Abstracts Exercise : Scientific Writing Class 3

Exercise 1: Identify the components which make up the five *Astronomy and Astrophysics* abstract sections*: Context, Aims, Methods, Results, Conclusions*.

- Note the following:
  - variation in phrasing and structure
  - sentence transitions
  - theme stretched across sentences
  - repetition for clarity
  - tense: present or past ? active or passive ?
  - length: too short? too long?
  - equations, citations, jargon: too much or too little?
- Can you suggest improvements?

1) Probing star formation across cosmic time with absorption-line systems

Ménard et al; Monthly Notices of the Royal Astronomical Society; Volume 417, Issue 2, pages 801–811, October 2011

We present an empirical connection between cold ($\sim$ 104K) gas in galactic haloes and star formation. Using a sample of more than 8500 Mg ii absorbers from Sloan Digital Sky Survey (SDSS) quasar spectra, we report the detection of a 15σ correlation between the rest equivalent width W0 of Mg ii absorbers and the associated [O ii] luminosity, an estimator of star formation rate.

This correlation has interesting implications: using only observable quantities we show that Mg ii absorbers trace a substantial fraction of the global [O ii] luminosity density and recover the overall star formation history of the Universe derived from classical emission estimators up to $z \sim 2$. We then show that the distribution function of Mg ii rest equivalent widths, dN/dW0, inherits both its shape and amplitude from the [O ii] luminosity function $\Phi(\mathrm{L})$. These distributions can be naturally connected, without any free parameter.

Our results imply a high covering factor of cold gas around star-forming galaxies: $\mathrm{C}\gtrsim 0.5$, favouring outflows as the mechanism responsible for Mg ii absorption. We then argue that intervening Mg ii absorbers and blueshifted Mg ii absorption seen in the spectra of star-forming galaxies are essentially the same systems, implying that the observed outflowing gas can reach radii of $\sim$ 50kpc. These results not only shed light on the nature of Mg ii absorbers but also provide us with a new probe of star formation, in absorption, i.e. in a way which does not suffer from dust extinction and with a redshift-independent sensitivity. As shown in this analysis, such a tool can be applied in a noise-dominated regime, i.e. using a data set for which emission lines are not detected in individual objects. This is of particular interest for high-redshift studies.

2) Self-regulated star formation in galaxies via momentum input from massive stars

Hopkins, Quataert & Murray; Monthly Notices of the Royal Astronomical Society; Volume 417, Issue 2, pages 950–973, October 2011

Feedback from massive stars is believed to play a critical role in shaping the galaxy mass function, the structure of the interstellar medium (ISM) and the low efficiency of star formation, but the exact form of the feedback is uncertain. In this paper, the first in a series, we present and test a novel numerical implementation of stellar feedback resulting from momentum imparted to the ISM by radiation, supernovae and stellar winds. We employ a realistic cooling function, and find that a large fraction of the gas cools to $\lesssim 100\,\mathrm{K}$, so that the ISM becomes highly inhomogeneous. Despite this, our simulated galaxies reach an approximate steady state, in which gas gravitationally collapses to form giant 'molecular' clouds (GMCs), dense clumps and stars; subsequently, stellar feedback disperses the GMCs, repopulating the diffuse ISM. This collapse and dispersal cycle is seen in models of Small Magellanic Cloud (SMC)-like dwarfs, the Milky Way and $z \sim 2$ clumpy disc analogues. The simulated global star formation efficiencies are consistent with the observed Kennicutt–Schmidt relation. Moreover, the star formation rates are nearly independent of the numerically imposed high-density star formation efficiency, density threshold and density scaling. This is a consequence of the fact that, in our simulations, star formation is regulated by stellar feedback limiting the amount of very dense gas available for forming stars. In contrast, in simulations without stellar feedback, i.e. under the action of only gravity and gravitationally induced turbulence, the ISM experiences runaway collapse to very high densities. In these simulations without feedback, the global star formation rates exceed observed galactic star formation rates by 1–2 orders of magnitude, demonstrating that stellar feedback is crucial to the regulation of star formation in galaxies.

3) The scatter about the 'Universal' dwarf spheroidal mass profile: a kinematic study of the M31 satellites And V and And VI

Collins et al.; Monthly Notices of the Royal Astronomical Society; Volume 417, Issue 2, pages 1170–1182, October 2011

While the satellites of the Milky Way (MW) have been shown to be largely consistent in terms of their mass contained within one half-light radius (Mhalf) with a 'universal' mass profile, a number of M31 satellites are found to be inconsistent with these relations, and seem kinematically colder in their central regions than their MW cousins. In this work, we present new kinematic and updated structural properties for two M31 dwarf spheroidals (dSph), And V and And VI, using data from the Keck Low Resolution Imaging Spectrograph (LRIS) and the DEep Imaging Multi-Object Spectrograph (DEIMOS) instruments and the Subaru Suprime-Cam imager. We measure systemic velocities of $v_{\rm r} = -393.1 \pm 4.2$ and $-344.8 \pm 2.5\,{\rm km\,s^{-1}}$, and dispersions of $\sigma_v = 11.5^{+5.3}_{-4.4}$ and $9.4^{+3.2}_{-2.3}\,{\rm km\,s^{-1}}$ for And V and And VI, respectively, meaning these two objects are consistent with the trends in σ_v and rhalf set by their MW counterparts. We also investigate the nature of this scatter about the MW dSph mass profiles for the 'classical' (i.e. MV < -8) MW and M31 dSph. When comparing both the 'classical' MW and M31 dSph to the best-fitting mass profiles in the size–velocity dispersion plane, we find general scatter in both the positive (i.e. hotter) and negative (i.e. colder) directions from these profiles. However, barring one exception (CVnI) only the M31 dSph are found to scatter towards a colder regime, and, excepting the And I dSph, only MW objects scatter to hotter dispersions. The scatter for the combined population is greater than expected from measurement errors alone. We assess this divide in the context of the differing disc-to-halo mass (i.e. stars and baryons to total virial mass) ratios of the two hosts and argue that the underlying mass profiles for dSph differ from galaxy to galaxy, and are modified by the baryonic component of the host.

Exercise 2: Rewrite the following abstract in traditional form, i.e. a single paragraph, and improve it if you can.

Flare occurrence and the spatial distribution of the magnetic helicity flux

Romano and Zuccarello; Astronomy and Astrophysics; 2011 Volume 535

Context. The accumulation of magnetic helicity via emergence of new magnetic flux and/or shearing photospheric motions is considered an important tool for understanding the processes that lead to eruptive phenomena.

Aims. We highlight a specific aspect of the magnetic helicity accumulation, providing new observational evidence of the role played by the interaction of magnetic field systems that are characterized by opposite signs of the magnetic helicity flux in triggering solar eruptions.

Methods. The amount of magnetic helicity injected into the corona through the photosphere in a sample of active regions (ARs) during their passage across the solar disk was measured by inferring the apparent motion of photospheric footpoints of magnetic field lines from a time series of MDI full-disk line-of-sight magnetograms. The temporal variation of the maps of magnetic helicity flux was analysed by measuring the fragmentation of the patches that are characterized by the flux of magnetic helicity. The temporal correlation between the number of these patches and the flare and coronal mass ejection (CME) occurrence has also been studied.

Results. The fragmentation of the patches singled out in the maps of the magnetic helicity flux provides a useful indication of the evolution of the AR complexity. The more fragmented the maps of the magnetic helicity flux are, the higher is the flare and CME frequency. Moreover, most of the events occur for low values ($\sim 3 \div 17$) of the difference of the number of patches with opposite signs of magnetic helicity flux.

Conclusions. These results indicate that not only the accumulation of magnetic helicity in the corona, but also its positive and negative fragmentation and distribution should be taken into account to provide a more confident indication of AR complexity and flare/CME productivity. In particular, the interaction of magnetic systems characterized by opposite sign of magnetic helicity flux may be responsible for many observed eruptions.

Exercise 3: Can you suggest improvements for the following abstracts?

1) SWIFT observations of the Arp 147 ring galaxy system

Fogarty et al.; Monthly Notices of the Royal Astronomical Society; Volume 417, Issue 2, pages 835–844, October 2011

We present observations of Arp 147, a galaxy system comprising a collisionally created ring galaxy and an early-type galaxy, using the Oxford SWIFT integral field spectrograph (IFS) at the 200-inch Hale telescope. We derive spatially resolved kinematics from the IFS data and use these to study the interaction between the two galaxies. We find the edge-to-edge expansion velocity of the ring is $225 \pm 8\,\mathrm{km\,s^{-1}}$, implying an upper limit on the time-scale for the collision of 50 Myr. We also calculate that the angle of impact for the collision is between inline image, where 0° would imply a perpendicular collision. The ring galaxy is strongly star forming with the star formation likely to have been triggered by the collision between the two galaxies.

We also measure some key physical parameters in an integrated and spatially resolved manner for the ring galaxy. Using the observed B—I colours and the Hα equivalent widths, we conclude that two stellar components (a young and an old population) are required everywhere in the ring to simultaneously match both observed quantities. We are able to constrain the age range, light and mass fractions of the young star formation activity in the ring, finding a modest age range, a light fraction of less than a third, and a negligible (<1%) mass fraction. We postulate that the redder colours observed in the south-east corner of the ring galaxy could correspond to the nuclear bulge of the original disc galaxy from which the ring was created, consistent with the stellar mass in the south-east quadrant being 30–50% of the total. The ring appears to have been a typical disc galaxy prior to the encounter.

The ring shows electron densities consistent with typical values for star-forming H ii regions. The eastern half of the ring exhibits a metallicity a factor of ~ 2 higher than the western half. The ionization parameter, measured across the ring, roughly follows the previously observed trend with metallicity.

2) Evolutionary models of the optical component of the LMC X-1/Star 32 binary system

Ziolkowski 2011, accepted for publication in MNRAS (http://xxx.soton.ac.uk/abs/1110.5312)

Calculations carried out to model the evolution of Star 32 under different assumptions about the stellar wind mass-loss rate provide robust limits on the present mass of the star. The obtained range is 31 to 35.5 $\mathrm{M_\odot}$, which is in very good agreement with the orbital solution of Orosz et al., namely 28.3 to 35.3 $\mathrm{M_\odot}$. The initial mass of Star 32 had to be in the range 35 to 40 Msun and the present age of the system is 3.7 to 4.0 Myr.

3) Determination of homogenized effective temperatures from stellar catalogs

Malyuto and Shvelidze, 16 pages, 10 figures Journal-ref: Baltic Astronomy, 20, 91-106, 2011 (http://xxx.soton.ac.uk/abs/1110.4987)

Some selected catalogs of the effective temperatures for F, G and K stars are analyzed. By an improved technique we estimate the external errors of these catalogs from data intercomparisons. The values of the effective temperatures are then averaged with the appropriate weights to produce a mean homogeneous catalog based on the selected data. This catalog, containing 800 stars, is compared with some other independent catalogs for estimating their external errors. The data may be used as a source of reliable homogeneous values of effective temperatures, together with their errors.

4) Can apparent superluminal neutrino speeds be explained as a quantum weak measurement?

Berry et al.; arXiv 1110.2832

Probably not.