

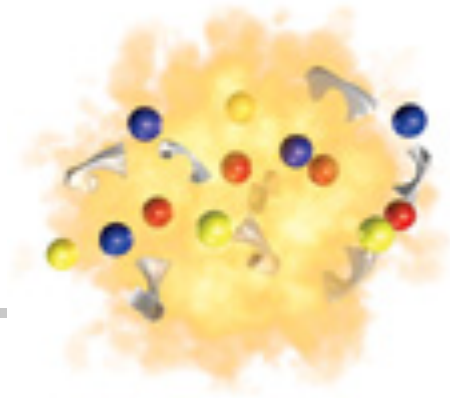
The 12th International Conference on
Hypernuclear and Strange Particle Physics

HYP2015

September 7 – 12, 2015
Tohoku University, Sendai, Japan



Strangeness @ extremes



ICE

Laura Tolós

IEEC  **CSIC**
CONSEJO SUPERIOR DE INVESTIGACIONES CIENTÍFICAS

ICE, IEEC/CSIC, Barcelona
FIAS, University of Frankfurt



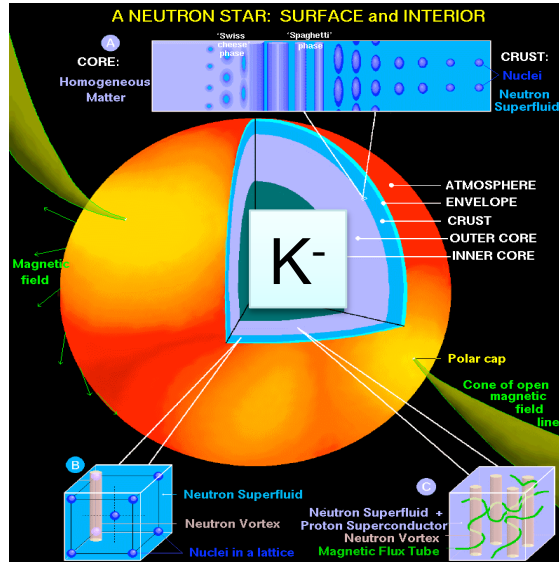
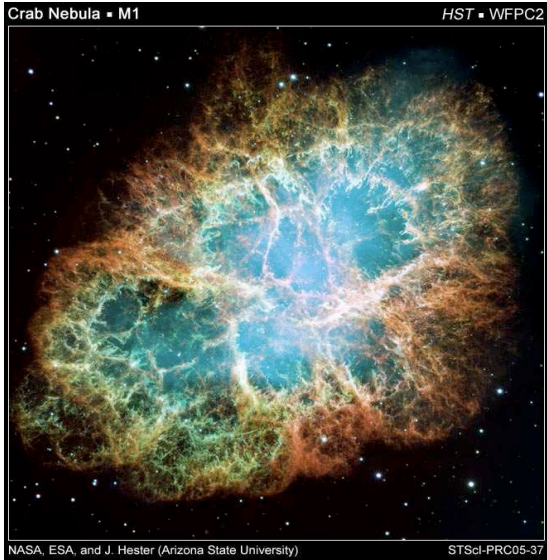
FIAS Frankfurt Institute
for Advanced Studies



In collaboration with

Daniel Cabrera, Kanchan Khemchandani, Alberto Martinez-Torres,
Eulogio Oset and Angels Ramos;
Elena Bratkovskaya and Joerg Aichelin

