Experimental setup and observation of comet Hyakutake:

For comet Hyakutake observation, we used same Scintillation detector. Our experimental set up on the terrace of the Building of Physics Department of College of science, Mohan Lal Sukhdia University, Udaipur. For this study, calibration, it is **4.545 KeV/Channel using standard sources of Co^{60}**. We took observation on 28th ,29th ,30th and 31st March 1996, pointing our detector towards Comet Hyakutake and also observed background after two hours on above dates when comet set below Horizon (comet disappeared from the sky and was not visible in the sky) as shown Figure (graphs 8 nos.) below:

Spectrum of Secondary radiation flux of Hyakutake in March, 1996 gave very special feature as follows:

1. Large amount of soft X-rays flux is observed more than 10 times as compared to background and double the Hard X-rays of energy 281.79 KeV on 28th March. On contrary, on 29th March hard X-Rays were totally absent, but soft X-rays flux declared to about 3 Times of background. But on 30th and 31st march nothing like X-rays were observed except high-energy secondary flux of about 1.5 times of background

2. Some specific prominent peaks of energies 1.127 MeV, 2.29 MeV and 3.66 MeV have been observed on 28th March with the enhancement in flux on an average 7 to 10 times of background flux. This was unique and astonishing result we observed first time in the study of Comet. It may be due to high energy cosmic radiation collision with comet nuclei which undergo fragmentation followed by the emission of light nuclei (p, n, π, α) with energy around 10 MeV

3 On 29th March 1996, Comet went away from the Earth at a larger distance as compared to 28th March. Due to large oblique distance, radiation of high energy either from Comet or Galactic cosmic rays produced little less secondary flux such that 1.127 MeV vanished but 2.29 MeV and 3.666 MeV are subsidized to just about double of background.

4. On 30th march 1996 comet went to still large oblique distance from the Earth and able to produce only 3.18 MeV peak energy with flux enhancement of 2 times of the background. Other energy peaks disappeared.

5. On 31st March almost all peaks vanished and uniform enhancement of above 1.5 times of background was observed. Position of comet on 31st was almost on Horizon.

Discussion on result of Hyakutake:

We have observed very surprising results in the study of comet Hyakutake in March 1996 first time in high energy range in fact we missed data of Hyakutake on 25th, 26th and 27th March due to some problem with equipment but it has been resolved on 28th march and observations were started on successive days 29th, 30th and 31st march 1996. It would have been better if

we could take observation on 25th and onwards because comet had closest approach of 0.1 AU to the earth on 25th March at 07:OO UT.

In text of Introduction, we have already mentioned one of the surprising results of strong X-ray radiation of about 100 times brighter than the most optimistic prediction from Germany's orbit ROSAT satellite. We always learn some thing new when we study an object at different wavelength. Same thing happened in our observation. In sequence, we shall discuss these results in the light of existing models, which have been proposed in the chapter-2 as follows:

1. Soft and hard x rays in energy spectra of 28th and 29th and almost negligible in 30th and 31st March with exponential decrease in flux indicate absorption effect and large oblique distance covered by radiation in atmosphere as comet receded after 25th March from closest approach to the earth. Production of unexpected X-rays from comet may be due to absorption of X-ray from the sun by a cloud of gases water molecule surrounding the nuclei of the comet and then remitted by the molecules in a process of Fluorescence. Another possible explanation is that the X-rays are produced from the violent collision between the comet material and supersonic wind of plasma and high energy particles streaming away from the Sun. Still Scientist are trying to learn about Hyakutake structure and composition for these unique X-rays images.

2. Another surprising result was unique and prominent peaks in energy spectra of 28th, 29th and 30th March 1996 observation of Hyakutake comet. Probably it could be attributed to the strong impact of high energy Galactic, Anomalous and Solar cosmic rays on the nucleus of comet containing water, Methane, Ethane and other gases. As a result of these strong impact, there would be production of secondary cosmic radiation flux consisting mainly proton ,neutron mesons and electrons and may be directed to the Earth for further secondary flux production in our atmosphere. The charged particles, if they do not undergo nuclear reaction, interact with atomic and molecular electrons loosing energy by ionization and excitation. From these interactions basically pions come with strange particle like Kayons.

