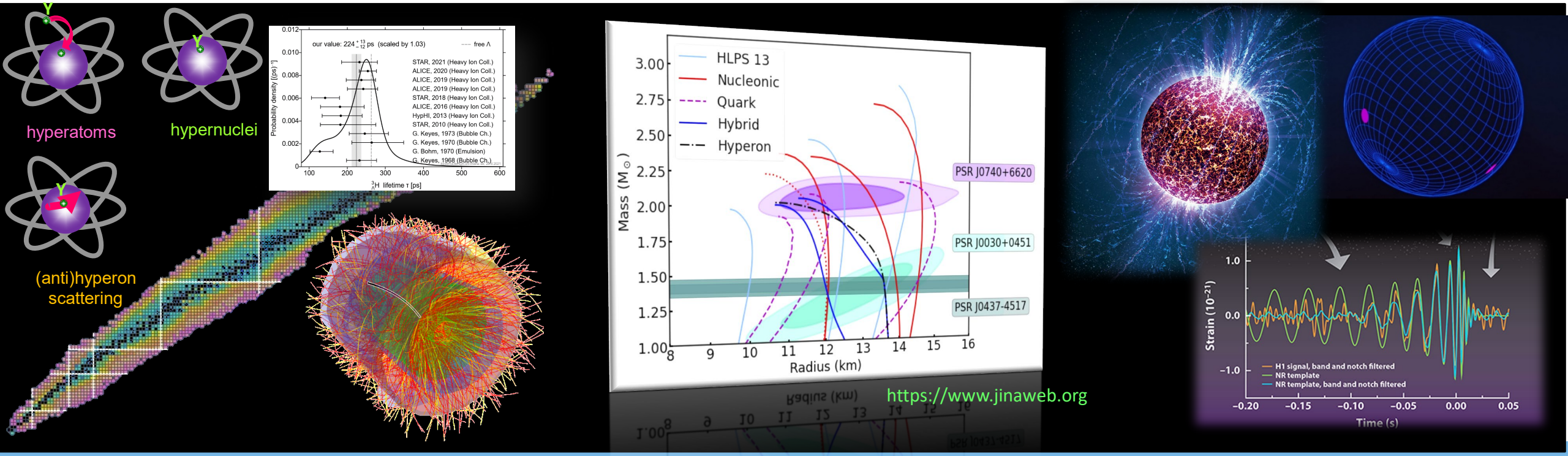


WP16: THEIA: Strange Hadrons and the Equation-of-State of Compact Stars

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 824093

Deliverables:

D16.1: Study of A=3 hypernuclei $^{3}_{\Lambda}$H and $^{3}_{\Lambda}$n	month 36 -	report
MS20: First data taking by WASA@GSI/FAIR searching for nnΛ ~~tentatively~~ scheduled in February (commissioning) and March (physics run) in 2022		
D16.2: Study of antihyperons in nuclei; PANDA software tools	month 30 -	demonstrator
MS21: Design report for antihyperons in nuclei ready	month 30	
D16.3: Theoretical and experimental studies of bound mesonic systems	month 30 -	report
MS22: SIDDHARTA-2 progress report	month 30	
D16.4: Hypernuclear database	month 48 -	public/webpage

