Current Status

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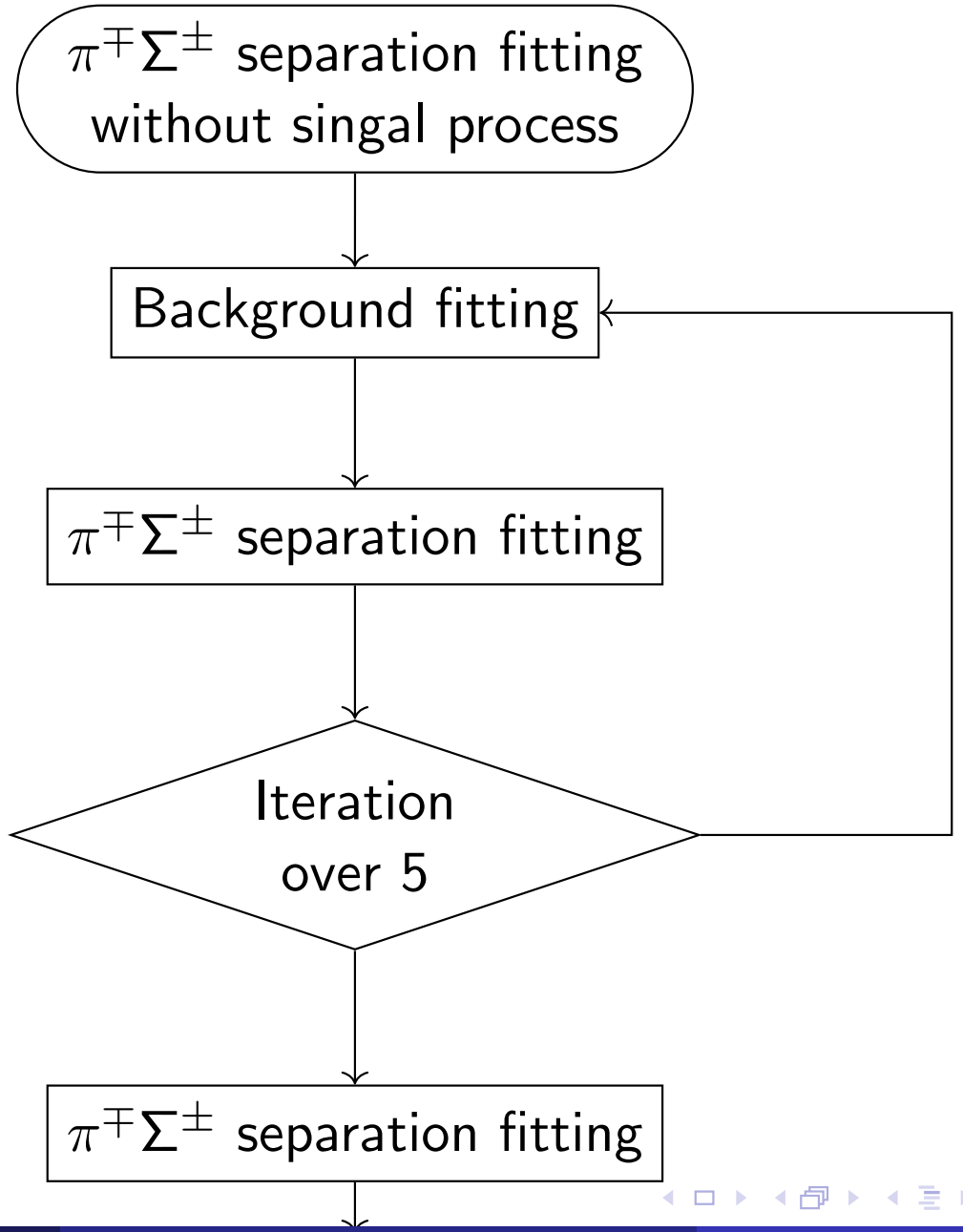
Fitting assuming the 2-step reaction

$$\frac{d\sigma}{dMd\Omega} = \int T_{\bar{K}N\to\bar{K}N}\Phi_d(q_N 2)G_0 T_{\bar{K}N\to\pi\Sigma}dq$$

