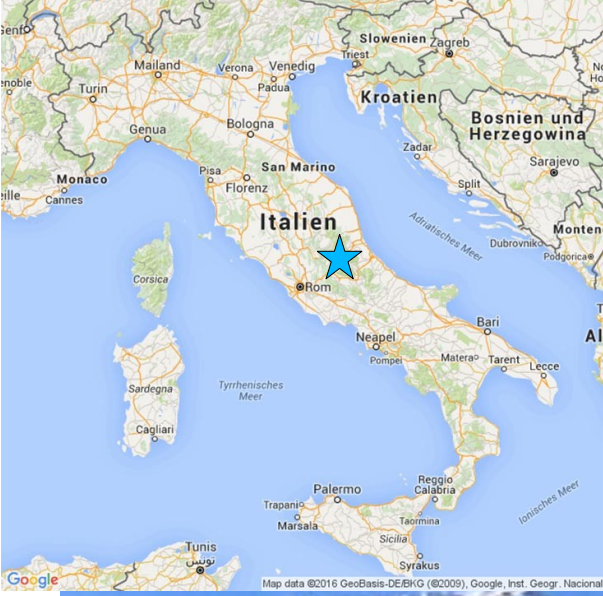
Particle Interactions



Description via Feynman-Diagrams
graphical representation of complicated calculations

