Particles Associated with $\Omega$ Produced at Intermediate $p_T$

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Abstract

The dual observation of the $\Omega$ production in central Au-Au collisions having both an exponential $p_T$ distribution and also associated particles above the background has been referred to as the $\Omega$ puzzle. We give a quantitative description of how that puzzle can be understood in terms of phantom jets, where only ridges without peaks are produced to give rise to both the $\Omega$ trigger and its associated particles. In the framework of recombination of thermal partons we are able to reproduce both the $\Delta\phi$ distribution and the trigger-momentum dependence of the yield of the associated particles. We make predictions on other observables that can be checked by further analyses of the data.
1 Introduction

Recent data on the production of $\phi$ and $\Omega$ at the Relativistic Heavy ion Collider (RHIC) at intermediate $p_T$ have revealed important properties of the $s$ quarks in the dense medium created by the collision of Au nuclei at 200 GeV [1, 2]. Both $\phi$ and $\Omega$ exhibit exponential behavior in their $p_T$ distributions up to $p_T \approx 4.5$ GeV/c. Such properties of the $\phi$ and $\Omega$ spectra have been reproduced in [3] as consequences of recombination of thermal partons. The implication is that before hadronization the dense system consists of thermalized partons that include the $s$ quarks. That is the main characteristic that quark-gluon plasma (QGP) should possess. The production of $\phi$ and $\Omega$ provides a clear window through which one can observe the thermal source without the contamination of shower partons due to hard scattering, which is suppressed for $s$ quarks. Since QGP is a description of the bulk medium, one can reasonably ask what the properties are at the edge of that medium, namely, when the partonic $k_T$ is $> 1$ GeV/c. Recent data from STAR on correlation that uses $\Omega$ as trigger in the intermediate $p_T$ region has revealed interesting properties of the associated particles [4]. The dual features of the exponential spectrum of $\Omega$ and the existence of associated particles above background have been referred to as the $\Omega$ puzzle [5]. This paper is aimed at providing a quantitative resolution of that puzzle.

Particles produced at intermediate and high $p_T$ in heavy-ion collisions are associated with jets due to hard scattering of partons. The medium effect on hadronization has been successfully described in the recombination model in terms of the recombination of thermal and shower partons [6]. The single-particle $p_T$ distributions of $\pi$, $K$ and $p$ are well reproduced, showing power-law deviation from the exponential behavior at low $p_T$ that is due to
the recombination of thermal partons. The hadronization mechanism that works for those particles that have light quarks as constituents does not work for the production of $\Omega$ that contains only $s$ quarks. Strange shower partons are suppressed whatever the initiating hard parton may be \cite{3}. For that reason the $p_T$ distribution of $\Omega$ is essentially exponential up to the highest measured value of nearly 6 GeV/c \cite{7}, as has been well reproduced by the recombination of three thermal $s$ quarks \cite{3}.

Since shower $s$ quark does not participate in the formation of $\Omega$, it is natural to conclude that jets play no role and that the production of $\Omega$ is not accompanied by any associated particles, which are usually present in events triggered by less strange hadrons. The distributions of associated particles in the latter case have also been satisfactorily described by the recombination of thermal and shower partons in $p_T$ \cite{8}, as well as in $\Delta\eta$ and $\Delta\phi$ \cite{9}. Without jet production there should be no jet structure characterized by associated particles distinguishable from the background.

The discovery that $\Omega$ trigger is accompanied by associated particles above the background has been astounding \cite{4,10,11}. How can a trigger particle formed by thermal partons have partners above the background, since they are presumably also of thermal origin? That is the $\Omega$ puzzle.

2 The Ridge

Conventional jet structure consists of a peak above a pedestal, when the trigger momentum ($p_T^{\text{trig}}$) and those of the associated particles ($p_T^{\text{assoc}}$) are not too high. STAR has adopted the terminology Jet (J) for peak and ridge (R) for pedestal. The J to R ratio of their yields
depends on $p_T^{\text{trig}}, p_T^{\text{assoc}}$ and centrality [12]. For $p_T^{\text{trig}}>4$ GeV/c and $p_T^{\text{assoc}}>2.3$ GeV/c in central Au-Au collisions at 200 GeV, it has been shown that $J/R \approx 1$. However, at lower values of $p_T^{\text{assoc}}$ the $J/R$ ratio is smaller, becoming as low as $0.1 - 0.15$ at $p_T^{\text{assoc}} \sim 1.2$ GeV/c [13]. For $\Lambda$-triggered events that ratio is even lower ($< 0.1$). No data for that ratio yet exist for $\Omega$-triggered events, but one may anticipate it to be further lower according to the trend of increasing strangeness. If that is true, then the particles associated with $\Omega$ will not exhibit any significant peak in the $\Delta \eta$ distribution, which is where $J$ and $R$ are usually seen with non-strange triggers. On the basis of the study done in [3], where $\Omega$ is shown to originate from thermal sources, we can assert that the Jet component should be absent, and that only the ridge will be observed.

