EXOTIC NUCLEAR PHYSICS: FROM COLD FUSION TO ANTIKAONIC NUCLEAR CLUSTERS

Tullio Bressani
Dipartimento di Fisica Sperimentale, Universita' di Torino
Istituto Nazionale di Fisica Nucleare, Sezione di Torino

ICCF-15

15° International Conference on
Condensed Matter Nuclear Science

Roma, October 5-9, 2009

SUMMARY

1 . Introduction

2. The case of Antikaonic Nuclear Clusters (AKNC's)

3. Experimental results with K^-

4. Experimental results with $\bar{p}$

5. Conflicting conclusions

6. Similarities and differences between the Cold Fusion and AKNC's scientific cases

1. Introduction

- Very active with my Group on experiments in Cold Fusion (gas loading, neutron and ^{4}He detection) from 1989 to 1998

- Attended all ICCF from 1 to 7 (organized ICCF2)

- Activity stopped in 1999, mainly for not enough personal expertise in Condensed Matter Physics (I was always and I am a nuclear/particle physicist). Difficulty also in obtaining positions for young reaserchers

-Never denied the reality of Cold Fusion (for scientific case, not applications)

2. The case of Antikaonic Nuclear Clusters (AKNC's)

- Starting point: the interaction $\bar{K}$-N in the I=0 channel is strongly attractive at threshold

1986 – S. Wychech – NPA 450 (1986), 399c

1997 – T. Waas, M. Rho e W. Weise,- NPA 617 (1997), 449

2000 – A.Ramos ed E. Oset, NPA 671 (2000), 401

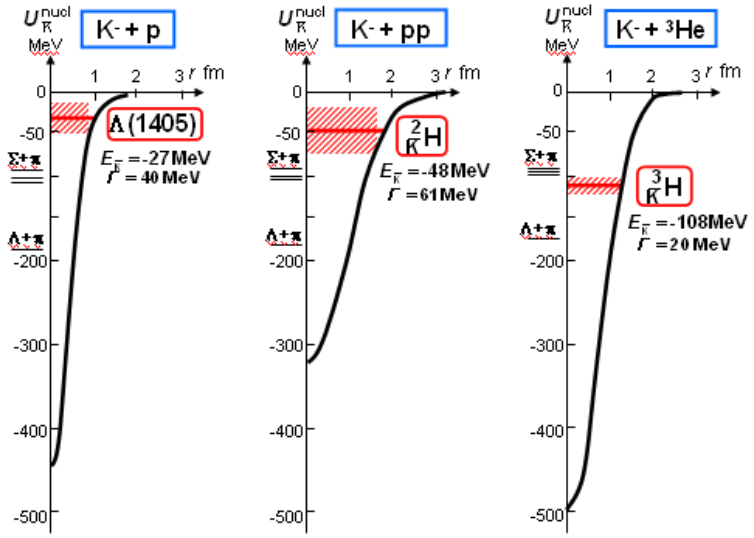
- Different theoretical approaches but similar conclusions: B.E. ~20 ÷100 MeV

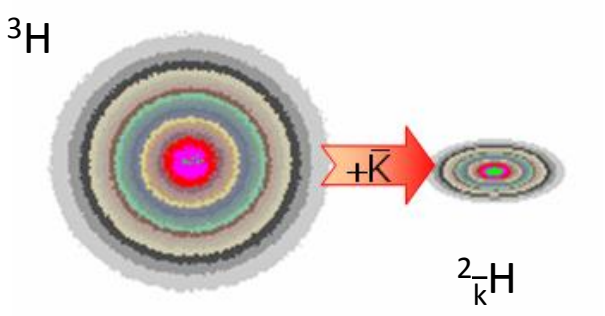
but large Γ (100 MeV). Experimentally non interesting.

