The increased ‘plateau’ of transverse energy resulting from the collisions of 6.4 TeV (6400 GeV) sulphur ions compared to what was seen last year with 3.2 TeV oxygen ions, as seen in the NA34 (HELIOS) experiment at CERN. Complementary results come from the WA80 (‘Plastic Ball’) and NA35 streamer chamber experiments.

![Graph showing transverse energy distribution for O16 and S32 ions]

The synchrotrons tune up using the plentiful deuterons and oxygen 16 ions available from Linac 1. With the two varieties of ions having similar charge to mass ratio, the oxygen/sulphur mixture is accelerated in Linac 1 and the Booster. Separation takes place by manipulations at the transition stage of accelerations in the PS, so that either oxygen 16 or sulphur 32 is fed to the SPS. Four PS extraction cycles are stored in the large machine, giving a current of about $2 \times 10^7$ sulphur 32 ions per cycle, just above the SPS minimum for controlled acceleration. Nevertheless skilled operation of the machine ensured that eagerly waiting experiments had their first taste of sulphur after only two days of setting up and only two weeks after the SPS successfully mastered positrons (see November issue, page 19).

Among the experiments now scanning their sulphur data are the four major setups which saw action with oxygen 16 last year – WA80 (Plastic Ball), NA34 (HELIOS), NA35 (streamer chamber) and NA38 (muon pairs) – together with smaller studies, mostly using nuclear emulsions, and two big newcomers – WA85 (Omega spectrometer) and NA36 (time projection chamber).

About 400 physicists are now involved in this work. The results emerging from last year’s run with oxygen ions at CERN and from lower energy studies at Brookhaven were discussed at the recent ‘Quark Matter 1987’ Conference at Nordkirchen (see November issue, page 5). The expected indicators of a new kind of nuclear matter (J/psi formation, two-pion interferometry and transverse energy spectra) already showed significant deviations from what would be expected from a mere superposition of nucleons and physicists hope that these trends will be accentuated with the heavier projectiles.

From Reinhard Stock

FERMILAB
First collider results

The big Collider Detector at Fermilab (CDF) intercepting the 900 GeV proton and antiproton beams in the Tevatron ring completed its first run in May. The experiment accumulated about 30 inverse nabobarns of data (about the same as the output at the CERN proton-antiproton collider in its second run back in 1982) on tape with an extremely large data acquisition system composed of 1250 FASTBUS modules of 62 different varieties. One of the most difficult things was to learn how to handle a detector of CDF’s size and complexity.

The collaboration had three initial goals – to develop the data analysis software for the data from the first run and get it ready for the next run, to check out the performance of detector hardware, and to get first hints of physics.

One of the biggest software development problems is to learn how to analyse a large amount of data involving complex events.
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Production of 'jets' of hadrons in proton-antiproton annihilation, as seen in the CDF detector at Fermilab’s Tevatron.

With no instruction book to follow, developing a standard reconstruction package (SRP) has been a major undertaking, involving over 1 million lines of computer code. The SRP processes a raw data tape, searching for such things as electrons, high energy jets of particles, missing transverse energy (indicative of invisible particles), and the basic types of particles expected.

The SRP then takes a subset of the data from the tape, and makes several different summary files or 'output streams' for physics analysis. This SRP processing takes several hours per tape, and with 500 tapes to process even this first pass was no mean task. The CDF collaboration is now tuning up the SRP analysis in anticipation of the upcoming run.

The performance of the detector hardware is gauged through 'minimum bias' analysis, looking at the average properties of all the events taken together as well as the details of each event.

Using the processed data tapes from the SRP output streams, CDF physicists have isolated promising physics events. It is premature to announce physics results during this learning process, but the electron output stream has yielded about 25 W events and 5 or 6 Z candidates (see front cover of the July/August issue). This production rate of W and Z particles – the carriers of the weak nuclear force – is roughly in line with theoretical predictions, indicating that the detector is working properly and that backgrounds are low.

The data also show a number of 'new territory' jets carrying more than 150 GeV. These particle clusters are much more complicated to analyse than the Ws and Zs because of the large number of particles produced and the complicated reconstruction process. These preliminary 'expected'
physics results will probably be ready next year. With at least ten times more data expected from next year’s run, the CDF team is eagerly anticipating ‘discovery’ physics.

