Abstracts

Listed alphabetically after surname

Alarie, Alexandre

A new shock model database for multipurpose applications
I will present a newly created shock model grid containing over 50,000 models calculated with the shock modeling code MAPPINGS. The grid covers multiple abundances and various shock parameters (shock velocity, magnetic field, pre-shock density, age of the shock) in order to be useful for various applications such as the study of galaxies at high redshift as well as galactic objects. The grid comes with a set of tools such as an open access SQL database as well as a web interface in order to be readily usable by anyone for any projects. After a brief demonstration of the tools available, I will follow with the study of supernova remnants both galactic and extragalactic observed with the iFTS SITELLE installed at CFHT. Challenges associated with the comparison between SNRs observations and shock models will be presented using a set of new and classical diagnostic diagrams.

Azanha, Luiz

J-PAS, J-PLUS and S-PLUS: the sky in multicolor
Javalambre Physics of the Accelerating Universe Astrophysical Survey, J-PAS, is an unprecedented photometric sky survey of 8500 deg2 visible from Javalambre in 59 colors, using a set of broad, intermediate and narrow band filters. J-PAS will discover an unprecedented number of stars, galaxies, supernovas, quasars and solar system objects, which will be mapped with exquisite accuracy. The innovative designs of the J-PAS camera and filter system will allow, for the first time, to map not only the positions of hundreds of millions of galaxies in the sky, but their individual distances to us as well, providing the first complete 3D map of the Universe. The 56 filters of ~100 A FWHM effectively provide low resolution spectroscopy of all observed objects. This means that J-PAS will generate an impressive amount of data that will be extremely valuable for researchers of all areas of astronomy. This filter system will, for example, allow to measure many parameters which are relevant for the study of the evolution of galaxies: direct stellar temperatures, stellar masses, distribution of stellar ages, metallicity, dust extinction, and interstellar gas emission. Furthermore, emission lines of nearby galaxies will be studied pixel by pixel, a very important piece in our understanding of the spatial evolution of thousands of galaxies.

Borthakur, Sanchayeeta

Emission-lines from the circumgalactic medium - tracing the pathways in and out of galaxies!

Chatzikos, Marios

Advances in the C17 release of the spectral code CLOUDY
In a two-part presentation, we shall discuss advances in the C17 release of the spectral code CLOUDY, as well as ongoing development that should be of interest to observers and modelers alike. One of the most significant changes has been the export of atomic and ionic data sets to external data bases, Chianti and Stout. This enables CLOUDY to compute spectra with much more rigor and detail than was previously possible. In addition, the atomic data for the H-like and He-like iso-sequences have undergone major review. Corrections for isotropic radiation fields are now applied by default. Optical depth calculations have greatly improved. The implementation in Cloudy of a matrix condensation method will permit calculations

including a high number of Rydberg levels, and allow computationally fast and reliable simulations of radio recombination lines. Other ongoing efforts will enable CLOUDY to compute spectra of discontinuous shocks, such as those produced in supernovae. CLOUDY is developed interactively with, and in response to the necessities of the astronomical community.

Chiaki, Gen

Ionization and supernova feedback from the first stars
The first light in the Universe is given by the first-generation metal-free (PopIII) stars. It modifies the density distribution of the cosmic structures, and affects the efficiency of metal enrichment. The elemental abundances of Pop III stars are considered to be inherited by the nearby extremely metal-poor (EMP) stars. To investigate the dominant enrichment process and ionization efficiency of Pop III stars, we carry out a series of numerical simulations including the feedback effects of photoionization and supernovae (SNe) of Pop III stars with a range of masses of minihaloes (MHs), M_halo, and Pop III stars, M_PopIII, and compare with the metallicity range and elemental abundances of observed EMP stars. We find that the metal-rich ejecta reaches neighboring haloes, and external enrichment (EE) occurs when the ionization front expands. The neighboring haloes are only superficially enriched, and the metallicity of the clouds is [Fe/H].

Cormier, Diane

Revealing the ISM properties of star-forming dwarf galaxies with CLOUDY
To understand how star-formation properties in galaxies evolve, a better characterization of their interstellar medium is needed. Thanks to Spitzer, Herschel, and now SOFIA, ALMA, we have detected for the first time in low-metallicity galaxies important cooling lines that provide great insight on the physical conditions of the ISM closely related to star formation.
I will talk about our on-going efforts to model the multi-phase ISM of nearby low-metallicity star-forming galaxies using IR-mm observations and the spectral synthesis code Cloudy. We find that the low-metallicity ISM differs dramatically from that of more metal-rich objects. It is characterized by harder radiation fields and a porous structure, with larger filling factors of ionized gas. The C+ emission arises mostly from PDRs, which have low covering factors and moderate UV fields. We also find that most of the molecular gas mass in those galaxies resides in PDRs not traced by CO.

Doughty, Caitlin

Relating [C II] emission and C IV absorbers during the epoch of reionization
[C II] emission is widely used as a tracer of galactic structure due to its brightness and visibility over large distances, and at $z > 6$ becomes redshifted to wavelengths > 1 millimeter, becoming visible to facilities such as ALMA. Further, it is of interest to tie the characteristics of metal absorbers in the CGM to their potential galactic "hosts". C IV absorption (1548 Angstroms) within quasar absorption spectra is a particularly promising probe of the ionizing background, as well as of galactic feedback, at the epoch of reionization. Using results from a cosmological simulation that applies on-the-fly radiative transfer calculations to model a local ultraviolet background, fully accommodating the 'patchiness' of the process of reionization, we predict the [C II] emission characteristics of simulated galaxies as a function of the traits of the nearest C IV absorber.

Ferland, Gary

The Orion Nebula: a case study for emission from star-forming regions

Fritz, Jacopo

Modeling gas properties in Jellyfish Galaxies: the GASP project
I will present some results from the survey "GAs Stripping Phenomena in galaxy with MUSE", a project which aims at studying the physical conditions and the stripping history of gas in local galaxies accreting onto clusters.

Gray, William

The Effect of Turbulence on Nebular Emission Line Ratios
Motivated by the observed differences in the nebular emission of nearby and high-redshift galaxies, I will describe a set of direct numerical simulations of turbulent astrophysical media exposed to a UV background. The simulations assume a metallicity of $Z/Z_\odot=0.5$ and explicitly track ionization, recombination, charge transfer, and ion-by-ion radiative cooling for several astrophysically important elements. Each model is run to a global steady state that depends on the ionization parameter and the one-dimensional turbulent velocity dispersion, σ_{1D}, and the turbulent driving scale. I will report our results as several nebular diagnostic diagrams and compare them to observations of star-forming galaxies at a redshift of $z\approx2.5$, whose higher surface densities may also lead to more turbulent interstellar media. With a driving scale ≈0.1 pc, a moderate amount of turbulence can reproduce many of the differences between high and low redshift observations without resorting to harder spectral shapes.

Guzman, Francisco

Advances in the C17 release of the spectral code CLOUDY
In a two-part presentation, we shall discuss advances in the C17 release of the spectral code CLOUDY, as well as ongoing development that should be of interest to observers and modelers alike. One of the most significant changes has been the export of atomic and ionic data sets to external data bases, Chianti and Stout. This enables CLOUDY to compute spectra with much more rigor and detail than was previously possible. In addition, the atomic data for the H-like and He-like iso-sequences have undergone major review. Corrections for isotropic radiation fields are now applied by default. Calculation of optical depths have greatly improved. The implementation in Cloudy of a matrix condensation method will permit calculations including a high number of Rydberg levels, and allow computationally fast and reliable simulations of radio recombination lines. The treatment of the correction of the isotropic radiation fields and optical depths have been greatly improved. Other ongoing efforts will enable CLOUDY to compute spectra of discontinuous shocks, such as those produced by supernovae. CLOUDY is developed interactively with, and in response to the necessities of the astronomical community.

Haydon, Daniel

Creating a synthetic ALMA Ultra Deep Field
A true understanding of galaxy formation must come from the combined study of galaxy simulations and observational data: the baryonic physics built into our simulations are driven by observations. It is therefore critical to fully understand the emission tracers we rely upon. Synthetic observations are the key: they teach us how different emission tracers change with

environment as well as redshift and, through comparisons with observational data, how well our simulations describe the real Universe.
In the wake of ALMA, we can now use CO transitions to trace molecular gas out to virtually any redshift; this has enabled surveys like ASPECS - an ALMA spectroscopic survey in the Hubble Ultra Deep Field (UDF) - which surveys molecular gas in high redshift galaxies.
I will present our work to create the synthetic equivalent of the ASPECS observational data. We produce our synthetic ALMA UDF by using the snapshot data from the Illustris cosmological simulations at different redshifts and constructing a synthetic light cone spanning z~1-4. We create synthetic CO observations in both 2D (RA/DEC) and 3D (+redshift) by feeding the gas particle data within our light cone into DESPOTIC - a model for deriving the energetics and spectra of molecular clouds. In addition, we have coupled the stellar population synthesis code SLUG to galaxy simulations, allowing us to generate SFR tracer maps. With our 2D and 3D synthetic observations we will not only directly test the current state-of-the-art in galaxy formation simulations against UDF observations, but also improve the understanding of the observations themselves.

Hirschmann, Michaela

Cosmic evolution of synthetic nebular emission lines of simulated galaxies
Galaxies occupy different regions of the [OIII]λ5007/Hβ-versus-[NII]λ6584/Hα emission-line ratio diagram in the distant and local Universe. We investigate the origin of this intriguing result by modelling self-consistently nebular emission from young stars, accreting black holes (BHs) and older, post-asymptotic-giant-branch (post-AGB) stellar populations in galaxy formation simulations in a full cosmological context. In post-processing, we couple new-generation nebular-emission models with high-resolution, cosmological zoom-in simulations of massive galaxies to explore which galaxy physical properties drive the cosmic evolution of the optical-line ratios [OIII]λ5007/Hβ, [NII]λ6584/Hα. The line ratios of simulated galaxies agree well with observations of both star-forming and active local SDSS galaxies. Towards higher redshifts, at fixed galaxy stellar mass, the average [OIII]/Hβ increases and [NII]/Hα decrease -- widely consistent with observations. We identify the chemical enrichment and star formation history — the latter controlling nebular emission from young stars via the ionization parameter — as the primary drivers of the cosmic evolution of [OIII]/Hβ and [NII]/Hα. Instead, changes in the hardness of ionizing radiation, ionized-gas density, the prevalence of BH accretion relative to star formation and the dust-to-metal mass ratio play at most a minor role in the cosmic evolution of simulated galaxy line ratios. While at high redshifts, optical diagnostic diagrams fail to distinguish the main ionising source in galaxies, our simulations demonstrate that instead UV-based emission-line diagnostics allow for an accurate selection of different types of primeval galaxies. Overall, our simulation predictions will be crucial for the interpretation of up-coming observational high-z spectroscopic data, e.g. from NIRSpec on board JWST.

Izquierdo, Andres

Radiative transfer modelling of W33A MM1: 3-D structure and dynamics of a complex massive star forming region
We present a composite model and radiative transfer simulations of the massive star forming core W33A MM1. The model was tailored to reproduce the complex features observed with ALMA ~0.2 arcsec resolution in CH3CN and dust emission.
MM1 is fragmented into six compact sources within 1000 au. In our models, three of these compact sources are better represented as disc-envelope systems around a central (proto)star, two as envelopes with a central object, and one as a pure envelope. The model of the most prominent object (Main) contains the most massive (proto)star (~7 Msun) and disc+envelope

(Mgas ~0.4 Msun), and is the most luminous (~10^4 Lsun). The model discs are small (a few hundred au) for all sources.
The composite model shows that the elongated spiral-like feature converging to the MM1 core can be convincingly interpreted as a filamentary accretion flow that feeds the rising stellar system. Fragmentation within this filament and smaller filamentary flows between pairs of sources are proposed to exist.
Our modelling supports an interpretation where what was once considered as a single massive star with a ~10^3 au disc and envelope, is instead a forming stellar association in which accretion to individual objects is still disc-mediated, and the stellar group itself is being fed by filamentary accretion from the outside. The new stellar association appears to be virialized and already follows a bottom-heavy mass distribution.

Kolwa, Sthabile

Dissecting the multi-phase haloes of high redshift radio galaxies with ALMA and MUSE
With the use of VLT/MUSE integral-field spectroscopy, we aim to study the intricate morphology of gas haloes surrounding high-redshift radio galaxies (HzRGs). HzRGs are an important component in massive galaxy evolution given their stellar masses i.e. M* ~ 1010-11 M⊙. Also, their high redshifts, 1.0 < z < 5.0, make them good probes for testing cosmological theory. We also use HzRG observations to determine the role of positive and negative AGN feedback on star-formation among other internal mechanisms within radio galaxies.
For a sample of 7 HzRGs, we have obtained ALMA [CI](1-0) and MUSE data. I will present the most up-to-date observations of ionisation and excitation lines in the MUSE spectra of MRC 0943-242 at z = 2.93. The spatial distribution of MUSE-detected emission in these lines reveals interactions between the galaxy's radio jets and its ionised gas as well as possible evidence for tidal disruptions possibly associated with a minor merger. Line profile fitting to emission only components in CII, CII], CIII], HeII, NIV] and OIII] reveal kinematically perturbed gas (FWHM > 1000 km/s) within a 40 kpc radial extent from the AGN. Fitting emission and absorption to resonant lines, Lyα, CIV, SiIV and NV, reveal absorption shells at z=2.91 and z=2.92. We measure their HI column densities. Additionally, we use this to indirectly determine the extent of HI gas prior to the emergence of sensitive radio interferometry that will measure HI at z > 1 directly.

Magdis, Georgios

Turning observables to gas mass across cosmic time.
One of the major challenges in the studies of galaxy evolution remain is to determine the gas mass reservoir of galaxies and its evolution with cosmic time.
In this talk I will combine results from our recent ALMA and IRAM programs that target star-forming galaxies from z=0.0 to z=3, and present scaling relations between various observables and the gas molecular gas mass of the galaxies, ranging all the way from mid-IR PAH features to [CI], C+, CO far-IR lines and mm continuum flux densities.
Among others, the new observations include:
- a large [CI] survey of z~1 normal star-forming galaxies,
- CI[1-0] and CI[2-1] observations of a template star-bursting galaxy at z=4.0 (GN20),
- [CII] observations of normal z~2 star-forming galaxies as well as
- CO and mm continuum observations of intermediate redshift ULIRGs and z~3 LBGs.

I will discuss how these new observations combined with ancillary data, including Spitzer IRS spectroscopy and Herschel broadband photometry, are used to establish universal scaling relations that can serve as tools to measure the ISM content of galaxies at various epochs and provide a better picture of the role of gas in galaxy evolution.