The notion of phantom jet was suggested in [5] to describe the phenomenon in which a jet is produced without the Jet part being observed. The ridge that is observed provides the evidence that there is an underlying jet. Such a scenario has not been confirmed by data, but is our conjecture as a solution to the $\Omega$ puzzle, the quantitative description of which will be given in the following two sections. A confirmation would be in evidence when the $\Omega$-triggered $\Delta \eta$ distribution exhibits a ridge without a peak. At this point the statistics in the data for $2.5 < p_T^{\text{trig}} < 4.5$ GeV/c and $1.5 < p_T^{\text{assoc}} < p_T^{\text{trig}}$ is not high enough to give a discriminating $\Delta \eta$ distribution. What is seen in the $\Delta \phi$ distribution cannot distinguish Jet from ridge because there is no elongation in the $\phi$ direction as there is in the $\eta$ direction due to longitudinal expansion [9].

A phantom jet is seen as an ordinary jet if the trigger is a non-strange particle. It may be initiated by a gluon or a light quark, which can generate non-strange shower partons that hadronize as $\pi, K, p$ or $\Lambda$. If $p_T^{\text{trig}}$ is not too high, the hard scattering may occur in the interior
of the bulk medium. The scattered hard parton traverses the medium and loses energy on its way out to the surface. The energy deposited in the medium enhances the thermal motion of the partons in the vicinity of the trajectory. Those partons hadronize and form the ridge that is above the background. Such a sequence of processes is conventional, and has been described successfully in [9] that gives both the $\Delta \eta$ and $\Delta \phi$ distributions. However, the $\Omega$-triggered events are not conventional, even though the underlying jet is conventional as described above. The reason is that the $s$ quarks are suppressed in the shower. Without the $s$ shower partons $\Omega$ cannot be formed as a direct consequence of hard scattering. It can, however, be formed indirectly from the ridge that is thermal and has ample supply of $s$ quarks. Events triggered by $\Omega$ produced that way are rare at high $p_T^{\text{trig}}$, since the thermal spectrum is exponential. Thus the $p_T^{\text{trig}}$ threshold is set low, like 2.5 GeV/c. The corresponding $p_T^{\text{assoc}}$ threshold is even lower, like 1.5 GeV/c, in order to have enough statistics to produce a meaningful associated particle distribution. When $p_T^{\text{assoc}}$ is so low, the ridge component dominates over the peak so the $J/R$ ratio is very small. The ordinary jet thus becomes a phantom jet under the condition of low $p_T^{\text{trig}}$ and lower $p_T^{\text{assoc}}$.

If the ridge can supply $s$ quarks to form the $\Omega$ trigger, it can surely supply light quarks to produce other lower-mass charged hadrons. Those are the associated particles detected [4]. Thus the ridge of the phantom jet is the key to the solution of the $\Omega$ puzzle. The $\Omega$ has a $p_T$ distribution that is exponential, on the one hand, because it is formed by the thermal partons in the ridge, and it has associated particles, on the other hand, because the ridge is above the background.
3 The Background

Our aim now is to describe the $\Delta \phi$ distribution of the associated particles in events triggered by $\Omega$ \[4\]. The signal is less than 4% of the background height. Thus in order for us to reproduce quantitatively the signal, it is necessary to show first that the background can be accurately obtained in our formalism. There is a $v_2$ oscillation due to elliptic flow, resulting in

$$\frac{dN_{\text{bg}}}{d\Delta \phi} = 6.9 + 0.1 \cos 2\Delta \phi$$

(1)

for the background. We aim to get the central value of 6.9 from the single-particle distribution of pion for $p_T < 3$ GeV/c that we have obtained previously \[6, 9\].