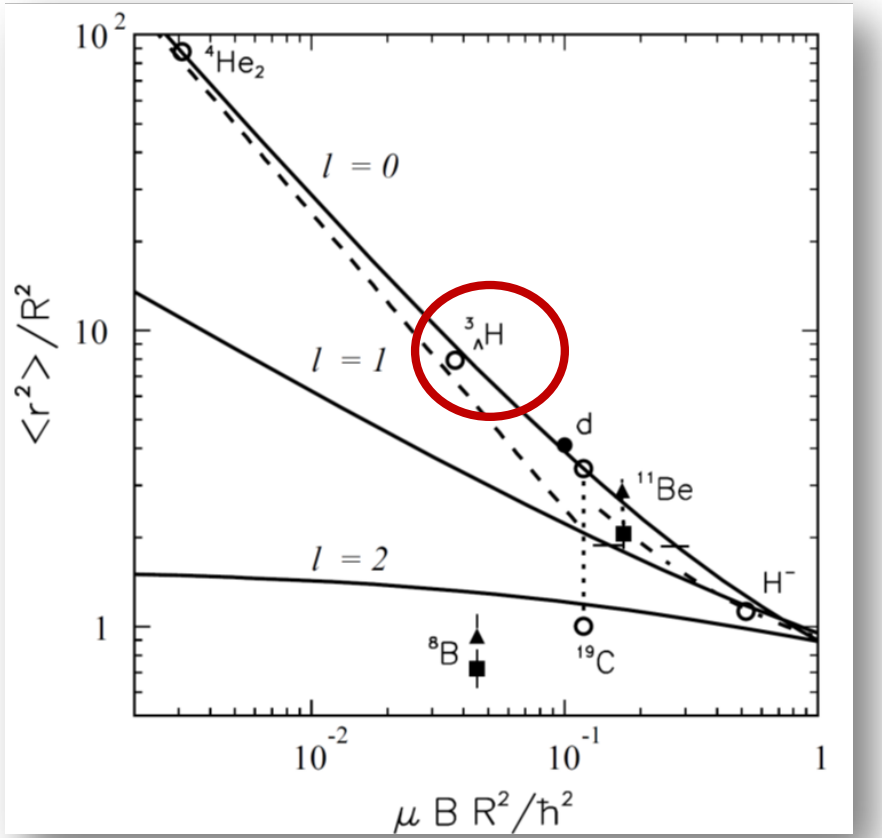
Annual workshops to guarantee effective and fruitful interactions

Deliverable 16.1: A=3 hypernuclei

- Hypertriton puzzle: very loosely bound system
  - Expected $\tau(^3_\Lambda\mathrm{H}) = \tau(\Lambda)$ $\Leftrightarrow$ observed: $\tau(^3_\Lambda\mathrm{H}) < \tau(\Lambda)$

$$\left\langle \Delta r^2 \right\rangle = \hbar^2 \,/\, (4\mu B) \xrightarrow{^3_\Lambda\mathrm{H}} 10\,\mathrm{fm}$$

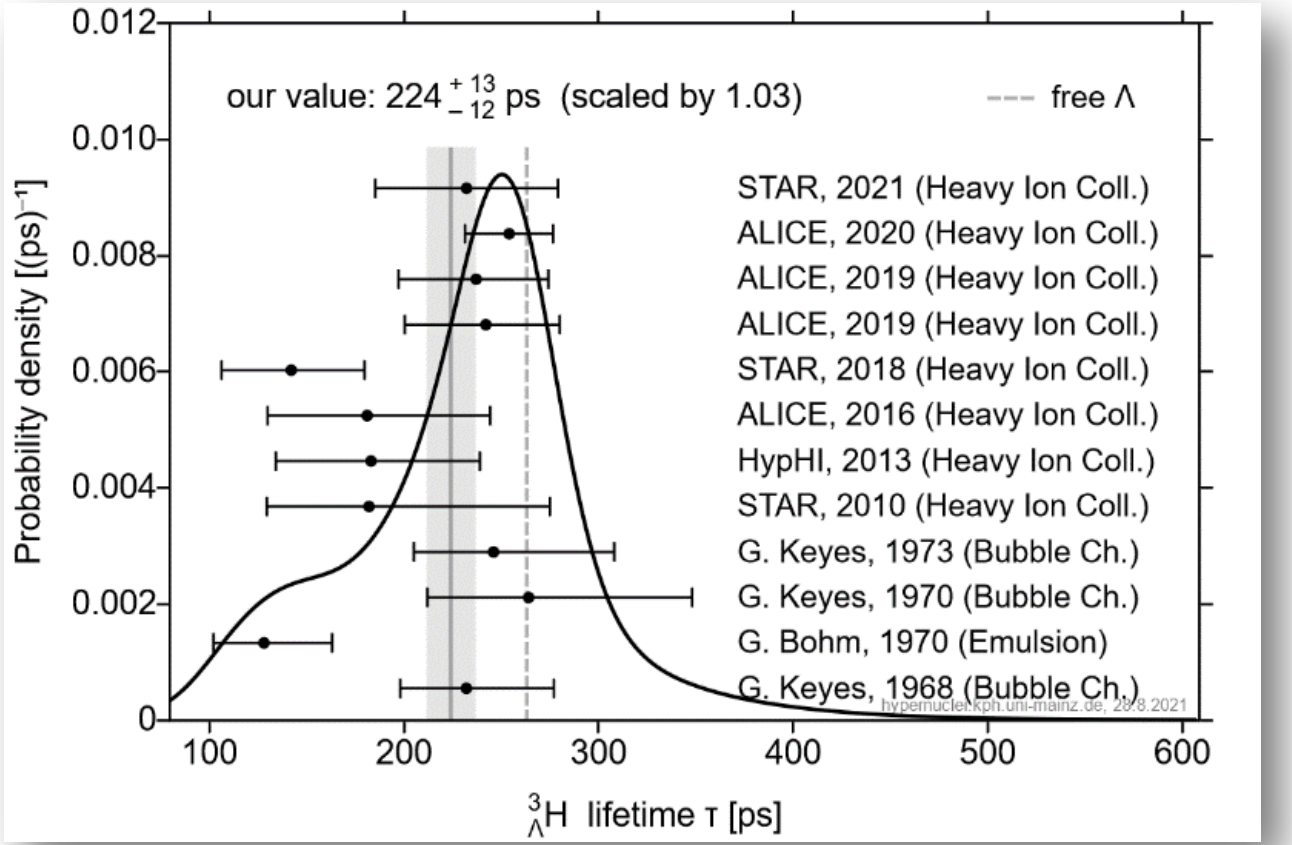
- Does a neutral A=3 hypernucleus nnΛ exist?
  - Observed tentatively by HypHI
  - Theoretically unlikely to exist
  - Needs experimental confirmation: Jlab E12-17-003, WASA@FAIR