3. Gradual fall in flux of each peak suggest further secondary flux production during high energy cosmic rays impact on molecules of Methane ,Ethane and water. As comet receded away from the Earth obliquely, flux intensity would have been reduced to produce same effect

4. Secondary flux intensity should have been further reduced on 30th March 1996 so as to produced only 3.18 MeV energy flux of two times of background. Of course 3.18 MeV energy peak is not apparently prominent on 28th and 29th March but becomes clear on 30th March when other energies peaks are subdued.

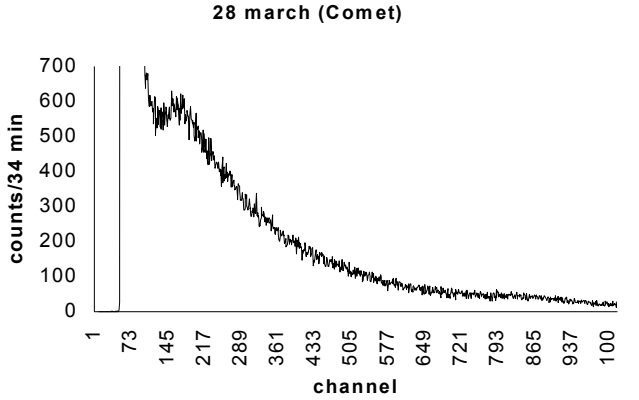
5. On 31st March energy spectrum is almost straight without any apparent prominent peak and suggest that Comet had gone far away from the Earth at horizon producing diffused secondary flux in atmosphere of the Earth with approximately 1.25 times of uniform background cosmic flux.

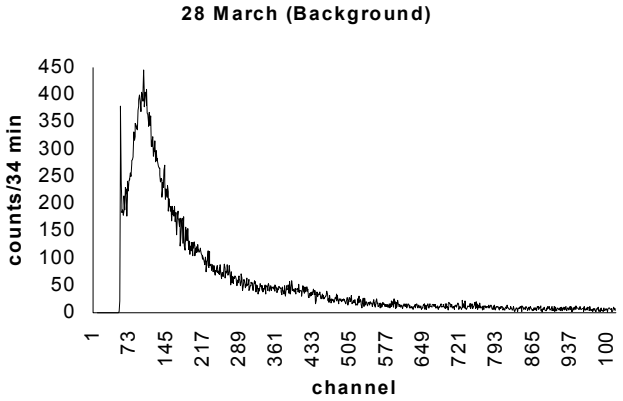
Conclusion:

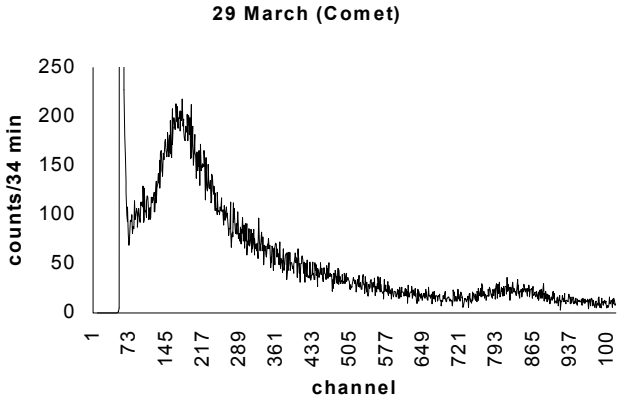
Results of our experimental studies of Comet Hyakutake are another signature of emission of short wavelength invisible radiation. It indicates that

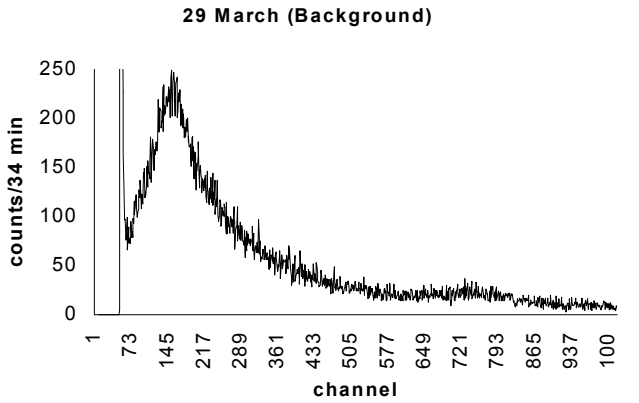
Cosmic rays, Solar energy particles and Anomalous Cosmic rays interact strongly with Hyakutake material molecules and produce fluorescence. Prominent energy peak of 3.18 MeV is a big surprise in the study of Comet. It would be interesting to observe in future during next celestial event of Comet.

