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12 JUNE 1990
TUESDAY MORNING
Session 20: Invited Talk
Oral Session, 8:30-9:20 am
Ballroom A/B
20.01
Quasars in Full View.
B. J. Wilkes (SAO)

Even after almost 30 years of study, most aspects of quasars remain a mystery to us. Observational constraints are insufficient to narrow the field of imaginative models that have been proposed. This lack of definite knowledge is largely due to the large distance and resulting faintness of most quasars and the difficulty of making observations over wide wavelength range needed to investigate their emission mechanisms. During the past few years substantial improvement and automation of observing techniques and improved communication between those with differing areas of expertise has made it easier to make multi-λ observations of quasars. This has been an exciting development since they emit roughly equal amounts of energy at all wavelengths (far infra-red (IR) to γ-rays).

Over the past ~ 5 years, several groups have embarked on multi-λ studies of quasars, both observationally and theoretically, with the aim of identifying the dominant components and understanding their relations to one another. The optical/UV blue bump is now well-established as the dominant component in this spectral region. Although they are by no means unique, accretion disk (AD) models with a range of temperatures can reproduce this component, provided an underlying power law also contributes. Extension of the AD model into the X-rays has been considered theoretically in only a few studies, although the presence of a soft X-ray excess in > 50% of active galaxies makes this interpretation provocative. Our sample of quasar energy distributions (QEDs), extending to the soft X-ray, indicates the lack of spectral information for the soft X-ray excess in available data prevents confirmation of a direct connection with the blue bump. The IR emission is complex. It is unclear whether an underlying, non-thermal, power law component contributes, as implied by the strong IR/X-ray correlation, or whether the IR continuum is entirely thermal dust emission. Color-color diagrams, used to study the relation between emission in the different spectral regions from 100μm to 3.5 keV in our sample of QEDs for 70 radio-loud/quiet and X-ray-loud/quiet objects, have uncovered a class of quasars with virtually no blue bump, arguing for an underlying, IR-UV power law. The range of colors in our sample is small and is consistent with a changing mix of AD and α ~ 1 power law models. A detailed investigation of the relation between IR and X-ray emission in our sample is underway.

Panchromatic observations are greatly increasing our knowledge of quasars. In the 1990s, ROSAT, HST, GRO, AXAF, SIRTF ... will expand our horizons even further. Starting this year, ROSAT will allow spectral study of the flat X-ray excess and HST will provide full optical/UV coverage to faint magnitudes, avoiding uncertainties in this band due to non-contemporary observations.

Session 21: Solar Flares
Display Session, Ballroom C
21.01
The Evolution of Decimetric Millisecond Spikes and Hard X-Ray Emission during Solar Flares
M.J. Aschwanden (NASA/GSFC), M. Güdel (ETH/Zürich)

A total of 75 radio millisecond spike events have been observed with the IKARUS radio spectrometer of ETR/Zürich and simultaneously with the Hard X-Ray Burst Spectrometer (HXRBS) on TIM. The radio spikes are characterized by a total of 10,000 single spikes with durations of 20-200 μs and bandwidth of 10 MHz, occurring between 200 MHz and 2 GHz. The circular polarization was found dominantly in the X-mode with degrees varying from 70%. The center-to-limb variation shows a directivity at moderate angles of ~45° for spikes emission.

Radio millisecond spikes are strongly associated with flares (90% for SMM flares). They accompany the entire impulsive and decay phase of simple HXR flares, or individual HXR components in complex HXR flares. The duration of the spiky radio emission is well correlated with the associated HXR counterpart; however the start and peak time of the radio emission is delayed with respect to the corresponding HXR times, by an amount of 3 s in the statistical average. The evolution of the ms spikes radio flux exhibits a very close similarity to the 25-50 keV HXR emission if the HXR time profile is convolved with a delayed Gaussian response function. Numerical fits of the convolved HXR time profile with the radio spikes emission reveal delays of 0 to 4 s for the radio emission.

For the interpretation of this close co-evolution of HXR and radio spike emission, a common accelerator mechanism is assumed. The HXR time profile, interpreted as thick-target bremsstrahlung, is believed to represent also a good approximation of the particle injection from the accelerator into a coronal trap responsible for the radio emission. The delayed radio emission, interpreted in terms of loss-cone-drown electron-cyclotron maser emission, requires a secondary trigger mechanism linked to a particle trap. Precession effects in the order of 3 s are unlikely for 25-30 keV particles in coronal loops. Trigger mechanisms propagating with the speed of shock fronts, thermal conduction fronts or Alfvén waves are considered. A coupling between the primary flare loop and adjacent arcades of magnetic loops is not excluded.

21.02
First Observations of Millisecond Microwave Spike Bursts with Spatial Resolution
D. E. Gary, G. J. Hurford, and D. J. Flees (Caltech)

We report successful observations of a number of millisecond spike bursts obtained with the solar-dedicated Owens Valley Radio Observatory (OVRO) frequency-agile interferometer. Spikes were observed at both 1.4 and 2.8 GHz with one-dimensional spatial resolution, and with 20 ms time resolution. The best observed of the spike bursts has been analyzed in detail, and one-dimensional positions of the spikes are compared with the flare seen in Hα and magnetograph images. The spikes, observed at 2.8 GHz, are found to arise ~ 25" ± 1" to the east of the main burst, directly overlying the umbra of the leading sunspot of the active region. Spikes in both senses of polarization arise from the same 1-d location, with the brightest spikes being left-hand circularly polarized (LCP).

We investigate the possible emission mechanisms responsible for the spikes. Since the sunspot is of negative magnetic polarity, the LCP spikes are in the sense of x-mode emission, effectively ruling out the possibility of the spikes being due to plasma emission. This suggests that at least some of the spikes may be due to electron-cyclotron maser (ECM) emission in the x-mode. If the spikes are due to ECM at the fundamental of the gyrofrequency, the 2.8 GHz spikes must arise in a magnetic field of 1000 G, which is consistent with the observed position of the spikes near the sunspot umbra. The umbral source also fulfills the requirement that electrons in a strongly diverging magnetic field give rise to the ECM instability.

21.03
Millimeter-Interferometer Observations of Solar Flares
M.R. Kundu, S.M. White and N. Gopalaswamy (Astro Phys, Univ MD), J.H. Bieging (Univ Ca-Berkeley), G.J. Hurford (Caltech)

We report on millimeter-interferometer observations of solar flares carried out with the three-element interferometer at Hat Creek at a frequency of 89 GHz. At this frequency both non-thermal gyrosynchotron and thermal bremsstrahlung can contribute to the observed emission, and careful comparison with observations at