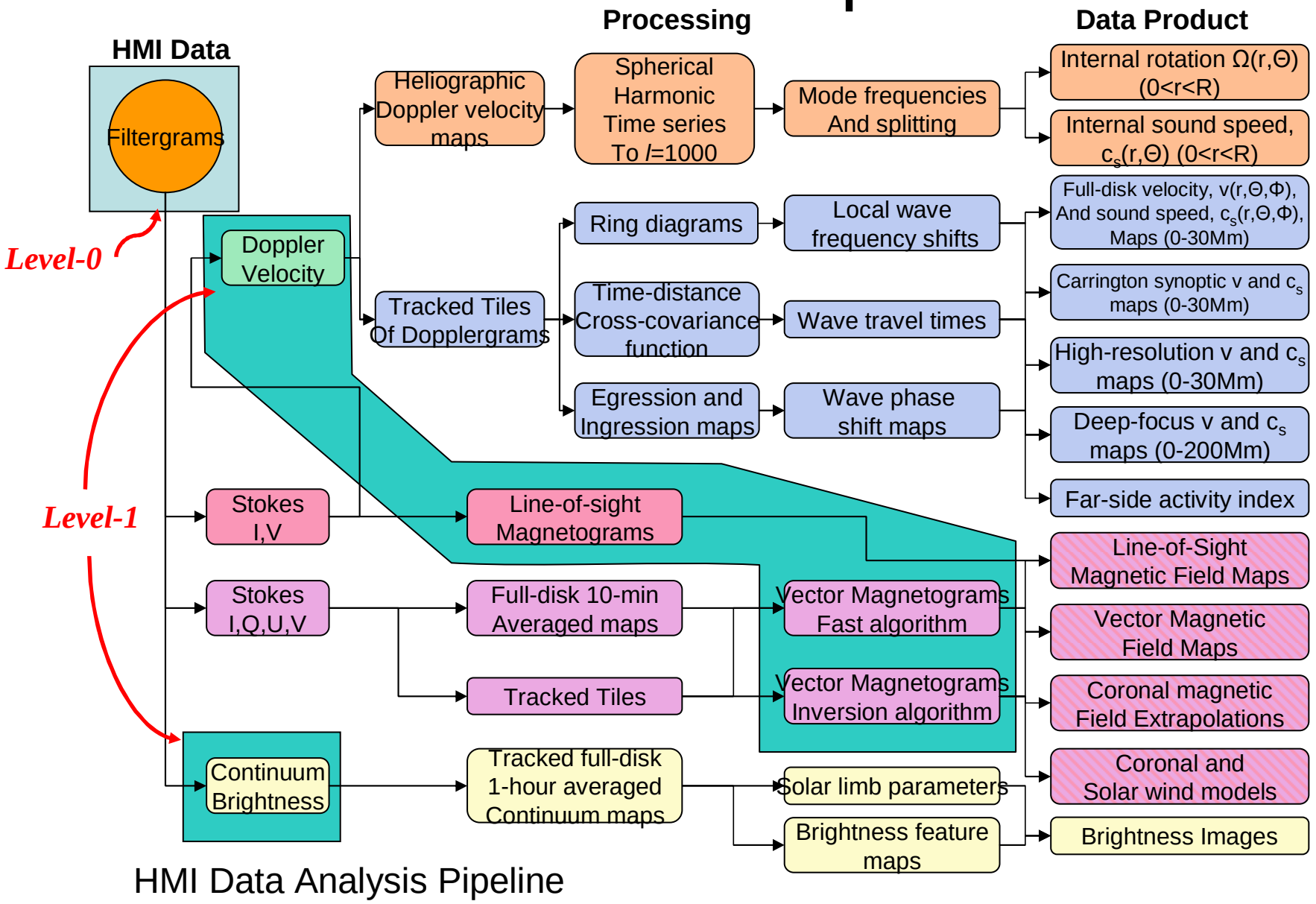
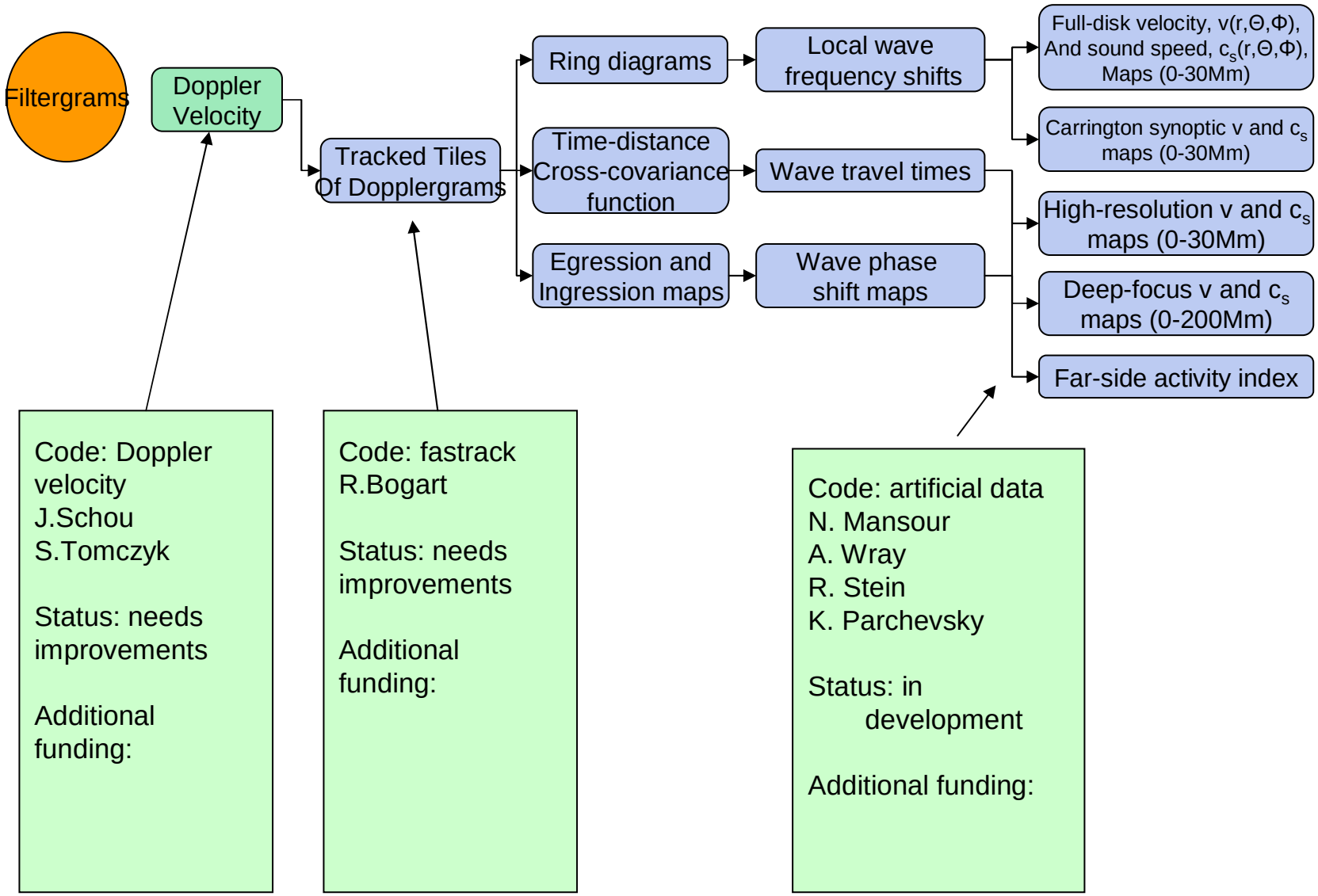
HMI Time-Distance Helioseismology Pipeline

HMI - SOC Pipeline

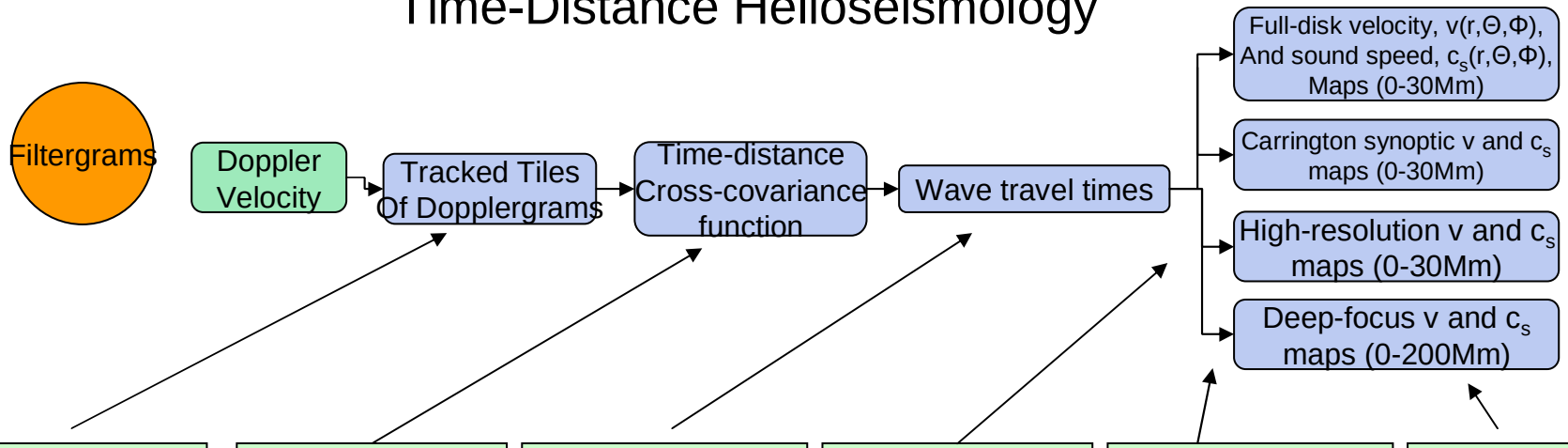


HMI Data Analysis Pipeline

Local Helioseismology



Time-Distance Helioseismology



Code: fastrack
R.Bogart,
T.Duvall
J.Zhao

Status: needs improvements (remapping issues)

Additional funding:

Code: cross-covariance
T.Duvall
J.Zhao

Status: needs improvements

Additional funding:

Code: travel time fitting
T.Duvall
J.Zhao
S.Couvidat

Status: needs improvements

Additional funding:

Code: sensitivity kernels
A.Kosovichev
J.Zhao
A.Birch

Status: needs improvements

Additional funding:
Birch: 2 PM

Code: inversions
A.Kosovichev
J.Zhao, A.Birch
S.Couvidat
Ju.Toomre
B.Hindman

Status: needs improvements

Additional funding:
Toomre:5 PM

Code: deep-focus maps
T.Duvall
A.Kosovichev
J.Zhao

Status: needs substantial development

Additional funding: need new postdocs at Stanford

Total for phase D: 5 (Toomre) + 2(Birch)=7 PM

Key HMI science problems

1. Dynamo and activity cycle
2. Emergence and evolution of AR
3. Energetics and triggering of flares and CMEs

Level-2 Data Products

- **Full-disk synoptic flow maps:**
  - Area: from -60 to +60 deg in longitude and latitude (30x30 deg tracked regions, sampling TBD)
  - Depth: 0-30 Mm (~ 20 distances)
  - Cadence: 3 per day
  - Resolution: 0.2 deg per pixel
  - Comment: systematic errors for sound-speed maps may be too large; usefulness is unclear – suggestion: descope
- **Carrington synoptic maps:**
  - Central meridian flow maps made from the full-disk maps
- **High-resolution flow and sound-speed maps of tracked AR**
  - Area: 30x30 deg
  - Depth: 0-30 Mm
  - Cadence: 8 hours (with a 2-hour shift? Need to study this option)
  - Resolution: 0.06 deg/pixel
  - Track areas of all AR in NOAA from -60 to +60 longitude (including periods prior flux emergence and after disappearance)
  - Need matching vector magnetograms
- **High-resolution flow and sound-speed maps of flaring AR**
  - Area: 30x30 deg
  - Depth: 0-30 Mm
  - Cadence: 4 hours (with a 1-hour shift)
  - Resolution: 0.06 deg/pixel
  - Track AR with NOAA probability of X-class flare > 30% ? (need selection criteria)
  - Need corresponding high-cadence vector magnetograms
- **Deep-focus flow maps**
  - Keep a research topic, include in pipeline when ready. Additional funding/FTE required.

Organization of TD pipeline

- **Two parallel techniques:**
  1. Gabor wavelet fitting for phase and group travel times + ray-path inversions
  2. Cross-correlation measurement of reference travel times + Born inversions

– **Two data analysis options:**
  1. Standard pipeline processing with standard fitting and inversion parameters
  2. Interactive processing (Junwei's IDL widgets) – should be able to import intermediate data from pipeline processing (e.g. travel times for experimental inversions)