structures such as spurs/feathers and wiggles as well as in angular momentum transport between stars and gas. We present our recent results of global magnetohydrodynamic simulations to study nonlinear responses of self-gravitating and magnetized gas to an imposed stellar spiral potential. We vary the arm strength, the arm pattern speed, and magnetic field strength to explore various galactic situations. Magnetic fields not only reduce the peak density of galactic spiral shocks but also make angular momentum transport more efficient via magnetic pressure and tension forces. The extent and shapes of gaseous arms as well as the radial mass drift rate depend rather sensitively on the magnetic field strength. The wiggle instability apparent in unmagnetized models is suppressed with increasing magnetic field strength, while magnetic fields promote the development of magneto-Jeans instability of the arms and magnetic islands in between arms. We quantify the angular momentum transport by spiral shocks, focusing on the effects of magnetic fields. We also present physical interpretations of our numerical results and discuss astronomical implications of our findings.

[구 GC-24] Viscosity and Turbulence Dynamo in the Intracluster Medium

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The origin of magnetic fields in the intracluster medium (ICM) is uncertain: it can be either primordial or astrophysical. Turbulence plays important roles in the origin of magnetic fields in the ICM. This is because turbulence can amplify a weak seed magnetic field very efficiently. The efficiency of the turbulence dynamo critically depends on the magnitude of viscosity: the smaller the viscosity is, the more efficient the turbulence dynamo is. In this talk, I'll discuss turbulence dynamo in both very small viscosity limit and very large viscosity limit. I'll show that when the viscosity in the ICM is comparable to the Spitzer viscosity, the origin of magnetic field in the ICM is likely to be astrophysical. On the other hans, when the viscosity is much smaller than the Spitzer value, the origin of magnetic field can be either astrophysical or primordial.

[구 GC-25] The evolution of Magnetic fields in IntraClusterMedium

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IntraCluster Medium (ICM) located at the galaxy cluster is in the state of very hot, tenuous, magnetized, and highly ionized X-ray emitting plasmas. High temperature and low density make ICM very viscous and conductive. In addition to the high conductivity, fluctuating random plasma motions in ICM, occurring at all evolution stages, generate and amplify the magnetic fields in such viscous ionized gas. The amplified magnetic fields in reverse drive and constrain the plasma motions beyond the viscous scale through the magnetic tension. Moreover, without the influence of resistivity viscous damping effect gets balanced only with the magnetic tension in the extended viscous scale leading to peculiar ICM energy spectra. This overall collisionless magnetohydrodynamic (MHD) turbulence in ICM was simulated using a hyper diffusivity method. The results show the plasma motions and frozen magnetic fields have power law of $E_V^k \sim k^{-3}, E_M^k \sim k^{-1}$. To explain these abnormal power spectra we set up two simultaneous differential equations for the kinetic and magnetic energy using an Eddy Damped Quasi Normal Markovianized (EDQNM) approximation. The solutions and dimensions of leading terms in the coupled equations derive the power spectra and tell us how the spectra are formed. We also derived the same results with a more intuitive balance relation and stationary energy transport rate.

[구 GC-26] Radiation mechanism of gamma-ray burst prompt emission

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Synchrotron radiation of relativistic electrons is an important radiation mechanism in many astrophysical sources. In the sources where the synchrotron cooling timescale is shorter than the dynamical timescale, electrons are cooled down below the minimum injection energy. It has been believed that such fast-cooling electrons have a power-law distribution in energy with an index −2,

and their synchrotron radiation has a photon spectral index −1.5. On the other hand, in a transient expanding astrophysical source, such as a gamma−ray burst (GRB), the magnetic field strength in the emission region continuously decreases with radius. Here we study such a system, and find that in a certain parameter regime, the fast−cooling electrons can have a harder energy spectrum. We apply this new physical regime to GRBs, and suggest that the GRB prompt emission spectra whose low−energy photon spectral index has a typical value −1 could be due to synchrotron radiation in this moderately fast−cooling regime.