Strange mesons in dense matter

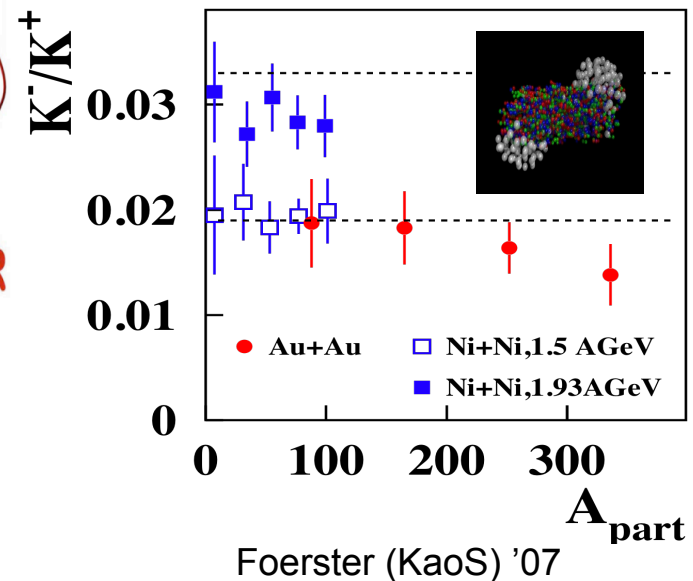
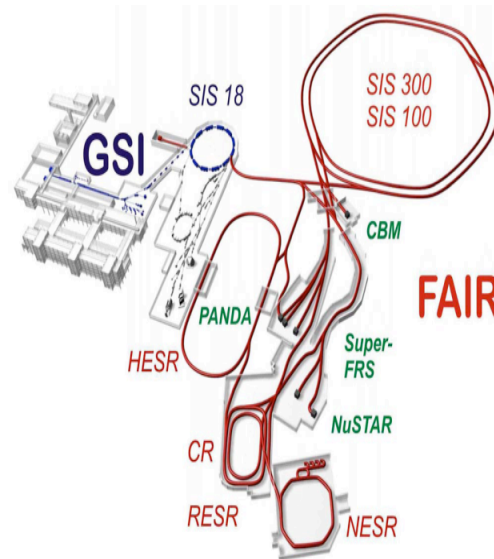


