

A new Cluster Finding method for the Silicon Strip Detector in the STAR experiment at RHIC

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Le ‘Silicon Strip Detector’ (SSD) est la quatrième couche du détecteur de vertex de l’expérience STAR auprès du collisionneur RHIC. Le SSD a été intégré entièrement pour la première fois en 2005 et a pris de données des collisions Cu+Cu a 200 et 62 GeV en 2005, et des collisions Au+Au a 200 GeV en 2007. L’inclusion des détecteurs en silicium est particulièrement importante pour l’identification des saveurs lourds et l’étude de leurs «jet-quenching» dans les collisions d’ions lourds. L’efficacité du SSD varie et peut attendre des valeurs assez bas (e.g. 50%). Nous présentons ici une nouvelle méthode pour la recherche des « clusters » dans le SSD, qui a pour but d’augmenter l’efficacité du détecteur.

The Silicon Strip Detector has been successfully included in the heavy ion runs of STAR that took place after its full installation in the experiment, namely the runs taking data from Cu+Cu collisions at 200 and 62 GeV in 2005, and from Au+Au collisions at 200 GeV in 2007. The inclusion of the SSD is important for charm and beauty identification using microvertexing techniques. The efficiency of the SSD varies and can reach values as low as 50%.

We propose here a new method of Cluster finding, based on the TSpectrum [1] ROOT Class, which is developed and investigated with the goal to improve the efficiency of the SSD.

In the present situation the Cluster Finder used for the SSD inside the STAR reconstruction software (which we will call here Standard Cluster Finder (SCF)), is being performed by checking both the P and N sides of the SSD for topological correlation between strips as well as “charge-matching”. At the same time it has been observed and studied [2] that the N side presents a rather noisy behavior. As a result, many of the fired strips in P side do not match with the strips in the opposite side, and it is expected to have a negative impact on the detector’s global tracking efficiency.

In the present study we investigate for the first the cluster finding efficiency on each side and compare the efficiencies of the presently used method (SCF) and the new method.

The new method consists of the following steps. Every wafer and every side (P and N) is treated independently regardless of it’s neighboring opposite side.

A first scan is being performed on the strips that have noise $rms < 15$. We accept only the clusters that fulfill the following condition:

$$\frac{A}{\delta A} > 5$$

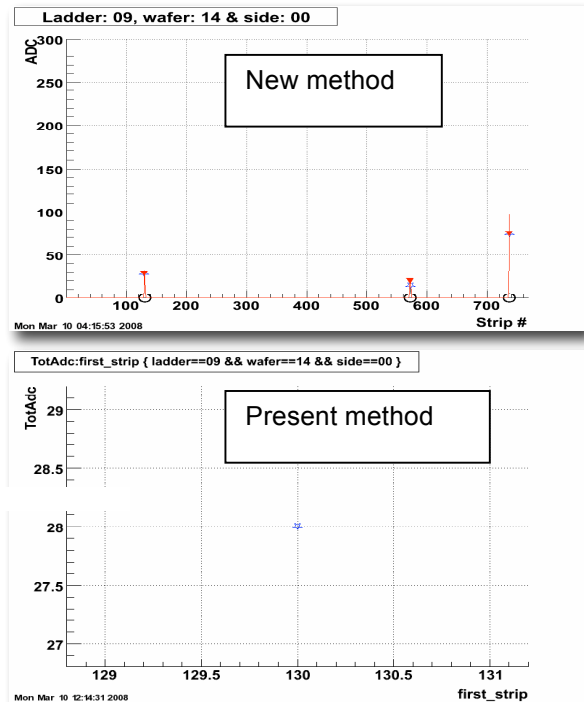


Fig 1: Upper plot: Cluster candidates found by the new method in one event (**black open circles on x-axis**) and measured ADC counts of fired strips (**red stars**). Bottom plot: cluster candidate (zoomed) found by the SCF method in the same event (**blue star**).

where $(A \pm \delta A)$ are the values of the area and error, beneath the Gaussian fit that is performed via this method to each cluster candidate.

Here we show first results on the peak finding efficiency on each side separately, independent of P/N matching.

An analysis has been performed on a small event sample for every wafer, side and ladder. The number of clusters found with the two different methods, have been compared.

