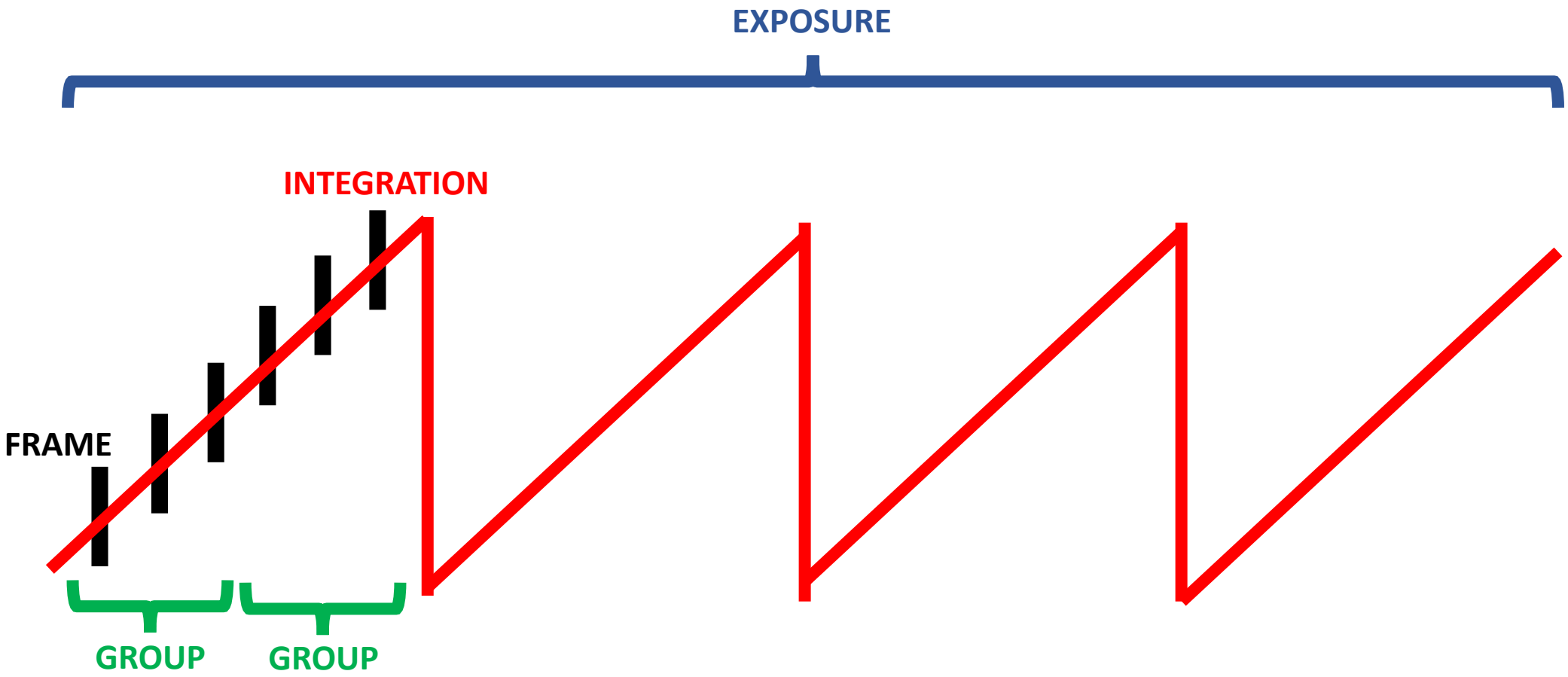
JWST Data Processing and Products


EXPOSURE
INTEGRATION
FRAME
GROUP
GROUP

What comes from the spacecraft?