Direkter Nachweis Dunkler Materie







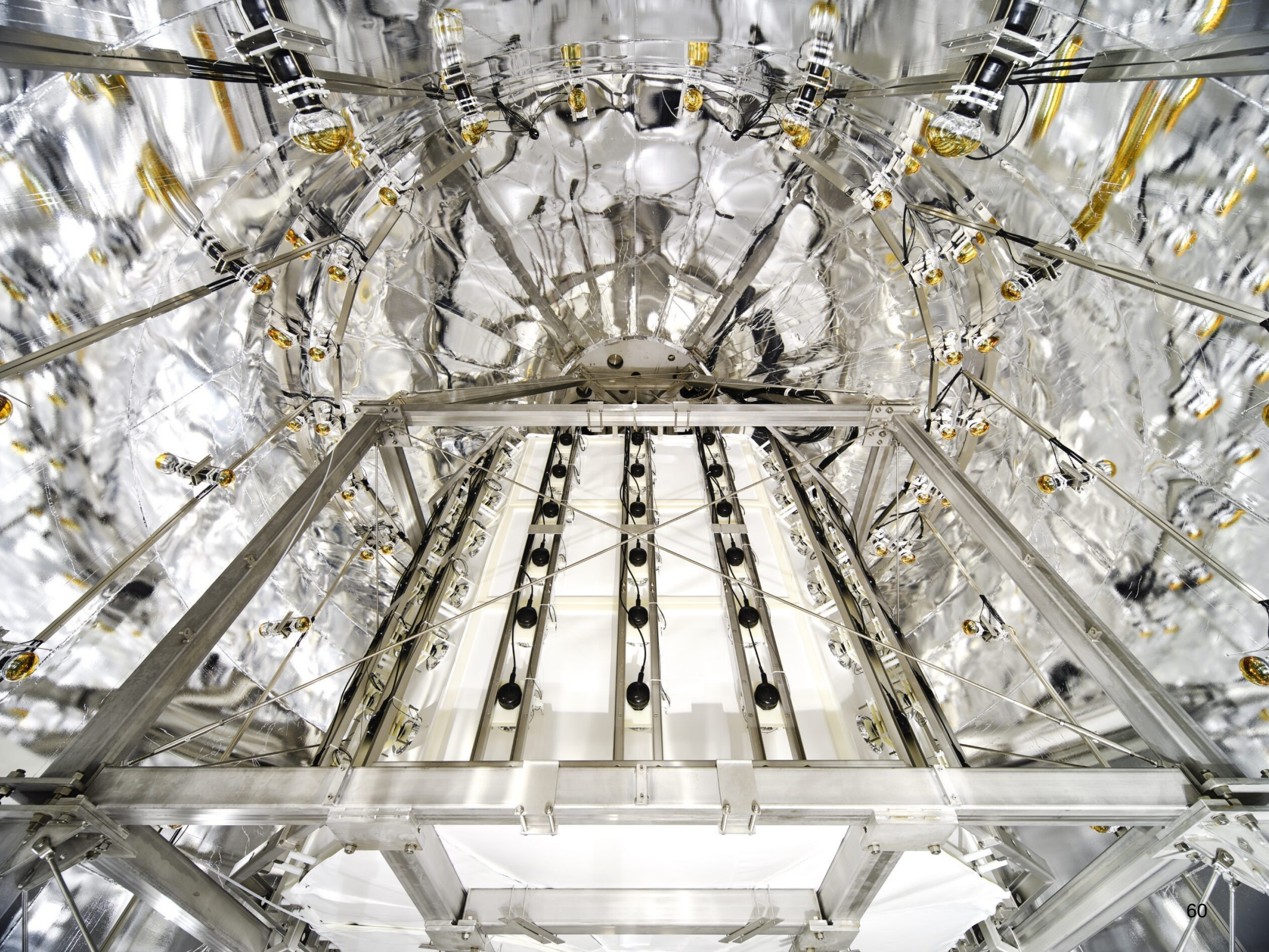


Laboratori Nazionali del Gran Sasso