With the increased energy of the Tevatron and the experience gained from the first generation experiments at CERN’s proton-antiproton collider, the CDF experiment is in a good position. Co-Manager Roy Schwitters, Manager of CDF, states ‘CDF’s detector was built with knowledge from CERN’s experiments. It’s the dawn of a new generation of collider detectors both for the energy and the detector capability, and therefore one can move from the expected physics of Ws, Zs and jets into new discoveries rapidly.’

The next CDF run is scheduled to begin on 1 March.

Central computing upgrade

The central computing facilities at Fermilab are being upgraded in a multi-faceted project including a new building for central computing to house a new large scale scientific computer (LSSC), an expanded VAX cluster, and farms of microprocessor-based parallel processing systems. The LSSC acquisition is being evaluated prior to the award of the contract. However the building is rapidly coming to completion and is visible for all to see. The overall cost of the project is $25 million dollars, with about $9 million for the new building, scheduled for completion next spring.

The first floor will house computing hardware, a user area and a tape vault capable of storing over 150 000 10.5 inch reel tapes. In addition to the present system of 10.5 inch 6250 bpi tapes, the LSSC should be compatible with new data storage systems such as tape cartridges and optical disks.

The second floor will be dominated by the LSSC mainframes and other CPUs, disk drives, and an area for maintenance. The third floor will house the Physics Research Equipment Pool (PREP) and three groups of Computing Department personnel currently housed on the 6th and 11th floors of Wilson Hall.

The Central Computing Upgrade Project is a major step to meeting the future computing needs of the Fermilab community. Now that fixed-target and colliding beam experiments are accumulating bigger data samples, the computing demand is impossible to meet with the existing computing systems. The lack of room in Wilson Hall for more equipment further complicates the problem.
KEK
Eventful year

Just one year ago, the three-kilometre TRISTAN ring at the Japanese KEK Laboratory saw its first electron-positron collisions. In a few months of actual running time it has gone on to achieve its basic design aims and to supply important physics. While the Stanford Linear Collider struggles to achieve its hairsbreadth colliding beams and with CERN’s LEP machine still two years away from switchon, TRISTAN has the high energy electron-positron stage to itself.

Earlier this year, TRISTAN supplied 25 and 26 GeV colliding beams and all three major experiments – VENUS, AMY and TOPAZ – collected good data samples (see September issue, page 25).

One of today’s major particle physics preoccupations is the search for the long-awaited sixth (‘top’) quark. While other experiments have inferred that it is heavier than about 45 GeV, confirmation comes from direct scan of electron-positron annihilation.

Thus the three TRISTAN experiments looked closely at hadron production from annihilations at these newly available collision energies, but saw no sign of any increased activity. In addition, the shape of the hadron production patterns is in accord with a five quark picture. Thus the top quark was out of TRISTAN’s reach. However next year the radiofrequency accelerating power will be boosted, and a higher energy region will be carefully scanned.

Physicists had been bewildered by the isolated muons accompanied by a broad spread of hadrons reported by some experiments at the PETRA electron-positron ring at the German DESY Laboratory in Hamburg in data collected several years ago (see September issue, page 37). As the first TRISTAN analyses got underway this year, there was a suggestion that these unexpected single muons were still there (see October issue, page 1), but now the combined weight of all three experiments is pushing these signals towards oblivion in the statistical junkyard. Nobody ever saw a corresponding effect with electrons anyway.

In October, TRISTAN started a new physics run at 27.5 GeV per beam.

DESY
Magnet string tests

A 36 metre chain of superconducting magnets built for the HERA electron-proton collider has been under test since April at DESY in Hamburg.

The magnet string is composed of three full-sized prototype dipole magnets (with coils made at DESY and mounted in cryostats at BBC-Mannheim) and two quadrupoles (made at Saclay). They are installed in a tunnel-shaped hall and mounted with an inclination of one per cent corresponding to the largest slope of the HERA tunnel. The system has its own 900 watt helium refrigeration plant and is provided with full quench protection and complete vacuum equipment, as they will be installed for HERA.

The magnet string has already been cycled several times between room temperature and liquid helium temperatures and has been kept cold for extended periods. It has been quenched more than 20 times at magnetic fields between 1.8 and 5.8 tesla, the latter corresponding to a proton beam energy of 1010 GeV (the HERA design value is 820 GeV). In these tests the current was limited by one of the prototype dipole-magnets, which was made using an old type of cable.

The total heat leak is in good agreement with the values previously measured for the individual magnets and no decremental effect