Kaon condensation in neutron stars

Kaplan and Nelson '86 ...

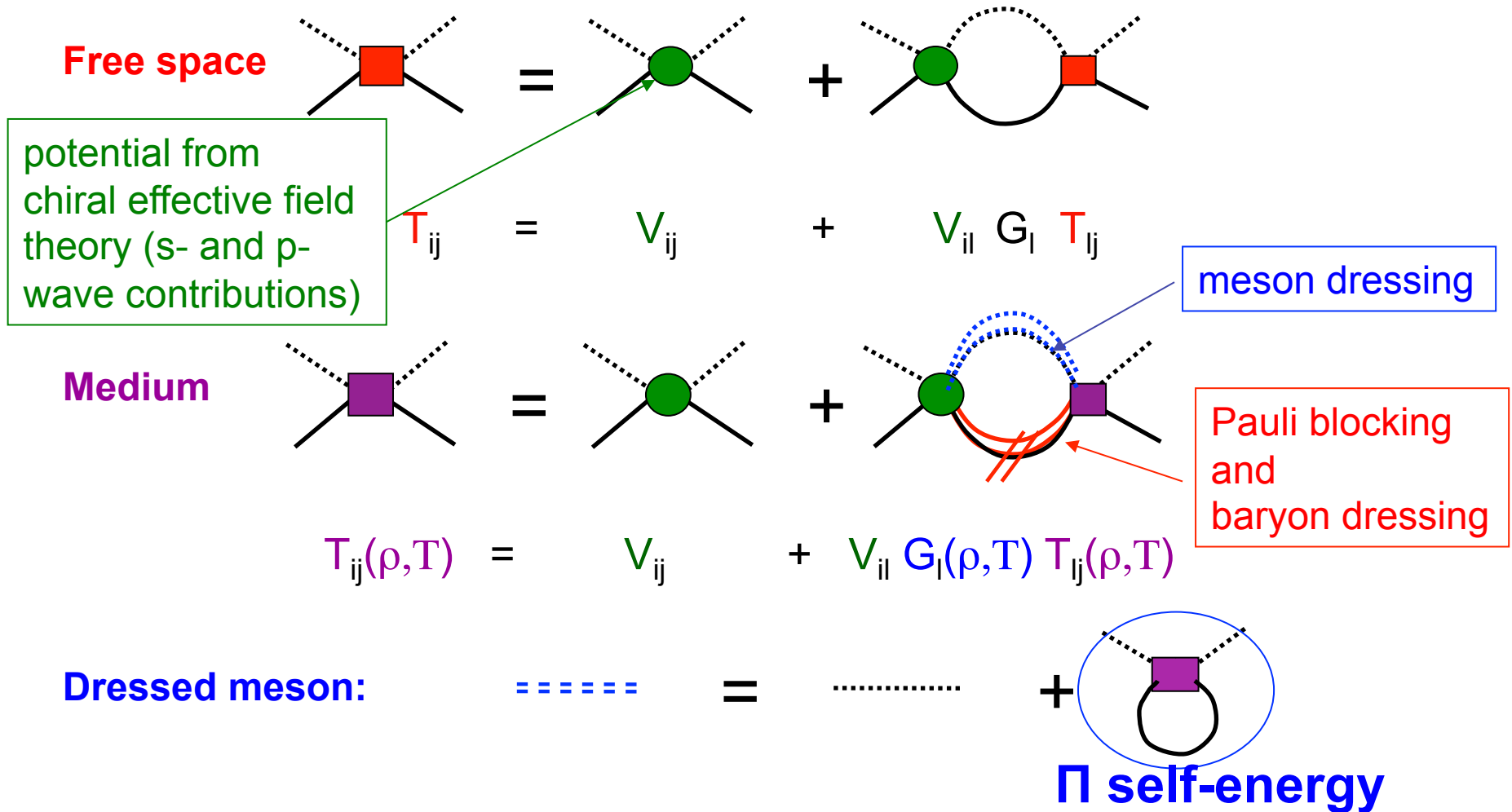
GSI/SIS data (KaoS/FOPI/HADES) and future FAIR