Spectrum of secondary radiation of Hykutake Comet in March ,1996 With Comet and Background

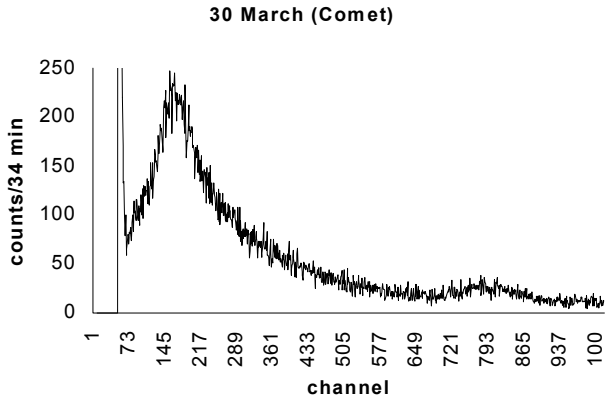


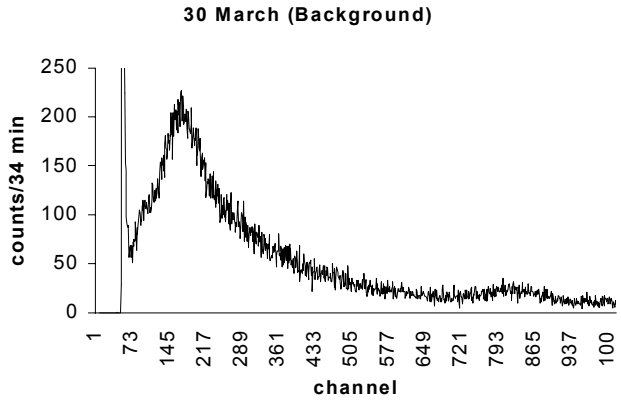


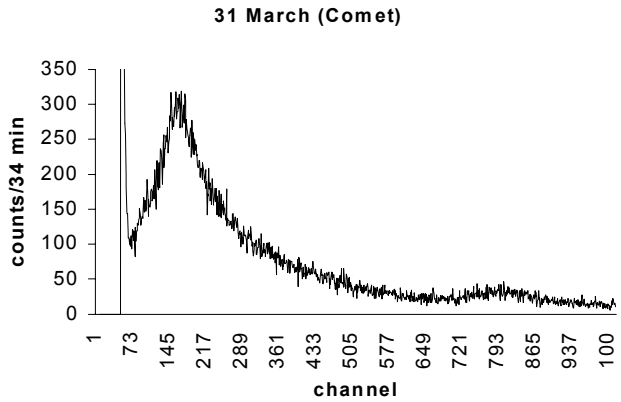


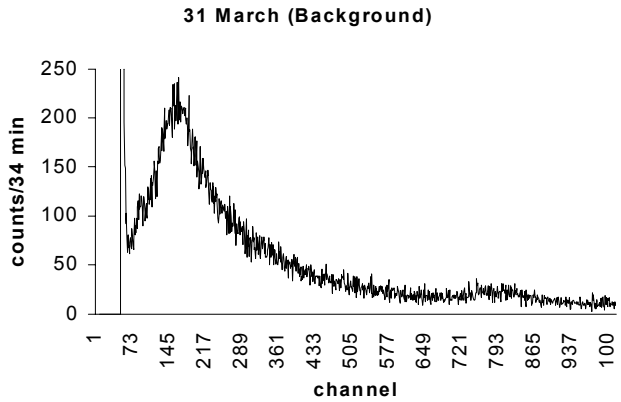


Spectrum of secondary radiation of Hykutake Comet in March ,1996
With Comet and Background









Later **ratio of** data of Hyakutake and background of same day was obtained as shown in another Figure (4nos.) below:

Spectrum of secondary radiation of Hykutake Comet in March,1996
Comparison with Comet and background