Polarization Profiles

Haixin Huang

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AGS Polarization Profile at Flattop

$$P^V_{max} = \frac{P_0}{(1+R_V)\sqrt{1+R_H}}$$

$$P^H_{max} = \frac{P_0}{(1+R_H)\sqrt{1+R_V}}$$

$$P_0 = \sqrt{P^V_{max} P^H_{max}}(1+R_V)^{\frac{3}{4}}(1+R_H)^{\frac{3}{4}}$$

P_0 is the polarization with zero emittance or source polarization. P^v_{max} equivalent to fixed target measurement done with vertical target.

Condition	P^V_{max}		R_H		P^H_{max}		R_V		P_{0_mea}		P_{200MeV} -> P_0	
JQ on	72.6	0.6	0.057	0.014	69.6	0.8	0.102	0.018	79.7	1.4	82.0	80.3
JQ off	66.6	0.7	0.115	0.016	67.0	0.8	0.129	0.021	79.4	1.5	82.2	80.5

The measured and expected P_0 agreement is reasonable.

•Haixin Huang

RHIC Polarization Profile at Store

$$< P^V >= \frac{P_0}{(1+R_V)(1+R_H)}$$

$$< P^H >= \frac{P_0}{(1+R_H)(1+R_V)}$$

$$P_0 = \sqrt{< P^V >< P^H >}(1+R_V)(1+R_H)$$

Fills 18673-18694(2/14-2/20), 10 fills. B1V1 target was broken in the middle of the range but was still used.
Later in a store, the P_0 seems more reasonable.

Condition	$<P^H>$	R_V	$<P^V>$	R_H	P_{0_mea}	P_{200MeV}-> P_0
Yellow						
Flattop	65.8 0.7	0.118 0.031	63.7 0.6	0.048 0.022	75.9 2.7	79.5
Rot. Ramp	63.6 0.8	0.017 0.033	62.9 0.7	0.067 0.024	68.7 2.8	79.5
4 hours	62.7 0.9	0.141 0.044	60.6 0.7	0.154 0.031	81.2 3.9	79.5
8 hours	60.3 0.9	0.129 0.045	59.0 0.7	0.130 0.031	76.1 3.8	79.5
Blue						
Flattop	65.5 0.7	0.098 0.032	66.0 0.6	0.011 0.019	72.9 2.6	77.1
Rot. Ramp	64.1 0.8	0.054 0.033	63.4 0.7	0.067 0.029	71.7 3.1	77.1
4 hours	62.7 0.9	0.141 0.044	58.2 0.8	0.123 0.031	77.3 3.8	77.1
8 hours	59.6 0.9	0.150 0.046	59.0 0.7	0.130 0.031	77.1 3.8	77.1

•Haixin Huang

BROOKHAVEN NATIONAL LABORATORY

RHIC Polarization at Store

- We could not get consistent P_0 for injection measurement, as R values are around 0.02 and <P>~65%. This is something new this year.
- For these 10 stores (jet data missing 18687, so 9 stores instead):

Yellow1(H) 62.3+-0.5 Yellow2(V) 60.9+-0.4 Jet 59.4+-1.4
Blue1 (V) 62.3+-0.5 Blue2 (H) 60.2+-0.4 Jet 58.9+-1.4

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Polarization evolution in AGS and RHIC (run11)

- Polarization loss from intrinsic resonances: polarization lost at edge of beam → polarization profile
- Impact of polarization profile on beam polarization at collisions $P_{coll.}$:

$$P(x,x',y,y') = P_0 e^{-\frac{x^2+x'^2}{2\sigma_{x,P}^2}} e^{-\frac{y^2+y'^2}{2\sigma_{y,P}^2}}; \quad I(x,x',y,y') = I_0 e^{-\frac{x^2+x'^2}{2\sigma_{x,I}^2}} e^{-\frac{y^2+y'^2}{2\sigma_{y,I}^2}}; \quad R_H = \frac{\sigma_{x,I}^2}{\sigma_{x,P}^2}; \quad R_V = \frac{\sigma_{y,I}^2}{\sigma_{y,P}^2}$$

$$\langle P \rangle = P_0 \frac{1}{(1+R_H)(1+R_V)}; \quad P_{coll.} = P_0 \frac{1}{\sqrt{1+\frac{1}{2}R_H}\sqrt{1+R_H}\sqrt{1+\frac{1}{2}R_V}\sqrt{1+R_V}} = \langle P \rangle \frac{\sqrt{1+R_H}\sqrt{1+R_V}}{\sqrt{1+\frac{1}{2}R_H}\sqrt{1+\frac{1}{2}R_V}}$$

- For RH ≈ RV and small: $P_0 = \langle P \rangle (1+\langle R \rangle)^2$; $P_{coll.} = \langle P \rangle (1+½\langle R \rangle)$
- Note that P_0, the polarization of the core particle, should be equal to the maximum achievable polarization.

	<P>	**<R>**	**$P_{coll.}$**	**P_0**	**$P_{max.}$**
AGS extr.	67.6 ± 1.0	0.08 ± 0.02		78.8 ± 1.0	79.4
RHIC inj. B	65.7 ± 0.3	0.08 ± 0.02		76.6 ± 0.4	76.1
RHIC inj. Y	66.3 ± 0.3	0.08 ± 0.02		77.3 ± 0.4	78.7