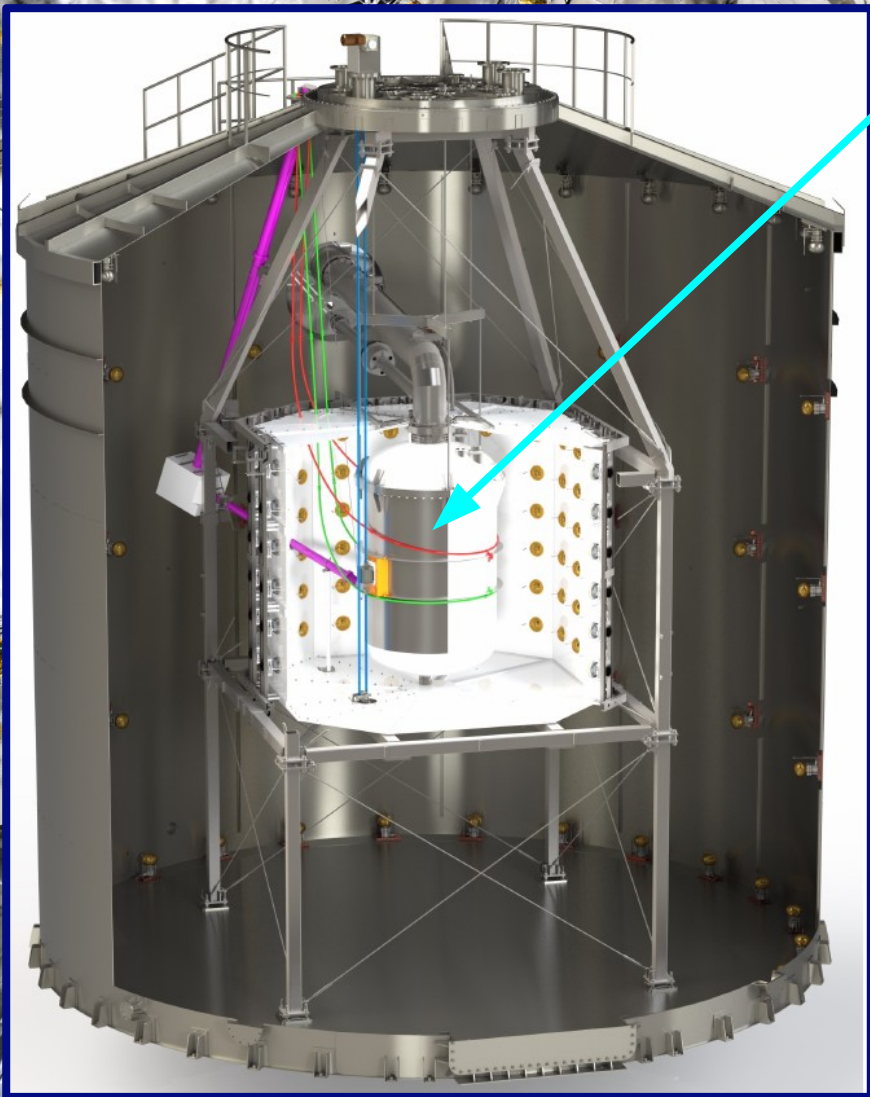


XENONnT @ LNGS





The xenon detector sits here...