The start-up of the story:

2002 – Y. Akaishi e T. Yamazaki (recently involved in CF too!!), PRC 65 (2002), 0044005

B.E. 100 ÷200 MeV but small Γ (20 ÷30 MeV)

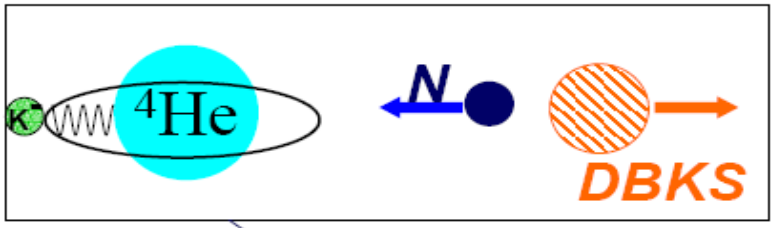




Trigger of the experiments but also of theoretical confutations

3. Experimental results with K⁻

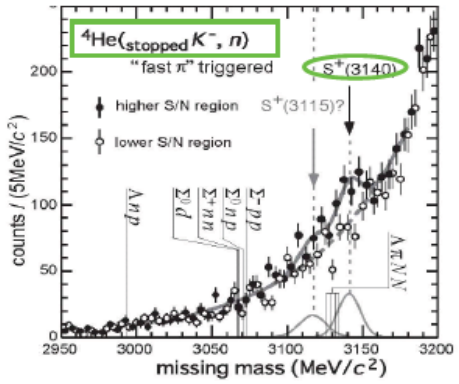
Triumphant title of the paper: “Discovery of…”