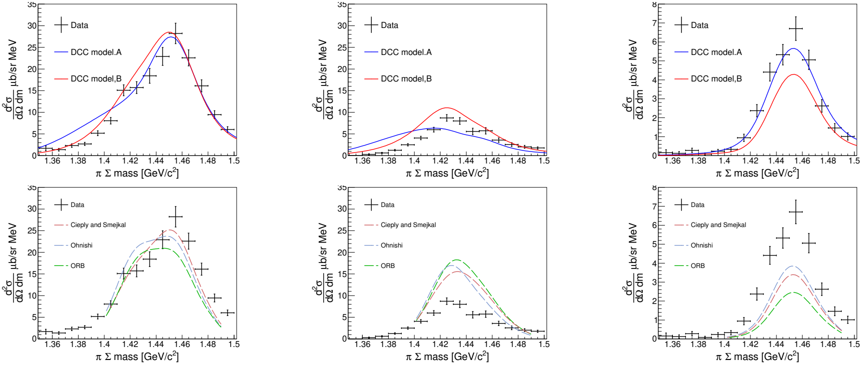
$$f_{res}(M_{\pi\Sigma}) = \left|\int T_{\bar{K}N\to\bar{K}N}G_0\Phi_d(q_{N2})\right|$$

$\pi^{\pm}\Sigma^{\pm}$ Separation



$K^-(d, n)\pi\Sigma$ Reaction

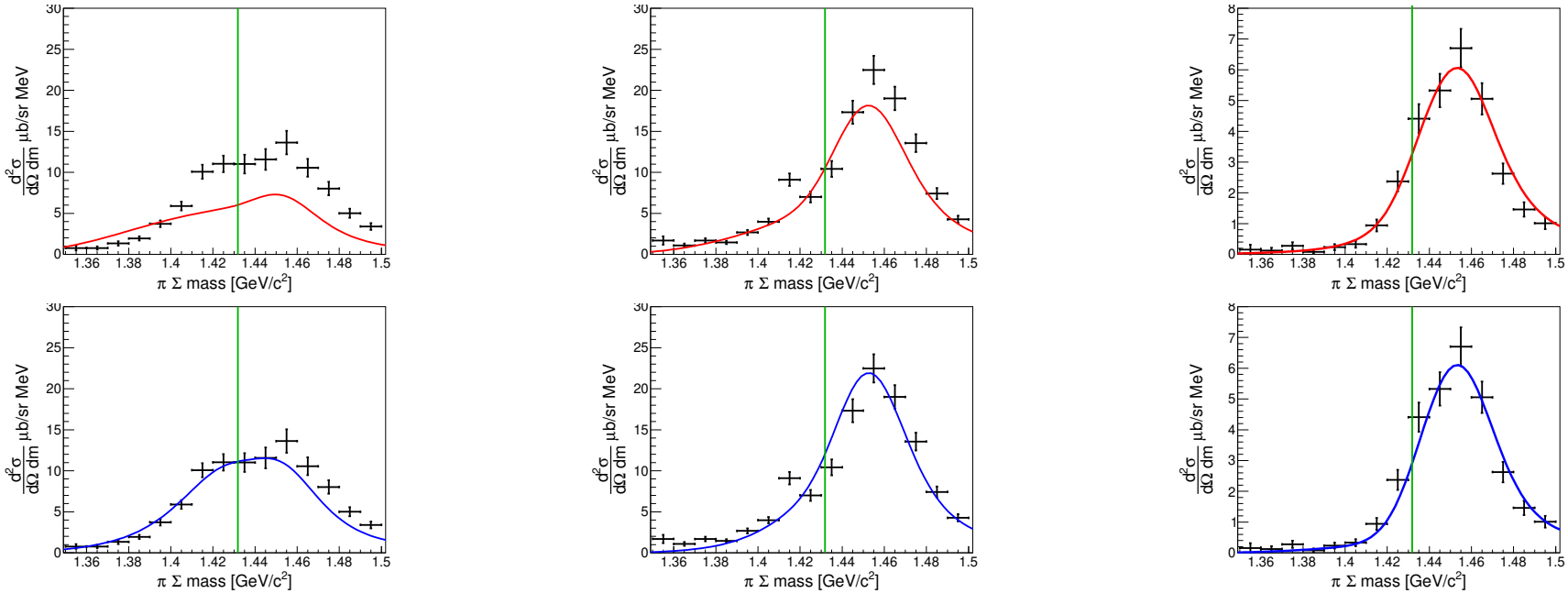
Comparison with Theoritiacl Calc



No fitting parameter

⇒ DCC corresponds all spectra