K.Riisager,D.V.FedorovandA.S.Jensen, Europhys. Lett 49, 547 (2000)

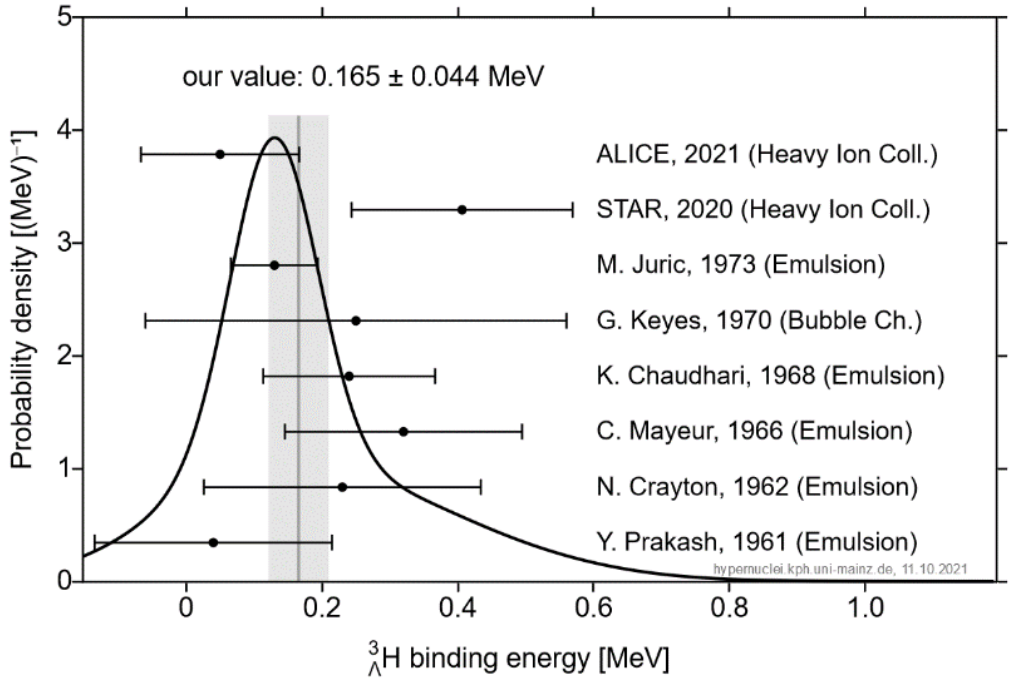
Deliverable 16.1: Hypertriton lifetime

- recent ALICE and STAR data show larger lifetime
  - average value still 15% below $\tau(\Lambda)$
- Ongoing or planned activities
  - J-PARC P73
    - successful test with ^{4}He target ($^4_\Lambda$H)
    - Expected error for lifetime ~ 10ps
    - stage-1 approval, waiting for ^{3}He run
  - WASA@GSI/FAIR (2022)
  - ELPH@TOHOKU (2022)
  - HADES: analysis ongoing