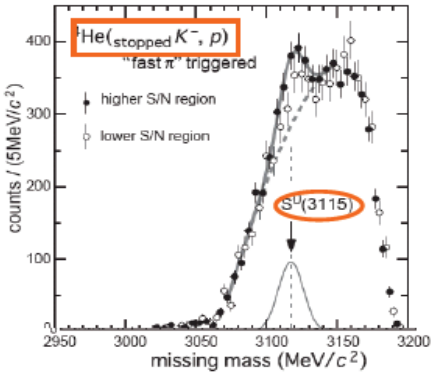


KEK, AGS, FINUDA

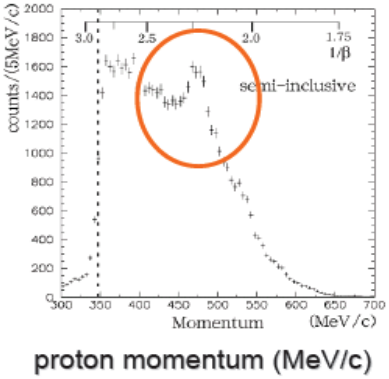
First Observation By Missing Mass

KEK-PS E471 *miss. mass method*
Suzuki et al, Phys. Lett. B597 (2004) 263





KEK-PS E471 *miss. mass method*,
Suzuki et al, NPA 754 (2005) 375

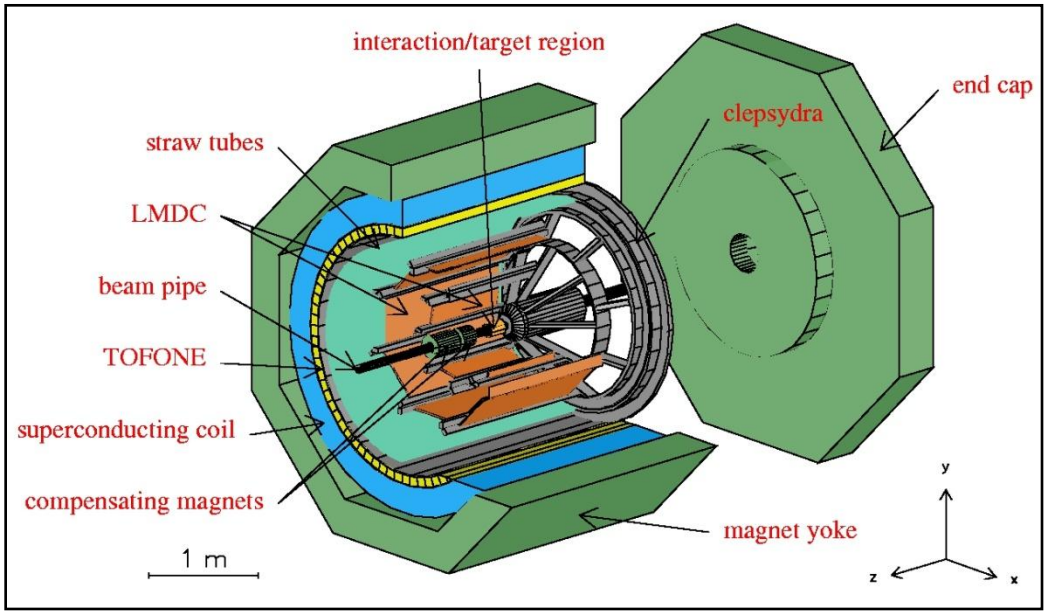


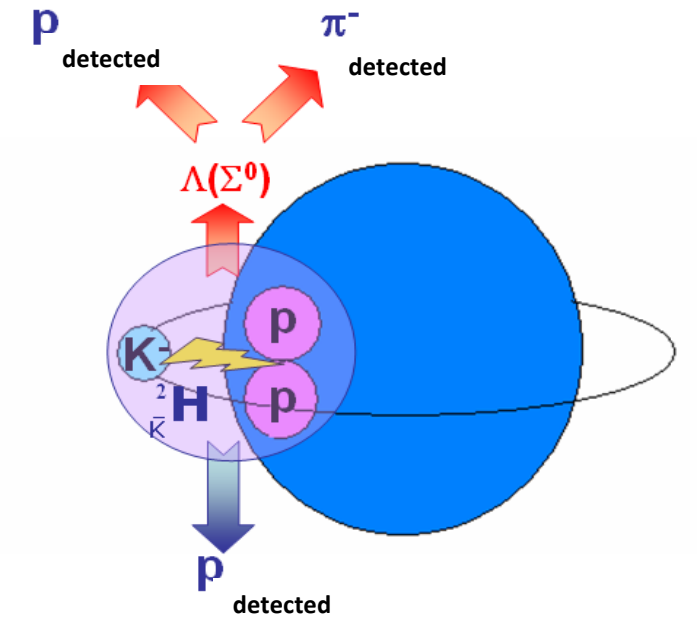
Remarks from an experimentalist:
Dedicated experiment; stopped K⁻, LHe target, good neutron detector, scarce π⁻ momentum identification (light release in scintillators)

Unexpected result (proton peak around 500 MeV/c) – momentum measured by TOF
Narrow width<21 MeV → resemblance with AY prediction, but not exactly

