Dust millimetre emission in Nearby Galaxies with NIKA2/IRAM-30m: major challenges and latest results of the IMEGIN Large Program.

L. Pantoni[1,2], F. Galliano[1], S. Madden[1], and NIKA2 collaboration.

[1]AIM, CEA, CNRS, Université Paris-Saclay, Université Paris Diderot, Sorbonne Paris Cité, F-91191 Gif-sur-Yvette, France, [2]IAS, Université Paris-Saclay, 91405 Orsay, France

The millimetre part of the spectrum is one of the least explored parts of a galaxy's spectral energy distribution (SED), yet it contains emission from three fundamentally important physical processes. These processes are thermal emission from dust, free-free emission from ionized gas and synchrotron emission from relativistic charged particles moving in the galactic magnetic field.

The NIKA2 camera (IRAM-30m telescope), observing at 1 mm and 2 mm, provides additional data points for input into the comprehensive SED models and allows us to:

1. disentangle spatially resolved galaxy SEDs from dust contribution, free-free and synchrotron emission;
2. constrain the evolution of the dust-to-gas mass ratio within galaxies, which provides a direct link to the chemical evolution of galaxies and the reservoirs for dust production;
3. study the microscopic properties of dust, i.e. constraints on millimetric opacity;
4. study the sub-millimeter excess in galaxies, whose origin is still unknown.

These are some of the main objectives of the IMEGIN Large Program (Interpreting the Millimetre Emission of Galaxies with IRAM-NIKA2; PI S. Madden), targeting 22 nearby galaxies in the millimetre continuum regime with the NIKA2 camera.

In my talk, I will present the main and latest results of the IMEGIN collaboration, which gathers researchers from 7 institutes in France (CEA, IAP, IRAM, LAM, IRAP, IAS, IPAG), and other 7 abroad (Athens observatory, University of Ghent, IPM/Iran, STScI, Calar Alto Observatory, Nat. University of Ireland, University Cardiff). The NIKA2 millimetre data, combined with a suite of observations at other wavelengths (from multi-wavelength catalogs such as Dustpedia [1]; CO and HI surveys, e.g. [2], [3]), allow us to model the IR-to-radio SED and to put constraints on interstellar medium and dust grains properties of galaxies.

Our SED analysis (performed globally and locally) makes use of the state-of-the-art hierarchical bayesian fitting code HerBIE [4], [5] with the prescriptions of the dust evolution model THEMIS, that is anchored to the laboratory-measured properties of ISD analogues [6].

During my presentation, I will focus on the major challenges linked with data processing and uncertainty propagation; large scale emission filtering in NIKA2 maps (due to atmosphere subtraction during data reduction process); latest significant results on NGC891 (Katsioli et al. in prep.) and NGC4254 (Pantoni et al. in prep.); ongoing projects (Ejilali et al. in prep. and Nersesian et al. in prep.) and future perspectives/applications.

References

[1] http://dustpedia.astro.noa.gr/ [2] Jiménez-Donaire et al. 2019, ApJ, 880:127 (55pp) [3] Chung et al. 2009, AJ, 138, 1741 [4] Galliano 2018. MNRAS 476, 1445–1469 [5] Galliano et al. 2021, A&A, Vol. 649, id.A18, 42 pp. [6] Jones et al. 2017. A&A 602, A46