- Crochet et al (FOPI)'00
- Wisniewski et al (FOPI) '00
- Foerster et al (KaoS) '07
- Salabura '12 (HADES)
- CBM (FAIR) Physics Book '11..



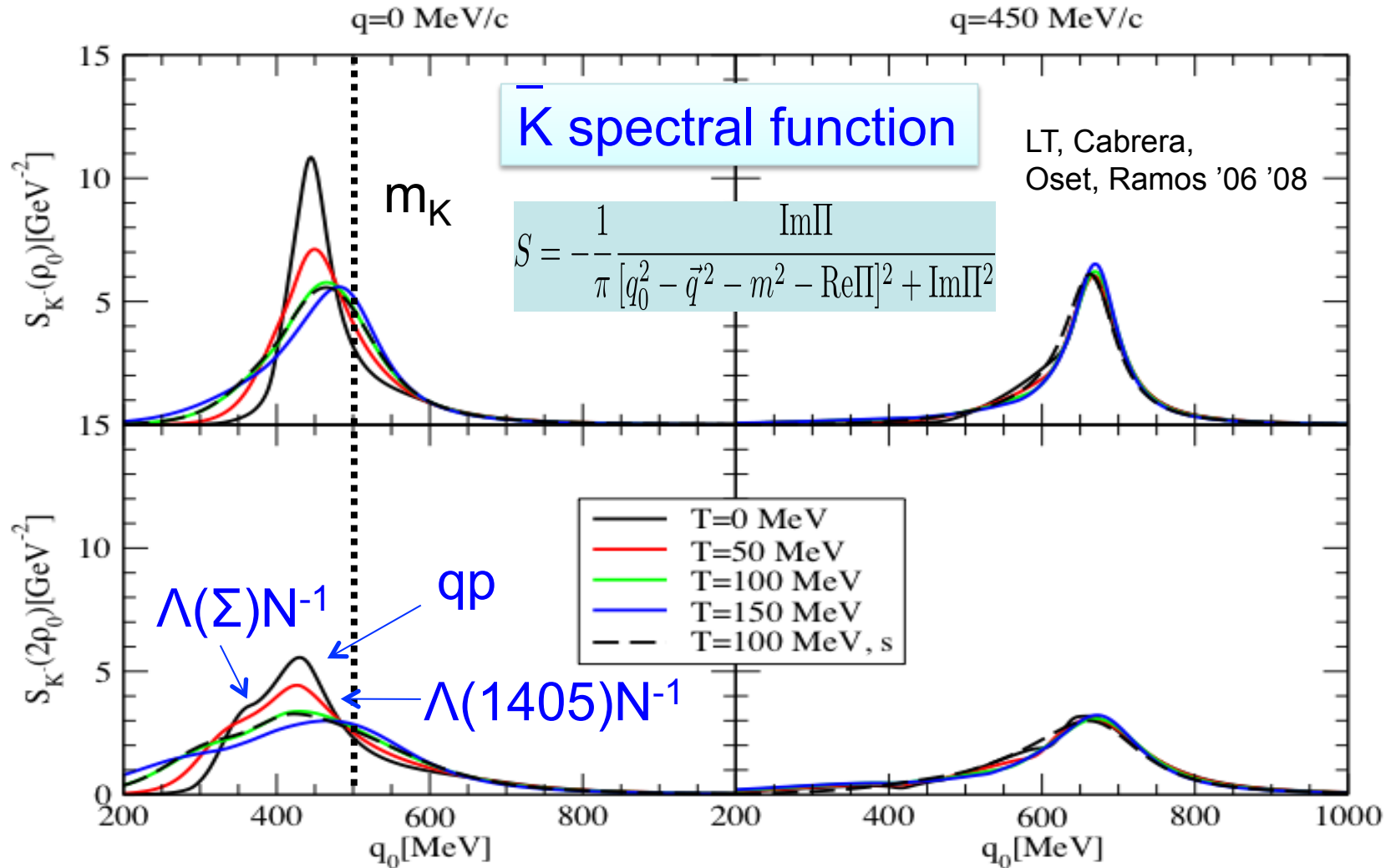
Pseudoscalar mesons with strangeness: \bar{K} in matter