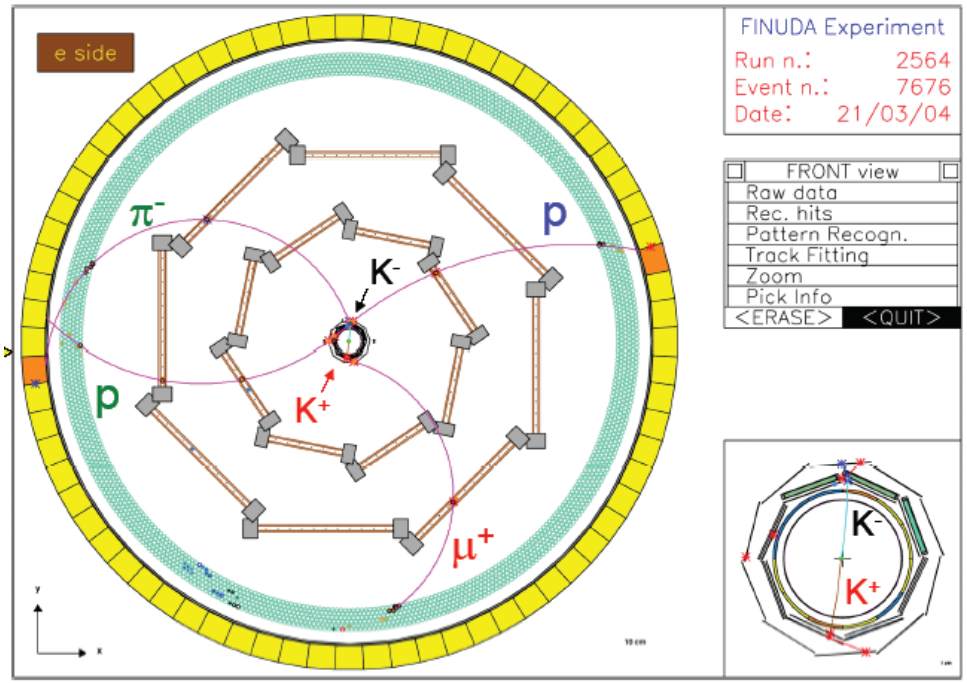
NOTE:
only dedicated experiment

Observation with experiments on Invariant Mass (Λ-p) system

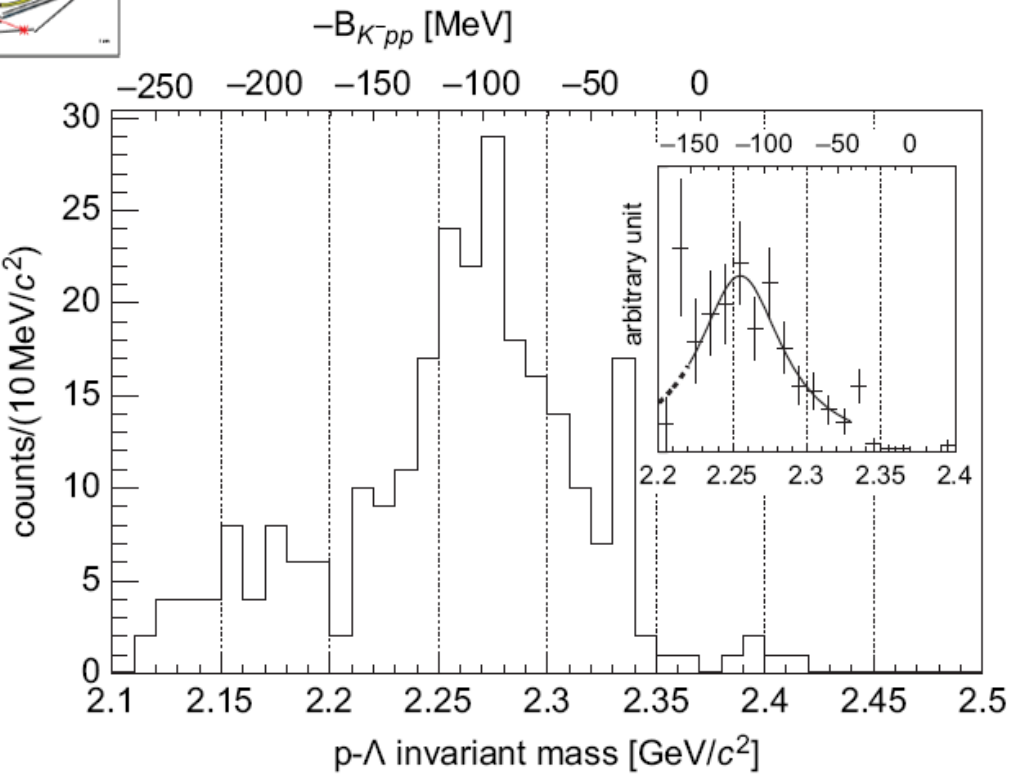




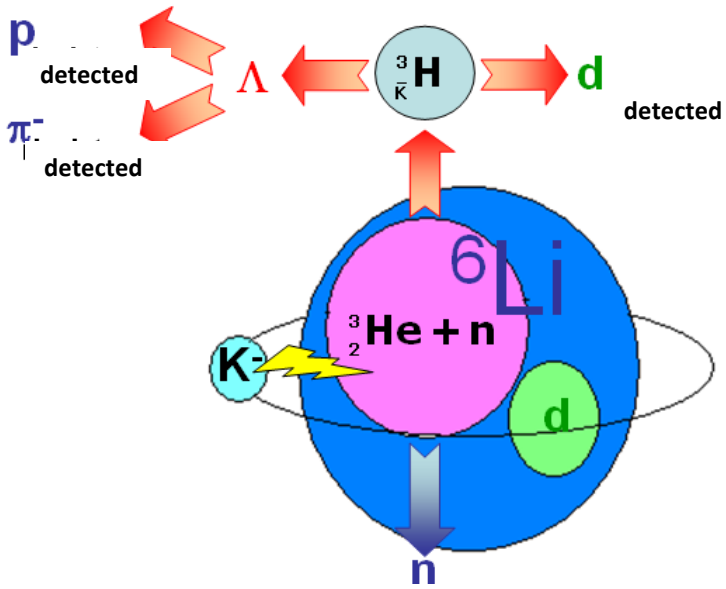
Not dedicated experiment

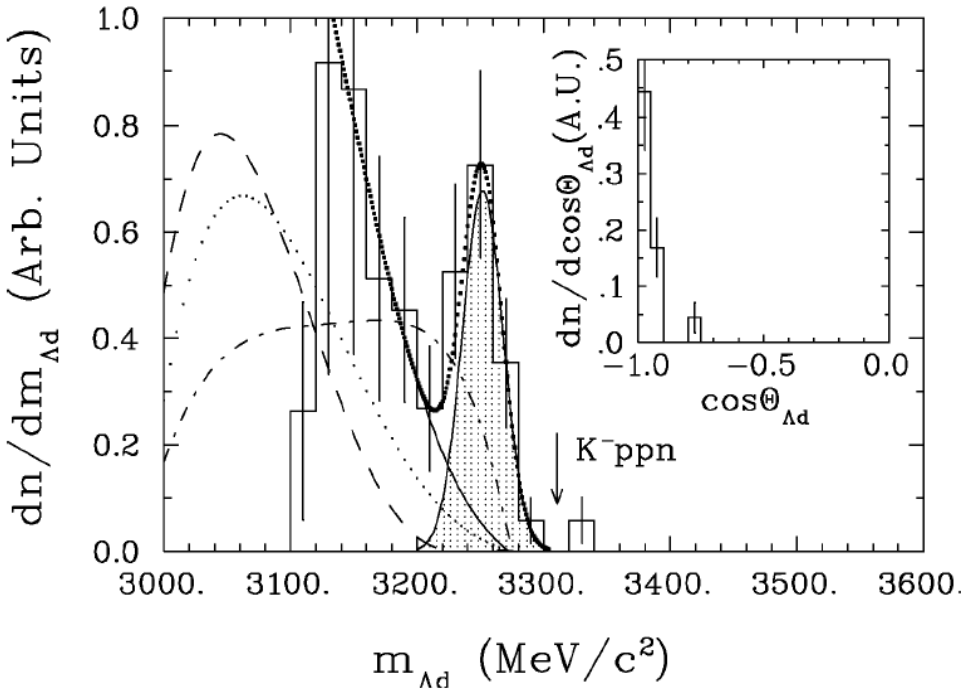


FINUDA Coll., PRL 94(2005)212303



(Λ-d) system

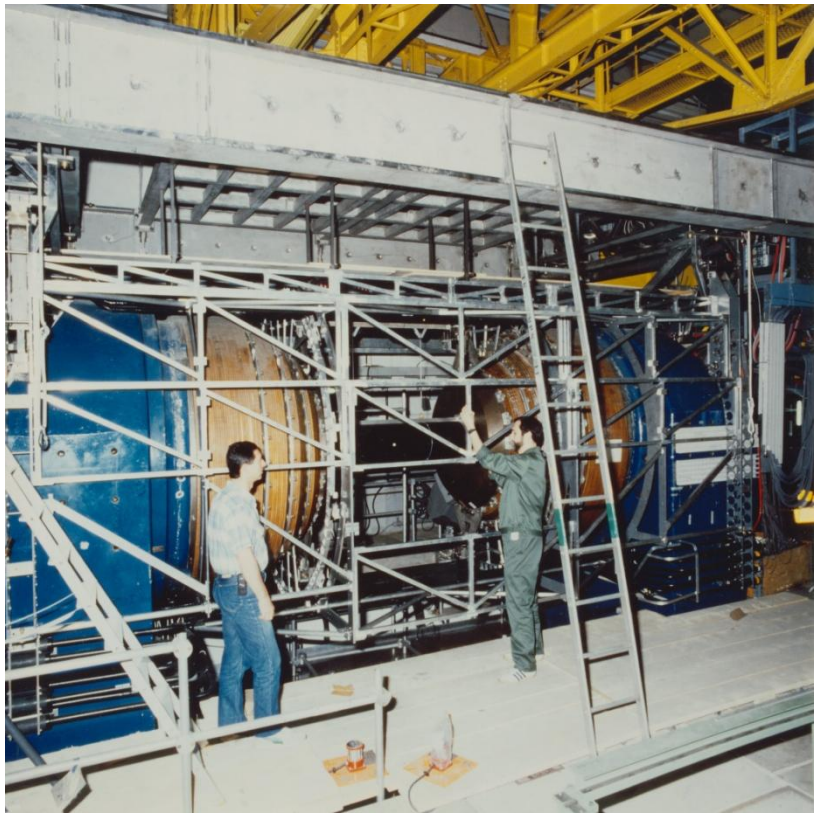




B= -58 ± 6 MeV Γ = 36.5 ± 14.1 MeV

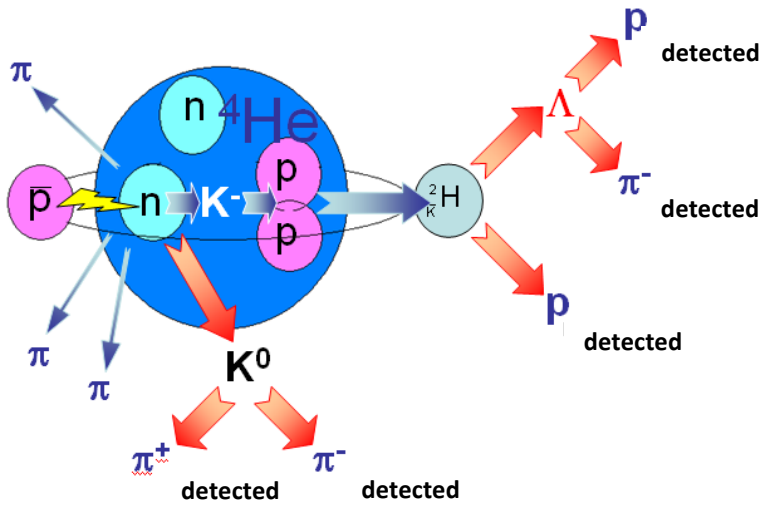
FINUDA Coll., PLB 654 (2007), 80