- One file per exposure (which typically means one file per dither position)
- Raw (uncalibrated) data from all groups in an exposure
  - Dimensions of file: nrows x ncolumns x ngroups x nintegrations
- Referred to as “Stage 0” data products
- Suffix: “uncal”

Stage 1: Ramps to slopes

- Ramp fitting converts raw count rates from individual groups into a “slope” image with units of DN/sec
- Also addresses linearity, known detector effects, and cosmic rays
- Input: “uncal”
- Key outputs: “rateints” and “rate”
  - rateints: 3D product, each plane is a 2D slope image corresponding to a specific integration within the exposure
  - rate: 2D product, average of all the slope images within the rateints file

Interlude

- Stage 1 processing is applied to all imaging and spectroscopic observations
- Stage 2 and 3 processing have separate “branches” for imaging and spectroscopy
- Time series observations (TSOs) represent another flavor that will not be discussed further here

Stage 2: Calibration of imaging data

- Input: “rate”

- Key imaging outputs: “cal” and “i2d”
  - cal: Calibrated product for the average of all integrations, units of MJy (NIRSpec & NIRISS SOSS) or MJy/steradian (all other modes)
  - i2d: Resampled calibrated data (removes distortion), same units as above

Stage 2: Calibration of spectroscopic data

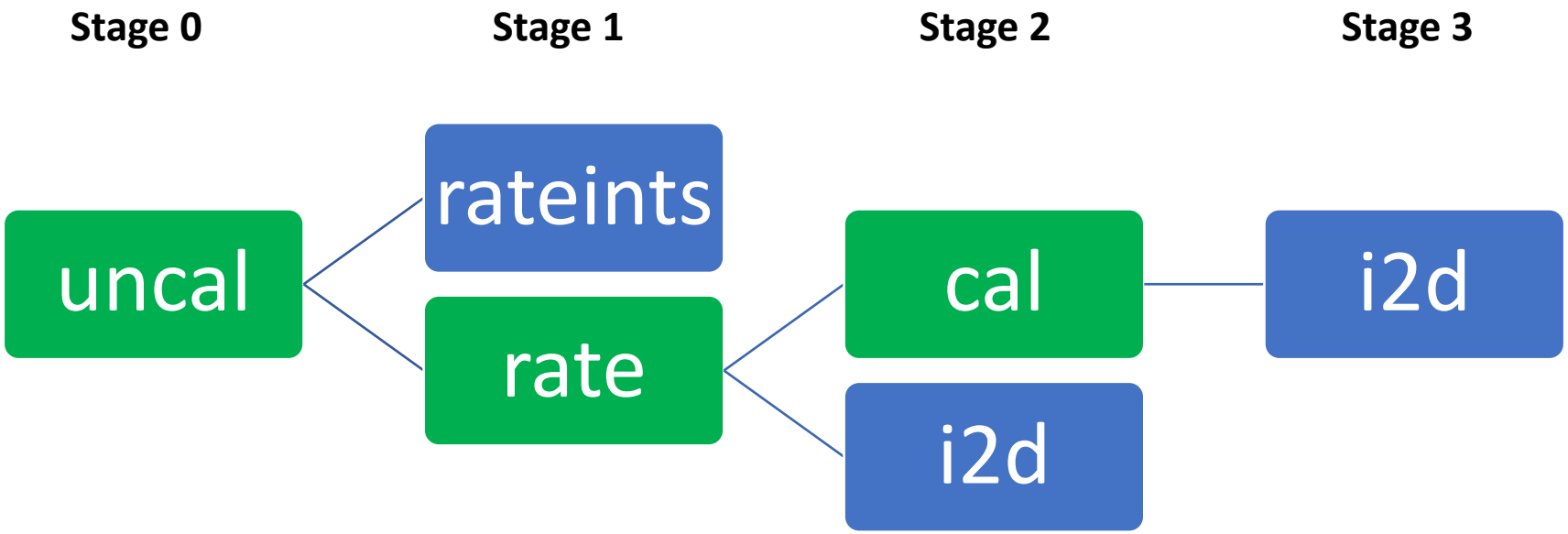
- Input: “rate”