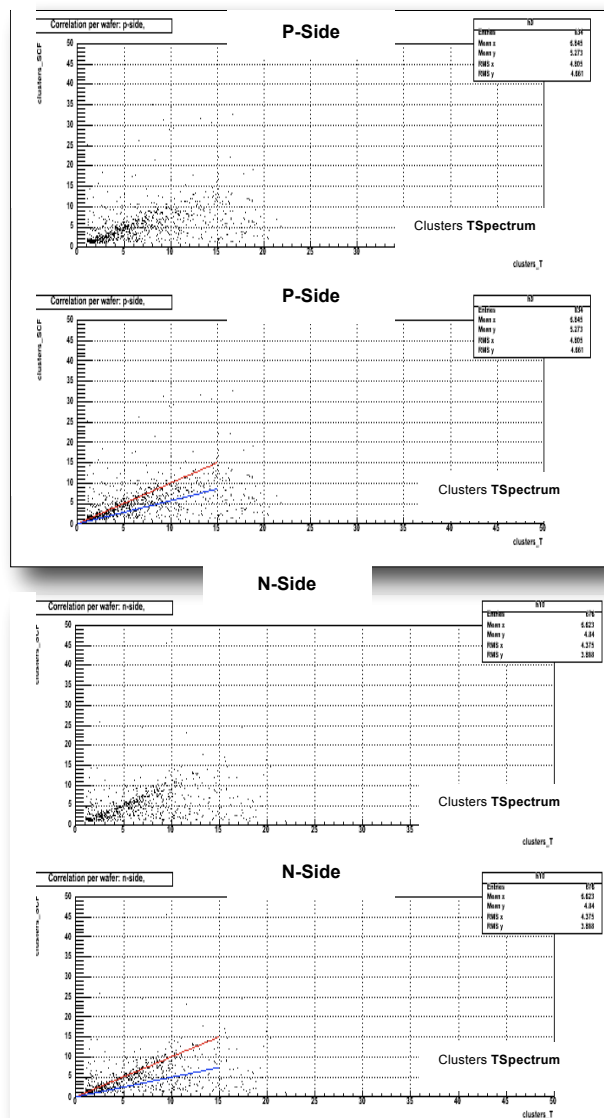


Fig 2: Correlation between the two methods. The Y-axis: Number of Clusters found by SCF. X-axis: Number of Clusters found by the new method. The red line represents the case in which the results coincide. The blue line show the result of a linear fit to the data. Upper 2 plots: P side. Bottom 2 plots: N side.

Fig. 1 upper plot shows the 3 clusters found by the new method in one SSD event (open black circles set indicatively in the x-axis), and the corresponding ADC counts in red, while fig. 1 down plot, shows that in the same event only one of those clusters has been found by the 'present' method SCF (blue point) (this plot is zoomed around the only found peak).

In fig. 2 we plot the number of clusters found by SCF as a function of the number of Clusters found by the new method. The blue line shows the result of a linear fit to the data. The red line represents the case in which the results coincide. The difference of the slopes between the blue and the red line indicate that the new method finds approximately 43% more Clusters than the old method for the N side and 51% for the P side (preliminary result). Future plans include analysis with Monte Carlo, and estimate of the fakes rate and the SSD efficiency, including the tracking, on a high statistics sample. The method can be used in future reproductions of already taken events with the SSD, in particular for the data of 2007 and 2005. The future runs with the SSD upgrade and the Heavy Flavour Tracker (HFT), will ofcourse also benefit, from an improvement in the SSD peak finding efficiency.

Le détecteur en Silicium de l'expérience STAR (SSD) doit permettre pour la première fois, d'utiliser la technique du microvertexing dans les collisions d'ions lourds dans le but d'identifier les saveurs lourdes. L'efficacité du SSD varie et peut atteindre des valeurs assez basses (e.g. 50%). Dans ce rapport, nous avons présenté les premiers résultats d'une nouvelle méthode de Cluster Finder pour le SSD, en utilisant les données de 2007(Au+Au a 200 GeV). Grâce à cette méthode, nous avons trouvé approximativement un taux de 40 % de clusters de plus qu'avec la méthode présente sur la piste P, et 50 % de plus sur la piste N. Ces résultats sont préliminaires. Des calculs Monté Carlo sont aussi à réaliser et l'efficacité des 'fakes' du SSD dans la reconstruction sont a étudier avec les deux méthodes. Cette nouvelle méthode peut être utiliser pour la reproduction des données existantes (2005 et 2007) et aussi pour les futurs runs du STAR avec le SSD upgrade et le futur Heavy Flavour Tracker (HFT) de STAR dans lequel le SSD fait partie.

[1] <http://root.cern.ch/root/html/TSpectrum>

[2] "Performances du détecteur en Silicium à micropistes de l' experience STAR a RHIC", Thesis of J.Bouchet, 2007, p.79