4. Experimental results with $\bar{p}$

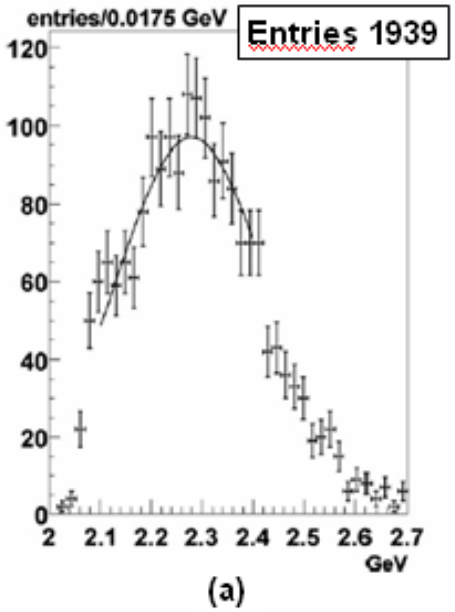


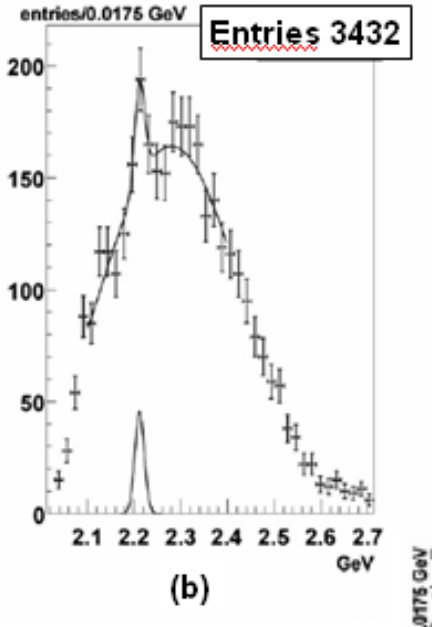
OBELIX

M.I. Λ-p



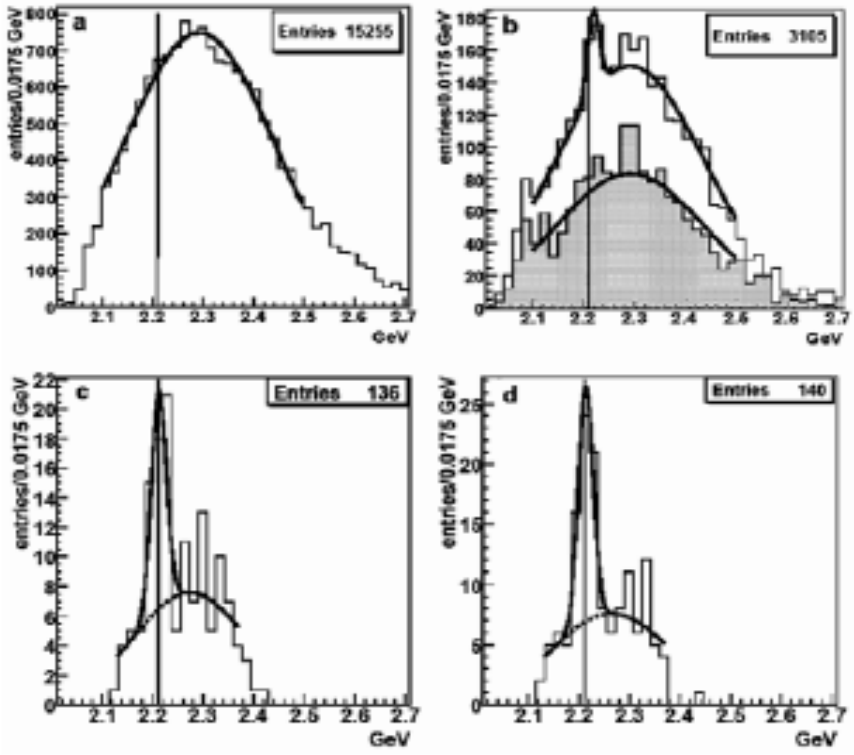
Not dedicated experiment





Statistical Sign. =3.0 σ

G. Bendiscioli, T. Bressani et al., NPA 789 (2007), 222

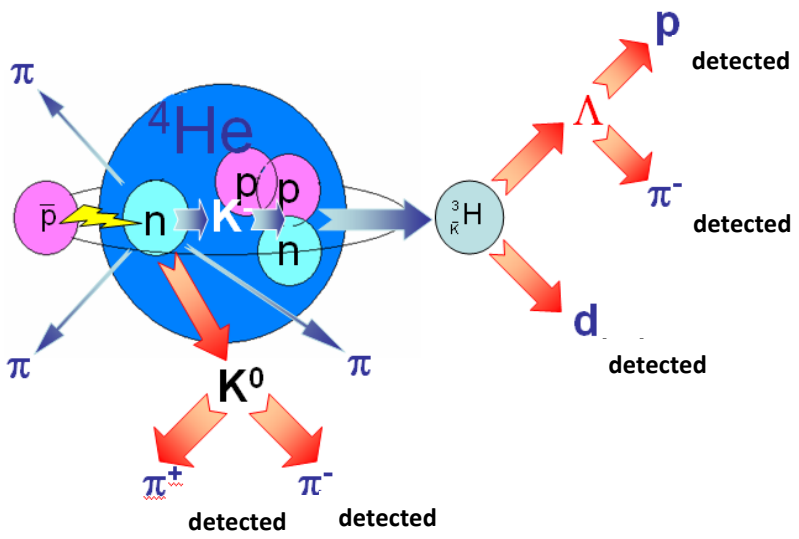


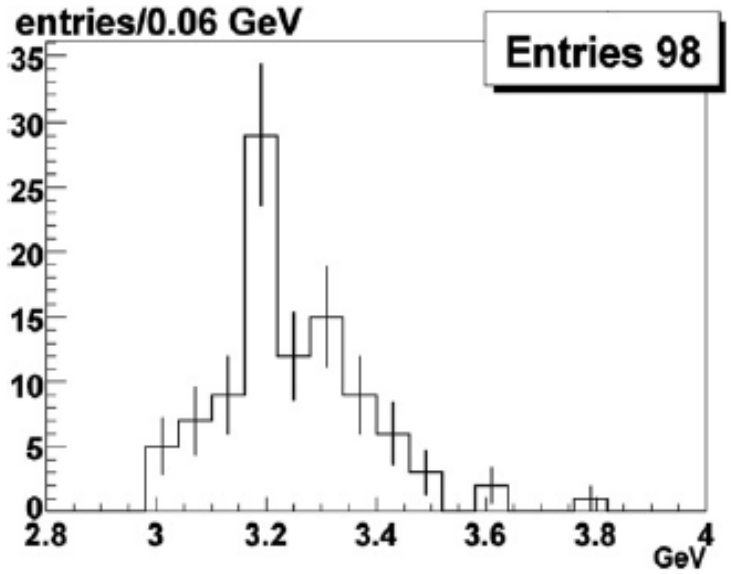
Statistical Sign. =4.7 σ

Final Result: -151.0± 3.2(stat.) ±1.2 (sist)

G. Bendiscioli, T. Bressani et al.,EPJ A 40 (2009) 100878

Invariant Mass (Λ-d)





Statistical Sign. = 2.6 σ

Final Result: B=-121.0± 15

Γ< 60 MeV

5. Conflicting Results

We compare the results reported in experiments with k^- at rest (FINUDA) with those with $\bar{p}$ (OBELIX)

Binding energies and widths:

		B(MeV)	Γ(MeV)	Ref.
$^{2}_{k}H$ (k^-pp)	K^- at rest	- 115 9	- 67 15	PRL 94 (2005),212303
	$\bar{p}$ at rest	- 151.9 3.2±1.2(sist.)	<39.4 6.2	EPJ A 40 (2009),100878
	Theory	- 48	61	Phys. Rev.C 65 (2002), 044005
$^{3}_{k}H$ (k^-ppn)	K^- at rest	- 58 6	-36.6 14.1	PLB 654 (2007),80
	$\bar{p}$ at rest	- 121 15	<60	Phys. Rev.C 65 (2002), 044005
	Theory	- 108	20	PLB 535 (2002),70

Even worse concerning the capture rates

Some other results by non-dedicated experiment (DISTO) also not in agreement

Other dedicated experiments approved and ready to run

E15 → J-PARC K^- in flight → I.M.+M.M.

FOPI :→ GSI pp-> $pK^+\Lambda$ → I.M.+M.M.

Ratio of the theo./exp. published papers > 10

6. Similarities and differences between the Cold Fusion and AKNC's scientific case

	C.F.	AKNC
Applications	*****	*
Impact on media	*****	*
Scientific interest	*****	****
Acceptance by theoreticians	*	****
Acceptance by experimetalist	**	*****
Papers on Physics journals	*	*****
Financement by Public Agencies	*	*****
Positions for young reaserchers	*	***
Interest by students	*****	***

Hope that in a (near) future C.F. physicists will again be part of the broad Nuclear Physicists community