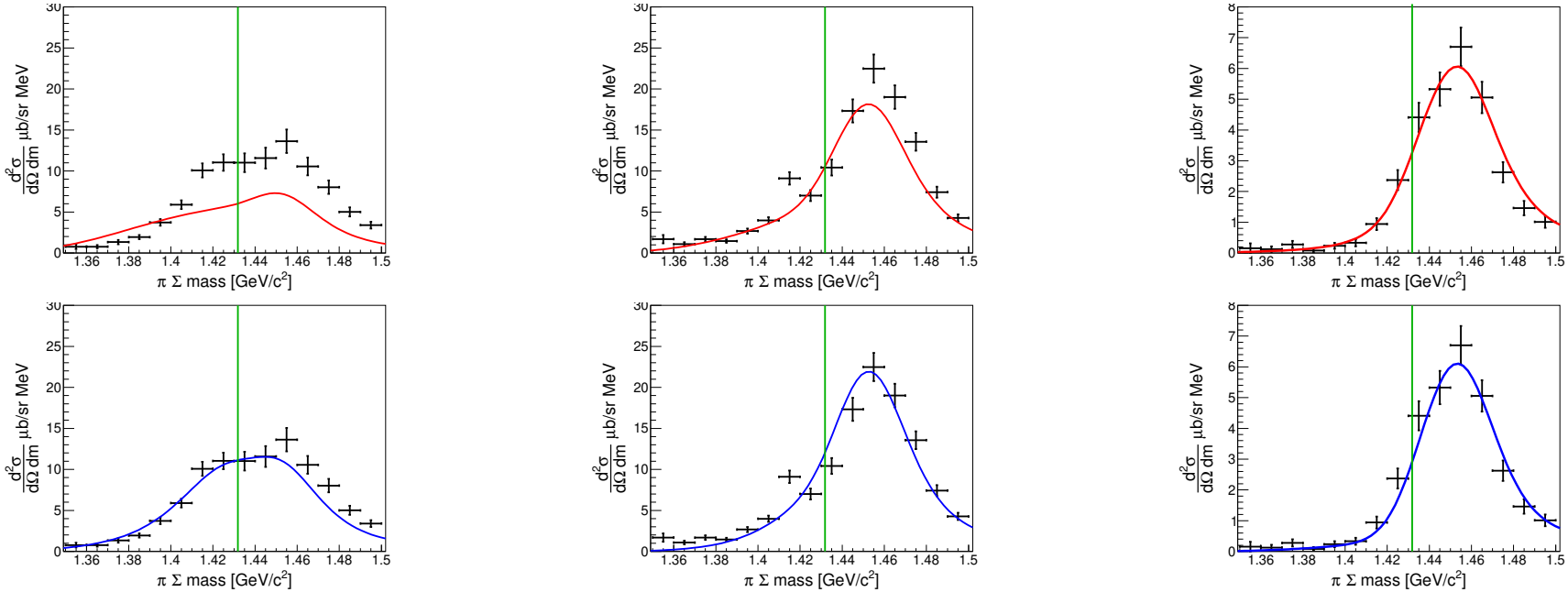
Fitting with Scaleing Parameter



	Scale $I=0$	Scale $I=1$	χ^2/NDF
Model.A	0.562 ± 0.015	1.070 ± 0.040	$691/42 = 16.4$
Model.B	0.721 ± 0.016	1.423 ± 0.055	$220/42 = 5.25$

	pole1($\bar{K}$)	pole2($\pi\Sigma$)
Model.A	$1437 - 75i$	$1372 - 56i$
Model.B	$1428 - 31i$	$1397 - 98i$