- Key spectroscopic outputs: “cal”, “s2d”, “s3d”, “x1d”
  - cal: Calibrated product for the average of all integrations, units of MJy (NIRSpec & NIRISS SOSS) or MJy/steradian (all other modes)
  - s2d: 2D (long slit) spectra, resampled calibrated data (removes distortion), same units as above
  - s3d: 3D (IFU) spectral cube
  - x1d: Extracted 1D spectrum, aperture extraction
    - For long slit spectra: Rectangular aperture extraction is used
    - For IFU cubes: Circular aperture extraction with background subtraction is used for point sources, for extended sources the entire scene is extracted with no background subtraction

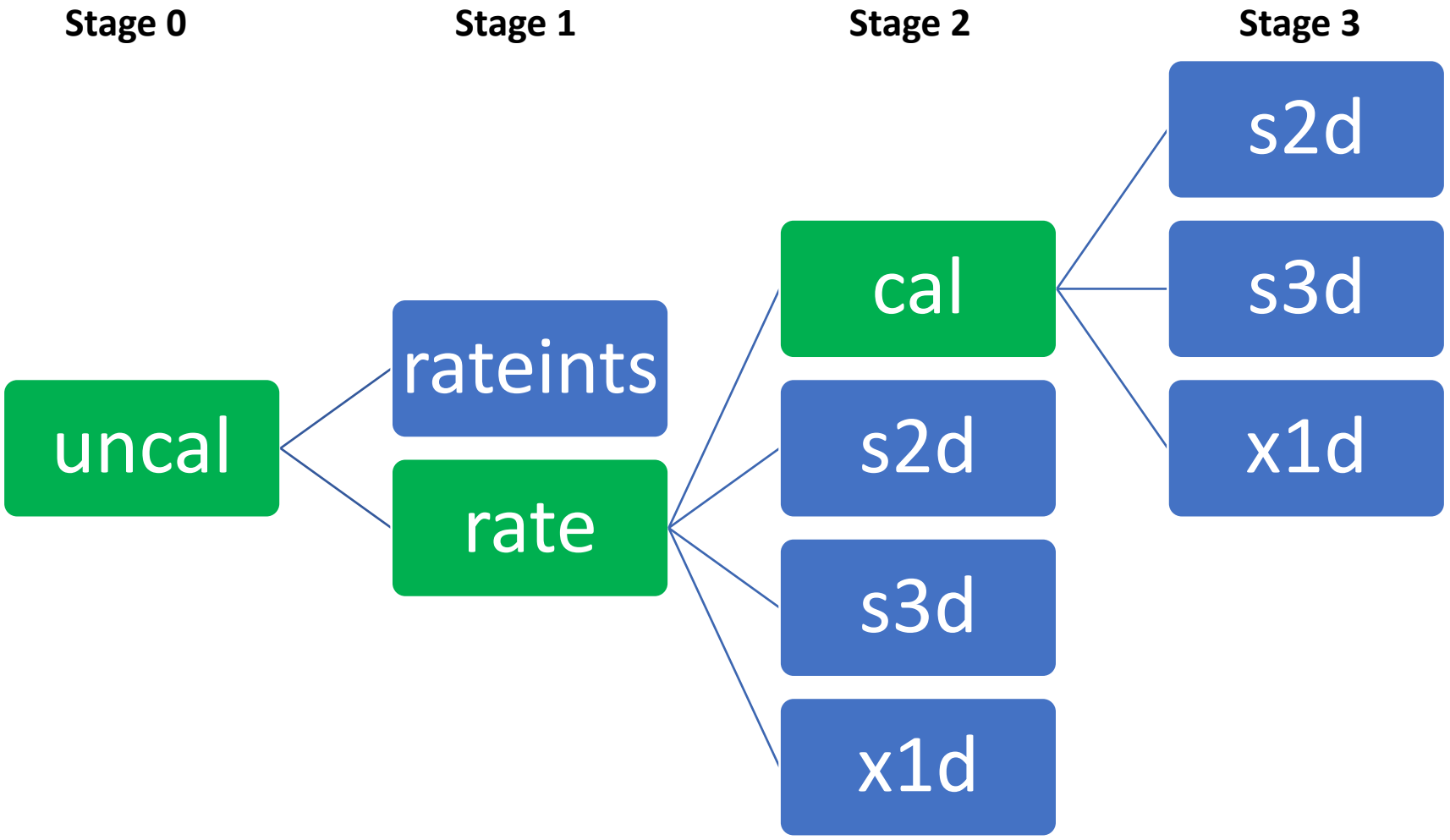
Stage 3: Dither combination

- Input: “cal”
- Key imaging outputs: “i2d”
- Key spectroscopic outputs: “s2d”, “s3d”, “x1d”
