











Р P $^{1}\text{H}+^{1}\text{H}\rightarrow^{2}\text{H}+\beta^{+}+\nu$



Life of a High Mass Star







The Elements of Life

Hydrogen Carbon Nitrogen Oxygen Sulfur Phosphorus





Questions?



In 1967, a radio source emitting regular, 0.04-second long pulses every 1.3373 seconds was found (Jocelyn Bell Burnell) for the first time



Instead, it turned out to be radio emissions from a pulsar, PSR B1919+21, the first one ever identified as such.





To achieve this density of a neutron star at home, just cram a herd of 50 million elephants into the volume of a thimble.

— Neil deGrasse Tyson —







Black Hole M = 1.5 M_{sun} R_s = 4.5 km

Neutron Star M=1.5 M_{sun} R≈10 km







Questions?











STANDARD MODEL OF ELEMENTARY PARTICLES





The Standard Model



How strong in the strange matter interacting with the "normal" (u, d) matter?



ADA (1961)



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Observing on fixed target



- Matter is mainly empty
- All those particles which did not interact get lost
- Energy loss by moving the center of mass
- Target is complex

First Frascati's idea





Bruno Touschek

- The non-interacting particles can be re-used in the successive rounds
- · Collisions are performed in the center of mass frame
- The circulating particles can be either elementary or complex (nuclei or atoms)

Second Frascati's idea



 $\mathbf{E} = \mathbf{m} \mathbf{c}^2$

Bigger the energy is, more and more particles can be studied

ADA (1961)



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ADONE (1969-1993)



DAFNE (1997)











LHC at Cern (Geneve) 2008









Questions?

Kaonic atoms spectroscopy:

211.44







Flux of produced kaons: about 1000/second

K- interaction (contains the strange quark!)







Neutron

STRUCTURE OF AN ATOM









Kaonic atom formation



SIDDHARTA overview



In total 48 new SDD arrays will be used





SIDDHARTA-2 setup





SIDDHARTINO installed on DAFNE (17 April 2019)



SIDDHARTA-2 Collaboration

Silicon Drift Detector for Hadronic Atom Research by Timing Applications









LNF- INFN, Frascati, Italy SMI- ÖAW, Vienna, Austria Politecnico, Milano, Italy IFIN – HH, Bucharest, Romania TUM, Munich, Germany, Germany RIKEN, Japan Univ. Tokyo, Japan Victoria Univ., Canada Univ. Zagreb, Croatia Helmhotlz Inst. Mainz, Germany Univ. Jagellonian, Krakow

SIDDHARTA K-H measurement



SIDDHARTA-2 K-d measurement (Monte Carlo simulation)

Kaonic deuterium run in 2020800 pb⁻¹to perform the firstmeasurement of the stronginteraction induced energyshift and width of the400kaonic deuterium groundstate (similar precision as K-p) !



precision: shift: 30 eV width: 75 eV

SIDDHARTA-2 kaonic deuterium at DAFNE





We may also learn something about general relativity and....beyond





Credit: Adam Apollo



Some infos on theory beyond SM?



WE HAVE CALCIUM IN OUR BONES, IRON IN OUR VEINS. CARBON IN OUR SOULS. AND NITROGEN IN OUR BRAINS. 93 PERCENT STARDUST WITH SOULS MADE OF FLAMES. WE ARE ALL JUST STARS THAT HAVE PEOPLE NAMES. – Nikita Gill.





Farnesina Ministero degli Affari Esteri e della Cooperazione Internazionale





John Templeton Foundation







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