Fitting with Scaleing Parameter

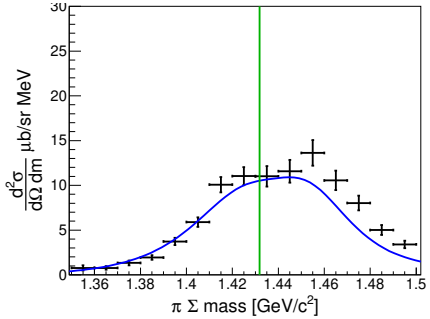


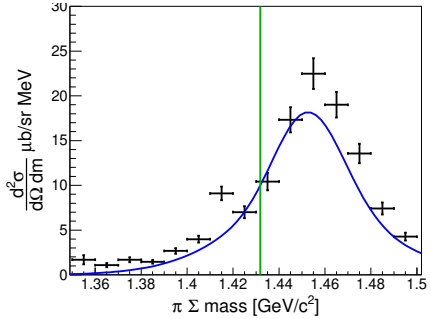
$\Rightarrow$ Model.A not corresponds due to wide width of pole.1.

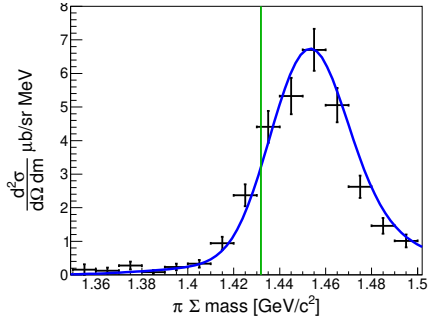
	pole1($\bar{K}N$)	pole2($\pi\Sigma$)
Model.A	$1437 - 75i$	$1372 - 56i$
Model.B	$1428 - 31i$	$1397 - 98i$

Fit with interference term

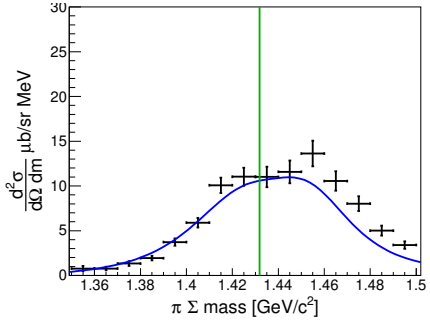
Fix $I = 1$strength by $\pi^-\Sigma^0$ spectra

