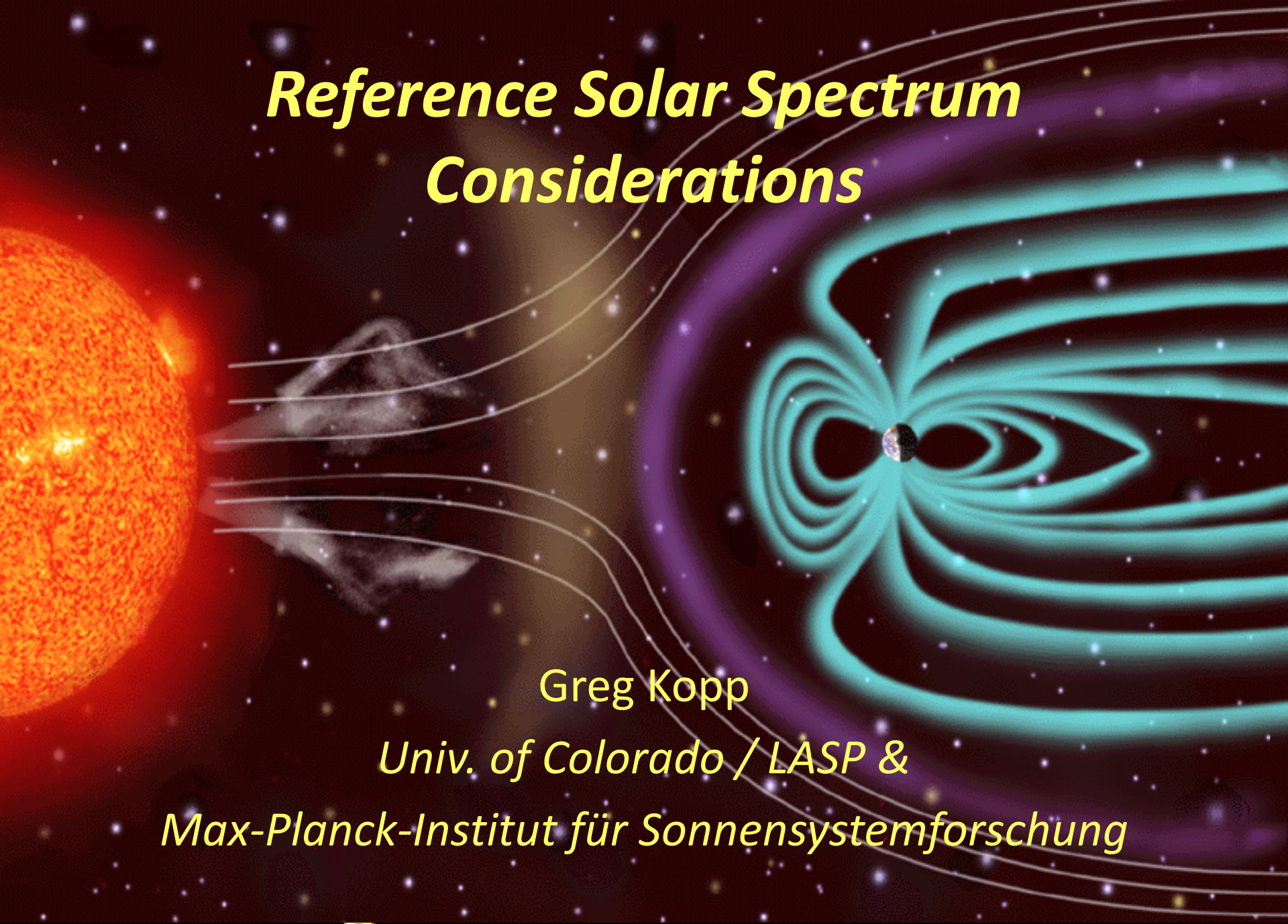
Reference Solar Spectrum Considerations



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Disclaimer

- I have no bias and I'm not presenting my "favorite" spectrum
- I'm presenting an *approach* to creating a reference spectrum for the community

What Does Community Need?

Creating a reference with broad applicability requires addressing diverse community needs

- Applications include
  - Solar physics (high time cadence; UV spectra)
  - Climate research (long-term variations with solar-cycle stability; accuracy)
  - Atmospheric modeling (UV spectra; seasonal stability)
- What do users want? **Everything!**
  - Good spectral resolution
  - Broad spectral range
  - Different solar-activity types

Suggested Approach

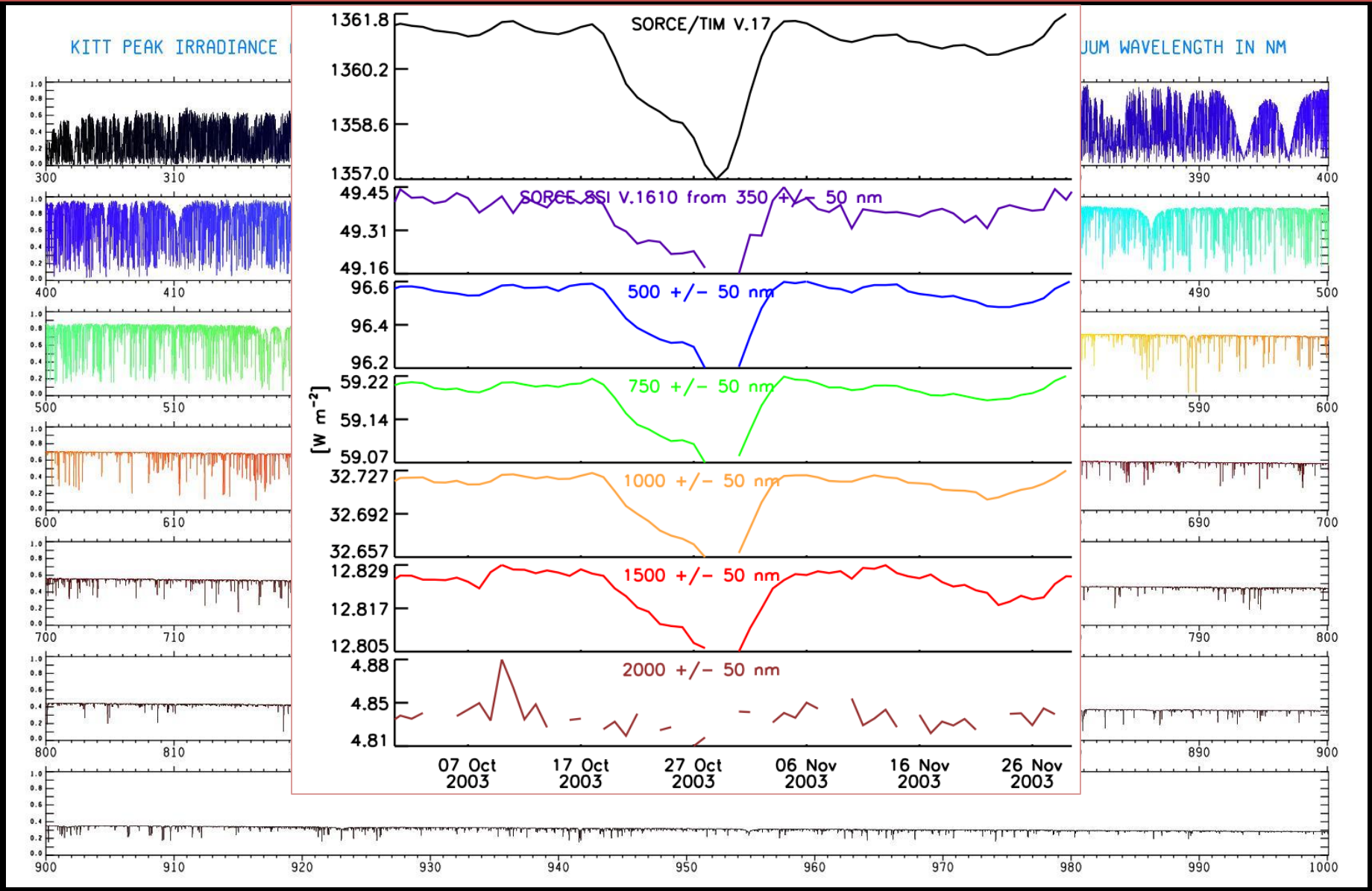
1. ***Use a composite***: Reference will require a composite with inputs from several instruments
   - No single instrument provides full spectral range with narrowest spectral resolution
2. ***Enhance with solar-atmospheric models***: NLTE solar-atmospheric models can provide spectral resolution and range not achieved by accurate, space-based instruments
   - But these rely on space-based instruments for absolute accuracy
3. ***Time-extend with solar-irradiance models***: Solar-irradiance models can relate spectra under different temporal and activity conditions
   - Can extend to times when observations were unavailable

Get Beyond Individual('s) Spectra

Dataset	Wavelength		Resolution	Time Range		Accuracy	Stability		Dataset Summary & Reference
	Minimum [nm]	Maximum [nm]	[nm]	Minimum	Maximum	[%]	Solar-Cycle [%]	27-Day [%]	
ATLAS 1	0.5	2,400.0		1992		3.0%			Observationally-based composite spectrum of high solar activity
ATLAS 3	0.5	2,400.0		1994		3.0%			Observationally-based composite spectrum of low solar activity; used as "standard" spectrum
Whole Heliosphere Interval (WHI)	0.1	2,400.0	0.1	10-Apr-2008	16-Apr-2008				Space-based observational composite spectrum of quiet Sun at solar minimum; Woods et al., GRL, 2008
SAO2010	200.0	1,001.0	0.04			5.0%			Observationally-based composite; Chance, K. & Kurucz, R. L., J. of Quantitative Spectroscopy and Radiative Transfer, 111, #9
Solar Radiation Physical Model (SRPM)	200.0	100,000.0							Computationally-based NLTE spectrum of quiet Sun; Fontenla et al., ApJ, 707, 2009, doi: 10.1088/0004-637X/707/1/482
SOLSPEC SOLAR 2	200.0	2,400.0		2008		3.0%			SOLSPEC instrument on ISS at solar minimum; Gerard Thuillier et al., Solar Physics, 2015, 290 (6), doi:10.1007/s11207-015-0704-1
SATIRE	115.0	160,000.0	1.0	1610	present				Semi-empirical physical model-based spectrum of Sun; daily values; Krivova et al., 2010, JGR doi:10.1029/2010JA015431
NRLSSI	120.0	100,000.0	1.0	1610	present				Empirical model-based spectrum of Sun; daily values since 1882; Coddington et al., BAMS, 2016, doi:10.1175/BAMS-D-14-00265.1
Code for Solar Irradiance (COSI)									Computationally-based NLTE spectrum; Shapiro et al., A&A, 517, 2010, doi:10.1051/0004-6361/200913987
Kurucz Model Spectrum			0.02						Computationally-based NLTE spectrum based on KPNO FTS

- Need to fill in a table of possible inputs rather than focus on each individually
- Speakers should provide *perspective* on their presented spectra for it to be beneficial to group

Example


KITT PEAK IRRADIANCE
UM WAVELENGTH IN NM
SORCE/TIM V.17
SORCE SSI V.1610 from 350 +/- 50 nm
500 +/- 50 nm
750 +/- 50 nm
1000 +/- 50 nm
1500 +/- 50 nm
2000 +/- 50 nm
[W m-2]
07 Oct 2003
17 Oct 2003
27 Oct 2003
06 Nov 2003
16 Nov 2003
26 Nov 2003

Creating a Reference Spectrum – Summary

- Get a high-level overview of possible input spectra
  - Consolidate summary of spectral range, resolutions, accuracies, times, etc.
- Identify which spectra provide the best qualities
  - i.e. absolute accuracy, spectral resolution, etc. as function of wavelength
- Combine into a composite spectrum
  - Emphasize accurate absolute value over spectral resolution or range
  - *Space-based data have best absolute accuracy*
- Add spectral resolution from physics-based model
  - *Physics-based models have best spectral resolution*
  - Scale to absolute value from most accurate measurement-based spectra
- Allow for temporal variations via irradiance models
  - Needed for climate and solar-physics research