Hyperon polarization in PHSD model – recent status.

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Based on MA thesis of N.S. Tsegelnik

Relativistic thermal vorticity

$$\varpi_{\mu\nu} = \frac{1}{2}(\partial_\nu \beta_\mu - \partial_\mu \beta_\nu) \qquad \beta_\nu = \frac{u_\nu}{T}$$

Polarization due to spin-orbital interaction

F. Becattini et al. Eur. Phys. J. C75, no. 9, 406 (2015)
Spin vector:

$$S^\mu(x,p) = -\frac{s(s+1)}{6m}(1 \pm n(x,p))\varepsilon^{\mu\nu\lambda\delta}\varpi_{\nu\lambda}p_\delta$$

s − spin, p_δ − 4 momentum of particle

- Thermodynamic equilibrium.
- The mechanism is not strictly defined.

Polarization of particle with spin

$$\mathbf{P} = \frac{\mathbf{S}^*}{s}$$

$\mathbf{S}^*$ spin vector in rest frame

✠ **PHSD transport model**

  ✠ **Partonic phase** $\varepsilon > \varepsilon_{cr} = 0.5 GeV/fm^3$

  ✠ **Parallel ensemble method**

- **Fluidization**

  ✠ **Hydro velocity (Landau frame)**

$$u_\mu \, T^{\mu\nu} = \varepsilon \, u^\nu$$

  ✠ **"Fluid"** $\varepsilon > 0.05 GeV/fm^3$

- **Trace last interaction point for hyperons**

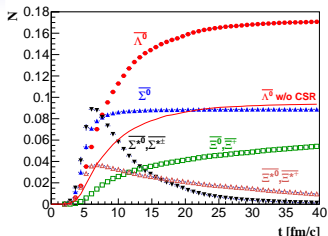 ✠ **We consider polarization of hyperons at last interaction point**
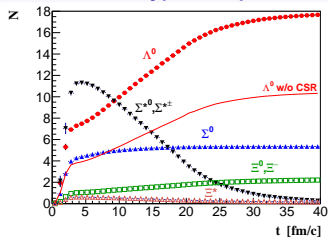
    - **inside fluid: set polarization**
    - **outside fluid: reset polarization**

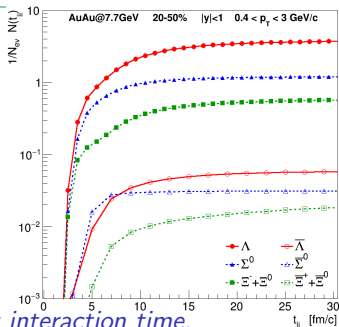 ✠ **Spin and strong decays** $\Sigma^*, \Xi^* \to \Lambda$ **are taken into account.**

    - **Spin vector** $\sim s\,(s+1)$
    - **Spin vector of daughter particle is equal to** $1/3$ **of spin vector of** Σ^*, Ξ^*

PHSD: W. Cassing, E.L. Bratkovskaya PRC 78 (2008) 034919; NPA831 (2009) 215; EPJ ST 168 (2009) 3

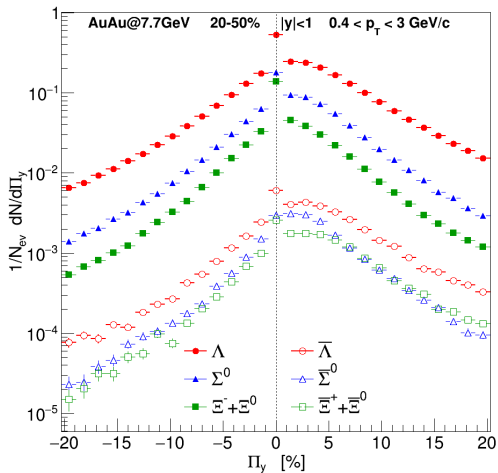## Hyperons production in AuAu@7.7GeV b=7.5fm

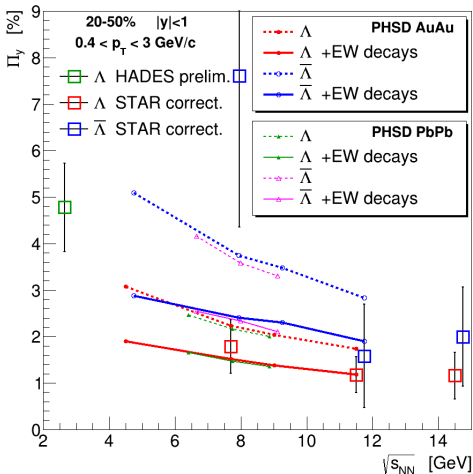*Numbers of strange particle/anti-particles as functions of collision time*

... as function of last interaction time.
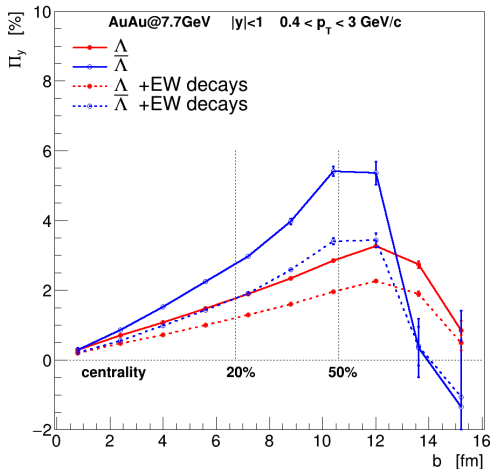
Probability of polarization

- **Distribution is asymmetric**
- **If no fluid then $\Pi_y = 0$**
- **Remind that $C_{\Lambda \Sigma^0} = -1/3$**

Polarization of Λ-hyperons

Strong decays are taken into account – difference in magnitude of feeddown between our calculations and Becattini&Karpenko
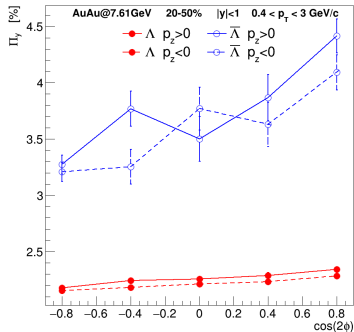
Polarization of Λ-hyperons

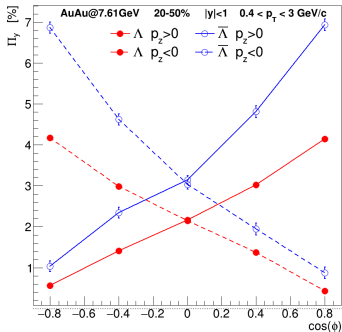**Strong decays are taken into account – difference in magnitude of feeddown between our calculations and Becattini&Karpenko**

Polarization of Λ-hyperons

Strong decays are taken into account – difference in magnitude of feeddown between our calculations and Becattini&Karpenko

Conclusion

- $\bar{\Lambda}$ is more polarized then Λ hyperons.
- We underestimate polarization – more algorithms are requested.

- *Description of Σ^*, Ξ^* is important.*
- *Big feed-down effect from EW decays.*
  Question about Σ^0 ($\Sigma^\pm$) production?

Thank you!