Unitarized theory in matter:
selfconsistent coupled-channel procedure

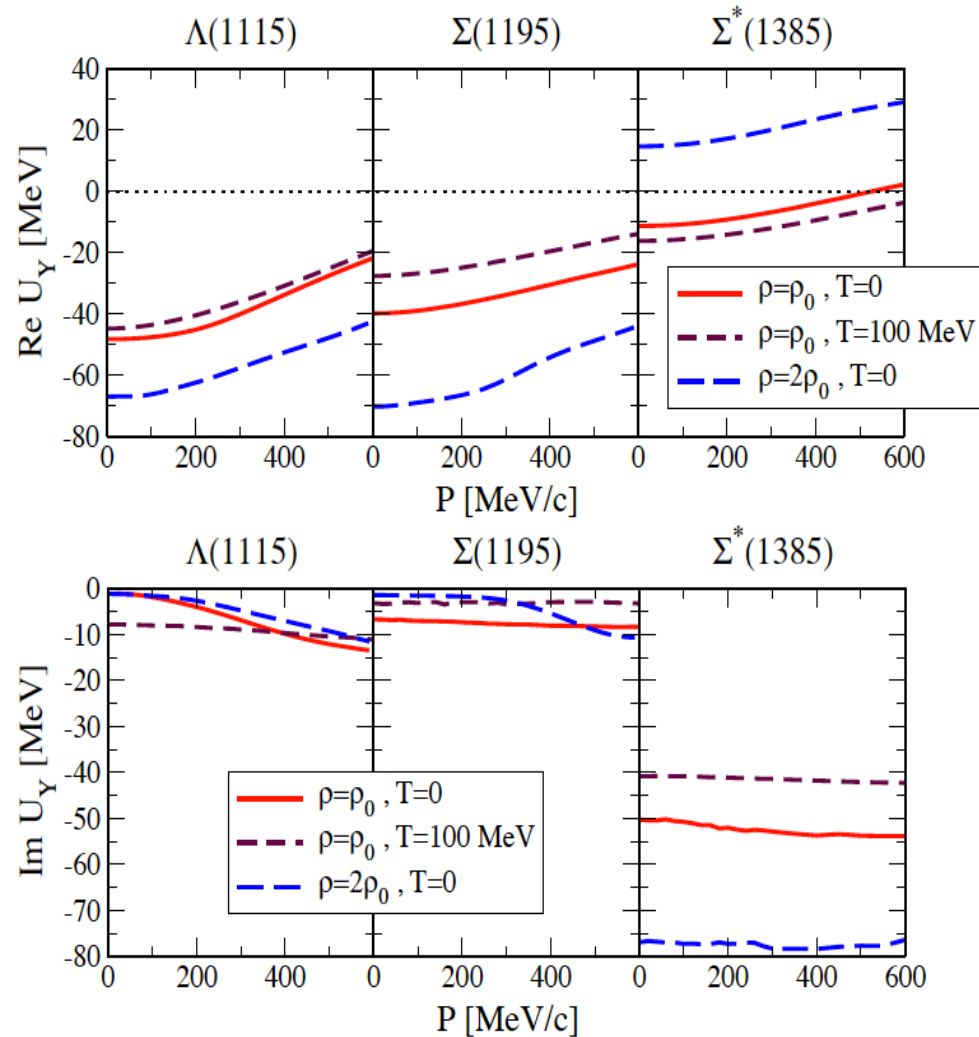


Unitarized theory in matter: selfconsistent coupled-channel procedure

Koch '94; Waas and Weise '97;
Kaiser et al '97; Oset and Ramos'98;
Lutz '98; Schaffner-Bielich et al '00;
Ramos and Oset '00; Lutz et al '02 ;
LT et al '01 '02; Jido et al '02 '03;
Magas et al '05; LT et al '06 '08;
Lutz et al '08



Some recent results on hyperon potentials...



- $\text{Re } U_\Lambda(\rho_0) = -50 \text{ MeV}$
 $\text{Re } U_\Sigma(\rho_0) = -40 \text{ MeV}$
 Experimentally, ΛN interaction in matter is attractive and ΣN interaction in matter is under debate

- Λ and Σ acquire a finite width at finite density and temperature

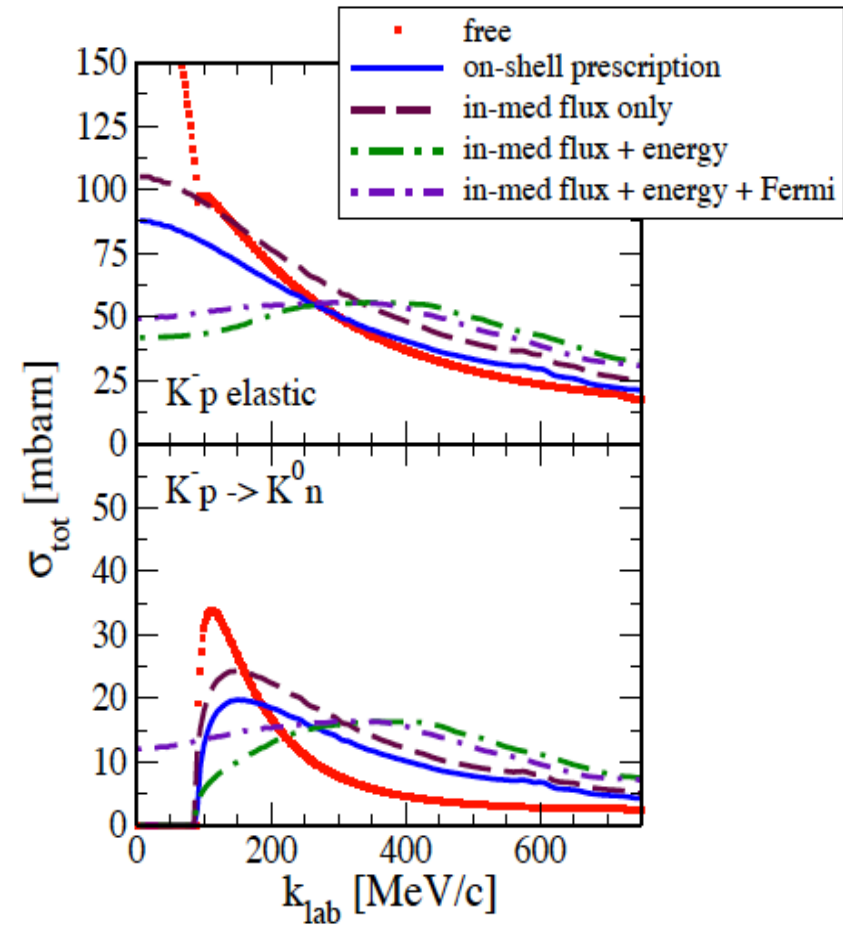
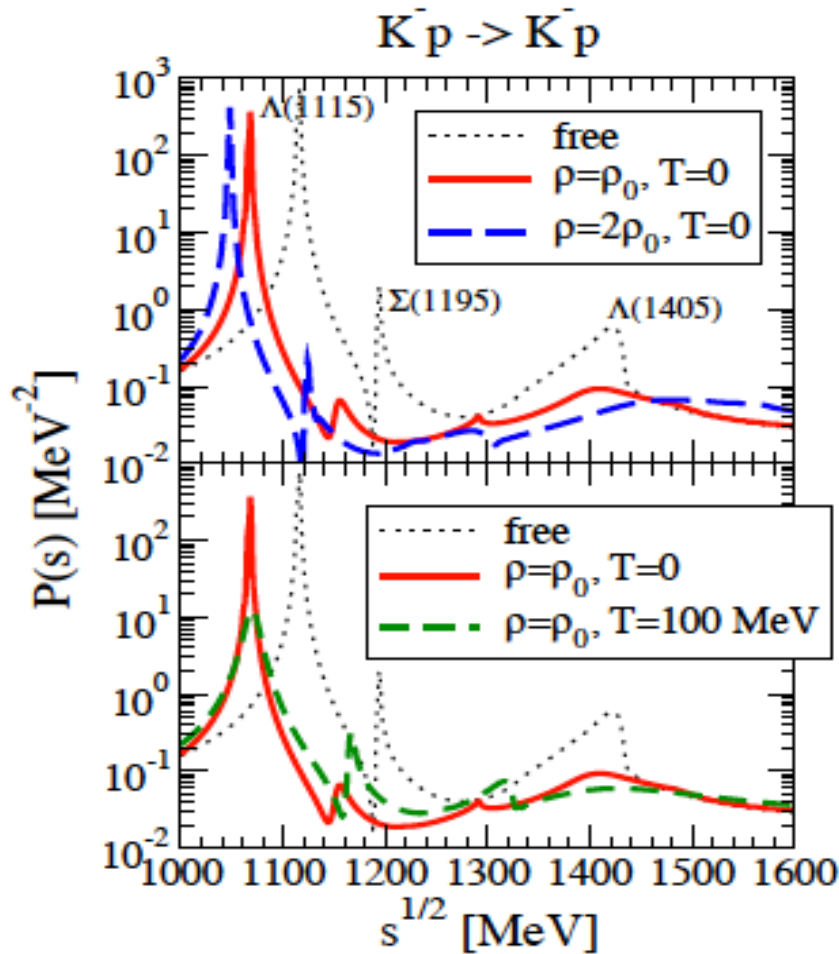
- Σ^* develops a small real part while imaginary part is more important

- Smooth behavior of hyperon potentials with momentum, density and temperature

..and on transition probabilities/cross sections in hot dense matter

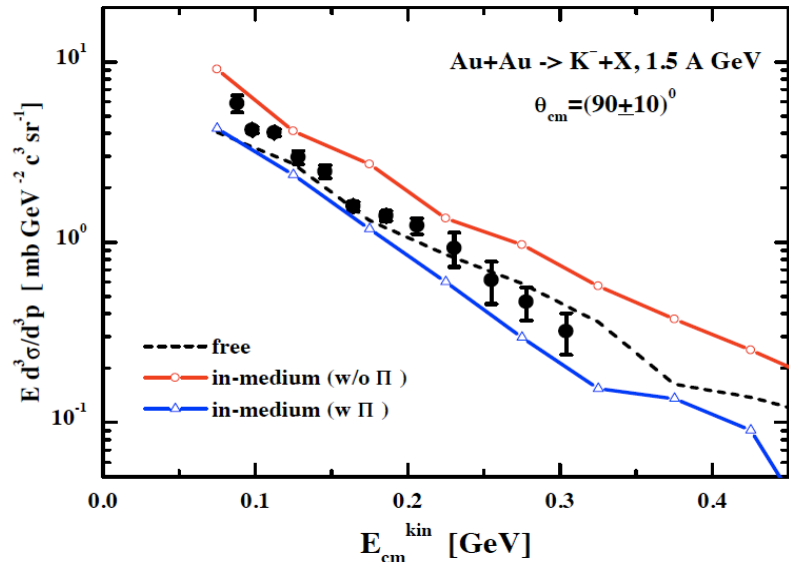
$$P = \int d\Omega |T|^2$$

$$\sigma(s) \propto \frac{M_i M_j}{s} \frac{q_j}{q_i} \int d\Omega |T|^2$$



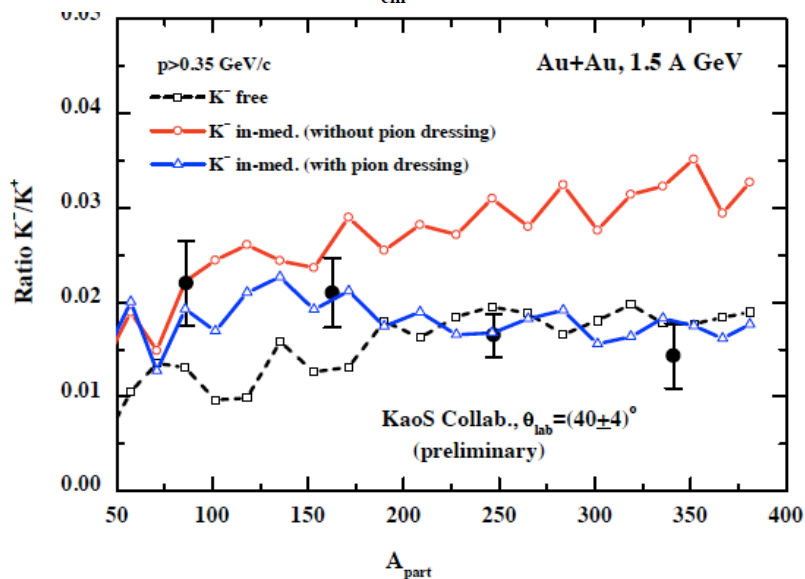
Strangeness production in heavy-ion collisions

Recent report on strangeness production close to threshold in proton-nucleus and heavy-ion collisions Hartnack et al. '12



First attempts to describe all data simultaneously with full spectral features of strange mesons

Cassing, LT, Bratkovskaya and Ramos '03



Collaboration ICE-FIAS-SUBATECH:

Working on implementing the properties of strange mesons in dense hot matter coming from chiral effective theory in an off-shell transport model for heavy-ion collisions

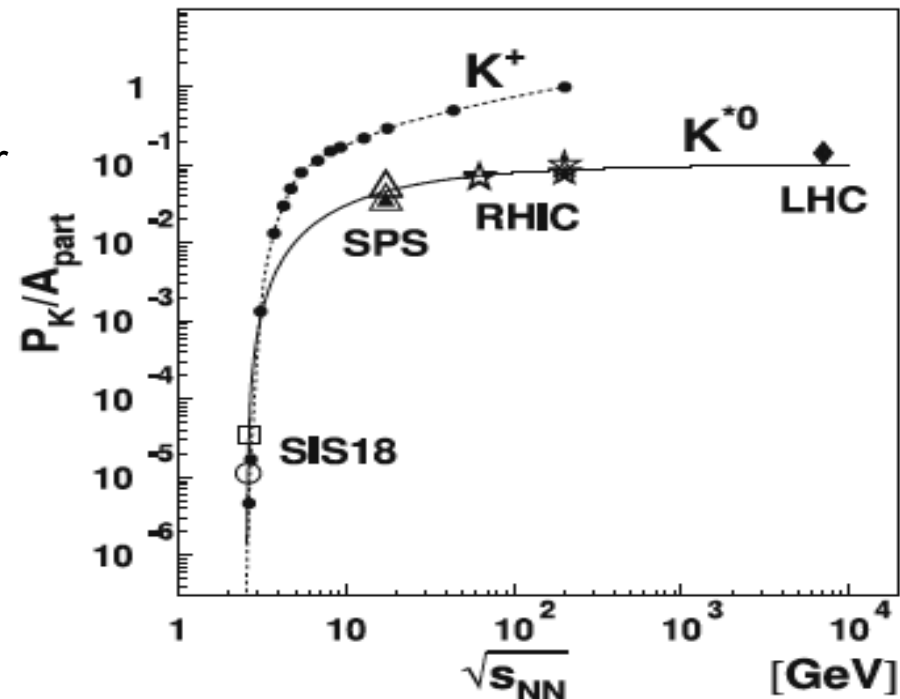
Vector mesons with strangeness: K^*

- Vector mesons in nuclear matter are tied to fundamental aspects of QCD
- Lot of attention paid to ρ , ω , ϕ in dense matter
- What about strange vector mesons, such as K^* ?

Working on the $K^{*(0,+)}$ properties in the nuclear medium at HADES

Some results on K^* properties in matter
Ilnert, Cabrera, Srisawad and Bratkovskaya '14

Recent results on deep subthreshold $K^*(892)$ production in Ar+KCl at 1.76 AGeV
Agakishiev et al (HADES) '13



Recent results on strangeness +1 KN - K*N systems

Khemchandani, Martinez-Torres, Navarra, Nielsen and LT '15

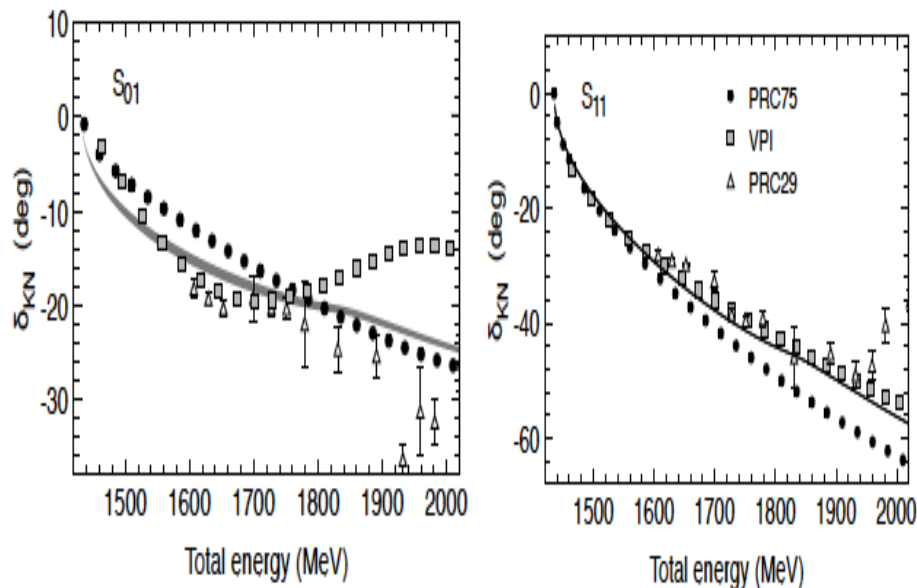
Potential for

KN : LO chiral Lagrangian

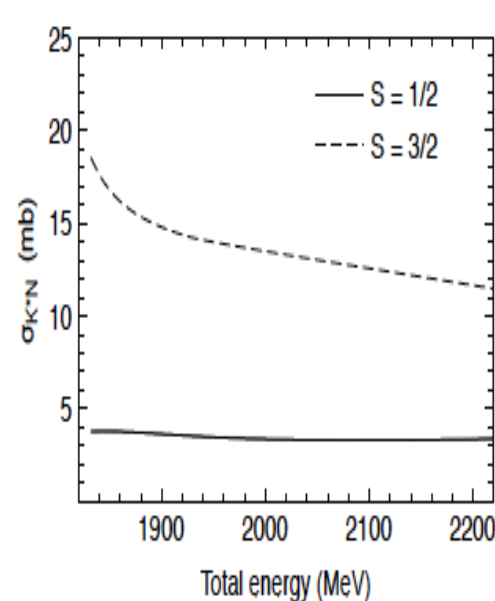
K*N : s-,t-,u- channels and contact term from hidden gauge formalism

KN-K*N : extension of Kroll-Ruderman term

We fit subtraction constants to KN I=0 and I=1 phase shifts



We predict KN and K*N cross sections, and K*N scattering lengths



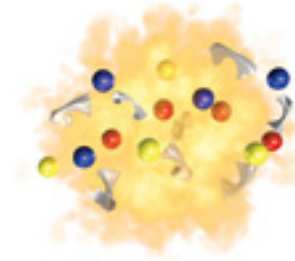
$a_{K^*N}^{I,S}$ (fm)
$I = 0, S = 1/2$
(0.2, 0.03)
$I = 0, S = 3/2$
(-0.08, 0.04)
$I = 1, S = 1/2$
(0.1, 0.0)
$I = 1, S = 3/2$
(-0.31, 0.03)

Results of special interest from K* production in p+p and p+A collisions

@ HADES, STAR and NA49

Present and Future

- it is an **exciting moment**
- there are several **open questions in strangeness in hot and dense matter**
- **theoretical effort** is needed
- in close **connection to experiments**



HIC | **FAIR**
for
Helmholtz International Center