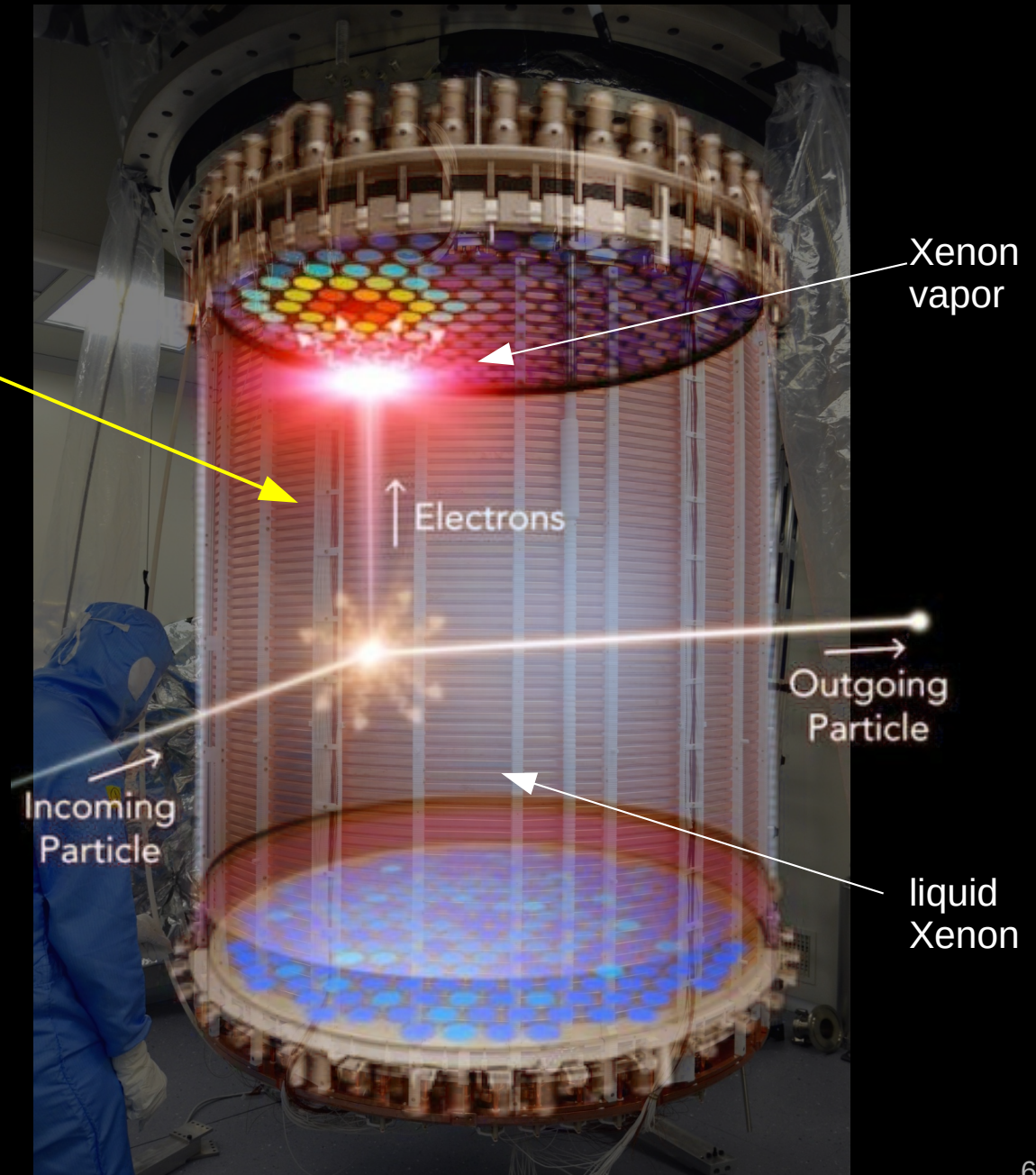


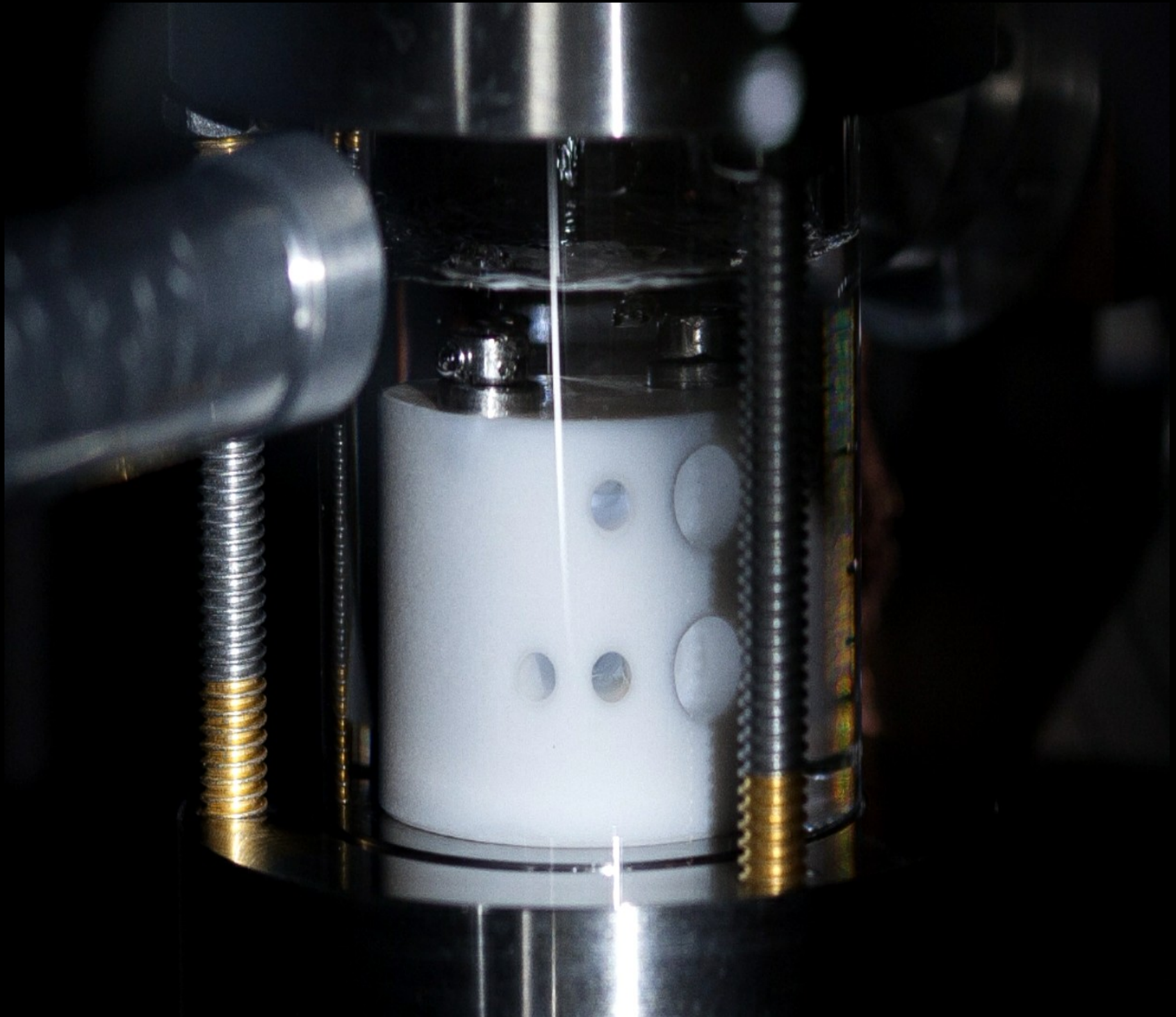
XENONnT

universität freiburg

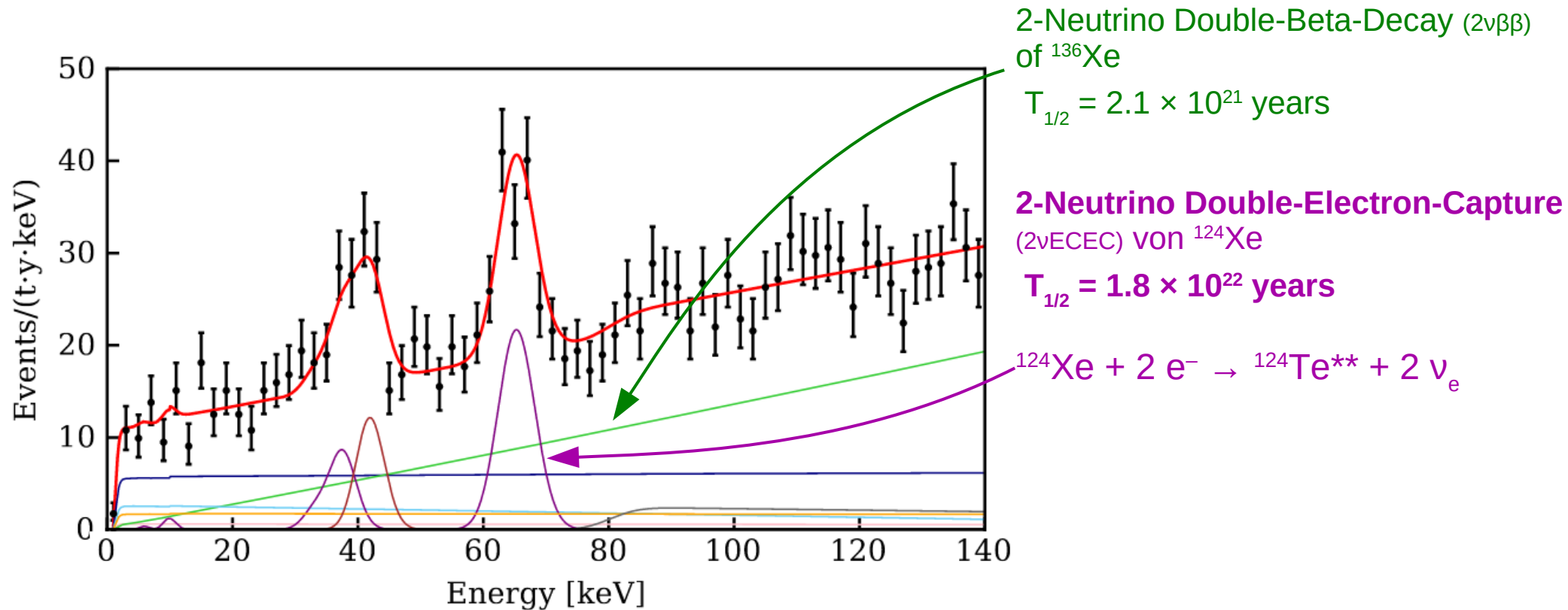
Liquid xenon gas is an excellent scintillator ($\rightarrow$ light) und can easily be ionized ($\rightarrow$ electrons).

- active Xe mass: 5.9 t
- very few background signals
- data taking since 2020



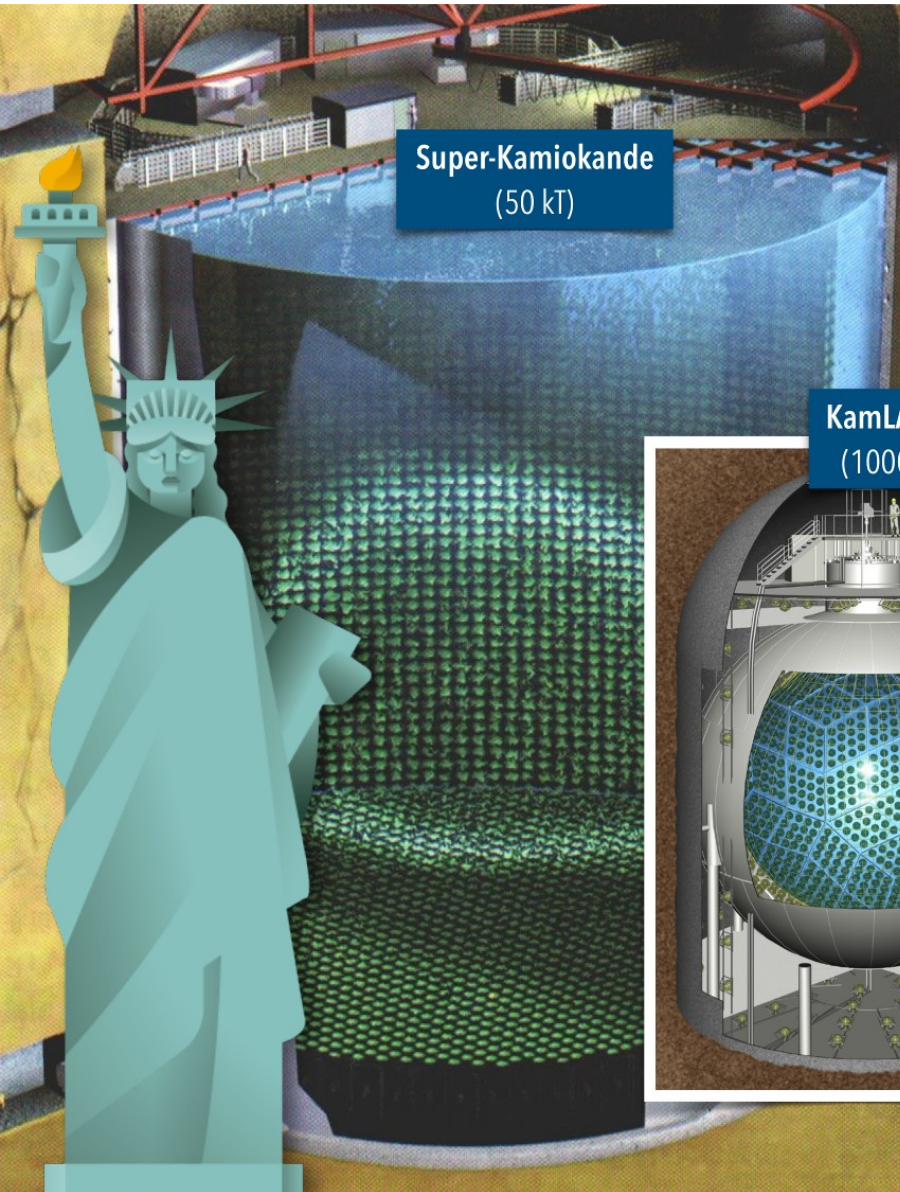


World Records



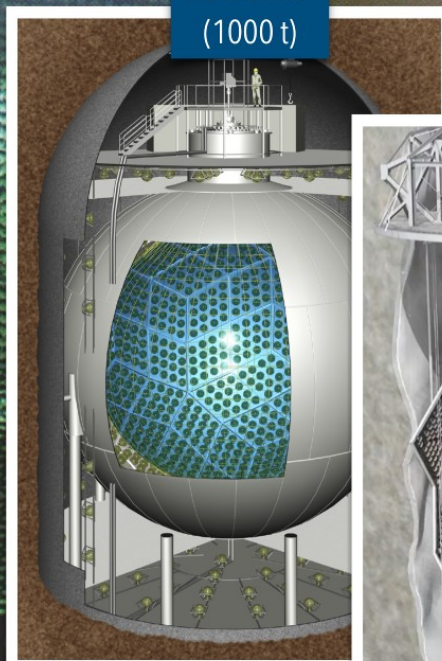
2022: lowest background levels of
all dark matter detectors

2024: first measurement of solar ^8B neutrinos via
coherent elastic scattering off atomic nuclei

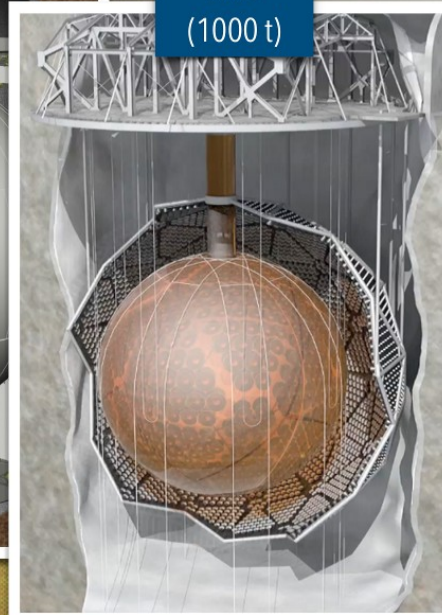


Super-Kamiokande
(50 kT)

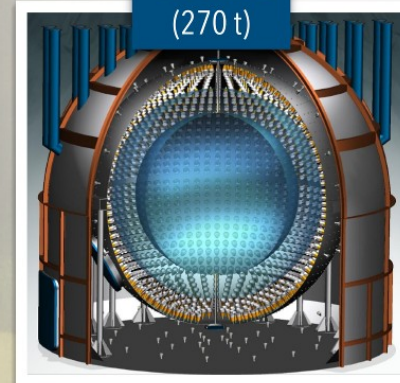
XENONnT: The Smallest Solar Neutrino Detector



KamLAND
(1000 t)



SNO
(1000 t)



Borexino
(270 t)



XENONnT
(5.9 t)

Slide courtesy: R. Hamann

UFR: DM Projects and Contributions

- **XENONnT** (Xenon)
 - **Xe-Detector** → **lab tests**
 - data acquisition
 - low-background materials
 - simulation, analysis

Further projects:

- **XLZD** (Xenon): future dark matter observatory
 - project leader
 - **research and development** → **Lab**, simulations
- **DELight** (Helium): search for light dark matter
 - Low-background environment, shielding, control system
- **SHiP**: search for „hidden sector“ particles at CERN
 - detector development (liquid scintillator)