  - New ALICE and STAR data



Deliverable 16.1: Hypertriton binding energy

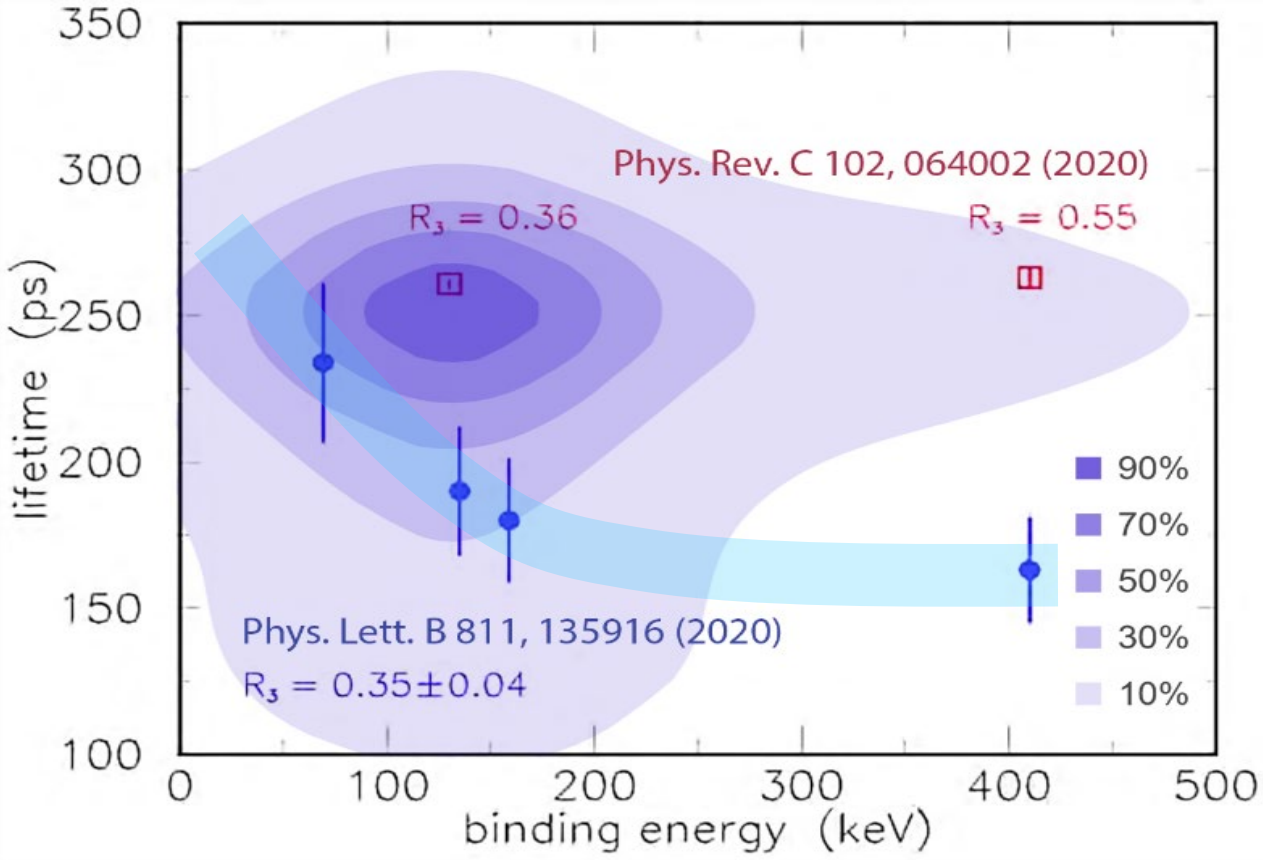
- Present situation
  - Emulsion data suggest very small binding energy ~130keV
  - New data from STAR show stronger binding ~410keV
  - Recent ALICE result ~50keV
- Ongoing and planned activities
  - MAMI: high resolution pion spectroscopy 2022, $\delta B_{sys} \approx 20$keV
  - Jlab (C12-19-002)
  - Analysis of JPARC-E07 emulsion data
- R3B@FAIR: Cross section for $^{3}_{\Lambda}$H: giant Λ-halo?