The experimental conditions are that in 0-10% central Au-Au collisions at 200 GeV/c the $\Omega$ trigger is detected in the window $2.5 < p_{\text{trig}}^T < 4.5$ GeV/c with $|\eta| < 1$ and the unidentified charged particles associated with it are in the range of $1.5 < p_{\text{assoc}}^T < p_{\text{trig}}^T$. Let the trigger distribution be denoted by

$$N(1) = \frac{dN_\Omega}{dp_1 d\eta_1}$$

(2)

and the two-particle distribution by

$$N(1, 2) = \frac{dN_{\Omega,2}}{dp_1 dp_2 d\eta_1 d\Delta \eta d\Delta \phi},$$

(3)

where $\Delta \eta = \eta_2 - \eta_1$, $\Delta \phi = \phi_2 - \phi_1$, and $p_i$ being short for $p_{iT}$. The associated particle distribution per trigger is then

$$\frac{dN}{d\Delta \eta d\Delta \phi} = \frac{\int_{p_c}^{p_{i1}} dp_1 \int_{p_c}^{p_{i2}} dp_2 \int_{-1}^{-1} d\eta_1 N(1, 2)}{\int_{p_c}^{p_{i1}} dp_1 \int_{-1}^{-1} d\eta_1 N(1)},$$

(4)
where \( p_a = 1.5, p_c = 2.5 \) and \( p_d = 4.5 \) all in units of GeV/c. For the background distribution \( N(1, 2) \) is factorizable, i.e.,

\[
N_{bg}(1, 2) = N(1)N_{bg}(2).
\]

(5)

It follows that on the right hand side of Eq. (4) the \( \eta_1 \) integrations in the numerator and the denominator are trivially cancelled, leaving

\[
\frac{dN_{bg}}{d\Delta \eta d\Delta \phi} = \frac{\int_{p_a}^{p_d} dp_1 N(p_1) N_{bg}(p_1, \Delta \eta, \Delta \phi)}{\int_{p_a}^{p_c} dp_1 N(p_1)},
\]

(6)

where

\[
N_{bg}(p_1, \Delta \eta, \Delta \phi) = \int_{p_a}^{p_1} dp_2 \frac{dN_{bg}}{dp_2 d\Delta \eta d\Delta \phi}.
\]

(7)

Since \(|\eta| < 1\), \( \Delta \eta \) ranges from \(-2\) to \(+2\). Assuming \( dN_{bg}/dp_2 d\Delta \eta d\Delta \phi \) is independent of \( \Delta \eta \), we obtain upon integration of (7) over \( \Delta \eta \)

\[
N_{bg}(p_1, \Delta \phi) = 4 \int_{p_a}^{p_1} dp_2 \frac{dN_{bg}}{dp_2 d\Delta \eta d\Delta \phi} = \int_{p_a}^{p_1} dp_2 \frac{dN_{bg}}{dp_2 d\Delta \phi}.
\]

(8)

For 0% centrality there is no azimuthal asymmetry, so the \( \Delta \phi \) distribution of the background is uniform.

We can determine \( dN_{bg}/dp_2 \) from our previous work on recombination model [6, 9] so as to establish a connection with that formalism, on the basis of which we shall calculate the ridge in the next section. The particles in the background are formed by the recombination of thermal partons, whose invariant distribution is [6]

\[
T_0(q) = q \frac{dN_{th}}{dq} = C_0 q e^{-q/T_0},
\]

(9)

where

\[
C_0 = 23.2 (\text{GeV/c})^{-1}, \quad T_0 = 0.317 \text{GeV/c}.
\]

(10)
The recombination of those partons to form thermal pions is given by \[6\]
\[
\frac{dN_{\pi}^{th}}{dp} = \frac{1}{p^2} \int_0^p dq \, T_0(q) T_0(p - q) = \frac{C_0^2}{6} p e^{-p/T_0},
\]
where the recombination function \(x_1 x_2 \delta(x_1 + x_2 - 1)\), \(x_i\) being the momentum fraction, has been used in the integral above. That is for any one of the three charge states of pions. For the charged pions we gain a factor of 2. For other charged particles, we take \(K^\pm/\pi^\pm = b\) and \(p^\pm/\pi^\pm = cp\), where \(p\), as for all momentum symbols, denotes transverse momentum. The numerical factors can be taken to be \(b = 0.4\) and \(c = 0.3\ (GeV/c)^{-1}\) as reasonable approximations of the data, where the linear growth in \(p\) of the ratio \(p^\pm/\pi^\pm\) is approximately valid up to about 3 GeV/c \[6\]. Thus for unidentified charged particles in the background we adopt for the integrand in Eq. (8) the form
\[
\frac{dN_{bg}}{dp_2 d\Delta\phi} = \frac{4}{3} C_0^2 p_2 (1 + b + cp_2) e^{-p_2/T_0},
\]
Upon integration over \(p_2\) from \(p_a\) to \(p_1\), we obtain
\[
N_{bg}(p_1, \Delta\phi) = \frac{4}{3} (C_0 T_0)^2 h(p_1, T_0),
\]
where
\[
h(p_1, T_0) \equiv f \left( \frac{p_a}{T_0}, T_0 \right) - f \left( \frac{p_1}{T_0}, T_0 \right),
\]
with
\[
f(x, T_0) = (1 + b)(1 + x) + c T_0 (2 + 2x + x^2) e^{-x}.
\]