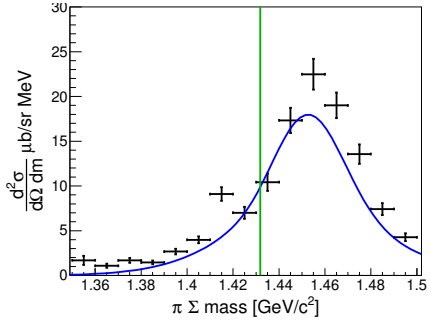


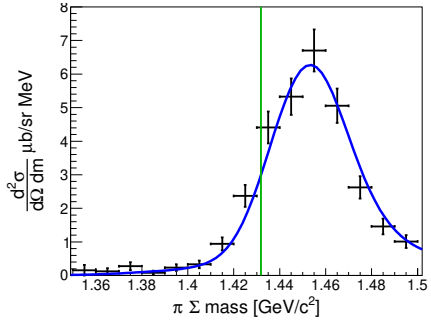




All parameters are simultaneously fitted





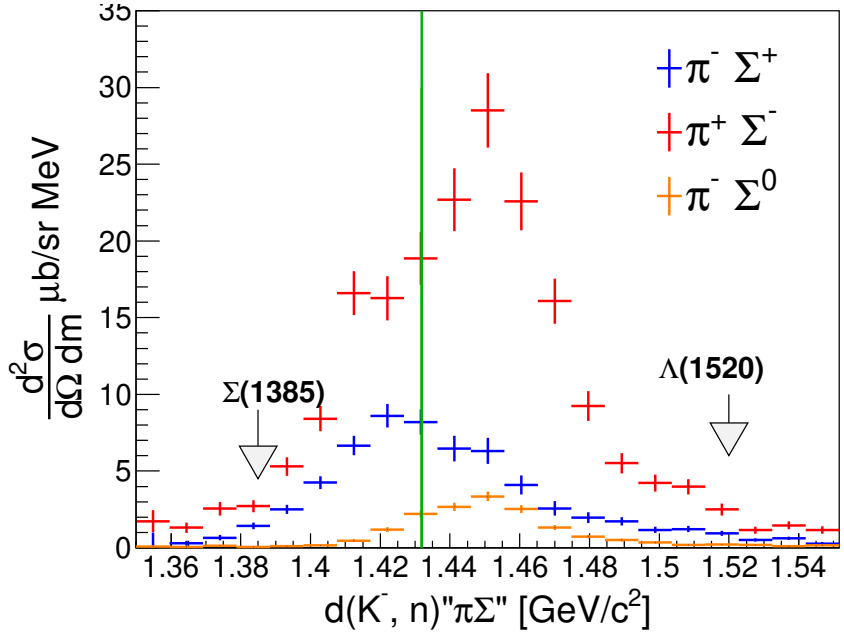


	Scale $I = 0$	Scale $I = 1$	interfer	χ^2/NDF
Fix $I = 1$	0.682 ± 0.017	1.570 ± 0.058	0.811 ± 0.030	$184/41 = 4.48$
All fit	0.686 ± 0.017	1.462 ± 0.059	0.828 ± 0.030	$187/41 = 4.56$

Fit is improved.

Almost same result fix $I = 1$ or not.

Spectra



$$\frac{d\sigma}{d\Omega dM}(\pi^{\mp}\Sigma^{\pm}) \propto \left| C^0_{K^-N\to\bar{K}N}\, T^{I=0}_{\bar{K}N\to\pi\Sigma} \mp C^1_{K^-N\to\bar{K}N}\, T^{I=1}_{\bar{K}N\to\pi\Sigma} \right|^2$$
$$\mp 2\mathrm{Re}\left(C^0_{K^-N\to\bar{K}N} C^1_{K^-N\to\bar{K}N}\, T^{I=0}_{\bar{K}N\to\pi\Sigma}\, T^{I=1}_{\bar{K}N\to\pi\Sigma} \right) \quad (1)$$

$$\frac{d\sigma}{d\Omega dM}(\pi^-\Sigma^0) \propto \left| C^1_{K^-N\to\bar{K}N}\, T^{I=1}_{\bar{K}N\to\pi\Sigma} \right|^2 \quad (2)$$

Table of Content

Discovery of the $\Lambda(1405)$

$\Lambda(1405)$(PDG)