Deliverable 16.1: Status Hypertriton Puzzle

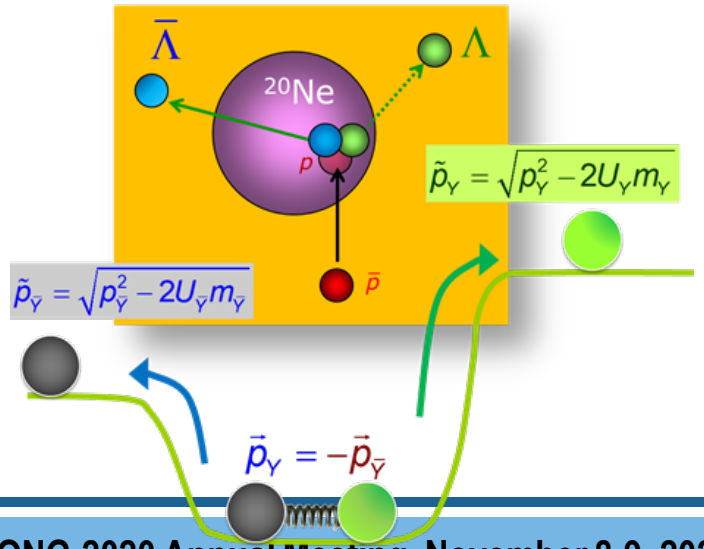
- Obiol et al., EFT
- π distorted waves and
- ΣNN admixture important
- $\Rightarrow$ strong relation between BE and τ

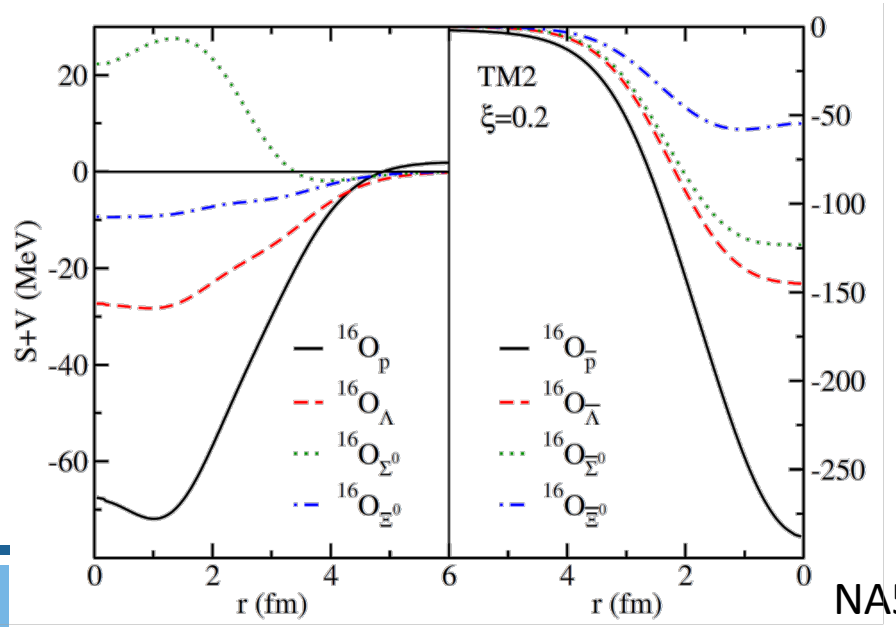
- Future experiments will focus on precision studies
- Guidance by nuclear theory (EFT, Lattice,…) is indispensable !