- Same output file types as Stage 2, except all dithers are combined
  - Distortion correction step is performed prior to combination
  - Outlier rejection step is also performed

Summary diagram: Imaging



Summary diagram: Spectroscopy

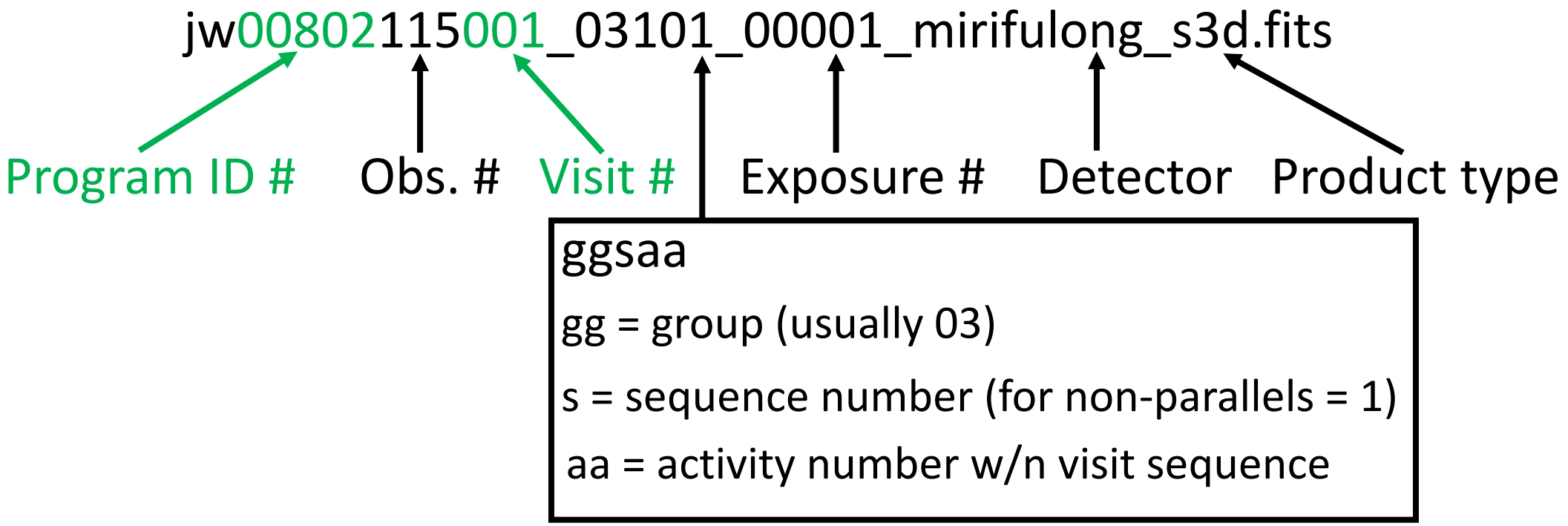


What should I use?

- Calibrated, distortion-corrected, per dither: i2d/s2d/s3d (Stage 2)
- Calibrated, distortion-corrected, dither-combined: i2d/s2d/s3d (Stage 3)
- The intermediate data products are less useful, except for re-running the pipeline if, e.g., saturation occurs before the end of a ramp
- Use x1d products at your own risk

Interpreting file names (Stage 2)

Example for a MIRI IFU long-wavelength data cube:



Interpreting file names (Stage 3)

Example for a MIRI IFU long-wavelength data cube: