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#
# Plot M-stars vs SFR and calculate a linear correlation
# (by Antonello Venturino, 3 June 2018)
#
#   SFRs from 3 emission lines in file SFRs.txt
#   Masses in second column of file stellar_mass.txt
#
import sys
import astropy.units as u
import numpy as np
import matplotlib
import matplotlib.pyplot as plt
import scipy.stats as st
import math as m
import astropy as astr

#Setting plot
plt.rc('text', usetex=True)
plt.rc('font', family='serif')
matplotlib.rcParams['figure.dpi'] = 2.5 * matplotlib.rcParams['figure.dpi']
 #high dpi for 4k screen

# Reading SFRs from emission lines
gals, ha, o2 = np.loadtxt("SFRs.txt", unpack=True, usecols=(0,1,2))   #
 Here file with all lines

# Reading stellar masses
gals2, m = np.loadtxt("masses_NEW.txt", unpack=True, usecols=(0,1))

# Check consistency of data
if len(gals) != len(gals2):
    sys.exit("Numbers of galaxies doesn't match")

for i in range(0, len(gals)):
    if gals[i] != gals2[i]:
        sys.exit("Numbers of galaxies doesn't match")

# Take the correct SFR. First from the H-Alpha emission line, if it is
 unavailable take from OII emission line.
sfr = np.zeros(ha.size)
sfr_ha = []
sfr_o2 = []
m_ha = []
m_o2 = []
for i in range(0, len(ha)):
    if ha[i] >= 0:
        sfr[i] = ha[i]
        sfr_ha.append(sfr[i])
        m_ha.append(m[i])
    elif o2[i] >= 0:
        sfr[i] = o2[i]
        sfr_o2.append(sfr[i])
        m_o2.append(m[i])
    else:
        print("The SFR of the galaxy %d is unavailable", gals[i])
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        sys.exit(1)

# Polynomial linear correlation between stellar mass and SFRs and plot
plt.plot(log10(m_ha), log10(sfr_ha), 'ro')
plt.plot(log10(m_o2), log10(sfr_o2), 'gs')

x = np.array(log10([min(m), max(m)]));

coeffs = np.polyfit(np.log10(m), np.log10(sfr), 1)

plt.plot(x, coeffs[0]*x+coeffs[1], 'm--')

title = ["Correlation between stellar mass and SFRs: ", "%.3f" % coeffs[1],
 " + ", "%.3f" % coeffs[0], "$M_\odot$"]

plt.title(r"".join(title), fontsize=10)
plt.ylabel(r"SFR [$Log (M_\odot yr^{-1})$]",fontsize=16)
plt.xlabel(r"Stellar mass [$Log ( M_\odot )$]",fontsize=16)
#plt.yscale('log')
#plt.xscale('log')
#plt.grid()
plt.legend([r'SFR from H$_\alpha$', r'SFR from OII', r'Linear correlation'])
plt.show
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