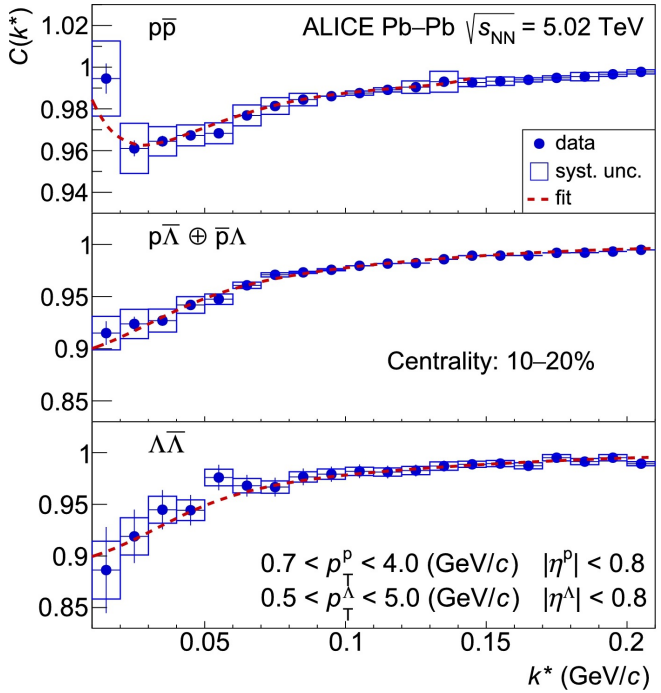
Deliverable 16.2: Antihyperons in Nuclei

- Baryon-antibaryon interactions can be studied by two-particle correlation functions in HI
- PANDA will measure the effective potential of Λ hyperons by the exclusive $^{20}Ne(\bar{p},\bar{\Lambda}\Lambda)$ reaction during PHASE-1 of PANDA
- ongoing work: development of reconstruction software (low momentum Λ and Λ decays !)





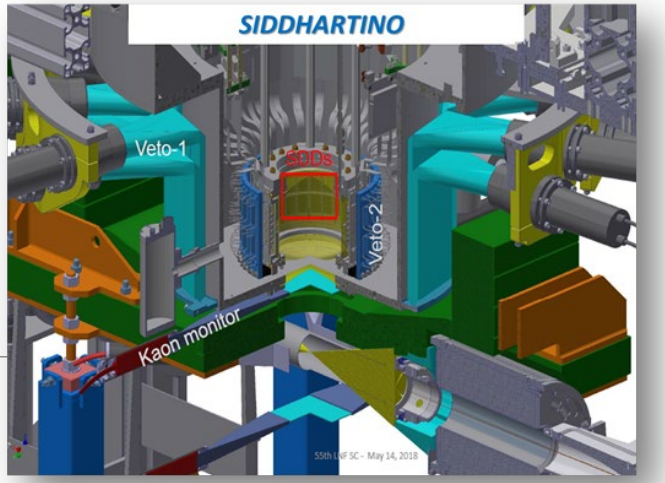
Physics Letters B 802 (2020) 135



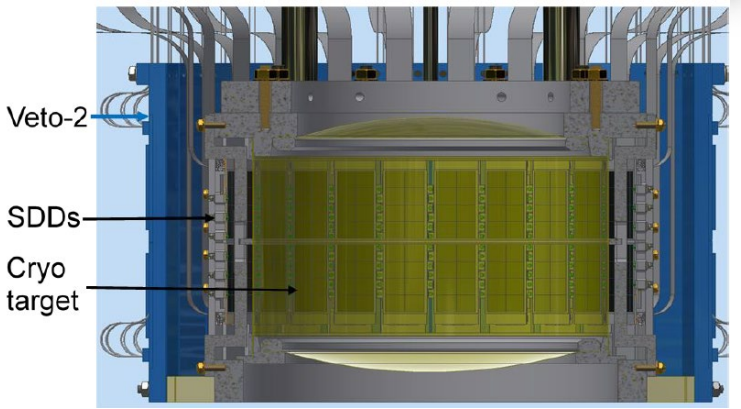
Jaroslava Hrtánková and Jirí Mareš
J. Phys.: Conf. Ser. 599 012007

