OBSERVATION OF METEOR TRAINS BY HIGH SENSITIVITY DIGITAL STILL CAMERAS. Masayuki Toda[1], Masa-yuki Yamamoto[2], Kouji Maeda[3], Yoshihiko Shigeno[4], Yoshihiro Higa[5], Jun-ichi Watanabe[6], [1]Meteor Train Observation Team/Nippon Meteor Society(metrotokyo_masa_toda@yahoo.co.jp), [2]Kochi University of Technology(yamamoto.masa-yuki@kochi-tech.ac.jp), [3]Nippon Meteor Society(mae@mrf.biglobe.ne.jp), [4]Meteor Science Seminar(Shigeno.Yoshihiko@nikonoa.net), [5]Nippon Meteor Society(mvland@ceres.dti.ne.jp), [6]National Astronomical Observatory of Japan(jun.watanabe@nao.ac.jp)

Introduction: During the storm of Leonids in November 18, 2001, many persistent meteor trains were recorded by the photographic method in Japan [1][2]. Generally it took about a few to ten seconds to turn a camera to a meteor train after the appearance, therefore, the initial phase of the trains could not be recorded. In order to observe time variation of the train from the initial through the end phases, a continuous observation should be valid by using a fixed camera waiting for the apparition of a meteor train without any break. One of the authors (K. Maeda) tried a new method to take continuous frames of a fixed direction by using a digital still camera together with a video observation in 2005. When we find a meteor in a certain frame, then we inspected if there was a train in the next snapshot. One of the authors (M. Toda) started to apply a high-sensitivity digital still camera Nikon D3 in 2007 to this method at the maximum night of major meteor showers. In this paper we summarize the results of our observations.

Observation: A digital still camera Nikon D3 is used under the ISO setup of 6400, 12800, and 25600. The sensitivity is changed according to the transparency of the atmosphere and to the moonlight. We point the camera to the direction near the radiant point of a meteor shower. We apply the shutter speed of 1 second for each frame. The limiting magnitude of stars and meteors are approximately 7 and 6-7, respectively. We can detect 10 to 30 meteors per hour. Mt. Yatsugatake south base in Yamanashi-Pref. (138.4E, 35.8N, Height: 1135m) is selected for the single-station observation site. We show the data on the number of meteors, that with trains, their ratio, and the average magnitude respectively for all the meteors, shower meteors, and sporadic meteors, obtained during three meteor showers of 2009 Quadrantids, 2009 Orionids and 2010 Geminids:

2009, Jan. 3, 11h34m31s - Jan. 3, 18h10m10s(UT):
ALL: 79, 28, 35%, 3.44; QUA: 47, 16, 34%, 3.06;
SPO: 32, 12, 37%, 4.00.
2009, Oct. 22, 15h27m32s - Oct. 22, 17h16m23s(UT):
ALL: 114, 84, 72%, 3.06; ORI: 84, 69, 81%, 2.93;
SPO: 30, 15, 50%, 3.43.
2010, Dec. 14, 11h30m54s - Dec. 14, 20h41m43s(UT):
ALL: 89, 18, 18%, 2.30; GEM 70, 10, 14%, 2.20;
SPO: 19, 8, 42%, 2.94.

Figure 1 shows the time variation of the brightness of the persistent meteor trains along with short-duration meteor trains observed in the 2009 Orionids. Frame No. 1 in the horizontal axis shows the apparition of the parent meteors. From frames 2 to 6 the brightness corresponds to the meteor trains. A vertical axis is the magnitudes of either a parent meteor or meteor trains. The number of plotted samples is 69.

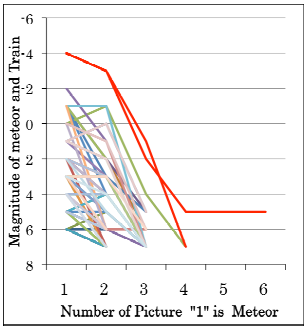

Fig.1: Time variation of the brightness of meteor trains after the apparition of the parent meteors observed in the 2009 Orionids. The time is up to 6 seconds.

Discussion and future: Application of the high-sensitivity instruments provides us to a tool to separate the parent meteors and their short-duration meteor trains by the high time resolution. Furthermore, the judgment of the short-duration meteor train of a faint light became easy, owing to the full color picture. This report is the first data about a meteor and short-duration meteor train obtained with the high sensitivity digital still camera, and it was proved that a high sensitivity digital still camera could be used for faint and short-duration astronomical phenomena such as meteor trains.

References: [1] M. Toda, M.-Y. Yamamoto, Y. Higa, and M. Fujita (2003) *Inst. Space Astro. Sci. Rep. SP, 15,* 229-236. [2] Y. Higa, M.-Y. Yamamoto, M. Toda, K. Maeda, and J.-I. Watanabe (2005) *Publ. Natl. Astron. Obs. Japan, 7*, 67-131.