To carry out the integrations over \(p_1\) in Eq. (13) we need the single-particle distribution for the production of \(\Omega\), which can be determined in the same way as for proton by recombination \[3, 6\], except that it is simpler when only thermal \(s\) quarks contribute. The result is \[3\]
\[
\frac{dN_{\Omega}}{dp_1} = \frac{C_\Omega^3}{27} \frac{p_1^3}{p_{10}} e^{-p_1/T_s},
\]

8
where $p_{10} = (p_1^2 + M_\Omega^2)^{1/2}$ and

$$T_s = 0.33 \text{ GeV/c.} \quad (17)$$

The normalization factor $C_\Omega$ is immaterial, since it appears in both the numerator and the denominator of Eq. (6), so they cancel each other.

Integrating both over $p_1$ and $\Delta \eta$ in Eq. (6), we finally have

$$\frac{dN_{bg}}{d\Delta \phi} = \frac{4}{3} (C_0 T_0)^2 \langle h(p_1, T_0) \rangle,$$  \quad (18)

where

$$\langle h(p_1, T_0) \rangle = \int_{p_c}^{p_d} dp_1 \frac{dN_\Omega}{dp_1} h(p_1, T_0) \left/ \int_{p_c}^{p_d} dp_1 \frac{dN_\Omega}{dp_1} \right| = f \left( \frac{p_a}{T_0}, T_0 \right) - \left\langle f \left( \frac{p_1}{T_0}, T_0 \right) \right\rangle. \quad (19)$$

The last term on the right hand side of Eq.(19) is given by

$$\left\langle f \left( \frac{p_1}{T_0}, T_0 \right) \right\rangle = \frac{1}{I(x_s, y_s)} \frac{T_0^3}{T_s^3} \int_{x_0s}^{y_0s} dx \left[ (1 + b)(1 + z) + \tau_0 (2 + 2z + z^2) \right] \frac{x^3}{(x^2 + \mu_0^2)^{1/2}} e^{-x}, \quad (20)$$

with the variable of integration $x = p_1/T_s$. The limits of integration are $x_{0s} = p_c/T_{0s}$ and $y_{0s} = p_d/T_{0s}$, where $T_{0s} = T_0 T_s/(T_0 + T_s)$. The other symbols are $z = (T_{0s}/T_0)x$, $\tau_0 = cT_0$ and $\mu_{0s} = m_\Omega/T_{0s}$. The denominator of the first factor is given by

$$I(x_s, y_s) = \int_{x_s}^{y_s} dx \frac{x^3}{(x^2 + \mu_s^2)^{1/2}} e^{-x}, \quad (21)$$

with the integration variable $x = p_1/T_s$. Other symbols $x_s, y_s$ and $\mu_s$ are respectively $p_c/T_s$, $p_d/T_s$, and $m_\Omega/T_s$.

For the trigger momentum range being specified by $p_c$ and $p_d$ given just below Eq. (4), the effective value of $p_1$ found for $\langle h(p_1, T_0) \rangle$ is 2.8 GeV/c. Using the parameters for the thermal
partons given in Eq. (10), we can now compute the background height for the associated particles and obtain

\[ \frac{dN_{bg}}{d\Delta \phi} = 6.9. \]  

(22)

This result agrees well with the data [4], and gives us confidence in the formalism to proceed to the calculation of the ridge.

It should be noted that the \( \Omega \) spectrum is stated in Eq. (16) without reference to it being in the ridge, since the calculation was done in [3] using a fitted value of \( T_s \). The fact that the value of \( T_s \) being slightly higher than \( T_\theta \) is a hint that the thermal source is enhanced. But the procedure of calculating the hadron distribution by recombination of thermal partons is insensitive to whether the thermal source is enhanced or not.