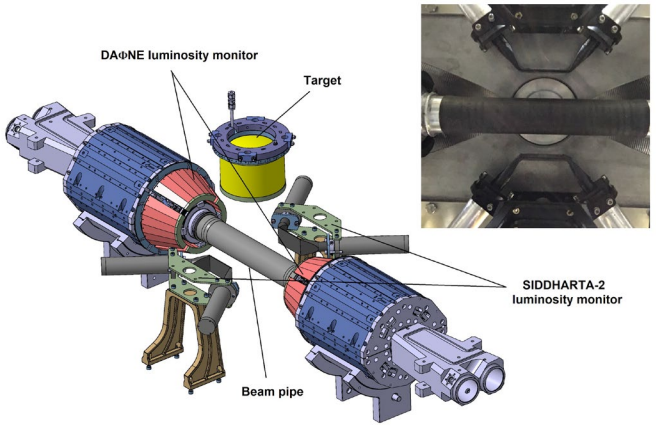
NA5 THEIA

Deliverable 16.3: SIDDHARTA-2



- Goal: study of kaonic deuterium with drastically increased signal-to-background ratio, by gaining in solid angle, by taking advantage of the new SDDs with improved timing resolution and by implementing additional veto systems.
- measurements with SIDDHARTINO (PHASE 1) will determine and contribute to optimize the level of the background and the Signal/Background optimized working conditions for SIDDHARTA-2.
- SIDDHARTINO is a reduced version of SIDDHARTA-2 - with 1/6 Silicon Drift Detectors
- Timeline
  - SIDDHARTINO: January 2021 – July 2021: kaonic helium
  - SIDDHARTA-2 - end 2021 to all 2022: kaonic deuterium





Deliverable 16.3: SIDDHARTA-2

- SIDDHARTINO run from January to 18 July 2021
- Main goal
  - commissioning and check detectors
  - measure machine luminosity
  - Background optimization background

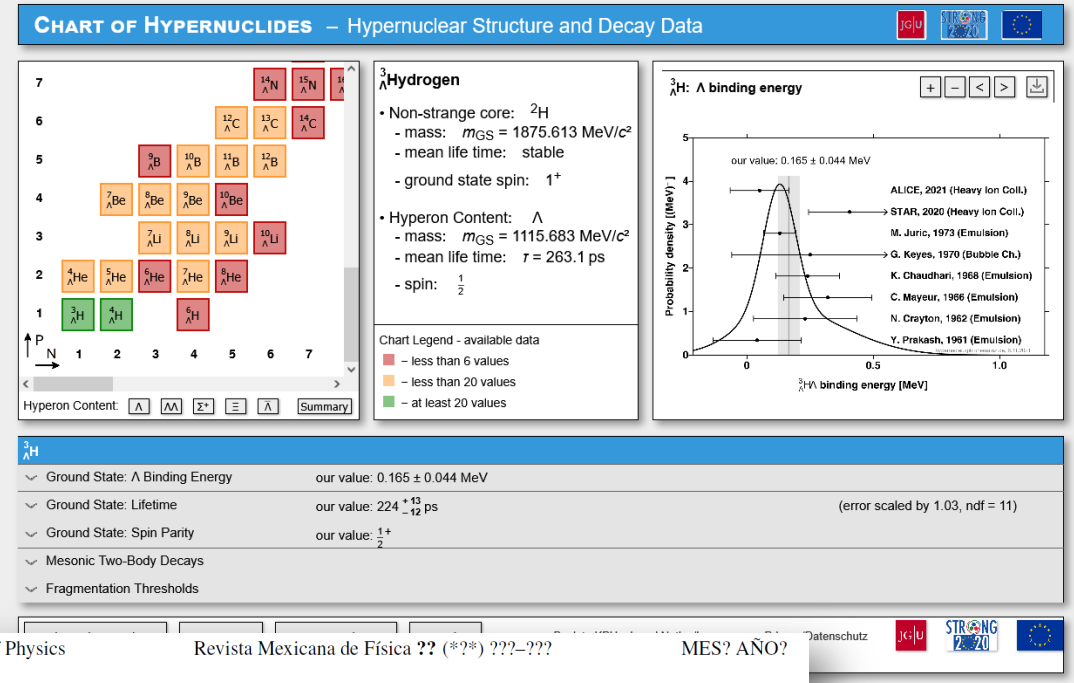
- Physics run:
  - kaonic helium at 2 densities: 1.5% liquid and 0.75 % liquid densities
  - most precise measurement of K_{He} transitions to 2p level in gas.