Maji, Moupiya

Radiative transfer of Lya emission from high-redshift quasars using ART2 code
The emergence of the first galaxies and quasars is one of the most important unsolved problems in cosmology. We investigate this problem by combining multi-scale cosmological simulations with multi-wavelength radiative transfer calculations in order to follow the formation, evolution and multi-band properties of the first galaxies and quasars. We analyze a suit of cosmological zoom-in simulations of massive galaxies (few ×10^12 – 10^13 solar mass) and follow their evolution starting from z ~ 63 to after reionization z ~ 5. These hydrodynamic simulations have high spatial (~ 0:25 kpc/h) and mass (gas mass few ~ 10^5 solar mass) resolutions and are likely progenitors of massive galaxies.
We analyze these simulations with a 3D radiative transfer code ART2 to obtain the observational signatures of these galaxies at different redshifts. The RT code contains multi-wavelength continuum, Lyα line, the hydrogen ionization and the CO lines. We predict from the SED continuum that JWST may be able to detect massive galaxies up to redshift z~15. Furthermore, we find that seed black holes can grow rapidly via cold gas accretion under Eddington limit and reach 10^9M at redshift z > 6. Lastly, we explore the effects of different parameters, e.g. the galaxy mass, its environment, different models of black hole accretion and radiative feedback on the observable signatures of the first galaxies.

Morisset, Christophe

3D spectroscopy and models
In this talk I will present the way an observer can be tempted to deal with 3D IFUs spectroscopic observations of resolved nebular regions.
I will especially show the consequences of trying to reproduce the observed gradient of some emission line ratios with models of entire regions.

Pallottini, Andrea

The impact of chemistry on internal structure and emission from high-redshift galaxies
The discovery and characterization of primeval galaxies represent some of the biggest challenges of current observational and theoretical cosmology. This kind of studies recently entered a golden era, thanks to the unprecedented capabilities of the Atacama Large Millimeter Array (ALMA). Far infrared fine structure lines -- [CII]158μm in particular -- are exquisite tools to search for and characterize the most remote system in the Universe. These experiments can be combined with detailed galaxy simulations to achieve a solid theoretical understanding.

I will present cosmological, zoom-in, AMR, high-resolution (30 pc) simulations of high-redshift (z~6) galaxies with the aim of characterizing their interstellar medium and chemical structure. Comparing line and continuum emission from our simulations with the most recent observations of LAEs and LBGs allow us to draw novel and unique conclusions. In addition, such comparison is fundamental to constrain feedback prescriptions and radiation transfer methods in simulations, which are a far cry from being fully understood.

Penaloza, Camilo

Using CO line widths to test the accuracy and biases of the viral parameter

The virial parameter is a widely used measure of the dynamical state of astronomical systems. Within the interstellar medium (ISM) it can help determine whether a molecular cloud (MC) is gravitationally bound, unbound or being ripped apart by turbulent energy. To calculate the virial parameter we rely on line emissions from which the velocity dispersion, and therefore the kinetic energy, can be obtained.

In this work, we focus on mimicking the CO emission for simulated MCs in order to test how their dynamical state changes as a function of metallicity. We perform a set of smooth particle hydrodynamics (SPH) simulations with time-dependent chemistry, in which metallicity was systematically varied. The simulations were then post-processed using radiative transfer (via RADMC-3D) to produce synthetic emission maps.

In this talk, I will present three main results. First, show how the "observed" velocity dispersion significantly decreases with lower metallicities and how this is reflected in the virial parameter. Second I will highlight the importance of understanding the intrinsic assumptions that go into calculating the virial parameter, such as how the mass and radius are derived. Finally, I will show how the virial parameter of a cloud changes with metallicity and how the 'observed' virial parameter compares to the 'true' value in the simulation.

Popping, Gergö

Modeling CO and [CII] from z=0 to z=6 in cosmological simulations

Revalski, Mitchell

Using Photoionization Modeling and Line Diagnostics to Quantify Feedback from AGN Driven Outflows

Active Galactic Nuclei (AGN) can deliver feedback to their host galaxies by driving powerful outflows of molecular and ionized gas that may clear the bulge of star forming gas and regulate the supermassive black hole (SMBH) accretion rate. Using spatially resolved Hubble Space Telescope (HST) spectra and [O III] imaging, emission line diagnostics, and Cloudy photoionization models, we aim to quantify feedback from narrow line region outflows in nearby Seyfert AGN. This technique allows us to quantify mass outflow rates and energetics as functions of distance from the supermassive black hole (SMBH), and to probe the physical conditions of the ionized gas. We present here our techniques for modeling the outflows using Cloudy, and discuss the results of our analysis for several Seyfert galaxies. The discussion will emphasize modeling details relevant to a wide range of astrophysical situations including emission line diagnostics to constrain the ionizing continuum, element abundances, dust grain content, gas temperature, and density.

Richardson, Mark

Simulating the ISM and its Line Emission

Integral field observations of galaxies now produce spatially resolved emission line diagnostic diagrams that can reveal the diverse processes impacting the ISM, and are necessarily dependent on the geometry and distribution of their gas clouds. Simulations of galaxies can now model the diverse geometries of interstellar clouds, which are often different than the simple geometries employed in photoionisation codes like cloudy. Thus, we suggest that the future of emission line modeling will necessarily require combining photoionisation models with full hydrodynamical simulations of galaxies, ideally including radiative transfer as well. I will present an overview of the interstellar clouds produced in the NUT and NEPHTHYS galaxies, formed in high-redshift, zoom cosmological simulations of up to 10 pc resolution. I will then present our methods to characterise feedback as it impacts these clouds, and predict the resulting emission lines. Finally, emission line model tools also play a role in predicting the abundance of ions in the circumgalactic medium (CGM), which are observed in absorption in observations of background quasars. Thus, we suggest future development of line emission models keep the CGM in mind, as galactic processes that impact the ISM also impact the CGM. Taken together observations of the ISM and CGM can be more constraining for these models.

Richings, Alex

Molecular emission lines from simulations of AGN-driven molecular outflows
Observations of AGN host galaxies have detected fast molecular outflows, with velocities up to ~1000 km/s and outflow rates up to ~1000 Msol/yr. To explore the origin of these molecular outflows, we ran simulations of an isotropic AGN wind interacting with a uniform ambient ISM. By modelling the time-dependent molecular chemistry in these simulations, we showed that these molecular outflows can arise from the in-situ formation of molecules within the AGN wind. In this talk, I will present the results of radiative transfer modelling of molecular emission lines from these simulations in post-processing. We found that the molecular outflow rates derived from CO emission lines in our simulations at solar metallicity are in agreement with observations. By comparing the CO emission to the actual H2 mass in the simulations, we derive a CO-to-H2 conversion factor of 0.13 Msol/(K km/s pc^2), a factor of 6 lower than the standard ULIRG value that is often assumed in these observations. We also found strong infrared emission lines from warm H2, with excitation temperatures of 400-550 K. The mass of H2 inferred from this warm H2 emission is within a few per cent of the total H2 mass. These warm H2 emission lines are potentially observable by JWST.

Rigopoulou, Dimitra

New gas phase metallicities based on FIR fine structure lines
In this talk I will present new diagnostics for the gas phase metallicities in galaxies based on FIR Fine Structure lines.
We used the photoionization code CLOUDY to model the far-infrared emission from a star-forming galaxy and derived metallicity sensitive diagnostics based on combinations of far-infrared fine structure line ratios. Amongst the ratios used, we found that combinations including [OIII]88, [OIII]52 and [NIII]57 lines, are the most sensitive ones. Metallicities including these ratios are robust in the presence of an AGN and are also insensitive to changes in the age of the ionizing stellar spectrum. These FIR diagnostics were used to determine metallicities in a sample of local Ultraluminous Infrared Galaxies (ULIRGs) with FIR spectroscopy available from Herschel. We found that ULIRGs are underabundant (by about a factor of two) in the mass-metallicity relation compared to other galaxies of same mass.
We further explored on the applicability of the [OIII]88 /[NII]122 line ratio as a gas phase metallicity indicator in high redshift submillimetre luminous galaxies. The [OIII]88 /[NII] 122 ratio is strongly dependent on the ionization parameter (which is related to the total number of ionizing photons) as well as the gas electron density. We propose the use of the 88 /122 continuum ratio to get an estimate of the ionization parameter while the electron density can be constrained from the [NII] 122/205 ratio. We use the [OIII]88 /[NII]122 line ratio from a sample of

nearby normal and star-forming galaxies to measure gas phase metallicities and find that their mass metallicity relation is consistent with the one derived
using optical emission lines. Finally, we derived FIR based metallicities for a small sample of z~3 submm galaxies with no previous metallicity estimates. We found the metallicities of these z~3 submm luminous galaxies to be consistent with solar metallicities and that they appear to follow the mass-metallicity relation expected for z~3 systems.

Otho, Ulrich IV

Emission Line Equivalent Widths for AGN Modeling
The Cloudy spectral synthesis code is used to produce contours of equivalent widths for several Balmer, Paschen, and Helium lines, and Lyman-alpha, across a parameter space of hydrogen density and hydrogen-ionizing flux, which are useful to AGN modeling. The locally optimally emitting cloud model integrates line fluxes and cloud distributions across the expected parameters to predict resultant spectra from and properties of the broad line and narrow line regions. Extinction between the nucleus and the BLR and NLR in local Seyfert galaxies is computed by fitting the observed emission line ratios to contours in the parameter space. The line equivalent width and ratio dependencies on metallicity and spectral index, H-I emitting radii, and BLR/NLR extinction ratios are computed from these results. The Seyfert galaxies are classified with greater resolution than the traditional Seyfert 1 and 2 classes by binning according to the BLR/NLR extinction ratios.

Vazquez-Semadeni, Enrique

Do infall line profiles systematically underestimate the infall speeds in prestellar cores?
Moderately optically-thick molecular lines are often used to infer infall speeds in dense molecular cloud cores. In dense (>~ n~10^5 cm^-3), prestellar cores, the inferred infall motions are often found to be subsonic, in opposition to the infall velocities found in numerical simulations of collapsing cores. This has been interpreted as implying that the cores are not collapsing freely, but instead turbulence or magnetic fields support them against their self-gravity. Here, we present synthetic observations of a numerical simulation of spherical collapse, and show that the inferred infall speed is lower than the actual speed by factors ~3. The understimation arises because the radial velocity profile in collapsing prestellar cores is of an outside-in nature (i.e., has the largest speeds at a finite distance from the core
center), contrary to the standard assumption of a Shu-like inside-out profile, which has the largest speeds at the core center. The outside-in profile causes the largest velocities to receive a lower weight in the line profile, creating the appearance of a lower infall speed. This result suggests that prestellar cores can be in full collapse without contradicting the observed subsonic speeds.

Wofford, Aida

Stars and gas in the most metal-poor galaxies I: SBS 0335-052E
Understanding the properties of stars and gas at low metallicity is of large relevance for a variety of fields in astrophysics, since it relates to multiple topical questions which range from understanding the properties of galaxies that contributed to cosmic reionization to the evolution of metal-poor massive stars that give rise to the formation of heavy binary black holes. Crucial are observational constraints for the theoretical predictions. These can be obtained from rest-frame ultraviolet and optical spectra of the most metal-poor galaxies known. Among these, SBS 0335-052E (z=0.0135, 12+log(O/H)=7.3) is one of the most well-studied. For this galaxy, we present Hubble Space Telescope (HST) / Cosmic Origins Spectrograph (COS) detections of the C IV 1549, 1551, He II 1640, O III 1661, 1666, [C III]

1907, and C III] 1909 UV emission lines; and a Very Large Telescope (VLT) / Multi Unit Spectroscopic Explorer (MUSE) spectrum covering from 4600 to 9400 Ang, which is co-spatial with the UV data and integrated over the same area. Using these datasets we test: a) the latest Charlot & Bruzal spectral synthesis models with very massive (300 Msun) single non-rotating stars; b) the performance of the spectral analysis tool, BayEsian Analysis of GaLaxy sEds (BEAGLE); and c) the extent to which physical properties of the gas and dust derived independently from the UV and optical with BEAGLE are constrained.