[구 GC−27] A New Hydrodynamic Simulation Using Unstructured Moving Meshes

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We present a new hydrodynamic simulation based on the unstructured moving mesh scheme. The simulation utilizes the Voronoi tessellation technique that produces polygonal cells composed of, on average, 13 surfaces each in 3D. We devise the incremental expanding method (IEM) and hybrid−neighbor searching algorithm and achieve the CPU time just proportional to the number of particles, i.e., O(N). We show the results of requisite tests for hydrodynamic simulations and demonstrate superiority of our code over the conventional codes using the stationary meshes. The applications in the context of cosmological and galactic simulations are also discussed.

특별 세션 한국전파천문학의 역사

[구 RA−01] 30 Years History of TRAO 14m Radio Telescope

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전파천문학의 불모지였던 우리나라에 전파천문학이 잉태된 것은 1980년으로 국립천문대가 발족한지 불과 6년이 지난 시점으로, 소백산 61cm 광학망원경의 광전측광관측이 궤도에 진입하던 시기였다. 우리나라에서 현대천문학이 겨우 걸음마를 할 시기에 mm파 전파망원경의 도입은 용감한 도전으로, 5년여 간 많은 우여곡절을 겪으며 1985년에 전파망원경이 설치되었다.

1985년 대덕에 14m 전파망원경을 건설하며 시작된 우리나라의 전파천문학은 지난 30년간 발전을 거듭하며 전파간섭계인 한국우주전파관측망(KVN) 건설과 태양전파망원경 설치로 이어져 AGN, 원시성 및 만기형성의 미세구조 연구, 태양폭발현상 연구 등 연구 영역을 확장하고 있다.

2015년은 14m 전파망원경 건설 30주년을 맞는 해이다. 본 발표에서는 대덕전파천문대가 지난 30년간 걸어온 발자취를 살펴보고, 이를 기반으로 한 발전방향을 논의하고자 한다.

[구 RA−02] Seoul Radio Astronomy Observatory

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서울전파천문대(Seoul Radio Astronomy Observatory; SRAO)는 서울대학교 물리·천문학부(천문전공)이 교내에 설치 운영하고 있는 전파천문대로서, 지름 6미터의 안테나와 밀리미터파 수신기를 갖추고 있다. 전파망원경은 1999년 10월에 설치를 시작한 후 1년 반만인 2001년 3월 8일에 완공되어 '최초의 전파'를 검출하였다. 안테나 조립에서부터 수신기 개발까지 대부분의 일이 대학원생들에 의해 이루어졌다는 점에서 유일무이한 전파망원경이다. 2002년 4월 2일에는 관측소를 완공하고 SRAO의 개관식을 가졌다. 설치 초기에는 85−115GHz 수신용 SIS 수신기와 최대 대역폭 50MHz의 1024채널 자기상관 분광기 등을 갖추었으며, 이후 관련 기술 개발을 지속적으로 추진하여 2002년 홀로그래피 방법을 이용해서 경면 정밀도를 90마이크론 수준으로 향상시켰으며, 2003년에는 230GHz 대역용 수신기 개발에 착수하고 2008년 완성하여 우리나라에서 처음으로 230GHz대역 전파 창을 개척하였다. 운영 초기부터 공동활용을 도모하여 서울대학교의 학생, 교수뿐만 아니라 국내외의 다른 대학, 연구소의 연구자들에게도 시간을 할애하였다. 지난 10여년간 학술지에 약 25편의 논문을 게재하였고, 관측과 기기개발을 주제로 약 12명의 석박사를 배출하였다. 서울대학교 전파망원경은 국내 대학이 보유한 연구용 장비로는 그동안 가장 경쟁력이 있는 장비로 자리매김을 하였고, 천문기기분야의 후진을 양성하는데 중요한 기여를 하였다.

[구 RA−03] Construction and development history of Korean VLBI Network

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대덕 14m 전파망원경에 의한 밀리미터파 관측연구 경험을 바탕으로 시작된 한국우주전파관측망 (Korean VLBI