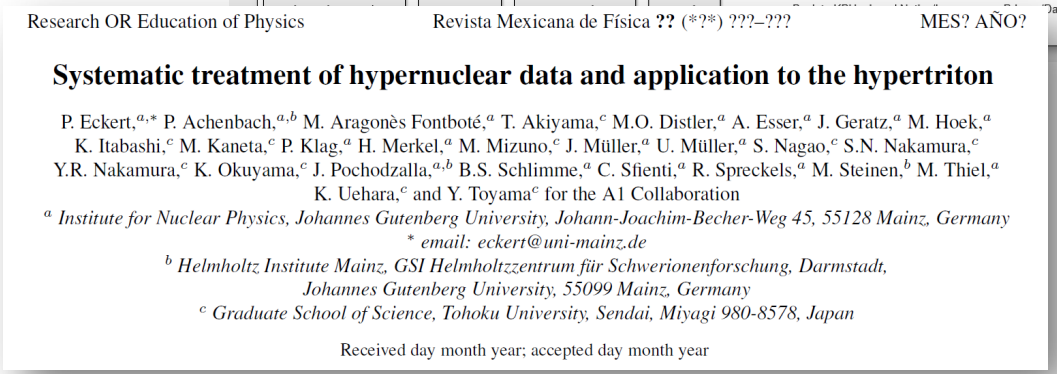
GDPR

Deliverable 16.4: Hypernucleus Database

- a interactive hypernucleus database is being built at Mainz
  - https://hypernuclei.kph.uni-mainz.de/
  - goal: provides complete overview of existing data
  - summary plots, errors etc generated automatically
  - export data and plots to files possible

- DB will continuously updated with new data
- First report will be published in HADRON2021 proceedings





Research OR Education of Physics Revista Mexicana de Física ?? (*?*) ???–??? MES? AÑO?

Systematic treatment of hypernuclear data and application to the hypertriton

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Received day month year; accepted day month year

Deliverable: Workshops

- First workshop in Speyer Nov. 2019
  - https://indico.gsi.de/event/8950/
- Online web-seminar due to Covic-19
  - Seminar 2020/2021
  - https://indico.gsi.de/category/513/
  - 47 talks during 27 weeks
  - Seminar 2021/202
  - https://indico.gsi.de/category/571/
  - Started 20th October 2021
- Future
  - HYP2022 in Prague, June 27 – July 1, 2022 (planed in to be hold in presence)
  - Spring 2023 location tba

Summary

Despite many rescrictions due to the pandemic, all delivarables and milestone will be achieved within duration of STRONG2020

D16.1: Study of A=3 hypernuclei $^{3}_{\Lambda}$H and $^{3}_{\Lambda}$n	month 36 - report
MS20: First data taking by WASA@GSI/FAIR searching for nnΛ scheduled in spring 2022	month 36
D16.2: Study of antihyperons in nuclei; PANDA software tools	month 30 - demonstrator
MS21: Design report for antihyperons in nuclei ready	month *30 + ?*
D16.3: Theoretical and experimental studies of bound mesonic systems	month 30 - report
MS22: SIDDHARTA-2 progress report	month *30 + ?*
D16.4: Hypernuclear database is online and will continually updated	month *End* - public/webpage

Annual workshops will be resumed in 2022 if COVID-19 situation allow