4 Associated Particles

Since our resolution of the \( \Omega \) puzzle is based on the validity of the assertion that both the trigger and its associated particles are formed from the ridge, we must now show that the \( \Delta \phi \) distribution of the associated particles from that source agrees with the data [4]. The calculation of the ridge follows essentially the procedure used in [9], except that we are hampered this time by the lack of data on \( \Delta \eta \) distribution that was available for unidentified charged triggers. Indeed, to be sure that one has a ridge, it is usually necessary to find it in the \( \Delta \eta \) distribution that exhibits the longitudinal elongation. Since we are dealing with phantom jets that show imperceptible evidence for Jet in the events triggered by \( \Omega \), all that have been seen in \( \Delta \phi \) (and presumably will be seen in \( \Delta \eta \)) are in the ridge.
The basic difference between the ridge and the background is that for the former we have new parameters $C$ and $T$ for the enhanced thermal partons, while for the latter $C_0$ and $T_0$ are given in Eq. (10). There is also a $\Delta \phi$ dependence which is forced to vanish at $\Delta \phi = \pm 1$ due to the subtraction procedure used in the data analysis. We write

$$C(\Delta \phi) = C_0 H(\Delta \phi) = C_0 H_0 \exp \left[ -\frac{(\Delta \phi)^2}{2\sigma^2} \right],$$

where the values of $H_0$ and $\sigma$ are discussed below. Since associated particles in the ridge are unidentified charged hadrons, just as in the background, we obtain by thermal recombination as done in the preceding section

$$\frac{dN^R}{d\Delta \phi} = \frac{4}{3} (C_0 T)^2 H(\Delta \phi) \langle h(p_1, T) \rangle - \frac{dN^b}{d\Delta \phi},$$

where the last term is as calculated in Eq. (18), given in (22), but supplemented by $v_2$ oscillation and therefore behaves as in Eq. (1).

The value of $T$ for the enhanced thermal source may be inferred from either $T_s$ or the value of $\Delta T = T - T_0 = 15$ MeV determined in [9]. They are consistent with each other. We shall use $T = T_0 + 0.015 = 0.332$ GeV. The width $\sigma$ is fixed by the condition $dN^R/d\Delta \phi = 0$ at $\Delta \phi = \pm 1$; it turns out to be around 3.6. We do not know the normalization $C$ of the enhanced thermal partons. Even if we did, the width of the ridge in $\Delta \eta$ is unknown, since no data exist. The normalization of the first term of Eq. (24) should depend on the width of that ridge. At this point the data on the $\Delta \phi$ distribution, being blind to the ridge in $\Delta \eta$, are determined by integration over the range $-2 < \Delta \eta < 2$. Thus there is no alternative but to fit the height of the peak in $\Delta \phi$ by adjusting the value of $H_0$, on which $dN^R/d\Delta \phi$ depends sensitively because Eq. (24) gives the difference between two terms of comparable magnitudes. The data on $dN^R/d\Delta \phi$ are not the only data we must fit: Ref. [4] also shows
the near-side yield for various trigger hadrons that all exhibit similar dependence on $p_T^{\text{trig}}$. In contrast to $dN^R/d\Delta\phi$ which involves integration over $p_1$, the yield $Y(p_1)$ involves integration over $\Delta\phi$ instead. If we denote

$$\tilde{H} = \int_{-1}^{1} d\Delta\phi H(\Delta\phi),$$

then the yield is

$$Y(p_1) = \frac{4}{3} C_0^2 \left[ \tilde{H} T^2 h(p_1, T) - 2 T_0^2 h(p_1, T_0) \right].$$

Equations (24) and (26) are, of course, interrelated, but they provide independent checks on $H_0$ and $T$, since $\langle h(p_1, T) \rangle$ depends on the range of $p_T^{\text{trig}}$, while $\tilde{H}$ depends on the range of $\Delta\phi$.

We show in Figs. 1 and 2 the results of our calculation for two values of $H_0$:

$$(a) \quad H_0 = 0.795, \quad (b) \quad H_0 = 0.790.$$  

The corresponding values of $\sigma$ are 3.5 and 3.7, respectively. For less than 1% variation in $H_0$ there is a 20% variation in the height of the ridge. In either case the agreement with data in the two figures is good, given the fact that the data have large errors. Since the process in which the energy loss by a hard parton is converted to the enhanced thermal energy of the medium is not calculable, especially since the energy and location of the originating phantom jet is unknown, the result that we have obtained is perhaps the most one can expect as a phenomenological explanation of why the $\Omega$ trigger is accompanied by associated particles observable above the background.