$S = -1, J^P = (\frac{1}{2})^-$

$m = 1405.1^{+1.3}_{-1.0} MeV/c$

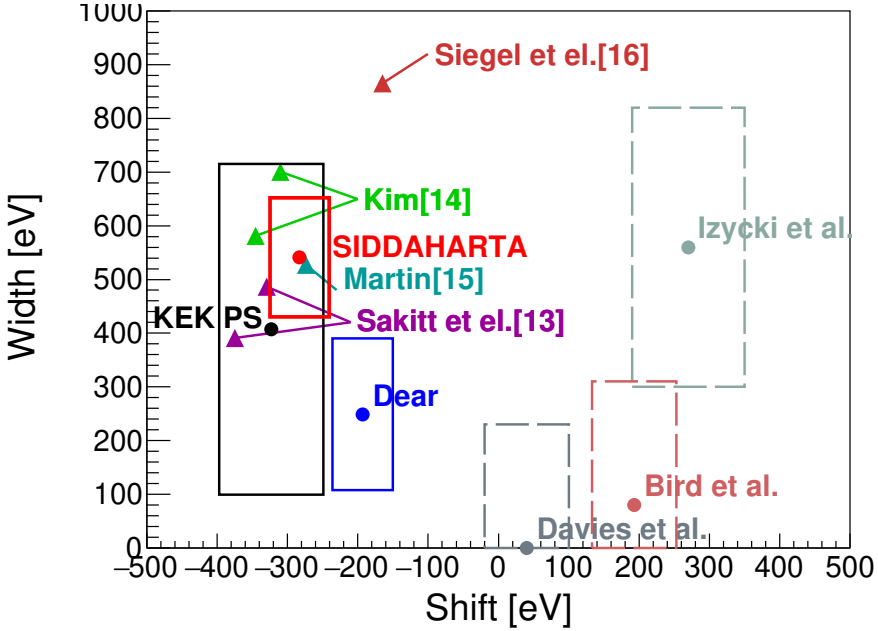
$\Gamma = 50.5 \pm 2.0 MeV/c$

1959 R. H. Dalitz and F. taun was predicted.

1961 The candidate was discoveried in $K^- p \to \pi\pi\pi\Sigma$ at the LRL.
There are ambiguity of π.

1985 The high statics data was reported with 4.2 GeV/c K^- beam by R. J. Hemingway.
$\Rightarrow \pi^+\Sigma^-$ spectrum was used first analysis by the R. H. Dalitz.

$\bar{K}N$ interaction (Kaonic hydrogen puzzle)



Deser-Trueman formula

$$\Delta E_1^s - \frac{i}{2}\Gamma_1 = -2\alpha^3 \mu_c^2 a_{K^- p}$$

1960's-1980's

1980 M. Izycki et al.,
Z. Phys. A 297, 11

1979 J. D. Davies et al.,
Phys. Lett. B **83**, 55

1983 P. M. Bird et al.,
Nucl. Phys. A **404**, 482

Improve by usage of gasses target

1997 M. Iwasaki et el., Phys. Rev. Lett. **78**, 3067 **KEK PS**

2005 G. Beer et el., Phys. Rev. Lett. **94**, 212302 **Dear**

2011 M. Bazzi et el., Phys. Lett. B **704**, 113 **SHIDDARTA**

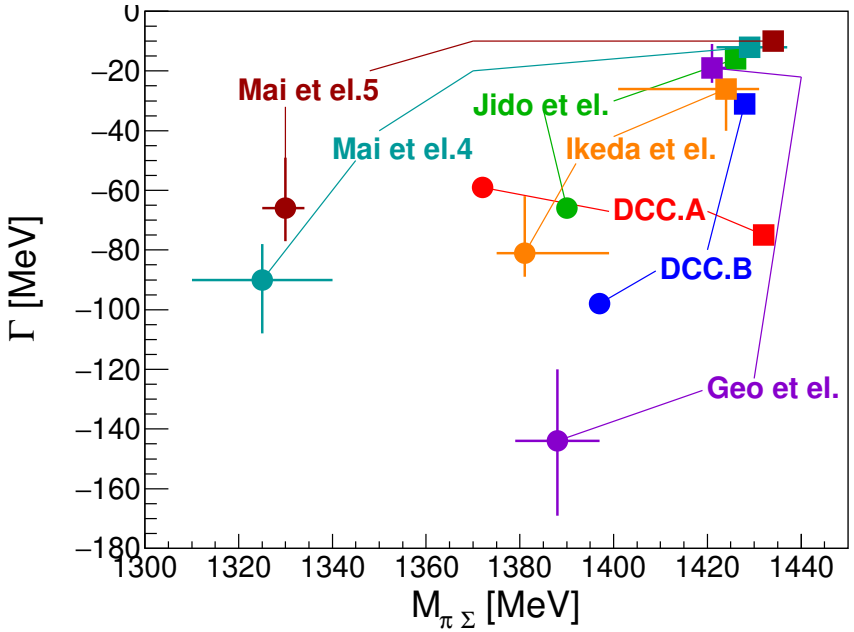
$\Rightarrow$ Using as $\bar{K}N$ Constraint

Recent theoritial status

D. Jido et el. suggested tow pole state, $\bar{K}N$(higher) and $\pi\Sigma$(lower).

Nucl. Phys. A 725, 181 (2003).

$\Rightarrow$ Similar method and result were come out.



NLO w/ Constraint by SHIDDARTA.

Y. Ikeda, et el.,

Nucl. Phys. A **881**, 98 (2012)

Z.-H. Guo and J. Oller,

Phys. Rev. C **87**, 3, 035202 (2013)

Filltering by CLAS data

M. Mai and U.-G. Meiβner

Eur. Phys. J. A **51**, 3, 30

DCC method

H. Kamano et el.

Phys. Rev. C**92**, 025205 (2015)

$d(K^-, n)$ reaction and J-PARC E31