Since our calculation of the $\Delta\phi$ distribution and the yield does not depend crucially on the exact nature of the trigger, it may be taken to explain why our calculated results are
roughly in accord with the data not only for Ω trigger, but also for Λ and Ξ triggers, shown also in Figs. 1 and 2. Although the $J/R$ ratio for Λ is not zero, being less than 0.1 would still imply that the ridge is dominant, so its associated particles would arise mainly from the ridge, with shower partons playing a minimal role. The case with Ξ trigger would be even closer to that of the Ω trigger.

Assuming that the range of the ridge in $\Delta \eta$ is from $-2$ to $+2$, as we have done in Eq. (24) in accordance to the present experimental cut, we can calculate the total number of charged particles in the ridge corresponding to an interval $I$ in the $\Delta \phi$ distribution

$$N^R_I = \int_{-I/2}^{I/2} d\Delta \phi \frac{dN^R}{d\Delta \phi}.$$  

(28)

Thus the predicted ridge height (to be compared to the data after the removal of the background which includes the $v_2$ contribution) is given by

$$\frac{N^R_I}{\Delta \eta} = \frac{N^R_I}{4} = \frac{1}{3} C_0^2 \left[ T^2 \hat{H}_I \langle h(p_1, T) \rangle - T_0^2 I \langle h(p_1, T_0) \rangle \right].$$  

(29)

where $\hat{H}_I = \int_{-I/2}^{I/2} d\Delta \phi H(\Delta \phi)$. The predicted ridge heights for the two cases considered, for $I = 1$, are

(a) $\frac{dN^R}{d\Delta \eta} = 0.065$,  
(b) $\frac{dN^R}{d\Delta \eta} = 0.054$.  

(30)

If the data on the ridge in $\Delta \eta$ turn out to have a width different from 4, then the height will also be different accordingly. Subject to that qualification, a height of 0.06 is our first-order prediction. It is of interest to note that the ridge height envisioned here is roughly the same as the one observed in [14] for unidentified charged trigger with $4 < p_{T}^{\text{trig}} < 6$ GeV/c and associated particles in $2 < p_{T}^{\text{assoc}} < 4$ GeV/c.
5 Conclusion

We have presented a quantitative description of how the Ω puzzle can be resolved. We have shown that the particles associated with Ω can be understood as products of recombination of thermal partons in the ridge. Although the non-perturbative dynamical process that leads to the formation of the ridge cannot be calculated, there are aspects of the data that need coordinated explanation in a specific hadronization scheme. We have reproduced in Figs. 1 and 2 both the $\Delta \phi$ distribution and the $p_T^{\text{trig}}$ dependence of the yield of the associated particles. One parameter $H_0$ is used to fit the height of $dN^R/d\Delta \phi$, which depends on the exact value of $H_0$ so sensitively (to within 1% in the margin of error) that it is beyond the scope of any dynamical theory to predict. What we have learned from this phenomenological study is that the particles in the peak observed in the $\Delta \phi$ distribution are all from the ridge, contrary to the usual identification of peaks with Jets. Phantom jets have no peaks. Our finding implies that there should not be a peak in the $\Delta \eta$ distribution, still to be produced by further analysis of the data. When that distribution becomes available and shows only a ridge, then our solution of the Ω puzzle will finally be considered confirmed.

In the framework in which we have calculated the $\Delta \phi$ distribution of the associated particles, it is implied that the $p_T$ distribution of the pions will have an inverse slope $T = 0.33$ GeV for $1.5 < p_T < 3$ GeV/c and that the $p/\pi$ ratio will increase as $0.3 p_T$ in the same region for the same reasons as those found to explain similar phenomena related to non-strange triggers [3 9].

While we have focused our attention in this paper on the Ω-triggered events, it is natural to predict that exactly the same features will be observed for the particles associated with
the production of $\phi$ under the same conditions. Both $\phi$ and $\Omega$ are produced from the same enhanced thermal source, so their associated particles should both be formed from the ridges of similar characteristics.

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Figure 1: (Color online) Calculated associated particle distributions in events triggered by \( \Omega \) for (a) solid (red) line, \( H_0 = 0.795 \), and (b) dashed (blue) line, \( H_0 = 0.790 \). The data points are from [4] for three hyperon triggers. The dashed-dotted line is the background.
Figure 2: (Color online) The yield of the associated particles on the near side for Ω trigger as a function of the trigger momentum. The solid, dashed lines and data points are as in Fig. 1.